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EFFECTS OF PRE-RECOGNITION EXPOSURE
AND EMPHASIS ON THE SUBSEQUENT
RECOGNITION OF MUTILATED WORDS

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ABSTRACT

EFFECTS OF PRE-RECOGNITION EXPOSURE AND EMPHASIS ON THE SUBSEQUENT RECOGNITION OF MUTILATED WORDS

by Gilbert S. Rothman

This thesis represents a study of the relationships between two pre-recognition variables and the visual recognition of mutilated words. The experimental investigation of word recognition has traditionally been concerned with the measurement of thresholds by means of tachistoscopic procedures. In the present study, an alternative technique for measuring the visual recognition of verbal stimuli was employed. This consisted of presenting each of 12 mutilated English words on a screen for a duration of six seconds. In this manner, a high degree of stimulus impoverishment was attained at suprathreshold levels. The mutilated word test has been considered as a measure of perceptual closure.

The experimental variables under consideration were isolated and defined with respect to a series of complete, i.e., non-mutilated, words exposed on a screen during a pre-recognition period. The series contained 36 words, each of which was exposed for five seconds. Twelve words in this series were designated as relevant words, since each subsequently appeared in mutilated form in the recognition test. The remaining 24 words, which did not appear in the latter test, were designated as irrelevant words.

The pre-recognition variables were defined by (a) the number of exposures to the series of complete words, and (b) the presence of structural emphasis of certain words in the series. Two conditions of

exposure frequency and three conditions of structural emphasis were administered. Either one or two prior exposures to each of the words in a series were given in combination with a particular emphasis condition. Structural emphasis was accomplished by varying the size and color of certain words in a given series. The emphasized words were characterized by letters which were slightly larger than those comprising other words in the same series, and which appeared red, in contrast to the others which appeared black. On this basis, the emphasis conditions consisted of exposure to a series in which either (a) the 12 relevant words were emphasized, (b) 12 of the irrelevant words were emphasized, or (c) none of the words was emphasized.

Six experimental groups, each containing 20 subjects, constituted the possible combinations of exposure and emphasis conditions. A control group of 20 subjects had no pre-recognition exposure to the series of complete words during the experiment.

The main findings of this study were as follows:

1. Visual recognition of mutilated words is facilitated by increasing the number of pre-recognition exposures to the series of complete words.
2. Visual recognition of mutilated words is facilitated by emphasizing (or directing attention to) the relevant, i.e., corresponding non-mutilated, words during pre-recognition exposure. Lack of emphasis during pre-recognition exposure, or emphasizing those words not presented for recognition in mutilated form reduces subsequent recognition.
3. Any form of prior exposure to a series of complete words, containing the relevant words, facilitates the visual

recognition of mutilated words. Lack of pre-recognition exposure reduces recognition.

The following were additional findings with respect to errors and early success on the word recognition test:

1. Subjects under the Relevant Emphasis condition are more likely to make errors of omission, whereas subjects under the No Emphasis and Irrelevant Emphasis conditions are more likely to make errors of commission.
2. Subjects under the Relevant Emphasis condition are more likely to be successful early in the recognition test than are subjects under the Irrelevant Emphasis condition.

The Relevant Emphasis and No Emphasis conditions do not appear to be related to early success.

Approved 
Chairman

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By

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INTRODUCTION

Research pertinent to the perception of words as stimuli has given rise to a number of stimulating theoretical and experimental issues. In this respect, the study of word recognition has had considerable bearing on the rapprochement among theories of personality, cognition, verbal learning, and perception. Most of the experimenters in this area have employed the tachistoscopic presentation of words or nonsense-syllables in attempts to study relationships between an array of psychological variables and certain categories of perceptual response. Some of the variables regarded as determinants of perceptual outcome are past experience, preparatory set, defense mechanisms, personal values, needs, and emotionality.

The tachistoscopic experiment represents both a technique for varying the amount of stimulus information and a method of obtaining visual recognition thresholds. The customary procedure for determining recognition thresholds consists of increasing either the duration of exposure to the stimulus, or the contrast between stimulus figure and background. When words are presented tachistoscopically, under conditions of low illumination or short duration, recognition is impaired. As illumination and/or the duration of exposure are increased, the association between the stimulus and the verbal response is strengthened. The stimulus is presented repeatedly until, at threshold levels, the correct response is given. Psychophysical methods are applied in order to locate the average or most representative value of the stimulus threshold. These thresholds thus provide a quantitative index of the ease of recognition, or the amount of stimulus information required for evocation of the correct response.

A review of the research, bearing on the present investigation of word recognition, is given in the following sections. The topics include verbal learning, set and past experience, stimulus emphasis as an attention-getting variable, and perceptual closure.

Verbal learning.

The relationship between recognition thresholds for words and frequency of word occurrence has been demonstrated repeatedly in tachistoscopic experiments. The relative frequencies with which words occur in the written English language have been used as estimates of frequency of prior usage or response. In this manner, ease of recognition appears to be related to the strength of verbal habits of responding to written words in the past. The principle of frequency has thus served as a common point of contact between the fields of perception and verbal learning.

Howes and Solomon (1951) found a high inverse relationship between the logarithm of relative word frequency and visual duration thresholds. Their correlations ranged from -0.68 to -0.75, depending on which measure of central tendency was applied to the threshold data, and which measure of word frequency was used. These results were explained on the basis of a response probability variable underlying relative frequency of usage of words in written English.

McGinnies, Comer, and Lacey (1952) replicated the above experiment and obtained similar results. In addition, these experimenters found that the effect of frequency interacts with that of word length. The frequency effect appears to be most apparent with long words, and the length effect is most striking with low frequency words.

Solomon and Postman (1952) experimentally controlled for relative frequency of word usage. Their subjects leafed through a set of cards

which contained nonsense-words, and were instructed to pronounce each word as it appeared. The frequency of appearance of different words in the list ranged from 1-25. In this situation, frequency of usage was also found to have a significant effect on duration thresholds. In a related experiment, King-Ellison and Jenkins (1954) obtained a correlation of -0.99 between mean exposure time and the logarithm of frequency of presentation.

Postman and Conger (1954) attempted to distinguish between frequency of past usage and frequency of past visual exposure per se as the crucial variable. They used the Thorndike-Lorge word counts as estimates of the frequency of usage of three-letter words. Frequency of usage was interpreted as the frequency of response to different combinations of letters as word units. A correlation of -0.39 between this variable and duration threshold was obtained. The second variable under consideration was trigram frequency. Trigrams are letter combinations which form part of other words in addition to being meaningful units themselves. The relative frequency of occurrence of trigrams provided estimates of the frequencies with which three-letter combinations function as visual stimuli in English reading matter. Since the correlation of 0.20 between these two measures of frequency was not significant, the experimenters considered them to be independent. The correlation between trigram frequency and recognition threshold was found to be 0.09. Postman and Conger concluded that the strength of verbal habits associated with letter sequences, rather than sheer frequency of exposure, is the important variable in speed of recognition. These results lend additional support to the response probability hypothesis.

Set and past experience.

Experimental manipulation of stimulus events prior to the presentation of specific tasks has been shown to influence perceptual behavior. The effects of prior stimulation appear to outlast the duration of the events themselves, a result interpreted by some theorists to indicate the existence of a "trace" mechanism. This idea is present in a number of cognitive theories of perception which address themselves to the problem of "set" as an independent variable in recognition experiments. Preparatory set may be introduced either implicitly or explicitly, depending on the set-inducing operation provided by the experimental design and by the instructions given to subjects.

Cognitive variables are considered to arise from the previous perceptual history of the organism and to presumably involve higher-level processes. Such concepts as set, attitude, expectancy, meaning, hypothesis, and tuning have been used extensively to refer to such variables. In general, the organism is considered to be an active perceiver, one who is "prepared" for certain kinds of stimulation. Perceptual outcome is, at least, partly a result of the particular preparation.

Siipola (1935) tested the effect of preparatory set on subjects' ability to perceive ten stimulus words exposed tachistoscopically. Four of the items were real words, and the other six were ambiguous items which might be seen as fitting two different set conditions. The purpose of the experiment was to determine whether two groups of subjects would perceive the same ten items in accordance with their different preparatory sets. Subjects were told that the words they were about to see belonged to certain classes of things. Subjects in one group were told to expect words having to do with animals or birds, and those in the other group were told to expect words pertaining to travel or transportation. The results showed that the two groups

perceived the common list of stimulus words differently in accordance with their respective sets. The effects of set were shown to:

(a) facilitate the correct perception of those items which fitted a particular set, (b) distort the irrelevant stimulus words so as to perceive them as related to their set, and (c) convert the ambiguous items into words in accordance with a given set.

Postman and Bruner (1949) tested the effect of single vs. multiple sets on thresholds following explicit instructions to subjects. The recognition thresholds for single sets were found to be lower than for dual set conditions. If the subjects were given an inappropriate set, one which was "misleading," the thresholds were raised.

In an experiment by Freeman and Engler (1955), no differences were found between single- and multiple-set conditions when thresholds were measured for words presented singly. They did report that set in general had a facilitating effect when the set was relevant, as compared to a detrimental effect when the set was inappropriate. However, the facilitating set was effective only for unfamiliar words.

Neisser (1954) attempted to distinguish between perceptual process and verbal response in tachistoscopic experiments. His study demonstrated that the effect of preparatory set in the tachistoscopic situation is to facilitate the perception of the stimulus words presented rather than facilitating only the verbal responses to them. Furthermore, Neisser maintains that set in general does not increase the probability of correct verbal responses. An increase in this probability occurs only when a relevant set is introduced under specific stimulus conditions, that is, when the expected words are presented.

Ross, Yarczower, and Williams (1956) used a modification of Neisser's study to determine the effects of set and the structural characteristics of the words themselves. Subjects were first exposed to a series of stimulus words and were told that these words might

help them in recognizing other words to be presented later in the experiment. The hypothesis was that the closer the structural relationship between the original and test words, the more would set facilitate recognition of the test words. Conversely, the effect of set should decrease with increasing dissimilarity between set and test words. The results supported Neisser's hypothesis that set facilitates the recognition of specific visual patterns. Their hypothesis that a continuum underlying perceptually similar elements bore a functional relationship to recognition thresholds was not supported. The effect of such a similarity continuum was confounded by interfering responses due to word length, and number of identical elements, and by possible changes in response probability.

Leeper (1935) found that subjects would generally see Street figures as meaningless collections of fragments upon first presentation. A Street figure is a type of "hidden picture" in that the figure is incomplete. It represents one form of mutilated stimulus. After observing these figures for a brief period, accompanied by verbal hints from the experimenter, subjects saw the figures as meaningful objects. A past experience effect was demonstrated when the same Street figures were exposed, tachistoscopically, several weeks later and were quickly recognized in their meaningful form.

Postman and Leytham (1950) analyzed the process of perceptual organization with respect to the arousal and confirmation of the perceiver's "hypotheses." The concept of hypothesis refers to a selective readiness to organize external stimulus cues as a result of past experience with the environment. Depending on their particular characteristics, stimulus cues tend to arouse, confirm, or deny certain hypotheses. Thus a stable perceptual organization results when information from the environment matches an hypothesis. The experiment reported by these investigators was concerned mainly with the relationship

between recognition and the dimension of "hypothesis strength." The latter refers to the number and intensity of stimulus cues required to arouse, confirm, or deny an hypothesis. A strong hypothesis is one which requires less stimulus information to arouse and confirm it. In their study, frequency of past confirmation was found to be a major determinant of hypothesis strength. According to Postman and Leytham, "Once a strong hypothesis has been aroused and confirmed, it becomes a powerful determinant of perceptual sensitivity. When environmental events fail to conform with the hypothesis, recognition is slowed down."

Stimulus emphasis as an attention-getting variable.

Most recent psychologists have considered the concept of attention to be related to those aspects of subjective experience not properly included in the contemporary study of behavior. Nevertheless, notable attempts to reformulate the problem of attention in more objective terms have been seen in the work of Hebb (1949) and Berlyne (1960).

Hebb states that attention refers to selectivity of response. That is, the organism continuously responds to certain stimuli in the environment and not to others that could be responded to in a similar manner. In these terms, the problem of attention is directed to the particular attentive responses the organism makes in the presence of a given set of stimuli. To account for the effects of attention, Hebb postulates a selective central factor, referred to as an "autonomous central process." The latter is somewhat similar to the notion of a "stimulus trace." The properties of such a mechanism have a selective effect on behavior without being part of the present afferent stimulation. Considered in this manner, the concept of attention is similar to set, expectancy, and hypothesis. The basic assumption made by

theorists in this area is that the organism's response in certain situations is determined by something besides the immediately preceding sensory stimuli.

Berlyne considers attention to be an important factor contributing to "stimulus selection." This concept refers to ". . . processes that determine which elements of the stimulus field will exert a dominating influence over behavior." In this scheme, the experimental situation in which behavior is observed is made more complex. This is accomplished by confronting the organism with several novel stimuli (i.e., those which have been rarely or never experienced) which are presented simultaneously. Hence, the problem of attention may be considered in terms of stimulus selection, or as Berlyne poses, "To which stimulus will this animal respond?"

The problem of attention for psychology and, especially, behavior theory has been somewhat limited by the nature of traditional experiments, according to Berlyne. The procedure has usually consisted of determining the effect of a single variable on behavior in an oversimplified and artificial manner. In these experiments, background stimuli which may distract the subjects' attention by competing with the stimuli of interest are removed or reduced considerably. Berlyne contends that a reformulation of the problem of attention in terms of stimulus selection will allow for a closer relationship between the situation of the laboratory and the extra-experimental environment of the organism.

In an early experiment by Wilcocks (1928), the effect of an unexpected heterogeneous stimulus on the degree of attention was determined by a memory test. The experiment consisted of presenting a number of series of letters in succession to the subjects. The letters appeared singly in each series, and were all of the same color with the exception of one letter. This letter appeared in the last series, and

the change in color was unexpected by the subjects. The letter with the heterogeneous color was referred to as the "critical" letter. Following the exposure of each series, the subject had to write down as many of the letters in the previous series as possible. The immediate memory effect for the critical letter thus formed a measure of the degree of attention. On the average, retention for the critical letters was higher than for all other letters in a series. The author concluded that this was due to the increased degree of attention having been given the heterogeneously colored letter.

Berlyne (1951) indicates that change in stimulation per se, and not other factors such as preference for color or shape, is the important attention-getting variable. His hypothesis states that a stimulus which has recently changed is more likely to be responded to than others which remain unchanged.

Green (1958) also found that items were favored in recall during a serial learning task because unexpected change attracted attention. Structural change in his experiment was defined as the introduction of a new type of item, that is, new in relation to immediately preceding items. Green suggests that change per se, expected or unexpected, has an effect on learning in terms of the probability of recalling certain items. The effect is somewhat greater under unexpected change conditions. His experiments demonstrated that the structure of a list of items in a serial learning task has a reliable influence on the probability of recalling a particular item due to its attention-getting properties.

Perceptual closure.

The concept of closure was first introduced by the Gestalt psychologists. In Gestalt theory, closure is one of the phenomenal laws of organization, and is considered to be a special case of the

Law of Prägnanz. This law holds that percepts tend to be organized into the best possible figure that the stimulus-pattern will allow.

Whereas a "closed" form is a "good" gestalt, an "open" form tends to complete itself, that is, to achieve closure. This tendency toward meaning and good form is basic to the process of perceiving according to the Gestaltists.

Mooney (1954) developed a series of tests which measure the perception of incomplete or disorganized configurations. In his research, the results of a series of different tests were factor analyzed for the purpose of defining a perceptual closure dimension. One of the tests in this battery was the Mutilated Words Test which consisted of 20 simple words with highly mutilated letters. This test was found to have the highest factor loading (.728), of any of the tests defining the closure dimension, and was considered to be a substantial measure of the strength of perceptual closure.

According to Mooney, closure refers to the resolution of a perceptual act. During the process of closure, "meaning" is ascribed to or emerges from the stimulus configuration. The author states that, "The clearest example is afforded by the simple instance of an incomplete picture of an everyday object or a mutilated word. Here a specific object has been whittled away beyond immediate recognition; a few scattered bits and pieces, meaningless in themselves, together comprise a vestigial pattern or configural representation of a whole thing which an observer is to recognize or identify."

Bobbitt (1948) reviewed some of the various definitions of closure which have appeared in the literature. According to this author, the most generally agreed-upon definitions of closure in perceptual theory refer to this process as the perceptual act of completing stimulus configurations which are physically incomplete. That is, parts of a given configuration are organized in such a way that a stable perception

of the complete figure is achieved. Bobbitt suggests that, in order to explain the results of closure phenomena from a behavioristic point of view, the influence of past experience on perceptual response must be considered the crucial variable. The author maintains that:

"Specifically, an explanation stated in such terms would have to assume that a person's experience with a complete figure and its various incomplete forms would result in his recognition of the relationship of the incomplete representation to the complete figure. Such a theory would have to assume that after sufficient experience of this kind, a person would be able to recognize a partial representation of a figure as belonging to a complete form. The amount of experience would, of course, determine the facility with which the recognition process takes place. Stated in these most simple terms, then, closure would become, in terms of this explanation, a phenomenon dependent upon perceptual habits."

The results of a study by Postman and Bruner (1952) lend some support to the view that frequency of past experience influences the operation of closure through a mechanism such as "hypothesis strength." In their research, training with open circles inhibited closure when the test stimuli were shown tachistoscopically. On the other hand, training with closed circles facilitated closure. In considering the effects of such factors as set, past experience, and previous learning, Postman and Bruner have also stressed the importance of internal forces of organization and the constraints imposed on the perceiver by external stimulus configurations. As the authors state, "Conditions brought about by past experience operate by affecting the operation of Gestalt factors, not by supplanting them." As a guide to further research on closure, these investigators suggest that past experience should be systematically varied in order to observe the resultant changes in perceptual organization. In this manner, the experimenter can determine the particular stimulus conditions in past experience which produce significant differences in perceptual response. The relative effects of various past experience variables on internal organizing processes can then be more clearly evaluated.

Barratt and Barratt (1957) recommend a similar approach to the study of closure phenomena. According to these authors, closure should be treated as a dependent variable, and the conditions under which it occurs should be analyzed in terms of clearly defined independent variables. In their experiments, incomplete geometric figures were presented tachistoscopically. The findings support the hypothesis that named figures, which are familiar to the perceiver, show a greater tendency to the closure effect than unfamiliar figures. In addition, the closure effect appears as an inverse function of the time of exposure to the stimulus material. The latter finding emphasizes the importance of controlling the duration of exposure in situations where the effect of specific past experience variables on closure is considered.

Statement of the problem.

The experimental investigation of word recognition has typically been confined to the measurement of various kinds of thresholds by means of tachistoscopic procedures. Psychologists in this area have particularly emphasized the close relationships between such factors as verbal learning, preparatory set, past experience, and recognition thresholds for verbal stimuli.

In the present study, an alternative technique for measuring the visual recognition of words was employed. This consisted of a modification of the word recognition test devised by Cureton, Cureton, et al. (1955). The test, composed of mutilated words, has been considered as a measure of the perceptual closure factor. The experiment represents an attempt to (1) extend the problem of word recognition to include processes operating at suprathreshold levels, (2) relate the concept of attention to visual word recognition, (3) compare the frequency effect observed in the present study with that demonstrated in previous experiments, and (4) consider the visual recognition of mutilated words in terms of the operation of closure.

The main purpose of the experiment was to determine the relative effects of two pre-recognition variables on the subsequent recognition of mutilated words. Prior to the recognition test, subjects were exposed to a series of complete, i. e., non-mutilated, English words. Some of the words in this series were the same words which subsequently appeared in mutilated form in the recognition test. The remaining words did not appear in the latter test. The two independent variables, defined with respect to these complete words, were (1) number of prior exposures, and (2) presence of structural emphasis of certain words in the series. The questions raised regarding the operation of these variables were:

1. Do number of prior exposures and structural emphasis of particular complete words in a pre-recognition series influence the subsequent visual recognition of mutilated words?
2. If so, what is the specific nature of their effects?

Hypotheses.

1. Visual recognition of mutilated words is facilitated by increasing the number of pre-recognition exposures to the series of complete words.
2. Visual recognition of mutilated words is facilitated by emphasizing (or directing attention to) the corresponding non-mutilated words during pre-recognition exposure. Lack of emphasis during pre-recognition exposure, or emphasizing those words not presented for recognition in mutilated form reduces subsequent recognition.

METHOD

Subjects.

The Ss were 140 volunteer students from the introductory classes in psychology at Michigan State University. The sample included 93 males and 47 females all of whom received credit for participating in the experiment. The subjects were assumed to be selected at random and representative of the various levels of intelligence, verbal ability, visual acuity etc. in the larger population of such Ss.

Materials.

The apparatus consisted of an opaque projector used to project a pre-recognition series of non-mutilated words, a 35 mm. Kodak 300 slide projector used to project the mutilated words, a 45" x 60" screen, and a stopwatch for timing. Paper for Ss to record their responses during the word recognition test was supplied by the experimenter.

Twelve 2" x 2" Kodak slides were used, each slide containing a single mutilated word photographed from a list in the Multi-Aptitude Test (Cureton, Cureton, et al., 1955). A mutilated word is one which is physically incomplete in that only fragments of each letter are present. The list of mutilated words as they appeared in the word recognition test is shown in Appendix 1. The test stimuli were six-letter words occurring 100 or more times per million words in standard English reading matter according to the Thorndike-Lorge count (Thorndike and Lorge, 1944). All words were classified in the general literature category and were considered to be "neutral," that is, void of strong emotional tone.

A set of 36 complete words composed the pre-recognition series which was experimentally manipulated with respect to number of exposures and structural emphasis. Of these 36 words, 12 were designated as relevant words since each subsequently appeared in mutilated form in the recognition test. The remaining 24 words were designated as irrelevant words since they did not appear in the subsequent test. A list of the 36 complete words is given in Appendix 2. These words were printed on white index cards with a LeRoy lettering set. The cards were cut into smaller strips, approximately 2" x 6", and pasted on separate sheets of black construction paper to facilitate handling. The 24 irrelevant words were matched with the 12 relevant words with respect to both word length and frequency of occurrence. The irrelevant words were selected randomly from all six-letter words occurring at least 100 or more times per million in the general literature included in the Thorndike-Lorge count.

Experimental variables.

The two main independent variables in this experiment were a) number of exposures to the series of complete words prior to the recognition test, and b) presence of structural emphasis of particular words in the series.

The number of prior exposures was either one or two:

- One exposure -- each of the 36 complete words in a given series was exposed a single time.
- Two exposures -- each of the 36 complete words in a given series was exposed twice. For this condition, a series was repeated a second time in the same order.

Structural emphasis was accomplished by varying the physical characteristics of certain words in the pre-recognition series. The emphasized words differed from others in the same series in both

size and color of the letters constituting the words. The particular words emphasized during pre-recognition exposure to a given series were characterized by letters which were $1/2$ " in height and printed in red ink. Those words not emphasized consisted of letters which were $3/8$ " in height and printed in black ink. On this basis, three conditions of structural emphasis were included:

Relevant Emphasis (RE) -- The 12 relevant words in the series were emphasized, and the remaining 24 irrelevant words were not emphasized.

Irrelevant Emphasis (IE) -- Twelve of the 24 irrelevant words were chosen randomly and emphasized. The remaining 12 irrelevant and the 12 relevant words were not emphasized.

No Emphasis (NE) -- None of the 36 words in the series was emphasized.

For each of the three emphasis conditions described above, a separate set of complete words was constructed. The serial position of each word in the series was constant for the three conditions.

Description of the six experimental groups and the control group.

The two conditions of prior exposure and the three conditions of structural emphasis constitute the six experimental groups. Each of these groups represents a combination of a particular exposure frequency condition with a particular emphasis condition during the pre-recognition period. The groups are described as follows:

<u>GROUP</u>	<u>DESCRIPTION</u>
Relevant Emphasis-One exposure (RE_1)	-- Ss were given one exposure to each of the 36 complete words in the Relevant Emphasis series.
Irrelevant Emphasis-One exposure (IE_1)	-- Ss were given one exposure to each of the 36 words in the Irrelevant Emphasis series.
No Emphasis-One exposure (NE_1)	-- Ss were given one exposure to each of the 36 words in the No Emphasis series.
Relevant Emphasis--Two exposure (RE_2)	-- Ss were given two exposures to each of the 36 words in the Relevant Emphasis series.
Irrelevant Emphasis--Two exposure (IE_2)	-- Ss were given two exposures to each of the 36 words in the Irrelevant Emphasis series.
No Emphasis--Two exposure (NE_2)	-- Ss were given two exposures to each of the 36 words in the No Emphasis series.

Subjects in a control group were given no prior exposure to any of the complete words during the experiment. These Ss were tested exclusively for their recognition of mutilated words.

Experimental design and statistical analysis.

The experiment was designed to compare the recognition of mutilated words for different groups of Ss following administration of

the various pre-recognition exposure conditions. Six experimental groups and a control group, each containing 20 Ss, were tested. The control group, which had no pre-recognition experience with the complete words, was external to the main design as illustrated in Table 1.

Table 1. Design of the Experiment

O		Number of Prior Exposures	
		1	2
Control Group n = 20	Irrelevant Emphasis	n = 20	n = 20
	No Emphasis	n = 20	n = 20
	Relevant Emphasis	n = 20	n = 20

The 2 x 3 factorial design permits significance tests of the main effects of both the exposure frequency and the emphasis conditions on mean recognition scores, as well as the two-factor interaction. The total number of correct responses made by each experimental subject on the recognition test was used in the analysis of variance.

Procedure.

Each subject was assigned to one of the seven independent groups. The groups were not matched on the basis of sex since results from a previous study gave no indication of reliable sex differences on the mutilated word recognition test (Rothman, 1960). Small numbers of Ss were tested together. The groups ranged in size from one to seven, with an average size of about four. Ss were seated in the center of the testing room, approximately 10-14 feet from the screen in order to

provide optimum conditions for viewing the stimuli. During presentation of the pre-exposure and the test words, the room was dimly lit. The stimulus words superimposed an area of approximately 8" x 18" on the screen.

Pre-recognition exposure period.

1. All Ss were asked to cooperate in maintaining silence during the experiment and were not permitted to ask questions at any time. The instructions given to Ss during the pre-recognition period were as follows:

A series of English words will be shown on the screen one at a time. You are to look at each word as it appears.

Note: the above instructions were given to all groups with the exception of the control, since the latter was given no prior exposure to the complete words.

2. The different series of complete words were then presented to the respective groups of Ss. The words were shown in succession by means of an opaque projector. The duration of exposure for each word was five seconds. There was a five-second interval between each presentation.

Recognition period.

1. The instructions given to all Ss, including the control Ss, prior to the word recognition test were as follows:

A series of English words will now be shown on the screen. However, these words have been partly erased. Try to decide what the word is, and then print it on the given line on your sheet. If you don't recognize a word, make the best guess you can. Leave the line blank only if you have no hunch whatever. Make sure you write your answers in order. If you cannot give an answer to a particular word, leave that line on your paper blank. Use the next line for the following answer.

2. The 12 mutilated words were then shown in succession on the screen by means of a slide projector. Each mutilated word was exposed for six seconds. There was a 14-second interval between each presentation. Ss wrote their responses on paper during or after each presentation.
3. Upon completion of the recognition test, Ss in the Relevant and Irrelevant Emphasis groups were asked to give their impressions of the emphasized words exposed during the pre-recognition period.

RESULTS

Analysis of the recognition data.

Means and variances on the word recognition test for each group are shown in Table 2. These measures are based on the total number of correct responses made by each subject on the 12-item test.*

Table 2. Means and Variances on the Word Recognition Test for Control and Experimental Groups. For Each Group N=20.

Group	Mean	Variance	Group	Mean	Variance
Control	2.70	2.22			
IE ₁	5.65	4.66	IE ₂	6.10	4.20
NE ₁	6.40	2.57	NE ₂	6.65	2.45
RE ₁	7.10	2.73	RE ₂	8.45	3.73

As shown in Figure 1, the mean recognition scores for the seven groups were consistent with respect to the exposure and emphasis classifications. Mean recognition of mutilated words was highest for the RE groups, followed by the NE, IE, and control groups, respectively. For each of the three emphasis conditions, mean recognition was higher for the 2-exposure than for the corresponding 1-exposure groups.

To determine the significance of these results, an analysis of variance was performed on the recognition scores for the six experimental groups. The results of this analysis are summarized in Table 3.

* Recognition scores for all 140 Ss are given in Appendix 3.

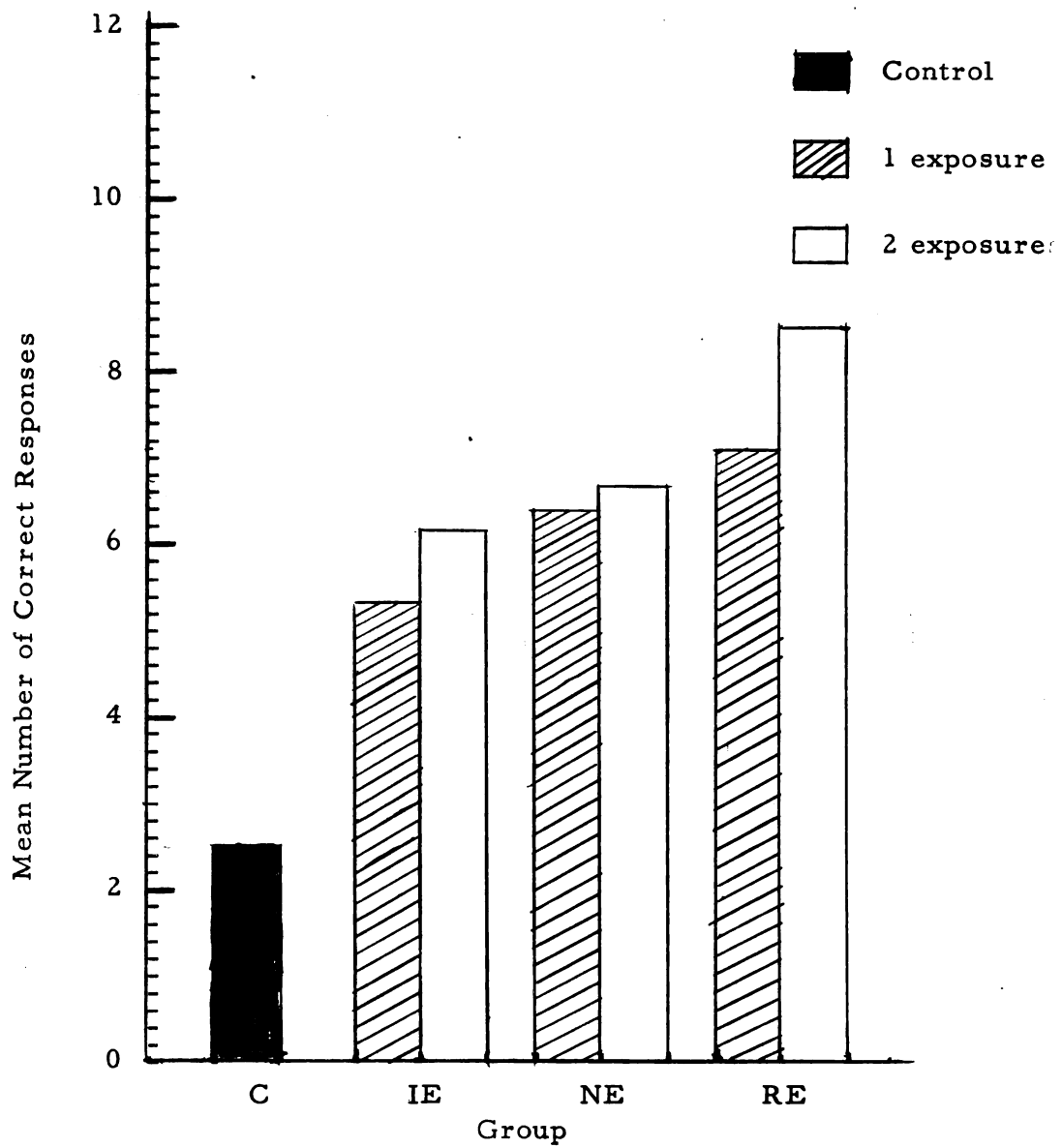


Figure 1. Bar graph showing average recognition of mutilated words for control and experimental groups.

Table 3. Analysis of Variance of Recognition Scores for the Six Experimental Groups.

Source	DF	SS	MS	F	P
Exposure Frequency (F)	1	14.00	14.00	4.13	< .05
Emphasis (E)	2	74.60	37.30	11.00	< .005
F X E	2	6.87	3.44	1.01	> .05 (N.S.)
Error	114	386.45	3.39		
Total	119	481.92			

The assumptions underlying the application of F-tests to the recognition data obtained in this experiment appear to be met satisfactorily in each case:

- 1) Ss in each group were from the same population of elementary psychology students at Michigan State University. They were considered to have been assigned randomly to the six groups.
- 2) The distribution of recognition scores for each experimental group appeared to be approximately normally distributed.
- 3) The variances of the scores for each group, which ranged from 2.45 to 4.66, did not differ significantly from one another as determined by the F-max test ($F_{\text{max}}=1.90$, $P>.05$). The assumption of homogeneity of variance is therefore considered tenable.

The significance test of the F X E interaction indicated that the observed interaction between exposure frequency and emphasis was negligible ($F=1.01$, $P>.05$). The hypothesis of no interaction between these factors, so far as this population of Ss is concerned, is therefore assumed to be tenable. Following the procedure of Lindquist (1953), interest is directed to the evaluation and interpretation of the main effects of both prior exposure frequency and structural emphasis.

The test of the exposure frequency effect disclosed that the difference between the means of the two exposure conditions was statistically significant ($F=4.13$, $P<.05$). When the data were averaged over the three groups under both the 1- and 2-frequency conditions, the means were 6.38 and 7.07, respectively. The results indicate that the number of prior exposures to a series of complete words has a significant effect on the subsequent recognition of mutilated words. Under the conditions of this experiment, a second exposure to the complete words facilitates recognition as measured by mean number of correct responses.

The test of the emphasis effect showed that the differences among the means of the three emphasis conditions were also statistically significant ($F=11.00$, $P<.005$). When the data were averaged over the two groups under each emphasis condition, RE, NE, and IE, the means were 7.78, 6.52, and 5.88, respectively. These results indicate that the presence of structural emphasis of particular complete words in a pre-exposure series has a highly significant effect on the subsequent recognition of mutilated words.

Significance tests of the differences between individual pairs of means were made for the three emphasis conditions. Since homogeneity of variance was assumed, the error MS was used as the variance term in the denominator of the t-ratio. Since all possible comparisons were made, the t-ratio required for significance at a given level was determined using the Studentized Range procedure. The results are shown in Table 4.

The comparisons showed that the mean recognition score for the Relevant Emphasis condition was significantly greater than that for either the Irrelevant Emphasis or No Emphasis conditions. The difference between the means for the NE and IE conditions was not statistically significant. The results indicate that, under these

Table 4. Individual Comparisons of the Means for the Three Emphasis Conditions. N= 40 for Each Condition.

Comparison	Difference	t	P
RE-IE	1.90	4.63	< .001
RE-NE	1.26	3.07	< .01
NE-IE	0.64	1.56	> .05 (N.S.)

experimental conditions, visual recognition of mutilated words is greatest following exposure to a series of complete words in which the relevant words are emphasized.

Table 5 shows the comparisons between the control mean and each of the experimental means.

Table 5. Individual Comparisons Between Each Experimental Group and the Control. N=20 for Each Group.

Comparison	Difference	t*
IE ₁ -C	2.95	5.03
IE ₂ -C	3.40	6.01
NE ₁ -C	3.70	7.57
NE ₂ -C	3.95	8.88
RE ₁ -C	4.40	8.85
RE ₂ -C	5.75	10.55

* For all comparisons, $P < .001$

The differences between control and experimental means were statistically significant in each case. These results indicate that any form of prior exposure to a series of complete words, containing the relevant words, facilitates the visual recognition of mutilated words.

Analysis of errors on the word recognition test.

The data obtained on the recognition test were analyzed in terms of the kinds of errors made by Ss. Incorrect responses could be classified into three categories defined as follows:

- 1) Error of Omission (O) -- a failure to respond to a given item.
- 2) Error of Commission (C) -- an incorrect response which was a correctly-spelled English word with dictionary meaning. In some cases these words were the same as the irrelevant words exposed in the pre-recognition series.
- 3) Nonsense Error (N) -- an incorrect response which was an incorrectly-spelled word, meaningless, or merely a series of letters.

The results of the analysis of error data are summarized in Tables 6, 7, and 8.

Table 6. Breakdown of Errors on Recognition Test for the Six Experimental Groups. The Total Number of Possible Responses per Group was 240.

Group	Number of Errors	O	C	N	O+C
RE ₁	98	53	40	5	93
RE ₂	71	38	27	6	65
NE ₁	112	44	52	16	96
NE ₂	107	43	54	10	97
IE ₁	127	49	63	15	112
IE ₂	118	49	60	9	109
Totals	663	276	296	61	572

As shown in Table 6, errors of commission were more frequent than errors of omission for all six groups combined. Of the total number of errors made on the recognition test, 47% were errors of commission and 43% were errors of omission. Nonsense errors were relatively infrequent, accounting for only 10% of the total.

Since the total number of errors in each group was different, the frequencies of the various kinds of errors were not directly comparable. In order to obtain a clearer picture of the results, the proportion of omissions and commissions were computed using O+C as the total.

Table 7. Proportions of Omissions and Commissions for the Two Exposure Frequency Conditions.

Condition	O/O+C	C/O+C
One Exposure	.48	.52
Two Exposure	.48	.52

Table 7 shows the proportions with respect to the frequency of exposure conditions. The proportions of omissions and commissions for Ss under the 1-exposure and 2-exposure conditions were identical. Slightly more than half of the total O+C were errors of commission.

Table 8. Proportions of Omissions and Commissions for the Three Emphasis Conditions.

Condition	O/O+C	C/O+C
IE	.44	.56
NE	.45	.55
RE	.58	.42

Table 8 shows the proportions with respect to the three emphasis conditions. The proportions of omissions and commissions for Ss under the IE and NE conditions were approximately equal. These Ss showed a tendency to make a greater proportion of errors of commission than omission. The opposite result was found for Ss under the RE condition. This discrepancy is noteworthy in view of the previous finding that the RE Ss had a significantly greater mean recognition score than those under the IE and NE conditions. The apparent difference in mode of response, in terms of O and C, for Ss under the various emphasis conditions suggested further analyses.

Prevalence of O versus C for each subject.

The omission and commission data, as summarized above, was not directly amenable to a statistical analysis due to lack of independence between these classifications. Each subject was therefore classified as making more or less errors of omission than commission. Ss for whom $O=C$ were excluded. The results are presented in Table 9.

Table 9. Observed Numbers of Subjects Making More and Less Errors of Omission than Commission Under the Three Emphasis Conditions.

	O > C	O < C	Total
RE	23	12	35
NE	13	22	35
IE	15	23	38
Total	51	57	108

A test of the discrepancies between observed and expected results for the data shown in Table 9 supported the hypothesis that the emphasis conditions are related to the prevalence of errors of omission over errors of commission (Chi-square = 7.15, $P < .05$). The data suggest that Ss under the RE condition are more likely to make errors of omission, whereas Ss under the other conditions are more likely to make errors of commission.

Inspection of the data showed that commission errors were of two kinds: (1) intrusions, i. e., words which came from the pre-recognition series but were incorrect, and (2) words not from the pre-recognition series. Of the total number of commissions made by all experimental subjects, 42% were intrusion errors. This is additional evidence for the general effect of pre-recognition exposure on errors of recognition. The percentages for subjects under the IE, NE, and RE conditions were 37%, 42%, and 49%, respectively. There do not appear to be substantial differences among the three emphasis conditions with respect to intrusion errors.

Accuracy of recognition on the first two test items.

To provide additional information about Ss' performance during the early part of the testing period, responses on the first two items of the recognition test were analyzed. It was conjectured that on the basis of their expectancy for certain words, success early in the recognition test might make the RE Ss more "confident" and therefore more able to tolerate omission errors if the stimulus word was not easily recognized. The hypothesis was that the proportion of Ss responding correctly to the first two items would be greater under the RE condition than under the IE or NE conditions. The results are presented in Tables 10 and 11.

Table 10. Observed Numbers of Subjects Giving Correct and Incorrect Responses to Items 1 and 2 under the Relevant and No Emphasis Conditions.

	1 and 2 Correct	1 and 2 Incorrect	Total
RE	31	9	40
NE	26	14	40
Total	57	23	80

Table 11. Observed Numbers of Subjects Giving Correct and Incorrect Responses to Items 1 and 2 Under the Relevant and Irrelevant Emphasis Conditions.

	1 and 2 Correct	1 and 2 Incorrect	Total
RE	31	9	40
IE	21	19	40
Total	52	28	80

Although the proportion of Ss getting the first two items correct was greater under the RE condition than the NE condition, as shown in Table 10, this difference was not statistically significant (Chi-square = 1.52, $P > .05$). The results failed to support the hypothesis that the RE and NE conditions as related to performance on items 1 and 2. The hypothesis was supported for the comparison between the RE and IE conditions. For the results shown in Table 11, the difference between the proportions of RE and IE Ss responding correctly to the first two items was statistically significant (Chi-square = 5.49, $P < .05$). The data suggest that Ss under the RE condition are more likely to get the first two items correct than are Ss under the IE condition.

DISCUSSION

This study is related to the program of research dealing with stimulus impoverishment. The latter term refers to a distortion of the task or stimulus condition presented to the subject on the basis of which he is required to give some response. The situation has also been referred to as one of "marginal" or "substandard" stimulus conditions.

The experimental setting provides an opportunity to impose limitations on the external stimulus patterns by artificially reducing the amount and/or kinds of information (or "cues") available to the perceiver. From the subject's point of view, the incoming information is likely to arouse some degree of uncertainty about the stimulus. In this sense, the task constitutes a perceptual problem, the solution of which depends on the particular experimental variables introduced by the investigator.

The general literature in this area suggests that two basic types of variables determine the outcome of such a problem. These have been classified as either stimulus variables or organismic variables. Stimulus variables determine the degree of impoverishment of the stimuli depending on such factors as the duration of exposure, amount of illumination, or ambiguousness of the stimuli. Organismic variables, on the other hand, include a number of behavioral determinants which involve the way in which perceptual functioning interacts with other factors arising from personality characteristics, previous learning, preparatory set, or past experience in general.

In the present study, no attempt was made to analyze the problem of recognizing mutilated words in terms of stimulus variables. Variables pertaining to the verbal stimuli, such as degree of mutilation and amount of illumination, were held constant. Several organismic variables did

enter into the experiment and were systematically manipulated with respect to the subjects' pre-recognition experience with complete, non-mutilated words.

Studies have shown the importance of previous experience as a determinant of word recognition. The experiments of Howes and Solomon (1951), and McGinnies, Comer, and Lacey (1952) have demonstrated that frequency of prior usage or response to written English words is a significant variable influencing visual duration thresholds. The frequency hypothesis was again confirmed in other experiments in which relative frequency of word usage was controlled for in the experiment (Solomon and Postman, 1952; King-Ellison and Jenkins, 1954). Results of a study by Postman and Conger (1954) were taken as providing additional support for the hypothesis that frequency of past usage, rather than frequency of past visual exposure per se, is the crucial variable in speed of recognition.

The frequency variable under consideration in this experiment was the number of pre-recognition exposures to a series of complete words. These words occur with approximately the same relative frequency in written English as determined by the Thorndike-Lorge word count. No attempt was made in this study to distinguish between frequency of prior "response" to the complete words or frequency of prior visual exposure per se since these variables could not be clearly isolated. It is likely that subjects did make some subvocal or covert responses during the pre-recognition exposure period. Some of the subjects later remarked that they had tried to memorize certain words. One and two pre-recognition exposures, however, were found to have different effects on the subsequent recognition of mutilated words. The results appear to indicate that frequency of encountering both relevant and irrelevant words in the past, facilitates the ease with which a later mutilated verbal stimulus is recognized. The frequency effect obtained in this context is similar to that in previous tachistoscopic studies of word recognition.

Other past experience variables have been referred to as preparatory set, hypothesis, and prior attention. Siipola (1935) reported that different subjects perceived a common list of stimulus words, which were either relevant, irrelevant, or ambiguous, in accordance with their appropriate preparatory sets. In the experiments of Postman and Bruner (1949) and Freeman and Engler (1955), relevant sets were found to have a facilitating effect on ease of recognition as compared to a detrimental effect when sets were misleading. According to Postman and Leytham (1950), when past experience is analyzed in terms of hypothesis strength, the frequency with which a perceiver's hypothesis has been confirmed in the past is a major determinant of perceptual sensitivity.

Hebb (1949) and Berlyne (1960) have made some attempt to reformulate the traditional problem of attention in more objective terms. Attention is generally considered to refer to a complex selective mechanism which determines the organism's attentive responses in the presence of a given set of stimuli. Studies dealing with the relationships between attention and response to verbal stimuli have been somewhat limited to the serial learning situation. In an experiment by Wilcocks (1928), it was found that a heterogeneously colored stimulus (letter) attracted attention during a training series, and subsequently increased retention for this stimulus. The later work of Berlyne (1951), however, indicates that change in stimulation per se, and not preference for such factors as color or shape, is the important attention-getting variable. Green (1958) refers to structural change during a serial learning task as the introduction of a new type of item. His experiments have demonstrated that the structure of a list of items has a significant influence on the probability of recalling a particular item due to its attention-getting properties.

The pre-recognition variable introduced in the present study was defined as the presence of structural emphasis of particular complete words.

Under three conditions of structural emphasis, (Relevant, Irrelevant, and No Emphasis), all subjects were exposed to the same words for an equal duration of time. A further consideration was Ss' lack of fore-knowledge of either the structure of these words, i.e., their color and size), or the nature of the task they were to perform after the exposure period. The instructions were identical for each condition and gave no indication that some words would appear differently than others. The subjects were told only to look at each word. However, the pre-recognition experience of subjects under these conditions was shown to be differentially effective in the subsequent recognition of mutilated words.

The differences in recognition observed in this experiment are considered to be attributable to the presence of structural emphasis. It appears that the particular structural emphasis of the complete words was such as to enhance the attention-demand value of the stimuli. Hence, there is demonstrated a relationship between attention-demand value and effective utilization of the stimulation in the solution of a subsequent relevant problem.

Impressions of the emphasized words on subjects in the RE and IE groups are exemplified by the following remarks obtained after the experiment:

"As soon as I saw the first red word, I felt that this would be more important than the others. From then on, I concentrated on the red words more than the others."

"I felt that the red words made more of an impression on me. They seemed to catch and hold my attention."

"I thought that there was some connection between the idea of some words being red and larger than the others, and our being able to retain them."

"When I saw the first red word, I thought it was special. I tried to remember it, especially, and later found myself concentrating on the red words much more than the black ones."

"My first reaction on seeing the first red word was one of curiosity. I wondered why they were there."

In addition to the specific effects of exposure frequency and structural emphasis, a general effect attributable to past experience was demonstrated. Any form of prior exposure to the series of complete words, containing the relevant words, facilitates the subsequent recognition of mutilated words. Lack of pre-recognition exposure reduces recognition. The results point to a strong relationship between pre-recognition exposure per se and the successful utilization of prior stimulus information in the subsequent task.

The effect of structural emphasis of words exposed during the pre-recognition period also appears to be related to the kinds of errors made during the recognition test. It was found that subjects in the RE groups are more likely to make errors of omission, whereas subjects in the other groups are more likely to make errors of commission. In addition, RE subjects are more likely to be successful early in the test than are subjects in the IE groups.

The attention-demand value of the emphasized words is likely to have induced an implicit set or expectancy for these words. The RE subjects, whose expectancy was partially confirmed early in the subsequent recognition test, were therefore more confident of their responses to the remaining items. In this respect, there was a tendency for these subjects not to respond if the stimulus word was not readily identifiable since they were more able to tolerate omission errors. The IE subjects, whose expectancy was not confirmed, tended to be less confident and therefore made more errors of commission than omission. The NE subjects, however, had no particular expectancy with regard to either the relevant or irrelevant words. These subjects may be considered to have had a general set for any of the previously-exposed words. Success early in the test was not sufficient to overcome their lack of ability to

tolerate errors of omission. These subjects, therefore, tended to make more errors of commission than omission partly because of ineffective utilization of their prior experience with non-emphasized words.

Finally, it is suggested that the pre-recognition variables under consideration in the present study influence the process of closure. This process is considered to be a contributing factor in the recognition of incomplete stimulus words. Number of exposures and the presence of structural emphasis of particular complete words either facilitates or inhibits the subsequent operation of closure. The result is determined by the specific kind and amount of pre-recognition experience of the subjects.

The closure effect demonstrated in this study is somewhat similar to that found by Leeper (1935), Postman and Bruner (1952), and Barratt and Barratt (1957). In these experiments, the stimuli were either incomplete pictures or geometric figures. According to the Gestalt notion, an "open" or incomplete form tends to complete itself, that is, to achieve closure. Bobbitt (1948) reports that the most generally agreed-upon definitions of closure in perceptual theory refer to this process as the perceptual act of completing stimulus configurations which are physically incomplete.

In this experiment, subjects were called on to recognize a meaningful verbal stimulus in impoverished form. This task appears to differ somewhat from the traditional perceptual closure situation in which incomplete stimulus configurations were reported as having been seen as meaningful whole objects. It is suggested that the relationship between the pre-recognition variables introduced in this experiment and the subsequent visual recognition of mutilated words may involve a broader and more complex process than is indicated by the concept of perceptual closure. Such a process may be referred to as "cognitive" closure. This is defined as the resolution of a cognitive act (i. e., obtaining

knowledge of an object) in the presence of an impoverished, but potentially meaningful verbal stimulus. Cognitive closure would thus include not only perceptual processes, but also those of recognition, conception, thinking, memory, etc. and their interactions.

SUMMARY AND CONCLUSIONS

This experiment was concerned with the relationships between two pre-recognition variables and the visual recognition of mutilated words. The technique for measuring recognition of verbal stimuli consisted of presenting each of 12 mutilated English words on a screen for a duration of six seconds. In this manner, a high degree of stimulus impoverishment was attained at suprathreshold levels. The mutilated word test has been considered as a measure of perceptual closure.

The experimental variables under consideration were isolated and defined with respect to a series of complete, i. e., non-mutilated, words exposed on a screen during a pre-recognition period. The series contained 36 words, each of which was exposed for five seconds. Twelve words in this series were designated as relevant words, since each subsequently appeared in mutilated form in the recognition test. The remaining 24 words, which did not appear in the latter test, were designated as irrelevant words.

The pre-recognition variables were defined by (a) the number of exposures to the series of complete words, and (b) the presence of structural emphasis of certain words in the series. Two conditions of exposure frequency and three conditions of structural emphasis were administered. Either one or two prior exposures to each of the words in a series were given in combination with a particular emphasis condition. Structural emphasis was accomplished by varying the size and color of different words in a given series. The emphasized words were characterized by letters which were slightly larger than those comprising other words in the same series, and which appeared red, in contrast to the others which appeared black. On this basis, the emphasis conditions

consisted of exposure to a series in which either (a) the 12 relevant words were emphasized, (b) 12 of the irrelevant words were emphasized, or (c) none of the words was emphasized.

Six experimental groups, each containing 20 subjects, constituted the possible combinations of exposure and emphasis conditions. A control group of 20 subjects had no pre-recognition exposure to the series of complete words during the experiment.

The main findings of this study are as follows:

1. Visual recognition of mutilated words is facilitated by increasing the number of pre-recognition exposures to the series of complete words.
2. Visual recognition of mutilated words is facilitated by emphasizing (or directing attention to) the relevant, i.e., corresponding non-mutilated, words during pre-recognition exposure. Lack of emphasis during pre-recognition exposure, or emphasizing those words not presented for recognition in mutilated form, reduces subsequent recognition.
3. Any form of prior exposure to a series of complete words, containing the relevant words, facilitates the visual recognition of mutilated words. Lack of pre-recognition exposure reduces recognition.

The following are additional findings with respect to errors and early success on the word recognition test:

1. Subjects under the Relevant Emphasis condition are more likely to make errors of omission, whereas subjects under the No Emphasis and Irrelevant Emphasis conditions are more likely to make errors of commission.

2. Subjects under the Relevant Emphasis condition are more likely to be successful early in the recognition test than are subjects under the Irrelevant Emphasis condition. The Relevant Emphasis and No Emphasis conditions do not appear to be related to early success.

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APPENDICES

APPENDIX 1

LIST OF MUTILATED WORDS WHICH APPEARED
IN THE WORD RECOGNITION TEST

summan

for-b...

dr. w.

act.

ommun.

h. y. er

cia

v. h. y.

h. y. y.

h. y. y.

h. y. y.

mir. re

APPENDIX 2

LIST OF COMPLETE WORDS SHOWN DURING PRE-RECOGNITION PERIOD

flower	degree
refuse	people**
second**	decide*
summer*	narrow
health**	obtain
middle	listen**
forest*	yellow*
remain	effort**
answer*	knight*
though**	better**
garden	valley
doctor*	double*
always	farmer***
beauty**	corner
common*	system**
sister**	father*
happen*	winter
animal**	minute*

* Indicates relevant word emphasized.
** Indicates irrelevant word emphasized.

APPENDIX 3

WORD RECOGNITION SCORES FOR THE 140 SUBJECTS IN THE
EXPERIMENT. EACH SCORE REPRESENTS THE NUMBER
OF MUTILATED WORDS CORRECTLY RECOGNIZED

Ss	Control	IE ₁	NE ₁	RE ₁	IE ₂	NE ₂	RE ₂
1	0	2	4	4	1	3	5
2	1	3	5	5	3	4	6
3	1	3	5	5	5	5	6
4	2	3	5	6	5	5	7
5	2	4	5	6	5	6	7
6	2	4	5	6	5	6	8
7	2	4	5	6	5	6	8
8	2	5	6	7	5	6	8
9	2	5	6	7	5	6	8
10	2	5	6	7	6	7	8
11	2	6	6	7	6	7	8
12	3	6	6	7	7	7	8
13	3	7	7	7	7	8	8
14	3	7	7	7	7	8	9
15	3	7	7	8	7	8	9
16	4	8	7	9	8	8	10
17	4	8	8	9	8	8	11
18	5	8	9	9	9	8	11
19	5	9	9	10	9	8	12
20	6	9	10	10	9	9	12

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