# AN INVESTIGATION OF

# THE PROCESS OF WORD RECOGNITION

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By

RONALD DICK LAMBERT, B. A.

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AUTHOR: Ronald Dick Lambert, B.A. (McMaster University)

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SCOPE AND CONTENTS:

Two experiments were conducted to examine parameters of the process of word recognition. In both experiments, subjects were required to guess the identity of words from which letters were exposed.

In the first experiment, independent variables were frequency of occurrence in the language of stimulus words, number of letters selected from the words, and the position of the letters within the words. All three variables yielded significant effects.

Connotative meaning of the stimulus words and the number of letters exposed from the beginning of the words were varied in the second experiment. As in the first experiment, the effect due to number of letters was significant. Connotative meaning, however, did not contribute significantly to subjects' recognition latencies.

CONTENTS

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# INTRODUCTION

The late 1940's witnessed the introduction of what has been called the "New Look" in perception (Allport, 1955). The term "New Look" denotes the interest shown by psychologists in the effect of motivational and other personality variables on the perceptual process. Lively experimental and theoretical controversy has centred around whether or not such determinants operate at preconscious levels of awareness.

This interest is in marked contrast with the traditional approaches which were concerned almost exclusively with stimulus variables as determinants of perception. Perception experiments were designed to analyze the relations between an observer's response and specified stimulus conditions, including the context of the stimulus. Representative of the traditional approach is Gestalt psychology. Gestalt psychologists described objective features of the stimulus, such as its internal organization, spacing, similarities among constituent elements, and so on. The fact that two different stimuli were seen differently could be traced to these objective variations in the stimuli.

"New Look" psychologists, on the other hand, ask why the same stimulus is responded to differently by different subjects. They believe that the observer is directed, in some manner, to attend to stimuli which accord with his dominant value orientation or are congruent with his principal need states. Illustrative of

experiments investigating some of these factors are studies by Bruner and Goodman (1947) and Postman, Bruner and McGinnies (1948). Their experiments were among the earliest within the "New Look" tradition and have done much to stimulate interest in the area.

The Bruner and Goodman (1947) inquiry found that children from lower socio-economic homes tended to overestimate the size of coins more than did children from more prosperous families. Postman, Bruner, and McGinnies (1948) found evidence suggesting that a subject's dominant value orientation, as measured by the Allport-Vernon Scale of Values, enabled him to recognize words from the area in question at shorter exposure durations than were required for words representing non-dominant value areas. For example, a person whose dominant value area is religious would be expected to perceive the word "devotion" at an exposure duration shorter than required for the word "financial", representing what might be his least favored value area. As will be noted later, however, certain other variables must be controlled before this effect can legitimately be attributed to value rank.

Since many of the experiments to be described are concerned with the determinants of recognition thresholds, a brief description of the method of measurement would seem appropriate. Typically, the stimulus material is exposed by a tachistoscope, an apparatus which may take one of two forms. One device is box-shaped with an aperture in one end through which a subject views stimulus material exposed at the opposite end. A second instrument is simply a projection lantern which casts the stimulus on a screen

or wall. In either case, the experimenter may regulate the duration for which a stimulus is exposed or he may systematically vary the illumination of the stimulus. In the first instance, the experimenter might expose the stimulus to the subject for an initial duration of 20 milliseconds, illumination constant. If the subject fails to report correctly the identity of the stimulus, it is again exposed, but this time for a duration of 30 milliseconds. Successive exposures are increased by steps of 10 milliseconds until recognition occurs. The exposure duration required for the subject to identify the stimulus is taken to be his threshold. The second technique varies the illumination at which the stimulus is exposed, with duration of exposure held constant. Following each unsuccessful trial (exposure), the illumination is increased by a specified amount and the amount required for recognition is taken to be the threshold.

Newbigging (1961a) has defined the process of recognizing tachistoscopically presented words as "the redintegration of the stimulus word from a seen fragment." He assumes that, on a given exposure, the subject perceives only a portion of the stimulus, and this he incorporates into his verbal response. Insofar as the observer is unsuccessful on a number of trials, longer exposure durations permit him to see increasing amounts of the stimulus, and consequently incorporate more of the stimulus into his responses. Thus, Newbigging predicted and found increasing structural similarity of responses to the stimulus over a succession of trials.

Newbigging (1961b) has extended the foregoing analysis to describe the transmission of connotative meaning by seen fragments.

Words which had been rated on Osgood's "good-bad" scale of the semantic differential (Jenkins, Russell, and Suci, 1958) were presented tachistoscopically. He found that a longer exposure duration was required to recognize a fragment (recognition being defined by inclusion of the fragment in the subject's response) from a "bad" word as contrasted with a fragment of equal size seen in a "good" or "neutral" stimulus word.

The present thesis is concerned with the process of perceptual redintegration as it has been experimentally defined by Newbigging. The purpose of the first experiment was to assess the relative efficacy of letters seen in different positions of a word in promoting the recognition of the word. The contributions of different size fragments in relation to their position within the word were also measured. Both of these variables were related to the variable of frequency of occurrence of the word in the English language. Frequency estimates were obtained from the general count of the Thorndike-Lorge word count (1944).

It was the purpose of the second experiment to examine the effect of connotative meaning on the redintegrative process. Fragments differing in size were selected from the beginning letters of words falling at either extreme of the "good-bad" continuum. Hypotheses tested pertained to the contribution of "goodness" of the stimulus to its speed of redintegration. A mention will now be given to a review of the literature which provides a background to the problem of this thesis.

## HISTORY

In this section, brief attention will first be given to research investigating the effects of values and need states on perception. The findings reported will then be evaluated in terms of three different theoretical schema proposed by Bruner (1957a, 1957b), Solomon (Solomon and Postman 1952), and Eriksen (1958, 1960), each of which tries to account for the experimental results. Bruner (1957a, 1957b) looks to personality structure and the inner workings of the organism to explain perception. The organism possesses predilections which serve to select from the stimulus complex elements to be accented, others to be ignored. In contrast, Solomon and Postman (1952) describe recognition in the language of learning theory. In accepting the S-R paradigm as basic, they look for manipulations which alter perceptual stimulus - verbal response association strengths. A more intermediate position is occupied by Eriksen. He supposes sources of error specific to different response systems, thus accounting for the apparent superiority of one mode of response as contrasted with another. Research exemplifying each emphasis will be described in conjunction with the points of view outlined.

Findings yielded from a series of experiments conducted by Sperling (1960) will next be described. These experiments, concerned with the amount of information contained in a brief exposure of a stimulus, suggest important considerations in respect to the discussion of the perception of partial cues (redintegration) which follows. Finally, the hypotheses to be investigated will be

noted.

The Role Of Value And Need In Perception.

Postman, Bruner, and McGinnies (1948), in a paper already cited, presented for tachistoscopic recognition thirty-six words selected so that six were related to each of the six value areas measured by the Allport-Vernon-Lindzey Study of Values. Subjects' thresholds and prerecognition hypotheses for all six groups of words were analyzed in relation to each subject's dominant and non-dominant value areas. As far as the threshold measurement was concerned, it was shown that words relevant to the subject's dominant value area were recognized at significantly shorter exposure duration than was the case for words related to non-dominant value areas. Pre-recognition responses were classified into five categories as follows: (1) covaluant - responses resembling the stimulus in their common representation of a specific value area; (2) contravaluant - the evaluative opposite of the stimulus; (3) structural - dissimilar in meaning, but similar to the stimulus by virtue of their inclusion of elements found in the stimulus; (4) nonsense, and (5) unrelated responses.

Of particular interest as far as the present thesis is concerned is the fact that the structural category contained a sizeable prpportion of the total unsuccessful hypotheses. Structural similarity suggests that the observer has recognized some of the stimulus; though the letters which are seen do not provide enough information for identification, nevertheless, they are incorporated into the subject's response. Postman et al also observed that

subjects tended to make covaluant responses to stimuli incorrectly perceived in their respective dominant value areas. There was also a tendency for contravaluant and nonsense responses to be elicited by low value area stimuli. The authors propose three selective mechanisms to account for these different responses: selective sensitization, perceptual defense, and value resonance. The first mechanism produces lower thresholds for stimuli from the favored value area while the second process defends a subject from incongruent stimuli (cf. Eriksen, 1954). Value resonance refers to the observer's tendency to give prerecognition hypotheses covaluant with his dominant value orientation.

The frequency with which the stimulus words occurred in the language, subsequently shown to be an important determinant of the recognition threshold, was not controlled in this study so that the results are not open to unambiguous interpretation. Solomon and Howes (1951) and Postman and Schneider (1951) followed up this early paper, controlling for word frequency. In both of these experiments, the main effect for the value variable failed to attain statistical significance, but significant value rank x word frequency interactions were obtained. That is, rank acts as a determinant of the threshold for words occurring infrequently in the language, but not for more frequent words.

Solomon and Howes argue that the small effect on the threshold of the value rank of infrequently occurring stimulus words may be most simply interpreted in terms of idiosyncratic word frequency, rather than in terms of the subtle and complex mechanisms

described by Postman et al (1948). The point they make is simply that an individual is likely to read material relevant to his dominant value area and therefore see words relevant to that area more frequently than individuals with a different value orientation. Arguments have been advanced against this interpretation (see, for example, Postman and Schneider, 1951) but the issue is tangential to our main concern and will not be followed up here. Rather, attention will now be turned to a group of experiments concerned with need as a directive factor in perception.

Eriksen (1951) found a direct relationship between socially unacceptable needs and recognition thresholds using pictures representing individuals gratifying the needs in question. He measured the presence and strength of three need states in a word association test. The needs were aggression, succorance, and homosexuality. Not only were the recognition thresholds for the crucial pictures elevated, but it seemed to the experimenter that the pre-recognition responses, too, possessed a "defensive flavor". The latter finding indicated that the subjects derived cues enabling a primitive categorization of the stimuli as to affective content, the unpleasant characteristics of which presumably served to inhibit correct identification.

Consistent with Eriksen's (1951) results are findings obtained by Lazarus, Eriksen, and Fonda (1951). They observed a relationship between subject's ability to perceive sentences of a sexual or aggressive nature, presented against a background of white noise, and their willingness to provide such endings in a sentence

completion test.

Eriksen (1951) has suggested requirements which he feels research in this area ought to satisfy. (1) The experimenter, in addition to providing a definition of the need in which he is interested, should also provide the scaling technique by which the strength of the need can independently be measured. (2) "A provision must be made for determining which needs will lead to perceptual defence in the case of each subject, and prediction should be made prior to the fact . . . (thus), it is necessary to consider the factor or factors which determine why one need leads to sensitization and another to defence" (p. 557). (3) The defence process should be set within the context of the total personality structure. Elaboration of other personality dimensions should be made, particularly as they are thought to affect the nature of the defensive mechanisms. Eriksen (1954) feels that when these requirements are met, there still seems to be good evidence arguing for the role of need structure in directing perception.

A favored procedure in investigating the defensive nature of perception involves the comparison of recognition thresholds of neutral and socially taboo words. Two studies by Dixon (Dixon 1958a, 1958b) are representative and are now briefly described. In the first noted study, Dixon obtained continuous measures of the shifts in the threshold of absolute awareness from one eye while verbal stimuli were exposed at below threshold durations to the other eye. Although the verbal material differed in frequency, he found higher thresholds in the case of the two taboo words (i.e. "penis" and

"whore") than for the neutral stimuli. Furthermore, a sex difference was found, suggesting to Dixon that the emotional connotations of taboo words differ between sexes.

In his second experiment, Dixon (1958b) obtained further proof of the role of "endopsychic factors." Having first calculated his subjects' absolute thresholds for awareness, he presented tachistoscopically a series of verbal stimuli differing in emotional loading. A week later, each subject was asked to match the responses made in the earlier session to the stimuli exposed on that occasion. Dixon observed a significant tendency for the subjects to check the correct associations. "That the responses were, in fact, responses to meaning was further supported by the subjects' ability to match them against the synonyms of the stimulus items by which they had been evoked" (p. 35).

In the tachistoscopic portion of his experiment, Dixon also found a clear relationship between deflections in the galvanic skin response tracings and the presentation of taboo words. Subjects exhibited a marked increase in autonomic arousal in the presence of these stimuli. The response latency index did not reflect any significant relationship, although the scores on this measure tended to fall in the expected direction. Dixon interprets his results in terms of the perceptual defense hypothesis. He rejects a partial discrimination interpretation (i.e. that subjects were responding to partial cues provided by the stimulus) on the main grounds that the subjects' introspective reports indicated that they saw nothing during the exposures. Such subliminal projections simply afforded no

material to discriminate at a conscious level. Further, examination of the data failed to reveal any important structural resemblances between the response words and the stimulus words. As will be noted later, however, Fuhrer and Eriksen (1960) have challenged Dixon's findings.

Theory.

Experiments, of which those described above are representative, have stimulated considerable theorizing about how such variables as value and need have their effect on perception and, more specifically, on the recognition of tachistoscopically presented words. The main disagreement between theorists concerns whether these variables have their effect on perception of the stimulus as such or on the verbal or other response which identifies the stimulus. As will be apparent from the following review of the theories most strongly associated with the names of Bruner, Postman and Solomon, and Eriksen, the disagreement resolves itself to a matter of emphasis. Bruner (1957a, 1957b) elaborates a mechanism by which he attempts to show how these variables could operate on perception. Postman and Solomon, on the other hand, emphasize the role of value, need and other such variables in facilitating or inhibiting the identifying verbal or other motor response. They then attempt to account for the results of recognition threshold experiments in these terms. Eriksen's position is somewhat intermediate between these two. These theoretical views, together with relevant experimental data, are now reviewed in the order in which they are referred to above.

Bruner conceives of the perceptual act as a decision process which results in the assignment of the stimulus input to a category.

He defines "category" as "a set of specifications regarding what events will be grouped as equivalent - rules respecting the nature of criterial cues required, the manner of their combining, their inferential weight, and the acceptance limits of their variability" (1957a, p. 133). Four mechanisms are postulated to mediate the decision. These are: (1) grouping and integration; (2) access ordering; (3) match-mismatch; and (4) gating.

By "grouping and integration", Bruner refers to the anatomical substrate of the categories and physiological functions relating the categories. This conception owes much to Hebb's views concerning the conceptual nervous system. "Access ordering" suggests that some categories are more available, more accessible, than others to the input. Consequently, a stimulus from a more accessible category would have a lower threshold than a stimulus from a less accessible category. Accessibility of the classification system is assumed to be determined by two major classes of variables: the different frequencies with which events in the environment are encountered - "learned expectancies," and the organism's "search requirements," rooted in the more or less stable need structure of the personality. It may be noted that by these mechanisms Bruner can account for the lower threshold of frequent as compared with infrequent words, and of need and value related words.

The "match-mismatch" mechanism relates the cues characterizing the stimulus with the specifications of appropriate categories. It signals the extent of fit and error, serving to terminate examination of the stimulus if the event is successfully categorized or to

initiate further inspection if the discrepancy between input and specifications is not within tolerable limits. The "gating" mechanism denotes peripheral inspection of the stimulus input. Programmed by a "central cognitive state", instructions stipulating criteria for acceptance of input are fed to these distal inspection stations. Bruner finds some support for his views concerning the gating process in physiological research, notably in experiments conducted by Galambos, Sheatz, and Vernier (1956) and by Hernandez-Peon, Sherrer, and Jouvet (1956).

Bruner analyzes the psychology of the organism's reception of the stimulus into its component stages. (1) Primitive categorization: this is the period of shifting attention; events are selected for further, more intensive, examination. (2) Cue search: the organism is maximally receptive to the event, inspecting it for cues which will facilitate classification. (3) Confirmation check: cues are sought which will confirm the tentative classification which the organism has already made. "The 'openness' to stimulation decreases sharply ... . (as) a tentative placement of identity having occurred, the search is narrowed for additional cues to confirm this placement. We shall speak of a selective gating process coming into operation in this stage, having the effect of reducing the effective input of stimulation not relevant to the confirmatory process" (1957a, p. 131). (4) Confirmation completion: results in the final assignment of the input to its category; inappropriate cues, aspects of the input inconsistent with the favored coding, are "normalized".

Certain features stand out in Bruner's emphasis of the

perceptual, rather than the response side, of perception. (1) The observer is active and has some say as to what shall win his attention. (2) He need not devote his full attention to the ongoing situation, but can rely on more distal check points, under the control of central agencies or states, to quietly process the incoming communications. Some of these will be delayed or pigeon-holed, depending on the individual's predilections. (3) While the world outside the skin is admittedly important, the subtleties of individual behaviour can profitably be studied as expressions of the personality structure. The following studies are illustrative of such a point of view, though they do not necessarily support in detail Bruner's version of it.

Cowen and Beier (1950, 1954), for example, report evidence showing that perceptually defensive behaviour reveals itself in the nature of prerecognition response made to threatening stimuli. Thus, while a large proportion of affectively neutral prerecognition responses were elicited by neutral stimuli, emotionally-loaded prerecognition hypotheses occurred frequently in response to threatening stimuli. Furthermore, there was a tendency for subjects to make more prerecognition responses structurally similar to neutral stimuli than to threatening stimuli. Subjects were able, in other words, to respond to the affective loading of words in the absence of correct verbal identification.

Fulkerson (1957) has obtained information which bears on the situational salience and meaningfulness of classes of stimuli to which an observer responds. Fulkerson found that recognition thresholds obtained when subjects had been warned that off-color words would be

flashed did not differ significantly from his uninformed condition. However, thresholds for taboo words varied inversely with the number of such stimuli presented in a series made up of both taboo and neutral words. That is, the larger the proportion of 'loaded' words, the lower their thresholds. These differential effects due to background or context conditions, in contrast, did not extend to the neutral stimuli.

Fulkerson observed a tendency for threatening stimuli occurring frequently in the language to produce higher thresholds than for non-threatening frequent words, while less frequent unpleasant words were perceived at a somewhat lower level than were infrequent non-threatening words. He interprets these differences as perceptual defense and perceptual vigilance, respectively. The context x taboo interaction is interpreted in terms of a systematic heightening of the salience or prominence of a class of stimuli, i.e. taboo words. That no such effect was evidenced by neutral stimuli is understandable in the absence of any meaningful dimension along which these words could be located. Definition by exclusion, i.e. non-taboo words, apparently does not delimit a convenient or manageable class of stimuli.

The low incidence of emotionally toned prerecognition responses in Fulkerson's data raises the question of deliberate response suppression . Experiments by Newton (1955) and Zigler and Yospe (1960) are representative of attempts to circumvent the objection that subjects deliberately withhold identifying responses to taboo words. In the former study, Newton selected a sample of words from

the Thorndike-Lorge word count (1944). These were rated on a seven point pleasant-unpleasant scale and the 14 extreme words, seven at either end, were selected for tachistoscopic exposure. Since frequency was controlled, supposedly any effect which might arise would not be attributable to this variable. Newton rules out the response suppression hypothesis (Howes and Solomon, 1950) on a priori grounds; he argues that the unpleasant stimuli were not such as to give any reason to anticipate conscious response suppression as in the case of taboo stimuli.

All 14 words were exposed in a different random order for each of three projection settings. Although the technique did not yield thresholds in the usual manner, it did permit an analysis of the subjects' hypotheses in relation to the two classes of stimuli. Newton found that the unpleasant words elicited significantly more incorrect responses than did the pleasant words. Inasmuch as word frequency was experimentally controlled and the possibility of deliberate response suppression was ruled out, Newton interprets his results as favoring a perceptual defense point of view.

Zigler and Yospe (1960) required a group of subjects to rate a sample of words in terms of familiarity and pleasantness. They found high and significant correlations between the Thorndike-Lorge frequency estimates and familiarity ratings, on the one hand, and the judged pleasantness of the words on the other. The more frequent or familiar a word, the more likely it was to be judged pleasant.

Recognition threshold estimates were then determined for a group of subjects different from the group which rated the stimuli

on the familiarity and pleasantness dimensions. Each member of one experimental group was requested to record his hypothesis after each exposure. The exposure duration at which a subject made his second successive correct identification of a stimulus was taken as an estimate of his threshold for the word. A second experimental group was administered the words in a similar manner, except that they were required to rate each stimulus on a pleasant-unpleasant scale after each exposure. The latter subjects did not verbalize the response and did not record it in writing as the first group did. When a subject had assigned the same rating on five successive occasions, the exposure duration at which he made the second rating was designated his threshold.

Both methods of measurement resulted in lower threshold values for neutral as contrasted with unpleasant stimuli. Comparing the two methods, the checking procedure yielded lower thresholds for both classes of words than did the more usual technique. Zigler and Yospe acknowledge that the difference between neutral and unpleasant words is subject to a response suppression interpretation (cf. Newton, 1955; Eriksen, 1954), but the difference still apparent using the second method is not as easily handled by this interpretation inasmuch as subjects were not required to verbalize the response, but simply to rate its connotation. Nor is the explanation based on deliberate delay of responding consistent with the additional finding that positively-rated words tended to be recognized sooner than the neutral stimuli. Finally, they report "a (positive) relationship was discovered between the amount of response suppression exhibited toward a word and the word's familiarity" (p. 237). The latter

finding is suggestive of Fulkerson's (1957) report of an elevation in the recognition level for frequent taboo words, interpreted as perceptual defense. As was noted at the time, Fulkerson also observed what appeared to be a perceptual vigilance effect in response to relatively infrequent stimuli which had been judged unpleasant.

Finally, a rather extreme set of assumptions is represented in an experiment by Neisser (1954). In defense of perceptual interpretations, he presents what he believes to be "an experimental distinction between perceptual process and verbal response." To a sample of 12 subjects, he presented a list of 10 words which were to be examined for a period of one minute. At the conclusion of inspection, recognition thresholds were measured for five words selected from the list, five homonyms of the remaining words on the inspection list, and five control words not hitherto encountered in the experiment. "The results indicate that the preliminary presentation facilitated the recognition of specific items on the list, but in no way facilitated the recognition of their homonyms. Since the same verbal response is employed in reporting a homonym as in reporting the word itself, it appears that the effect of a set of this type is to facilitate recognition processes without generally facilitating the corresponding verbal responses" (p. 402).

While these experiments are generally supportive of Bruner's view that the main locus of the effect of such variables as word frequency and connotative meaning is the perceptual process, they are by no means crucial and alternative interpretations are possible.

Solomon and Postman (1952) propose that on a given trial a fragment of the total stimulus is effective in eliciting a reponse. Not only is this fragment assumed to represent a point on the generalization gradient of the stimulus, but it generally lies on a number of such generalization gradients appropriate to different words. "Which verbal response will be given depends on the relative strengths of association which have been established, through generalization, between the particular stimulus fragment and the different response words" (p. 199). They suggest that we "may describe the increase in effective stimulation as limiting the range of competing 'hypotheses' or . . . of a restriction of stimulus generalization" (p. 200).

In any event, it seems clear that response interpretations such as Solomon and Postman advance are not exclusively 'response' accounts. Each response is under the control of specified stimulus conditions. The speed with which a given response is made is thus a function of the fragment of the total word presently available and the biasing factors operative in the general experimental task - the instructions, perhaps sex of the experimenter, and so on. This account would predict the increasing structural similarity of pre-recognition responses to the stimulus word as the duration exposure is increased, a prediction which Newbigging (1961a) has confirmed.

Howes (1954), too, has advanced a response probability theory of perceptual recognition. He analyzes the probability of occurrence of a response 'x' into two components. The "base probability" is estimated by the Thorndike-Lorge word count; the

frequency counts contained in the latter estimate the likelihood that a subject will produce response 'x' apart from the tachistoscopic situation. When the subject's recognition threshold for 'x' is being obtained, the increasing exposure durations progressively limit the available responses, thereby supplying an increment to the probability of occurrence of response 'x'.

A number of experiments have yielded results consistent with this interpretation as the following review will show. In an experiment by Postman, Bronson, and Gropper (1953), taboo and neutral stimuli were equated for frequency on the basis of the Thorndike-Lorge word count and threshold measures were then taken. To determine the thresholds, subjects were assigned to four different groups. The experimental variable was the type of instructions administered. Under instructions which were designed to facilitate subjects' giving socially reprehensible responses, subjects obtained recognition thresholds for taboo stimuli lower than the other three groups. At the other extreme was a group which was uninformed as to the nature of the list to which they were being exposed. Groups which were either merely informed that such loaded words were to be included or were instructed with the view to maximizing their hesitation yielded approximately equal thresholds.

Strangely enough, the neutral words which Postman et al used produced thresholds higher on the average than the taboo words in each group (cf. Eriksen, 1954). They concluded that "The difference in thresholds is probably due to a systematic underestimation of the familiarity of the taboo words" (p. 223). The authors decide in

favor of set and "selective verbal report" as explanatory variables. To account for the additional finding that female subjects generally had higher thresholds for loaded stimuli than did males, Postman et al cite the same variables (See also Dixon, 1958a). To support their conclusion, they cite an unpublished study by McGinnies which yielded a considerably smaller discrepancy in thresholds, though still higher for taboo stimuli, than he reported in his earlier studies (McGinnies, 1949; see also Duffendack, 1954).

In spite of the fact that Postman, Bronson, and Gropper refused to recognize McGinnies' (1949) classification of pre-recognition responses and their differential association with the two classes of stimuli as a crucial test, they examined their data in a similar fashion. They found no tendency for the taboo words to prompt nonsense and unlike hypotheses or for the neutral words to elicit relatively more similar and part responses as McGinnies had.

Whereas Fulkerson (1957) showed the factor of set induced by experimental instructions to be of no significant consequence in affecting thresholds for recognizing taboo stimuli, Postman et al (1953) demonstrated differences in performance depending on the nature of the instructions. Freeman (1954) has also investigated this variable and has obtained positive results, preparation for taboo words having the effect of lowering the subjects' recognition thresholds.

Freeman describes what might be called a "sensitization effect" where a subject has been instructed to expect taboo stimuli.

The effect of instructions is such as to favor a certain class of hypotheses over others. With no specific instructions, a process of "habituation" is evidenced, i.e., the recognition exposures become shorter with successive presentations of the noxious stimuli. Not only did the set group achieve a lower threshold for the taboo stimuli, but their recognition responses to the neutral words were emitted sooner than the control groups. "This would seem to indicate that the effect of set or a hypothesis that is confirmed early in the series is to lower thresholds in general as compared to no specific set . . . or a set that is not confirmed" (p. 287; cf. Fulkerson, 1957). The latter comparison to which the quotation refers involved a group in which an inappropriate set had been experimentally induced.

In his second experiment, Freeman instructed subjects to look for taboo words, although there were no such words in fact presented. Two taboo words with their first letters altered to make inocuous English words were critical, i.e., "hiss" and "muck" for "piss" and "fuck". Freeman reports that (a) there was no threshold elevation for the taboo-similar words and (b) subjects gave significantly more taboo prerecognition responses to both taboo-similar stimuli than would have been expected to occur by chance alone. Freeman interprets his findings as being unfavorable to the perceptual defense hypothesis.

A study by Forrest (1957) which has already been mentioned warrants a few more comments. Briefly, he found the visual recognition threshold to vary inversely with frequency of auditory

and more conventional recognition experiments.

While the theoretical interpretation of Postman and Solomon, and the similar one by Howes, does provide for the role of both perceived word fragments and response biases in determining word recognition thresholds, emphasis is clearly on response biases. Eriksen has been more specific in his statement of the role of perceived word fragments and his analysis is now described.

Eriksen (1954) proposes that even if the subject does not recognize a complete word, he may perceive sufficient fragments of it enabling a rather primitive categorization. He views the task confronting the individual in the tachistoscopic situation as "essentially a problem-solving situation." The information sampled by the observer need only be enough to locate the word in a class having aversive qualities. The consequence would perhaps be anxiety arousal; thus, "If anxiety (interferes) with the availability and flexibility of hypotheses, then it is to be expected that stimuli provoking anxiety may require more cues before correct recognition occurs" (p. 180). This brief sequence he supposes to occur below the level of consciousness.

A more complete outline of Eriksen's views appears in the 1958 edition of the Nebraska Symposium on Motivation (see also Eriksen, 1960). A study central to his discussion of the "subception effect" was carried out by Lazarus and McCleary (1951). They presented 10 nonsense syllables tachistoscopically at a constant exposure duration. This duration had previously been shown to permit approximately 50% correct identification. Further, 5 of the

10 syllables were conditioned stimuli for anxiety as a result of prior association with shock. It was found that when the subjects' guesses of the identity of a stimulus were in error, the average galvanic skin response deflection obtained from the shock syllables was greater than for the neutral syllables. So far as the relative accuracy of the two response systems was concerned, Eriksen concludes that "if an observer wished to predict whether a shock or a nonshock syllable had been presented the subject and could use only one of the subjects' responses, the verbal report or the GSR, he would have been considerably more accurate using the subjects' verbal report" (Eriksen, 1958, p. 187).

Nevertheless, the apparent superiority of the autonomic index under the circumstances noted above requires some explanation. This Eriksen does in terms of his "partial correlation model." Considering the GSR and verbal indices to be concurrent responses to the stimulus, "the necessary and sufficient conditions (for the apparent subception effect) are fulfilled when both responses are independently correlated with the stimulus, but less than perfectly, and less than perfectly correlated with each other (p. 189). That is, the two systems have components of independent error presumably due to the mechanics of reception and transmission unique to either system. "In other words, the GSR is at least partially determined by the stimulus and the intervening perceptual process and not solely by the verbal response" (p. 189). Figure I diagrams the model as Eriksen sees it.

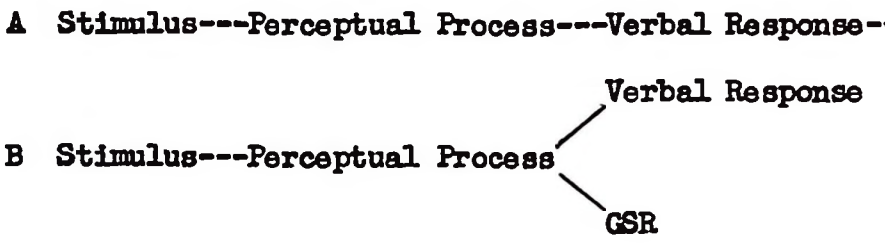


Figure I. According to Eriksen, the subception effect - as was obtained by Lazarus and McCleary (1951) - can be accounted for by the partially independent response systems of B, but not by the linear model of A. (After Eriksen, 1958, p. 190)

Eriksen describes several experiments designed to sort out some of the factors responsible for the noncorrelated error characterizing the two dependent variables, the one autonomic and the other verbal. In the first study (Eriksen, 1956), a GSR and verbal response "6" were conditioned to a square stimulus of given size. This stimulus occupied the intermediate position among eleven square stimuli varying in area. One group of subjects was then permitted the use of 11 verbal responses, ranging from 1 to 11, to describe the squares when they were presented individually. In contrast, a second group was allowed only two responses: the number "6" for the training stimulus and "no" for all other stimuli. Results were quite clear-cut in showing (a) that the GSR deflection varied, though not perfectly (as required by Eriksen's model) as a function of stimulus size, and (b) the two experimental groups did not differ significantly in their GSR gradients descriptive of the stimulus series.

Comparing the two conditions of the verbal response system, the following relationships were obtained: (1) the simple dichotomy yielded more generalization than did the more highly differentiated

code. That is, the response "6" occurred more often to the middle stimulus and to other stimuli than when the subjects were permitted a finer response classification. (2) While a subject might be incorrect in the assignment of his verbal labels (also satisfying a premise of Eriksen's model), the GSR deflections reflected the objective variations in stimulus size. Although the GSR seems to convey information where the verbal response does not, Eriksen cautions that this not be construed as evidence for "discrimination at the autonomic level without verbal awareness" (1958, p. 193).

A follow-up experiment (Eriksen, 1957) allowed the subjects to express the direction of their uncertainty upon emission of a verbal response from 1 to 11. He also substituted a lever positioning response for the autonomic GSR index. Eriksen observes: "Even when the subject is allowed verbal responses to reflect the direction of his uncertainty, there is still an additional amount of discrimination that is carried by the nonverbal (lever positioning) response. In keeping with the definition of awareness in terms of verbalization, this result would certainly suggest the human organism is capable of making discriminations beyond awareness" (1958, p. 196). Nevertheless, Eriksen concludes: "It would seem more meaningful to think of this result in terms of limitations of our language system to reflect perceptions" (1958, p. 196). It is of some interest to note the successful substitution of the lever positioning response for the GSR, indicating that the apparent efficacy of the nonverbal response repertoire is not limited exclusively to the autonomic nervous system.

In a later study (Eriksen, Azuma, and Hicks, 1959), subjects were instructed to rate the stimuli on an affective scale of pleasantness and to guess their identity. There was no evidence that subjects' effective thresholds were lower than their visual thresholds (cf. Zigler and Yospe, 1960). There was, however, a significant tendency for the subjects' affective judgments to be correct when their verbal reports were not.

A further experiment by Fuhrer and Eriksen (1960) assessed Eriksen's partial correlation model against findings reported by Dixon (1958a). It will be recalled that Dixon found GSR deflections to differ significantly between stimuli dichotomized for emotional content. Subjects also matched their unsuccessful responses with the stimulus items at a better than chance level of expectancy. Two of Fuhrer and Eriksen's groups constituted what were essentially replications of Dixon's experiment except that GSR tracings were not obtained. For one group, the absolute awareness threshold was determined in the manner described by Dixon; a forced-choice technique, considered more reliable, was adopted for the second experimental group.

In contrast to the seven subjects used by Dixon, the present authors employed 16 per group. The results which they obtained were not at all in agreement with Dixon's; the null hypothesis of no difference could not be rejected inasmuch as there was clearly no evidence of any ability possessed by the subjects allowing them to match their responses to the stimuli.

In addition to the first two groups, Fuhrer and Eriksen

included two other groups for control purposes. Group III was presented with the same series of stimuli except that an exposure level was adopted which permitted the subjects to report 13% of the material correctly. Group IV was presented with the same stimuli as were used in the other three groups, except that they appeared in an upside-down and backwards position. This procedure would seem to preclude the subjects making their responses to the meaning of the stimuli as such. The matching task also differed: subjects were requested to match their responses to a list including the original 10 stimuli and 10 new items resembling the original stimuli structurally, but the opposite in their affective components.

Both groups III and IV produced better than chance matching, but did not differ significantly from each other on this criterion. If it can be assumed that Group IV was not responding to the meaning variable (see Taylor, 1958), there is no evidence that Group III was doing so. To further ensure that the subjects in Group III were in fact responding to structural features of the stimuli rather than to meaning, a more detailed analysis revealed that the subjects showed no preference for the like-meaning stimuli as opposed to the new items in making their matches.

Fuhrer and Eriksen comment briefly on differences in procedure which might account for the marked discrepancy between Dixon's results and those which they reported. Dixon's use of but seven subjects introduced the serious possibility of sampling error, particularly inasmuch as all were undergraduates and of these, four were in psychology. His instructions, too, to the effect that his subjects

would not be able to see the stimuli, may have created a response bias tending to obscure acknowledgment of very small but perhaps crucial cues. Finally, Fuhrer and Eriksen point out, Dixon did not indicate whether his subjects were dark-adapted when their awareness thresholds were being determined. During the course of the experiment, increasing dark adaptation might have improved the subjects' perceptual sensitivity to the point where they might benefit even more from faint discriminanda present in their visual fields.

Fuhrer and Eriksen conclude that the important cues in the conditions established both by Dixon and themselves were provided by the structural properties of the stimuli, and particularly the length of the stimuli. "No evidence was obtained that subjects respond to the meaning of verbal stimuli prior to recognition of the stimuli" (p. 438).

That some such clues to the class membership of stimuli, such as are contained in their structural features, must be involved in alleged instances of subliminal perception is further attested to by Wiener and Schiller (1960). They successfully demonstrated that supraliminal cues can frequently be specified when careful controls are implemented (see also, for example, A. E. Edwards, 1960). In their experiment, Wiener and Schiller exposed 10 ambiguous drawings for 15 seconds each. Subjects were required to select the more descriptive of two words located at the bottom of each design. To assist the subjects in their choice, a circle surrounding one word was exposed at levels varying in

intensity, whereas the figure and words were always exposed at illuminations clearly supraliminal. Besides selecting one of the words, subjects were instructed to check statements indicating whether or not they saw the circle, and how certain they were in this subject.

"The results of this study support the hypothesis of 'perception of partial cues.' The experimental stimulus, i.e., the circle presented below absolute threshold, appeared to be effective in influencing choice behaviour only when the subliminally presented influencing stimulus was reported Seen or Possibly Seen. In most experiments, since the circle would not be identified in the Possibly Seen conditions, these would have been considered true subliminal trials." It will be recalled that this was the point of Eriksen's studies (1956, 1957) in which he illustrates the importance of a response system sufficiently fine enough to reflect the organism's perceptions. As well, there was apparently no effect upon choice behaviour when the subjects reported not seeing the stimulus at all. Thus, "choice behaviour was modified by subliminal presentation (i.e., the circle presented below the absolute threshold) only on those trials in which there was partial or complete verbal awareness of the experimental subject" (Wiener and Schiller, 1960, p. 129; cf. Bach and Klein, 1957).

In a further experiment, Wiener and Schiller (1960) examined the GSR generalization gradient to (a) words structurally similar but semantically dissimilar as contrasted to (b) words semantically similar but structurally dissimilar. The GSR was conditioned

originally to a series of words and the generalization of this response tested to the words having the stated relation above. All words were exposed at short durations somewhat below threshold in order to ensure the emission of incorrect hypotheses.

A two-process view (e.g., Bruner, 1948, 1957a, 1957b; Lazarus and McCleary, 1951; and McGinnies, 1949), holding that subjects respond to subliminal stimuli on the basis of some such dimension as meaning or emotional connotation, would predict that the GSR would generalize from the shocked words to the semantically similar non-shock words. In contrast, a view such as Eriksen's which argues that portions of the stimulus incorrectly perceived possess cue function, predicts that generalization would be along the structural dimension. The latter prediction was sustained, thus arguing in favor of the partial cue hypothesis.

In concluding this outline of the three theoretical points of view, it may be profitable to note briefly in what respects they are in agreement and in what respects they are not. It seems that the account which Eriksen (1958) proposes can readily subsume the rather parsimonious explanation offered by Solomon and Postman (1952). Eriksen regards perception as involving a range of response systems, both autonomic and voluntary in nature, involved in S-R sequences. Solomon and Postman, in contrast, confine their explanation to verbal reports on the response side of the S-R paradigm. One of the consequences of Eriksen's approach is that, by lengthening the chain of events occurring between stimulus and verbal response, he can formulate an explanation of perceptual sensitization and defense

phenomena which does not deny the essential function implied by the names given these phenomena. Thus, where Solomon and Postman can, in a sense, explain away perceptual sensitization and defense in terms of differential stimulus-verbal response associations, Eriksen leaves the way open for some such explanation as is afforded by avoidance of interfering responses (1954) or noncorrelated sources of error in different response systems (1958). Essentially, however, S-R associations accomplish much the same explanatory task in the two interpretations.

Bruner's point of view is in marked contrast to the above. Although he describes the property of accessibility of the category system to which sensory input is ordered as dependent on two classes of variables - "search requirements" and "learned expectancies," Bruner does not specify (a) how environmental events become 'need relevant' as the term "search requirements" seems to imply, or (b) how the "learned expectancies" operate. He does not elaborate how or what sequence of events serves to mediate selectivity and defense. Thus, while postulating that a "gating mechanism" acts to select events may serve as a convenient summary statement, such a statement lacks the precision of reference which Eriksen's (1958) view allows. Whereas the explanations proposed by Solomon, Postman, and Eriksen make necessary the specification of stimulus dimensions which function to convey the information upon which defensive, and other, behaviour would necessarily depend, Bruner seems to take these dimensions for granted.

In the following section experiments are discussed which are

concerned specifically with the problem of how much stimulus information is available in a brief exposure. Particular attention is given to findings from a series of experiments conducted by Sperling (1960). He reports evidence which suggests that there is a very brief span of time during which the complete word or considerable fragmentary portions of it are available to a subject, even prior to correct verbal identification. As will become clearer, Sperling's work provides an interesting and perhaps a necessary framework within which to view Newbigging's (1961a, b), and others' notions concerning redintegration. A review of this last mentioned work constitutes the final part of this History.

Stimulus Information Available From Brief Exposures.

Woodworth summarizes a frequent observation made by experimenters of an earlier period. "Even when O can report but a few, he believes he has seen all the letters distinctly during the actual exposure. Unless they formed a familiar word, he forgot them before reaching them in his report . . .; unless some word suggested itself at once, brute memory would not hold all the disconnected letters. But if O is not mistaken in this impression, he gets for an instant perfectly adequate cues of a correctly presented word. If for an instant he sees the whole word clearly, as he thinks he does, he has all the cues he could desire" (1938, p. 742).

More recently, Sperling (1960) has made experimentally explicit what his predecessors suspected. It seemed to Sperling that traditional methods of measuring the span of immediate memory tended to underestimate the amount and variety of information which

the subject had initially at his disposal. Typically, the span of immediate memory has been derived from the gross number of items which the subject has been able to report after a brief exposure of the stimulus. In contrast, Sperling's method of partial report involves instructing the subject to report what he sees of a selected portion of the material; these instructions are given immediately following the exposure.

What is required in the technique advocated is not at all unlike ordinary classroom testing procedures, Sperling observes. The course exam samples the material taught, assuming that this bears some correspondence to what the student knows over and above what is specifically requested in the way of answers on the exam paper. "On each trial the instruction, which calls for a specified part of the stimulus, is randomly chosen from a set of possible instructions which cover the whole stimulus. By repeating the interrogation (sampling) procedure many times, many different random samples can be obtained of an observer's performance on each of the various parts of the stimulus. The data obtained thereby make feasible the estimate of the total information that was available to the observer from which to draw his report on the average trial" (Sperling, 1960, p. 2).

Sperling's first two experiments showed that the span of immediate memory is very much limited. In spite of considerable variations in the amount and nature of the stimulus material and the exposure durations, a stable span of approximately 4.3 items was found.

Compared to the first two experiments, the third using the

partial report procedure yielded significantly more accurate reports. In this experiment the stimulus was exposed for 50 milliseconds, at the end of which a tone was sounded. The pitch of the tone served to instruct the subject which of three lines of figures he was to identify. On the average, Sperling's subjects had 9.1 letters available from which they made their reports; this compares with only 4.3 obtained in the preceding experiments.

The fourth experiment varied the delay in the instructional signal at the termination of the stimulus exposure. At a delay of 1.0 seconds, Sperling found that the accuracy of the partial report had decreased to that evidenced by measures of the immediate span of memory. In contrast, the accuracy of the whole report was quite independent of delay of report.

Sperling's assumption that the immediate memory of the stimulus is present in the rapidly dissipating retinal impression or after image produced by the exposure was tested in his fifth experiment. This procedure involved the presentation of a white post-exposure field. In line with his predictions, the accuracy of both partial and whole reports was seriously impaired, thus supporting the supposition of an extremely short-lived information bank constituted by reception processes. "Short-term storage has been tentatively identified with the persistence of sensation that generally follows any brief, intense stimulation. In this case, the persistence is that of a rapidly fading, visual image of the stimulus" (p. 26).

The next experiment, Sperling's sixth, measured the efficacy

of different kinds of partial reports. Whereas the preceding experiments had stipulated position (row) as the basis of report, in this case a signal tone told the subject to report either the letters or the numbers in the stimulus material. The results clearly favored the superiority of partial report based on position to partial report based on category. The latter proved to be no better than whole reports of both letters and numbers.

Sperling draws from his series of investigations this conclusion: "The high accuracy of partial report observed in the experiments does not depend on the order of report or in the position of letters on the stimulus, but rather it is shown to depend on the ability of the observer to read a visual image that persists for a fraction of a second after the stimulus has been turned off" (p. 27).

A study by J. Brown (1960) is relevant to Sperling's sixth experiment. It concerns the differential efficiency with which the organism can code and report the fleeting percept provided by a very short exposure duration. He found that subjects instructed to report on the basis of position, color, and class of stimuli, or class alone, were superior to conditions in which either position or color alone was specified. This relationship held when the instructions were given two seconds before the stimuli were presented. Brown observes: "When a complex stimulus field is presented tachistoscopically, the subject's report consists of several responses made one after another and only the first of these, if any, can be regarded as immediate in a literal sense. The

efficiency of report must therefore depend partly on the efficiency with which the stimulus information is stored as it is perceived" (p. 180).

Brown thus emphasizes the differential storage of information. In this regard, Sperling spoke of "reading a visual image," suggesting that the verbal report is a response not to the stimulus itself, but to the percept. If perception is conceptualized as an intermediate or mediating response as Eriksen (1960) has done, it is clear why the efficiency with which the subject can provide at least short term information storage is so important.

While it seems clear, especially from the work of Sperling, that briefly exposed stimuli convey a good deal of information, it must be borne in mind in considering his findings in relation to the problem of this thesis that the stimulus material he employed consisted of random series of letters and numbers. Where meaningful words are the stimuli, variables other than those examined by Sperling undoubtedly act as determinants of the correspondence between the subject's response and the stimulus. The fact that words involve sequences of letters which are not random but rather, to some degree, predictable, would appear of particular importance. As a consequence of this predictable order recognition of a few letters of a briefly exposed word may serve as a sufficient cue for the ellicitation of the remainder and thus of the correct response. This process is called redintegration and a discussion of it constitutes the next section.

The Redintegration Process.

Whether or not the recognition of a few letters in a briefly exposed word constitutes a sufficient cue for the redintegration of the word would appear to depend at least on the response strength of the word and the position within the word of the recognized letters. While there has been very little research directly concerned with the variables that control the redintegration process, the following are relevant.

The first three experiments to be discussed are concerned with the probability of a given response in a tachistoscopic situation as a function of the responses made on previous trials.

Blake and Vanderplas (1950) investigated an hypothesis suggested by Bruner. The prediction was: "The stronger an invalid hypothesis, the more (or the wider the range of) inappropriate information necessary in order to reject it" (p. 98). The authors presented a list of 84 words aurally to their subjects. The series was then divided into two classes of stimuli on the basis of each individual's performance in assessing their auditory thresholds using the ascending Method of Limits. One class was constituted of words for which a subject's correct recognition was preceded by at least one incorrect hypothesis; the second class included only words for which a subject had given only the correct response.

Blake and Vanderplas found that words for which correct recognition had been preceded by incorrect responses yielded significantly higher aural recognition thresholds than words to which only a correct response had been given. The authors report that there were few words which failed to demonstrate the same

tendency.

The authors postulate two mechanisms which seem to them to explain the results obtained. (1) It seems that the occurrence of a response ipso facto reinforces itself. (2) There is the "tendency of a stronger hypothesis to monopolize and use whatever in the stimulus input is relevant to its continued confirmation," and "to 'ignore' whatever in the stimulus is irrelevant or incongruent" (1950, p. 111). The nonindependence of successive trials in sensory threshold determination procedures has also been described (Verplanck, Collier, and Cotton, 1952; Collier and Verplanck, 1958).

A study by Bricker and Chapanis (1953) presents evidence which is not easily reconciled with either the results or the interpretation reported by Blake and Vanderplas. In agreement with Blake and Vanderplas, Bricker and Chapanis found successive trials to be dependent; unlike the results obtained by the former pair of researchers, however, Bricker and Chapanis did not find that incorrect responses raised the recognition threshold. Consequently, Bricker and Chapanis do not view perception as quite the autistic process pictured by Blake and Vanderplas in their second mechanism.

Bricker and Chapanis found that "following an initial wrong response, the number of additional guesses necessary to name the stimulus correctly is fewer than would be expected by chance" (p. 185). This suggested to the authors that, though a stimulus might be perceived incorrectly, it could still transmit information useful in later recognition (see also Haslerud and Clark, 1957). They also

noted what seemed to be a tendency for subjects to perseverate on certain letter combinations over a succession of unsuccessful trials.

In comparing the Method of Limits with a modified Method of Random Series, Postman and Adis-Castro (1957) found no significant difference between mean thresholds yielded by either method. Where the ascending Method of Limits involved the presentation of a word at 20 milliseconds on the first trial with increments in exposure time of 10 milliseconds on successive trials, the Method of Random Series required the presentation of all words, in random order, at an initial exposure of 20 milliseconds and different random orders at each new exposure level 10 milliseconds longer than on the preceding trial. Failure to obtain a significant difference between methods, where one might have expected a rather lower threshold for the Method of Limits suggests the relative independence of the trials.

In addition, Postman and Adis-Castro noted that while the proportions of meaningful prerecognition responses were identical in both instances, the Method of Limits yielded significantly more nonsense responses. They conclude: "Meaningful responses . . . depend on the discrimination of stimulus fragments which enable the subject to attempt a reconstruction of the stimulus word. It appears that successive exposures of the same word do not substantially accelerate the discrimination of minimally effective stimulus fragments" (p. 194).

Newbigging (1961a) investigated and confirmed the hypothesis that frequently occurring words because of their high response

probability should be redintegrated from smaller fragments or cues than low probability infrequent words. The method involved comparing the similarity of prerecognition responses to the stimulus word. The method of assessing similarity was as follows: for any prerecognition hypothesis (RT-n) with which the subject responds, he suggests the assignment of one point per letter agreeing with the stimulus and, to take patterning into account, crediting the subject with another point per pair of letters in correct combination. Thus, for example, the stimulus 'symphony' allows a maximum possible fifteen points awarded as described for eight letters and seven two-letter combinations. If, after an exposure, the observer should respond with the word 'sympathy,' this hypothesis would be assessed 60% similar, i.e., on the basis of six letters and three letter pairs in accord with the stimulus word 'symphony'.

Newbigging (1961a) found that the similarity of the response immediately preceding correct identification of the stimulus, i.e., on trial RT-1, varied inversely with the frequency of usage of the stimulus word. From this, he inferred that on the recognition trial itself the subject requires smaller stimulus fragments in order to redintegrate the correct response where high frequency words are exposed as compared with low frequency words. The experimenter, it should be noted, cannot directly assess the number of letters and their patterning "actually seen" by the subject and supposedly incorporated into his estimate of the stimulus.

Further, Newbigging made several other relevant deductions which he tested experimentally. He found that responses at RT-1

and RT-2 tended to be words of rather high frequency for both frequent and infrequent stimuli, and further, that words elicited by the infrequent stimuli tended to have relatively lower frequency values on both of these trials than did those by the high frequency stimuli. Such findings are indicative of the apparent advantage enjoyed by words possessing higher associative value in one's response hierarchy, while the course taken by the sampling process is evident in the still somewhat lower frequency of responses elicited by low frequency stimuli. Consistent with the above results, Newbigging also found that the response time for infrequent words was longer than for frequent ones.

In an attempt to isolate some of the important factors involved in redintegration, Haslerud and Clark (1957) investigated the question of which positions in the word are most critical. They presented tachistoscopically a series of English words differing in frequency of occurrence in the language, the length of the words being controlled. Upon exposure of a word at a constant 40 milliseconds, each subject did the following in the order noted. (a) He guessed the identity of the stimulus. (b) A list of five words was given from which the subject was requested to select the one which had been exposed. The four additional words resembled the stimulus word with respect to the beginning and end letters. (c) Finally, the subject was given four possible definitions of the stimulus from which he was asked to pick the correct one.

Haslerud and Clark found that ability to define the stimulus produced no differential effects on the multiple-choice recognition

test (b), but the subjects were able to report correctly three times as many defined words as undefined words in (a), the unaided recognition task. The authors observed that the most crucial portions of the word were at the ends; this they attribute to the sharp figure-ground gradient at these points. They suggest that this advantage would probably disappear were the stimulus word set within a line of print.

An interesting finding concerns the disappearance of the physical advantage enjoyed by the ends in the multiple-choice recognition task; under these conditions, the hitherto masked middle letters were found to assist perception. The restriction introduced with the set of alternatives apparently makes supraliminal cues which are provided by the middle letters. "Our experimental results point away from a single factor concept like generalization, and instead, show the need for two successive responses to two different behavioural supports, the one in the experimental environment and the other in the organism" (1957, p. 101). They regard their results as further evidence favoring the role of meaning in promoting correct verbal redintegration.

Further evidence of the redintegrative nature of the recognition process is afforded by studies reported by Boardman (1957) and Wiener and Schiller (1960). The latter study has already been mentioned, while the former has been reserved until this point because of its emphasis on the role of fragment cues in facilitating the classification of stimuli prior to identification.

Boardman favors the view that affect influences the recognition

process by altering response probabilities rather than perception *per se*. He presented a series of four letter words, constituting three types of stimuli. These classes were designated as follows: O - Offensive or taboo words; I - Imitation - these were similar to the O words in spelling; N - Neutral - inoffensive stimuli. Two different classificatory schemes are applicable to the stimuli: (1) Structural - O and I words *versus* the N words; (2) Affective - N and I words *versus* the O words. Boardman observed that the resemblance of the prerecognition hypotheses to the stimulus words concerned increased progressively over trials. "The comparatively early discrimination between the N words and the (O and I words) is consistent with a gradually developing process of recognition, since the perception of any two letters in an N word would be sufficient to differentiate it from the I and O words" (p. 682).

The Present Study.

Newbigging (1961a, and 1961b) has based his speculations concerning the course taken by redintegration on the assumption that subjects see only portions of the stimuli. It is not clear, however, whether subjects see the complete word or only a portion of it from which they extrapolate on the recognition trial itself. In any event, the experimenter does not "know" what subjects see in the way of fragments on any trial. He must infer this from some aspects of the prerecognition hypotheses emitted by the subjects.

It is in view of the experimenter's inability to "know" what a subject sees in the stimulus that the experiments to be reported have controlled the letters and their positions exposed. Not only

is there uncertainty concerning the amount seen at threshold exposure, but Sperling's findings throw considerable doubt on the validity of the assumption that the similarity index at RT-n trials in any way accurately reflects the amount of the word which the subject sees. It may well be the case that the same amount of the stimulus words are seen, regardless of frequency or of semantic value, on any given trial. What may be crucial in the first instance is the availability of the correct response (i.e., frequency of occurrence in the subject's vocabulary, hence, its association value) in order to capitalize on the information momentarily made available to the subject. In the second instance, avoidance responses (e.g., as in Eriksen, 1954, or Newbigging, 1961b) may disrupt the activation of the identifying response, stimulus frequencies held constant.

Thus, in view of the abundance of confusion concerning what the subject sees and what he reports, it seemed advisable to obtain some base level measure of contribution of verbal stimuli varied along a number of dimensions. The exposure of word fragments in flash card form permitted just such a control of the stimulus material, obviating the sources of doubt described.

The first experiment systematically varied word frequency according to the Thorndike-Lorge word count (1944), the location of the fragments within the words, and fragment size. Considering word frequency alone, it was predicted that subjects would guess high frequency words from which fragments were exposed faster than less frequent words. This prediction follows from Solomon and Postman's (1952) conceptualization of an individual's vocabulary as a response

hierarchy of different association strengths. A word occurring frequently in the language is assumed to possess a higher association value in a subject's response hierarchy than a less frequent word. Hence, frequent words incorporating a given fragment should occur before less frequent words also incorporating the fragment.

Four positions were tested; these were the beginning, middle, end, and combined beginning plus end positions. On the basis of Haslerud and Clark's results, the extreme locations should be superior to the middle. Extrapolating from Mishkin and Forgay's (1952) findings concerning the effect of the direction in which a culture reads (cf. Melville, 1957), any difference between the extreme positions should favor the initial letters. The combined fragment should be superior to the middle position, but there is no compelling argument for predicting its rank with respect to the two extreme positions. Speed of recognition should also vary directly with the number of letters in the fragment.

The second experiment varied the connotative meaning of the stimulus words. It took as its point of departure Newbigging (1961b). In this paper, Newbigging confirmed Johnson, Thomson, and Frincke's (1960) finding that "bad" words have higher recognition thresholds than do "good" words. He disagreed with them, however, on their contention that "good" words are redintegrated from less information than are "bad" words; his similarity indices suggested that subjects' correct responses at RT develop from equivalent redintegrative cores at RT-1. Newbigging's argument, of course, assumes that at RT itself, not

only at RT-1, subjects have as much information from which to redintegrate "good" words as they have for "bad" words. He offers the following findings in support of his postulation of a perceptual defense mechanism: (1) the exposure at RT-1 was significantly longer for "bad" words as opposed to "good" or "neutral" words; (2) the latency time for response at both RT-1 and RT was longer for "bad" words than for "good" words.

If, as Newbigging suggests, "certain letter combinations involved in 'bad' words become conditioned to some emotional response that has an inhibitory effect," it would be predicted that subjects in the second experiment will require more time to guess the correct word. That is, inasmuch as the letters constitute a portion of a word which itself possesses aversive qualities, the letters participating in this aversiveness should function to impede the emission of the correct response. It is anticipated, too, that word frequency and fragment size will be related to response speed.

## METHOD

Both experiments were conducted in a small room in which distractions were at a minimum. Sessions were approximately 60 minutes long in Experiment I and approximately 30 minutes long in Experiment II. First, what was methodologically common to the two studies will be described with the points on which they differed following in separate sections.

Subjects: All subjects were selected randomly from English speaking volunteers, 19 to 25 years old, attending the Hamilton Teachers' College. In each experiment, a total of 36 subjects was used; in the first, both sexes were equally represented while in the second, all were female since few males attended the College and, among these, volunteers were difficult to obtain. Subjects were experimentally naive and were requested not to discuss with the other students what happened in the experiment.

Procedure: The stimulus material was presented on $3\frac{1}{2}$ by $5\frac{1}{2}$ inch white cards. Cards were presented singly by the experimenter on a support placed on a table immediately in front of the subject. One English word in fragment form was written in black upper case Elite type on each card. A solid line proportional in length to the missing letters indicated where the fragment was to be supplemented to complete the word.

The experimenter recorded recognition with a hand stop-watch, rounding off to the nearest half-second.

Subjects were instructed as follows. The numbers in brackets refer to the second experiment.

> In the stand before you is a deck of cards. On each card are several letters which form a portion of an English word, a different word on each card.
>
> You are to guess what the word is. Since you will be allowed 60 (90) seconds per card, guess as many words incorporating the letters as you can. When either the 60 (90) seconds is up or you have guessed the correct word, you will be shown the next card in the deck, and so on.
>
> In the case of each item, the correct word is approximately 10 (8) letters in length. The more guesses you make, the more likely you will give the correct word.
>
> Are there any questions? (If there were, the relevant portions of the instructions were reread.)
>
> Here, then, are a few examples.

Each card was exposed for a maximum of 60 seconds in Experiment I and 90 seconds in Experiment II, or until the subject guessed (redintegrated) the correct word. It should be noted, too, that subjects were told the approximate length of the words from which the letters had been taken, 10 letter words in the first study and 8 letter words in the second. This was done on the assumption that subjects obtain an impression of the general length of a word, in addition to a few specific letters, when words are exposed

tachistoscopically. Subjects were also encouraged to guess freely. This contrasts with tachistoscopic procedure in which subjects are generally allowed only one hypothesis per exposure.

Experiment I.

A total of 41 words were used. These consisted of five practice words and 36 experimental words. All words from which the fragments were extracted were 10 letters in length.

The independent variables were word frequency, fragment size, and fragment position. There were three levels of word frequency, low, medium, and high, with each level represented by 12 words selected from the general count of the Thorndike-Lorge word book (1944). Low frequency words had a frequency of occurrence in the language of once in 3.6 million words. Medium and High frequency words had frequencies of once in 1.8 million and 50 and over per million words.

Four, six, and eight letter fragments were used. These were selected from four different positions in the words: the beginning, middle, end, and the combined beginning plus end. The combined fragments of eight letters, for example, consisted of four letters from the beginning and four letters from the end of the word.

A Subjects x Treatments design was used. This meant that all subjects experienced all treatment levels of every experimental variable. Four different positions and three different fragment sizes permitted a total of 12 possible combinations. Each combination was represented once per frequency and, since there were three different frequencies, a given size by position combination

appeared three times per subject. Moreover, each word was represented in all 12 possible combinations. No word, however, occurred more than once per subject. Since there were 36 subjects, each word was presented to three different subjects in a given position-size combination.

Table I provides a list of the words employed while Table II summarizes a sample word.

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Insert Tables I and II Here

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From the total of 432 cards, composed of 36 words x 4 fragment positions x 3 fragment sizes, 12 decks of 36 cards each were constructed. Each deck was used for three subjects and was shuffled before presentation.

TABLE I

STIMULUS WORDS

| 1/3.6 Million* | 1/1.8 Million | 50 +/ Million |
|---|---|---|
| IRRELIGION | ENTICEMENT | DEMOCRATIC |
| UNDULATORY | TUMULTUARY | CONFIDENCE |
| INVETERACY | PREARRANGE | INDIVIDUAL |
| DISHARMONY | MILITIAMAN | AUTOMOBILE |
| EULOGISTIC | PROGNOSTIC | EVERYWHERE |
| BREADFRUIT | MUTABILITY | POPULATION |
| CONVENTUAL | HORSEFLESH | FRIENDSHIP |
| POINSETTIA | UNABRIDGED | APPEARANCE |
| SIMULATION | JACKRABBIT | THOUGHTFUL |
| CROSSBONES | INCESTUOUS | DIFFERENCE |
| ADMONITORY | EPISCOPACY | REVOLUTION |
| NECTAREOUS | FILTRATION | IMPOSSIBLE |

* frequency of occurrence according to the Thorndike-Lorge general count

TABLE II

Sample Word "Philosophy" As It Would Appear In

12 Different Fragment Forms

| Position | Number of Letters | 4 | 6 | 8 |
|---|---|---|---|---|
| BEGINNING | | PHIL------ | PHILOS---- | PHILOSOP-- |
| MIDDLE | | ---LOSO--- | --ILOSOP-- | -HILOSOPH- |
| END | | ------OPHY | ----OSOPHY | --ILOSOPHY |
| COMBINED | | PH------HY | PHY----PHY | PHIL--OPHY |

## RESULTS

### Experiment I

Response Speed: For purposes of analysis, response latencies were converted to reciprocals to give a measure of response speed. Thus, an infinite latency, i.e., failure to recognize a word within the 60 second time limit, was assigned a value of zero. The resulting distribution was bimodal in nature as subjects tended to guess the correct word within a few seconds of exposure or failed to guess it altogether.

The assumption of homogeneity of variance was rejected upon examination of the data. Cell variance ranged from 0 in one instance to 43,529.17 in another (F = infinity). A more stringent significance level of $p \leq .01$ was adopted (Lindquist, 1953) and a Subjects x Treatments analysis of variance was performed. A summary of the analysis appears in Table III.

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Insert Table III Here

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It can be seen from Table III that all three main effects - word frequency, fragment size, and fragment position - yielded F values significant at $p < .001$ as did two of the three two-way interactions (i.e., frequency x fragment size and fragment x fragment position), while the third, fragment size x fragment position, had a

TABLE III

SUMMARY OF ANALYSIS OF VARIANCE OF SPEED OF RECOGNITION DATA

| Source | df | MS | F | P |
|---|---|---|---|---|
| S | 35 | 29,550.77 | | |
| A (Frequency) | 2 | 4,646,272.70 | 252.531 | < .001 |
| B (Size) | 2 | 3,493,192.62 | 174.072 | < .001 |
| D (Position) | 3 | 290,400.33 | 13.584 | < .001 |
| S x A | 70 | 18,398.81 | | |
| S x B | 70 | 20,067.49 | | |
| S x D | 105 | 21,378.00 | | |
| A x B | 4 | 393,353.70 | 20.907 | < .001 |
| A x D | 6 | 76,120.12 | 4.024 | < .001 |
| B x D | 6 | 34,119.50 | 2.240 | < .05 |
| S x A x B | 140 | 18,813.77 | | |
| S x A x D | 210 | 18,912.73 | | |
| S x B x D | 210 | 15,230.02 | | |
| A x B x D | 12 | 43,790.16 | 2.867 | < .001 |
| S x A x B x D | 420 | 15,270.03 | | |
| Total | 1295 | | | |

$p$ value of $< .05$. The triple interaction, tested against its interaction with subjects as the error term, was significant at $p < .001$. Figures II through VI present the important relations in graphic form.

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Insert Figures II - VI Here

---

As may be seen from Figures II and III, the effects due to word frequency and fragment size were quite regular with respect to the dependent variable, response speed. As either word frequency or fragment size was increased, speed of response increased significantly. Application of Duncan's New Multiple Range Test (Edwards, 1960) yielded significant differences between each pair of treatment means for both variables. A $p$ value of $< .001$ was associated with each of these comparisons except for the difference between the medium and low frequency stimuli which had a $p$ value of $< .005$.

The fragment position variable also yielded a significant main effect. This, however, resulted principally from the very large contribution made by the beginning position to the correct identification of the words, while the other positions contributed approximately the same amount (Figure IV). Duncan's Test revealed significant differences between the beginning position and each of the other three levels of this variable ($p < .001$ associated with each comparison), but insignificant differences between each pair

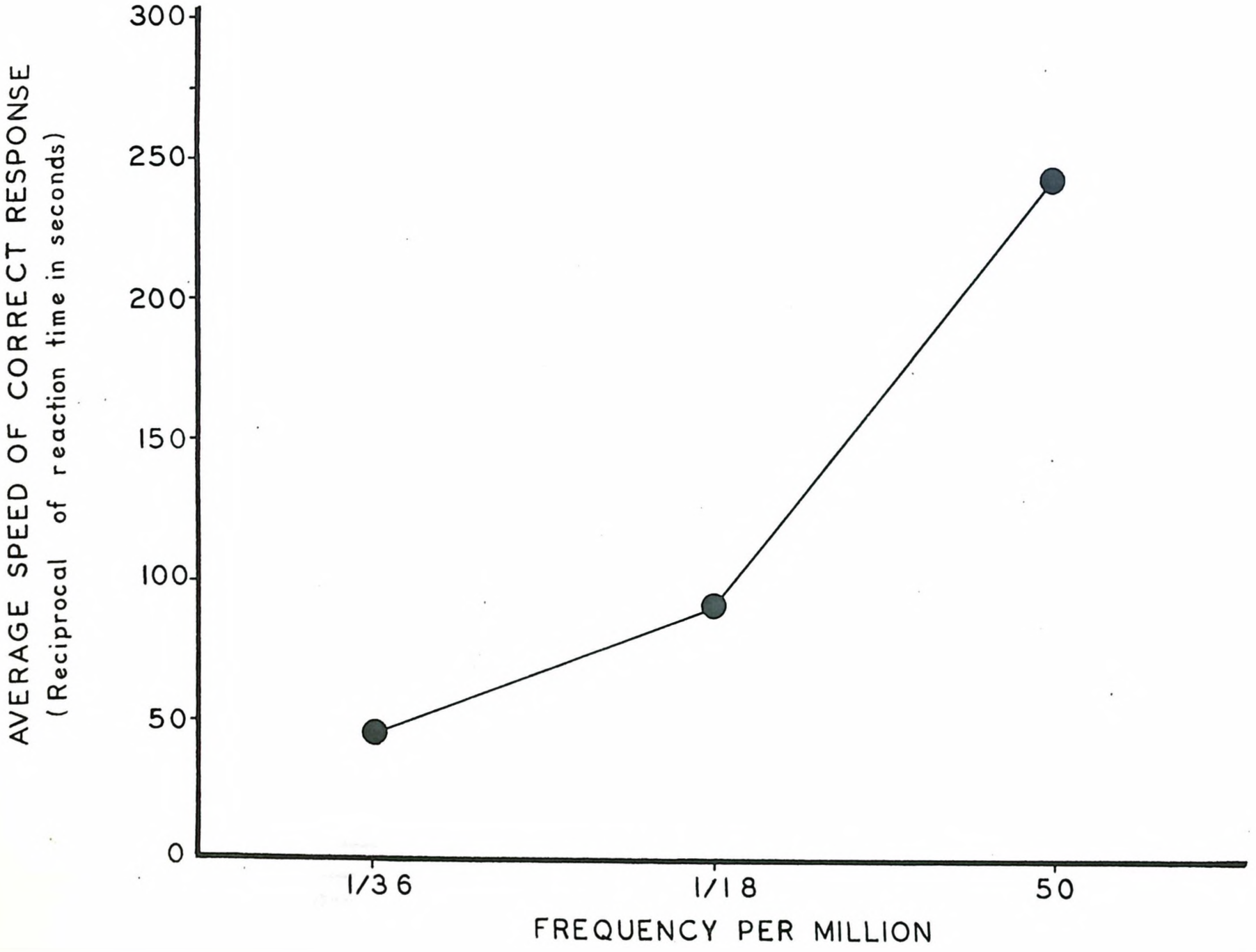
AVERAGE SPEED OF CORRECT RESPONSE
(Reciprocal of reaction time in seconds)
300
250
200
150
100
50
0
1/36
1/18
50
FREQUENCY PER MILLION

Fig. II

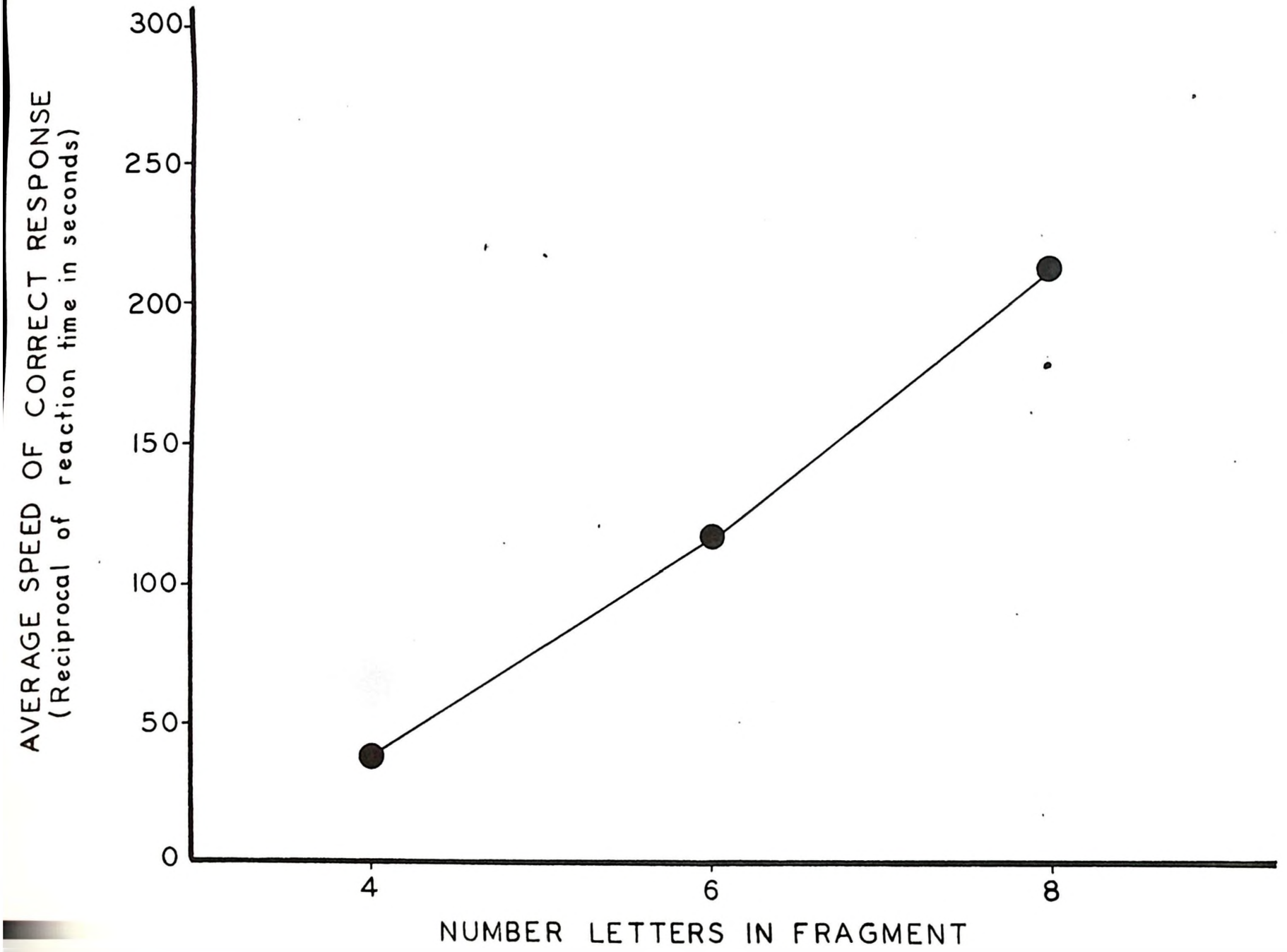
AVERAGE SPEED OF CORRECT RESPONSE
(Reciprocal of reaction time in seconds)
300
250
200
150
100
50
0
4
6
8
NUMBER LETTERS IN FRAGMENT

Fig. III

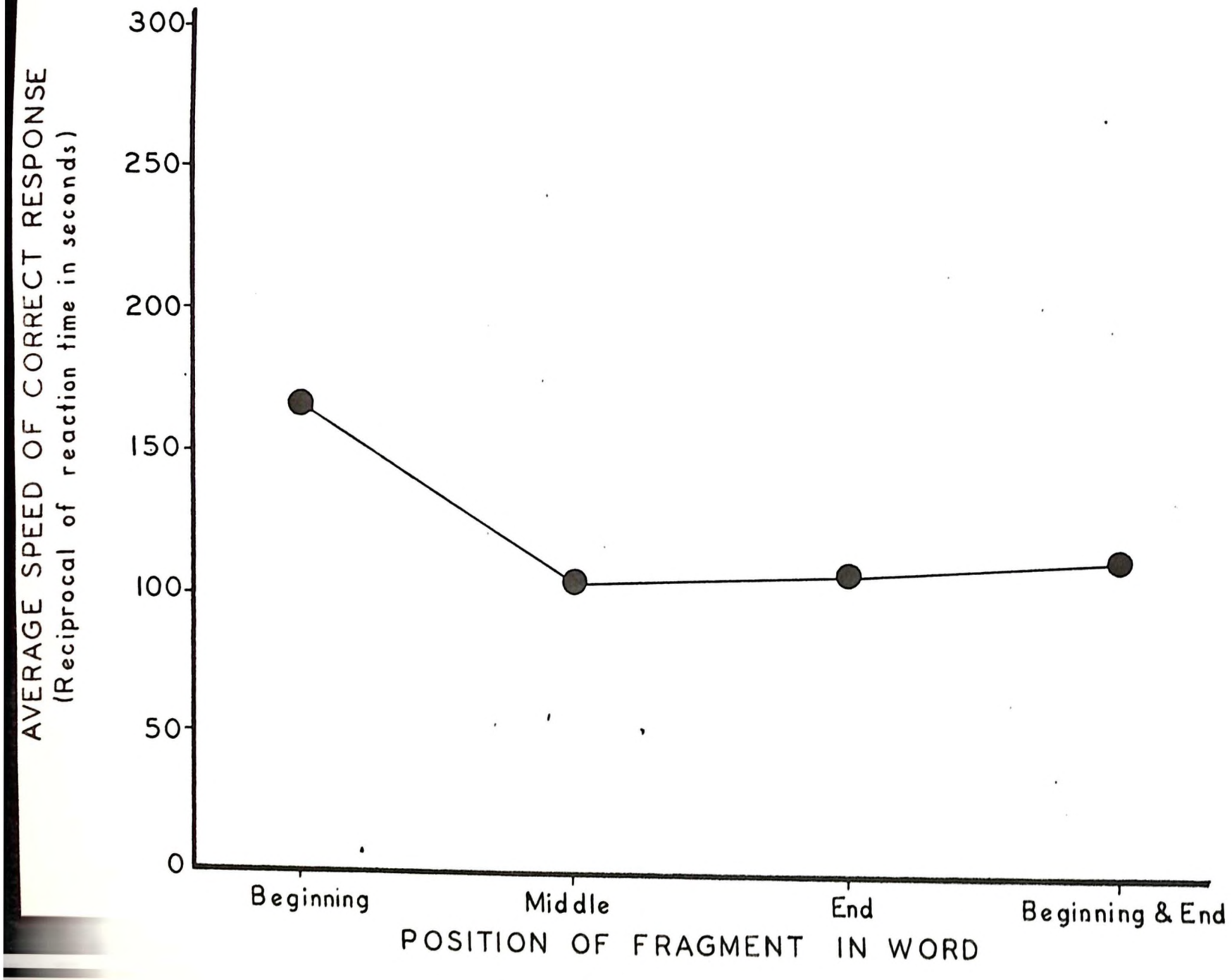
AVERAGE SPEED OF CORRECT RESPONSE
(Reciprocal of reaction time in seconds)
300
250
200
150
100
50
0
Beginning
Middle
End
Beginning & End
POSITION OF FRAGMENT IN WORD

Fig. IV

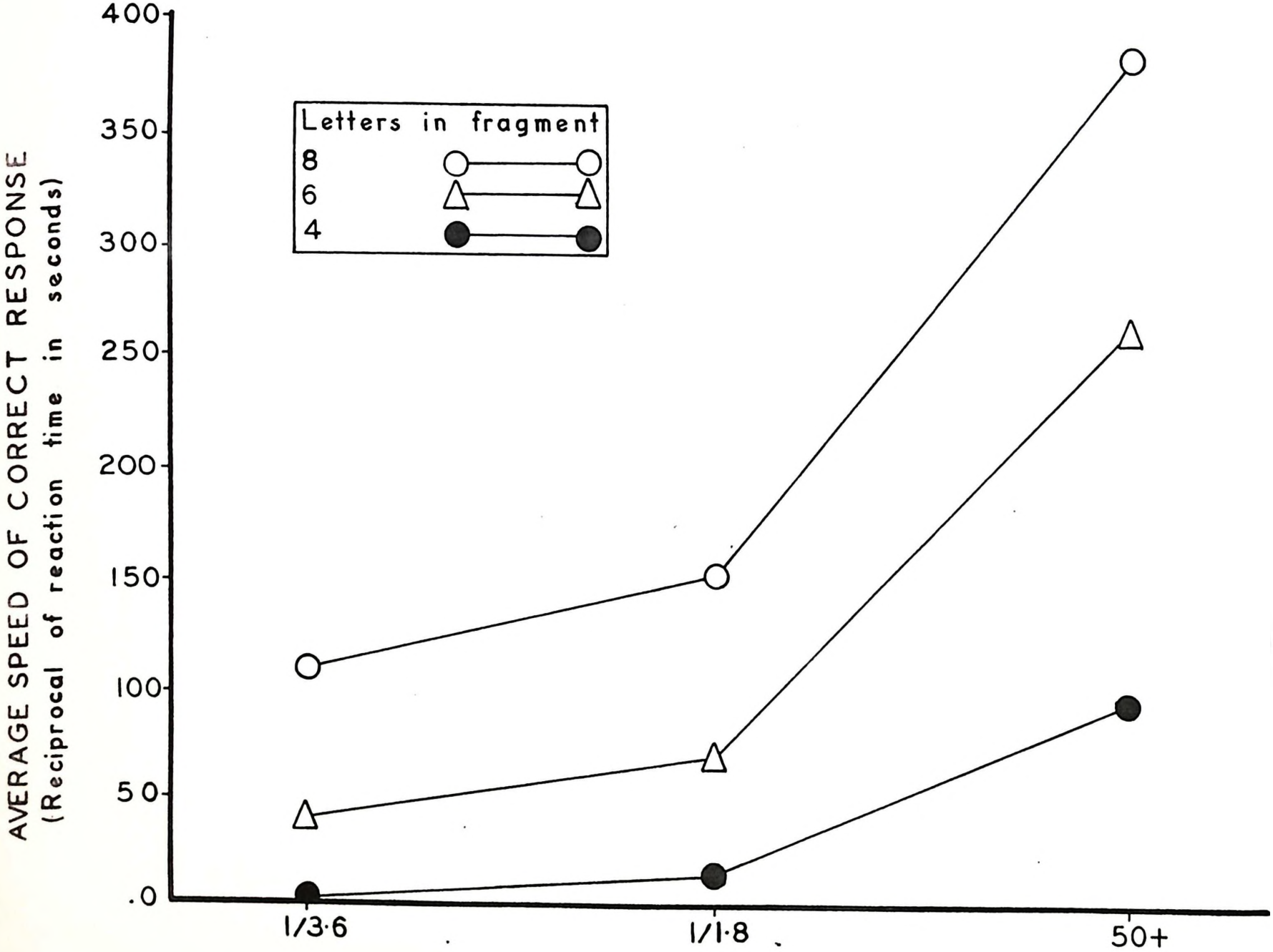
400
350
300
250
200
150
100
50
.0
AVERAGE SPEED OF CORRECT RESPONSE
(Reciprocal of reaction time in seconds)
Letters in fragment
8
6
4
1/3·6
1/1·8
50+
FREQUENCY OF OCCURRENCE PER MILLION

Fig. V

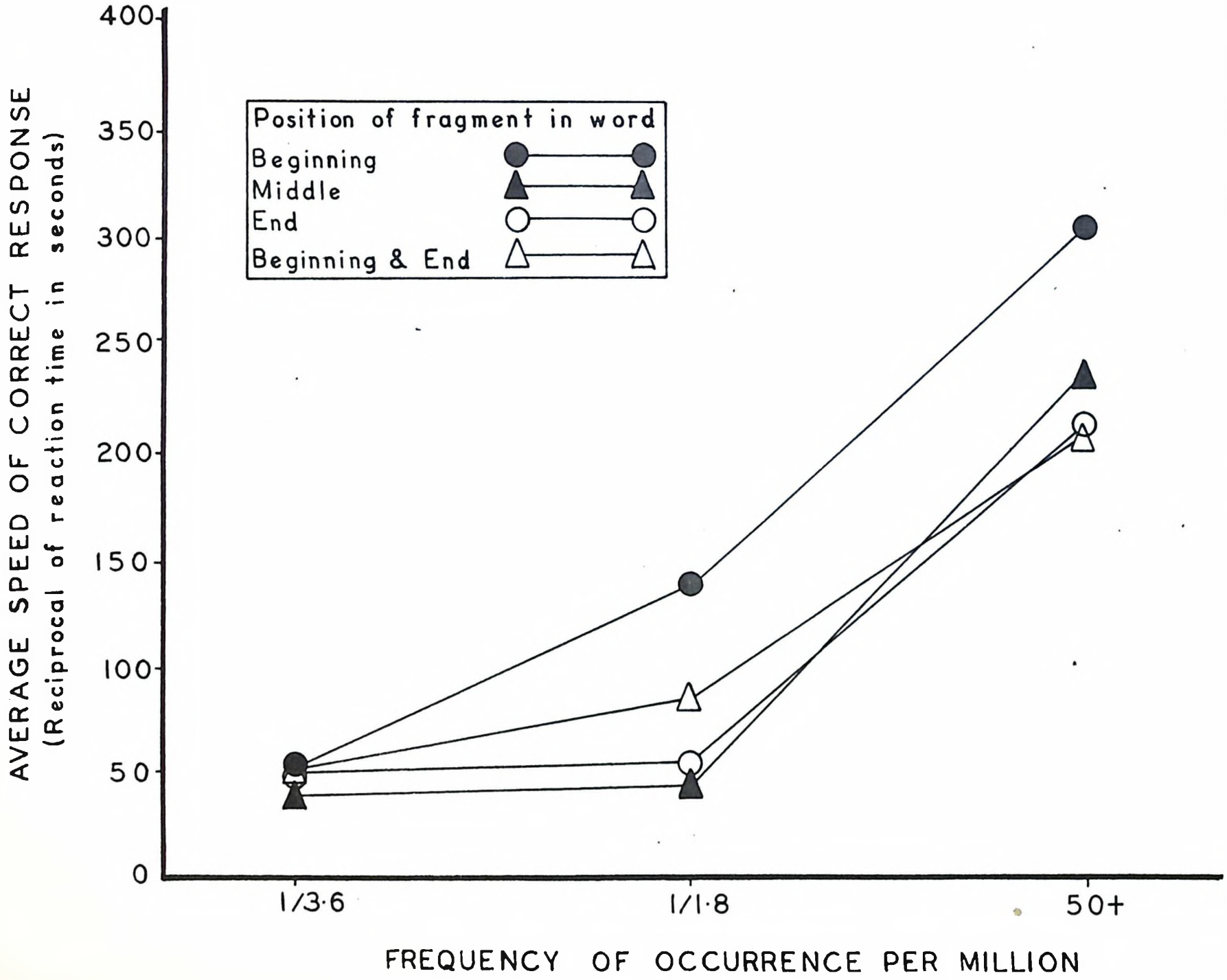
AVERAGE SPEED OF CORRECT RESPONSE
(Reciprocal of reaction time in seconds)
400
350
300
250
200
150
100
50
0
Position of fragment in word
Beginning
Middle
End
Beginning & End
1/3·6
1/1·8
50+
FREQUENCY OF OCCURRENCE PER MILLION

Fig. VI

consisting of the middle, end, and combined positions. It may be noted at this time that the above is not in accord with Haslerod and Clark (1957) who found the beginning and end letters to contribute significantly more to redintegration than the middle portion of the word.

Turning to the interactions, it seems that the significant interaction obtained between fragment size and frequency (Figure V) is attributable to the relative ineffectiveness of the smallest fragments at any frequency. Figure VI indicates that the significant fragment position x frequency interaction resulted from the relative ineffectiveness of any position where low frequency words were concerned, as contrasted with the increasing efficiency of the beginning position relative to the three remaining positions at each of the other two word frequencies. The significant triple interaction was produced mainly by three things: the common convergence of all fragment positions for the low frequency stimuli, the marked superiority of the beginning position for the other two frequencies, and the slight contribution of the smallest fragment size for the three levels of the frequency variable.

Failures to Recognize Words: The percentage of failures associated with the several levels of each independent variable was examined. There were no marked discrepancies between the order of importance of the levels as far as this variable was concerned and the order yielded by the response speed measure. The proportion of failures decreased with increasing frequency of the stimulus words. While the medium and low frequencies accounted for 39% and 44% of the total

failures, respectively, the high frequency stimuli resulted in only 17% failures. Considering fragment size, the six-letter fragment accounted for above 17% fewer failures than the four-letter fragment, but 18% more than the eight-letter fragment with 16%. In contrast to the two variables already noted, the position variable was not as clear in its differential effects. The best and worst positions - beginning and end - were separated by only 7% at 21% and 28% of the failures, respectively.

## METHOD

### Experiment II

This experiment investigated the effect of connotative meaning on recognition latency for words from which fragments were selected and varied systematically in size. Stimulus words were selected from a Semantic Atlas compiled by Jenkins, Russell, and Suci (1958). The Atlas consists of 360 words evaluated along a number of connotative dimensions. A total of 18 words, nine from either extreme of the "good-bad" dimension were used. All words were eight letters long. Because there are relatively few words of this length in the Atlas, word frequency could not be controlled experimentally. Therefore, in assessing the effects due to the connotative variable, it was necessary to statistically control for the effect of word frequency. Table VII presents the sample of words selected from the Atlas and their respective frequency and semantic values.

---

Insert Table IV Here

---

The fragment was always taken from the beginning of the word. This position was selected because it was found to be the most important for word recognition in the first experiment and it was desirable to minimize the number of infinite latencies.

TABLE IV

| Stimulus Word | Semantic Rating[1] | Log Frequency[2] |
|---|---|---|
| sunlight | 1.43 | 2.7604 |
| complete | 1.50 | 3.2553 |
| hospital | 1.50 | 2.9542 |
| loveable | 1.77 | 1.7324 |
| progress | 1.80 | 2.9542 |
| religion | 1.87 | 2.9542 |
| symphony | 1.87 | 2.0334 |
| graceful | 1.90 | 2.5340 |
| minister | 1.97 | 2.9542 |
| overcast | 5.37 | 1.5563 |
| feverish | 5.50 | 2.1004 |
| deformed | 5.57 | 1.7324 |
| inferior | 5.80 | 2.5340 |
| mosquito | 6.17 | 2.1584 |
| stagnant | 6.27 | 1.8573 |
| sickness | 6.30 | 2.6532 |
| abortion | 6.43 | 1.2304 |
| criminal | 6.43 | 2.7466 |

[1] Semantic Ratings from Jenkins, Russell, and Suci, 1958

[2] Log Frequency based on frequency estimates in Thorndike and Lorge, 1944.

Three sizes of fragments, two, four, and six letters, were used. Six words per subject appears in each fragment size, three words from either extreme of the connotative dimension. Each word appeared equally often per fragment size when all 36 subjects are considered. Three decks of 18 cards each plus three practice items were constructed. Each deck was used for 12 subjects and was shuffled before presentation.

It has already been noted that 90 seconds per exposure, rather than 60 seconds as in Experiment I, were permitted. This change was made in order to increase the number of correct identifications.

## RESULTS

Response Speed: Response latencies were converted to reciprocals. While word frequency could not be experimentally controlled, it was taken into account statistically. In assessing the contribution of this variable to the variance in the dependent variable, log frequency of occurrence was used.

Pearson Product-Moment correlations were computed relating word frequency, semantic value, and response speed for four six-letter fragments. The obtained correlations are summarized in Table V. . .

| | Word Frequency | Semantic Rating | 4-letter R speed | 6-letter R speed |
|---|---|---|---|---|
| Word Frequency | ---- | -.527* | .440 | .519* |
| Semantic Rating | | ---- | .034 | .472* |

* $p < .05$

Table V: Summary of Pearson Product-Moment correlations relating Word Frequency, Semantic Rating, and Response Speed as per 4 and 6 letter fragments.

Stimulus frequency was found to correlate significantly with the semantic measure ($r = -.527$, $p < .05$). That is, more frequent words in the sample tended to be more favorably evaluated along the good-bad simension. This relation is consistent with that reported by Zigler and Yospe (1960).

Neither the frequency nor the semantic variable correlated significantly with the response speed for the four-letter fragments, although a correlation value of .440 ($p < .10$) was obtained in the former instance. Both frequency and semantic measures correlated significantly with the speed of response for the six-letter fragments ($p < .05$). However, when the effect of frequency was partialled out, the relation between goodness of word and speed of recognition dropped to a nonsignificant value ($r = -.272$, $p < .10$).

The response measures obtained for the two-letter fragments did not lend themselves to statistical analysis. In only 21 instances, out of a possible maximum of 216, did the subjects guess the correct word when a two-letter fragment was exposed. In contrast, subjects were correct on 138 and 201 occasions in guessing the identity of the four and six-letter fragments, respectively.

Failures to Recognize Words: As in the first experiment, fragment size seemed to produce a marked effect, failures varying inversely with the number of letters in the fragment. "Good" words accounted for 48% of the failures, leaving 52% to the "bad" words. Finally, there appeared to be no clear difference between "good" and "bad" words within fragment size.

## DISCUSSION

The results of the first experiment are generally consistent with those obtained in tachistoscopic studies of the effect of word frequency on the recognition threshold. The failure of the second experiment to demonstrate an effect of connotative meaning on recognition speed may be attributed to the procedure employed. This point is discussed fully below.

Newbigging (1961a) has found useful Solomon and Postman's (1952) interpretation of recognition threshold data. The findings reported in this thesis can also be handled conveniently by the Solomon and Postman interpretation. This is not meant to imply, however, that other explanations, starting out from quite different assumptions, cannot necessarily account for the observations equally as well. Nevertheless, it does provide a reasonably parsimonious account of the available data.

In line with Solomon and Postman's suggestions concerning differential association strengths, as measured for the verbal community by the Thorndike-Lorge word count (1944), frequency had a demonstrable effect on response speed. Thus, words which are most frequently used by the community, and hence, by inference, most frequently used by a given member of the community, possess higher association strengths with respect to specified stimuli (cf. Neisser, 1954) than do relatively infrequent words. Consequently, when a

fragment of a word is perceived, it evokes frequent response words before less frequent ones. If the stimulus word from which a fragment is presented is itself frequent in usage, the subjects will tend, on the average, to guess it before another less frequent word, although both the frequent and infrequent words may equally satisfactorily incorporate the fragment seen.

Consistent with the above, fragment size operates to delimit the class of associations sampled by the fragment seen. The frequency variable is thus conceived to operate within the class limits imposed by the elements constituting the fragment.

It was remarked earlier that Experiment II was not an adequate test of Newbigging's views on the role of connotative meaning in perception. In support of this contention, an important distinction between our procedure and the more usual tachistoscopic procedure (where Newbigging demonstrated the effect in question) should be noted. In the latter case, the stimulus is only briefly exposed, and it is to the residue of a rapidly disintegrating impression formed during stimulation to which the subject matches his response. The point at which the availability of a report permits an observer to transect the course of the decaying impression is of primary consequence. It is here that word frequency is crucial insofar as this measure may be assumed to represent response availability (association strength).

Thus, if for some reason the verbal response is delayed or inhibited, a less than optimum pairing of response with stimulus will result. Delay means that the verbal response is made to a residue

of information which has diminished rapidly and considerably. This impedance might be expected to take a form such as anxiety arousal and/or the activation of competing judgmental (mapping) responses and/or perseveration on available, but inappropriate hypotheses. These various possibilities were noted in the History. Crucial assumptions, then, view the perceptual process as intermediary in nature and occurring at a covert level. While it is said that a "judgmental process" results in the choice of a response or responses (more than one level of response may be activated) utilizing the information which the percept makes available, no little man in the head need be invoked to account for the selection of a response. It is important only that an associative hierarchy be developed as a function of the organism's experiences. Although several stages in the stimulus input - verbal output (hypothesis) may be isolated analytically, it need only be supposed that associations differing in strength account for the connotative meaning - recognition data.

In any event, if some such mechanism as described above is operative in tachistoscopic recognition, the second experiment probably did not constitute an adequate test of such a process. Subjects were presented with a continuous exposure of the stimulus, in which case any effects which might ordinarily be attributed to a perceptual-judgmental process would not have an opportunity to establish themselves. Instead, connotative effects - if such there be - were effectively restricted in their operation to pure response-side loci. That is, the badness of a word would seem to be limited

in its effect to the availability of responses per se, inasmuch as ordinary conditions of impoverished stimulation cannot be said to have existed. And so, any effect attributable to negative connotative meaning would be obscured by word frequency, the latter a potent determinant of recognition behaviour.

In other words, our procedure - while it did only permit a limited portion of the stimulus word, still provided subjects with at least this much of the stimulus at full intensity and for an extended duration. A tachistoscopic exposure, however, introduces the important factor of memory with which possible connotative factors may interact so as to produce differential recognition. Tachistoscopic exposures place a premium on the rapid utilization of cues. According to Sperling (1960), these cues are available for only a few tenths of a second. Continued exposure of word fragments does not allow for differential cue availability. This seems to be the point of Newbigging's (1961b) observation: "The finding in the present experiment, that it requires a significantly longer exposure time for the recognition of the same size fragment of a 'bad' as compared with a 'neutral' or 'good' word suggests that this inhibitory process operates on perception as well as on the motor response as is suggested by the significantly longer response times for 'bad' words, even prior to their correct recognition."

Nevertheless, on the basis of the correlations obtained in the second study, a word of caution often repeated seems advisable, once again. It is recalled that a significant correlation was

obtained relating frequency of occurrence in the language and semantic rating of the words used. The more frequently a word is used, the more favorably it is evaluated. In addition, a significant correlation was found to relate the semantic ratings to the speed with which subjects identified the six-letter fragments. This latter correlation, however, was reduced to a nonsignificant value when the effect due to word frequency was statistically held constant. Thus, what at first appeared to be a connotative effect seems to be more economically handled by the frequency variable, already known to be a powerful determinant of threshold phenomena. This argues, then, that the connotative variables be regarded as explanatory only after all reasonable precautions have been exercised to control for factors such as word frequency and structural properties of the stimulus material.

## SUMMARY

Two experiments were conducted to investigate characteristics of English words which contribute to the process of word recognition. The first studies the effects of word frequency, the number of letters seen (fragment size), and the position of the letters within the word (fragment position). The second studies the role of connotative meaning.

The method employed in both experiments involved the presentation of the stimulus material on white cards approximately three inches by five inches. Letters were systematically selected from the words and displayed in upper case print. Solid lines, proportional in length to the missing letters, indicated to the subjects where the letters should be supplemented in order to spell the correct word.

Each card was exposed for a duration of 60 seconds in Experiment I and 90 seconds in Experiment II. The experimenter recorded the time of emission of subjects' correct responses. These response latencies were converted to reciprocals, yielding a measure of response speed.

The data yielded in Experiment I was found to be heterogeneous, by F test. For this reason, a more stringent significance level of $p = .01$ was adopted and a Subjects x Treatments analysis of variance was performed.

The speed of response was observed to vary directly with both word frequency and fragment size, such that the more frequent the

word or the larger the fragment, the quicker the recognition. The position variable also attained statistical significance, the beginning position being significantly superior to the other three positions which differed insignificantly among themselves.

Two important relationships summarized by the interactions statistics were the following. First, the small size fragment was observed to be relatively ineffective in its contribution to response speed at any level of the word frequency variable. Secondly, all fragment positions were approximately equivalent and relatively inconsequential with respect to the response speed measure at the low frequency words. Only at the two higher frequency levels did the beginning position show evidence of marked superiority to the other three positions.

In Experiment II, the semantic measure proved to be unimportant as a determinant of word recognition. Although a significant correlation was found to relate connotative meaning with the response speed to the six-letter fragments, this relationship was reduced to a non-significant magnitude when the significant correlation between word log frequency and connotation was statistically partialled out. There was no evidence of a relationship between the semantic variable and response speed to two- and four-letter fragment sizes.

The first experiment has provided base-line measures of the contributions of a number of variables to word recognition. The differential effects attributable to word frequency, the number of letters seen, and the position of the letters within the words, were

seen to be pronounced.

Important procedural differences were noted between the method used in the second experiment and conventional tachistoscopic techniques. These differences seriously limited the adequacy of Experiment II as a test of the role of connotative meaning. A definite amount of the word exposed for an extended period of time precluded the possible effect of differentially available visual cues, such as might be provided by a rapidly decaying information store. The latter could constitute the basis of responses competing with or inhibiting the emission of the verbal response identifying a 'bad' word.

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