# ANAGRAM SOLUTION TIME AND STIMULUS PERSEVERATION AS FUNCTIONS OF MEANING AND FAMILIARITY

by

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# CHAPTER I

## INTRODUCTION

Over the past three decades, researchers have sought to test the hypothesis, deduced from Gestalt theory, that word (W) anagrams are more difficult to solve than nonsense (NS) anagrams. (A W anagram is a sequence of letters which forms a word but which can be rearranged to form a new word; a NS anagram is a sequence of letters which does not itself form a word but which can be rearranged to form a word). According to Gestalt theory, "configurational tendencies of stimulus patterns are enhanced by meaningfulness (Nissenson and Sargent, 1941)." The W anagram is a meaningful verbal unit and should, therefore, comprise a more cohesive configuration than the NS anagram. Since anagram solution is attained by breaking down the initial stimulus configuration, W anagrams should take longer to solve than NS anagrams. Recent empirical findings (1962-1967) favored this prediction but theoretical analyses appeared to be superficial, making a clearcut interpretation of results difficult, if not impossible.

The purpose of this dissertation is to clarify and develop the various theoretical viewpoints adopted by researchers who have dealt with the above empirical problem, in order to contrast them. Opposing interpretations yield contradictory predictions regarding the same experimental manipulations, making possible a test of the several positions.

## Survey of the Literature (1935-1967)

Early studies of W and NS anagrams were designed to test the Gestalt based hypothesis that W anagrams are more difficult to solve than NS anagrams, but their findings were equivocal. Hollingworth (1935, 1938), Sargent (1940), and Nissenson and Sargent (1941) found that W anagrams were no more difficult to solve than NS anagrams. On the other hand, Devnich (1937) obtained positive findings in support of the Gestalt position, and Nissenson and Sargent (1941), following up their main study with a qualitative one in which Ss were trained to "think aloud" and provide retrospective reports, concluded that "many...subjects do... experience greater difficulty in rearranging the letters of meaningful words (p.88)."

The inconsistency of this early research may be attributed to the failure of these researchers to provide adequate controls for relevant solution time variables. In a recent review of anagram problem solving, Tresselt (1968) stated that the three major task variables which influence anagram solution are word frequency, letter order, and transitional probability.[1] Word frequency is simply defined as the number of times the solution word occurs in a normative language sample such as that of Thorndike and Lorge (1944). Letter order is measured by the degree of positional displacement of the letters in the solution word from their original positions in the anagram stimulus. Transitional probability

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[1] Tresselt discussed a fourth variable: set. Some anagram researchers(e.g., Rees and Israel, 1935; Maltzman and Morrisett, 1953) have manipulated Ss' expectations regarding the nature of the solution word by providing them with special instructions to search for solutions which were members of some restricted class such as "nature words." However, the present research is limited strictly to a consideration of <u>task</u> variables which operate in anagram solution.

refers to the serial relation between letters which determines the likelihood of occurrence of any letter given the occurrence of a precedent letter or letters. The transitional probability of any particular letter sequence is estimated by obtaining the frequency of occurrence of this sequence in a normative sample of the language.

Studies by Mayzner and Tresselt (1958, 1959) demonstrated the operation of these three factors, but not one of them was controlled in the earlier research being questioned. Transitional probability in particular is a variable which has generated great interest. Mayzner and Tresselt's (1959) research suggested that this factor may have been confounded with meaningfulness in Devnich's study (1937). Mayzner and Tresselt, controlling solution word frequency, letter order factors, and set, found that NS anagrams with greater transitional probability totals took longer to solve than those with smaller transitional probability totals. This result was interpreted by hypothesizing that the "high transition bind between the sequential letters (Mayzner and Tresselt, 1959, p. 121)" of stimuli in the high transitional condition impeded the letter rearrangement activities required for solution of the anagram task.

In Devnich's (1937) earlier work, the transitional probabilities of the stimuli were not controlled. In view of Mayzner and Tresselt's (1959) findings, it became unclear whether the configurational meaningfulness (as suggested by Devnich) or the relatively greater transitional probability totals of Devnich's W anagrams (if, indeed, they had greater totals) was responsible for their relative difficulty with respect to the NS anagrams.

Beilin and Horn (1962) addressed themselves to this problem. They presented Ss and W and NS anagrams whose digram frequency totals,

solution word frequencies, and letter switching orders were equated. Solution times for W anagrams were found to be significantly longer than those for NS anagrams. The authors concluded that Mayzner and Tresselt's explanation should be rejected. Based upon retrospective subjective reports, Beilin and Horn stated that "Ss perseverate on the word anagram to such an extent that problem solution is interfered with. Whether perseveration is due to attention to the meaning associated with the word or to its sound is not clear (Beilin and Horn, 1962, p. 517)."

Mayzner and Tresselt (1965) repeated Beilin and Horn's (1962) study, but varied the nature of the stimulus materials. Instead of employing W and NS anagrams with different solution words and equating these words for the relevant solution time variables, they constructed their NS stimuli from the same letters as the W stimuli and attempted to arrange their design so that the solution word for each W anagram was the same as that for its NS counterpart. Since the NS form must have two solution words -- both the W anagram and its solution -- Mayzner and Tresselt required Ss to attempt both solutions but recorded only the appropriate one, i.e., the solution word of the W anagram. Their findings contradicted those of Beilin and Horn: W anagram solution time was found not to differ significantly from NS anagram solution time.

Beilin (1966) was quick to point out a glaring flaw in Mayzner and Tresselt's scoring technique which may have influenced their results. Mayzner and Tresselt had not accounted for the generation order of the two solution words to a NS stimulus. Thus, it was not clear whether the recorded solution time for the appropriate solution to a NS anagram did or did not include the solution time of the inappropriate solution word. If the appropriate solution was given second, its recorded time would be spuriously inflated by the unaccounted for time that it took to produce

the first solution. Beilin replicated Mayzner and Tresselt's study, correcting their scoring error. If the appropriate solution word occurred second, its solution time was recorded from the time the first solution was gotten. Beilin found then that W anagrams took significantly longer to solve than NS anagrams.

Two other studies lent empirical support to Beilin's result but provided different interpretations for it. Ekstrand and Dominowski (1965) offered an Associational explanation. They began by applying Underwood's (1965) hypothesis that "Ss make two responses to a verbal unit: 1) a representational response (RR) which is the response necessary to perceive the stimulus, and 2) an implicit associative response (IAR) which consists of associates of the stimulus (Ekstrand and Dominowski, 1965, p. 240)." Ekstrand and Dominowski postulated that both types of responses should inhibit the solution of W anagrams more than that of NS anagrams:

> The RR is likely to be a word in the case of W problems; whereas, for NW problems it is likely to consist of a series of letters, a more appropriate response for solving anagrams. For NW problems, the IAR might be associates of the letters, while for W problems it should be associates of the word. Giving word associates to W problems should be inhibitory since the solution word will rarely be among the associates (Ekstrand and Dominowski, 1965, p. 240).

Giger (1966) employed a "word construction" task in which Ss were presented with a single 7-letter stimulus and were required to construct as many words as they could in a 20 minute period with no restriction on the number of letters in the solution words. The stimulus was presented in three forms: (a) as a word ("FORTUNE,") (b) as a nonsense arrangement whose digram frequency total matched the word ("FRNTOUE,") and (c) as a nonsense arrangement whose digram frequency total was significantly smaller than the word ("TNRFUOE.") Giger found

that the two nonsense groups, though differing in the digram frequency totals, did not differ significantly in number of obtained solutions. Yet, both nonsense groups elicited significantly greater numbers of solutions than the word group. Although it was not Giger's explicit intention, her findings supported those of Devnich (1937), Beilin and Horn (1962), Ekstrand and Dominowski (1965), and Beilin (1966).

But Giger offered a Hebbian explanation of her results, employing Hebb's physiological construct, the "cell assembly," in her analysis. A "cell assembly is defined as the simplest instance of a representational process (in the nervous system)" which "develops as a consequence of the constancies in repetitive patterns of stimulation (Giger, 1966, p. 3)." The anagram is a stimulus which activates cell assemblies which may be simple or complex. The simplest cell assemblies evoked by a given set of letters would merely be representations of those letters in the nervous system. But if a particular group of cell assemblies evoked by a stimulus have occurred frequently together in the past, they may have become integrated into a more complex unit cell assembly with properties of its own. Moreover, this complex unit cell assembly may, in turn, evoke other cell assemblies which have been frequently associated with it in the past.

Giger contended that the W anagram was a stimulus which elicited the more complex, integrated type of cell assembly since its letters have been frequently experienced together in everyday life. On the other hand, the NS stimulus, not having been previously encountered, presumably evoked the simpler types of cell assemblies which were merely representations of the individual letters of the NS stimulus. Giger further postulated that a complex, well-integrated cell assembly accompanied by a hierarchy of associated assemblies has a lower threshold

of activation than a simpler, more loosely organized set of assemblies. The anagram stimulus which evokes the former type of assembly should pre-empt a S's attention to a greater degree than one which elicits the latter type. Since the anagram task is to decompose the stimulus and rearrange its letters, the relatively great attentional priority of the W anagram due to its lowered threshold of activation should inhibit the solution process. This explains her finding that the W stimulus yielded significantly fewer solutions than either NS version.

## Reassessment of Theoretical Positions

### Meaning and Familiarity

Five apparently distinct explanations have been offered above to account for the finding that W anagrams are more difficult than NS anagrams: (a) the classical Gestalt position (e.g., Nissenson and Sargent, 1941); (b) Mayzner and Tresselt's transitional probability approach (1959, 1965); (c) Beilin's structural viewpoint (1962, 1966, 1967); (d) Ekstrand and Dominowski's Associational framework (1965); and (e) Giger's analysis (1966). However, a closer examination of these disparate approaches reveals that they dealt with but two stimulus attributes: familiarity and meaning.

The familiarity of a verbal stimulus may be defined theoretically as the integration status of its component letters in a S's perception of this stimulus. Accordingly, Goss and Nodine (1965) stated that "techniques of familiarization can be viewed as experiences which serve primarily to increase the integration of recognition responses to stimuli (p. 153)." A recognition response is simply "a convenient name for (the) response(s) of spelling or pronouncing all or part of the word or sequence, whether or not in an approved or correct manner (Goss and Nodine, 1965,

p. 113)." Letter integration is believed by Associationists[2] to depend upon number of previous exposures. Noble (1954) demonstrated a strong, positive relationship between judged familiarity and frequency of previous stimulation. In fact, the familiarity of a verbal stimulus is often defined directly in terms of its frequency of previous occurrence.

Meaning has been assigned a multitude of theoretical definitions, beginning with James' (1890) definition of the dynamic meaning of words as "the fringes of feelings of fitness to their contexts (Creelman, 1966, p. 27)," to Osgood's (1963) notion of meaning as a fractional, representational, anticipatory goal response. Noble (1963) defined meaning logically as a dyadic, non-serial relation between terms. Meaning is non-serial because it is symmetrical and reflexive. Noble states: "At first sight this appears to preclude any attempts at measurement... one does not measure relations. Consider physics: The dimension measured by manipulating a yardstick is length, not 'longer than' (Noble, 1963, p. 84)." The measurement of a semantic relation would be just as untenable as that of a physical one. Noble circumvented this dilemma of obtaining an operational definition of meaning by measuring the number of relations between a stimulus and its referents, rather than attempting to measure a relation, per se. Specifically, he evoked continuous associations to a verbal stimulus, assuming that each associate was related to the stimulus through the formation of an S-R habit bond. The number of continuous associations given to a stimulus in a 60-second

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[2] The Gestalt position on familiarity will be elaborated in a later section (see p. 21).

interval was defined as the meaningfulness, "m," of that stimulus. Noble validated his operational definition, m, by demonstrating its strong, positive relationship with judged meaningfulness (1963).

What implications do the logical definitions of meaning and familiarity have for covert activity thought to occur during anagram solution? In characterizing the familiarity of a stimulus, one refers to the stimulus itself, e.g., "I've seen that word before." However, the meaning of a stimulus refers not to the stimulus alone, but to its relation(s) with its referent(s), e.g., "This means that." Accordingly, when the difficulty of an anagram problem is attributed to its familiarity, covert behavior should be said to involve the S's dysfunctional attention to the stimulus itself. On the other hand, if meaning is invoked as the critical stimulus attribute, implicit intervening behavior should be interpreted in terms of dysfunctional attention to the relation(s) between the stimulus and its referent(s).

An examination of the five theoretical positions discussed above reveals that they each were dealing with meaning and/or familiarity, though it was not explicitly stated in each case. The classical Gestalt approach accounted for the relative difficulty of the word anagram stimulus in terms of its "meaningfulness."[3] This attribute was believed to enhance the "configurational tendencies (Nissenson and Sargent, 1941, p. 185)" of its letters making their sequential relationship more "cohesive (p. 88)" and, therefore, more resistant to the rearrangement required for

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[3] This usage of the term "meaningfulness" should not be confused with Noble's special adaptation of it which occurred later on. In this context, it is assumed that the users of the term simply intended it to refer to the state of having meaning.

anagram solution. Stimulus "cohesiveness" logically results in dysfunctional attention to the stimulus whole: if, when S attends to the W anagram stimulus, its letters resist rearrangement, he is, in effect, attending to its whole. On the other hand, the meaningless and, thus, less "cohesive" NS stimulus does not involve attention to the whole, and is, therefore, more conducive to letter manipulating activity required for anagram solution.

However, Nissenson and Sargent did not attempt to explicitly define meaning or meaningfulness. Apparently, a popular understanding of the terms was assumed. This treatment of these terms seems to have resulted in a confusion of the logical definitions of meaning and familiarity. According to the logical definition of meaning provided by Noble, if a S is attending to the meaning of a stimulus he is attending to its relation(s) with its referent(s), not strictly to the stimulus itself. The properties attributed to the W anagram by the Gestaltists, therefore, appear to satisfy the logical and theoretical definitions of familiarity, not meaning: the familiarity of a verbal stimulus is defined as the status of integration (Gestalt "cohesiveness") of its component letters. The possessive pronoun "its" is accentuated to indicate that familiarity is a logically self-referential attribute. The Gestaltists did not even consider meaning, as defined by Noble.

Mayzner and Tresselt attempted to establish transitional probability in place of the vaguely defined Gestalt notion of meaningfulness as the critical stimulus variable responsible for W anagram difficulty. The distinction between transitional probability (as defined by Mayzner and Tresselt) and familiarity appears to be one of convention rather than logical necessity. Familiarity is a term which is usually applied to the verbal stimulus as a whole, whereas transitional probability characterizes

letter relations within the stimulus. But they have both been defined operationally in terms of previous occurrence in a normative sample of language. Thus, it should be as legitimate to speak of the familiarity of the digrams (two-unit letter sequences) in a stimulus as it would be to speak of the transitional probability of the whole stimulus.

The inferred effect of transitional probability upon covert verbal activity during anagram solution is similar to the influence of "meaningfulness" as conceived by the Gestaltists. Mayzner and Tresselt's concept of "transition bind"--S's difficulty in breaking a particular letter sequence frequently encountered in the past--is formally equivalent to the Gestalt quality of "configurational cohesiveness." Both imply dysfunctional attention to letter groupings which retards solution by interfering with the more task-appropriate activity of letter manipulation. The difference is that Gestalt "meaningfulness" presumably leads to preoccupation with the stimulus as a whole whereas "transition bind" produces attention to the digram sequences of the stimulus.

Beilin and Horn (1962) asserted on the basis of retrospective reports that their Ss tended to perseverate (repeat over again) upon W anagrams, but not upon the NS problems. However, it was not clear "whether perseveration (was) due to attention to the meaning associated with the word or its sound...(Beilin and Horn, 1962, p. 517)." Meaning is legitimate as a possible critical stimulus attribute, since W anagrams have meaning and NS anagrams do not. But sound, per se, is an attribute of both W and NS stimuli. Therefore, an additional question must be asked: what differences between the sounds of W and NS stimuli might account for the greater rate of perseveration upon the former? The most obvious possibility is the difference in familiarity; the sound of the W stimulus has most probably been previously encountered by S, but that of

the NS stimulus has not.[4]

It might be argued that perseveration upon the sound of the W stimulus could be attributed to the word's pronunciability rather than to its familiarity. However, Neisser (1966) in his critique of Gibson, demonstrated that the effect of pronunciability is reducible to familiarity, if the latter is defined in terms of prior experience.

> The emphasis which the Gibson group puts on the pronunciability of the letter groups deserves careful analysis. At one level of theory (which unfortunately predominates in the 1964 paper), reliance on pronunciability is simply circular. It makes little sense to say that "pronunciability confers unity"... a cluster of letters cannot be pronounced until after it has been identified. At the more sophisticated level of the 1962 paper, this circularity was avoided: the effect of pronunciation was clearly referred to past experience (p. 113).

Hence, Beilin's analysis may be reinterpreted as follows: W anagrams are more difficult than NS anagrams because Ss perseverate either upon the meaning of the W and/or upon the sound of the W, since the W is likely to have a familiar sound, but they do not perseverate upon the meaningless and unfamiliar sounding NS anagram.

Ekstrand and Dominowski (1965) postulated that W anagrams took longer to solve than NS anagrams because representational and implicit associative responses (RR's and IAR's) to the W problems (see p. 5) inhibited solution more than those to the NS problems. The basis of the inhibitory influence of an RR was apparently its level of integration, precisely the same factor specified by Goss and Nodine (1965) as the prime determinant of the familiarity of a stimulus (see p. 7).

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[4] Sub-sequences of letters within a NS stimulus may appear familiar to S, but here concern is with the familiarity of the entire stimulus, since Beilin was dealing with perseveration upon the whole anagram. In fact, as was already noted, Beilin controlled the familiarity values (transitional probabilities) of sub-sequences of letters for W and NS anagrams, thus eliminating familiarity differences below the level of the whole stimulus.

Ekstrand and Dominowski speculated that S perceptually responded to the W anagram as a word, i.e., as an integrated unit. But S's RR to a NS stimulus was a series of segregated letters, "a more appropriate response for solving anagrams (Ekstrand and Dominowski, 1965, p. 240)." How does this differ from the assertion that S will dysfunctionally attend to a whole when it is "cohesive" or has "high transition bind," (i.e., when it is a word) but respond to its separate elements when these attributes are not present (i.e., when it is nonsense)?

An IAR to a W anagram is hypothesized to inhibit solution more than one to a NS problem because the latter is believed to be an associate of the letters of the anagram while the former is thought to be an associate of the word itself. "The solution word will rarely be among (Ekstrand and Dominowski, 1965, p. 240)" such word associates to the W anagram. Though Ekstrand and Dominowski did not explain this prediction, their assumption was apparently that the basis for association to a W stimulus is <u>semantic</u>, just as it was in Underwood's (1965) research, which Ekstrand and Dominowski used as their point of departure. If Underwood gave his Ss the W stimulus "TABLE" their IAR might be "CHAIR." "TABLE" and "CHAIR" make reference to objects in the non-linguistic world which are closely related. But there is no significant formal relationship between this stimulus and its associate. They share no phonetic elements and but one orthographic component, the letter "A." Suppose, however, that one subject responded to Underwood's stimuli only on the basis of their formal properties. When he came to the stimulus word "TABLE," he might produce the IAR "BLEAT," a word whose letters are identical to those of "TABLE." Interestingly, this hypothetical subject had instantaneously generated the solution of the W anagram "TABLE." But such a

subject would indeed be rare. Thus, the solution word to a W anagram would "rarely be among the associates."

On the other hand, when the stimulus is a NS anagram, the above situation reverses itself: a formal mode of response now becomes the "rule," and a semantic one, an "exception." NS stimuli, by definition, have no direct relations with objects, events or attributes of the non-linguistic world. Therefore, the only basis for association to the NS stimulus is a formal one. Since the relationship between an anagram and its solution is also formal (rather than semantic) IAR's to NS anagrams should be more functional for solution than those to W anagrams. For example, if the NS stimulus were "ABTEL," most IAR's would consist of letters and/or sounds common to both this stimulus and its two solution words, "TABLE," and "BLEAT." But what direct semantic associates could be evoked by "ABTEL"?

If the meaning of a stimulus is defined in terms of its semantic referents (as done above) Ekstrand and Dominowski's analysis may be summarized in the following manner: The W anagram is solved more slowly than the NS anagram because the familiarity (i.e., integrated RR's) and meaning (i.e., semantic IAR's) of the W stimulus interfere with the letter manipulations required for anagram solution.

Giger's (1966) analysis differed little in essence from the others; she merely expressed it in highly speculative physiological terms. The integration of a complex unit cell assembly was presumed to develop from repeated evocations of a set of relatively simple assemblies. This clearly corresponded to the process of "familiarization" (see p. 7) whereby the letter integration of a verbal sequence is achieved through repeated exposures to the sequence. Giger also assumed that the complex

unit assembly evoked related cell assemblies, undoubtedly the hypothetical physiological counterparts of what other theorists have labelled meanings or associations. Both the level of cell assembly integration and the degree of development of associated assemblies were thought to be directly related to the "attentional priority" of the anagram stimulus. Since attending to the stimulus as an integral unit or to its associates impeded anagram solution, attentional priority was presumed to be directly related to anagram difficulty. The W anagram stimulus, believed to evoke a complex, integrated cell assembly which in turn elicited a set of associated assemblies, was, therefore, assumed more difficult to solve than the NS anagram. The latter was thought merely to evoke a set of simple assemblies corresponding to the individual letters of the anagram.

But Giger's data shed no light on her theoretical analysis. They provided no evidence for the physiological events thought to occur during word construction. Hence, Giger's analysis may be restated in non-physiological terms and summarized as follows: The familiarity and meaningfulness of the W anagram stimulus lead the S to attend dysfunctionally to the whole stimulus or its relations with its semantic referents, respectively. However, the unfamiliar and meaningless NS anagram stimulus does not lead to such dysfunctional attention and is, therefore, solved more easily.

Classical Gestalt and Associational Interpretations of Meaning and Familiarity and Their Deductive Consequences for Anagram Solution

Five apparently distinct interpretations for the finding that W anagrams are solved more slowly than NS anagrams have been reviewed. It has been demonstrated that the five analyses actually dealt with but

two critical stimulus attributes; meaning and/or familiarity. But these various approaches can be further differentiated into two classical theoretical camps which provide opposing conceptions of the factors of meaning and familiarity: Associationism and Gestalt psychology. The theorists discussed above did little more than proclaim their nominal allegiance to one of these two schools; indeed, in some cases even this had to be inferred. Consequently, the theoretical analysis attempted by this investigator will go considerably beyond those reported above. It will examine the basic assumptions of Gestalt and Associational theorists in order to determine distinctions which have critical deductive consequences for anagram solving.

Meaning

Despite the traditionally nongenetic character of Gestalt analyses, Associational and Gestalt psychologists would agree that the meaning a verbal symbol acquires depends upon the various contexts in which the S has previously encountered it. Each new context may contribute a new element or elements to the symbol's meaning structure. But the development of such a meaning structure would be viewed differently by Associational and Gestalt thinkers.

The critical point of departure of Gestalt from Associational theory would concern the process by which bonds are formed between a sign and its referents and the resulting nature of the connection. G. A. Miller (1951, p. 162) described the Associational process of bond-formation as one in which "the connections between parts are purely mechanical and may be broken at will." Learning occurs by rote--"with little intelligence...(by)...routine or repetition carried out without understanding or mechanically (Websters New Collegiate, p. 749) When the learner

contributes nothing from his preexistent repertoire of behavior to learning and when connections are made regardless of the nature of the elements being connected, acquisition is strictly a function of a process of stamping-in by sheer repetition. It is, therefore, not surprising that Associationists have traditionally viewed learning as a gradual and continuous function of the frequency of occurrence of the materials to be learned with much trial and error along the way.

The Gestaltists would not accept this view of the ontogeny of meaning. A sign does not acquire meaning for a subject automatically; he must actively integrate this sign and its referent(s) into an organized whole. Hence, Kohler (1947) posed the question: "Is an association a mere bond, which connects experiences in the way in which a string connects two objects? (p. 258)." He cited findings which led him to quite a contrary conclusion. He reported that "meaningful nouns form associations much more readily than does nonsense material (p. 264)" even though the nouns (e.g., "lake-sugar, boot-plate, girl-kangaroo") are apparently unrelated to each other. The Associational prediction would be opposed to the obtained findings since each member of the meaningful pair should have many other stronger associations which should interfere with their association to each other. "Gestalt Psychology offers a different interpretation. When I read these words I can imagine, as a series of strange pictures, how a lump of sugar dissolves in a lake, how a boot rests on a plate, how a girl feeds a kangaroo, and so forth. If this happens during the reading of the series, I experience in imagination a number of well-organized, though quite unusual, wholes (pp. 265-266)."

Supporting Kohler's view, Katz (1950) asserted that:

> A sort of "mental energy" is needed to produce association and recall. Gestalt terminology would refer to a need or an interest. Associative binding by contiguity of elements would be just as

> ineffectual as the coupling of two railroad cars which were being shunted about and happened to touch each other. Recall of one element by another cannot occur without special mental energy any more than the railroad car can move without being attached to a locomotive (p. 95).

Finally, Ausubel wrote:

> The essential feature of meaningful learning is that it embodies a distinctive kind of learning process in which the learner employs a "set" to incorporate within his cognitive structure, in nonarbitrary, nonverbatum fashion, potentially meaningful materials which are subsumed by established entities within that structure (1963, p. 34).

The meaning of a sign is conceived to develop in this manner. Each new context in which the sign occurs is actively integrated into the meaning structure which already existed.

Kohler further stated that active organization may not be necessary:

> In order to exclude the possibility of frequent similar connections in the past, I had, of course, to choose strange pairs of nouns, the meanings of which can be organized into larger pictures, but do not do so quite spontaneously. If I am not mistaken, the combinations and sequences which are even more easily associated in everyday life are simply instances of entirely spontaneous organization (1947, p. 266).

Kohler summarized his position in the following manner:

> Where organization is naturally strong, association occurs spontaneously. In the absence of specific organization no association is to be expected, until the subject establishes some particular organization intentionally (p. 268).

In either case, the influence of frequency per se on organization is absent.

Ellis (1950) reported an experiment in the perception of visual forms conducted by Gottschaldt which also disconfirmed the importance of the frequency variable. Two groups of Ss were presented with a relatively simple geometric figure, the first group being exposed to it 3 times and the second, 50 times. Then both groups were presented with a complex figure in which the first figure was embedded. The Associationist would predict that the simple figure should stand out from its

embedding context more readily for Ss who had encountered the simple figure more frequently in the past--the well-learned simple figure should comprise a relatively strong component of the complex figure. On the other hand, the Gestaltist would predict no differences between the two groups because he would contend that Ss do not perceive the components of the complex figure but rather the single, high-order relationship existing among the parts. Gottschaldt reported that "difference in frequency of past experience failed to elicit any marked differences between the two groups (Ellis, 1950, p. 113)," thus confirming the Gestalt position.

How would the distinct views of learning held by Gestalt and Associational theorists influence their specific conceptions of extant meaning structure? The associative meaning structure of a W stimulus would be composed of a discrete number of elements corresponding to the various contexts in which behavior has been connected to the word; the number of different elements in the structure would define the scope of meaning of the stimulus word. (Meaning scope is equivalent to Noble's m discussed above). The stimulus word will reoccur more frequently in some contexts than in others and the behavior which occurs in the former would, therefore, be better associated to the stimulus than that which occurs in the latter. Hence, the frequency of occurrence of the stimulus in a particular context would define the strength of that particular meaning of the stimulus.

The Gestalt concept of the dynamic integration of elements would lead to a distinctly different view of meaning structure than that derived from the Associational principle of mechanical connection. When a new element is integrated into a preexisting structure it becomes part of a totality, losing its individual identity. The Gestalt meaning structure

is built up from a succession of such integrations so that the final product is a single, high-order relationship, not a collection of discrete elements. Therefore, the scope of a Gestalt structure cannot be defined by the number of elements which went into its original composition. In fact, the concept of scope becomes useless when meaning structure is defined as a single, high-order relationship. Since an element dynamically integrated into an extant structure loses its individual identity, its strength, or any other attribute it possesses, also becomes obscured. Yet, even if elements did not lose their distinctiveness, meaning strength, as conceived by Associationists, would not be a relevant attribute for the Gestaltists. Meaning strength is strictly a function of the frequency of occurrence of the stimulus in a particular context. But, as discussed above, the frequency variable is relatively unimportant in a process of one-trial learning by dynamic integration.

Contrasting Gestalt and Associational conceptions of meaning lead to differential predictions regarding anagram solution. They would concur that the W anagram should be more difficult to solve than the NS anagram because S should attend to the meaning of the word rather than performing the more task-appropriate activity of manipulating its letters.[5] But the Associationist would argue that attending to the word's meaning should involve attention to the associations which have been more or less well connected to the word. The Associationist would predict

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[5] This statement tacitly assumes that NS stimuli have no meaning. For the present, this assumption will be retained. Later it will be considered more carefully (see p. 29).

that solution difficulty should be some positive function of the number (meaning scope) and frequency of occurrence (meaning strength) of these inhibitory associations. On the other hand, the Gestaltist would argue that even though a discrete collection of associates can be evoked to a word, if not instructed to do so, S will attend to the phenomenal meaning of the word: the single, high-order relationship among the components of the word's meaning structure which has resulted from successive integrations of relations between components. Since this process of repeated integration obscures the distinctive identities of the components, the attributes of an associative meaning structure such as number and strength of discrete associations become irrelevant to the covert activity which occurs during anagram solution. Gestaltists would, therefore, predict that solution difficulty should not be a function of systematic variations in such attributes.

Familiarity

The familiarity of a verbal stimulus has been theoretically defined as the perceived integration of its component letters (see p. 7). Gestalt and Associational interpretations of the development of familiarity would differ on the same point on which they were opposed in their analyses of meaning strength. The Associationist would contend that the integration of the perceptual recognition response to a verbal stimulus is a strict function of frequency of occurrence of the letter sequence, with the S playing a relatively passive role. Integration would, therefore, be a gradual and continuous process. The Gestaltist, on the other hand, would minimize the importance of the frequency variable in accordance with his contention that learning is a dynamic process. He would tend

to categorize verbal stimuli as being either familiar (well-integrated) or unfamiliar (not integrated), reflecting the discontinuity of the learning process. In contrast, the Associationist would speak more in terms of levels of familiarity (partial integration) since he views learning as a continuous process.

Familiarity, like meaning, is an attribute possessed by W but not by NS stimuli. Hence, both the Gestaltist and Associationist would predict that W anagrams should be more difficult to solve than NS anagrams. The S would attend to the W as an integrated whole but to the individual letters of the NS stimulus, an activity more appropriate to the solution of anagrams. However, the Associationist would further predict that the relative difficulty of W anagrams will depend upon their relative frequencies of occurrence whereas the Gestaltist would consider the frequency variable to be an ineffective predictor of anagram solution difficulty.

"From Association to Structure"

In an apparent effort to update and resolve the classical controversy between Associationism and Gestalt psychology, Mandler (1962) defined a broad family of "structural" theories which included "the so-called cognitive theories,...the gestalt school and its heirs (and) also the speculations of Piaget, Bartlett, and Hebb, among others (p. 415)." He attempted to develop a concept of structure so general that it would accomodate not only the "structural" theories but Associational theory as well. Mandler offered the following definition of "structures."

> Structures are temporal and probabilistic linkages of inputs and behavior which are available in functional units (his italics). These units--broadly conceived--may be as... associationistic as a habit-family hierarchy, or as cognitive as a means-end relationship (p. 415-416).

Mandler postulated that specific responses are learned to specific stimuli in the initial acquisition of a behavior sequence, but when learning becomes stabilized, additional trials lead to "response integration." The individual responses of the original sequence become integrated into a functional unit: "the whole sequence is elicited as a unit and behaves as a single component response has in the past, any part of it elicits the whole sequence (p. 417)." Mandler further hypothesized that

> once a response sequence has been integrated and acts as a unit, it develops a structural representation, a "central" analogue of this new response unit which can function independently of the overt response sequence (p. 417).

Mandler concluded that "structures are developed on the basis of associationist stimulus-response relationships but, once established, enable the organism to behave 'cognitively' (p. 417-418)."

At first glance, Mandler's analysis appeared to have accomplished his aim of making the transition from "association to structure." But structural theorists, particularly Gestaltists, would object to Mandler's assertion that structures develop according to associational principles. Mandler argued that the appearance of discontinuity in complex behavior conceals a gradual and continuous process of structural development. He further stated that "one of the major variables of associative theories--frequency--appears to be an important antecedent of simple structures (p. 418)." The Gestaltist, however, would emphasize the occurrence of real, not apparent, discontinuities in learning which would result from an <u>active</u> integrative process.

The critical issue between Associational and "structural" theories is not the <u>fact</u> of integration--as one might be led to believe from Mandler's analysis--but rather its <u>means</u>. Associationists would not deny

that integration will occur under certain conditions. Both the Gestaltist and the Associationist would, in fact, define the familiarity of a verbal stimulus in terms of the integration of its letters. But the Gestaltist would assert that integration occurs when the S actively imposes structure on elements which may be disparate while the Associationist's position implies that integration is achieved passively as a function of the frequency of occurrence of contiguous elements. If this distinction is recognized to be critical, Mandler's analysis would no longer be viewed as a transition from Associational to structural theories; rather it would be more properly limited to the Associational realm. Accordingly, when Mandler's general concept of structure is applied specifically to meaning and familiarity and their consequences for anagram solution, it will be demonstrated that his predictions would closely approximate those which would be made by the Associationists, as discussed above.

Application of Mandler's theory to familiarity, meaning, and anagram solution. Mandler's analysis of the influence of familiarity on anagram solution would be identical to that of the Associationist. The letter sequence of a verbal stimulus becomes integrated into a "functional unit" as a strict function of its frequency of previous evocation. A S presented with a NS stimulus has probably not encountered that sequence previously; he will, therefore, perceive the individual letters of the sequence, an appropriate response for the anagram task which requires letter manipulation. But the letters of the W anagram form a functional unit. The strength of the unit depends upon the frequency of previous evocation of the word. Hence, Mandler, like the classical Associationist, would predict that W anagram difficulty will be a direct function of word frequency. In contrast, the Gestalt concept of dynamic integration would rule out frequency-based discriminations among functional units.

Mandler's analysis of meaning structure would appear to replace the discrete association with a more functional unit. Meanings which become connected to a stimulus may also become associated with each other. If they occur together frequently enough, response integration may result. Hence, the collection of discrete, overt responses evoked to a stimulus in the laboratory will not necessarily correspond to the S's covert reactions to the stimulus when not instructed to associate to it. Mandler's analysis would recommend that some sort of cluster analysis be done on associations, with clusters replacing discrete associations as functional units. Meaning scope and strength would then need to be redefined in terms of the new functional unit. W anagram solution would be said to be a function of the number and strength of associative clusters, rather than of discrete associations.

The Gestaltist would argue that a S will perceive the meaning of a stimulus as but one "cluster," a single, high-order relationship, regardless of the number of discrete associations evoked to the stimulus or the number of associative clusters which would be derived from a cluster analysis. This is because integration is not a gradual assimilation of frequently occurring contiguous elements but an active encorporation into the total structure of elements which may even be quite disparate. The agent of integration for Mandler and the classical Associationists is environmental contingencies (specifically, frequency of occurrence of elements in proximity), but for the Gestaltist it is the S himself. This appears to be the crux of the distinction between the two approaches.

Perhaps added emphasis should be placed upon the distinction between the classical and the more sophisticated brands of Associationism, the second of which is represented here by Mandler's theory. Terms like

"integration" and "structure" call to most minds the Gestalt approach to psychology. But neo-Associationists like Mandler have no trouble incorporating these constructs into their theories while retaining the basic assumptions of Associationism which were discussed above. Hence, the critical issue underlying the Gestalt-Associational dialogue is no longer structure vs. association. Rather it deals with the manner in which structures are integrated, and the consequences of this for the nature of extant structures.

In the studies to be described below, the classical Associational measures of meaning scope and strength will be employed, as the development of new measures based on Mandler's analysis would not lead to different predictions regarding their influence on anagram solution. A W stimulus which has a greater number of associations than another word should tend also to have a greater number of clusters. Since a cluster can be composed of any number of elements the greater the total number of elements, all other things being equal, the greater the probable number of clusters. The strength of an association would also be proportional to the strength of a cluster. Mandler stated that the occurrence of any component of a functional unit "elicits the whole sequence (p. 417)." Therefore, if strength is defined in terms of frequency of occurrence, the strength of a discrete association would imply the strength of the cluster to which it belongs. Hence, Mandler, like the classical Associationist, would predict that the difficulty of anagram solution would be a function of the number and strength of discrete, inhibitory associations.

Like Mandler's approach, three of the five theoretical accounts of anagram solving behavior are essentially Associational in nature.

Ekstrand and Dominowski (1965) clearly placed themselves in the Associational camp when they invoked Underwood's (1965) theory of Implicit Associative Responses. Mayzner and Tresselt (1959), in predicting solution time to be a function of digram transitional probability totals, made the essentially Associational assumption that the "transition bind" (i.e., familiarity) of two-letter sequences is a gradual function of their frequency of previous occurrence. Giger (1966) appeared to be making the same assumption when she stated that "groups of cell assemblies that are frequently active simultaneously will tend to acquire interfacilitation and function as an...integrated total pattern (p.3)." Giger also provided an associative definition for a meaningful cell assembly: one which has "a large number of associations with other events or objects (p. 37)."

However, early investigators of W and NS anagram solution (e.g., Devnich, 1937; Hollingworth, 1935, 1938; Nissenson and Sargent, 1941) asserted that they were testing Gestalt theory. Unfortunately, the Gestalt theory and its deductive consequences for anagram solution were not clearly developed by these researchers. This writer must, therefore, assume that had such a development taken place, it would have resembled the elaboration of Gestalt theory set forth in the present analysis.

The remaining theoretical position not yet accounted for is that of Beilin (1962, 1966, 1967). Beilin has distinguished his analysis from Associational interpretations like those offered by Mayzner and Tresselt, and Ekstrand and Dominowski. Speaking of his own view, Beilin stated: "It differs from these (Associationist) accounts in that it emphasizes structural rather than associational aspects of word arrangement (1967, p. 527)." He did not further elaborate the distinction between the

"structural and associational aspects of word arrangement," or its implications for anagram solution. But in a personal communication with this investigator (Spring, 1969) Beilin stated that he considered the classical Gestalt viewpoint to be "old-fashioned" and that his predictions regarding the solution of W anagrams varying in associative meaning and familiarity would not differ from those of the Associationist. Perhaps his distinction between structure and association is similar to that made by Mandler. In any case, Beilin will be classified with the Associationists.

It has now been demonstrated that the five theoretical analyses which appeared in the literature to explain the relative difficulty of W anagrams dealt with but two critical stimulus attributes, meaning and familiarity, each of which was interpreted from one of two broad theoretical orientations, Gestalt or Associationism. Only the earliest anagram studies dealt with the classical Gestalt approach. But this fact did not result from a disconfirmation of the Gestalt position. Indeed, none of the studies of W and NS anagrams surveyed went beyond the prediction of the relative difficulty of the W problems. It was demonstrated above that both theoretical positions would expect this outcome. Contemporary deemphasis of Gestalt concepts in anagram studies probably reflects a more general disaffection with the Gestalt school. Hilgard (1966) viewed the current zeitgeist as a reaction against the mysticism and lack of system of some Gestaltists, not disproof of Gestalt theory. The present investigator reasoned that if he could specify systematically certain critical assumptions of Gestalt and Associational theories and derive opposing empirical predictions therefrom, he would be justified in retaining his Gestalt-Associational analysis, even though the former approach has gone out of vogue, perhaps temporarily.

## Preliminary Study

### Are NS Stimuli Really Meaningless?

When Beilin and Horn (1962) speculated that the meaning of their W anagrams may have made them more difficult to solve than their NS anagrams, they were making the tacit assumption that NS anagrams have no meaning. This appears to be reasonable in view of the conventional definition of nonsense. However, in the present research the meaning of anagram stimuli was measured. Before it could be asserted that the NS stimuli have no meaning--at least not in the same sense as do ordinary words--an apparent paradox in the Associational literature had to be resolved.

Noble (1952) operationally defined meaningfulness, m, as the mean number of continuous associations evoked to any stimulus in a 60-second interval. Accordingly, it was possible to declare certain NS stimuli to be more meaningful than certain W stimuli. For example, the NS stimulus "BRUGEN" had an m value of 1.79 while the W stimulus "MATRIX" had an m value of 1.73. Hence, "BRUGEN" was said to be more meaningful than "MATRIX"!

However, Noble's index of meaningfulness failed to consider a difference in the nature of associative responses to W and NS stimuli. The distinction was made by Ekstrand and Dominowski (1965). They suggested the following.

> For NW problems, the IAR (Implicit Associative Responses) might be associates of the letters, while for W problems it should be associates of the word. Giving word associates to W problems should be inhibitory, since the solution word will rarely be among the associates (p. 240).

The implications of this statement were considered above (see pp. 12-14). The NS stimulus is nonsensical in that the S has not previously encountered it. On the other hand, the W stimulus has been encountered by the S in various contexts which correspond to events, objects, or attributes

of the non-linguistic world. Consequently, if the S is required to provide associations to a NS stimulus, he can only respond to it in terms of its formal similarity (common letters and/or sounds) to verbal entities with which he has had prior experience. But the S will respond to the W stimulus on a semantic basis, i.e., in terms of those events, objects or attributes of the non-linguistic world to which the W stimulus has become related. Semantic associations should have no systematic formal relationship to the stimuli which evoke them. Therefore, it was predicted that the formal similarity between a NS stimulus and its associates should be significantly greater than that between a W stimulus and its associates.

Goss and Nodine (1965) provided an operational definition of formal similarity in terms of common elements and common ordinal position. Their analysis of word pairs was applied to pairs composed of stimuli and their primary (first) associates. For each pairing, two ratios were obtained and their corresponding percentages averaged, as suggested by Goss and Nodine. The numerators of the two ratios were identical, each consisting of the number of letters common to each member of the pair which occurred in the same ordinal position in each member (this was determined by placing the stimulus and its associate side by side at their first letters). The denominator of the first ratio comprised the total number of letters in the stimulus; that of the second ratio, the total number of letters in the primary associate. By taking into account the number of letters in each member of a pair, the formal similarity of pairs of verbal units whose numbers are of any length can be obtained.

If the expected results were obtained, could it be concluded that W anagrams are meaningful whereas NS are not? In its broadest sense, meaning is logically defined as the relation between a sign and its

referent, with no necessary implications for the nature of the relation. If this definition is accepted, it would be incorrect to say that a NS stimulus has no meaning. Any stimulus capable of eliciting any sort of response would be said to have meaning. However, a confirmation of the research hypothesis stated above would justify drawing a distinction between two types of meaning relations. Associations to W stimuli are believed to be based upon events, objects, or attributes which have become related to the stimulus through direct prior experience. Such associations would define the primary meaning of the stimulus. On the other hand, associations to NS stimuli are not themselves based upon previous, non-linguistic experience. Rather, these associations make reference to other linguistic entities which are so based, namely, words. Therefore, associations to NS stimuli would define their secondary meaning. While the word is in direct relation to non-linguistic experience, the NS stimulus is in direct relation to the word and, hence, is one step removed from primary experience.

The primary meaning of the W anagram should inhibit W solution more than the secondary meaning of the NS anagram should inhibit NS solution. It was predicted that the NS stimulus and its associates would have more letters in common than the W stimulus and its associates. Recall that the anagram stimulus shares all of its letters with the solution word. If the above hypothesis were confirmed, it would follow that the associates of the NS stimulus would share more letters with the solution word than would the associates of the W stimulus and that, therefore, the latter associations should inhibit anagram solution more than the former. This is apparently what Ekstrand and Dominowski (1965) meant when they hypothesized that "the solution word will rarely be among the associates" to the W anagram. Hence, meaning would be retained as an explanation for

the greater difficulty of W anagrams relative to NS anagrams but the distinction between meaning and lack of meaning would be replaced by the distinction between primary and secondary meaning.

A number of terms related to meaning have so far been employed. Before continuing, a summary of the definitions of these various terms might be warranted to prevent confusion. In general, the meaning of any entity is simply that to which the entity refers, regardless of the specific content implied by the word "that." The relation between the entity and its referent is expressed by the verb "to mean" as in the statement "This means that." When a S is required to give his associations to a stimulus, his responses signify those things to which the stimulus has come to refer in his life experience. In this sense, associations are meanings. If a S is presented with a verbal stimulus which he has not previously encountered (e.g., a NS stimulus), his responses to it cannot be based upon direct prior experience. If required to associate to this stimulus he should respond in terms of its formal similarity to linguistic entities in his repertoire which do make reference to aspects of his prior life experiences. Hence, the formal associates of NS stimuli have been designated as meanings only in a secondary sense while the semantic associates of W stimuli have been termed primary meanings.

Another term involving meaning which has been employed above is meaning structure. It refers to properties of the set of meanings associated with a particular entity. Two such properties are meaning scope and meaning strength. Meaning scope refers to the number of meanings associated with a specific entity and meaning strength to the

potency of a given meaning relationship. The former term is equivalent to what Noble called meaningfulness, m. Meaning scope is probably a better label for the attribute in question than meaningfulness since the latter term is often used interchangably with meaning in lay parlance.

Measurement of Meaning Structure

The second purpose of the preliminary study was to measure two attributes of meaning in the W stimuli which were to be employed in the anagram study. The properties which were measured were discussed in the theoretical analysis of meaning. They were meaning scope and meaning strength. Noble's m (1952) was employed as the operational definition of meaning scope: m is the mean number of continuous associations evoked to a stimulus in a 60-second interval. Cofer (1958) obtained the frequencies of the most frequent primary responses given to his stimuli (the primary response is the first response given by the S to the stimulus). Cofer's measure was used as the operational definition of meaning strength. In effect, it is an index of the strength of the strongest meaning associated with the stimulus. The primary association is assumed to be the strongest response given to a particular stimulus by a particular S. The frequency of occurrence of a primary response tabulated over a number of Ss was considered to indicate the strength of the relation between the stimulus and the primary. Therefore, the most frequently occurring primary was assumed to be the strongest meaning of the stimulus. This frequency value was employed in the anagram study to indicate the meaning strength of a W anagram stimulus.

## Anagram Study

### Independent Variables

Four independent variables were employed in the anagram study. The first was anagram type, W or NS. Meaning scope of the W anagram was the second, defined operationally by Noble's m. The third was meaning strength of the W anagram, operationally defined as the frequency of the most frequent primary association to it. Familiarity of the W anagram was the fourth independent variable defined operationally by its frequency of occurrence in the Thorndike-Lorge word count (1944).

### Dependent Variables

Two dependent measures were used. The first was anagram difficulty, operationally defined as the time needed for solution. The second was the level of covert attention to the anagram stimulus as a whole, defined operationally as the rate of perseveration (PR) upon the stimulus.

Perseveration rate. When Nissenson and Sargent (1941) could not confirm the Gestalt thesis that W anagrams are more difficult to solve than NS anagrams, they collected additional, qualitative data. Ss were trained to solve anagrams by the "talking-out" method. They also furnished retrospective reports regarding their thought processes during solution, after completing a list of 10 problems. Nissenson and Sargent present examples of talking-out and retrospective protocols:

> For example: Subject J.A., talking-out while solving HOT TAR: "Hot tar-tar-oat-or, ort, art, art, hart, hotter, hot art; H-O, H-O-T. no! Otter, hatro, tar, tar, tar, hatter, no! I can't seem to concentrate on anything else but hot tar."
>
> Subject V.S., retrospective report: "Those words that made sense were harder to get out of my mind; they kept on bothering me and sort of wouldn't let me break them up."
>
> Subject P.Z., retrospective report: "Say, those words that made sense were harder (Nissenson and Sargent, 1941, pp. 87-88)."

The investigators concluded, on the basis of their qualitative data, that "many...subjects do...experience greater difficulty in rearranging the letters of meaningful words (p. 88)."

Similarly, Beilin and Horn (1962) examined the retrospective reports of their subjects and stated: "Some Ss comment that word anagrams often bind them whereas nonsense anagrams do not." Beilin concluded that, "These Ss perseverate on the word anagrams to such an extent that problem solution is interfered with (Beilin and Horn, 1962, p. 517)."

The present investigator provided further support for these qualitative findings. In a pilot study (Summer, 1969), twenty Ss were given a questionnaire after solving eight W and NS anagrams. One question was whether they found the W problems easier, more difficult, or the same as the NS problems. Approximately two-thirds of the Ss reported that the W anagrams were more difficult. When these Ss were then asked why they had found the W's more difficult, many of them gave responses similar to those reported by Nissenson and Sargent (1941) and Beilin and Horn (1962). In fact, some Ss volunteered these sorts of comments during anagram solution, (i.e., before being given the questionnaire). In order to study more objectively the hypothesis that Ss become fixated on the W anagram stimuli, this investigator attempted to develop a formal measure of perseveration during anagram solution.

Initially, Mayzner, Tresselt and Helbock's (1964) procedure was to be adopted for use with W and NS anagrams. These experimenters presented Ss with 6-letter, NS anagrams, each letter appearing individually on a small, flat, wooden block. Ss were required to manipulate the blocks while also "thinking out loud" as they attempted to solve the anagrams. Verbalizations were recorded on tapes and then transcribed orthographically (i.e., the characters of the written language were employed. The re-

searchers presented a portion of a typical protocol for the anagram "RTEOPS" (the solution word is "POSTER"):[6]

> "Torp, ster, tro, top, stop, pose, serop, pers, te, reports, opest, tempest, pro,...etc." (Mayzner, Tresselt and Helbock, 1964, p. 267).

However, it is known that the spoken and written languages do not correspond perfectly. A given phoneme is not always associated with the same letter(s) and the converse is also true. This circumstance might have led to ambiguities in Mayzner and Tresselt's transcription from the spoken to the written language. Suppose, for instance, that the above S had included "sɛtɝ"[7] (as in Irish Setter) in his verbalizations. How would this be orthographically transcribed? When the S looked at "RTEOPS" and pronounced "sɛtɝ" was he covertly duplicating the "t" and "e" to match the word "setter" (just as he had done to match the word "tempest") or was he simply perceiving the letter sequence "setor" or "setr"? In fact, the S may not have been visualizing a definite orthographic sequence at all!

The present investigator dealt with this problem by employing the method of phonetic transcription. Ss were trained to verbalize their thinking as they attempted to solve 5-letter W and NS anagrams. They were instructed to put their thoughts in the form of discrete sounds, letters or words, rather than sentences. Before attempting to solve an anagram, Ss were first required to pronounce it. All verbalizations were recorded on tape. Later, the initial pronunciations of the stimuli were transcribed in phonetic characters. These first responses served as

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[6] In a personal communication, Webster (1970) discovered another possible solution to this anagram unforseen by Mayzner, Tresselt and Helbock: "REPOTS."

[7] These are phonetic characters, taken from Kenyon and Knott (1953).

baselines in the measurement of perseveration rate. Subsequent responses were monitored and a tally recorded for each reoccurrence of the initial pronunciation. Perseveration rate (PR) was defined as the proportion of the total number of verbal responses which consisted of repetitions of the initial pronunciation of the stimulus.

## Hypotheses of the Anagram Study

### Hypotheses derivable from both the Gestalt and Associational positions.

I. W anagrams take longer to solve than NS anagrams. W anagrams are both familiar and meaningful, in the primary sense; NS anagrams possess neither attribute. Consequently, the S spends significant amounts of time attending to the W stimulus as an integrated unit and to the semantic referents of the word, but attends primarily to the letters of the NS stimulus and to words which sound or are spelled like it. The latter activity is more appropriate for anagram solution.

2. W anagrams have greater PR's than NS anagrams. When S perseverates, i.e., repeats his initial pronunciation of the stimulus, it is assumed that he is perceiving it as an integrated whole. The S perceives the W stimulus as a whole, but attends primarily to the individual letters of the NS stimulus, since the former is familiar while the latter is not. It is, therefore, hypothesized that he perseverates more upon the W anagram than the NS anagram.

3. PR and solution time are significantly related to each other in the solution of W anagrams. Perseveration upon the W anagram reflects an underlying preoccupation with the W stimulus as a whole which is attributable to the familiarity of the word. Since such a preoccupation leads to a significant increase in solution time (see Prediction 1), greater

PR's are associated with longer solution times, in the case of W anagrams.

4. PR and solution time are not significantly related to each other in the solution of NS anagrams. If it occurs at all, perseveration upon the NS stimulus does not reflect an underlying preoccupation with the stimulus as a whole because the NS stimulus lacks familiarity, i.e., S perceives the NS stimulus in terms of its individual letters. The occurrence of NS perseveration might indicate a return to the beginning of the problem for a fresh start after exhausting some unsuccessful line of approach. In any case, there is no reason to believe that NS perseveration, if and when it occurs, leads to significant increases in solution time, as was true for W perseveration. Hence, PR is not associated with solution time in the case of NS anagrams.

Hypotheses derivable from only the Associational position.

1. W anagram PR is a direct function of familiarity, with familiarity defined as the frequency of occurrence of the word in the Thorndike-Lorge (1944) frequency count. PR was said to be an operational measure of the S's covert attention to the anagram stimulus as an integrated whole. Furthermore, such covert attention was presumed to depend directly upon the S's prior experience with the stimulus which, in turn, was related to the Thorndike-Lorge frequency value of the word. It therefore follows that the PR obtained for a W anagram is directly dependent upon its Thorndike-Lorge frequency value.

2. The influence of meaning scope and strength upon PR is difficult to determine. Attention to meanings might draw attention away from the stimulus itself. If this occurs, PR would be an inverse function of the scope and strength of the meanings. On the other hand, Noble (1963) stated that the meaning relation is reflexive. If this is the case, attention to meanings would redirect attention back to the stimulus in

the manner of a feedback loop. Here, PR would be a direct function of the scope and strength of the meanings. But attention to meanings may be neither mutually exclusive of nor mutually dependent upon attention to the stimulus per se, because these are not the only two activities in which the S engages during anagram solution. In fact, the successful anagram solver should spend the bulk of his time neither perseverating upon the stimulus as a whole nor attending to its meanings, but rather manipulating its component letters. The two dysfunctional activities may operate independently to impede letter manipulation. Hence, the influence of meaning strength or scope upon PR is presently indeterminate.

3. W anagram solution time is a direct function of familiarity, with familiarity defined as the frequency of occurrence of the word in the Thorndike-Lorge (1944) frequency count. It is assumed that the frequency of occurrence of a word in the language sample is directly related to the S's prior experience with it. In addition, the more frequently S has encountered the word, the better integrated is his recognition response to it. A W anagram which evokes a better integrated recognition response leads to greater dysfunctional attention to itself as a whole than an anagram which evokes a less well-integrated recognition response. Hence, W anagrams with greater Thorndike-Lorge frequency values take longer to solve than those with smaller Thorndike-Lorge frequency values.

4. W anagram solution time is a direct function of the meaning scope of the anagram, with meaning scope defined as the average number of continuous associations elicited to the anagram stimulus in a 60-second interval (i.e., Noble's m, 1952). Attention to the semantic associates of the W anagram stimulus inhibits anagram solution since the task requires the manipulation of letters. Consequently, the greater the number of

associates the stimulus is capable of evoking, the greater the potential number of inhibitory elements which can occur during anagram solution to increase solution time.

5. W anagram solution time is a direct function of meaning strength, with meaning strength defined as the frequency of the most frequent primary associate elicited to the anagram stimulus (Cofer, 1958). The more frequently a primary associate to a W stimulus occurred in the normative sample of the preliminary study, the more likely it is to intrude during anagram solution, thereby increasing solution time. Hence, W anagrams whose strongest primaries occurred more frequently in the normative sample take longer to solve than those whose strongest primaries occurred less frequently.

The Gestalt position regarding Associational predictions. The PR and solution time of W anagrams are not systematically influenced by their varying levels of meaning scope, meaning strength or familiarity. The measurement of the latter three variables is based upon the underlying assumptions of gradual, passive learning and the importance of prior experience, as such. The Gestaltist would deny these assumptions. Consequently, he would assert that the three variables are ineffective predictors of anagram solution.

# CHAPTER II

## PRELIMINARY STUDY AND METHOD OF ANAGRAM STUDY

### Method of Preliminary Study

#### Subjects

The sample consisted of 100 Brooklyn College undergraduates enrolled in an introductory child psychology course.

#### Materials

A set of six 5-letter, single-solution W anagrams and six such NS anagrams were selected from Olson and Schwartz's (1967) tables of all possible 5-letter, single and multiple-solution anagrams (the basis for selection will be detailed further below).

#### Procedure

Noble's (1952) procedure for measuring meaningfulness, m, was generally followed. W and NS stimuli were presented to Ss in booklet form. Each stimulus was printed on a separate sheet in the test booklet, in order to maintain a "uniform set (Noble, 1952, p. 424)." To implement the continuous association procedure in which S responds only to the original stimulus (i.e., he does not chain associate) each stimulus was printed once at the top of the page and repeated 13 times in each of three columns. S was required to write every response to the stimulus on a line provided just to the right of each repetition. "To minimize constant errors due to fatigue, decreasing motivation and inter-item interaction..." the order of presentation of the stimuli was varied randomly. This also

served to randomize the presentation order of W and NS stimuli.

Ss were tested in a large lecture room during a single session. They responded to each stimulus for 60 seconds. The inter-item interval was 5 seconds.

Instructions to Ss. Parts of the instructions to Ss were taken verbatum from those employed by Noble; changes were made where appropriate. The chief reason for departing from Noble's original instructions was that, although he employed both W and NS stimuli (the latter were called "paralogs"), his instructions clearly led Ss to expect that they were only to receive word stimuli. The instructions employed in the present research made it clear to the Ss that they were to receive both W and NS stimuli (see Appendix B).

Ss were given two practice problems, a W and a NS stimulus, before beginning the sequence of stimuli which were to be measured.

## Results and Discussion of Preliminary Study

Of 100 Ss, 12 were eliminated from the formal similarity analysis (see p. 30) for giving unacceptable primary associations to one or more of the 12 anagram stimuli (6W and 6 NS) which were presented to them.[8] For each of the remaining Ss, the mean formal similarity computed for the 6 NS stimuli was compared with that obtained for the 6 W stimuli. As predicted, in 83 of 88 cases, the mean formal similarity between the NS stimuli and their primary associates exceeded that between the W stimuli

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[8] Ss were eliminated when: (a) no associations were given to a stimulus; (b) the primary association was a repetition of an earlier stimulus which had been presented to S, rather than a response to the current stimulus; (c) the primary associate was a comment on the general situation (e.g., "fed-up," "pointless") rather than a response to a specific stimulus; (d) the primary association was a response to the tense of the W stimulus, rather than to its root (e.g., to the stimulus "ACTED," two Ss responded "past)."

and their primaries. No further statistical analysis was deemed necessary.

The result supported the proposition that W and NS stimuli have different types of meaning relations. The referents of the W stimulus are semantic, being based upon direct prior experience with objects, events or attributes of the non-linguistic world. Therefore, the W stimulus was said to have primary meaning. However, the associates of the NS stimulus were shown to be formal, being dependent upon the S's previous encounters with language. The NS stimulus was, therefore, said to have only secondary meaning. Predictions regarding the influence of secondary meaning on NS anagram solution might have been formulated, but this investigator was primarily concerned with attributes of W anagram stimuli which may be responsible for their relative difficulty. Consequently, the meaning analysis in the anagram study was restricted to the W stimuli.

Table 1 shows the 6 W stimuli rank-ordered according to the magnitude of their average meaningfulness values, m. Also displayed in the table are the most frequent primary associations given to each stimulus (the column labeled "strongest primary"), and their associated frequency values, expressed as percentages. The final column shows the sample size, N, on which the measurement of each stimulus is based. Although a sample of 100 Ss was employed, specific stimulus items were eliminated in a few cases because Ss made too many unacceptable responses.[9] This accounted for the unequal N's appearing in the table.

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[9] Following Noble (p. 425) three categories of responses were not acceptable: (a) illegible responses; (b) repetitions of the same response to the same stimulus; (c) "failures of set." The third category included two types of errors, "free or tangential associations: (e.g., LEMUR--Dorothy, Hope, faith, charity..."; and "clang or alliterative associations," e.g., HANGS--bangs, fangs, etc.)

TABLE I

Average Meaningfulness ($\bar{m}$) and Strongest Primary Associates of W Anagram Stimuli

| Stimulus | $\bar{m}$ | Strongest Primary | Percent Occurrence | N |
|---|---|---|---|---|
| ACTED | 11.77 | Play(-s) (-ed) | 22% | 100 |
| LAMBS | 11.52 | Sheep | 24% | 100 |
| HANGS | 11.21 | Picture(-s) | 14% | 99 |
| MOIST | 10.79 | Wet | 65% | 100 |
| CLAYS | 10.54 | Play(-s) | 16% | 99 |
| TAPED | 10.41 | Record(-s) (-ed) (-ing) | 15% | 97 |

The obtained range of variation of $\bar{m}$ was so restricted that the 6 W stimuli were considered to be invariant with respect to this meaning attribute. Consequently, the predictions of the anagram study concerning the influence of meaning scope could not be tested.

Upon inspecting the relative strengths of the primaries of the W stimuli, two levels were apparent: the five primaries which clustered within a relatively restricted range of 10 percentage points (14%-24%) seemed to comprise a low level of strength and WET which had been given by 65% of the Ss to MOIST appeared to be at a high level of strength.

To confirm this impression, Cochran's Q Test (1950) was employed. This statistic is useful in repeated measurements designs where the data is dichotomous, i.e., in cases where each S gets every treatment and for each treatment his performance is classified in one of two categories, scored 0 or 1. In the present example, the six W anagrams were the treatments and for each presentation of a stimulus, the S either responded with

its strongest primary (scored 1) or did not (scored 0). Two Q statistics were calculated. The first tested the hypothesis that five of the six primaries, those with the relatively low percentage values, formed a cluster with no significant variations among the members. The tabled $X^2$ required for significance at the .05 level (two-tailed) with 4 df is 9.49. The obtained $X^2$ for the five primaries was 4.55. The failure to reach significance confirmed the hypothesis of no significant difference among the five primaries in question.

The second Q statistic was obtained for all six primaries. It was predicted that the introduction of WET into the analysis would yield a significant $X^2$. The tabled $X^2$ required for significance at the .001 level with 5 df is 20.52. The obtained $X^2$ for the six primaries was 93.57. On the basis of the two Q tests it was concluded that the original impression conveyed by the distribution of strengths of primary associates was confirmed. The five stimuli with the relatively weak primaries, i.e., ACTED, HANGS, CLAYS, LAMBS, and TAPED, were considered to comprise a low meaning strength condition and MOIST, by itself, the high meaning strength condition.

## Method of Anagram Study

### Subjects

A sample of 40 Brooklyn College undergraduates were recruited from introductory child psychology classes, similar in composition to the one used in the preliminary study. Most of the students were freshmen or sophomores and the distribution of sexes was approximately equal (there may have been several more females than males).

### Materials

The 12 5-letter W and NS stimuli scaled for meaning scope (m)

and meaning strength in the preliminary study were employed as anagrams in the present study. Each anagram problem was typed in capital letters on white 3 x 5 index cards. Ss had these cards in view during attempted solutions.

Experimental Design

The stimuli were selected from Olson and Schwartz's (1967) exhaustive list of all 5-letter, single and multiple-solution anagrams possible in the English language. Selection was determined by two criteria. First, W anagram stimuli were chosen to provide systematic variations in their levels of familiarity, with familiarity defined as the frequency of occurrence of these words in the Thorndike-Lorge (1944) word count. Three levels were obtained, with two stimuli at each level. The two high f stimuli each had AA T-L (Thorndike-Lorge) values;[10] the medium f anagram stimuli had T-L values of 45 and 43; the low f stimuli had T-L values of 19 and 8. The second basis for the selection of stimuli was the control of three of the most important solution time variables (Tresselt, 1968): anagram and solution word transitional probability totals, solution word Thorndike-Lorge (1944) frequency values, and degree of letter manipulation required to go from the anagram to the solution word. W and NS stimuli were equated for stimulus and solution word digram frequency totals, computed from Mayzner and Tresselt's (1965) frequency counts. The mean digram frequency total for W anagrams was 1633.33 while that for NS anagrams was 1646.33; the difference between means was not significant. The mean digram frequency total for solution

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[10] The Thorndike-Lorge word count designates as "AA" words which occur 100 or more times per million.

words of W anagrams was 1176.17 while that for solution words of NS anagrams was 1193.50; the difference between means was not significant. W and NS stimuli were also equated for solution word Thorndike-Lorge frequencies. The mean T-L value for W anagram solution words was 5.17 while that for NS anagram solution words was 5.00; the difference between means was not significant. Difficult letter-orders were chosen for all anagram problems from a table of all possible letter-orders for a 5-letter anagram problem (Mayzner and Tresselt, 1966, p. 296, Table 4). The table consists of 14 categories of letter-order difficulty, based on the degree of displacement of letter positions in solution words from their positions in anagram stimuli. Only anagrams in the three most difficult categories were selected. Finally, each of the 12 anagrams had but one possible solution.

Solution words were also individually equated for transitional probability and Thorndike-Lorge values. The T-P and T-L values of all chosen solution words varied within a narrowly restricted range, relative to the ranges of the frequency samples from which they were selected. The range of variation of digram frequency totals selected was 662 while that of all possible five-letter combinations appearing in Mayzner and Tresselt's (1965) sample is approximately 9000. The frequency range of words selected from the T-L sample is 15 per million words, whereas that of all five-letter words in this sample is 100+ (see Appendix A for table of anagram stimuli and solution words and their individual values on controlled variables).

A repeated measurements design was employed: every S received each of the 12 anagrams. Possible sequence effects were controlled by first establishing two separate sets of random orders for W and NS stimuli and then alternating W with NS anagrams in presenting them to Ss.

Instructions to Ss

Your task will be to solve some letter rearrangement problems. For each problem, you must try to form a word by rearranging the order of the letters you see. Some problems will begin as words. Here, you must try to rearrange the letters to form a new word.

You will be shown a series of index cards. One letter rearrangement problem will appear on each card. When you first see the problem, pronounce it before you begin working on it.

I want to find out just what you are thinking as you attempt to solve the problems. Say aloud thoughts which are relevant to the problem solving process. Say one thought at a time. Put your thoughts in the form of sounds, letters, words--whatever best reflects your actual thinking process while solving the problems. Do not say sentences explaining your thinking. Just say the thoughts themselves, one at a time.

Do not attempt to censor your thinking even if your thoughts are repetitious, incomplete, or nonsense. Say them anyway because the important thing is that your responses accurately reflect your thinking while you are solving the problems.

Also, some of the problems are difficult and you are not expected to solve them right away, if at all.

Let's try some practice. When I show you the first index card and I say "start," you will pronounce the problem you see and then begin working on it. Remember, put your thoughts in the form of sounds, letters, words--whatever best reflects your actual thinking process. Say one thought at a time so that I can hear you. When you've got the solution, say it first and then make sure to spell it out so that I know you've got it.

## Procedure

All Ss were tested individually. Before beginning the 12 experimental anagrams, Ss were presented with 4 practice problems, 2 W and 2 NS. One problem from each pair was relatively easy[11] and served to motivate Ss by building their confidence in their ability to succeed with the task.

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[11] The two easy practice items, FHESL AND SHRUB, were selected from Mayzner and Tresselt's (1966) table of median solution times, their median times being 6.0 and 7.5 seconds, respectively. One of the difficult problems, OCEAN, was also selected from this table, its median solution time being 240 seconds. The other difficult problem, DLEIA, was taken from a pilot study conducted by the present investigator (1969).

The other members of the pairs were more difficult training problems. During the solution of these, Ss were cued when appropriate. The investigator repeated the portion of the instructions relevant to any error being made by the S. Also, Ss were reinforced verbally when they began to respond appropriately (e.g., "mm-hmm" or "that's right"). The sequence of presentation of the practice problems alternated the W and NS and easy and difficult items.

After the practice problems, Ss were instructed not to attempt to communicate with E during subsequent solution periods. They received a maximum of 4 minutes per anagram, as determined by the use of a stop-watch, and their verbalizations were recorded on tape. After the sixth problem, Ss received a five minute rest period. At the conclusion of each session, S was presented with a brief questionnaire designed to provide additional, informal support for the predictions of the present investigation and to substantiate the earlier qualitative findings of other researchers. The results concerning the two most relevant items will be reported. The first was: "Did you find the problems which began as words (a) easier, (b) more difficult, or (c) the same as those which began as nonsense?"[12] The second important question was: "If your answer to (the previous question) was either (a) or (b), explain this answer briefly." Ss reactions to one other item on the questionnaire will be reported: "How accurately did your spoken responses reflect your actual thinking processes? (a) no correspondence, (b) loose correspondence, (c) close correspondence, (d) perfect correspondence." This question was designed as an informal check on the validity of the perseveration measure.

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[12] The words "nonsense" and "words" were interchanged for alternative Ss to safeguard against the operation of any sequence bias.

After the experimental sessions, PRs were determined from the phonetic transcriptions of the initial pronunciations of the anagram stimuli and the tallying of subsequent repetitions of these pronunciations (see pp. 36-37). PR = $\frac{P}{N}$, where P is a repetition of the first pronunciation of the stimulus and N is the total number of verbal responses given to the stimulus. The solution time for each anagram stimulus was recorded from the tape with a stopwatch.

# CHAPTER III

## RESULTS OF ANAGRAM STUDY

Mayzner and Tresselt (1966) employed non-parametric inferential statistics because they found solution time distributions to be markedly "skewed as well as having an artificial ceiling imposed of 240 sec. (p. 102)."

The frequency distributions of solution times and the two frequency distributions associated with the PR measure, one for perseverative responses only (scores in the numerator of PR) and one for all responses, perseverative and non-perseverative (scores in the denominator of PR) were obtained. The distribution of solution times was bimodal. Eighty percent of attempted anagram problems had solution times which occurred in the first or last quarter of the frequency distribution, 37% occurring in the first quarter and 43% in the last quarter. The frequency distribution of perseverative responses was markedly skewed. Ninety-seven percent of attempted anagram problems had perseverative response frequencies which were in the first quarter of the distribution, 21% in the second quarter, 4% in the third quarter, and 1% in the last quarter. In view of the dramatic departures from normality obtained for each of the frequency distributions of the dependent variables, this investigator, like Mayzner and Tresselt (1966), employed nonparametric inferential statistics to test his research predictions.

## Tests of Hypotheses Derivable from Both the Gestalt and Associational Positions

Although non-parametric procedures were subsequently used to test these hypotheses, Table 2 provides an initial visual statement of the results in terms of mean W and NS performance.

TABLE 2

Anagram Performance Expressed by Stimulus and Stimulus Type (W or NS)

| W Stimulus | Total PR | Mean Sol. Time | Median Sol. Time | Percent Ss Solving |
|---|---|---|---|---|
| LAMBS | 24/650 = .0369 | 106.90 | 49 | .70 |
| ACTED | 69/1100 = .0627 | 189.79 | 240 | .38 |
| TAPED | 28/711 = .0394 | 103.68 | 69 | .83 |
| HANGS | 37/957 = .0386 | 169.56 | 240 | .44 |
| CLAYS | 62/1137 = .0545 | 167.95 | 240 | .43 |
| MOIST | 44/1572 = .0279 | 209.63 | 240 | .25 |
| Mean | .0433 | 157.92 | 179.67 | .51 |
| NS Stimulus | | | | |
| CATEF | 12/596 = .0201 | 111.03 | 96 | .75 |
| COLAV | 15/577 = .0260 | 106.78 | 93.5 | .75 |
| YUINT | 9/346 = .0260 | 70.43 | 29 | .88 |
| MUTRO | 11/582 = .0189 | 99.03 | 61.5 | .80 |
| ANORY | 37/1212 = .0305 | 176.83 | 237 | .50 |
| WORPL | 10/422 = .0236 | 75.40 | 42.5 | .88 |
| Mean | .0242 | 106.58 | 93.25 | .76 |

By inspection of Table 2, it is generally apparent that Ss perseverated more upon W than NS stimuli and took longer to solve the Ws. Also, a smaller percentage of Ss solved W than NS stimuli. In

fact, in the case of perseverative behavior, an inspection of values for individual W and NS stimuli reveals little overlap in performance on these two types of anagrams. Only one NS stimulus had a higher PR total than a W stimulus (ANORY had a higher PR than MOIST). While somewhat greater overlap is indicated for the three remaining dependent measures, each suggests on the whole that W anagrams were substantially more difficult to solve than NS anagrams. Non-parametric statistical support for these initial impressions follows.

W Anagrams Take Longer to Solve than NS Anagrams

A Wilcoxin Signed-Ranks Test (1949) was performed (this is a non-parametric statistic appropriate for repeated measurements designs). For each of the 38 Ss,[13] solution times were pooled to obtain a solution time total for the 6 W anagrams and one for the 6 NS anagrams. Signed differences between scores were gotten for each S and ranked. A Z score was computed based on the sum of the ranks with the less frequent sign (this sum is Wilcoxin's T score). The obtained Z was +4.73 with p = .000006 (two-tailed). It was concluded that W anagrams took significantly longer to solve than NS anagrams.

W Anagrams Have Greater PRs than NS Anagrams

The Wilcoxin Signed-Ranks Test was employed. For each S, PRs were pooled to obtain an overall PR for the W anagrams and one for the NS anagrams. The obtained Z was +3.39 with p = .0006 (two-tailed). It was concluded that W anagrams had significantly greater PRs than NS anagrams.

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[13] Two Ss from the original sample of 40 were eliminated because of technical difficulties.

PR and Solution Time Are Significantly Related to Each Other in the Solution of W Anagrams

A Spearman (Siegal, 1956) rank-ordered correlation was performed (this is a non-parametric statistic of relationship). For each of the 38 Ss, solution times and PRs were pooled to obtain a solution time total and an overall PR for the 6 W anagrams. These scores were ranked and the ranks were correlated. The obtained Spearman r was .07, indicating a lack of relationship between the two variables.

However, a further inspection of the distribution of solution time and PR scores indicated that the data might warrant dichotomous treatment.

TABLE 3

Overall Frequency of Occurrence of Perseveration and Anagram Solution

| Perseveration | Solution: Solved | Solution: Not Solved | |
|---|---|---|---|
| Not Perseverated | 222 | 88 | 310 |
| Perseverated | 59 | 85 | 144 |
| | 281 | 173 | 454 |

The marginal frequencies of Table 3 demonstrate that a substantial proportion of attempted problems were either not solved (38%) or not perseverated (68%). Therefore, each variable was reduced to two categories: solved and not solved, perseverated and not perseverated. Since it is predicted that a significant relationship between solution and perseveration will be obtained for the Ws but not the NS stimuli (see pp. 37-38), Table 3 was recast into two separate tables, one for W and one for NS anagrams.

TABLE 4

**Frequency of Occurrence of W Perseveration and W Anagram Solution**

| Perseveration | Solution: Solved | Solution: Not Solved | |
|---|---|---|---|
| Not Perseverated | a 87 | b 51 | 138 |
| Perseverated | c 30 | d 67 | 97 |
| | 117 | 118 | 235 |

TABLE 5

**Frequency of Occurrence of NS Perseveration and NS Anagram Solution**

| Perseveration | Solution: Solved | Solution: Not Solved | |
|---|---|---|---|
| Not Perseverated | a 135 | b 37 | 172 |
| Perseverated | c 29 | d 18 | 47 |
| | 164 | 55 | 219 |

By inspection of the tables, it can be seen that an extremely large proportion of NS anagrams were both solved and not-perseverated. In cases where perseveration did occur, there was a greater number of solutions than non-solutions, suggesting that perseveration did not impede the solution of NS anagrams. However, for W anagram solution, the frequency of cases is not concentrated in cell a. A substantially greater number of cases are concentrated in the a-d diagonal (66%) than in the b-c

diagonal (34%), confirming the expected relationship between perseveration and solution for W problems. Moreover, a comparison of cells c and d reveals that more than twice as many problems could not be solved as were solved when S perseverated. When the comparison of cells c and d for W anagrams is contrasted with that shown for NS anagrams, it appears that perseveration has a substantially greater negative effect on W than on NS solution.

At first it was thought that these informal observations could be tested by performing a chi square on each of the tables, with the prediction that significance would be obtained for Table 4 but not for Table 5 (this was actually done and expectations were unequivocally confirmed). However, it was subsequently recognized that such chi squares were inappropriate because the frequencies in the cells were partially contributed to by the same Ss (each S solved 12 anagrams and, therefore, contributed 12 tallies to be distributed among the cells). It was consequently decided that the relationship between perseveration and solution for W and NS anagrams would have to be statistically determined by a within-subjects procedure. Hence, a new hypothesis was set up to test the relationship between the two dependent variables which were now expressed dichotomously:

A Significantly Smaller Proportion of Solutions of W Anagrams Are Obtained When S Perseverates than When He Does Not Perseverate

Six W anagrams were attempted by each S. The proportion solved of those problems on which S perseverated was compared with the proportion solved of those on which S did not perseverate. The Wilcoxin Signed-Ranks Test was performed on the difference between the two proportions obtained

for each S.[14] The computed Z was +3.49 with p = .0004 (two-tailed). It was concluded that a significantly smaller proportion of anagrams were solved when Ss perseverated than when they did not perseverate. Hence, the solution of W anagrams was considered to be related to the occurrence of perseveration upon them, despite the lack of relationship between solution time and PR indicated by the rank-order correlation.

The Proportion of Solutions of NS Anagrams Obtained When S Perseverates Does Not Differ Significantly from that Obtained When He Does Not Perseverate

The Wilcoxin Signed-Ranks Test yielded a T of 30.5. With N = 15, the T value required for significance at p = .05 (two-tailed) is 25 or less (Siegel, 1956, p. 254).[15] The null hypothesis was accepted and it was concluded that the solution of NS anagrams was not related to the occurrence of perseveration upon them.

The relationship between perseveration and solution for W and NS anagrams was further examined by grouping Ss into high, medium and low levels of perseveration and comparing the median number of solutions obtained for each group. First, the number of problems each S perseverated upon was tabulated. Ss were rank-ordered in terms of number of perseverations and were then divided into 3 groups based on the rankings: hi, med, or lo perseveration (the number of Ss in each group was

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[14] Cases were eliminated in which Ss either perseverated on all 6 W problems or perseverated on none of them. In such instances, the two proportions required for comparison could not be obtained.

[15] When N is greater than 25, as in the case of the W anagram analysis, a Z score and its associated exact probability may be computed from the Wilcoxin Test. But when N is 25 or less, Siegel (1956) recommended that his table of critical values of T be consulted.

approximately equal). Subsequently, the median number of solutions obtained by each group was computed. This procedure was followed for W and NS anagrams separately. The values gotten and their ranges are tabled below.

TABLE 6

Median Number of W and NS Solutions Obtained by Ss in Low, Medium and High Perseveration Groups

| | Lo P | Med P | Hi P | Range |
|---|---|---|---|---|
| NS | 5.10 | 5.00 | 4.30 | .80 |
| W | 3.80 | 2.90 | 2.30 | 1.50 |

These results are expressed graphically in Figure 1.

These findings lend additional support to the hypothesized influence of perseveration on anagram solution and, specifically, to its differential effect on W and NS anagrams. Both curves indicate that obtaining solutions is negatively and monotonically influenced by the level of perseveration. But an inspection of the two curves reveals that the W

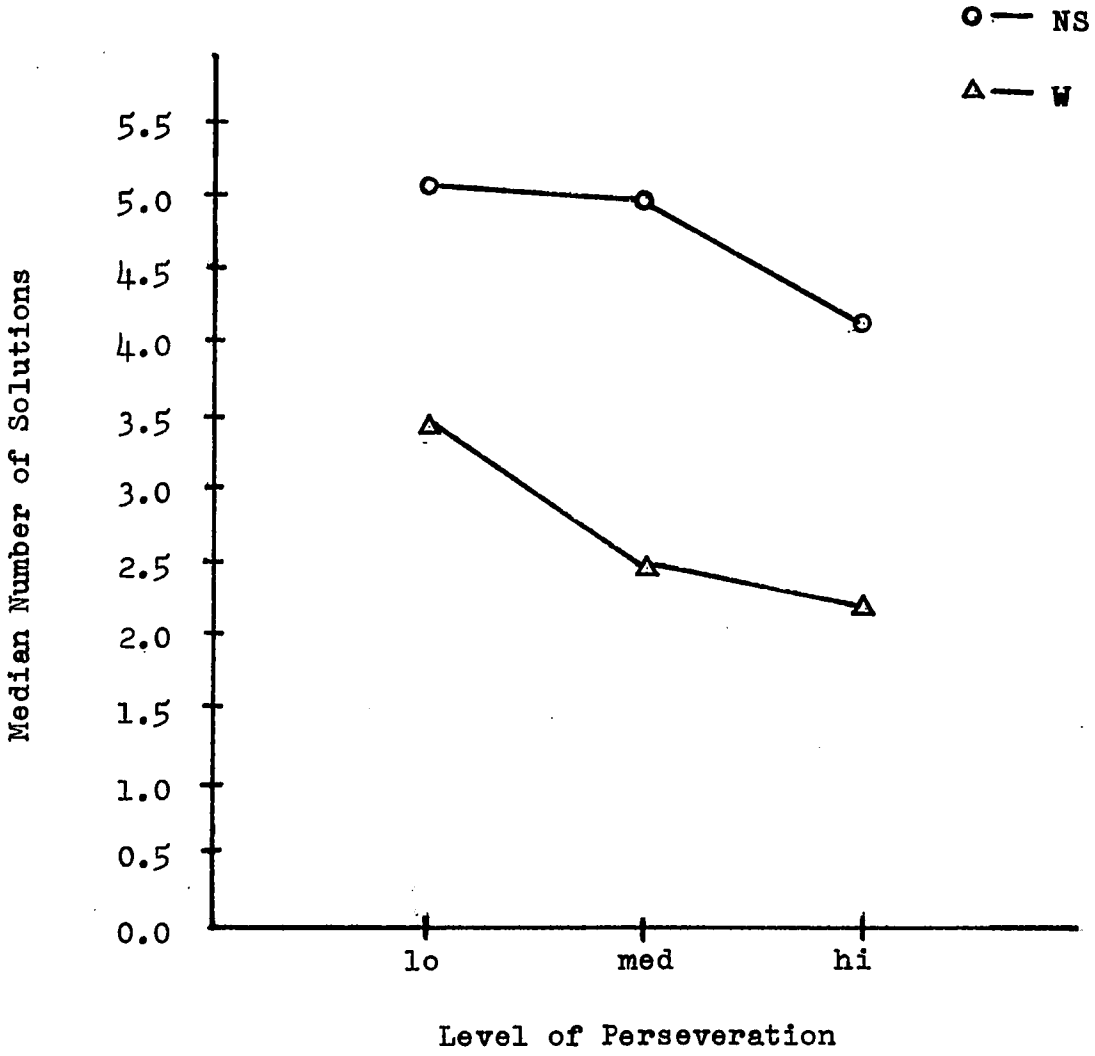


FIGURE 1

Number of Solutions as a Function of Level of Perseveration

curve is steeper than the NS curve. This difference is reflected in the fact that the range of medians for the Ws practically doubled that for the NS anagrams.

Tests of Hypotheses Derivable from Only the Associational Position

Had the influence of meaning and familiarity upon W anagram solution, as conceived by the Associationist, been investigated under ideal circumstances, a factorial study would have been conducted assessing the independent main effects of meaning scope, meaning strength, and Thorndike-Lorge (1944) frequency upon PR and solution time, and also testing interaction effects among the three independent variables. However, several restrictions were placed upon the experimental design which made such an analysis untenable. First, as reported above, the frequency distributions of the dependent variables departed from normality to such an extent that the use of non-parametric statistics was suggested, following Mayzner and Tresselt (1966). But even if the appropriate transformations could have been done on the distributions to normalize them, the performance of a factorial study would still have been questionable. The 12 W and NS stimuli were selected from an exhaustive list of all possible 5-letter anagrams in the English language (Olson and Schwartz, 1967). Selection was based upon the control of a number of variables relevant to anagram solution (see pp. 46-47). Of the thousands of possible combinations of anagrams in the source list, only 6 W and 6 NS stimuli remained which permitted the control of all the relevant variables and at the same time featured systematic variations among the W anagrams in one of the independent variables,

Thorndike-Lorge frequency.[16] Consequently, a measurement of the W stimuli was required for the other two independent variables, meaning scope and meaning strength, with no guarantee of the outcome. As reported in the results of the preliminary study, the W stimuli were found to be virtually invariant with respect to meaning scope and unevenly distributed in the case of meaning strength (five stimuli formed a cluster of low meaning strength with only one stimulus being of high strength). Hence, a factorial study could not be performed because anagram stimuli were not available which would satisfy all the controls and also fill all the cells of a three-way factorial analysis, or even a two-way analysis (if one of the independent variables was disregarded). It was, therefore, decided to employ non-parametric procedures to determine the influence of meaning and familiarity upon W anagram solution.

But before proceding to the non-parametric techniques which essentially involve within-subject analysis, a preliminary indication of the results is expressed by stimulus in Table 7 (see p. 62). The Noble $\bar{m}$ and most-frequent-primary values presented in Table 7 were determined in the preliminary study and transcribed from Table 1 (p.44). As was stated above, the W stimuli were found to be statistically invariant with respect to m. Also, the preliminary study revealed that the first primary to MOIST, namely WET, occurred significantly more often than the first primaries to the other W stimuli. Accordingly, MOIST was interpreted as a high meaning strength stimulus.

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[16] A computer was not available to the investigator at the time of selection. However, he spent over a month working with the source list. Considering the number of restrictions he imposed upon himself, he considered himself fortunate to obtain the set of stimuli he did.

TABLE 7

W Anagram Variables Expressed by Stimulus and Level of Familiarity[a]

| | Independent Variables | | | | | Dependent Variables | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Stimulus | T-L | Noble $\bar{m}$ | Most Frequent Primary | % Occur. of Most Frequent Primary | Total PR | Mean Sol. Time | Median Sol. Time | Percent Ss Solving |
| High Familiarity | ACTED | AA | 11.77 | Played | 22 | .0627 | 189.79 | 240 | 38 |
| | HANGS | AA | 11.21 | Picture | 14 | .0386 | 169.56 | 240 | 44 |
| | | | | | | Mean .0507 | 179.68 | 240 | 41 |
| Medium Familiarity | LAMBS | 45 | 11.52 | Sheep | 24 | .0369 | 106.90 | 49 | 70 |
| | CLAYS | 43 | 10.54 | Plays | 16 | .0545 | 167.95 | 240 | 43 |
| | | | | | | Mean .0457 | 137.43 | 144.5 | 57 |
| Low Familiarity | MOIST | 19 | 10.79 | Wet | 65 | .0279 | 209.63 | 240 | 25 |
| | TAPED | 8 | 10.41 | Recorded | 15 | .0394 | 103.68 | 69 | 83 |
| | | | | | | Mean .0337 | 156.66 | 154.5 | 54 |

[a] Familiarity is operationally defined in terms of Thorndike-Lorge value(T-L).

Table 7 displays performance on the four dependent measures for each stimulus and for each of three levels of familiarity (familiarity is operationally defined in terms of Thorndike-Lorge values). Performance on each dependent variable is averaged for the two stimuli at each level of familiarity. By inspection of the table, mean PR increases directly with familiarity, as was predicted. For each of the three remaining measures of solution difficulty, the greatest difficulty occurs in the high familiarity condition, as was also expected. However, solution difficulty in the low familiarity condition appears greater than or equal to that in the medium familiarity case. This finding is clearly attributable to the extreme difficulty of MOIST, one of the two low familiarity anagrams. MOIST had the longest mean solution time of all stimuli and was solved by the smallest percentage of Ss. However, MOIST also had significantly greater meaning strength than any other stimulus, an attribute expected to increase solution difficulty. Therefore, Table 7 generally provides informal support for the hypotheses. Formal statistical confirmation of these initial impressions follows.

W Anagram PR Is a Direct Function of Familiarity (f), with Familiarity Defined as the Frequency of Occurrence of the Word in the Thorndike-Lorge (1944) Frequency Count

The Friedman analysis of variance by ranks (Siegel, 1956) was chosen to test the hypothesis since it is the non-parametric analogue of the randomized blocks analysis of variance. For each of the 38 Ss, PRs were pooled for the two W stimuli at each of the three levels of familiarity, yielding three PR scores per S. The scores were ranked for each S and the sum of ranks was computed. The sums obtained for the high f, medium f, and low f conditions were 87.0, 75.5, and 65.5, respectively. A $X^2$

was computed based on the sums of ranks. $X_r^2$ was found to be 6.09. With 2 df, tabled $X^2$ at .05 level of significance (two-tailed) is 5.99. It was, therefore, concluded that significant differences in PR existed among the three levels of f.

By inspection of Figure 2, the differences among the three sums of ranks are in the predicted direction. The high f condition yielded the greatest perseveration, medium f an intermediate level of perseveration, and low f the least perseveration. It was, therefore, condluded that W anagram PR was a direct function of familiarity as predicted.

Furthermore, the data indicated that the relationship between PR and familiarity was independent of meaning strength, with the latter defined as the frequency of the most frequent primary association to the stimulus, as determined in the preliminary study. The high meaning strength stimulus, MOIST, occurred in the low f condition. If meaning strength had an independent influence on PR, then the PR of the high meaning stimulus should differ significantly from that of the low meaning stimulus, TAPED, at the same level of f.

A Wilcoxin Signed-Ranks Test was performed comparing the PRs of MOIST with those of TAPED. The obtained T was 134. With N = 23, the tabled T at the .05 level of significance (two-tailed) is 73 or less. It was concluded that meaning strength had no influence on PR and that the obtained relationship between familiarity and PR was, therefore, independent of meaning strength.

W Anagram Solution Time Is a Direct Function of Familiarity, with Familiarity Defined as the Frequency of Occurrence of the Word in the Thorndike-Lorge (1944) Frequency Count

A second Friedman analysis was performed with solution time as the

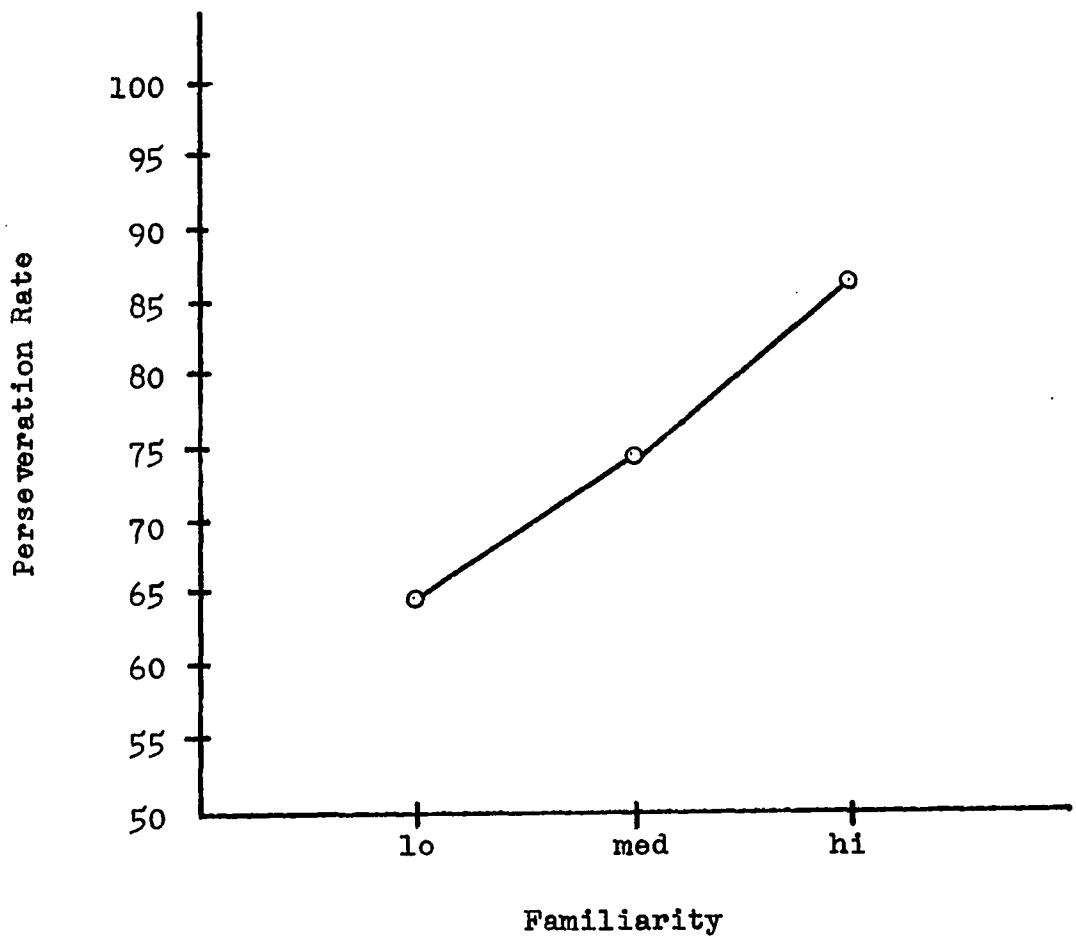


FIGURE 2

Perseveration Rate as a Function of Familiarity

dependent variable. The sums of ranks for the high f, medium f, and low f conditions were 92, 68.5, and 67.5, respectively. The obtained $X_r^2$ was 10.12. With 2 df, the tabled $X^2$ at the .01 level of significance (two-tailed) was 9.21. It was concluded that significant differences in solution time existed among the three levels of f.

By inspection of Figure 3, the differences among the three sums of ranks ($\Sigma R$) was in the predicted direction. The high f condition yielded the longest solution time, medium f an intermediate level of solution time, and low f the shortest solution time.

The data indicated that familiarity had an effect on solution time which was independent of meaning strength. High f and medium f solution times were compared, since the stimuli in these conditions were all at a low level of meaning strength. The Z obtained from the Wilcoxin Test was = 3.26, significant with p = .001 (two-tailed).

W Anagram Solution Time Is a Direct Function of the Frequency of the Most Frequent Primary Associate Elicited to the Anagram Stimulus (Cofer, 1958).

To determine the effect of meaning strength on solution time independent of the influence of familiarity, the solution times of MOIST, the only stimulus of high meaning strength, were compared with those of TAPED, these two stimuli being both of low familiarity. The Wilcoxin Test yielded a Z value of +4.51, significant with p = .000006 (two-tailed). Moreover, the absence of a significant difference between the low and medium f conditions evident in Figure 3 was apparently attributable to the independent and opposing influences of meaning strength and familiarity upon solution time. MOIST had clearly inflated the solution times of the low f condition. Not only did it have significantly greater solution

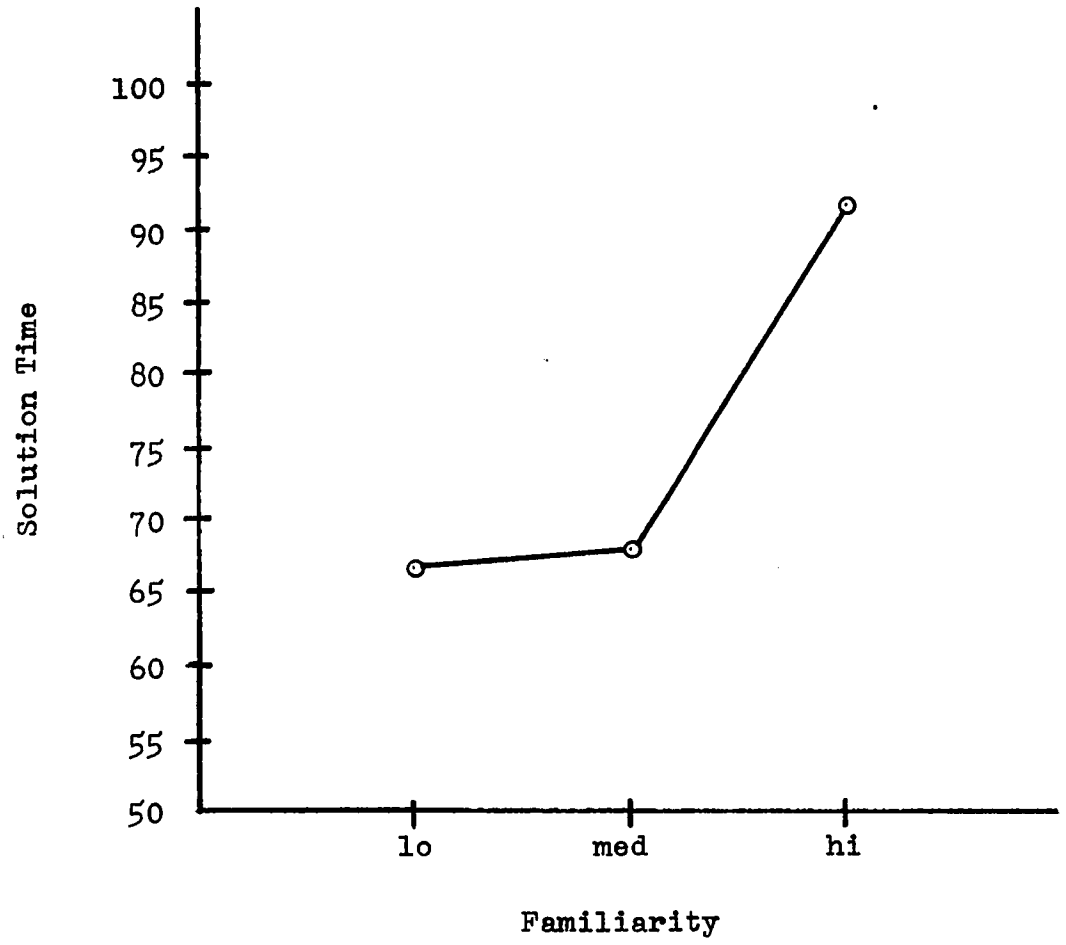


FIGURE 3

Solution Time as a Function of Familiarity

times than TAPED, but it had the longest mean solution time of all stimuli, at 209.63 seconds. Hence, it was concluded that solution time was a direct function of two independent influences, familiarity and meaning strength.

## Opposing Hypotheses of the Gestalt and Associational Positions

Of the four hypotheses which could be derived from only the Associational position, three were tested,[17] and each one was confirmed. These findings supported the Associational analysis while disconfirming that of the Gestaltists.

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[17] The fourth prediction, which concerned the influence of meaning scope on solution time, could not be tested because of the invariance of W stimuli in Noble's m obtained in the preliminary study.

## Overall Evaluation of the Anagram Study

Table 8 presents a summary of each prediction made in the anagram study and the outcome of the statistical test for each.

TABLE 8

Evaluation of the Anagram Study

| Prediction | Statistic | Result | Signif. Level[a] |
|---|---|---|---|
| W anagrams take longer to solve than NS anagrams. | Wilcoxin Signed-Ranks Test | Supported | p=.000006 |
| W anagrams have greater PRs than NS anagrams. | Wilcoxin | Supported | p=.0006 |
| PR and solution time are significantly related to each other in the solution of W anagrams. | Spearman Rank-Order Correlation (ordinal level of measurement) | Disconfirmed | |
| A significantly smaller proportion of solutions of W anagrams are obtained when S perseverates than when he does not perseverate. | Wilcoxin (nominal level of measurement) | Supported | p=.0004 |
| The proportion of solutions of NS anagrams obtained when S perseverates does not differ from that obtained when he does not perseverate. | Wilcoxin | Supported | |
| W anagram PR is a direct function of familiarity (f), with f defined as Thorndike-Lorge frequency. | Friedman analysis of variance by ranks | Supported | $p < .05$ |
| W anagram solution time is a direct function of f. | Friedman | Supported | $p < .01$ |
| W anagram solution time is a direct function of the frequency of the most frequent primary associate elicited to the anagram stimulus. | Wilcoxin | Supported | p=.000006 |

[a] All tests of significance are two-tailed.

# CHAPTER IV

## DISCUSSION OF ANAGRAM STUDY

The general purpose of this research project was the investigation of factors responsible for the relative difficulty of W anagram problems. Of course, it was first necessary to demonstrate that W anagrams were indeed more difficult to solve than NS anagrams. This was shown. The finding agreed with those of other contemporary anagram researchers, using different stimuli, the only notable exception being Mayzner and Tresselt (1965). But Beilin (1966) demonstrated that Mayzner and Tresselt's results were obfuscated by an error in their scoring technique. When Beilin corrected their error he obtained positive findings using the same stimuli. It was, therefore, concluded that W anagrams were more difficult to solve than NS anagrams.

The earliest and most intuitively tenable explanation for the relative difficulty of the W anagram was the supposition that the S tends to perceive the familiar word as an integrated whole instead of performing the more task-appropriate activity of manipulating its component letters. On the other hand, the unfamiliar NS stimulus is presumed to be perceived by S in terms of its individual letters, an activity more conducive to letter manipulation. Two of the studies reviewed above offered informal, qualitative findings supporting this hypothesis (Nissenson and Sargent, 1941; Beilin and Horn, 1962). The PR measure developed in the present research represented a more serious attempt in this direction. PR is a quantitative index conceived to

reflect the extent of S's covert attention to the anagram stimulus as a whole. In Giger's (1966) language, it is a measure of the "attentional priority" of the stimulus. Confirmation of the prediction that Ss perseverate more on W than on NS anagrams not only supported the hypothesized explanation for the relative difficulty of W anagrams but also provided validation for the PR measure, since it behaved in accordance with theoretical expectations. Thus, Ss apparently cannot avoid responding to the W anagram as an integrated unit, though they are certainly aware that such behavior impedes anagram solution.

Other factors might have contributed to the highly significant difference obtained between W and NS anagram solution times. The solution times of the W anagrams may have been inflated by S's attention to the meanings of these words at some level of awareness (tentative evidence for the influence of meaning strength on W anagram solution is discussed below). In addition, associations to the NS anagram stimuli may have facilitated solution in some cases. In the preliminary study these associates were generally found to be formally related to both their anagram stimuli and their corresponding solution words; the associations given to the W stimuli were found formally related to neither. Up to this point, emphasis has been placed upon the inhibitory influence of the associates to W stimuli. But evidence exists which indicates that it might be more useful in the future to consider the facilitory effects of associates to NS stimuli which are closely related to the solution word. The most dramatic example of this occurred in the case of the NS anagram YUINT. In the preliminary study, a number of Ss gave UNIT or UNITE as the first associations to this stimulus. These responses are formally almost identical to the anagram's solution, UNITY, and are also closely related semantically to this solution word. No other anagram

stimulus yielded such a strong relationship between its primary and the solution. The results of the anagram study revealed that YUINT was the easiest to solve of all 12 anagrams!

It was found that Ss tended to perseverate more upon W than NS anagrams. Yet, why should NS perseveration have occurred at all if perception of the NS stimulus involved attention to its individual letters? Perhaps repetition of the NS stimulus indicated a process other than an underlying preoccupation with this stimulus as an integrated unit. For instance, it might have represented a strategy of returning to the beginning of the problem after exhausting a particular line of approach. In any event, a two-process view of PR was testable because W perseveration was presumed to involve an activity which was necessarily dysfunctional for anagram solution while NS perseveration was not. Specifically, it was predicted that PR and solution time should be directly and significantly related in the case of W anagrams but not in the case of NS anagrams.

The first part of the prediction was not confirmed. Initially, this finding appeared not only to refute the two-process concept of PR but also to cast doubt on the validity of the PR measure. Repetition of the W stimulus was supposed to reflect an underlying preoccupation with it which would impede its solution. Yet, a greater rate of repetition was not found to be associated with longer solution times. Closer examination of the peculiar relationship between PR and solution time led to a reconsideration of these negative conclusions.

A correlation coefficient does not indicate causality. According to the theory, however, the predicted relationship between PR and solution time should be attributable to the operation of the former

upon the latter. But a counter tendency may also have existed which may have obscured the relationship between the two variables. During the course of the experiment, the investigator noticed that perseverative responses tended to be unevenly distributed over solution periods, appearing to occur less frequently with the passage of time (although some Ss increased perseveration toward the very end of unsolved problems). On the other hand, the output of all types of verbalizations appeared to be relatively constant. If this was, in fact, the case, PR should have been a negative function of solution time because the denominator of this index (consisting of the frequency of all types of verbalizations) would have increased at a disproportionately greater rate than its numerator (perseverative responses only). In other words, longer solution times would have yielded smaller PRs. Since no relationship between the two variables was obtained, it could be inferred that perseveration did tend to increase solution time. In short, this hypothesis suggests that the effect of PR on solution time was masked by a diametrically opposing influence, with the absence of a significant correlation being the net result.

To determine the relationship between perseveration and anagram solution, masking effects which could result from the independent influence of time on PR were eliminated by adopting a simpler level of measurement. PR and solution time were transformed into dichotomous variables, each with two categories. Performance on a given anagram was classified as perseverated or not perseverated, and solved or not solved. It was predicted that the occurrence of W perseveration would be associated with a smaller proportion of obtained solutions than its non-occurrence while this relationship would not hold for NS perseveration. Positive

findings were obtained which constituted support for both the two-process concept of perseveration and the explanation which was provided for the absence of a correlation between W PR and solution time.[18] Since the latter was interpreted as an artifact of the solution time-PR relationship rather than a general lack of validity of the PR measure itself, PR was retained in subsequent analyses not directly involving solution time.

PR was found to be a direct and significant function of W anagram familiarity, with familiarity defined in terms of Thorndike-Lorge frequency. This result substantiated the hypothesis that Ss become more preoccupied with stimuli which they have encountered more frequently in the past, since these presumably become better integrated than less frequently experienced stimuli. It was also demonstrated that familiarity had a direct effect upon solution time. Taken together, these results confirmed the causal connection predicted between familiarity and perseveration on the one hand, and perseveration and anagram difficulty on the other. One might argue that the influence of familiarity on solution time was independent of its effect on PR. But it has already been shown that perseveration impeded anagram solution.

The influence of meaning strength upon W anagram solution also suggested a perseveration effect, but one based upon semantic reference rather than familiarity. For the Associationist, the strength of a primary association would be assumed to be a direct function of the number of previous occurrences of this response to the stimulus word just as familiarity was believed to be dependent upon the frequency of

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[18] A formal analysis of the influence of time upon PR would be required for a more adequate and direct test of this explanation.

occurrence of the stimulus itself. Since a frequently encountered stimulus was presumed to have relatively great "attentional priority" (Giger's term) during anagram solution, the same should be true of a particular meaning relation which has been experienced often in the past.

While it had been possible to develop a direct measure of familiarity-related activity which had previously been covert (i.e., PR), such could not be achieved in the case of implicit behavior related to meaning. One of the chief problems in designing the perseveration measure was getting Ss not to suppress repetitions of the given letter sequence. This tendency was clearly evident and was undoubtedly attributable to S's realization that perseveration was purely dysfunctional. But at least such responses included elements contained in the solution word, since the anagram and the solution word were composed of the same letters. However, attending to the semantic referents of the W anagram constituted an even more dysfunctional activity, for these referents were not formally related to the anagram and, hence, could not be related to its solution word (this has been explicitly demonstrated in the preliminary study). Furthermore, while the W stimulus is printed on the index card set before the S, its meaning is only implicit. Consequently, it was not possible to get Ss to verbalize the meanings they thought of while trying to solve W anagrams without instructing them to do so directly, a procedure which would further disrupt the natural process of anagram solution. While a few Ss reported that they had attended to meanings during attempted solution, no S spontaneously verbalized a semantic referent of a W anagram at the time it occurred. Indeed, if attention to meaning occurred at all, it may have done so at a lower level of awareness than attention to the stimulus itself.

Hence, meaning perseveration had to be inferred rather than explicitly demonstrated. Such an inference was drawn when it was found that the only W anagram stimulus of high meaning strength (MOIST) not only had significantly longer solution times than its low familiarity control (TAPED) but the longest mean solution time of all W stimuli employed. The finding could not be attributed to stimulus perseveration since MOIST did not differ significantly from TAPED with respect to PR. The disproportionately long solution times of MOIST were, therefore, explained in terms of its relatively great meaning strength. Specifically, it was hypothesized that Ss tended to perseverate upon the potent primary associate of MOIST, namely WET, an activity which was dysfunctional for anagram solution.

Of the four Associational predictions derived in the introduction, three were testable and each of them was supported. These findings constituted refutation of the Gestalt position. For the present investigation, the critical aspect of Gestalt thought was its emphasis on an active rather than passive learning process and, hence, its minimization of the importance of the frequency variable in acquisition. Learning was conceived by the Gestaltists to be accomplished by the subject, occurring only when he perceived new materials in relation to some organized whole; it was not viewed as a gradual, automatic function of the number of presentations of the materials. The findings reported above were more favorable to the Associational outlook. Ss perseverated more upon the more familiar W stimuli and took longer to solve them presumably because they had encountered them more frequently in the past and the letters of these W stimuli had, therefore become more thoroughly integrated. Ss took longer to solve the high meaning strength W stimulus (even though it

was of low familiarity) ostensibly because they had become preoccupied (at some level of awareness) with its primary associate. It was assumed that Ss had had more frequent prior experience with this primary than with those of other W stimuli and that it had, therefore, become a better learned response. Hence, a mechanistic conception of learning appeared to be more applicable to the acquisition of meaning and familiarity than the dynamic approach advocated by Gestaltists.

However, the high meaning strength condition consisted of but one stimulus. Consequently, conclusions regarding the effect of this variable on anagram solving must be interpreted as suggestive and tentative rather than decisive. In fact, it is generally true that the results of the meaning and familiarity analyses would have constituted better support for Associational theory had a greater number of W stimuli been employed in each condition. This would have provided stronger assurance that obtained effects were due to the factors designated and not to the idiosyncratic properties of individual stimuli. But the comprehensiveness of the research objectives imposed severe limitations on the selection of stimuli. Control was sought with respect to a number of anagram variables not only among the W anagrams but between W and NS problems. This procedure drastically restricted the number of anagrams available in the original pool. But even if more anagrams could have been found which met the multiple requirements of the design, practical considerations would have prevented their use. Ss needed to be trained to verbalize their thinking and were then required to solve a difficult set of anagrams. The introduction of additional anagrams would have lengthened an already long procedure beyond the running time allotted to this investigator.

Support for the Gestalt position depended upon the attainment of negative findings when Associational variables were manipulated. If such had been obtained, the apparent weakness in the experimental design would have made interpretation difficult. However, all testable deductions from Associational theory were confirmed. These results were considered to have been achieved <u>despite</u> limitations in the design rather than because of them. It appeared unlikely that statistical significances could have been obtained which consistently supported a particular theoretical position but which were actually attributable to the operation of some unknown underlying factor.

In any case, subsequent research will feature stronger experimental design because it will be more limited in scope. The chief source of weakness in the present study was the need to control for a number of anagram solution time variables. But once the relationship between perseveration and solution time has been established, the investigator will be able to examine the influence of stimulus structure on perseverative behavior without regard to solution time. This will make available a great number of anagrams which had been excluded from the present research because they failed to meet control criteria. The influence of meaning and familiarity on perseveration can then be studied more systematically, perhaps employing a factorial design with appropriate transformations for the PR measure. Practical restrictions upon the number of anagrams presented to a given S can be dealt with by utilizing one of the incomplete block designs discussed by Winer (1962, Chap.9) or by employing a randomized groups design wherein an S is assigned to only one of the treatment combinations of the experiment and would, therefore, attempt only a fraction of the total number of anagrams employed.

Future research would also aim to extend the measurement of familiarity structure and, accordingly, to elaborate the PR measure. Familiarity would be defined not only by the frequency of occurrence of the complete stimulus but also by the frequencies of verbal units within the whole. Previous researchers have treated Thorndike-Lorge values and digram frequencies as distinct attributes of a stimulus. However, it might be more useful to view them both as aspects of the familiarity structure. Generally, total familiarity might be defined as some combination of unigram frequency totals, digram frequency totals... n-gram frequency (the last value would be formally equivalent to the Thorndike-Lorge frequency of the complete stimulus).

A corresponding generalization of the PR measure would be required. Instead of just phonetically transcribing Ss' initial pronunciation of the complete stimulus, all verbalizations would be transcribed. Then, frequencies of repetition would be determined for all verbal units contained in the original pronunciation. The prediction that perseveration upon the stimulus whole should be a direct function of its Thorndike-Lorge frequency would be viewed as a special case of the proposition that the level of attentional priority of any verbal unit should be dependent upon the normative frequency value of that unit. In short, the frequency of repetition of a verbal unit obtained during anagram solution would be expected to be directly proportional to its normative frequency, regardless of the length of the unit.

The normative frequencies of verbal units within stimuli were only partially controlled in the anagram study. The digram frequency total for the six W stimuli was nearly identical to that for the six NS anagrams. However, digram frequency totals could not be controlled for the analyses

performed within the W stimuli and no control was possible over unigram, trigram, or tetragram frequencies. What influence might these subsequence familiarity factors have had on the findings of the anagram study reported above?

Perseveration upon the anagram as a whole was found to be an activity which increased the difficulty of the W problem. But attention to familiar letter sequences within the word may well have made an independent contribution to W anagram difficulty which was not measured in the anagram study. The possibility of the subsequent perseveration effect posed a more serious threat to the interpretation offered for the results of the meaning strength analysis. It was found that the high strength stimulus took significantly longer to solve than the low strength stimulus. It was suggested that the solution time of the high strength stimulus had been inflated by Ss' dysfunctional attention to its relatively potent primary associate. But the two stimuli had only been controlled for Thorndike-Lorge frequency. If normative frequency totals for verbal units within the high strength stimulus had been found to have been significantly greater than those within the low strength stimulus, the validity of the meaning potency interpretation would have come into question. The longer solution times of the high strength stimulus might then have been attributable to dysfunctional attention to its relatively familiar letter sequences. The unigram, digram, trigram, and tetragram frequency totals of the two stimuli were compared (Mayzner and Tresselt's normative tables were employed, 1965). In no case did the frequency totals of the high strength stimulus significantly exceed those of the low strength stimulus. In fact, the low strength stimulus had greater frequency totals for all but the digram comparison and here the difference was small enough to consider the two stimuli controlled (Mayzner

and Tresselt had done so for a greater digram frequency total difference, 1966, p. 99). Hence, the meaning strength interpretation was retained.

The present investigator accounted for most of the major variables which have been employed in the study of W and NS anagram solution. Yet, neither this study nor any of the others considered above have begun to exhaust the pool of potentially influencial factors. For instance, the use of normative frequency totals obscured differences in the pattern of frequencies which comprised these totals; such patterns might have been important for anagram solution. Mayzner and Tresselt (1966) found that the frequencies of the digrams in the first two positions of a stimulus (reading from left to right) were better predictors of anagram solution time than subsequent digram frequencies. Consequently, two anagram stimuli could have had the same frequency totals but one might have taken longer to solve because a greater proportion of its total might have been concentrated in the first two digrams.

Other potentially relevant variables include the following: the degree of discrepancy between normative frequency totals in the anagram and those in the solution word (Duncan and Dominowski reported some positive evidence in this respect, 1964); the number of syllables in the anagram and in the solution word, and the discrepancy between these; the pronunciability of the NS anagram; the potential number of smaller words which can be generated from the anagram stimulus before the correct solution word is obtained; discrepancies between the phonetic values of the stimulus and those of the solution word, etc. It became evident in designing the present study that the finite number of anagrams available in the English language was hopelessly insufficient for a thoroughly controlled investigation in view of the number of potential sources of

variation.

The perseveration measure employed in this research represented a first attempt to deal with this problem and was, therefore, perhaps the principal contribution of the dissertation. Instead of strictly inferring Ss' covert verbal behavior from characteristics of the anagram stimulus, the investigator tried to make the behavior explicit so that he could determine just what did occur during solution. This was one reason for the familiarity analysis receiving stronger support than the meaning analysis. The predicted effects of familiarity on problem solving behavior and its consequences for anagram difficulty were confirmed by direct observation of the intermediary behavior while the specific influence of meaning strength could only be indirectly deduced and had, therefore, to compete with other hypothesized influences. The proposed extension of the phonetic transcription technique to include all verbalizations emitted during anagram solution would permit the investigator to perform direct tests of the operation of many of the various influences discussed above. For example, one hypothesis might be that anagrams whose solution words differed from them in number of syllables should take longer to solve than those whose solution words contained the same number of syllables. Presumably, Ss would tend to emit responses with the same number of syllables as the stimulus. The occurrence of such behavior would be directly determinable from the phonetic transcriptions which could be obtained.

However, much more work needs to be done to refine the method. The experimental situation and, especially, the use of a tape recorder apparently inhibited some Ss from verbalizing their thinking candidly. In such cases, long periods of silence occurred during attempted solutions despite the fact that these Ss had been previously given problems designed

both to train them to respond and to build their confidence in their ability to succeed at the task. In future research, Ss might be given more training and/or more time to habituate themselves to the apparatus; also, the tape recorder might be made less obtrusive or perhaps even concealed.

Another problem was indicated by the comments of some Ss that their thinking had occurred much more rapidly than they could speak. Consequently, while they were verbalizing one response, they found themselves thinking of several others. But even though all covert behavior was not verbalized, most Ss reported that the responses which were verbalized corresponded quite closely with actual thinking processes. In any case, future research would seek a means of making observable a greater proportion of Ss' covert activity.

A potentially greater source of difficulty lay in a possible tendency for Ss to selectively inhibit some of their verbalizations in favor of others which they believed would impress the experimenter rather than reflect their actual thinking. Some Ss reported that they felt foolish when they spoke nonsense. This might have resulted in a lowered rate of verbalization and/or a tendency to emit letter or word responses rather than meaningless sounds. One S employed in a pilot study responded almost exclusively in terms of words. This might illustrate the operation of another selection factor. A word response (e.g., MOST to MOIST) might be considered a "partial solution" to the problem in that the letters of the initial stimulus have been rearranged to form a meaningful sequence, although all of the letters have not been used, as the task requires. The S who emitted a high proportion of such responses might, in effect, have been attempting to impress the experimenter with her problem solving ability in view of the fact that she had not yet been

able to solve the problem at hand. Yet covertly, this S might well have been thinking also in terms of sound and letter combinations.

The validity problems which would arise from the occurrence of selective inhibition would certainly warrant a renewed effort to eliminate such behavior in any future use of the method of phonetic transcription. But, if it occurred, selective inhibition apparently did not invalidate the employment of the method in the present research. What type of response could have been more susceptible to suppression than a repetition of the initial pronunciation of the W stimulus? There was ample evidence that Ss recognized the intrusive and dysfunctional nature of such behavior. In their responses to the questionnaire, many Ss indicated that they had found W problems more difficult because they had become preoccupied with the word as an integrated whole, despite the task requirement that letter manipulation occur. A few Ss spontaneously reported their difficulty in breaking down the letter sequence of the W anagram during attempted solution. Comments appeared such as, "There's always MOIST again," and "It's back to ACTED." One S uttered perseverative responses in an exclamatory manner, laughing aloud as he did so in an apparent expression of exasperation. Indeed, selective inhibition was indicated in several cases in which Ss stated in the questionnaire that they had been preoccupied with the complete W stimulus but these Ss had not emitted any perseverative responses during attempted solution. Yet, overt perseverative behavior <u>did</u> occur during problem solving and to a great enough extent to enable confirmation of all hypotheses regarding this dependent measure. Thus, the problem of selective inhibition did not interfere with research objectives, at least in the present study.

The difficulty inherent in a direct measurement of Ss' attention to meaning relations during W anagram solution was discussed above

(see pp. 75-76). Although Ss might selectively inhibit perseveration they might not even be fully aware that they are emitting semantic responses to W anagram stimuli. An experiment performed by Underwood (1965) suggested one possible approach to this problem. Underwood devised a procedure to test for the occurrence of implicit associative responses. Ss were presented with a long list of words and required to indicate whether each word occurring at some later point on the list had or had not occurred earlier. The experimental stimuli consisted of words which were known associates of words which had been presented earlier on the list, but these associates had not themselves appeared earlier. For example, the word "DOWN" might be presented at one point in the list. Then, a known associate to "DOWN," the word "UP," would be presented at a later point. (The word "UP" itself would not have been presented before this). If Ss guessed that the word "UP" had occurred earlier, Underwood would infer that it had occurred <u>implicitly</u> as an associate to the word "DOWN," since it had not been explicitly presented. Underwood found that Ss gave a significantly greater number of false positive responses to experimental words (i.e., known associates of previously presented words) than to control words. The result was interpreted as confirmation of the hypothesis that Ss make implicit associative responses to the critical stimuli.

Underwood's experimental approach might be adapted to determine if Ss attend to the meanings of W anagrams during attempted solution. Ss would be presented with a list of words before beginning work on the W anagrams. After the anagram period, they would again be given a word list and would be required to guess whether or not they had encountered these words earlier. Now the critical word stimuli would be the strongest primary associates of the W anagrams, as determined in the preliminary

study. For example, since the greatest proportion of the Ss in the preliminary study gave WET as their first association to MOIST, WET would be included as a critical stimulus. Furthermore, instead of simply employing two classes of stimuli on the second list, associates and non-associates, differences in strength of associates would be taken into account. If the six W anagrams of the present study were utilized, it would be predicted that a significantly greater number of false positives would be given to WET than to the five other first primaries because WET was found to be the only high strength associate in the preliminary study (the other five associates comprised a low strength condition). Hence, not only would such a procedure enable the investigator to determine whether Ss attended to meanings during W anagram solution, but it would also permit him to test predictions regarding the inferred levels of such attention.

In conclusion, the general significance of this dissertation may lie in its implications for a unified theory of verbal behavior. Meaning and familiarity are variables which have been studied extensively by investigators of verbal learning. Yet, they had been virtually neglected in research of anagram problem solving prior to the present work. The theoretical analyses and empirical findings elaborated here may be examined in concert with previous research in verbal learning. Consistencies would lead to consolidation while discrepancies should stimulate new research conducted from a broader perspective. The ultimate goal would be to encompass the study of verbal learning and verbal problem solving within a single conceptual framework.

# CHAPTER V

## SUMMARY AND CONCLUSIONS

The recurrent finding that W anagrams are more difficult to solve than NS anagrams was replicated in the present study. This phenomenon was attributed to S's tendency to respond to the individual letters of the NS stimulus, but to attend to the W stimulus as an integrated unit. The latter behavior was thought to inhibit anagram solution which involves the manipulation of individual letters. Evidence for this explanation was provided by using a new technique for directly analyzing verbal behavior during anagram solution. The technique permitted the measurement of Perseveration Rate (PR), the number of times S repeats his initial pronunciation of the stimulus divided by the total number of verbal responses emitted in the course of anagram solution. A repetition of either the W or NS stimulus was initially presumed to indicate that S was perceiving the stimulus as an integrated unit. A significantly greater PR was found for W anagrams than for NS anagrams and it was, therefore, concluded that Ss tended to perceive the W stimulus as unit more frequently than the NS stimulus.

Subsequently, evidence was obtained which indicated that Ss never perceived the NS stimulus as an integrated unit, even when they repeated it. If repetition of the NS stimulus signified an underlying preoccupation with the stimulus as a whole, then the rate of repetition should have been related to anagram solution difficulty. However, such a

relationship was only obtained for W anagrams. Hence, the data seemed to suggest a two-process explanation of perseveration. While W perseveration was believed to involve perception of the stimulus as a whole, it was concluded that NS perseveration signified some other underlying process, though what that process might be remained a matter for speculation.

It was further found that perseveration upon the W anagrams was a direct and apparently linear function of the familiarity of the words (familiarity was defined in terms of Thorndike-Lorge frequency values). There was no evidence for the influence of meaning strength on PR (meaning strength was defined in terms of the frequency of the most frequent association to the W stimulus). On the other hand, W anagram solution time was found to be a direct function of both familiarity and meaning strength, though it was recognized that the evidence for the former was more convincing than that for the latter.

Finally, the data supported the Associational position, disconfirming the classical Gestalt view. Hypotheses derived from Associational theory were confirmed which were in direct opposition to Gestalt deductions. A contemporary position (that of Mandler, 1962) purporting to bridge the classical Gestalt and Associational approaches was found to be primarily based upon Associational assumptions.

## Appendix A:

## Stimulus Materials

W and NS anagrams are equated for stimulus and solution word digram frequency totals, solution word Thorndike-Lorge values, and stimulus to solution letter order (LO). Also the DF totals and T-L values of all solution words vary within relatively restricted ranges. Note that the letters "L," "M," and "N" in column LO refer to the three most difficult letter-displacement categories in Table IV of Mayzner and Tresselt (1966).

| NS STIMULUS | DF | LO | SOL.W | DF | T-L |
|---|---|---|---|---|---|
| CATEF | 1839 | L | FACET | 1054 | 1 |
| COLAV | 1081 | L | VOCAL | 1126 | 8 |
| YUINT | 1554 | M | UNITY | 1092 | 12 |
| MUTRO | 1268 | M | TUMOR | 1320 | 1 |
| ANORY | 2882 | N | RAYON | 1545 | 1 |
| WORPL | 1254 | M | PROWL | 1024 | 7 |
| Sum = | 9878 | | | 7161 | 30 |
| Mean = | 1646.33 | | | 1193.5 | 5.0 |

| W STIMULUS | DF | LO | T-L | SOL.W | DF | T-L |
|---|---|---|---|---|---|---|
| LAMBS | 574 | L | 45 | BALMS | 883 | 7 |
| ACTED | 1812 | M | AA | CADET | 1441 | 2 |
| TAPED | 1406 | N | 8 | ADEPT | 887 | 1 |
| HANGS | 3553 | N | AA | GNASH | 1142 | 3 |
| CLAYS | 840 | M | 43 | SCALY | 1355 | 4 |
| MOIST | 1615 | M | 19 | OMITS | 1349 | 14 |
| Sum = | 9800 | | | 7057 | | 31 |
| Mean = | 1633.33 | | | 1176.17 | | 5.17 |

## Appendix B:

## Measurement of Meaningfulness (m):

## Instructions to Ss

This is a test to see how many words you can think of and write down in a given period of time.

A series of answer pages follow these instructions. At the top of each page there will be a key stimulus. The stimulus may be a word or it may be nonsense. (For example, one word stimulus might be "DRESS" and a nonsense stimulus might be "BOLIG.") This key stimulus will be repeated a number of times on the page. You are to write down as many different words as you can which the stimulus brings to mind. Write each word you think of on the line next to each repetition of the key stimulus. These words which you write down may be things, places, ideas, events, or whatever you happen to think of when you see the key stimulus.

Each page will be divided into three columns of repetitions of the key stimulus. Begin working down the left hand column. Don't skip spaces.

No one is expected to fill in all the lines on a page, but write as many words as you can which the stimulus calls to mind. Be sure to think of the key stimulus before you write down each word because the test is to see how many different words the key stimulus makes you think of.

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