SEMANTIC SATIATION AND PAIRED-ASSOCIATE LEARNING

by

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CHAPTER I

INTRODUCTION

The normal human perceives his environment as a stable and meaningful world of objects, persons, and events, whereas for a new-born child, the same environment probably appears as an aggregate of meaningless shapes and movements. These differences in perceptions are attributable to differences in experiences and contacts with the environment. Through repeated contacts, the individual gradually learns to perceive stimuli in predictable relations and is able to improve his future reactions to the same or similar stimuli. In other words, perceiving meaningful elements in one's environment is a matter of learning. To explain the meaningful perception of the stimuli, psychologists have emphasized the importance of repeated experience, arguing that experience or contact with stimulus situations increases their meaningfulness, thereby facilitating subsequent learning. To support their contention, they point to much experimental evidence indicating that the effect of repeated experience with the environment (in the form of familiarization or predifferentiation training) leads to increased distinctiveness and meaningfulness of stimuli which, when transferred to the subsequent learning situations, facilitates learning.

The present research started with a skeptical attitude toward such contentions, based on everyday experience. For instance, when one hears the same music over and over again, the music gradually loses its charm and significance. Too frequently repeated words lose their effectiveness in communication. Wise artists protect themselves from over-exposure to audiences. Such phenomena raise the question whether repeated experience or practice with stimulus situations always increases meaningfulness or always facilitates subsequent learning. It is conceivable that beyond a certain limit extended practice may reduce meaning and have inhibitory effects on learning.

This possibility opens up a completely new area of research, the examination of the inhibitory role of practice in the perception of stimuli and in the realm of human learning. There are various forms of learning situations in which the inhibitory effects of practice could be studied. The present research deals only with the inhibitory effect of practice on the meaning of the verbal stimulus material and the transfer of such effect to a verbal learning situation requiring rote learning. The rote learning process is concerned with the formation and strengthening of associational connections between a stimulus situation and a behavioral response. The importance of such a process in the life of the human organism is evident from very early in life. For instance, the acquisition of language relies heavily on rote verbal learning. Recognizing the significance of the inhibitory effects of practice in human life, it becomes obvious that studies dealing with such effects on verbal learning will have immense practical implications.

The nature of the formation and maintenance of stimulus-response bonds can be studied best in a laboratory setting making use of paired-associate tasks. Using paired-associate verbal tasks, several studies in the past have consistently shown that the more meaningful the verbal materials, the better is their acquisition. If meaning is an important variable affecting verbal paired-associate learning, then it is obvious that any antecedent condition that results in changes of the meaning of verbal units is bound to be of importance for paired-associate type learning. One such antecedent condition is the repeated experiencing of the verbal stimulus material to the point where it loses meaning. This loss of meaning following repeated presentation of verbal stimuli has recently been investigated (Lambert and Jakobovits, 1960; Wertheimer, 1960), and has been named "verbal" or "semantic" satiation. Since the phenomenon of semantic satiation refers to an inhibitory effect of repeated experience or practice on the meaning of verbal stimuli, it is not unreasonable to presume that the phenomenon may have further implications for paired-associate verbal learning. Thus, the present study, by making semantic satiation a central variable in the systematic experimental and theoretical analysis of the rote learning process, also attempts to explore how meaning affects verbal learning. In trying to do so, it offers a tentative theoretical framework that integrates and resolves certain inconsistencies in experiments on verbal learning, especially those where learning is affected by meaning. As a secondary purpose, this research attempts to throw some light on the nature of the phenomenon of semantic satiation itself.

The Phenomenon of Semantic Satiation

The phenomenon of satiation has been described by Smith and Raygor (1956) as "the reduction in the effectiveness of a stimulus with continued exposure." Thus semantic satiation implies a loss of meaning or a reduction in the effectiveness of any verbal material following its continued perception. In the case of verbal stimuli two different methods have been used to produce the semantic satiation effect. One is the overt continued verbal repetition of the stimulus, and the other is the prolonged visual exposure of the stimulus. Both these methods of presentation will be referred to below as the "satiation treatment" and the effects of such treatments on a subject's efficiency of dealing with verbal material will be referred to as the "satiation effect." The satiation effect has also been measured in several different fashions, as will be made clear.

A review of the literature dealing with verbal satiation shows that an active interest in the matter developed in Titchener's laboratory during the first decade of this century. The interest did not continue for long, however, very likely for two reasons. First, the phenomena of lapse of meaning were linked with subjectivism since there was no reliable objective measure to record the effect. Second, there was little interest among psychologists of that era in developing any theory of meaning, because of their preoccupation with sense perception on the one hand and the immanent nature of "meaning" itself on the other. Had there been an interest in developing theories of meaning, it would have eventually led to research on the phenomena of semantic satiation, as has been the case during recent years.

Early Interest in the Phenomenon. In 1907, Severance and Washburn exposed words, one at a time, to trained subjects. Subjects were instructed to continuously fixate them and to describe any changes in the meaning of the stimulus word during the period of concentration. The experimenters concluded from their study that the meaning and the normal auditory-motor image or the sound image of the word disappeared from consciousness within a few seconds after the fixation began. They also pointed out that the meaning of the word vanished when its proper sound image disappeared, and that the disappearance was due to a shifting of attention from one part of the visually perceived word to another. For instance, for their subjects, the word "castle" became "cast-le", the word "toward" became "to-ward," and so on. They also noticed that with prolonged visual fixation a word may look familiar and yet may cease to have any meaning. The authors, following Titchener, interpreted the findings in terms of the "core-context" theory of meaning. For them the meaning of a word was determined by the associated ideas (context) that word evokes when presented to the subject. Thus they differentiated "meaning" from "familiarity," and they argued that their experiments clearly demonstrated the fact that familiarity does not necessarily involve associated ideas. In other words, prolonged visual fixation of a word leads to loss of meaning or "associative power" in a word without apparent loss of familiarity.

Bassett and Warne (1919) used a continued verbal repetition procedure and found that with repetition the word lost both its meaning and familiarity. The word after continued repetition appeared devoid of any sense and appeared foreign to their subjects. When the meaning of a word dropped away, subjects reported their experience to be very similar to that of encountering a nonsense syllable or a combination of sounds which was neither familiar nor unfamiliar. Occasionally the subjects reported "a feeling of blankness" probably due to the persistence of the sheer sound of the word. The meaning of the word was thus forced into the background and the word lost its distinctiveness.

The conclusions of both the above studies were based on introspective data. Whether the visual modality was used, as in the first study, or the auditory, as in the second, the introspective data revealed that continued exposure of a word might lead to loss of meaning or associative contents and sometimes even familiarity.

An experiment similar to that of Severance and Washburn (1907) was performed later by Don and Weld in 1924, again in Titchener's laboratory. Using the visual fixation method with common, familiar, monosyllable nouns, they found that the lapse of meaning took place almost immediately after fixation. Staring at a word led to its disintegration and made it nothing more than a series of letters. Subjects often had experiences of a mere "blankness," of encountering nonsensical, or strange, or comical stimuli. Comparing their results with those of Bassett and Warne (1919) the experimenters concluded that the meaning of a word lapsed as quickly with continuous visual fixation as with verbal repetition.

On the basis of some unpublished research, Gibson (1950, p.204) argued that after long fixation the visual appearance of a familiar word became prominent, the meaning became separated off somewhere, and the word disintegrated, looked unfamiliar, and sometimes became "geometrized." Similarly, with the continued repetition of a word, its sound became prominent and its pronunciation tended to disintegrate, thereby making the sound of the word meaningless. Gibson preferred to consider this phenomenon as a "recession of meaning" from the word rather than a "loss or lapse of meaning."

Mason's study (1941) seems to be the first attempt to obtain an objective index of certain changes in the meaning of verbal material. She studied the relation between changes in a subject's GSR (galvanic skin response) and three types of changes in verbal material, one of them being "loss of meaning." She had her subjects continuously repeat a familiar word, instructing them to give a signal when the word no longer made sense. However, due to certain methodological difficulties in her experiment, there was no way of indicating the degree to which the GSR changes corresponded to the loss of meaning. The only relationship observed was that "time intervals in which signals of loss of meaning occur are accompanied by a greater average extent of galvanometric change than intervals without signals" (p.398). In view of the fact that GSR changes can occur following any type of behavioral response, it is more likely that in her experiment the GSR changes occurred as an accompaniment of the response of "signalling" itself which is only an indicator of "realization of loss of meaning." The realization of loss of meaning probably occurred only after the loss.

Recent Interest in the Phenomenon. During the past decade one notes a revival of interest in the psychological implications of the phenomena of verbal satiation. This revived interest has been due in part to current theoretical attention given to the general matter of satiation (Kohler and Wallach, 1944; Eysenck, 1953, 1955; and Duncan, 1956) and to verbal meaning (Noble, 1952; and Osgood, 1952, 1953). In this section, therefore, several studies dealing with psychological implications of the phenomena will be briefly reviewed.

In 1954, Gaynor studied the role of verbal satiation in recall.

She argued that "If an auditorily given word arouses meaning in our experience it must be due to recall by association. The association in question connects the memory of the auditory events with the memory of the meaning. If this is correct, then it might also be possible to show the effect of repetition of a word by demonstrating the S's inability to recall an arbitrarily chosen associative content rather than a meaning content" (p.8). She instructed her subjects to learn a paired-associate list consisting of five pairs of nonsense syllables. During the learning phase of her experiment, each stimulus item in the paired-associate list acquires a response in the same sense as a familiar word acquires its meaning through repeated association of the word with its referent. Immediately after this learning phase, subjects were asked to repeat a stimulus item (the critical word) over and over again 100 times. After the repetition, subjects were tested for recall of the response members of each stimulus item. The results revealed that subjects took more time to recall the response to the critical word than to recall responses to the other stimuli serving as control words. Some of the subjects later reported that repetition of the critical word caused confusion during the test period and hence the delay in recalling its response. The experimenter also found similar results using younger subjects of 12 to 14 years of age.

Smith and Raygor (1956) attempted to relate the satiation process to certain aspects of personality. They demonstrated that (a) prolonged visual fixation of a stimulus word results in uncommon word-association responses; and (b) individuals categorized as "permeable" (sensitive, flexible, imaginative, extravert) tend to show less of effects of satiation than those categorized as "impermeable" (less sensitive to stimuli, rigid, withdrawn, introvert).

Recently, systematic experimental work on the phenomenon of lapse of meaning has been carried out by Wertheimer and his co-workers. Their usual procedure in studying the phenomenon has been to project a word onto a screen in front of the subject for a period of 60 sec. The subject is instructed to look fixedly at the word and indicate the time of meaning lapse. The main questions that concerned them were (a) why some words, for a given subject, lose their meaning more rapidly than others, and (b) why for one subject a given word loses its meaning more rapidly than for another subject. To answer the first question, three different studies have been reported. All of them deal with the effect of various characteristics of the word on its lapse of meaning. Wertheimer, Burns, and Gillis tested the possibility that emotional words take longer to lose their meaning than unemotional words, but failed to find any significant difference (Wertheimer, 1960). In a second study, Wertheimer (1958) found that words in which the sound and the appearance seem to fit the meaning take longer to lose their meaning than words which do not have this fittingness characteristic. The fittingness characteristic of the words was determined by a group of judges. For instance, the word "cool" was judged as a "fitting" word, and the word "teach" was considered a "non-fitting" word by the judges. The results revealed that the word "cool" takes twice as much time as the word "teach" to suffer lapse of meaning. Finally, in 1958, Wertheimer and Gillis studied the influence of practice and various other characteristics of the word on the rate of lapse of its meaning. They found that words which take a longer time to lose their meaning are (a) one syllable rather than two, (b) short rather than long, (c) likely to have an objective rather than an abstract referent, and (d) occur early rather than late in a sequence. However, their results failed to confirm the common impression that rare words lose their meaning faster than more frequently used or familiar words.

Wertheimer and his co-workers have not reported any study dealing with the second question, except the one by Wertheimer and Gillis (1958) where the effect of practice on verbal satiation was examined. In this context Wertheimer (1960) argues that practice in the process of observing loss of meaning tends to make the loss occur more rapidly. In other words, if a subject is presented words one after the other in such a manner that each new one comes only after the previous one has undergone meaning lapse, the later words in the sequence lose their meaning faster than the earlier ones. Obviously, this practice effect is attributable to a change in the subject's performance and not to the characteristics of the words presented later in the sequence.

More recently, a study by Lambert and Jakobovits (1960) has resulted in a more objective and reliable method of measuring the phenomenon of verbal satiation, thereby opening up various new avenues of research in this area. They have introduced "semantic differential" scales as their measuring instrument, and have studied the decrease in certain aspects of the connotative meaning of verbal symbols. By instructing their subjects to continuously repeat a word and then to rate the word along scales of the semantic differential, they found that there was a reliable movement of ratings toward the middle points of the scales. Thus they view the phenomenon of verbal satiation as a decrease in the intensity of meaning rather than as "lapse of meaning." Following this study, a series of experiments have been conducted by the same authors to study further implications of the phenomenon.

In one of their studies (Jakobovits and Lambert, 1961a) they have examined the effect of continued visual presentation on words as well as other stimuli such as real objects and photographs of objects. Their results revealed that only in the case of words was there a significant decrease in the intensity of their meaning as a result of satiation treatment. In the case of objects, however, there was a reliable increase in the intensity of their meaning as measured by the semantic differential scales.

In another study, (Jakobovits and Lambert, 1962a) using the verbal repetition procedure with digits as stimuli, evidence was obtained of an increase in the latency of solution of computational tasks which involve satiated digits. Such findings, according to the authors, may be considered analogous to the decrease of semantic ratings of words after their continuous repetition. The digits apparently lose their symbolic function in the same way as do words.

Extending the implications of the concept of semantic satiation into the area of linguistics, Jakobovits and Lambert (1961b) have been able to develop a behavioral measure to differentiate "compound" from "coordinate" bilinguals. They used a cross-satiation technique in which they measured the effect of the repetition of a word in one language upon the meaning of its translated equivalent in the other language. By means of this "cross-linguistic semantic satiation" procedure they found that compound bilinguals cross-satiate whereas coordinates do not. Comparing the results of this study with the results of their previous experiments with monolinguals (Lambert and Jakobovits, 1960), they substantiated the hypothesis that bilinguals in general are less susceptible to the satiation effect than are monolinguals. Added support to this hypothesis came from another study (Sepinwall, 1961), which showed a significant negative correlation between success in paired-associate learning and susceptibility to the semantic satiation effect. Such a correlation suggests that efficient verbal learning depends upon the ability to resist the semantic satiation effect. Apparently, balanced bilinguals who have demonstrated their skill in verbal learning represent those who resist the effects of semantic satiation.

A very recent study by Jakobovits and Lambert (1962b) was concerned with mediation in verbal transfer. In this study, by satiating verbal mediators, a generalized inhibition effect was observed from one learning task to another. Their general procedure was similar to the studies of Russell and Storms (1955) and McGehee and Schulz (1961). With the assumption that mediation follows the sequence B-C-D, they had their subjects first learn an A-B list, immediately after which the meaning of the inferred mediator, C, was reduced by the satiation procedure. Finally, their subjects learned an A-D list. They found that satiation of the mediator C resulted in a difficulty to learn the A-D list.

Semantic Satiation: Some Theoretical Considerations

Any empirical pursuit of psychological phenomena has always been accompanied by some theoretical explanations and the phenomenon of semantic satiation is no exception. Some investigators consider the phenomenon as a special case of fatigue. Smith and Raygor (1956), for example, proposed a "response probability" theory of satiation. They rely on Walker's suggestion as well as Hebb's notions about the neurological basis of satiation, which involves "a progressive reduction in response probability resulting from continued or repeated firing of a 'reaction system' with continued exposure to the stimulus. In Hebb's terms, it would result from continued elicitation of the relevant 'phase sequence'' (Smith and Raygor, 1956, p.323).

Such an interpretation is similar to Kohler and Wallach's theory (1944) of figural after effects, according to which repeated activation of a neural process interferes with its own continuation. Later Eysenck (1955) pointed out that Kohler and Wallach's postulation was parallel to Hull's reactive inhibition postulate. Hull has stated his principle of reactive inhibition as follows: "all responses leave behind in the physical structures involved in the evocation, a state or substance which acts directly to inhibit the evocation of the activity in question. The hypothetical inhibitory condition or substance is observable only through its effect upon positive reaction potentials. This negative action is called reactive inhibition. An increment of reactive inhibition (ΔI_R) is assumed to be generated by every repetition of the response (R), whether reinforced or not, and these increments are assumed to accumulate except as they spontaneously disintegrate with the passage of time" (Hull, 1943, p.297). Duncan (1956) also tries to show the similarity between Hull's I_R construct and satiation.

Lambert and Jakobovits (1960) viewed semantic satiation as a particular case of Hull's general formulation of the principle of reactive inhibition. However, the potential value of their interpretation lies not in viewing the phenomenon as a form of reactive inhibition, but in trying to relate the phenomenon of semantic satiation to Osgood's theory of meaning (Osgood, 1953). According to Osgood, the meaning of a symbol or sign is some replica or representation of the actual reactions elicited by the referent object or event for which the symbol stands. Such representations are conceptualized by Osgood as mediating reactions taking place within the organism. If meaning is considered as a representational mediating reaction, then the mediating reactions should be repeatedly and rapidly elicited during verbal repetition of the symbol. This process would generate a form of reactive inhibition which would temporarily decrease the effectiveness of mediating reactions. Furthermore, the Lambert-Jakobovits study suggested that such mediation processes are more of a central or cognitive form than simply peripheral or motor. In other words, satiation of the meaning of a symbol requires continuous elicitation of some particular cognitive activity related to the symbol. Thus the phenomenon is conceptualized by them as a cognitive form of reactive inhibition.

Wertheimer (1960) offers another important theoretical interpretation of the phenomenon that has led to much fruitful research. He views the phenomenon as a kind of change in the gestalt qualities of the verbal material, for which he offers a "trace" theory. Meaning change due to satiation treatment implies a change in the "trace complex" of a word, in which the associations of sound, appearance and meaning form one cohesive whole. To support this contention he has shown that the more cohesive a trace complex (as in the case of words having sound and appearance that seem to fit their meaning), the less rapidly it suffers lapse of meaning.

A third interpretation comes from the early investigators in Titchener's laboratory (Severance and Washburn, 1907; Bassett and Warne, 1919). They seem to have viewed the phenomena of semantic satiation in terms of Titchener's core-context theory of meaning. According to Titchener, meaning is not substantive or "existential," but only contextual. "That is to say, meaning is context. One group of sensations is usually focal -- this is spoken of as the 'core'. Other sensations or images that accompany the focal group provide, as its context, the logical meaning of the focal group" (Allport, 1955, p.78). In the case of a stimulus word, for example, the immediate visual-auditory impressions constitute the sensory core, and all other images associated with this core constitute its contextual meaning. With repeated presentation of the stimulus word, the context gets dissociated from the core, making the word temporarily meaningless. Severance and Washburn, for example, viewed semantic satiation as a form of "narrowing of consciousness" by which stimulus words lose their associative power.

Titchener's core-context theory of meaning is still important from the point of view of modern behavioristic psychology, because of its re-formalization by Boring (1929, 1938, 1942). According to Boring, the sensory core constitutes the stimulus aspect of the situation and the "context" is identified as response. In the case of verbal material, word-association responses are important providers of meaningful contexts.

In trying to develop a quantitative analysis of the attributes of meaning, Noble (1952) has derived his interpretation of meaning from Hull's behavior theory. But from an historical point of view, Noble's analysis seems analogous to that of Titchener and Boring. For Noble, meaning is "formally defined as a relation between S and R" and it is "coordinated with Hull's theoretical construct H by postulating that meanings increase as a simple linear function of the number of S-multiple R connections acquired in a particular organism's history" (p.429). Obviously, Noble regards meaning as a form of conditioned response. He has also proposed an objective measure of meaningfulness. According to him, the number of responses associated with a verbal unit available to a subject within a standard time period is a rational index of the meaningfulness of that word for that subject. A recent study (Kanungo and Lambert, 1962) attempted to extend this index of meaningfulness (m) to the measurement of semantic satiation, and thereby to explore the relation between the semantic satiation process and verbal associations. One of the important findings of the study was that the satiation treatment reduced the m values of the verbal units. Similar results were also obtained by Lambert and Jakobovits (1960) by using a different method. They have demonstrated, by using two seven-point bipolar scales (meaningful-meaningless and comprehensible-incomprehensible) that the satiation treatment makes a verbal unit more meaningless and incomprehensible. Their method of measuring meaningfulness is very similar to the "scaled meaningfulness" (m') technique developed by Noble, Stockwell, and Pryer, (1957) for measuring associative frequency. It may be pointed out that since there is a strong positive relationship between m and m' (Noble et al., 1957), m' or the meaningfulness scales used by Lambert and Jakobovits (1960) can be considered as an estimate of m.

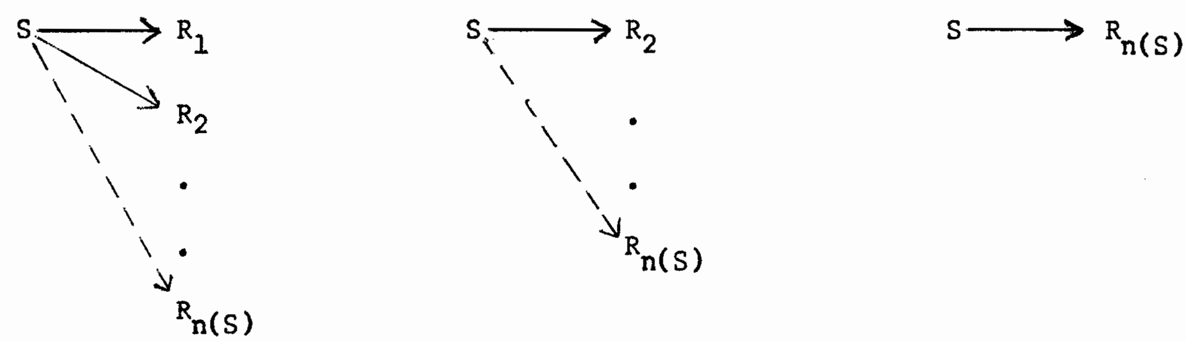
Other behavior theorists than Noble have offered theories of meaning (Bousfield, 1961; Osgood, 1953; Mowrer, 1954). Each of these theories has a distinctiveness in its description of the process of acquiring "meaning," and, consequently, in its rationale for quantitatively measuring meaning. But all of them agree however, that "meaning" is a response or a set of responses acquired through conditioning. In fact, there have been several attempts to show the basic similarities among these various S-R theories of meaning and their respective measuring devices (Bousfield, 1961; Jenkins and Russell, 1956; Noble, 1958; and Staats and Staats, 1959).

It can be argued that within a S-R theoretical framework, semantic satiation refers to a temporary experimental extinction phenomenon in which the response to or meaning of a verbal stimulus is temporarily extinguished due to continued repetition of the stimulus itself. As a consequence of continued repetition of a word, either its hypothetical mediators become reactively inhibited or the repeated word becomes associated with itself forming a word-word verbal connection, leading to the extinction of the original response or "meaning." The formulation of semantic satiation in terms of the development of a word-word habit is very similar to Robinson's description (1934) of the principle of competition in the work decrement of a given S-R connection. He gives a simple illustration of his principle as follows: "Let us assume that a given S has acquired the capacity to instigate either of the two responses R_1 and R_2; but that the connection with R_1 is slightly the stronger. Now suppose that there is a frequent occurrence of S. At first the response instigated will be R_1, but as repetition increases, R_1 will be less and less likely to be aroused. As a result, the connection between S and R_2 will have gained in relative strength, so that R_2, if inconsistent with R_1, will tend to block it or perhaps to occur in its stead" (p.614). Extending Robinson's illustration a little further and assuming that a stimulus word (S) can be a response to itself under certain experimental conditions, it can be stated that if the frequency of occurrence of S continues over and over again as in the case of the satiation procedure, then even R_2 will be blocked and will be replaced by S itself. In other words, during satiation treatment a S-S connection is being built up which blocks R_1, R_2, etc., by interfering with them. This is schematically represented in Figure 1. The research to be reported in subsequent chapters tries to explore the potentiality of such an associative interference interpretation of semantic satiation for paired-associate learning.

FIGURE 1.

Schematic Representation of Response Competition During Satiation Treatment

Before Satiation Treatment	With Increasing Satiation Treatment	After Satiation Treatment



Meaning as a Variable in Paired-Associate Learning

A comprehensive analysis of the whole field of verbal learning led Underwood and Schulz (1960) to the conclusion that the meaningfulness of verbal material is a most powerful variable, producing marked effects on the rate of verbal learning. It is a truism that a list of highly meaningful items is learned faster than a list of nonsense items. A review of the role of meaning in verbal learning by McGeoch and Irion (1952) clearly shows that there is a high positive correlation between meaningfulness of the material and the rate of its acquisition. Several recent experiments on paired-associate learning, where the meaning of the stimulus and the response units covaried, have supported the generalization that speed of learning and meaning are directly related (Kimbal and Dufort, 1955; Mandler and Huttenlocher, 1956; Noble and McNeely, 1957; and Noble, Stockwell, and Pryer, 1957). Furthermore, Underwood and Schulz (1960) observed that several investigators using quite different scaling methods for determining the meaningfulness of verbal units appear to end up with almost the same ordering of the verbal units. Learning experiments using these verbal units clearly establish the positive relationship between the meaning of the verbal units and the rate of learning.

An examination of the more analytic studies of the relative importance of meaning for stimulus and response members of paired-associate lists reveals that a given variation in the meaning of response members produces a greater variation in the rate of learning than does a corresponding variation in the meaning of stimulus members. For example, a study by Mandler and Campbell (1957) shows that as the meaning of response members decreases, with stimulus meaning held constant, the mean trials to the first correct anticipation increases. However, as the stimulus meaning is varied with response meaning held constant, there is no change in the rate of learning. Similarly, Cieutat, Stockwell, and Noble (1958), using paired-associate lists comprising four different combinations of high (H) and low (L) stimulus and response meaningfulness, found that the difficulty in learning increased in the order of H-H, L-H, H-L, and L-L. They therefore concluded that "at least twice the variance in performance due to meaningfulness (*m* or *m'*) is attributable to R as to S" (p.201). There are also other studies that support the above contention (e.g., Hunt, 1959; Sheffield, 1946) with one recent exception (Levitt and Goss, 1961) where the meaningfulness of the stimulus and the response members had almost similar effects on learning speed. However, the authors of the latter study have tried to explain their atypical results in terms of procedural differences.

Familiarity, Meaning, and Paired-Associate Learning

Some investigators (Underwood, 1949, p.411) have questioned whether meaning and familiarity are distinct concepts. This question led Noble in 1953 to investigate the problem of the functional relationship between meaning and familiarity. He regarded familiarity of a verbal unit as some function of its frequency of occurrence in one's experience. Thus, judged familiarity of a word (*f*) would depend upon the frequency of past contact one had with that word. In his study, he obtained a positive correlation between his measure of meaningfulness (*m*) and judged familiarity (*f*). He came to the conclusion that *f* is a correlate of *m*, and that both *f* and *m*, two distinct attributes of verbal units, are correlated to a third variable *n* or frequency of stimulation. He therefore entertained the hypothesis that a verbal unit acquires the attributes of *f* and *m* as joint functions of frequency of stimulation. In 1954, Noble got added support for the above hypothesis by demonstrating a positive relation between *f* and *n*. Through experimental manipulation of *n*, within the range of $n=0$ to $n=25$, he found that familiarity is a negatively accelerated function of frequency of stimulation.

Noble's hypothesis suggested that increasing familiarization training or frequency of exposure of nonsense words may lead to an increase in their f and m attributes, and if this happens, then pre-learning familiarization training can be considered as an important variable affecting paired-associate learning. Several studies have been carried out to determine the effect of pre-familiarization of stimulus and response items on subsequent paired-associate learning (e.g. Cieutat, 1960; Gannon and Noble, 1961; Hakes, 1961; Morikawa, 1959; Schulz, 1958; Sheffield, 1946; Weiss, 1958). In these studies, the general procedure has been to first familiarize the nonsense verbal materials by exposing them several times and then asking the subjects to learn them. In general, all these studies reveal that pre-learning familiarization of nonsense verbal material facilitates their learning. The facilitative effect of familiarization training, Sheffield (1946) suggested, can be attributed to an increase in the meaning of the familiarized items, thus making familiarization a vehicle through which meaning plays a role in verbal learning. Sheffield's argument was based on his finding that, with respect to rate of learning, meaningful three-letter words showed the same pattern of differences from unfamiliar nonsense syllables as that shown by familiar nonsense syllables. Cieutat, Stockwell and Noble (1958) maintained that familiarization may be the "sole" basis of the meaningfulness effect. Thus they argued if "meaningfulness is a secondary phenomenon derivable from the same basic variable," that is, frequency of stimulation (n) or familiarization training, then manipulation of n should affect the S and R terms differentially, as manipulations in meaning do. In other words, familiarization of R terms should facilitate paired-associate learning more than familiarization of

S terms. While the results of some experiments (Sheffield, 1946; Underwood and Schulz, 1960; Weiss, 1958) are in agreement with the above prediction, there are other studies which have either obtained no differences (Waters, 1939) or contradictory evidence (Cieutat, 1960; Gannon and Noble, 1961; and Hakes, 1961).

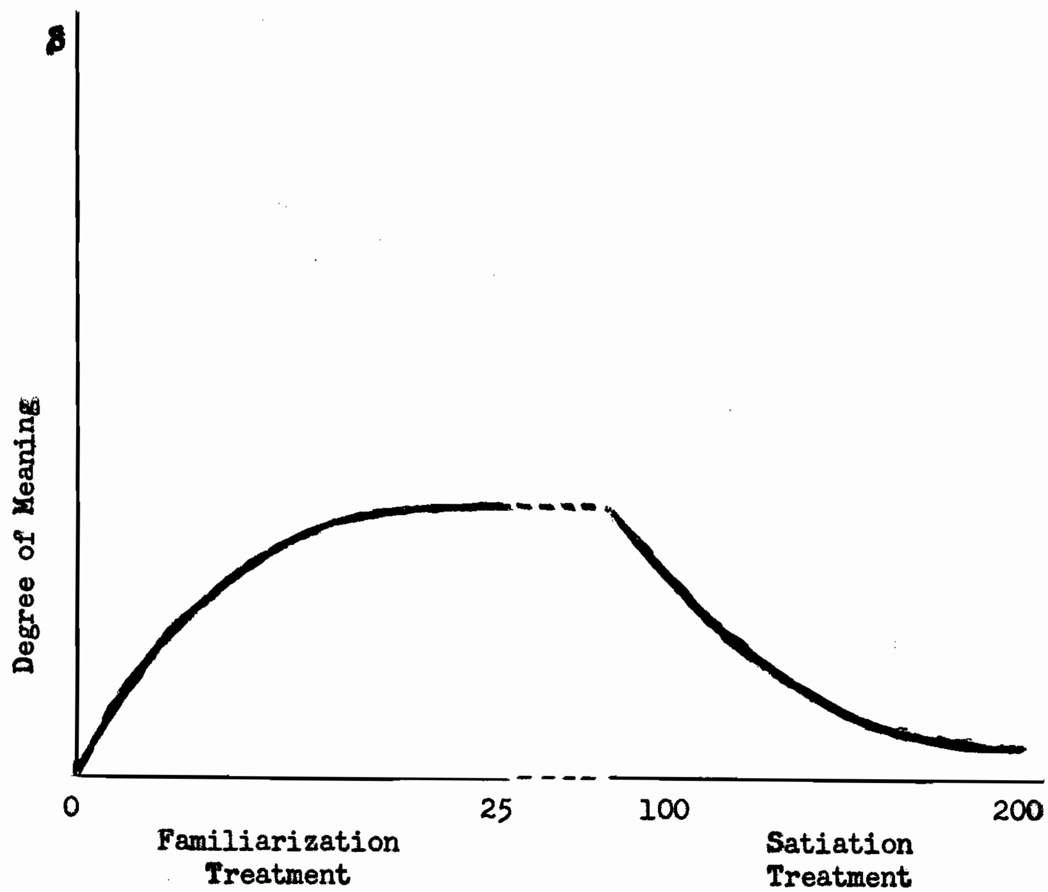
Noble (1953, 1954), pointed out that verbal materials may acquire the attributes of "meaning" and "familiarity" as joint functions of frequency of stimulation. The attributes of verbal materials are important variables affecting learning. But in familiarization studies, no attempt has been made to measure either the "meaning" or the increased familiarity of the verbal materials immediately after familiarization training.

It is apparent that familiarization training or manipulated frequency per se cannot give rise to such conflicting results. Thus it is conceivable that the interpretation of such conflicting results may lie in the unnoticeable changes in the inferred processes (some intervening variables) such as "meaning" and "familiarity." Both the variables, meaning and familiarity, though a joint function of manipulated frequency, can still be conceived of as two distinct variables influencing verbal learning. Epstein, Rock, and Zuckerman (1960) have shown that both familiarity and meaning have facilitative effects on verbal learning, but familiarity alone is not sufficient to explain all the meaningfulness effect, and therefore both variables have to be taken into account when dealing with the effect of familiarization training on paired-associate verbal learning. The need of the present moment, however, is to clearly formulate the exact role of these two variables in paired-associate learning, a task which is undertaken in chapter V.

Actually, familiarization studies concern themselves with only half of a dimension where certain experimental manipulations of frequency of verbal materials lead to increase in familiarity and meaning, which in turn facilitate verbal learning. The present investigation deals with the other half of this dimension, where certain other experimental manipulations of frequency, as in the satiation procedure, lead to measurable decrements in meaning, and ultimately affect verbal learning (see Figure 2).

Figure 2

Theoretical Curves Showing that Familiarization and Satiation Treatments Can be Placed on the Same Continuum of Manipulated Frequency, Although They differentially Affect the Degree of Meaning.



CHAPTER II

THE ROLE OF SEMANTIC SATIATION IN PAIRED-ASSOCIATE LEARNING

As stressed in the preceding chapter, meaning is a very important variable in verbal learning. Several studies dealing with the role of meaning in paired-associate learning were cited, and they have demonstrated without exception that meaning and the rate of learning are directly related. In other words, the more meaningful the items, the faster they will be learned and conversely, the less meaningful the items, the slower they will be learned. Further, it was pointed out that prior familiarization training with nonsense words resulted in faster learning, leading to the theoretical notion that familiarization may only be the vehicle through which meaning variable plays its role. (Sheffield, 1946; Cieutat, Stockwell, and Noble, 1958.)

The review of several semantic satiation studies presented in the introductory chapter revealed that certain experimental manipulations of highly meaningful words, such as their continued verbal repetition, results in a decrement or lapse of their meaning. An objective method for measuring such decrements in meaning of verbal units has been demonstrated by Lambert and Jakobovits (1960). Realizing the role of meaning in verbal learning and the existence of an operation through which meaning of a verbal unit can be reduced to an objectively measurable extent, it is a logical next step to study the implications of semantic satiation for the field of verbal learning. Experiment I to be reported in this chapter was a preliminary attempt to explore the role of pre-learning satiation treatment in paired-associate learning.

Experiment I: A Preliminary Investigation

This experiment questioned whether the reduction of the connotative meaning of words has a detrimental effect on subsequent acquisition tasks involving those very words. Two psychological principles which suggest divergent outcomes are brought together in this study. On the one hand, results of the semantic satiation experiments suggest that repeated experiences with verbal elements should lead to decrements in the meaning of these elements and consequently make the learning of tasks involving these satiated elements less efficient. On the other hand, theories of practice or familiarity, which question whether meaning and familiarity are actually separate variables, suggest that repeated experience should promote more efficient learning because response elements are made more available through repetition. In order to highlight the empirical test of these two conflicting principles, it was decided to administer the satiation treatment to response elements of S-R pairs.

Method. Thirty undergraduate students served as Ss. None had previously participated in a similar experiment.

Using nonsense syllables and words as stimulus and response members respectively, two lists of paired-associates, each containing eight pairs, were prepared. (See Appendix A, Lists 1 and 2.) Nonsense syllables were chosen from Hull's list of less than 20% association value (Stevens, 1958, pp.545), and the response words were chosen on the basis of their high frequency of usage (Thorndike & Lorge, 1944) and their high connotative meaning (Jenkins, Russell & Suci, 1958). Each list was printed on a strip of paper in five different random orders in a manner suited to the standard anticipation procedure with a memory drum. A 3-sec. interval separated the presentation of the stimulus and the stimulus-response pair, and a similar interval elapsed before the presentation of the next stimulus. The inter-trial interval was 6-sec.

Another eight words were chosen as controls on the same basis as described above, except that each of them was matched with a response word of the second list with respect to its length. These words were used as controls in the sense that they were not to enter into the learning task after they had been given satiation treatment. Care was taken that the control words were neither structurally nor semantically related to the response words of the paired-associates which were to be learned. (See the control words in Appendix A.)

Three semantic scales (good-bad, active-passive, strong-weak) representing the three major factors of connotative meaning (Osgood, Suci & Tannenbaum, 1957) were used for measuring the intensity of semantic ratings of words (See Appendix A). Each of three semantic scales represented a 7-point bipolar dimension. The meaning of a word such as "mother" is given by its placement on an evaluative factor (its degree of goodness or badness), on an activity factor (its degree of activity or passivity) and on a potency factor (its degree of strength or weakness). A word without any meaning would rest at the point of origin for all dimensions, which is, in this case, the middle of the seven points. Thus each scale has three degrees of polarity which describe the appropriate placement of the word along the scale, and they are scored as 1, 2 and 3. The middle position, however, indicates meaninglessness, and is scored as zero.

Each paired-associate response word and control word was printed on a separate 3X5 index card. Each semantic scale was also printed on a separate card. All cards were placed in a Kardex folder so that E could expose them in a predetermined random order, one at a time, first a word, and then a semantic scale along which S gave his ratings of the immediately preceding word.

Each S was tested individually. Initially, S was presented the first paired-associate list (List 1) with standard instructions for the anticipation procedure involving the use of a memory drum (See Appendix A). Before the actual presentation of the list, S was made familiar with the anticipation procedure by a single presentation of two practice pairs.

Three consecutive successful anticipations were considered as the learning criterion. On the basis of their learning scores, two groups, a control and an experimental, equated for both trials and errors, were formed for the main stage of the experiment. There were 15 Ss in each group.

The main phase of the investigation started approximately one week after each S's initial testing. For each S of the experimental group, the normal semantic profile was taken of each of the eight response words of the second paired-associate list (List 2). The procedure was the same as that used by Lambert and Jakobovits (1960). Each word was exposed for one sec. and then S was asked to indicate the appropriate semantic placement by pointing to one of the seven positions on the semantic scale. Then, for the satiation treatment, each of the response words was again exposed for one sec., and the S was asked to continuously repeat the word aloud for 15 sec., at a rate of 3-4 repetitions per sec. Immediately after the repetition, E exposed a semantic scale and S made his rating for the word. This procedure was repeated three times for each of the eight words, one time for each semantic scale. The words and the scales were presented in an order which maximized the separation of recurrence of a word. S's of the control group were given exactly the same type of treatment as given to the experimental group, except that the 8 words which were satiated were not those to appear as response words in the paired-associate list.

Immediately after the satiation treatment, each S of both the experimental and the control group was presented the second paired-associate list on the memory drum with exactly the same instructions as given for learning List 1. The same procedure and learning criterion as described for the initial stage were used again.

Results. Data presented in Table 1 reveal that the attempt to equate two groups on the basis of their learning measures in the initial stage of the experiment was successful.

Table 1.

Matching of Groups on Learning Measures, Initial Test

Measure of Learning	Group	N	M	SD	t	p
	Control	15	10.20	3.17		
Trials					0.12	ns
	Experimental	15	10.07	2.46		
	Control	(15)	20.00	12.58		
Errors					0.02	ns
	Experimental	(15)	20.07	9.86		

An examination of Table 2 indicates that the satiation treatment of words produced a reliable decrease in the intensity of their meanings. For the control group, the satiation treatment of the control words led to a significant decrement in their meaning. For the experimental group, the meaning decrement does not quite reach significance (p is between .10 and .05, 2-tailed test). A t-test applied to the mean satiation scores of both groups revealed no reliable differential effect of the satiation treatment on the two groups ($t = 0.55$).

The effect of satiation of response words on the acquisition of the second paired-associate list is shown in Table 3. The control Ss, given the satiation treatment for control words immediately before learning, were found significantly superior to the experimental group with respect to acquisition of the list. In terms of error scores, the difference between both the groups is significant beyond the .01 level, but in terms of trials to criterion, the difference is not reliable ($p < .10$).

Two general conclusions can be drawn from the results of this study. First, in support of the earlier findings of Lambert & Jakobovits (1960), the study shows that the satiation treatment of the words leads to a decrement in the intensity of their meaning. The second and most interesting finding is that the satiation treatment applied to response words has a negative transfer effect on the later learning of the paired-associate list. The results clearly show that the effect of satiation of response members on subsequent acquisition of paired-associates is quite contrary to what would be expected on the basis of practice or familiarity principles.

Table 2

Effect of Satiation Treatment on the Semantic Placement of Words

Groups	Before Satiation Treatment		After Satiation Treatment		Mean Change				
	M	SD	M	SD	M	SD	SE	*t*	*p*
Control (N = 15)	4.20	1.68	3.88	1.94	0.32	0.52	0.09	2.29	$<.05$
Experimental (N=15)	4.68	1.77	4.47	1.70	0.21	0.41	0.11	1.94	$<.10$ $>.05$

Entries are average polarity scores per word over the sum of 3 semantic scales.

Table 3

Effect of Satiation Treatment of Response Words on the Learning of Paired Associates

Measure of Learning	Group	N	M	SD	*t*	*p*
	Control	15	6.47	2.12		
Trials					1.20	$<.10 > .05$
	Experimental	15	8.20	2.45		
	Control	(15)	8.67	5.11		
Errors					2.94	$<.01$
	Experimental	(15)	14.47	5.35		

Earlier in Chapter I, it was pointed out that Lambert & Jakobovits (1960) conceptualized the phenomenon of semantic satiation as"a cognitive form of reactive inhibition" and related it to Osgood's theory of representational mediation processes. Their explanation was as follows: "During verbal repetition, the mediating reactions are repeatedly and rapidly elicited. Under such circumstances we would expect that a form of reactive inhibition would be generated which would temporarily decrease the availability of the mediators" (p.379). Their explanation also accounts for the superiority of the control group over the experimental group in paired-associate learning by assuming that reduction of the meanings of response members makes them more difficult to associate.

However, the results can also be accounted for in the terms of an associative learning interpretation of semantic satiation. This interpretation is derived from an S-R analysis of the attributes of meaning. As has been pointed out, Noble has attempted to show that frequency of stimulation (n) in familiarization trials is directly related to learning (Underwood & Schulz, 1960, pp. 77-88). It has been suggested that the facilitative effect of familiarization trials may be due to the known correlation between familiarity and meaningfulness, but this is not necessarily so. As Gannon & Noble (1961) argue; "high m theoretically requires high n but not conversely; i.e., one can build in n experimentally without affecting m" (p.15). To explain the relation between familiarity and meaningfulness, it has been presumed that "the more frequent the contact, the greater is the number of different contexts in which a word has been used" (Underwood & Schulz, 1960, p.23) thus leading to an increase in m components. They suggest that there may nevertheless be negative cases where the S has frequent contact with the word, but in the same context each time. In the present study, the satiation procedure is operationally analogous to this type of contact. In this situation, when a response member (R) is continuously repeated, the different associations elicited by the word (m components) may gradually extinguish whereas the R-R connection gets strengthened. This could be an instance where experimentally developed n may lead to decrease in m. Decrease in meaning in Osgood's sense (where a symbol-referent connection undergoes a process of extinction), or decrease in meaningfulness (in Noble's sense) as a function of satiation treatment, therefore, can be interpreted in terms of increasing S's tendency to connect the word with itself rather than to any of its common associates.

Thus the effect of satiation of response words on subsequent acquisition can be interpreted in terms of transfer from one learning situation to another. For the experimental group, the meaning of the response words decreased possibly because of the formation of an association of the response word with itself which would produce an impairment in the subsequent learning of the paired-associates. The situation is analogous to developing R-R connections for the experimental group where all the m components ("hooks" or associations) of R extinguished, and similarly X-X connections for the control group where all the m components of R remain unaffected before S-R learning. Extinction of the m components of R before learning for the experimental group would explain the superiority of the control group. This interpretation is also consistent with the view of McGeoch and Irion (1952) who suggest that the influence of meaning on learning is perhaps a special case of transfer (pp.471-472). In other words, if the meaning of a verbal unit is acquired through a process similar to S-R learning, then the rate of any subsequent S-R learning involving the same meaningful verbal units can be interpreted in terms of transfer from one learning situation to another. Thus, if acquisition of the meaning of a verbal unit is a matter of S-R learning, semantic satiation or loss of meaning of a verbal unit under continuous repetition conditions can also be interpreted in terms of associative learning principles, and its effect on the rate of any subsequent S-R learning involving satiated verbal units can be interpreted in terms of transfer from one learning to another. It is quite obvious that any treatment that increases meaning of verbal units through a process of S-R learning should facilitate subsequent learning involving those units

(Parker and Noble, 1960), which is a case of positive transfer from one learning situation to another. But any treatment that decreases meaning of verbal units (as in the case of continuous verbal repetition in semantic satiation studies), and therefore slows down the rate of subsequent learning involving those units, will be a case of negative transfer from one learning situation to another.

Another possible interpretation of the present results makes reference to a potential increase in similarity of responses. The prelearning satiation treatment given to the response words reduced their meaning, possibly making them more semantically alike. If so, one would expect to find more intralist response competition for the experimental group than for the control. An examination of errors revealed that 61% of all errors for the experimental group are intralist intrusions in comparison with 67% for the control, a comparison which rules out this interpretation.

CHAPTER III

THE EFFECT OF STIMULUS AND RESPONSE SATIATION IN PAIRED-ASSOCIATE LEARNING

The results of Experiment I showed that satiation of meaningful response members of a paired-associate list immediately before learning had some detrimental effect on subsequent acquisition. Thus knowing that satiation or the experimentally produced decrease in meaning has an inhibitory effect on subsequent acquisition, it was further necessary by means of analytic studies to answer the question whether pre-learning satiation is more influential on stimuli or responses in paired-associate learning. Experiment II, therefore, was designed to show the possibility of the differential effect of satiation of the stimulus and the response members in paired-associate verbal learning.

Experiment II: With Meaningful S-R Pair

It may be recalled that the results of various studies on the role of meaningfulness of stimuli and responses in paired-associate learning indicate that a given variation in the meaning of the responses produces a greater difference in learning rate than does a corresponding variation in the meaning of the stimuli. Such differential relations of stimulus and response meaning to the rate of paired-associate learning (Cieutat, Stockwell, and Noble, 1958) make it evident that a decrease in the meaning of the response member through satiation given immediately before learning should produce a greater inhibitory effect on the acquisition of the paired-associates than a similar decrease in the meaning of stimulus members through pre-learning satiation treatment. In other words, using high meaningful paired-associates (H-H), pre-learning satiation of response items would lead to a greater negative transfer than pre-learning satiation to stimulus items. Since through satiation treatment one could experimentally reduce a high meaningful verbal unit (H) to a low meaningful unit (L), it is obvious that in case of a list with both elements highly meaningful (H-H), when the response members are satiated, learning would become more difficult because the original H-H list would appear after response satiation as an H-L list. Similarly if the stimulus members are satiated, the list appears as L-H instead of H-H at the time of learning. Since any change in the meaning of the responses is more influential than similar changes in the stimuli, it would be expected that following either stimulus satiation (leading to L-H learning) or response satiation (leading to H-L learning) the list would appear difficult to learn when compared to the control (leading to H-H learning), and more difficulty would be faced after response satiation than after stimulus satiation. This expectation assumes that other variables affecting learning remain constant and that through the satiation treatment, changes in the meaning alone influence subsequent learning of the paired-associate list.

But according to the associationistic interpretation of semantic satiation, during the pre-learning satiation treatment the decrease in the meaning of the verbal unit is accompanied by the formation of a habit to connect the verbal unit with itself. Thus during the same period, besides the changes effected in the meaning of the verbal unit, the formation of a habit as a result of verbal repetition is taking place. This is similar to a situation where the formation of a new habit (the connection of the verbal unit with itself) also results in unlearning or temporary extinction of an old habit (the connection of the verbal unit with its meaning components). Such habit formation prior to the learning of the paired-associates could possibly be a variable affecting the acquisition. So the effect of satiation on subsequent learning can be conceptualized not only in terms of the unlearning of the old habit or the decrease in the meaning of the verbal unit, but also in terms of the transfer of the newly acquired habit to connect the verbal unit with itself during the satiation treatment to the subsequent paired-associate learning situation.

The question arises whether the effect of semantic satiation on paired-associate learning can be attributed entirely to the transfer of the new habit acquired through the satiation treatment, without having recourse to "decrement in meaning" as an explanatory principle. In other words, if the satiation treatment leads to two correlated effects, one being the decrement in meaning of a verbal unit and the other being the formation of a new habit to connect the verbal unit with itself, then is it possible that the latter is a sufficient condition to explain not only decrement in meaning of a verbal unit, but also the inhibitory effect of semantic satiation on subsequent paired-associate learning? In this connection it may be pointed out that Osgood (1953) makes an "analysis of the relations among successively practiced activities," while discussing the phenomena of transfer. According to him, a stimulus variation transfer paradigm, where stimuli are varied and responses are functionally identical, should yield positive transfer. Such positive transfer effects are mainly due to stimulus generalization. But the extent of stimulus generalization would depend upon the degree of similarity between the practice and the test stimuli. Further, he considers response variation to be a negative transfer paradigm. In other words, when stimuli are kept functionally identical and responses are varied, negative transfer should be obtained. It will be observed that pre-learning satiation treatment given to stimulus items of a paired-associate list is analogous to a response variation transfer paradigm, and thus should yield negative transfer. But similar treatment given to response items,being analogous to a stimulus variation transfer paradigm, should not, in any case, produce negative transfer. Such a comparison between Osgood's transfer paradigms and experimental designs involving pre-learning satiation treatments to stimulus and response is presented in Fig. 3.

Figure 3.

Analogous Proactive Transfer Paradigms for Experiment II

Conditions	Phases: Pre-Learning Practice	Phases: Test Learning Situation
1. Response Variation Transfer Paradigm	$S_1 - R_1$	$S_1 - R_2$
Stimulus Satiation Condition	A - A (e.g. "House-House")	A - B (House-Star)
2. Stimulus Variation Transfer Paradigm	$S_1 - R_1$	$S_2 - R_1$
Response Satiation Condition	B - B (e.g. "Star-Star")	A - B (House-Star)
3. Both Stimulus and Response Variation Transfer Paradigm	$S_1 - R_1$	$S_2 - R_2$
Different Word Satiation Condition	C - C (e.g. "Bible-Bible")	A - B (House-Star)
4. Control	______	S - R
Retest Control	______	A - B (House-Star)

This type of reasoning, emphasizing the role of a preceding habit on learning, suggests that pre-learning satiation applied to the stimulus items would yield negative transfer and therefore would make learning difficult, whereas pre-learning satiation given to response items, instead of producing any negative transfer, may or may not produce positive transfer depending on the similarity between the stimulus and the response items of the paired-associate list. These predictions, made on the basis of Osgood's transfer paradigms, are contrary to what would be expected if we simply assume that the effect of the satiation treatment on paired-associate learning is brought about only by changing meaning of the verbal units.

Thus in Experiment III, an attempt was made to clarify the conflicting issues presented above, and to specify the role of two variables involved in the satiation procedure, i.e., habit *per se* (the newly acquired habit of connecting the verbal unit with itself), and the decrease in meaning in paired-associate learning.

Method. Forty-eight English-speaking cadets of the Royal Canadian Air Force enrolled in a six-week training course at a base near Montreal were asked by their instructor to volunteer for the experiment. Each *S* was tested individually at the training base during regular work hours.

Three lists of paired-associates, each containing ten pairs, were prepared (see Appendix B, List 1, List 2a, List 2b). Both the stimulus and response members of each list were highly meaningful words. These words were chosen on the basis of their high frequency of usage (Thorndike and Lorge, 1944) and/or their high connotative meaning (Jenkins, Russell, and Suci, 1958). List 1 was used in an initial test and lists 2a and

2b were used in the main stage of the experiment. List 2b was different from List 2a only in one respect: the stimulus-response position of each pair in List 2a was reversed in List 2b. Each list was printed on a strip of paper in four different random orders in a manner suited to the standard anticipation procedure for a memory drum presentation. A 3-sec. interval separated the presentation of the stimulus and the stimulus-response pair, and a similar interval elapsed before the presentation of the next stimulus. The inter-trial interval was 6-sec.

Ten other highly meaningful words were chosen as controls on the same basis as described above. Care was taken that the control words were not semantically related to either the stimulus or the response words of List 2. (See the control words in Appendix B.) These words were used as controls in the sense that they were not to enter into the learning task after they had been given satiation treatment.

The three semantic differential scales used in Experiment I (good-bad; active-passive; strong-weak) were also used in the present experiment to measure the intensity of the semantic ratings of both stimulus and response words used in List 2 as well as the control words. Each word of the paired-associate list 2, and each of the control words were printed on a separate 3 X 5 index card. Each semantic differential scale was also printed on a separate card. All cards were then placed in a Kardex folder so that E could expose them in a predetermined random order, one at a time, first a word, and then a semantic scale along which S gave his ratings of the word just presented.

The procedures used for paired-associate learning and for semantic ratings of the words before and after satiation treatment were very similar to those of Experiment I. All forty-eight Ss were tested twice. In an initial stage, S learned List 1 to a criterion of three consecutive successful anticipations (for instructions, see Appendix B). On the basis of their learning scores, four groups, equated for both trials and errors, were formed and each group was assigned to a different condition in the main stage of the experiment. Figure 3 presents all these conditions. Two of these four groups, the Retest Control (RC) and the Different Word Satiation (DWS) groups, served as control groups. The other two, the Stimulus Satiation (SS) and the Response Satiation (RS) groups, served as experimental groups. Furthermore, six Ss of each group were given paired-associate list 2a to learn, while the other six Ss of each group were given paired-associate list 2b to learn. Care was taken that Ss forming the subgroups of six each were matched with respect to their learning scores in the initial test. It was mentioned earlier that the lists 2a and 2b contained the same pairs of words, differing only in that the stimulus-response position of each pair in List 2a was reversed in List 2b. By assigning List 2a to half of each group, and List 2b to the other half, any possible word-position effect was counterbalanced. This control was necessary in view of the fact that the items in both the stimulus and response positions of any pair in List 2 were not perfectly matched for their initial meaningfulness. Reversing their positions for half of the Ss made the initial meaningfulness level of stimulus-response positions of the pairs equivalent for the group.

The main stage of the experiment started approximately one week after each S's initial testing. For Ss of the RS group, the normal semantic profile was taken for each of the ten response words of the paired-associate list assigned them. Each word was exposed for one sec. and then S was asked to indicate the appropriate semantic placement by pointing to one of the seven positions on the semantic scale. Then for satiation treatment, as in Experiment I, each of the response words was again exposed for one sec., and the S was asked to continuously repeat the word aloud for 15 sec., at a rate of 3-4 repetitions per sec. Immediately after the repetition, S made his rating for that word on a semantic scale. This procedure was repeated three times for each of the ten response words, once for each semantic scale. Ss of the SS and DWS groups received exactly the same type of treatment as was given to the RS group except that the ten words which were satiated were stimulus words and control words respectively instead of response words. In other words, for each S of the SS group, stimulus words of the list to which he was assigned were given satiation treatment, and for each S of the DWS group the ten words which were satiated were not those to appear as either stimulus or response in the list to which he was assigned.

Immediately after the satiation treatment, in the case of RS, SS, and DWS groups, each S was presented the second paired-associate list which was designated for him to learn (List 2a or 2b). In the case of the RC group which received no satiation treatment, each S was presented the second list to learn (either 2a or 2b, as assigned to any individual S). The list was presented on the memory drum with exactly the same instructions as were given for List 1 (see Appendix B). The same standard anticipation procedure and learning criterion of three consecutive errorless trials were again used.

Results and Discussion. One-way analyses of variance performed on both the trials and error scores of the four groups of Ss in the initial test (List 1) are presented in Table 4. The values of F in the case of both trial and error measures are less than 1, revealing that the attempt to equate all four groups on the basis of their initial learning measures was successful.

Table 4

Analysis of Variance for Learning Data of the Initial Test

Learning Measures	Source of Variation	Sum of Squares	df	Variance Estimate	F	p
	Between Groups	1.062	3	0.354		
TRIALS	Within Groups	1265.918	44	28.77	0.012	n.s.
	Total	1266.98	47			
	Between Groups	149.229	3	49.743		
ERRORS	Within Groups	32220.751	44	732.289	0.067	n.s.
	Total	32369.98	47			

Table 5 presents the results of an analysis of variance performed on the semantic ratings for three groups of Ss who were measured twice, both before and after the satiation treatment. There were two ways of classification. One was the ratings of three groups, RS, SS, and DWS, given satiation treatment to response words, stimulus words, and control words respectively. The other classified the ratings of the two different measurement conditions, before and after satiation treatment. An examination of Table 5 reveals that the value of F of only one main effect, before and after satiation treatment, is significant at the .01 level.

Table 5

Analysis of Variance of Semantic Ratings for Three Groups (Groups RS, SS, and DWS) Before and After Satiation Treatment

Sources of Variation	Sums of Square	df	MS	F	p
1. Between Groups	7.092	2	3.546	0.719	n.s.
Between Ss in the same group	162.753	33	4.931		
Total between Ss	169.845	35			
2. Between Conditions (Before and After Satiation Treatment)	4.108	1	4.108	11.072	$<.01$
1 X 2	0.167	2	0.083	0.223	n.s.
Pooled Ss X 2	12.275	33	0.371		
Total within Ss	16.55	36			
TOTAL	186.395	71			

Since the mean semantic ratings for each group decreases after satiation treatment (see Table 6), it can be safely concluded that, in general, the satiation treatment applied to highly meaningful words leads to significant decrement in their meaning. When we compare the mean semantic ratings taken before and after satiation treatment for each group considered separately (see Table 6), only in the case of the SS group does the mean change of 0.58 scale units exceed the critical difference of 0.51 which is significant at the .05 level (Lindquist, 1956, p.93). However, this does not mean that the SS group is different from the RS or DWS groups, with respect to either their initial semantic ratings or their ratings after satiation treatment. Insignificant F ratios for between groups comparisons and for interaction in Table 5 show that the groups were neither significantly different with respect to their initial ratings, nor were their final ratings differentially affected by the satiation treatment.

Table 6

Effect of Satiation Treatment on the Mean Semantic Ratings[1] of Words for Each Group Taken Separately

Groups	N	Before Satiation Treatment	After Satiation Treatment	Mean Change
Response Satiation	12	4.633	4.283	0.35
Stimulus Satiation	12	5.316	4.733	0.58*
Different Word Satiation	12	5.441	4.941	0.50

* $p < .05$

[1]Mean ratings per word summed over three scales.

To determine if the experimental and the control groups differ in their learning of List 2 as a result of different pre-learning treatments, a one-way analysis of variance was performed on both trial and error scores for the four groups. The results, presented in Table 7, reveal that the between-groups F ratio for the trial measures is significant at .03 level, but the between-group F ratio for the error measures only approaches the significance level ($p < .06$).

Table 7

Analysis of Variance for Learning Data of the Main Test

Learning Measures	Source of Variation	Sum of Squares	df	Variance Estimate	F	p
	Between Groups	224.229	3	74.743		
TRIALS	Within Groups	948.084	44	21.547	3.468	$<.03$
	Total	1172.313	47			
	Between Groups	4459.063	3	1486.356		
ERRORS	Within Groups	23970.917	44	544.793	2.728	$<.06$
	Total	28429.980	47			

It will be recalled that all the four groups were presented List 1 to learn during an initial test which measured their initial paired-associate learning ability. But since there was a possibility that these initial learning measures (for List 1) would be positively correlated with the learning measures in the main test (for List 2), a covariance analysis of the data was thought to be appropriate in order to measure the precision of the significance test (see Edwards, 1950, pp.341-348). Table 8 presents the results of the analysis of covariance performed on measures of trials and errors for the four groups of Ss. As will be seen in Table 8, the significance levels of trial scores and error scores are raised from .03 and .06 to .005 and.025 levels respectively. Thus with the initial learning ability equated, there is little doubt that the groups differed significantly in their learning scores as a result of different pre-learning treatment. Furthermore, the correlation coefficient

Table 8

Analysis of Covariance of the Performance of Four Groups of Subjects

Learning Measures	Sources of Variation	Sums of Squares of Errors of Estimate	df	Mean Square	F	p
	Total	858.738	46			
TRIALS	Within Groups	619.619	43	14.409		
	Adjusted means	239.119	3	79.706	5.531	$<.005$
	Total	20262.322	46			
ERRORS	Within Groups	15696.635	43	365.038		
	Adjusted means	4565.687	3	1521.895	4.169	$<.025$

within groups, which is equal to .59 ($p < .01$), in the case of both trial and error measures, suggests that there is a tendency for Ss who were high in initial level of performance (List 1) to be high in the main test (List 2) under any given condition.

Since significant F values for the trials and error measures have been obtained, the adjusted criterion means in the main test for each group were computed. These are presented in Table 9 along with the original means in the initial and in the main test. The mean differences in the learning scores of any two of the four groups are presented in Table 10.

To ascertain whether these mean differences are significant, critical difference levels for trials and errors were calculated. In Table 10 it will be seen that those mean differences that exceed the

Table 9

Mean Learning Scores of Four Different Groups

GROUPS	N	TRIALS			ERRORS		
		Initial Test	Main Test	Adjusted* Means	Initial Test	Main Test	Adjusted* Means
Response Satiation	12	15.92	15.00	15.06	52.92	41.50	41.30
Stimulus Satiation	12	15.88	14.58	14.66	53.33	45.75	45.34
Different Word Satiation	12	16.17	9.12	9.85	54.25	24.33	23.79
Retest Control	12	16.17	11.25	11.18	49.58	34.50	36.00

*Since the covariance analysis resulted in a significant F both in the case of trials and error measures, adjusted mean scores for the main test were calculated following Wert, Neidt, and Ahmann, 1954, p.351-352.

Table 10

Mean Difference in the Learning Scores of Four Groups in the Main Test[1]

GROUPS	TRIAL MEASURE Mean Difference	GROUPS	ERROR MEASURE Mean Difference
Response Satiation > Stimulus Satiation	0.04	Response Satiation < Stimulus Satiation	4.04
Response Satiation > Different Word Satiation	5.21**	Response Satiation > Different Word Satiation	17.51*
Response Satiation > Retest Control	3.88*	Response Satiation > Retest Control	5.30
Stimulus Satiation > Different Word Satiation	4.81**	Stimulus Satiation > Different Word Satiation	21.55**
Stimulus Satiation > Retest Control	3.48*	Stimulus Satiation > Retest Control	9.34
Different Word Satiation < Retest Control	1.33	Different Word Satiation < Retest Control	12.21

[1]All the mean differences are calculated from the adjusted means.

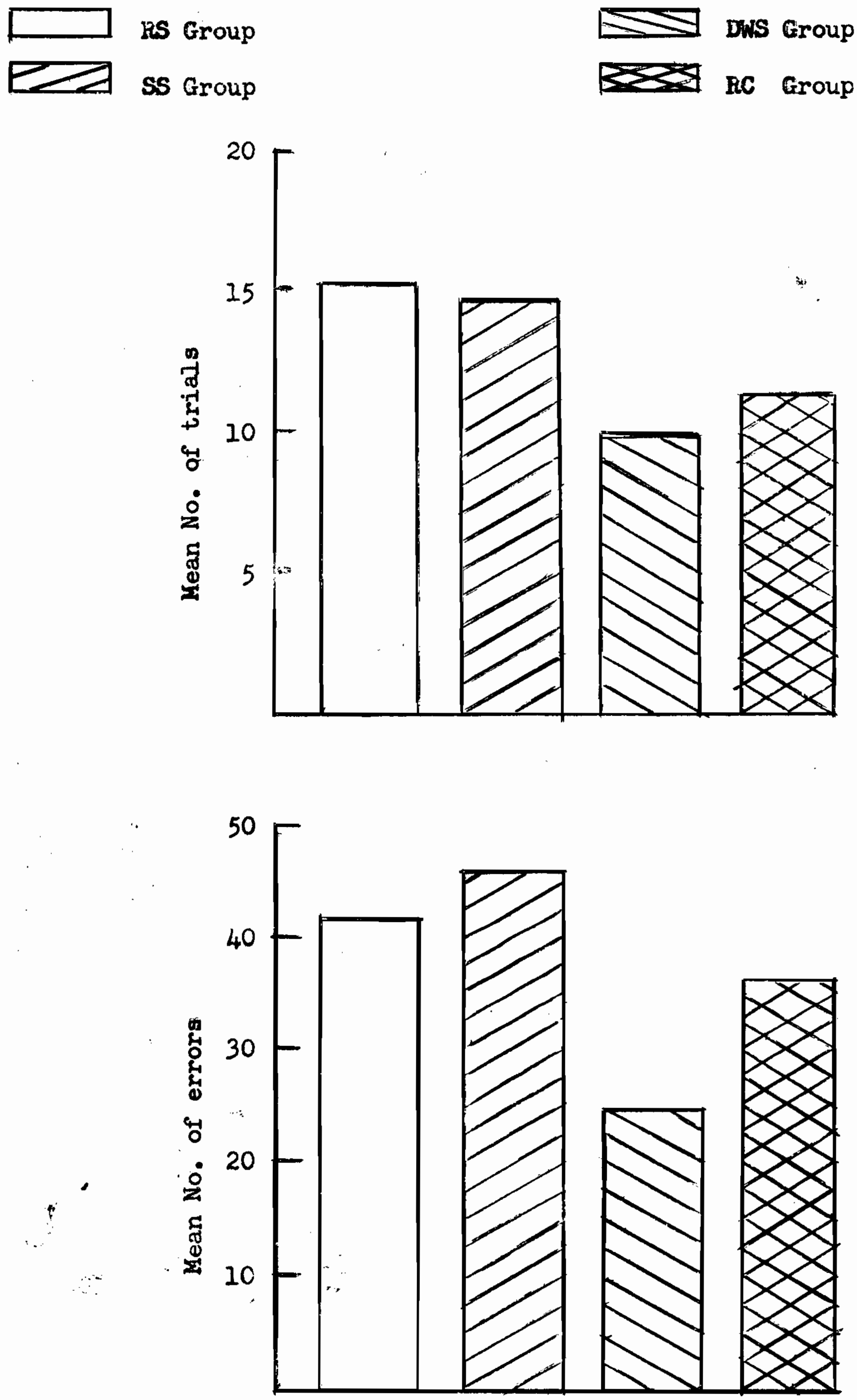
*These mean differences are significant at .05 level.

**These mean differences are significant at .01 level.

Figure 4

Mean Learning Scores for Different Groups in the Main Test

(Experiment II)



critical differences of 3.13 for trials and 15.76 for errors are significant at the .05 level. Similarly those mean differences that exceed the critical differences of 4.19 for trials and 21.09 for errors are significant at the .01 level. Bar graphs showing the mean learning scores of different groups on List 2 are presented in Figure 4.

An examination of Table 10 reveals that there is no difference between the two control groups, DWS and RC, with respect to their learning measures. Similarly no difference could be observed between the two experimental groups, RS and SS, suggesting that pre-learning satiation treatment administered to highly meaningful stimulus or response members does not result in any differential rate of paired-associate learning. However, comparison of each of the experimental groups with the control groups indicates that, in case of trial measures, both DWS and RC groups showed significant superiority over both experimental groups in their learning. The same trend is also shown in the case of error scores, except that the RC group is not significantly different from the RS or the SS groups. This is so because the RC group was slower than the DWS group in learning, as can be seen from the mean learning scores, even though the differences do not reach normal significance levels. There is no apparent reason why the RC group should be slower or faster in learning than the DWS group. The only explanation that seems plausible is that the Ss in the DWS group could build up a "performance set" for their learning during the pre-learning satiation treatment. The Ss in the RC group, however, lacked such a performance set, since they were asked to learn List 2 immediately after their arrival in the laboratory. Such a performance set by itself might in fact facilitate learning as is seen in the case of the DWS group. Furthermore, the DWS group should be considered the more appropriate control for comparison with the RS and SS experimental groups since all the three groups have the same opportunity to develop a performance set. Members of the RC group had no pre-learning treatment and can logically be excluded from such comparisons because as Arnoult (1957) has pointed out, "in general, this type of control group is unsatisfactory in that there is no control for the factors of performance set" (p.341).

In summary, then, the results of this experiment confirm the earlier findings that the overall effect of satiation treatment on highly meaningful words is to decrease their meaning. The results also reveal that in the case of pre-learning satiation treatment both to the stimulus and to the response,an equal amount of negative transfer was produced when compared to the control in the learning situation.

Thus the effects of satiation of stimulus and response members of paired-associate lists do not support the predictions based on Osgood's transfer paradigm. According to Osgood, stimulus satiation should produce more negative transfer than either response satiation or the control condition. Likewise, response satiation should not produce any negative transfer as compared to the control, but should be either equal to or better than the control in terms of learning efficiency. Furthermore, the results do not confirm the prediction based on the assumption that in pre-learning satiation of stimulus or response members it is meaning alone which is modified and only such modifications in meaning influence subsequent paired-associate learning. According to such predictions, any modification in the response meaning is more influential on subsequent paired-associate learning than similar modifications in stimulus meaning.

According to this view, both response satiation and stimulus satiation should produce negative transfer as compared to the control, but the amount of negative transfer should be greater following response satiation than following stimulus satiation. The fact that the RS and SS groups did not differ in their learning scores in the present experiment suggests that both habit and meaning play a role in the satiation procedure and have a joint effect on learning. According to the associationistic interpretation of semantic satiation, during continual verbal repetition of a word, two events occur simultaneously: the development of a habit to connect the repeated word with itself, conceptualized as a positive reaction tendency, and a decrease in meaning.

How do these two factors operate in paired-associate learning? Osgood's transfer paradigm, emphasizing only the transfer of habit formed during satiation treatment, would not predict any negative transfer in the case of the RS as compared to the control group. Since the RS group did show a significant amount of negative transfer, it appears that the decrement in meaning effected during satiation treatment is an important factor influencing paired-associate learning. However, the decrement in meaning taking place during the satiation treatment cannot by itself explain the results of the present experiment. If decrement of meaning alone influences paired-associate learning, then the SS group should show less negative transfer than the RS group. The results, however, indicate that the SS group does not differ from the RS group in amount of negative transfer. This finding suggests that the total amount of negative transfer obtained in the SS condition can be attributed partly to the effect of decreased meaning and partly to the effect of the word-word habit formed during satiation. These two factors, meaning decrement and word-word habit,have differential effects on stimulus and response members in paired-associate learning. In other words, when response words are satiated, it is the change in the meaning which accounts for the whole of the negative transfer observed, a conclusion in line with the importance attributed to meaning for the response members of paired-associate lists (see Underwood and Schulz, 1960, pp.35-42). When the stimulus words are satiated, part of the negative transfer observed is accounted for in terms of a meaning decrement and partly in terms of a word-word habit formed during the pre-learning satiation treatment, a conclusion compatible with the importance attributed to response variation leading to negative transfer, discussed by Osgood, 1953, (pp.525-527).

Experiment III: With Nonsense S-R Pairs

Having arrived at a tentative two-factor theory to explain semantic satiation and its role or roles in paired-associate learning, the next step was to examine the influence of each of the two factors separately, keeping the other constant. Studies on the role of meaning in paired-associate learning have pointed out the important effects of change in meaning for response members of paired-associate lists (Cieutat, Stockwell & Noble, 1958). In line with these findings, the negative transfer from pre-learning response satiation to the learning situation obtained for the experimental group in Experiment I and also for the RS group in Experiment II was attributed to a decrement in the meaning of response words which presumably occurs during satiation treatment.

What, then, is the effect of a word-word habit, also presumably formed during the satiation treatment, on subsequent paired-associate learning? A direct answer to this question can be obtained by using verbal units having very low meaning and very low frequency value. Satiation treatment administered to such units should have a minor effect in decreasing the meaning of such items since they have little meaning to begin with. But satiation treatment applied to such units should lead to the formation of a word-word habit, a positive reaction tendency to connect the verbal unit with itself. The transfer effects of such habits on paired-associate learning can be studied.

Experiment III was designed to specify the role of the word-word habit formed during satiation treatment by making use of nonsense verbal units. The following hypotheses were formulated. Hypotheses 2 and 3 were based on Osgood's analysis of the relations among successively practiced activities (Osgood, 1953, pp.525 ff.).

1. Satiation treatment administered to nonsense verbal units should not result in any significant change in the meaning of those units.

2. When the stimulus items are given pre-learning satiation treatment, it is anologous to the response variation transfer paradigm (see Fig. 3), and therefore should yield negative transfer as compared to a control condition wherein words that are given satiation treatment do not enter into the learning task.

3. When the response items are given pre-learning satiation treatment, it is analogous to stimulus variation transfer paradigm (see Fig.3), and therefore should yield positive transfer as compared to the control.

Method. Thirty-six undergraduate students served as Ss in this experiment. None had previously participated in any psychological experiment.

Twenty two-syllable nouns were chosen from Noble's list (1952) on the basis of their low meaningfulness, and two lists of paired-associates, each containing five pairs, were prepared (see Appendix C, List 1 and List 2). Care was taken to equate the meaningfulness of the stimulus and the response members of each list. Each of the stimulus and response members of both lists with their respective m values are presented in Appendix C. Each list was printed on a strip of paper in six different random orders, in a menner suited to the standard anticipation procedure using a memory drum. A 3-sec. interval separated the presentation of the stimulus and the stimulus-response pair, and a similar interval elapsed before the presentation of the next stimulus. The inter-trial interval was 6-sec.

Another five two-syllable nouns were chosen as controls, again from the same list (Noble, 1952) on the basis of their low meaningfulness. The average m value of the control words was matched with the average m value of either the five stimulus or the five response words of List 2. These words were used as controls in the sense that they were not to enter into the learning task after they had been given the satiation treatment.

The semantic differential scales used in this experiment were the same three scales (good-bad; active-passive; strong-weak) which were used in Experiment II. Each word of paired-associate List 2 and each of the control words was printed on a separate 3 X 5 index card. Each semantic scale was also printed on a separate card. All cards were then placed in a Kardex folder so that E could expose them in a predetermined random order one at a time, as was done in Experiment II.

The design of this experiment was similar to that of Experiment II, except that the Retest Control (RC) group was eliminated. Furthermore, there was no need of counterbalancing for the word position effect since the items in the stimulus and the response positions of any pair in List 2 were perfectly matched for their initial meaningfulness (see Appendix C for their m values).

The procedure was also similar to that of Experiment II. Each S was tested twice individually. In the initial stage, S learned List 1 to a criterion of three consecutive successful anticipations (for instructions, see Appendix C). Three groups were formed, equated on the basis of their trial and error measures on the initial test. Each group was assigned to a different condition in the main stage of the experiment. As in Experiment II, there were two experimental groups, a Stimulus Satiation (SS), and a Response Satiation (RS) group. There was only one control group, the Different Word Satiation group (DWS), similar to the DWS group of Experiment II.

In the main stage of the experiment, which started approximately a week after each S's initial testing, the normal semantic profile of each of the response and stimulus words of List 2, and each of the control words were taken for Ss in the RS, SS, and DWS groups respectively. Each word was exposed for one sec. and then S indicated the appropriate semantic placement. Following this, S was given satiation treatment on the words for which he had already given the normal semantic profile. Thus, each S of the RS group was given satiation treatment on the response words of List 2, and similarly, each S of the SS group and each S of the DWS group were given satiation treatment on the stimulus words of List 2 and the control words respectively. For such treatment, a word was exposed for one sec., and then S was asked to continuously repeat the word aloud for 15 sec., at a rate of 3-4 repetitions per sec. Immediately after the repetition, he made his rating for the word on a semantic scale. This procedure was repeated three times for each word, once for each semantic scale.

Immediately after the satiation treatment, each S of the RS, SS, and DWS groups was presented the second list on the memory drum with instructions identical with those given for the learning of List 1. The procedure and the learning criterion used for learning List 2 were the same as those described for the initial stage of the experiment.

Results and Discussion. The data of this experiment were treated in exactly the same manner as for Experiment II. A one-way analysis of variance performed on both the trial and error scores of the initial test is presented in Table 11. Insignificant values of F ($F = < 1$), in the cases of both trial and error measures, reveal that the attempt to equate all three groups for their initial learning ability was successful.

Analysis of variance calculated for the semantic ratings of the three groups of Ss, both before and after the satiation treatment, is presented in Table 12. As will be noted, the between-conditions (before and after satiation treatment) F ratio is not significant. Similarly, the interaction effect is also not significant.

This supports our first hypothesis, that satiation treatment to nonsense verbal units should not result in any significant change in the meaning of those units. The between-group F ratio, however, is significant at the .05 level, suggesting that groups RS, SS, and DWS are different in their semantic ratings of the low meaning words. This finding necessitates a closer examination of the data. Table 13 presents the mean semantic ratings

Table 11

Analysis of Variance for Learning Data of the Initial Test

Learning Measures	Source of Variation	Sum of Squares	df	Variance Estimate	F	p
	Between Groups	0.38	2	0.19		
TRIALS	Within Groups	1502.51	33	45.53	0.004	n.s.
	Total	1502.89	35			
	Between Groups	3.39	2	1.69		
ERRORS	Within Groups	9505.51	33	288.045	0.005	n.s.
	Total	9508.90	35			

Table 12

Analysis of Variance of Semantic Ratings for Three Groups
(Groups RS, SS, and DWS)
Before and After Satiation Treatment

Source of Variation	Sums of Square	df	MS	F	p
1. Between Groups	64.656	2	32.328	4.603	$<.05$
Between *Ss* in the same group	231.737	33	7.022		
Total between *Ss*	296.393	35			
2. Between Conditions (Before and After Satiation Treatment)	0.16	1	0.16	0.586	n.s.
1 X 2	0.447	2	0.223	0.816	n.s.
Pooled *Ss* X 2	9.013	33	0.273		
Total within *Ss*	9.62	36			
TOTAL	306.013	71			

of each of the three groups both before and after the satiation treatment. A mean comparison between groups, considered two at a time, both before and after the satiation treatment, is also presented in Table 14.

Table 13

Mean Semantic Ratings of Low Meaning Words for Each Group

Groups	N	Before Satiation Treatment	After Satiation Treatment	Mean Change
Response Satiation	12	2.45	2.77	.32
Stimulus Satiation	12	1.92	1.90	.02
Different Word Satiation	12	0.35	0.33	.02

Table 14

Differences Between Groups in Their Mean Semantic Ratings of Low-Meaning Words

Groups	Before Satiation Treatment	After Satiation Treatment
Response Satiation $>$ Stimulus Satiation	0.53	0.87
Response Satiation $>$ Different Word Satiation	2.10	2.44*
Stimulus Satiation $>$ Different Word Satiation	1.57	1.57

*$p < .05$

The critical difference computed to be significant at the .05 level was 2.21. In Table 14 it will be observed that with respect to the initial semantic ratings before satiation treatment, none of the group comparisons show any significant mean difference. The only mean difference that attained significance ($p < .05$) was the difference between the mean ratings of the RS and DWS groups after their respective satiation treatment.

A one-way analysis of variance performed on the learning data of the main test is presented in Table 15. It reveals that there is insufficient evidence, both in the case of trial and error measures, to show any significant difference in the rate of learning as a result of different pre-learning treatments given to the different groups. The F ratio for the trial measures only approaches significance ($p < .10$). To increase the precision in the test of significance by controlling the initial differences in learning ability, a covariance analysis of the data was performed. The results of such an analysis are presented in Table 16. The analysis of covariance reveals that the three groups significantly differ only with respect to the trial measures ($p < .03$), and they do not differ with respect to the error measures ($p < .20$). Furthermore, the within-group correlation coefficient, in the case of trials, equals .61, and, in the case of errors, is .63, both significant at the .01 level. This again suggests that Ss who were fast learners in the initial test tend to be the fast learners in the main test as well. Thus, with the initial trial measures completely equated for the three groups, different pre-learning treatments did result in different rates of learning. Error measures, however, failed to reveal such a relationship.

Since the F value for the trial scores was significant, the adjusted criterion means of each group in the main test was computed. These are

Table 15

Analysis of Variance for Learning Data of the Main Test

Learning Measures	Source of Variation	Sum of Squares	df	Variance Estimate	F	p
	Between Groups	188.71	2	94.36		
TRIALS	Within Groups	1130.51	33	34.26	2.75	$<.10$
	Total	1319.22	35			
	Between Groups	407.16	2	203.58		
ERRORS	Within Groups	5139.59	33	155.75	1.31	n.s.
	Total	5546.75	35			

Table 16

Analysis of Covariance of the Performance of Three Groups of Subjects

Learning Measures	Source of Variation	Sum of Squares	df	Mean Square	F	p
	Total	903.369	34			
TRIALS	Within Groups	714.788	32	22.337		
	Adjusted Means	188.581	2	94.290	4.221	$<.03$
	Total	3523.389	34			
ERRORS	Within Groups	3082.221	32	96.319		
	Adjusted Means	441.168	2	220.584	2.29	$<.20$

presented in Table 17 along with the original means for both the trial and error measures in the initial as well as the main test. The mean differences in the learning scores (both trials and errors) of any two of the three groups are presented in Table 18. To ascertain the significance of the mean differences in the case of trial measures, the critical difference of 3.13

Table 17

Mean Learning Scores of Three Different Groups

GROUPS	N	TRIALS Initial Test	TRIALS Main Test	TRIALS Adjusted* Means	ERRORS Initial Test	ERRORS Main Test
Response Satiation	12	17.67	10.67	10.61	35.83	16.33
Stimulus Satiation	12	17.58	15.92	15.91	35.08	24.42
Different Word Satiation	12	17.42	11.58	11.65	35.42	19.00

*Since covariance analysis resulted in a significant F only in the case of the trial measures, the adjusted means were calculated for them following Wert, Neidt, and Ahmann, 1954, pp.351-352.

Table 18

Mean Differences of the Learning Scores of Three Different Groups in the Main Test[1]

GROUPS	TRIAL MEASURE Mean Diff.	GROUPS	ERROR MEASURE Mean Diff.
Response Satiation < Stimulus Satiation	5.30*	Response Satiation < Stimulus Satiation	8.09
Response Satiation < Different Word Satiation	1.04	Response Satiation < Different Word Satiation	3.33
Stimulus Satiation > Different Word Satiation	4.26*	Stimulus Satiation > Different Word Satiation	5.42

[1]Mean differences for the trial measure were calculated from the adjusted means, and those for the error measures were calculated from the original means since the analysis of covariance performed on the latter resulted in an insignificant F.

*These mean differences are significant at the .05 level.

was calculated which is significant at the .05 level. Bar graphs showing the mean learning scores of different groups in the main test are presented in Figure 5.

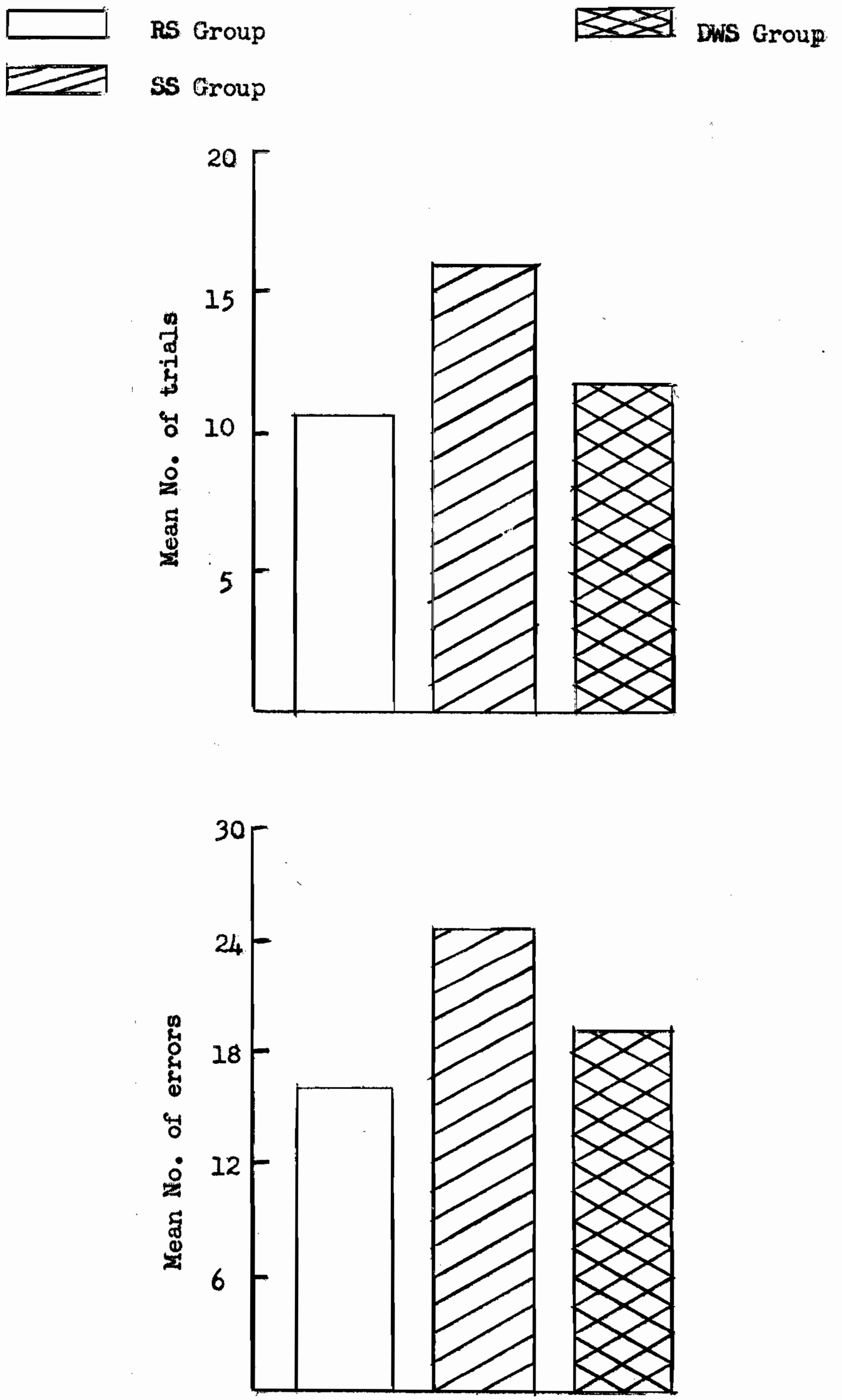
Results presented in Table 18 reveal that the SS group is significantly slower in learning than either the RS group or the DWS group. In the case of trial scores, the mean difference between the SS and the RS group is significant at the .05 level. Similarly, the mean trial difference between the SS and the DWS group is also significant at the .05 level. This, therefore, supports our second hypothesis that pre-learning satiation treatment given to the stimulus items should yield negative transfer as compared to the control. Such negative transfer cannot be attributed to the decrement of meaning of the stimulus items during the pre-learning satiation treatment because the satiation treatment did not produce any significant meaning decrement of the stimulus items for the SS group. Besides, the SS group is not significantly different in its mean semantic ratings from the DWS control group either before or after the satiation treatment (see Table 14). Thus it seems evident that the negative transfer obtained in the case of the SS group can only be attributed to the transfer of the positive reaction tendency of the word-word habit developed during the satiation treatment to the learning situation.

The results in Table 18 also reveal that there is no significant difference between the mean trial scores of the RS and the DWS group. This, however, does not support our third hypothesis which predicted that the response satiation condition, being analogous to a stimulus variation transfer paradigm, should yield positive transfer as compared to the control. At this point it may be pointed out that a stimulus variation transfer

Figure 5

Mean Learning Scores for Different Groups in the Main Test

(Experiment III)



paradigm yields positive transfer only through stimulus generalization, and such generalization should occur when there is a similarity between the practice and the test stimuli. In other words, if one first learns A-B and immediately after learns C-B, then the amount of positive transfer from A-B learning to C-B learning will depend upon the amount of similarity between A and C. The less the similarity between A and C, the less will be the positive transfer. In the present experiment, during satiation treatment to the response items, a positive reaction tendency to connect the response item with itself develops. For instance, one of the response items is "KUPOD." During the pre-learning satiation the "KUPOD-KUPOD" connection gets strengthened. In the learning situation, however, the S learns "WELKIN-KUPOD." The amount of positive transfer, in this case, will depend upon the similarity between the word "KUPOD" and the word "WELKIN" (as the stimulus members of the practice and the test phases respectively). Since the words "WELKIN" and "KUPOD" are similar only in the sense that they are both low meaningful words, little positive transfer should be expected in the present experiment. This is possibly the reason why the RS group did not differ significantly from the DWS group in the learning of List 2.

Thus, in conclusion, the results of this experiment demonstrated two different effects of the word-word habit formed during the pre-learning satiation treatment (practice phase) on the learning of paired-associates (test phase). First, in the case of the pre-learning satiation treatment of the stimulus members (for the SS group), negative transfer results because the responses of the practice and the test phases are different.

Second, in the case of the pre-learning satiation treatment of the response members (for the RS group), no positive transfer is obtained because the stimuli of the practice and the test phases are not similar.

From the above results it will be observed that the factor of a word-word habit *per se* generated in the satiation treatment has a greater influence on the stimulus members of the paired-associate task than on the response members. That is, satiation treatment given to the stimulus items produces negative transfer via transfer of the word-word habit formed during the treatment, but similar treatment to the response items does not seem to have any effect on learning through this habit factor. Thus in this attempt to specify the roles of habit *per se* and meaning decrement, it becomes evident that the two factors have differential effects on the stimulus and response positions in a paired-associate learning task. A decrement in the meaning of the responses produces greater variance in learning performance as compared to a similar decrement in the meaning of the stimuli. In contrast, an increase in the strength of the habit of connecting the stimulus with itself produces greater variance in the learning performance as compared to the similar habit strength of connecting the response with itself.

CHAPTER IV

THE ROLE OF INTERPOLATED SEMANTIC SATIATION ON RESPONSE RECALL

It was of interest to relate the phenomena of semantic satiation to another aspect of verbal learning, that of retroactive interference. In the preceding chapter, the two experiments that were reported related the effect of semantic satiation on subsequent learning, and the results were interpreted in terms of pro-active transfer. A two-factor theory was advanced to explain both the semantic satiation phenomenon and its pro-active transfer effects on paired-associate learning. The same line of reasoning can be extended to the study of the role of semantic satiation on response maintenance, rather than on response acquisition.

Here a reference should be made to two studies (Gaynor, 1954; and Peak and Deese, 1937) dealing with response maintenance as a function of repeated presentation of the stimulus. Both studies used low meaningful verbal units and found that the paired-associate connection can be retroactively disrupted by repeated presentation of the stimulus alone immediately after learning. There has not been any study showing such retroactive effects using highly meaningful material.

Experiment IV: With Meaningful S-R Pairs

Experiment IV was designed to study the disrupting effect of semantic satiation on response recall, when satiation treatment is given immediately after learning. Using a paired-associate task, the present study compared the effects of the satiation treatment on the stimulus and the response members of paired associates when the treatment was presented after the association had been learned. In this case both stimulus and response members were meaningfûl words. Use was made of a simple retroactive inhibition design, summarized in Fig. 6. During the original learning phase, the S-R connections were established, while during the interpolated phase either stimulus (for one group) or response elements (for the second group) were given the satiation treatment, and finally recall of response elements was tested when stimuli were presented.

This design permits one to ascertain whether the satiation procedure will have a detrimental effect on S-R associations which have been formed. Thus, if the association "table-star" has been made, we are concerned with the consequences of satiation treatment given to either "table" or "star" on the association.

Figure 6

Schematic Representation of the Procedure, Experiment IV

Phase	Stimulus Condition	Response Condition
I. Learning	S-R (4 trials)	S-R (4 trials)
II. Interpolated Period	satiation for half of stimulus members	satiation for half of response members
III. Recall	S-R	S-R

According to the two-factor theory of semantic satiation advanced in the preceding chapter, one would predict that there will be greater decrement in recall when the satiation treatment is given to the stimulus members. Here it is argued that continual repetition of a stimulus member (table, table, table, etc.) would strengthen the tendency for "table" to be given as a response to the stimulus "table," and this new S-S bond would interfere with the previously established S-R association. However, when a R-R connection in the retroactive paradigm is strengthened by continual repetition of a response member, it would not interfere with the already established S-R bond. The main purpose, then, is to determine if interpolated satiation actually does promote retroactive inhibition in verbal learning, and if so, whether the results will be consistent with the above prediction.

Method. Fifty-two undergraduate students served as Ss in this experiment. None had previously participated in an experiment of this type. Several quite different methodological procedures were used. Using meaningful words as stimulus and response members, a list of 12 paired-associates was prepared (See Appendix D). The words were chosen on the basis of their high frequency of usage in print (Thorndike & Lorge, 1944) and/or their high connotative meaning (Jenkins, Russell & Suci, 1958). Each of the 12 pairs was judged (by 12 students acting as judges) to have little or no immediate association between its stimulus and response members.

Each paired-associate pair was printed on a separate 5 X 3 in. card. Furthermore, each stimulus and response member was printed on a separate card. These cards were placed in a Kardex folder so that E could expose them in a predetermined random order. Each stimulus word was placed immediately before the paired-associate pair to which it corresponded so that E could expose the stimulus-response pair after the exposure of the stimulus word in a reliably constant manner with a minimum of delay. Three semantic scales were used for semantic ratings. These were: good-bad, active-passive, strong-weak.

The study used two test conditions, a "Stimulus Condition" and a "Response Condition." Each test condition was in the form of a retroactive inhibition paradigm and was divided into three phases (see Fig.6).

The learning phase was identical for both test conditions. Each S was given 4 trials, a complete trial consisting of the exposure, in a predetermined, random order, of each stimulus member of the paired-associates followed by the stimulus-response pair. Each stimulus member and each paired-associate pair was exposed for 3 sec. and a 10 sec. delay was given between trials.

After 4 learning trials, Ss were assigned to either the Stimulus or Response Condition depending on their learning efficiency, equating the two groups on paired-associate learning ability.

In the stimulus condition, the S's normal semantic profiles for all 12 stimulus words were first obtained. Each word was presented three times (for 1 sec. each time) for measurement on the three semantic scales. The words and scales were also presented in a predetermined randomized order.

Each of the 12 stimulus words was placed in one of two categories, Satiation Category (S.C.) or Non-satiation Category (N.S.C.). One half of the stimulus members of paired-associates which had been learned by the fourth learning trial were grouped in the S.C., while the other half were grouped in the N.S.C. Cases where odd numbers of associations had been learned were balanced through the total group. Further, one half of the stimulus members of paired-associates which had not been learned by the fourth learning trial were grouped in the S.C., the other half in the N.S.C.

Each word in the S.C. was exposed for 1 sec. and Ss were asked to repeat the word aloud for 15 sec. at a rate of 2-3 repetitions per sec. Immediately after the continual repetition, Ss rated the word on one of the three semantic scales. Each word in the N.S.C was exposed for 1 sec. and Ss rated it immediately after exposure. After the list had been subjected to this treatment once (each word in the S.C. receiving satiation treatment and measured on one scale, and each word in the N.S.C merely measured on one scale) all words were then rated in the usual way on the remaining scales. That is, each stimulus word was exposed for 1 sec. and then rated immediately on one of the two remaining scales. Note that the satiation treatment was only given once, before one of the semantic ratings, not before each rating as was the case in Experiment I. Initial and final semantic ratings were subsequently compared.

In the response condition, the procedure was identical to that for the stimulus condition, except that the response rather than the stimulus members were grouped into S.C. or N.S.C categories and then given the satiation treatment.

It can be seen from this procedure that words in the S.C. and words in the N.S.C. were exposed an equal number of times to the Ss. Furthermore, due to the equal division of the words belonging to correctly learned paired-associates into the S.C. and the N.S.C. in each test condition, a basis was established for comparing the effects of satiation and non-satiation treatments on the recall of learned paired-associates. Likewise, due to the division of the study into two test conditions, a basis was created for comparing the effect of satiation treatment given to stimulus and response words on their recall.

The recall stage of the study was identical for both test conditions. Ss were shown each stimulus word for 3 sec. and asked to recall the response word paired with it. The list was subsequently learned to a criterion of one perfect trial.

Results and Discussion. Table 19 presents the mean change in semantic polarity scores for stimulus and response words, respectively. It can be seen that in both cases the reduction in intensity of meaning as measured by the semantic differential is significant for words given satiation treatment ($p < .01$ for both stimulus words and response words). On the other hand, words not given satiation treatment showed no significant semantic change.

Table 20 presents the mean drop in recall scores for Ss under the stimulus condition. It will be noted that the mean drop in recall of learned paired-associates of which the stimulus member was given satiation treatment is 1.27. The mean drop in recall of paired-associates of which the stimulus members were in the N.S.C is .58. The difference between these means is highly significant ($p < .001$).

It can be seen that the mean drop in recall scores for learned paired-associates of which the response members were given satiation treatment was .69 and the mean drop in recall for learned paired-associates whose response members were in the N.S.C. is .81. The difference between these two means, of course, was not significant.

Some of the paired-associates which were originally unavailable to Ss after 4 learning trials were available at recall. It is difficult to speculate as to whether these paired-associates were at an "oscillation period" of availability (Osgood, 1953, pp. 503-504) or whether they were learned during the fourth trial when the correct response to the stimulus was exposed, or whether they were somehow made available during the interpolated period. Whatever the source of learning, its pattern is consistent with the other results. Of the 30 paired-associates unavailable after 4 trials in the stimulus condition which were subsequently available at recall (a total of 30 paired-associates for the group) 19 were ones whose stimulus members were in the N.S.C. while only 11 were ones whose stimulus members were in the S.C. Furthermore, of the 25 paired-associates unavailable after 4 trials in the Response Condition which were available at recall, 16 were ones whose responses were in the N.S.C. while 9 were ones whose responses were in the S.C. These observations clearly follow the trends established by the results presented in table 20.

The findings of the fourth experiment demonstrate that paired-associate connections can be retroactively disrupted if the satiation treatment is given to the stimulus members. However, associational bonds are not affected by satiating response members of already learned paired-associates.

It is possible to account for the above results in terms of the two-factor theory of semantic satiation advanced in the preceding chapter. If the interpolated satiation treatment involves formation of a positive reaction tendency or a word-word habit, then in the present experiment both the stimulus and the response satiation conditions can be considered analogous to the stimulus and the response variation retroaction paradigms,

Table 19

Average Change in Polarity of Paired-Associate Members over the Sum of Three Scales

		First Rating		Second Rating		Mean Change				
	Conditions	M	SD	M	SD	M	SD_D	SE_M	t	p
STIMULUS MEMBERS	Satiated	4.77	1.05	4.18	1.25	.59	.99	.20	2.95	$<.01$
	Non-satiated	4.89	1.15	5.09	1.16	.20	.62	.12	1.66	n.s.
RESPONSE MEMBERS	Satiated	4.97	1.52	4.46	1.26	.51	.73	.15	3.40	$<.01$
	Non-satiated	4.60	1.27	4.66	1.38	.06	.61	.12	.50	n.s.

Note: 26 Ss took part in each of the test conditions (Stimulus and Response).

Table 20

Effect of Satiation Treatment of Paired-Associate Members on the Recall of Paired-Associates

	Condition	Drop in Recall Scores M	SD	MD	SD_D	SE_M	t	p
	Satiated	1.27	.86					
STIMULUS MEMBERS				.69	.91	.18	3.78	$<.001$
	Non-Satiated	.58	.84					
	Satiated	.69	.82					
RESPONSE MEMBERS				.12	.85	.17	.68	n.s.
	Non-Satiated	.81	.68					

Note: 26 _Ss_ took part in each of the conditions (Stimulus and Response).

respectively. A schematic comparison between the two conditions of the present experiment and the respective retroaction paradigms is presented in Figure 7. Osgood (1953) has stated some empirical laws of similarity relations for each of the retroaction paradigms. According to Osgood (1953), in the case of response variation retroaction paradigms, where the stimuli of the original and interpolated learning situations are functionally identical and the responses are different, retroactive interference is obtained. For instance, if one first learns A-B, and then learns A-C, Response C interferes with Response B, and therefore makes Response B less available for Stimulus A. In the present experiment, the stimulus satiation condition is analogous to the response variation. In this condition, for example, S learns "Sin-Calm," and then is given satiation treatment to "Sin", whereby he is presumably forming the habit "Sin-Sin." The reaction tendency to evoke "Sin" as a response to the stimulus "Sin" during satiation treatment should interfere with the original response "Calm." This type of response interference explains the disruptive effect of stimulus satiation applied to response recall.

Furthermore, according to Osgood, in the stimulus variation paradigm, where the responses are identical but the stimuli of the original and the interpolated learning varies, retroactive facilitation should be obtained. In the present study, the response satiation condition is analogous to such stimulation variation (see Figure 7), but it fails to show any facilitating effect. The reason why such retroactive facilitation could not be obtained must depend upon factors other than the formation of the word-word habit *per se* during the interpolated period. It seems logical from the point of view of the two-factor theory of satiation to presume

Figure 7

Analogous Retroaction Paradigms for Experiment II

Phase	Response Variation (Stimulus Condition)	Stimulus Variation (Response Condition)
1. Learning	S_1- R_1 (A - B) e.g."House-Star"	S_1- R_1 (A - B) e.g. "House-Star"
2. Interpolated Period	S_1- R_2 (A - A) e.g."House-House"	S_2- R_1 (B - B) e.g. "Star-Star"
3. Recall	S_1-R_1 (A - B) e.g."House-Star)	S_1- R_1 (A - B) e.g. "House-Star"

that the reduction of meaning of the response items during the interpolated period might have counter-acted the facilitating effect of word-word habit. This explanation, however, leads to the theoretical expectation that the retroactive facilitation effect can be obtained after interpolated satiation treatment to the response items if one uses nonsense verbal units as responses. With such units, meaning is at a minimum and therefore there would be little scope for any further meaning reduction as a result of the satiation treatment, and consequently nothing will happen to counteract the facilitating effect of habit *per se*.

CHAPTER V

A TENTATIVE THEORETICAL FORMULATION OF THE EFFECTS OF FREQUENCY OF STIMULATION

The results of the experiments reported emphasize the role of semantic satiation as an important variable in paired-associate learning. In this chapter, a tentative theoretical framework is presented which serves three purposes. First, it attempts to relate certain experimentally controlled manipulations at the input phase of human behavior (independent variables such as frequency of stimulation) to certain observed behavioral consequences at the output phase (dependent variable such as paired-associate learning). In trying to do so, it makes use of some inferred intervening operations or variables. Secondly, it tries to integrate empirical findings and to resolve some of the apparent anomalies existing in the field of paired-associate learning as affected by meaning change. Lastly, such a theoretical system gives rise to a number of testable predictions for future investigation.

Relating Independent and Dependent Variables

There are two types of studies dealing with the effects of experimentally produced meaning change on paired-associate learning: the familiarization studies (Underwood & Schulz, 1960) and the semantic satiation studies reported in this thesis. In the familiarization studies, investigators (for example, Sheffield, 1946) find that prelearning familiarization training has consequences similar to the effect of increasing meaning. Researchers have inferred that the intervening operation must have at least functional congruency with an increase in meaning. In the semantic satiation studies, it was observed that prelearning satiation treatment results in a measurable decrease in the meaning of verbal units. From the point of view of the experimental control used in these studies, it is interesting to note that both the familiarization and the satiation treatments involve frequency of exposure or stimulation (n) of the verbal units. The only difference between the two treatments is that familiarization involves relatively small amounts of spaced stimulation (ranging from n = 0 to 25) while the satiation procedure involves a substantial amount of massed stimulation ranging approximately from n = 100 to 200). Since nothing is known about the effect of the intermediate range of stimulation, both treatments, familiarization (n_1) and satiation (n_2) will be discussed separately for their effects on paired-associate learning, assuming that both belong to a common continuum, n.

With respect to the general effects of these two treatments on verbal learning, it may be pointed out that treatment n_1 results in a positive transfer effect, whereas treatment n_2 results in a negative transfer effect. Such general effects of the treatments, however, depend upon the nature of the verbal material used. For instance, the verbal materials used in a verbal learning experiment can range from highly meaningful to completely nonsensical on a meaning dimension, from a highly frequently used to infrequently used, on a frequency dimension. Thus, depending on the nature of the verbal material, the amount of positive transfer effect attributable to treatment n_1 and the amount of negative transfer effect attributable to treatment n_2 will vary. The nature of such variations will be discussed. A schematic representation of the relations among treatments, the nature of the materials used, the presumed intervening processes, and the behavioral consequences is presented in Figure 8.(a and b)

Figure 8a

A Conceptual Framework Explaining the Role of Familiarization and Satiation in Paired-Associate Verbal Learning

INDEPENDENT VARIABLES: Experimental Manipulation of n	Nature of Verbal Material	Inferred Intervening Processes	DEPENDENT VARIABLES: Predictions in Paired-Associate Learning (S^* Vrs C, R^* Vrs C^*, S Vrs R)	Experimental Evidence in Support
n_1 (Familiarization training that promotes positive transfer effect.)	Meaningful Words	Familiarity per se	$S = C, R = C, S = R,$	
	Nonsense Material	Familiarity per se	$S > C, R = C, S > R,$	Gannon & Noble (1961) Hakes (1961)
		Familiarity per se + Increase in M	$S > C, R \gg C, S < R,$	Sheffield (1946) Morikawa (1959) Schulz (1958)

*S refers to Stimulus Condition and R and C refer to Response and Control Conditions, in designs for studying the roles of treatments n_1 and n_2 applied to stimulus and response members of a paired-associate list on subsequent learning.

Figure 8b

A Conceptual Framework Explaining the Role of Familiarization and Satiation in Paired-Associate Verbal Learning

INDEPENDENT VARIABLES: Experimental Manipulation of n	INDEPENDENT VARIABLES: Nature of Verbal Material	Inferred Intervening Processes	DEPENDENT VARIABLES: Predictions in Paired-Associate Learning (S* Vrs C, R* Vrs C*, S Vrs R)	A Experimental Evidence in Support
n_2(Satiation treatment that promotes negative transfer effect)	Nonsense Material	Word-word Habit Formation	S > C, R = C, S > R,	Exp.III
	Meaningful Words	Word-word Habit Formation	S > C, R = C, S > R,	To be tested
		Habit, per se + Decrease in M	S ≫ C, R ≫ C, S = R,	Exp.II

*S refers to Stimulus Condition and R and C refer to Response and Control Conditions, in designs for studying the roles of treatments n_1 and n_2 applied to stimulus and response members of a paired-associate list on subsequent learning.

Using verbal material having low meaning and low frequency, several experiments dealing with the locus of familiarization in paired-associate learning have produced conflicting results, though all of them suggest that treatment n_1 is facilitative. On the one hand, studies by Sheffield (1946), Weiss (1958), Morikawa (1959), Schulz (1958), and Mandler and Campbell (1957), show that treatment n_1 applied to response items leads to greater facilitation in learning than does a similar treatment given to stimulus items. On the other hand, results from the studies by Cieutat (1960), Gannon and Noble (1961), and Hakes (1961), indicate the opposite, i.e., that treatment n_1 applied to the stimulus items leads to greater positive transfer than does similar treatment given to the response items. These results seem contradictory when it is presumed that treatment n_1 affects paired-associate learning only by increasing the meaning of the verbal units, as has been suggested by Sheffield (1946). But such a presumption may not always be correct. A recent experiment by Riley and Phillips (1959) suggests that treatment n_1 applied to nonsense material increases familiarity *per se*, but does not increases the meaningfulness of the material. In other words, a familiarized nonsense syllable may still be nonsensical. Similarly Gannon and Noble (1961) point out that experimentally increasing *n* may not affect the meaningfulness of the word. In view of the fact that familiarity *per se* and meaning are independent variables affecting verbal learning, as has been shown by Epstein, Rock, and Zuckerman (1960), it is interesting to conceive of these two variables as two different consequent conditions of the same treatment. Thus, if we assume that in some experiments (such as those of Gannon and Noble, 1961, and Hakes, 1961), treatment n_1 did not lead to any increase in meaning, but affected learning only through familiarity, whereas in other experiments (such as Sheffield, 1946, and Schulz, 1958), both familiarity and meaning of the verbal units were increased, then the apparent contradictions seem to be resolved. In other words, meaning as a variable still retains its importance for the response positions in paired-associate learning and familiarity *per se*, resulting directly from frequency of stimulation (*n*), seems to be important for the stimulus positions. Thus, as a result of treatment n_1, when meaning is increased, response familiarization will produce greater positive transfer than stimulus familiarization as indicated by the studies of Schulz (1958), and Sheffield (1946). If, however, treatment n_1 does not affect meaning at all, then stimulus familiarization will produce greater positive transfer than response familiarization, as shown by Gannon and Noble (1961), and Hakes (1961).

This interpretation is similar to the two-factor hypothesis suggested by Gannon and Noble (1961) to account for their results. According to them, familiarization or frequency of stimulation (*n*) "is sufficient to influence behavior via the S term alone (Stimulus predifferentiation), whereas *m* is jointly necessary to affect behavior via the R term (response patterning)" (p.20). At present, however, to settle the familiarization issue by substantiating the interpretation presented above, research attempts should be directed to measure the effects of treatment n_1 on the meaning of the materials used in familiarization studies.

When treatment n_1 is given to highly meaningful words having high frequency of usage, the amount of positive transfer on their subsequent acquisition will be substantially reduced. The reasons are obvious. These words are familiar to the subjects to begin with. So a few more familiarization trials (exposures to these words) will add very little to the already existing frequency level and will not markedly affect subsequent learning by way of increasing familiarity _per se_. Similarly, since these words are already loaded with meaning, treatment n_1 will not add much to their meaning and will show little facilitating effect on their acquisition. Thus it is unlikely that the effects of treatment n_1 , either through familiarity _per se_ or through increasing meaning, will show up when highly meaningful words are used as material in paired-associate learning tasks. In other words, treatment n_1 applied to nonsense words of low frequency will produce greater changes in the rate of learning than similar treatment given to highly meaningful words. This is the reason why experiments dealing with the role of familiarization on learning have used nonsense verbal units rather than meaningful ones.

When considering the role of satiation treatment on paired-associate learning, again the cases of nonsense and meaningful material have to be considered separately. As already suggested, during the satiation treatment a positive reaction tendency presumably develops for the verbal unit to be connected with itself. In the case of highly meaningful words, the development of such a habit is presumably accompanied by the extinction of meaning. But in the case of low meaningful material (nonsense syllables or even words like "of", "and", etc.), treatment n_2 promotes the word-word habit, without having much effect on meaning.

With nonsense verbal units having low frequency value, treatment n_2 will affect paired-associate learning through the transfer of the habit formed during satiation treatment. Thus, as the results of Experiment II revealed, treatment n_2 applied to the stimulus items produces negative transfer while similar treatment given to the response items produces little positive transfer when compared to the control. In other words, the stimulus satiation condition is analogous to A-A learning preceding A-B learning and constitutes a negative transfer paradigm. Response satiation on the other hand is analogous to B-B learning preceding A-B learning, and represents a positive transfer paradigm (see Osgood, 1953, p.525 ff). In the response satiation condition, stimuli B and A are different and there would be little stimulus generalization from the satiation treatment situation to the learning situation, accounting for the fact that the response satiation condition does not produce any positive transfer as compared to the control.

Before dealing with the effect of treatment n_2 on meaningful words having high frequency value, it is important to make a distinction between two categories of words. There are some words, mostly nouns and adjectives, which have high meaning as well as high frequency of usage. Secondly, there are words, such as "of," "and," and other conjunctions and prepositions, which are frequently used but have little meaning. A word from this category has low meaning because, by itself, it does not have the capacity to function as a symbol. In this respect it is very much like a nonsense syllable. It derives its functional significance by being used with other more meaningful words in a sentence.

In view of the fact that the words belonging to the second category have low meaning, it is expected that the effect of satiation treatment on subsequent paired-associate learning using these words will be similar to the effect of satiation treatment given to nonsense verbal units, as discussed earlier. However, it seems that the effects will be less apparent, as the rate of learning in the case of these low meaning but highly used words will be faster than nonsense verbal units having low frequency value.

With respect to highly meaningful words, satiation treatment will promote a decrease in meaning. Thus, as was seen in Experiment II, both in the stimulus satiation and in the response satiation conditions, there will be a meaning decrement in the stimulus and the response items respectively. Since a given variation in response meaning should produce a greater difference in the learning rate than a corresponding change in the meaning of stimuli, it would be expected that satiation treatment applied to response items should produce greater negative transfer than similar treatment applied to stimulus items. But it is also presumed that the satiation treatment involves formation of a habit in addition to changing meaning, and further that such a habit influences the stimulus items of S-R pairs. Therefore, it is reasonable to presume that satiation treatment applied to stimulus items will produce negative transfer through the development of this word-word habit. In effect, satiation treatment given to the stimulus items produces about as much negative transfer as is produced by satiation treatment applied to response items.

In order to explain the effects of both treatments n_1 and n_2 on paired-associate learning, one needs to assume the presence of two intervening variables. In the case of treatment n_1 these are familiarity _per se_ and increase in meaning. In the case of treatment n_2 these are habit _per se_ and decrease in meaning. It may be noticed that familiarity _per se_ in the case of treatment n_1 and habit _per se_ in the case of treatment n_2 are a direct function of frequency of stimulation (_n_). Therefore, both of them can be conceptualized as variations of a single factor, practice (P).

In other words, low P with the verbal unit in the case of treatment n_1 produces what is commonly spoken of as familiarity, and high P with the verbal unit in the case of treatment n_2 produces a habit. Besides P, the other intervening variable is meaning (M). In the case of treatment n_1, M may or may not increase, whereas in the case of treatment n_2, M decreases. The relation of these two intervening variables, P and M, with treatments n_1 and n_2 is schematized in Figure 9.

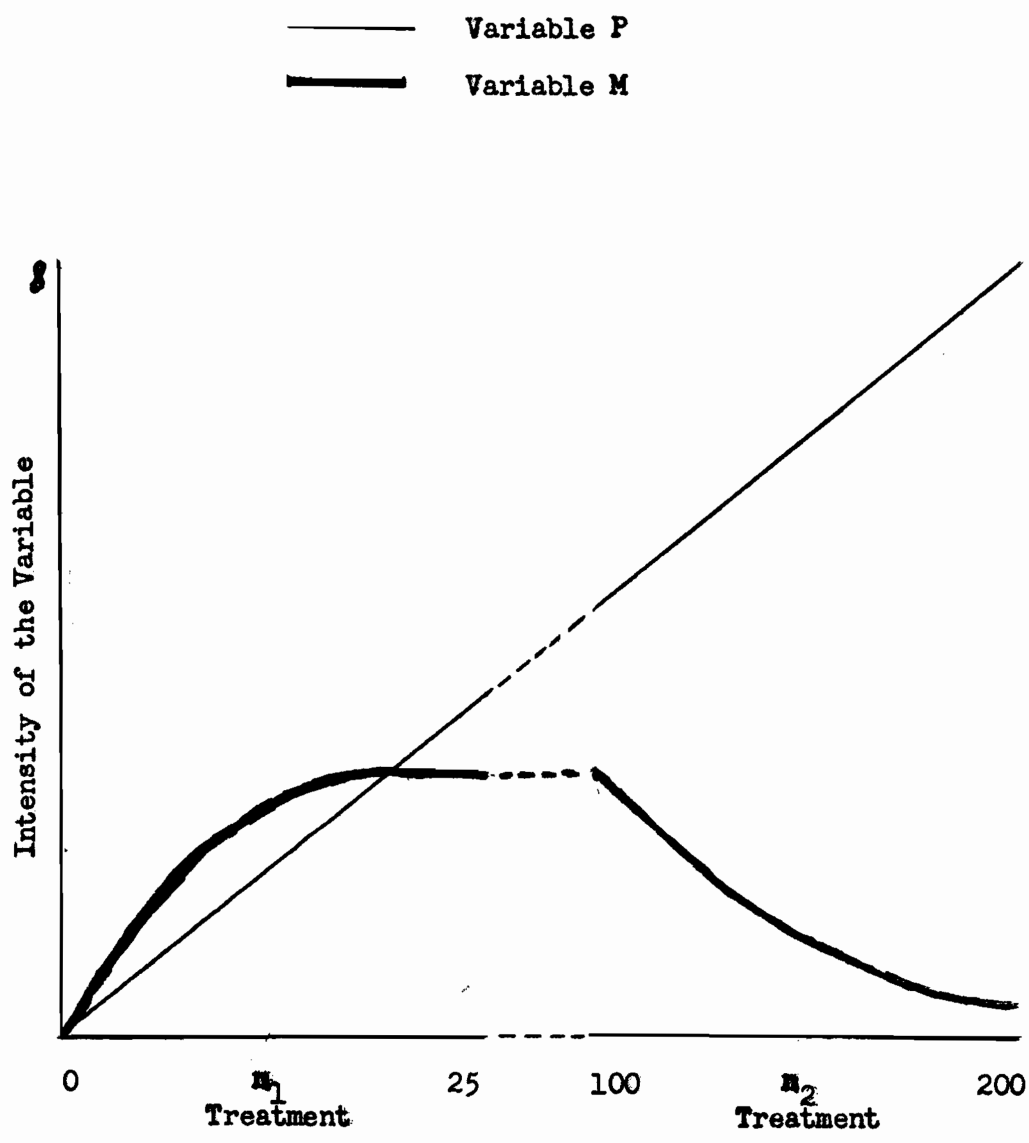
As to the specific roles of variables P and M in paired-associate learning, the empirical findings from both the satiation and the familiarization studies support the contention that variable M is more influential on verbal items in the response position than on those in the stimulus position while variable P is influential on the stimulus position alone in a paired-associate task. In other words, assuming that treatments n_1 and n_2 only affect M and not P, treatment n_1 applied to response items should produce greater positive transfer than similar treatment applied to stimulus items. Treatment n_2 applied to response items should produce more negative transfer than when similar treatment is given to stimulus items. Furthermore, if it is assumed that treatments n_1 and n_2 affect P and not M, then treatments n_1 and n_2 applied to stimulus items should produce positive and negative transfers respectively as compared to their respective controls, but either of the treatments applied to response items should produce no such effect.

Some Testable Generalizations for Further Research

On the basis of the two-factor theory offered to explain the effects of the experimental manipulation of *n* on paired-associate learning, the following generalizations are made. These generalizations, however, deal with the effects of satiation treatment on paired-associate learning. The first three generalizations state the transfer effects of the satiation

Figure 9

Theoretical Curves Showing the Changes in the Variables P and M as a Function of Treatments $\dot{n}_1$ and $\dot{n}_2$



treatment on stimulus-response acquisition, and the other two state the interference effects of interpolated satiation treatment on response recall.

(a) For S-R pairs composed of low meaningful stimulus items, satiation treatment produces negative transfer, the magnitude of which increases as the meaning of the stimulus item increases.

(b) For S-R pairs composed of high meaningful response items, satiation treatment produces negative transfer, the magnitude of which decreases as the meaning of the response item decreases.

(c) For S-R pairs composed of highly meaningful items, satiation treatment applied to either the stimulus item or the response item produces an equivalent amount of negative transfer. With S-R pairs composed of low meaning items, satiation treatment applied to the stimulus item only produces negative transfer.

(d) Interpolated satiation treatment applied to low meaningful response members of S-R pairs will produce retroactive facilitation, the magnitude of which will decrease as the meaning of the response member increases.

(e) Interpolated satiation treatment applied to the stimulus member will always produce retroactive interference irrespective of its meaning.

The empirical validity of the above generalizations, and therefore of the theory underlying them, will depend upon future research.

CHAPTER VI

SUMMARY

The role of semantic satiation in paired-associate learning was investigated in a series of studies. In the first experiment, two groups of 15 Ss each were matched in an initial test on the basis of their learning measures. In the main test, both the groups learned a paired-associate list. Immediately before learning, the experimental group received the satiation treatment for the response members of the S-R pairs while the control group was given similar treatment to control words which were not to appear in the list to be learned. Results indicated that: (a) the satiation treatment applied to words led to a reliable drop in their meaning as measured on semantic scales; (b) the experimental group was reliably slower in learning than the control group. It was concluded that an experimentally-produced decrease in the response meaning of response items has an inhibitory effect on subsequent acquisition. Semantic satiation was viewed as a form of simple associative learning in which a decrement in meaning is accompanied by the development of a word-word habit.

These findings necessitated further analytic studies to determine the differential effect of satiation on the stimulus and the response members of paired-associate lists. Experiment II, using a list of highly meaningful S-R pairs, was designed for this purpose. Four groups of 12 Ss each were matched for their learning ability on an initial test. In the main test one group (RS) learned the list after response members were satiated, another group (SS) learned the list after stimulus members were satiated, a third group (DWS) learned the list after words that were not

to appear in the list to be learned were satiated. The fourth group (RC) learned the list without any prior treatment. The results confirmed the earlier finding that the overall effect of satiation treatment on highly meaningful words is to decrease their meaning. Furthermore, both experimental groups (RS and SS) were equally slower in learning than the control groups (DWS and RC).

The results were interpreted in terms of two factors assumed to be involved in the satiation procedure: meaning decrement and the development of a word-word habit. The meaning decrement of the response members explained the poor learning of the RS group. The poor learning of the SS group, however, was explained partly in terms of meaning decrement and partly in terms of the development of a word-word habit.

Experiment III was designed to specify the role of the word-word habit formed during satiation treatment by making use of nonsense S-R pairs. Three groups of 12 Ss each were matched for their learning measures in an initial test. In the final test, the procedure was similar to Experiment II except that there was no RC group. Results indicated that the satiation treatment applied to nonsense words did not produce significant semantic change. Besides, the SS group was slower in learning than both the DWS control group and the RS group. The RS group did not differ from the DWS group in learning.

It was concluded that a decrement in the meaning of the response members of S-R pairs produces greater variance in rate of learning as compared to a similar decrement in the meaning of the stimulus members. But an increase in the strength of the word-word habit when the stimuli are given prior satiation treatment produces greater variance in the learning rate when compared to the strength of a word-word habit developed for response members when responses are given satiation treatment.

In Experiment IV, using a retroactive inhibition paradigm, the effect of the satiation treatment applied to stimulus members on the recall of already learned paired associates was studied. The satiation treatment resulted in significantly more retroactive interference than did the non-satiation control treatment. Similarly, the effect of satiation of response members during the interpolated period on recall of already learned paired associates was also studied and the results revealed no significant difference. Satiation treatment given to both the stimulus and the response words resulted in a significant reduction in the intensity of their meanings as measured by the semantic differential scales. The results were again interpreted in terms of the two-factor theory of semantic satiation.

Finally, a tentative theoretical framework was offered in which studies dealing with the role of manipulated frequency of stimulation and the role of meaning in associative learning were integrated.

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APPENDIX A

Materials and Instructions Used in Experiment I

APPENDIX A

1. Paired-Associate Lists

(a) List 1.

Stimulus	Response
YAF	HEALTH
MEJ	LEADER
VAH	HAPPY
DEJ	EFFORT
TUD	ARMY
NUY	FAMILY
PUV	MONEY
HIF	STREET

(b) List 2.

Stimulus	Response
ZUX	CAR
FAJ	HURT
KIV	DEVIL
ZER	SUCCESS
BOF	STUDY
WIB	TABLE
JUF	DOCTOR
YED	BABY

2. Control Words

TRUTH

BRIGHT

OCEAN

BIBLE

WAR

BROTHER

COAL

BOAT

3. Semantic Differential Scales

(a) GOOD :_____:_____:_____:_____:_____:_____:_____: BAD

(b) ACTIVE :_____:_____:_____:_____:_____:_____:_____: PASSIVE

(c) WEAK :_____:_____:_____:_____:_____:_____:_____: STRONG

4. Instructions for Learning

This is a memory test.

Please attend to the window of this memory drum. Soon after the apparatus starts, you will see a nonsense syllable in the window. You are to pronounce this syllable and those that follow it as you see them. First a nonsense syllable will appear alone, and then as the paper moves you will see the same syllable paired with another meaningful word. You are to pronounce them both. Similarly you will see other nonsense syllables, each of them first alone and then paired with another meaningful word. Try to read out through the window every nonsense syllable or word that is exposed to you.

After you have seen the entire list once, your job will be to call out each nonsense syllable presented alone and immediately to anticipate the word with which it was paired, before the pair appears in the window.

If you fail to anticipate an item, pronounce it when it appears anyway.

If you think you know what a word will be but not sure, guess. It will not hurt your score any more than to say nothing, and if you get it correct it will count as a success. If you anticipate a word incorrectly, correct yourself as soon as the word appears. Remember to pronounce each item aloud. Do not try to think ahead more than one step at a time or to count, because the order of the pairs will change as the list is repeated. Simply try to associate the two members of each pair as you see them.

ANY QUESTIONS?

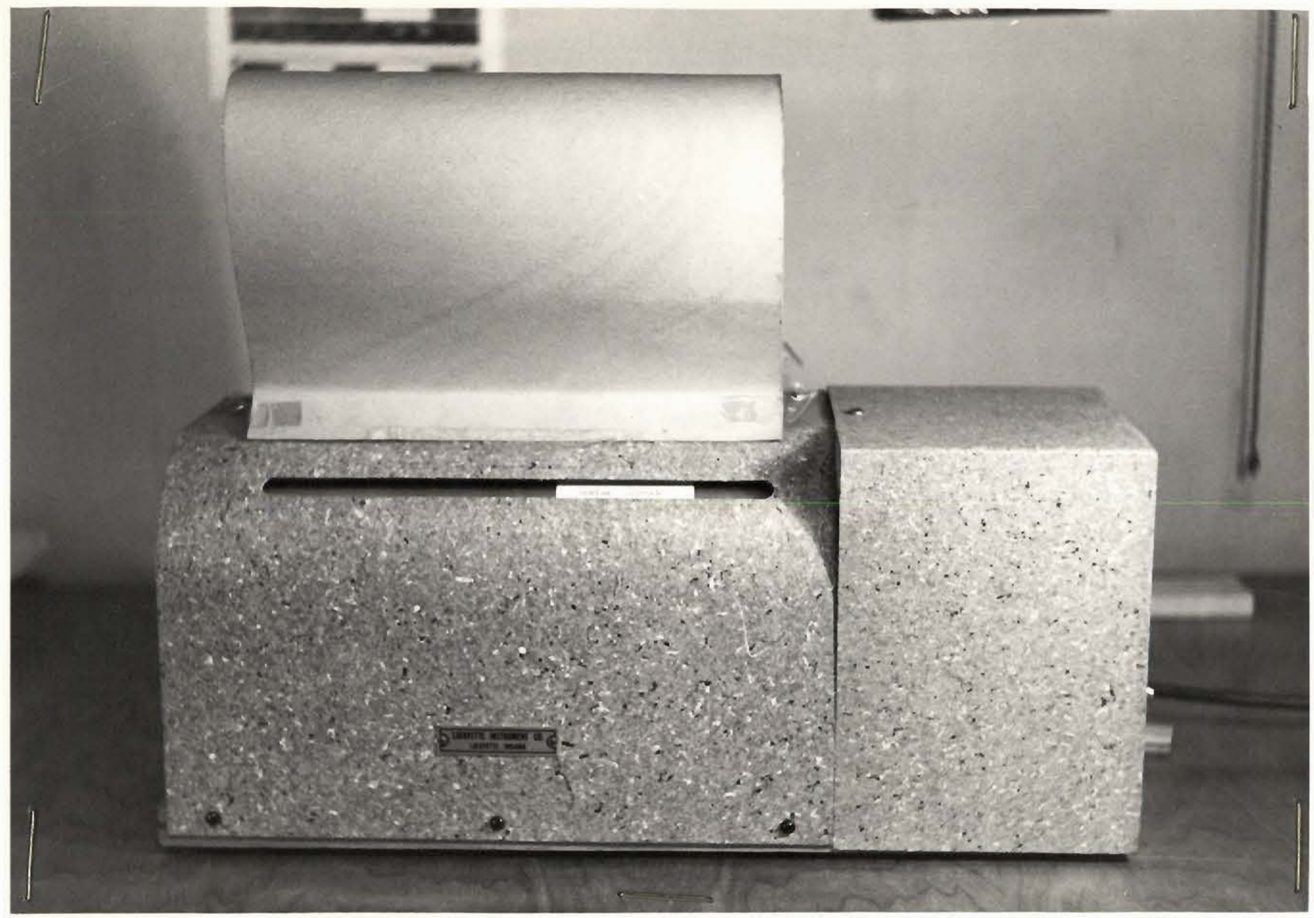
Let me show you an example. The list will appear in the following manner:

KAJ

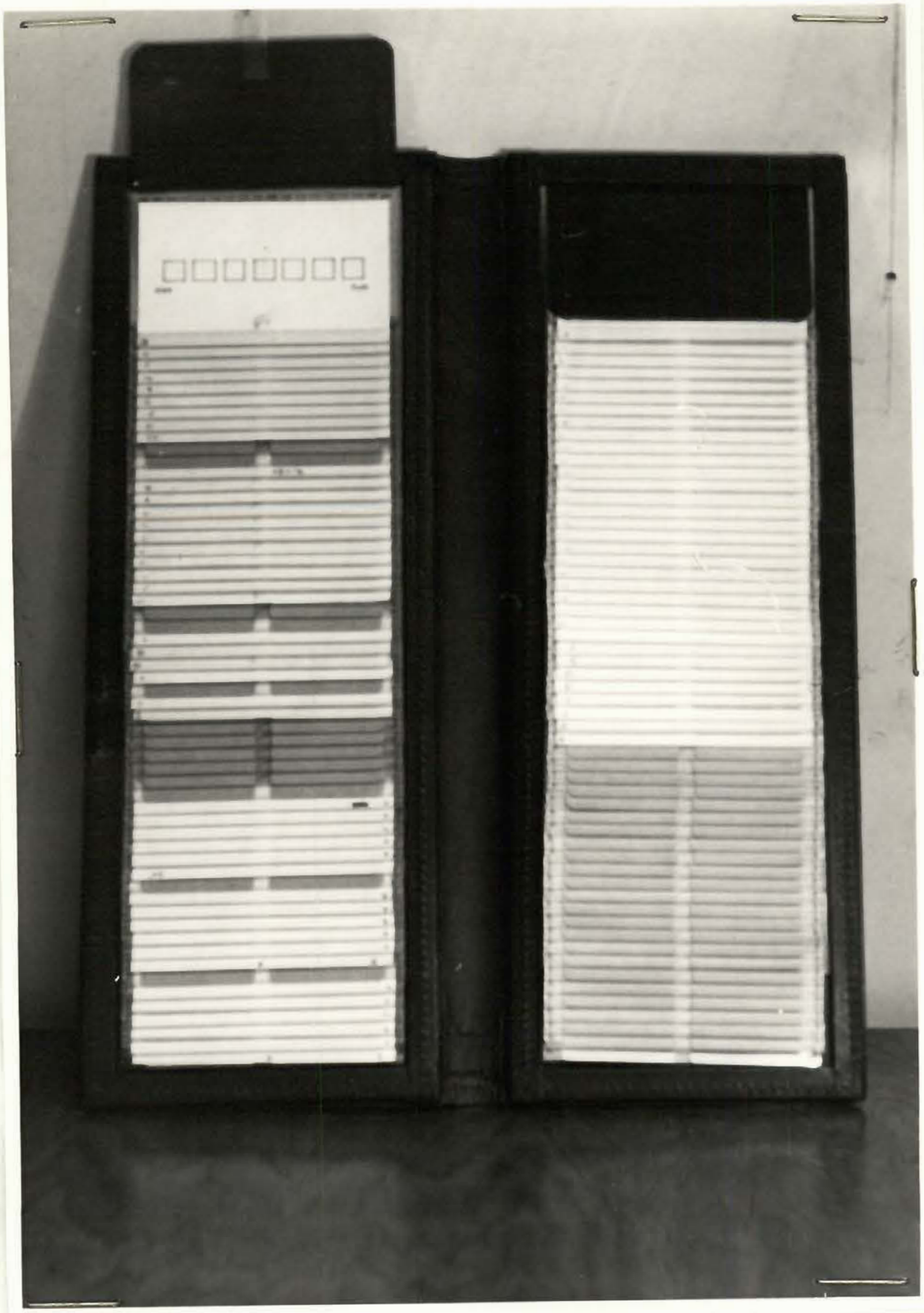
KAJ LOGIC

GIC

GIC POWDER



THE MEMORY DRUM USED IN THE EXPERIMENTS



THE KARDEX FOLDER USED IN THE EXPERIMENTS

APPENDIX B

Materials and Instructions Used in Experiment II

APPENDIX B

1. Paired-Associate Lists

(a) List 1.

Stimulus	Response
GARDEN	DECIDE
WINDOW	LEADER
STORE	NOBLE
PERIOD	LEG
INCREASE	BEAR
POINT	EXCEPT
CONTAIN	REPORT
GRASS	SOLDIER
DAILY	STATION
TREMBLE	ORDER

(b) List 2a / List 2b

List 2a Stimulus	List 2a Response	List 2b Stimulus	List 2b Response
SWEET	HURT	HURT	SWEET
GIRL	APPLE	APPLE	GIRL
BABY	JUSTICE	JUSTICE	BABY
LADY	PROGRESS	PROGRESS	LADY
CALM	SIN	SIN	CALM
MAD	CHURCH	CHURCH	MAD
UGLY	HAPPY	HAPPY	UGLY
ANGER	HOUSE	HOUSE	ANGER
SAINT	EAT	EAT	SAINT
PEACE	FATHER	FATHER	PEACE

2. Control Words

BEGGAR	CLEVER
PATIENT	SILVER
LOVER	NEIGHBOUR
TEACHER	SERVANT
AIRPLANE	EFFORT

3. Instructions for Learning

This is a memory test.

Please attend to the window of this memory drum. Soon after the apparatus starts, you will see a word in the window. You are to pronounce this word and those that follow it as you see them. First a word will appear alone, and then as the paper moves you will see the same word paired with another word. You are to pronounce them both. Similarly you will see other words, each of them first alone and then paired with another word. Try to read out through the window every word that is exposed to you.

After you have seen the entire list once, your job will be to call out each word presented alone and immediately to anticipate the word with which it was paired, before the paired words appear.

If you fail to anticipate an item, pronounce it when it appears anyway.

If you think you know what a word will be but are not sure, guess. It will not hurt your score any more than to say nothing, and if you get it correct it will count as a success. If you anticipate a word incorrectly correct yourself as soon as the words appear. Remember to pronounce each item aloud. Do not try to think ahead more than one step at a time or to count, because the order of the pairs will change as the list is repeated. Simply try to associate the two members of each pair of words you see.

ANY QUESTIONS?

Let me show you an example. The words will appear in the following manner:

LOGIC	
LOGIC	PIN
COURT	
COURT	ERASE

APPENDIX C

Materials and Instructions Used in Experiment III

APPENDIX C

1. Paired Associate Lists with *m* values

	List 1. Stimulus	List 1. Response	List 2. Stimulus	List 2. Response
	GOJEY (0.99)	NEGLAN (1.04)	LATUK (1.26)	QUIPSON (1.26)
	ROMPIN (1.90)	BALAP (1.22)	NARES (1.28)	ZUMAD (1.28)
	NOSTAW (1.34)	WIDGEON (1.78)	WELKIN (1.53)	KUPOD (1.55)
	BRUGEN (1.79)	TUMBRIL (1.84)	DAVIT (1.74)	ATTAR (1.71)
	VOLVAP (1.22)	SAGROLE (1.33)	TAROP (1.24)	XYLEM (1.24)
Total *m* Value	7.24	7.21	7.05	7.04
Mean *m* Value	1.448	1.442	1.410	1.408

2. Control Words with m values

BYSSUS(1.13)

DELPIN (1.60)

POLEF (1.30)

ULNA (1.50)

ICON (1.54)

3. Instructions for Learning

This is a memory test.

Please attend to the window of this memory drum. Soon after the apparatus starts, you will see a nonsense word in the window. You are to pronounce this word, and those that follow it, as you see them. First a nonsense word will appear alone, and then as the paper moves you will see the same word paired with another word. You are to pronounce them both. Similarly you will see other nonsense words, each of them first alone and then paired with another nonsense word. Try to read out through the window every word that is exposed to you.

After you have seen the entire list once, your job will be to call out each nonsense word presented alone and immediately to anticipate the nonsense word with which it was paired, before the paired words appear.

If you fail to anticipate an item, pronounce it when it appears anyway.

If you think you know what a word will be but are not sure, guess. It will not hurt your score any more than to say nothing, and if you get it correct it will count as a success. If you anticipate a word incorrectly correct yourself as soon as the words appear. Remember to pronounce each item aloud. Do not try to think ahead more than one step at a time or to count, because the order of the pairs will change as the list is repeated. Simply try to associate the two members of each pair of nonsense words you see.

IF THERE IS ANYTHING YOU DON'T UNDERSTAND, PLEASE ASK QUESTIONS.

Let me show you an example. The nonsense words will appear in the following manner:

KATUL

KATUL BHATI

PURNA

PURNA CHOLU

APPENDIX D

Materials and Instructions Used in Experiment IV

APPENDIX D

1. Paired Associate List

Stimulus	Response
FATHER	PEACE
SIN	CALM
HURT	SWEET
SUCCESS	BROTHER
EAT	SAINT
APPLE	GIRL
HAPPY	UGLY
HOUSE	ANGER
JUSTICE	BABY
CHURCH	MAD
PROGRESS	LADY
STEAL	PRETTY

2. Instructions for Learning

This is a memory test.

Please attend to what I will expose from this Kardex folder. First I will expose a card on which you will see a word. You are to pronounce this word. Then I will expose another card on which you will see the same word paired with another word. You are to pronounce them both. Similarly I will go on exposing other words, each of them first alone and then paired with another word. Try to read out every word that is exposed to you.

After you have seen the entire list once, your job will be to call out each word presented alone and immediately to anticipate the word with which it was paired, before I expose the paired words.

If you fail to anticipate a word, pronounce it when it appears anyway.

If you think you know what a word will be but are not sure, guess.

It will not hurt your score any more than to say nothing, and if you get it correct it will count as a success. If you anticipate a word incorrectly, correct yourself as soon as the word appears. Remember to pronounce each item aloud. Do not try to think ahead more than one step at a time or to count, because the order of the pairs will change as the list is repeated. Simply try to associate the two members of each pair of words you see.

ANY QUESTIONS?

Let me show you an example. The words will appear in the following manner:

LOGIC

LOGIC PIN

COURT

COURT ERASE