Chapter II

Historical Perspective

Before we proceed to describe the method and procedure to be employed in the experiments for verifying different hypotheses of the study, it seems important to provide a historical perspective on the study of verbal generalization with different types of material ranging from simple material involving phonemic syllables to a much more complex material involving sentences with different syntactical structures.

Experiments on verbal generalization, although they deal with an area of much greater significance to human learning and conditioning, are few and far between as compared to those on sensory generalization. Whatever limited number of studies the present investigator has been able to come across in the psychological research literature available to her may be classified according to the type of material used into four sections, namely, (a) experiments with phonemically-similar and semantically-similar material, (b) experiments with material involving synonyms, antonyms or both, (c) experiments with material involving concepts, and (d) experiments with material involving syntactical structures.
Whether a given experiment is to be classified under one or another of the above four categories will depend on what type of material has been used as stimulus components in experiments following the paired-associate method of learning, or as conditioned stimuli in experiments following the method of classical conditioning, regardless of the nature of the response component in the case of the former and the conditioned response in the case of the latter, or as stimuli to be learnt in a memory experiment with the recognition method to measure their retention. If the material consists of phonemically-similar items or words which are similar in meaning, they will be classified as experiments with phonemically-similar and semantically-similar material, respectively. If the material consists of items which, in addition to being meaningful words, are also synonymous or antonymous in relation to the items included in the generalization tests, and a comparison is made between the amounts of generalization for the two types of material, they will be classified as experiments with synonyms and antonyms. If, likewise, the material consists of items which, apart from being meaningful words, represent categories of objects, i.e., concepts, they will be classified as experiments with conceptual material. And, finally, if the material consists of whole sentences, whatever may be their grammatical forms, they will be classified as experi-
ments with syntactical material.

(a) **Experiments with Phonemically-Similar and Semantically-Similar Material**

Yum (1931) was probably the first to have performed an experiment which may now be regarded as one on generalization. He designed his experiment primarily to study the effect of transfer, and used 14 paired-associates, in which the stimulus items were two hyphenated trigrams and the response items were four-letter words. In the test of transfer one or more letters of the trigrams were changed so that the test of transfer could serve as a test of generalization as well. His results showed that if the first letter was changed, generalization was less than if other letters were changed.

This was probably the pioneering experiment on generalization in verbal learning, and is significant in that it demonstrates that the alteration of the first letter fails to elicit a response in transfer or generalization test, suggesting that the first letter provides an important cue to the elicitation of the response. If the first letter is changed the entire configuration of the stimulus item appears to be changed, thereby eliciting a discriminatory instead of a generalized response.

Wylie (1940) studied generalization with nonsense syllables. Her subjects learnt several pairs of syllables
by the paired-associate method and the first members of two of these pairs were then associated with shock. Generalization was found to be much greater to the syllables associated with the conditioned syllables than to those associated with nonconditioned syllables.

David and Price (1964) studied generalization of the conditioned eyelid response to structurally similar nonsense syllables. They used a nonsense trigram XUH as the conditioned stimulus. The test stimuli had either all the three letters, two letters, one letter or no letter in common with the conditioned stimulus. Generalization to the test stimuli was observed with a significant downward gradient as a function of decreasing stimulus similarity. This experiment was specifically relevant in the present context, because it pointed to generalization as being a function of variation in structural or physical similarity between the original and the test stimuli.

The above three experiments were performed with material involving phonemically-similar items. Three other experiments using semantically-similar items were carried out by Razran, Riess and Wylie.

Razran (1939) conditioned salivation for four stimulus words - STYLE, URN, FREEZE, and SURF, and tested generalization for synonyms and homophones of these words. These words were flashed on the screen while the subjects were eating,
the amount of salivation to each of the stimulus words, and subsequently to each of the homophones—STILE, EARN, FRIEZE, SERF, and synonyms—FASHION, VASE, CHILL, WAVE—were tested. The mean generalization in terms of salivation was 59% for the synonyms and 37% for the homophones.

Riess (1940) repeated Razran's experiment, using the same stimulus and test words, but employing GSR to a loud buzzer. Riess also found generalization to be greater for the synonyms than for the homophones.

Wylie (1940) conducted an experiment by conditioning the GSR (as elicited by shock) to certain words and testing generalization not only to homophones and synonyms of these words but also to other control words bearing no relationship to the conditioned words. She found evidence of greater generalization to the homophones and to the synonyms than to the control words, but her results indicated greater generalization to the homophones than to the synonyms. This variation from the findings of Razran and Riess may, perhaps, have resulted from the fact that her subjects said they expected shock more on the words that sounded like the conditioned words than the synonyms of those words. This experiment was in line with the earlier experiments, but its results were in conflict with the results obtained in the first two experiments, using semantic items, in that generalization was found to be greater for the synonyms than
for the homophones in the former, while it was found to be greater for homophones than for the synonyms in the latter.

The above experiments were either concerned with phonemically-similar items or with semantically-similar items. Some experiments were carried out, particularly by Russian psychologists, in which a comparison was made between generalization for items which were related semantically and for items which were related phonetically, i.e., words which were different in meaning but similar in sound. Among these experiments two are worth mentioning. In one, Shvarts (1954) following the classical conditioning paradigm, conditioned vasoconstriction in nine adult human subjects to the phonetically and semantically related words. The vasoconstriction response was conditioned to the words dom (house) and doctor (doctor) by applying 10°C thermal stimulus as US to the dorsal side of the left arm. The experimenter then tested CR transfer to phonetically related words dym (smoke) and dictor (announcer), and to semantically related but phonetically unrelated English word house (subjects knew the English language) and Russian word Vrach (physician), respectively. The experimenter tested the CR transfer after the completion of the CR training and then after the administration of chloral hydrate which tends to lower the functioning of the brain, and found that the phonetically related words did not
elicit the CR after the completion of the training, but after the administration of chloral hydrate these words elicited it, whereas the semantically related words elicited the CR after the completion of the training, but after the administration of the drug they failed to elicit it. This indicates that when conditioning was well established, the CR was generalized to semantically related words but not to phonetically related words, and when the brain function was lowered, the effect of conditioning was reversed so that the CR was elicited by the phonetically related words but not by the semantically related words.

In another classical-conditioning type of experiment Vinogradova and Eysler (1959) conditioned the vasoconstriction of seven university students to the word Skripka (violin) by combining the presentation of the word with the administration of an electric shock. After the CR was established, three types of words, one type related in different phonetic degrees to the conditioned word Skripka, such as Skrepka (paper clip), štrizka (hair cutting, shearing) and Škrytnost (reticence, secrecy), the second type of words related in different semantic degrees to the conditioned word, such as smichock (violin bow) gitara (guitar), struna (string), mandolina (madolin), arfa (harp), baraban (drum), orkestr (orchestra) and several others, and the third type of words wholly unrelated to the conditioned
word, such as **stakan** (glass), **lenta** (ribbon), **voda** (water) and so forth, were used in CR transfer tests, respectively. The main results showed the CR transfer to all the semantically related words, but in the case of phonetographically related words they showed CR transfer only to the word **skrepka**, and, of course, did not show any CR transfer to the unrelated words. This experiment also demonstrated that generalization occurs more frequently to semantically related than to phonetographically related words.

In both the above experiments the CR transfer test also served as a test of generalization in so far as it showed whether or not new stimulus words, related phonetographically or semantically to the old conditioned words, also elicited the conditioned response. Thus in these experiments phonetographic **vs** semantic generalization has been studied by employing a physiological reaction as the conditioned response.

In these experiments a comparison was made between generalization for meaningful words which are similar in appearance but different in meaning and generalization for those which are different in appearance but similar in meaning, and it was found that generalization for the former was less than that for the latter. A variation of this kind of experiment could be one in which a comparison is made between generalization for the latter type of words, i.e., words which are
different in appearance and similar in meaning, on the one hand, and generalization, not for words which are similar in appearance and different in meaning but for verbal items which are similar in appearance but without meaning (nonsense syllables) to be designated as phonemic items.

(b) **Experiments with Material Involving Synonyms, Antonyms, or Both**

The present investigator has not come across any study in research literature accessible to her, in which a direct comparison is made between generalization for synonyms and that for antonyms. The only experiments which do have a bearing on verbal generalization with materials involving synonyms and antonyms are those which have studied retention of such material by the method of recognition.

In experiments using recognition as a measure of learning, first a list of words is presented to the subject and after a brief interval a recognition test consisting of the original words randomly mixed either with synonyms or antonyms of the original words, or with words having some association, or having no association with the original words, is given, and the subject is required to state whether each one of the words included in the recognition test is an old one, i.e., a word which had appeared on the original list, or a new one, i.e., a word that had not appeared in the original list. False recognition of a new word as an old
one, i.e., as a word which had appeared in the original list, is counted as an error. The false recognition which is regarded as an error in this type of experiment may well be treated as an index of generalization on the assumption that false recognition is due to the fact that new words have some features in common with the old words and that these common features are conducive to the generalizability of the old ones to the new ones. Although the phenomenon of false recognition does not seem to be of much relevance except that it is used as a measure of learning, nevertheless it is of great significance in so far as it can be used as a measure of confusion between the new and the old words or, to be more precise, as a measure of generalizability of the latter to the former.

Some of the experiments on learning by recognition which are relevant to verbal generalization for material involving synonyms and antonyms may be mentioned here.

Anisfeld and Knapp (1968), for instance, performed an experiment on twenty-eight male university students, using recognition test as a measure of learning. The experimenters presented to the subjects two hundred words recorded on a magnetic tape at an interval of 10 seconds. Each word was recorded twice in immediate succession to make sure that it would be heard. The tape was played to a group of five or six subjects at a time. The words presented in recognition
test were related to the preceding words. Twenty five words were synonyms of the preceding words, while the remaining words were either common associates or control words. For each word the subjects were required to indicate whether it was an old one, by putting a plus sign, or a new one, by putting a minus sign, and they could also guess when in doubt. They found a greater number of recognition errors in the case of synonymous words as compared to the other type of words. These errors they interpreted in terms of certain 'features or attributes' which synonymous words had in common.

In another memory experiment, Fillenbaum (1969), while replicating and extending the work done by Anisfeld and Knapp (1968), also came to the same conclusion. He performed his experiment on seventy-nine students who were required to learn 240 words which had been tape-recorded and were presented to them at intervals of five seconds. Each word here also was recorded twice in immediate succession so as to make it sure that it would be heard correctly. The tape was played to the subjects in groups of ten subjects each. The retention of the words was measured by means of a recognition test in which some other words related to the preceding words were presented. Among these were 20 words which were synonyms and 20 words which were antonyms of the preceding words, while the remaining words were common associates or control words, i.e., which were neither synonyms nor antonyms of the preceding words. Thus he included in the recognition test not only the
synonyms of the original words but also their antonyms, along with their common associates and unrelated words. The experiments demonstrated greater number of recognition errors for the synonyms than for the antonyms, though the difference between the two was not statistically significant.

One drawback of the above experiments was that the synonyms and the common associates of the original words were not equated for associative strength in the first experiment, and the synonyms, the antonyms, and the common associates of the original words were, again, not equated for associative strength in the second experiment. This drawback was removed in a third experiment in which Grossman and Eagle (1970) first equated all the words for associative strength, and then used them in a recognition experiment in which they measured the retention of these words in terms of recognition. They performed their experiments on 100 subjects (32 male 68 female students) who were required to learn a list of ninety words. Out of these ninety words twenty seven were critical words which occurred in the list twice in two different positions in a random order, there being a total of 54 critical words. In addition to these fifty-four critical words there were 36 filler words which were distributed all over the list in a random order.

As the purpose of the experiment was to compare the recognition of the original words against their synonyms,
antonyms and common associates, the twenty seven critical words of the original learning list were randomly divided into three sets of 9 words each in order to match one set with 9 synonyms, another with 9 antonyms and the third with 9 common associates. In this manner 27 new words were selected which replaced the repeated 27 critical words of the original list. Thus with the 27 critical words, the 27 new words (9 synonyms, 9 antonyms and 9 common associates) and the 36 filler words, three lists for recognition test were prepared, each list consisting of 12 filler words, 9 critical words and 9 new words, the critical and the new words being selected in such a manner that for three critical words there were three synonyms, for another three critical words there were three antonyms, and for the remaining three critical words there were three common associates.

With this experimental manipulation the experimenters found more recognition errors, i.e., greater generalization for synonyms than for antonyms, a result which confirms the conclusion drawn earlier by Fillenbaum (1969), namely, that the frequency of false recognition is a function of the degree of semantic similarity, i.e., the greater the semantic similarity the more frequent is the false recognition.

The above-mentioned experiments are not, strictly speaking, experiments on generalization as such of words to their synonyms and antonyms; these experiments are, in fact,
concerned more with the extent to which words learnt earlier are confused with their synonyms, antonyms, and common associates. They have, however, been included in the review because for our purposes false recognition may be interpreted to imply generalization of the old words learnt earlier to the new words having some definite relationship with the original ones. The results of these experiments suggest that if generalization for synonyms is compared with that for antonyms by employing a direct test of generalization the study would be worthwhile.

(c) Experiments with Material Involving Concepts

One important type of verbal items are concepts which play a vital role in our understanding of objects and events and their relationships. Concepts, in fact, provide a basis for such mental processes as classification, generalization, discrimination and abstraction without which no thinking and reasoning is possible. A concept refers to properties or relationships common to a class of objects or ideas. A concept may be of a concrete nature referring to a given variety of objects, or it may be of an abstract nature referring to relationships common to many different kinds of ideas.

Psychological literature is replete with experiments on concept formation and its role in learning and thinking, but limited experimental data are available on the phenomenon
of generalization with material involving concepts, and that too is confined only to material involving concrete concepts.

Razran (1949) was probably the first to have used verbal material involving concepts in his semantic conditioning experiments. In these experiments it was found that the salivary response conditioned to superordinate words like bird was generalized to subordinate words like eagle. Here, obviously the response was conditioned to what Razran calls superordinate words and which may understandably be regarded as concrete concepts. When specific instances of these concepts were used in the generalization test, the response was found to be elicited by these instances as well, clearly indicating the occurrence of generalization from a given concept to its specific instances. Razran in these experiments used only one type of concepts, namely, concrete concepts.

There appears to be a long gap between Razran's experiment and the experiments which tried to follow the line of research initiated by him. Brotsky in 1968 and Brotsky and Keller in 1971 conducted important experiments using verbal material involving concepts.

In the first experiment Brotsky (1968) conditioned the GSR of 200 college students, with white loud noise as US, to five brand names of American cars Oldsmobile, Plymouth,
Pontiac, Mercury and Ford, and tested how far each of these names were generalized to the common name, car, used as a concept with different proper names of cars as its instances. The GSR to the first presentation of the word car in generalization test was regarded as a measure of generalization from the instances of the concept to the concept name. Thus it was found that the GSR which had been conditioned to different proper names of cars was also elicited by the common name car in the generalization test, demonstrating the generalizability of discrete instances of an object to a general concept.

In the second experiment Broksky and Keller (1971) combining the objectives of the first experiment and of the experiment carried out by Razran, studied the phenomenon of generalization of a general concept to its particular instances, as also of particular instances to a general concept under which all the instances could be subsumed. They performed this experiment on 48 subjects (24 male and 24 female students) by conditioning the GSR of 24 subjects to a concept name, in one condition, and the GSR of the other 24 subjects to a concrete instance of that concept, by using a white loud noise as US. They used three super-subordinate pairs: Car - Oldsmobile, Animal - Hamster and Sport - Hockey (they trained 24 subjects with superordinates, i.e., concept name and 24 subjects with subordinates, i.e., concept instance). The 24 subjects trained with concept name were
subdivided into three groups of 8 subjects (4 males and 4 females) each, and were trained with one of the three superordinates as the conditioned stimulus and were then tested for generalization on the related subordinates, i.e., concept instances. Similarly the 24 subjects trained with subordinates, i.e., concept instance, were subdivided into three groups of 8 subject (4 males and 4 females) each, and were trained with one of the three subordinates, i.e., concept instances, as the conditioned stimulus, and were tested for generalization on the related superordinates, i.e., concept names. Subjects trained on the superordinate, i.e., concept names and tested on subordinates, i.e., concept instances, showed greater generalization than subjects trained on the subordinate, i.e., concept instances and tested on superordinates, i.e., concept names.

The findings of these experiments led the investigators to conclude that the process of generalization is a two-way process, i.e., it occurs from a general concept to its particular instances as also from particular instances to a general concept, the former being relevant to inductive, while the latter to deductive reasoning.

The above-mentioned experiments were on generalization with concrete concepts. A survey of literature shows that experiments on generalization with abstract concepts are almost non-existent. It seems worthwhile, therefore, to
include material involving abstract as well as concrete concepts in the present study and compare generalization for the two types of material. A distinction between concrete and abstract concepts will help not only in clarifying the connotations in which these terms are to be used, but also in working out generalization gradients separately for materials involving the two types of concepts.

(d) Experiments Involving Syntactical Material

The pioneering experiment in this field was performed by Razran in 1952. This experiment was performed on eight American students. He used three five-word sentences in Russian language, the meaning of which the subjects learned pre-experimentally. These subjects were conditioned to salivate at the sight of the sentence, and then were tested for relative generalization to each word in terms of percentages. As may be seen, the amount of generalization reflected the grammatical and not the lexical character of the word, 35, 30, and 46 percent of generalization being for the predicative verbs; 9, 18, and 14 percent being for the subjects; 27, 26, and 28 percent being for the direct objects; and 11, 13 and 12 percent being for the qualifying adjectives. The differences between the predicative verbs plus the direct objects, and the subjects plus the qualifying adjectives were statistically significant beyond .01 level. No differences of any significance were, on the
other hand, found between the conditionability of the individual words in a control group.

Two other experiments on the same problem were performed by El'kin (1955, 1957) in the Soviet Union.

In the first experiment El'kin (1955) conditioned thirty university students to withdraw their fingers (with electric shock as the US) at the spoken sentences: Student vyderzhal ekzamen (The student/passed/the examination); Vklyuchayu tok (I am switching on/the shock); and Rukopis' prochitana (The manuscript/was read). The relative generalizations to the single words in the first sentence were 7% to student, 58% to vyderzhal, and 35% to ekzamen, in the second sentence generalization to each of the two words was 100%, whereas in the third sentence there was no generalization to any word. The experimenter attributes the results to differences in total sentential 'meaning load' carried by the separate words of the respective sentences. That is to say, in the first sentence the sentential 'meaning load' was differentially distributed among the three words, in the second sentence the total sentential 'meaning load' was divided equally between the two words, and in the third sentence the sentential 'meaning load' was implied in neither.

In the second experiment El'kin (1957) conditioned twenty-five school children of 10 to 16 years of age to
blink their eyes (with airpuff as the US) for nine sentences consisting of 2 to 5 words each. The main results showed that generalization was greatest to the predicate verb and that when the word order in the sentences was reversed (which in inflected Russian was still grammatical and conveyed the same meaning) generalization decrements were found only in the children of 10 to 12 years of age, but not in the older children.

Another important study was carried out in Linguistics by Hornby, et al., (1970) to investigate the early development of the distinction between the 'psychological' subject and predicate, and to compare it with the development of the distinction between the grammatical subject and predicate. In the first task, kindergarten and second grade children were asked to select the most important word in each of several sentences. Frequency of subject, verb and object being selected as the 'most important' word in the sentences were worked out. The analysis showed significant differences in the distribution of responses for the three word components between the two groups of younger and older children. The number of subjects and objects selected decreased and the number of verbs selected correspondingly increased as age increased. Separate $X^2$ were computed between subject and verb, and between object and verb. Significant differences in the distributions were
found in both cases. The results of this study indicate that the verb component in a sentence is more important for children of older age, while the subject and the object components are more important for children of younger age.

In the last of the four studies cited above the subject component of a sentence is found to be more important by younger children, while the verb component was found to be more important by older children. This study was not an experiment in the sense that no strict control was exercised with regard to the type of grammatical structure and to the type of component in different grammatical structures. Moreover, the study was carried out on children whose responses are modifiable on attaining maturity. The first three studies, on the other hand, having been carried out under controlled conditions and on older children and adults are, for obvious reasons, more valuable in the present context. All these laboratory studies show that the most important component, at least in one form of grammatical or syntactical structure, namely, the assertive type, is the verb component which occupies the focal position in this type of sentence, and the whole sentence is, therefore, more generalizable to this than to any other component of the sentence. The main question that has been suggested by these laboratory studies is whether it is the verb component to which the whole sentence is more generalizable in different
other type of syntactical structures as well, or the component to which the whole sentence is more generalizable varies from one type of syntactical structure to another. It is this question, precisely, which has been put to an experimental test in the fourth experiment of the present study.