

**SEMANTIC GENERALIZATION AS A FUNCTION OF CONNOTATIVE
SIMILARITY AND AWARENESS OF STIMULUS RELATIONSHIPS**

By

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AN ABSTRACT

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Various non-voluntary responses, when conditioned either to verbal or to non-verbal stimuli, exhibit generalization to other stimuli which are semantically related to the conditioned stimulus. Several studies indicate that this semantically mediated generalization frequently occurs in the absence of awareness by the subject of the relationship between the conditioned and unconditioned stimuli.

In the present study, the galvanic skin response was conditioned to a verbal stimulus and tested for generalization to a number of semantically related stimuli. The generalization of extinction of this response was also investigated. Forty-nine experimental subjects were employed, 32 of whom were aware of the conditioned stimulus-unconditioned stimulus relationship. The study was designed to test three hypotheses.

Hypothesis I predicted that semantically mediated generalization would be negatively related to the degree of connotative difference between the conditioned stimulus and the several generalization stimuli, as established by Osgood's Semantic Differential. Hypothesis II predicted that the aware subjects, as a result of the mediating function of their ability to verbalize the conditioned stimulus-unconditioned stimulus relationship, would exhibit greater generalization

than would the unaware subjects. Hypothesis III predicted that, for the same reason, the aware subjects also would exhibit greater generalization of extinction effects than would the unaware subjects.

The results clearly indicate the Hypothesis I is untenable. A non-hypothesized finding was that the degree of generalization was positively correlated with the magnitude of word-association frequency between the conditioned stimulus and the generalization stimuli. Hypotheses II and III are supported by the general trend of the data, although it is doubtful that a decisive test of the hypotheses was afforded by the present study.

The study raised a problem for future investigation of the degree to which word association frequency may be utilized in predicting the degree of semantic generalization between verbal stimuli. Problems were also raised with respect to the relationship between conceptualization and conditioning.

The results appear to warrant the following conclusions:

1. No relationship exists between connotative differences between words, as measured by the Semantic Differential, and semantic generalization to such words.
2. Semantic generalization may occur as a function of word-association frequency, as measured by the Kent-Rosanoff Word Association Test.
3. Awareness of the signal-function of a conditioned stimulus may increase speed and strength of conditioning.

4. Awareness of the signal-function of a conditioned stimulus may increase the generalization of responses conditioned to such stimuli.

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INTRODUCTION

Since the early reports by Russian investigators (16, 18, 19, 51, 54) that responses which had been conditioned to auditory and visual stimuli could be elicited by words referring to the conditioned stimuli, interest in semantic conditioning and generalization has increased steadily. Razran (39, 40, 41, 42, 43, 44, 45) has reported a series of investigations of semantic generalization of conditioned salivation. His results, as well as those of other authors (1, 2, 3, 5, 6, 7, 8, 9, 10, 17, 21, 22, 26, 46, 47, 55) have demonstrated the variety of the semantic relationships, and of the kinds of involuntary responses, which are susceptible to semantic generalization. Among the responses which have been utilized in these investigations are, besides the salivary response, vasoconstriction (29), acceleration of heart rate (21, 22), the pupillary response (19), retardation of the heart rate (20), and the galvanic skin response (3, 5, 17, 21, 22, 55).

The term, semantic generalization, refers to a special case of mediated generalization. The possible significance of mediated generalization for furnishing an account of many complex behavioral phenomena has been discussed at length by Cofer and Foley (1), Dollard and Miller (4), and by Osgood (35). The conventional paradigm,

essentially that used by each of these authors, is shown in Figure 1.

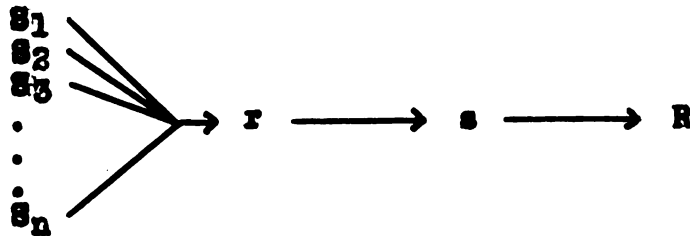


Figure 1. Paradigm for Mediated Generalization

$S_1, S_2, S_3, \dots, S_n$ here represent stimuli which have become attached, through a learning process, to the same cue-producing response, r . As a consequence of this learned association, they have become, in varying degrees, functionally equivalent for eliciting r , and therefore for eliciting R , an overt response. Gradients of generalization theoretically are determined by two factors.

First, where r represents a unitary response, generalization theoretically will depend upon the relative strengths of the associations between $S_2, S_3, \dots, S_n$, and r . If each is equally strongly associated with r , generalization should be complete; that is, each of the stimuli, $S_1, S_2, S_3, \dots, S_n$, will be equally effective in evoking R . On the other hand, where the strengths of association vary, the effectiveness of each stimulus in eliciting R will be a function of the degree to which it has previously

functioned in eliciting r .

However, r may represent a response complex, rather than a unitary response. In this case, the elements of the response complex may have become conditioned to S_1 , S_2 , S_3 , . . . S_n in varying degrees or combinations. Generalization might then be expected to follow a gradient which corresponds to the number of elements elicited by each stimulus. If S_1 is utilized as a conditioned response in a new learning situation, it is expected that stimulus generalization for the new response will be mediated by the already-existing relationships between S_2 , S_3 , . . . S_n and r in one of the ways just outlined.

Semantic Generalization

In the special case of semantic generalization, S_1 may consist of a verbal stimulus, an object, or a physical event. S_2 , S_3 , . . . S_n may be verbal stimuli which refer to S_1 , words bearing various semantic relationships to S_1 , or objects or events referred to by S_1 . An operational description of semantic generalization is afforded by the following quotation from Cofer and Foley:

A given word P , is presented and reinforced. According to the data of Diven [3], Razran [39], Riess [46], and Wylie [55], synonymous words, when presented, will likewise elicit a response, though in less degree. Now P may have only one synonym, or it may also have several synonyms; in the latter case these several synonyms may not bear to P the same degree of semantic relationship, i.e., one word (synonym) may be more completely interchangeable with P than the others although all

must bear some degree of interchangeability with P. (In this connection it should be noted that language authorities seldom assert that two words have precisely the same meaning. It seems likely, therefore, that the foregoing statement is sound.) Therefore, we may have a series of words, varying in semantic similarity to P, which would be likely to elicit different degrees of response as a function of the degree of their similarity to P. (5, p. 525).

The following paragraphs will review the studies which have been concerned with semantic generalization and with the nature of the stimulus gradients along which it occurs.

Early Russian studies, as summarized in the Psychological Abstracts, have demonstrated that responses which have been conditioned to colored lights and to bells exhibit stimulus generalization to the names of the stimuli. Kapustnik (16), first showed that children's responses may generalize from a name to a visual or auditory stimulus, or vice versa, and that extinction of the conditioned response leads to extinction of the generalized response. Traugott (54), next conditioned a response to a bell, and extinguished the same response to the bell paired with a blue light (conditioned inhibition). He then found that the word, blue, was more effective than the word, red, a variety of neutral words, or a red light, for inhibiting the response to the bell. He also reports that the word, blue, was more effective than the blue light for inhibiting other unrelated conditioned responses.

Smolenskaya (51), conditioned a bulb-squeezing response as a discrimination between a blue and a green light, and

between a red-white-yellow and a yellow-white-red sequence of lights. He found that the discriminations thus produced could be elicited by verbal presentation of the corresponding color names, while neutral words had no effect. Kotliarevsky (19, 20), showed that both the pupillary reflex and pulse retardation could be elicited by the word, ball, after having been conditioned to the tone of a bell.

Razran (39), in the earliest study in this country, used himself as a subject to study semantic generalization of salivation. He compared the amounts of saliva elicited by thinking of a series of nonsense syllables, and of the various equivalents of the word, saliva, in English, German, French, Spanish, and Gaelic. He found a relationship between the amount of saliva and the familiarity of the word, as measured by the double criterion of his speed of association to the word and his reading speed in the language. Utilizing the salivary response again in a later study, Razran (40), compared the amount of generalization of salivation to homophones and synonyms of words to which it had been conditioned. He found generalization to both, with synonyms regularly eliciting a greater response than did homophones. This suggested to him that mediated generalization is stronger than primary generalization.

The latter study was repeated by both Riess (46), and Wylie (55), utilizing the galvanic skin response. While Riess's results agreed with those of Razran, Wylie

found contradictory results, homophones eliciting greater generalization than synonyms. She relates this discrepancy, however, to her failure to mislead her subjects as to the nature of the experiment, with the result that several subjects reported that they expected reinforcement of the homophones, but not of the synonyms. She found also that the GSR, when conditioned to nonsense syllables, exhibited generalization to paired associates learned earlier.

Wylie's argument about the influence of set in determining her results is supported by further results of Razran (43). He compared the influence of various facilitory, inhibitory, and cognitive sets upon the degree of semantic generalization, and found that the gradients of generalization were modified by his instructions to the subjects. This study involved conditioning both to tones and to words, and yielded further evidence that semantic generalization may be greater than primary generalization.

Further knowledge as to what kinds of semantic dimensions may mediate generalization has resulted from studies by Razran (45), and by Diven (3). Razran investigated the dependence of generalization upon meaning changes by conditioning salivation to verbal propositions such as, "Poverty is degrading." He then reversed, and otherwise changed, subjects, predicates, and copulas, and tested for generalization to the new forms. He found greater generalization

to "propositionally" similar than to "sententially" similar forms of the sentences. Diven's study, which will be discussed more fully in a later section of this paper, revealed generalization of the GSR from the conditioned stimulus, barn, to rural words, and from taxi to urban words. This added a class-relation dimension to those already demonstrated.

Riess (47), studied the genetic aspects of semantic generalization by comparing four different age groups for the degree to which they exhibited generalization to homophones, antonyms, and synonyms. He found that young children (mean age, 7 yrs., 9 mos.) showed most generalization to homophones, next most to antonyms, and least to synonyms. An older group (10 yrs., 8 mos.) generalized most to antonyms, then to homophones, and least to synonyms. Finally, his two oldest groups (14 yrs., 0 mos., and 18 yrs., 6 mos.) showed the greatest generalization to synonyms, and least to homophones, with antonyms in between. He concludes:

"The present experiment has demonstrated that the relative strength of the semantic gradients does not depend on any a prior quality of the language, but upon the way in which the whole organism utilizes language in its development.... In other words, semantic conditioning does not depend solely upon any attribute of the stimulus as such, but the stimuli must be interpreted as part of large situationally experiential wholes within which the organism exists and has learned to use and interpret verbal stimulation". (47; p. 151)

Razran has contributed further evidence of the importance of learned relationships in mediating semantic generalization, as well as of the variety of these relationships. In one study (43), he compared the generalization on various semantic dimensions (part-whole, contrast, action-agent, etc.) to that on several phonetographic dimensions (pseudo-derivative, common elements). While he found a crude phonetic gradient, which was a function of the number of common elements, he also found semantic gradients. The greatest semantic generalization was to contrasts, coordinated, and subordinates. The importance of previously learned associations is sharply illustrated by Razran's findings when the stimuli were elements of compound words, such as Yankee Doodle.

He found that greater generalization occurs when the conditioned stimulus is Doodle, and the generalization stimulus is Yankee, than vice versa. Strong learning exists in English-speaking subjects which would lead to the elicitation of Doodle by presentation of Yankee, but not vice versa. Consequently, a greater probability exists that Yankee, presented as a generalization stimulus, will lead to fractional or implicit responses capable of mediating responses conditioned to Doodle, than the reverse.

A later study (44), supports this interpretation, and leads Razran to a similar conclusion. In this study, he

first had different subjects practice controlled association with various different verbal relationships, for example, part to whole, whole to part, sub- to superordinate, etc., He then tested for semantic generalization to words bearing these relationships to the conditioned stimuli. He found that the amount of generalization along a specific semantic dimension was facilitated or inhibited by the set resulting from the subject's previous practice. For example, greater generalization occurred from dog to terrier when the subject had practiced associating terrier-dog, than when he had practiced dog-terrier.

In the same study, subjects were given varying amounts of training in the meaning of Russian words. Responses were then conditioned to certain words, and the degree of generalization to other words was studied. When the subjects had no knowledge of the meaning of the words, generalization was greater to homophones than to synonyms, but, in consonance with the results of Riess's genetic study, there was an increase in generalization to synonyms with increasing knowledge of their meaning. Razran concludes from this study that semantic generalization is "...rooted in the learned activities of the individual." (p. 256)

Only two reported studies, by Eisen (5) and Keller (17), have failed to demonstrate semantic generalization. Eisen investigated the influence of set on semantic generalization. He gave experimental subjects practice in pairing words having various semantic relationships to each other, and then compared them for degree of generalization

with subjects who had been informed of the relationships between the conditioned stimulus and the generalization stimulus. Using a conditioned GSR, he found no significant difference between set conditions. Testing the hypothesis that the greatest generalization should occur to words with the highest Thorndike-Lorge word-count frequency, he found no significant gradient.

Examination of his criterion of conditioning, however, reveals that Eisen's measure may have been too insensitive to reveal either conditioning or generalization, if they did occur. He considered conditioning to have occurred when the conditioned stimulus elicited a measurable GSR, and the neutral stimulus did not. Since nearly any stimulus can elicit a measurable GSR in the presence of a sensitive measuring device, these results raise a question as to whether Eisen's apparatus was of sufficient sensitivity.

Keller conditioned the GSR to a picture of a Boy Scout hat and tested for generalization to a picture of a fireman's hat and to the word, hat. Although generalization occurred to the picture of the fireman's hat, none was found to the label, hat. Keller interprets this as evidence that simple labeling did not mediate the generalization between the two pictures. However, whether the observed generalization was primary or not, it is to be expected, in the light of the many other studies cited above, that hat also should

have exhibited generalization. The discrepancy between these results and those of other investigators remains unexplained.

In summary, these studies on semantic generalization, with two exceptions indicate that a variety of voluntary and involuntary responses, when conditioned to either verbal or non-verbal stimuli, exhibit semantic generalization. The relationship existing between the conditioned stimulus and the generalization stimuli need not be one of physical or sensory similarity, but may be any of a variety of learned semantic and conceptual relationships. There is definite evidence that the effectiveness of these relationships in mediating generalization is readily altered by situational learning or by set. Furthermore, several of the studies suggest that semantic factors may be more effective than sensory or physical similarity in mediating generalization.

Theoretical Significance of Semantic Generalization

Cofer and Foley and their associates (1, 2, 7, 8, 9) were the first authors to elaborate the theoretical possibilities for semantic mediation of complex behavior patterns. In the first of a series of articles on the topic (1) they summarize previous studies of generalization from object to sign, from sign to object, and from sign to sign, presenting an operational formulation of mediated generalization similar to the paradigm discussed above. They also outline

an elaborate theoretical scheme of higher-order generalization which utilized both homophones (non-mediated generalization) and synonyms (mediated generalization). The theoretical possibilities of their scheme are illustrated by the following example from their discussion of the mediation of emotional behavior.

In their example, elements of the feelings aroused by an anxiety-provoking experience, associated with the act of lighting a cigarette, may generalize to the verbal label, light. From this, generalization may occur to the synonym, lamp, and thence to the homophone, tramp. Further generalization may occur to another synonym, hobo. Finally, the arousal of the label, hobo, upon sight of the actual object may serve to reintegrate a portion of the original anxiety, resulting in a subjectively inexplicable phobia.

The occurrence of higher-order chains of generalization effects such as those hypothesized by these authors remains to be demonstrated, and in fact at least one author (28) has reported failure in an attempt to demonstrate it. It is apparent, nevertheless, that no such complex chains need occur in order for semantic factors to play a significant part in mediating many aspects of human behavior in which symbolic language processes are involved.

In their introductory article, Cofer and Foley outline possible applications of the concept of semantic generaliza-

tion to problems of perception, set, learning, memory, intelligence, reasoning, free association, and emotional behavior. Subsequently, they and their associates published a series of investigations of certain homophone and synonym gradients (7, 9), antonym gradients (2), and of the influence of differences in professional training upon word association (8). Each of these studies utilized transfer of verbal learning as the experimental technique.

The first such study tested for positive transfer to a word list from several other lists which the subjects had studied. Five learning lists were employed. Two of these consisted of homophones of the words in the test list, one was comprised of synonyms of the test-list words, and the fourth contained words which were synonyms of the words in the first synonym list, but which bore no semantic relation to the words in the test list. A control list was made up of words not semantically related to the contents of the test list. Five groups of subjects each studied one of the learning lists, and were then tested for positive transfer to the test list. Each of the first four listed, including the list of second-order synonyms, led to significantly greater positive transfer than did the control list. The greatest transfer, however, was to homophones, in conflict with the findings of all other investigators but Wylie.

Osgood (35) has made an important criticism of the de-

sign of this study, which holds as well for the rest of the series by these authors. This criticism may also account for the discrepancy between their findings and those of Rasan, et al., with respect to the relative order of homophones and synonyms in eliciting generalization. Osgood points out that the experimental technique in the above study allowed the subjects to recognize the nature of the relationships between word lists, and to reconstruct the test list on the basis of this knowledge. Any subject who recognized, during the presentation of the test list, that it consisted, for example, of synonyms of the list which he had previously studied, need then only recall the items of his learned list and manufacture synonyms, in order to achieve a high score on the test list.

The second study in this series utilized the same transfer technique to demonstrate semantic generalization from a learning list to a list of antonyms, yielding positive results. The third study used a group of subjects who had studied Spanish and a group who had not. They were compared for degree of positive transfer from a list of Spanish words to a list of English synonyms of the Spanish words. The Spanish students exhibited significantly greater transfer. However, both of these studies are equally susceptible to Osgood's criticism.

Dollard and Miller (4), have presented an elaborate analysis of complex human behavior, including reasoning, pro-

blem solving, formation of neurotic symptoms, conflict, and psychotherapy, in terms of the mediating function of language. A central process in their analysis is that of verbal labeling. They point out how verbalizations may function as cue-producing responses to a wide variety of stimulus situations, thereby mediating the generalization of previously learned responses to any new situation which may elicit these verbalizations. For example, they state that:

Attaching the same cue-producing response to two distinctive stimulus objects gives them a certain learned equivalence increasing the extent to which instrumental and emotional responses will generalize from one to the other. (p. 101)

When . . . fear is attached to response produced cues, any new stimulus that becomes able to elicit the response producing these cues will arouse the fear they elicit. For example, a young man may have fear attached to the cues produced by the first incipient responses of sexual excitement. Then if a previously indifferent girl is labeled "sexy," she may arouse incipient responses of sexual excitement which in turn elicit fear. (p. 162)

Although much of their exposition consists of untested hypotheses, it appears to afford a rich potential for explaining many complex processes in terms compatible with the concepts of general experimental psychology. Their emphasis on the mediating role of language serves to point up the potential importance of semantic generalization as a mechanism by which this may be accomplished.

Osgood (36), has elaborated the paradigm of mediated

generalization into a learning hypothesis which embraces not only instrumental learning but also problem solving, concept formation, and language behavior. With respect to the last of these, he states that:

In terms of its central relevance to general psychological theory and its potential applicability to complex social problems, no other area of experimental psychology so greatly demands attention as language behavior--and in the past has received so little. (p. 727)

An interesting example of the degree to which semantic generalization may be implicated in the complex mental processes is furnished by a recent experiment by Eisman (8). She first trained four groups of subjects to apply the labels, car, show, and egg, differentially to differently shaped whiteblocks. Each group was also trained to choose one of the shapes in preference to the others, by association of the shape with a reward. The second step was for the subjects to learn to apply each white block's label, car, show, or egg, to a black, yellow, or green rectangular block. That is, the subjects had now learned to apply the label, egg, for example, to a white triangular block and a green rectangular block, and so on.

In the final step of the experiment each group was treated differently. Group one was tested to determine whether they exhibited preference for any of the colored blocks, and its members showed a significant preference for the colored block bearing the same label as the rewarded

white block. Group two, when tested for preference between black, yellow, and green objects which they had not yet seen, also exhibited a significant tendency to choose the color which previously had been labeled the same as the rewarded block. Group three, when presented with new white blocks of different shapes from the originals, but bearing the same labels, tended to choose the block bearing the rewarded label. A fourth group, presented with a hypothetical situation in which they were to choose whether to invite a black, a yellow, or a green group of children to a party, tended significantly to prefer the group whose color had been associated with the rewarded label. Rewarded labels and colors were randomly distributed among members of each group.

Eisman states, "The investigation was designed to test the general hypothesis that a color-preference response (positive attitude) could be developed through mediated generalization, and that this preference could be demonstrated in four situations differing in context, complexity, and social significance." (p. 323) She concludes that the hypothesis is supported by her evidence.

THE PRESENT STUDY

The aim of the present study is two-fold: 1) to investigate the existence of semantic generalization along a semantic dimension which has not yet been explored, and 2) to shed some light upon the possible role of semantic generalization in mediating anxiety. These two aims will be discussed separately in the following paragraphs.

The Semantic Differential

Previous studies of semantic generalization have been concerned with semantic relationships of a culturally determined nature, based on the common denotative functions of the words involved. In contrast, the first aim of the present study is to determine whether relationships of a more idiosyncratic, connotative nature may also mediate generalization.

Osgood (34, 36, 37), has recently described a technique, the Semantic Differential, for scaling the difference in connotative meanings of words. Subjects are required to rate words, concepts, or objects in terms of a series of paired polar adjectives, such as good-bad, large-small, strong-weak, etc. Comparison of the ratings of different concepts or words on such a series furnishes a

measure of their connotative difference.¹ More specifically, the objective of the present study is to test the following hypothesis.

Hypothesis I

A response which has been conditioned to a verbal stimulus should exhibit generalization to another verbal stimulus inversely to the degree of connotative difference between the two words, as established by the Semantic Differential.

Here, the Semantic Differential is seen as establishing the degree to which S_1 (conditioned stimulus) and $S_2, S_3, \dots, S_n$ (generalization stimuli) may be functionally equivalent for eliciting r in the paradigm. S_1 will be conditioned to a response (R); the Semantic Differential will be utilized to order $S_2, S_3, \dots, S_n$; and the degree to which this ordering may be used to predict the order of $S_2, S_3, \dots, S_n$ as elicitors of the conditioned response will then be determined.

Previous authors, with the exception of Eisen (5), and Razran (39), have been concerned with the quantifica-

¹Ordinarily, a low difference score is considered to imply similarity. However, since a low difference score between two words on the Semantic Differential may be the result either of similarity of the two words or of the inapplicability of the scales to the particular words in question, it is incorrect to make this assumption. Consequently, the Semantic Differential will be referred to throughout this paper as a measure of difference, but not of similarity.

tion of semantic generalization only to the extent of determining the relative degree to which different semantic relationships mediate generalization. In the event that a relationship is found to exist between the Semantic Differential and degree of generalization, it is foreseen that Semantic Differential ratings may be useful for predicting the amount of generalization between many different kinds of stimuli.

Semantic Generalization of Anxiety

While few psychologists would hold that autonomic responses, per se, are identical with emotions or anxiety as conceived in humans, numerous authors (1, 4, 32, 36, 49, 50, 52), offer justification for regarding learning of these responses as a paradigm for learning of emotional responses.

A passage from Osgood contains the essence of this view:

Stimulus-objects typically elicit a complex pattern of reactions from the organism, some of which are dependent upon the sensory presence of the object for their occurrence and others of which can occur with-out the object being present. . . . When other stimuli occur in conjunction with the stimulus object, they tend to be conditioned to the total pattern of reactions elicited by the object; when latter presented without support of the stimulus-object, these stimuli elicit only the "detachable" reactions. (36, p. 396)

The studies reviewed in the first section of this paper have been largely concerned with semantic generalization of such "detachable" autonomic responses. The evidence of the readiness with which these responses are conditioned

and generalized, together with the evidence (16, 29), that they are often extremely resistant to extinction, is suggestive of the role they may play in clinical manifestations of anxiety. If an individual experiences frequent elicitation of a few such "detachable" reactions, it is readily seen how he may appear in the clinic with subjectively inexplicable complaints of "nervousness," headache, or a variety of psychosomatic symptoms. At the same time, as a result of repression, imperfect discrimination, or other factors, he may be unable to specify, either to his therapist or to himself, the nature of the situations which elicit his symptoms.

The second aim of this study is related to these considerations. Dollard and Miller (4), speak of psychotherapy as a labeling process. Insofar as psychotherapy deals with symptoms of the sort mentioned above, semantic generalization, mediated by verbal labels, should play a part not only in the appearance of such symptoms, as outlined by Cofer and Foley (1), but also in their effective removal. Several studies have demonstrated learning and semantic generalization of autonomic anticipatory responses in situations where many of the subjects were unaware of the nature of the stimuli to which they responded. The following paragraphs will discuss these studies briefly, and the hypothesis deriving from them will then be presented.

Diven (3) utilized the GSR, finger tremor, and differential recall of words to show that learning and generalization may take place without the subject's awareness. He presented his subjects with a word list in which the recurring word, barn, was followed by an electric shock. In an alternate form of the list, the critical word was taxi. Both lists contained a series of rural words, such as plow, wagon, etc., and a series of urban words such as subway, streetcar, etc. Subjects were instructed to respond to each word by free-associating until told to stop. The length of free association varied from one group of subjects to another, and the shock which followed either barn or taxi was delivered at the end of this interval.

Diven reported generalization not only to the words, red and yellow, which always preceded barn and taxi, respectively, but also to rural words in the case of the barn-shock subjects, and to urban words for the taxi-shock subjects. One of the most significant findings of Diven's study concerns the fact that, of his 52 subjects, 21 were unable to report at the conclusion of the experiment what word had served as a signal for the shock. Although examination of Diven's published data reveals that these unaware subjects may not have conditioned as well as the others, they appear to have generalized in the same way as did those who were aware of the barn-shock relationship.

A later study, modeled in part on Diven's was conducted by Haggard (10). He used shock to condition the GSR to the word, sword, which was always preceded by sharp, and embedded in a 42-word list. Since he was concerned with the effects of various situational factors upon the extinction of such a response, he did not test for semantic generalization. However, utilizing the same free association method as did Diven, with an interval of 10 to 12 seconds, Haggard found that, of 18 subjects, only 9 were aware, at the end of conditioning, of the relationship between sharp, sword, and shock. Two subjects reported that shock was preceded by a war word, while 7 subjects had no awareness of the relationship. He reports that there was no significant difference between his aware and unaware subjects with respect to their general reaction to conditioning, although the aware subjects exhibited a greater GSR to sharp and sword than did the unaware subjects.

Haggard states that ". . . several Ss in the Aware group mentioned . . . that they felt mild emotional disturbances whenever they heard or thought of the stimulus words, sharp, or sword, while the Unaware Ss spoke rather of a generalized feeling of apprehension or anxiety." (p.272) He hypothesizes that his unaware subjects were more disorganized by anxiety, and therefore less able to develop the necessary figure-ground relationship. He supports this by the observation that his unaware subjects reacted more strongly to the shock than did the aware subjects, and show-

ed less adaptation. Haggard evaluates his results as follows:

Is there any basis for assuming the occurrence of "unconscious emotions" in the Ss participating in this study? The answer rests on the definition of the term. If (a) we define "unconscious emotion" as a pattern of observable reactions of an individual (of which he is unaware) to stimuli which are known to be associated with objects or events which do elicit "conscious emotion" of which he is able to report, and if (b) the observable reactions (of which he is unaware) are not qualitatively different from those of individuals who, under similar circumstances do report having experienced affective disturbances, then the present data indicates the presence of such "unconscious emotions." (p. 275)

A third study, by Lazarus and McCleary (25), conditioned the GSR to nonsense syllables. When the syllables were subsequently presented tachistoscopically at speeds which precluded correct identification, incorrectly perceived shock-syllables elicited a greater mean GSR than did incorrectly perceived non-shock syllables. The authors conclude: "There seems little doubt that subjects can make autonomic discriminations when they are unable to report conscious recognition." (p. 118)

J. I. Lacey and Smith (21), have reported a study similar to those of Diven and Haggard. They presented 31 subjects with a word list which contained 8 repetitions of the words, cow and paper, 8 different rural words, and 11 non-rural words. Half of the subjects were shocked after 15 seconds free association to cow, while half received shock after paper. GSR, digital blood flow, and heart rate were

recorded, although the authors report only the heart rate data. After one presentation of the word list, the subjects were interviewed in order to determine their degree of awareness or unawareness of the cow-shock or paper-shock relationship. Of the 31 subjects, 6 were aware of the stimulus relations, 3 reported that a farm word had preceded shock, and 22 were unaware. Generalization was studied only for the 22 unaware subjects.

The cow-shock subjects developed significantly greater responses (accelerated heart rate) to rural than to non-rural words, while the paper-shock subjects did not. During a single extinction presentation of the word list, both groups exhibited significant extinction to their respective critical words. Lacey and Smith conclude:

. . . If a word-sign becomes the signal for a painful stimulus, without the subject being able to verbalize this relationship, an anticipatory autonomic response will ensue. This unconsciously formed anxiety reaction, moreover, will appear to other word-signs meaningfully related to the conditioned word.
(p. 1051)

They further conclude that the difference between cow-shock and paper-shock subjects in generalization to rural words may mean that such generalization depends upon semantic relationships previously formed in the subject's life experiences, rather than in the immediate situation. They also state that there was some evidence that the generalization response was stronger and more reliable than the con-

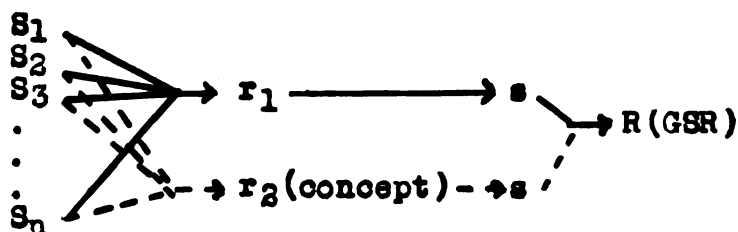
ditioned response.

A second publication, by Lacey, Smith, and Green (22), compares the responses of these same 22 unaware subjects to those of 20 subjects who were informed at the beginning of the experiment which word would be the signal for shock. They found that, except for the initial conditioning trials, when the informed subjects responded much more strongly to the conditioned stimulus, the two groups were approximately equal with respect to degree of conditioning. The unaware subjects appeared to generalize slightly more than did the aware subjects.

The second aim of the present study, to investigate semantic generalization of anxiety, stems directly from these studies. The fact that some individuals may exhibit conditioning and generalization of autonomic responses without forming a verbalizable concept of the relationship between the unconditioned and conditioned stimuli suggests a testable hypothesis about the role of mediating factors in such behavior. To return to the paradigm of mediated generalization presented earlier, the degree to which $S_2, S_3, \dots, S_n$ function as elicitors of R is seen as dependent upon the degree to which they function in common with S_1 as elicitors of r . It would seem reasonable to argue, in the case of the aware and unaware subjects in the above experiments, that r represents a more extensive complex for the

aware subjects, since it includes whatever response patterns may be assumed to underlie the formation of the verbal concept, "word-leads-to-check." On this basis, the sequence illustrated in Figure 2(a) should lead to greater generalization than should that in Figure 2(b).

(a)



(b)

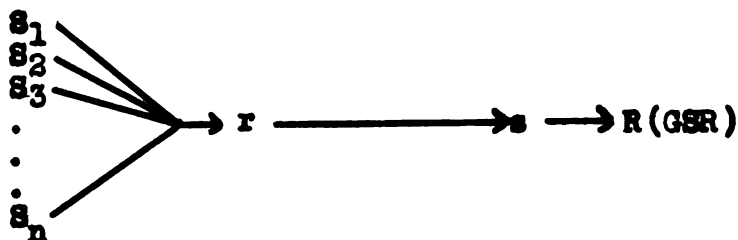


Figure II. Paradigm for Semantic Generalization of Aware and Unaware Subjects

That is, the aware subjects, through the mediation of their conceptual response to the situation, might be expected to show greater generalization to words related semantically to S_1 than should unaware subjects. This hypothesis is not in agreement with the results of Lacey, et al. However, it may be argued, since their aware group's advance

information that the critical word would signal shock implied that no other word would, the discrimination between S_1 and $S_2, S_3, \dots S_n$ was facilitated by the instructions. Thus the generalization of the aware group was minimized.

The present study will utilize as aware subjects those who become able spontaneously to conceptualize the stimulus relationship in the course of conditioning. These subjects will be compared to the unaware subjects in order to test the following hypothesis:

Hypothesis II

Individuals who are able to verbalize the fact that a particular verbal stimulus always precedes the unconditioned shock stimulus will tend to exhibit greater generalization to verbal stimuli bearing a semantic relationship to the conditioned stimulus than will subjects who are not able to verbalize this sign function of the conditioned stimulus.

If it is assumed that the same mediating factors function in the generalization of extinction effects, a similar hypothesis may be formulated for extinction. The following hypothesis will be tested:

Hypothesis III

Following experimental extinction of a conditioned response to a verbal stimulus, the ability to verbalize the relationship between the conditioned and unconditioned stimuli will be accompanied by greater semantic generalization of the effects of extinction, in the form of a proportionally greater decrement of response to the generalization stimuli.

Positive evidence with respect to Hypothesis III will furnish support of the hypothesis of Dollard and Miller that

proper labeling of situations facilitates the formation of appropriate responses to them. It may be seen that, if evidence from the present study supports Hypothesis III, the acquisition of appropriate labels during psychotherapy may be expected to result in heightened generalization of more adequate responses to extra-therapeutic situations.

METHOD

The procedure of this study represents a modification of that of Diven. It differs in one major aspect from that of Diven, Haggard, or Lacey, et. al. In these studies, the generalization stimuli were included in the initial conditioning list of words. In order both to take advantage of the incubation indicated by Diven's results, and to study generalization in a situation slightly removed from the immediate conditioning situation, the generalization stimuli were included in a separate list, and presented only after the completion of conditioning.

Selection of Stimuli

The conditioned stimulus, river, was chosen from the Kent-Rosanoff Word Association Test (18). In order to provide a rough continuum of similarity, part of the generalization stimuli were chosen from the Kent-Rosanoff frequency table of associations to river. Ten words were chosen which occurred more than once as associations to river, and five were chosen which occurred once only. The exact Kent-Rosanoff frequencies of these words are give in Appendix A. Ten more words, which did not appear in the Kent-Rosanoff table, were chosen at random form among the words in the Thorndike-Lorge word frequency table (53), which have a frequency of 50 per million or more. All the generalization

stimuli meet this criterion, affording a rough control for the effects of language frequency. Seven words, ocean, brook, stream, lake, flood, water, and current, all conceptually related to river, were included in order to provide a basis for comparing the Aware and Unaware groups for degree of generalization.

The Semantic Differential

In order to minimize, for the subjects, the connection between the conditioning experiment and their ratings of the stimuli on the Semantic Differential, the ratings were carried out separately from the rest of the experiment. Two psychology classes were asked to rate river and the 25 generalization stimuli on 20 of Osgood's scales. Subsequently, volunteer subjects were recruited from these classes, without being told of the connection between the earlier ratings and the experiment in which they were now being asked to participate.

The scales were chosen to represent equally Osgood's (34, 35), three semantic factors, Evaluation, Potency, and Activity. These scales and their factor loadings are given in Appendix B.

Subjects

The subjects in this study were 21 male and 34 female students from an introductory course in psychology. Since they were assigned to the Aware and Unaware groups on the

basis of their ability to verbalize the nature of the CS-UCS relationship at the end of the conditioning trials, it was impossible to match these groups in any respect.

Apparatus

The unconditioned stimulus for the GSR was shock, supplied by a pair of $1\frac{1}{2}$ volt dry cell batteries attached to a Harvard inductorium which was set at a scale reading of four. The shock was delivered to the right forearm by a pair of electrodes, secured to a web belt, and fitted snugly just below the elbow.

A pair of finger plungers was affixed to the end of the right arm of the upholstered chair in which the subject was seated. These were operated by the subject's right index and ring fingers. The index-finger plunger was attached to a mercury switch which activated an electric timer. Slight movements of this plunger in any direction alternately started and stopped the timer, resulting in rapid series of audible clicks.

The galvanic skin response was recorded by means of an electronic ohmmeter, which was designed to provide a direct current of approximately two milliamperes through the subject's skin. The instrument was equipped with a variable resistance switch, calibrated to yield a reading of the subjects basal resistance level. Skin resistance was read from a D.C. micro-ammeter, which was calibrated through the en-

tire range of the instrument, from 10 thousand to 110 thousand ohms. The instrument was operated in series with a voltage stabilizing transformer, which provided a constant line voltage. Figure 3 contains a schematic diagram of the instrument's construction.

Polarization of the zinc palmar electrodes was compensated by means of a reversing switch installed in the electrode circuit. The electrodes were mounted in a small block of plastic, which was fixed in the subject's palm by means of a heavy rubber band passed over the back of the hand. A small amount of electrode jelly was placed on the electrodes in order to insure good contact.

Experimental Procedure

The experiment was conducted in a semi-soundproof windowless room, which measured approximately six by nine feet. The subject was seated in an upholstered chair, facing the closed door of the room. All apparatus was located on a table directly behind the subject. The experimenter sat at this table in such a position as to be able to observe both the apparatus and the subject's face and right hand.

When the subject was seated, before the electrodes for either the GSR or the shock apparatus were put in place, the following explanation , adapted from Diven's, was given:

This is an experiment in psychology investigating muscle coordination. It has nothing to do with intelligence or personality, only your ability to coordinate your fingers. In order to register these coordinations electrically it is necessary to put your hand in an electrical circuit with the apparatus. You have probably heard of the galvanic skin response. That is what I am measuring. It is perfectly safe, so there's nothing to be alarmed about. The current is only a few thousandths of an ampere, and you won't even be able to feel it.

On your other arm, though, I want to put some electrodes which will give you a slight shock occasionally during the course of the experiment. It will definitely be uncomfortable, but it is not dangerous, since the current comes only from these three volts, so it can't possibly hurt you. I wonder how you feel about it?

Only one subject refused to undergo the procedure as presented above, although one other who went through the conditioning series refused to remain for the rest of the experiment, saying she had another appointment, and a third quit after receiving two or three shocks.

After the subject's consent had been obtained, the GSR electrodes were placed in the palm of the left hand, the shock electrodes were placed on the right forearm, and the subject's fingers were placed on the plungers. The experimenter then took his place at the table, out of sight of the subject, and proceeded as follows:

So you will know what to expect, let's make a

few trials with the shock now. First, just to see how sensitive you are to it, I will give you a very mild shock, which I really doubt that you will feel at all.

At this point, the doorbell button which activated the shock circuit was pressed. This caused the circuit breaker of the Harvard inductorium to emit a buzzing sound. However, since the secondary coil was withdrawn from the primary, no shock was delivered. Although three subjects reported feeling a barely perceptible shock, the majority said that they felt nothing. The secondary coil was then set up to about one quarter of the first interval on the inductorium scale, and the following instructions were given, followed by a slight shock.

Now I am going to give you a slightly stronger one, in order to see how strongly you react to it.

The secondary coil was then set up to the fourth interval on the scale, and, following the instructions below, shock was administered for approximately one second.

I am going to set this up now to the strength of shock which I have been using with all my other subjects, and give you one trial with it. If you think it is too strong, I can cut it down a little, but most of the others have been able to put up with it a few times.

Only three or four subjects reported that the shock was more than they thought they could tolerate, and for these the coil was moved back about a half-interval. The next instructions were as follows:

Now, in a little while I am going to call out a

series of signal or stimulus words. As soon as you hear the word I speak, I want you to call back to me the first related word that comes to mind, at the same time giving a light, even pressure on the plunger with your ring finger. Only the ring finger is to be moved. Keep the index finger quiet on its plunger. When you move the finger, you will hear a click. Try to keep from making any clicks by moving only your ring finger and keeping the index finger still.² This is the coordination I am interested in. Keep right on giving me words and pressures, then, until I say stop. Don't try to make any sense out of the task. I don't care what the words are that you say. All I want is for you to keep on giving me words and pressures, without moving the wrong finger, until I say stop.

For example, if I say carriage, and the first word you think of is horse, then say horse, and press with your ring finger. Then if the next word you think of is harness, say harness, and press again. Keep on like this until I say stop, then wait for the next word.

The subjects were then asked to find a comfortable position, to try to relax, and to refrain from unnecessary movement as much as possible.

After a short wait, in order to adjust the ohmmeter and to allow it to stabilize, the basal level of the subject's skin resistance was recorded, and Word List I was presented. The same order was used for all subjects. The subject was allowed twelve seconds for free association before the verbal signal to stop. Following the signal to

²The finger coordination task outlined in these instructions was purposely more complex than that of previous experimenters, in order to increase the proportion of unaware subjects.

stop, an interval was allowed to elapse before presentation of the next word, in order to allow the GSR to subside. This interval varied from a thirty second minimum to two or three minutes, depending on individual differences in the time required for the skin resistance to stabilize.

Word List I

one	union	cause	red	first	lamp
two	circle	circle	river	hang	river
five	large	bed	better	weather	hat
seven	river	plow	bright	circle	above
school	kiss	river	college	river	cook
river	horse	circle	circle	full	oil

After each presentation of the conditioned stimulus, river, the signal to stop was immediately preceded by a shock. A record was made of each subject's resistance level at the time of presentation of the critical word, as well as of the lowest level reached during the first post-stimulus excursion. The difference between these two levels was then taken as the GSR. The initial excursion only was recorded in order to avoid confounding the response to the stimulus word with responses to subsequent associations.

Where previous experimenters preceded the critical word with the same word on each presentation, each presentation of the critical word in the present study was preceded by a different word. This was done in order to furnish an internal control for conditioning. GSR was recorded for each pre-river word in the same way as for river.

One presentation of Word List I (six presentations of

the conditioned stimulus) comprised the conditioning series. Each subject was now asked to tell what he had noticed during the first part of the experiment, in order to discover whether he could verbalize the river-shock relationship. The subject's spontaneous responses to this question were noted, and further questioning was postponed until the end of the experiment.

At the end of approximately ten minutes' rest, during which the subject was allowed to walk around, smoke if he desired, get a drink of water, etc, he was once more seated in the armchair. The electrodes were again adjusted, and the subject was again requested to relax and to remain as motionless as practicable except for his finger movements. He was instructed, a la Diven, "To complete the word list, do just what you did before."

Word List II, the generalization list, was now presented, following the same procedure as with Word List I, except that the GSR was recorded for each word of List II, and no shock was administered. This presentation of List II will be referred to below as the generalization test. In order to control for possible position effects upon generalization, two different random arrangements of List II were utilized, each arrangement being presented to one-half of the subjects.

The next step consisted of two extinction presentations

Word List IIa

sugar
current
flow
body
tree
demand
ocean
brook
stream
ice
dinner
land
lake
desert
line
hunt
sand
boat
island
mountain
fish
table
flood
water
sky

Word List IIb

mountain
brook
flow
line
lake
island
sand
body
demand
current
sky
table
desert
tree
land
ice
dinner
flood
stream
sugar
fish
water
hunt
ocean
boat

of Word List I in which river was not reinforced by shock. This yielded an extinction series of twelve trials. These presentations differed from those of the conditioning series only in that for economy of time the first four and last four words were omitted from the final presentation. GSR was again recorded both for river and for the word preceding it on each trial.

Immediately following the extinction series Word List II was once more presented in order to test for generalization of extinction effects. The final presentation of List II will be referred to below as the extinction test. Each

subject received the same form of List II as he had in the generalization test.

At the conclusion of this test trial, the subject was once more questioned about the original conditioning series in order to determine more definitely whether he could verbalize the river-shock relationship. Subjects who had verbalized this relationship clearly, following the conditioning series, were not questioned further. The following questions were asked in order:

Did any of the words in the list you heard before the rest period seem to be any more important than the others?

Do you remember any of the words better than the others?

Were any of the words more disturbing than the others?

Was there any word which seemed to stand out more than the others on any basis other than repetition?

Did there seem to be any system to the shocks you were getting?

When did you expect the shock?

A few of the subjects who appeared unaware of the river-shock relationship were told at the conclusion, that shock had always followed river. In each case, these subjects denied having known this. In no case did a subject who, on the basis of questioning at the end of the conditioning series, had appeared to be unaware of the stimulus relations reveal such knowledge in the later questioning. All subjects

who failed specifically to verbalize the relationship, river-leads-to-shock, were assigned to the Unaware group, including the partially aware subjects.

Control Groups

In order to furnish a basis for estimating the effects of the extinction series on generalization, as well as the pre-existing stimulus value of the generalization words, two small control groups were utilized. One of these, designated the Extinction-control group, was treated in exactly the same way as the experimental groups, except that the extinction series was omitted. In order to preserve all possible unaware subjects for the experimental group, however, only the last six aware subjects were utilized as controls. Since these subjects received identical treatment with the experimental subjects throughout the conditioning series and the generalization test, their results were included with those of the Aware group in analyzing the results of this part of the experiment.

The second control group, the Generalization-controls, were merely instructed that it was desired to obtain their reactions to some words. They were seated, given an explanation of the GSR electrodes, and instructed to associate to the words in the same way as the experimental groups. The finger plungers and the shock electrodes were omitted. Word List II was then presented once, and the subjects' re-

sponses recorded in the same way as for the other groups.

RESULTS

Experimental Groups

Of the total of 55 subjects employed in the main body of the study, 35 became aware of the river-shock relationship during the conditioning series, 15 failed to conceptualize this stimulus relationship, and 5 exhibited a vague realization of it, making some such statement as, "I got shocked every time I said 'people' in response to 'river.'"

As a result of apparatus failure, and the subtraction of some of the experimental subjects to serve as controls, the net number of subjects employed in various parts of the experiment was somewhat smaller than indicated above. Figure 4 indicates schematically the disposition of subjects in successive stages of the experiment.

Method of Analysis

A problem in dealing with GSR data has been to obtain a unit of measurement whose distribution would fulfill the assumptions of conventional statistical techniques. Studies by Maggard (11, 12, 13), and by O. L. Lacey and Siegel (23, 24), indicate that this problem is best met by transformation of resistance data into units of conductance, the reciprocal of resistance. The formula for this transformation is as follows:

$$GSR = \frac{10^6}{R_2} - \frac{10^6}{R_1}$$

Total Subjects 55			
	Aware	Unaware	Generalization Controls
Conditioning Series	35 (3 discarded)	20 (3 discarded)	
Generalization Test	32	17	10
Extinction Series	26 (6 discarded)	17 (5 discarded)	
Extinction Test	20 Experimental 6 Extinction Controls	12	

Figure 4. Schematic Diagram of Disposition of Experimental and Control Subjects.

R_1 represents the resistance in ohms immediately preceding the stimulus, and R_2 is the lowest level of resistance reached in the initial excursion of the GSR following presentation of the stimulus. Multiplication by a factor of one million was carried out in order to eliminate decimal places. The unit thus obtained is the micromho. All GSR data on the following pages will be expressed in terms of this unit.

Significance tests were made by means of the t -test wherever the appropriate assumptions (28) of normality and equal variance could be met. Where these assumptions were not appropriate, the Mann-Whitney U -test (27, 31), was utilized. One-tailed tests were used wherever it was desired to test either of the hypothesis, $\bar{X} \geq 0$ or $\bar{X}_1 \geq \bar{X}_2$, and two-tailed tests were used where the direction of the differences was not of concern ($\bar{X} = 0$ or $\bar{X}_1 = \bar{X}_2$). The form of the hypothesis being tested will be specified below in each case.

Conditioning

The difference between GSR to river and GSR to the word immediately preceding each presentation of river was taken as the criterion of conditioning. Each subject's average response to the six conditioning presentations of river was compared with his average response to pre-river words, and the mean difference was computed. These data

may be found in Tables 3 and 4, Appendix C.

While the Aware group, according to this criterion, exhibited a significant amount of conditioning ($t = 3.07$), the Unaware group did not ($t = 0.13$). The difference between the two groups, as given by the U-test, was significant at the .05 level. The response levels of the Aware and Unaware groups are compared graphically in Figure 5.

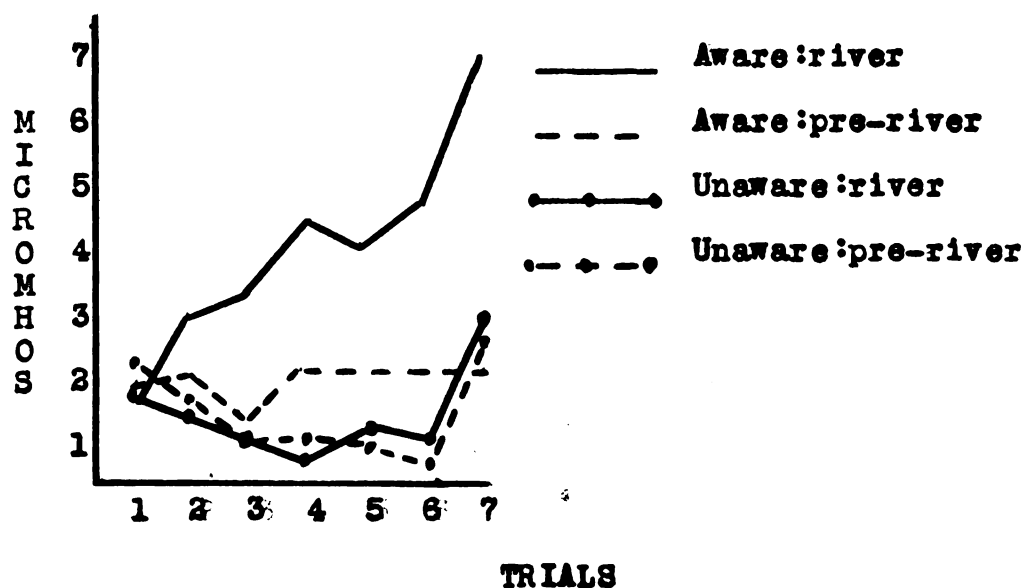


Figure 5. GSR to River and Pre-river Words in the Aware and Unaware Groups During the Conditioning Series

That the Unaware group not only showed a lower degree of conditioning, but also showed less overall reactivity during the conditioning series is suggested by the fact that the mean GSR to pre-river words alone was 1.01 micromhos for the Unaware group, while that of the Aware group was 1.98 micromhos. This difference was significant at the .02 level ($t = 2.62$).

Semantic Generalization and the Semantic Differential

In order to test Hypothesis I, the pre-experimental Semantic Differential ratings which had been obtained for the contents of Word List II were correlated with the generalization test GSRs obtained to the same words.

To obtain a measure of the connotative difference between river and each of the words in List II, the difference, d, between the rating of river and that of each other word on each single scale was obtained. These differences were squared and summed separately for each generalization stimulus, and the square root of the sum was taken. The result is Osgood's (34, 35, 37), difference statistic, D. The formula is given by $D = \sqrt{\sum d^2}$.

Since with both GSR and D a marked tendency was observed for the ranges of individual subjects to vary widely, all data were transformed into standard scores, based upon the means and standard deviations of individual subjects. The correlation between mean GSR and mean D by subjects, was - 0.15 ($P > .10$), indicating that GSR and D are independent measures.

The Pearson product-moment correlation for individual GSRs for each word, plotted against the corresponding D values, was found to be 0.01. For an N of 1218, based upon the product of the number of subjects and the number of responses for each subject, this correlation coefficient was not

significant. In order to guard against the possibility that this correlation had been attenuated by inclusion of the Unaware group, who apparently failed to condition or to generalize, (see below), a second correlation was computed with an N of 799, based upon the responses of the Aware group alone. In this group, where significant generalization was shown to have occurred, the correlation between GSR and D was 0.05. The probability of obtaining this value by chance was greater than .05. These results represent evidence against Hypothesis I.

Since the generalization stimuli had originally been chosen in part on the basis of their frequency of association with river, it was felt that it would be of interest to compute a correlation coefficient for the relationship between word-association frequency and GSR. Word-association data were available not only from the Kent-Rosanoff tables from which many of the words were taken, but also from a more recent Minnesota (48), sample of word associations. In the present data, the correlation between word-association frequency and GSR may be spuriously high, because of the fact that most of the words having high association frequencies to river are also water words. However, it was felt that such an analysis might still yield some information. Data were utilized only from the Aware group for this analysis, since they were the only group which had

shown definite generalization.

Since the frequencies of the generalization stimuli did not form a continuous distribution (see Appendix A), although it was assumed that such a distribution underlies association frequency, bi-serial r was employed for this comparison. Bi-serial r for Kent-Rosanoff frequency and individual GSR was 0.27, with N equal to 799. This was highly significant ($P < .001$). For Minnesota frequency and GSR, the bi-serial r was only 0.08, N equal to 799. This value was also significant, although not at so high a level as before ($P < .05, > .01$).

Relative Generalization of Aware and Unaware Groups

Average overall GSR of the Aware, Unaware, and Generalization-control groups to the first presentation of Word List II was first computed. These group averages are presented in Table 5, Appendix C. Comparisons between groups reveal no significant differences in overall level of response to Word List II in the generalization test. It is of interest, however, to note that the Unaware group mean is lower than that of either of the other groups. This is consistent with the apparently lower overall reactivity of this group in the conditioning series.

In order to determine whether the experimental groups exhibited differential semantic generalization effects, a

comparison was next made for each group between the average response to water words and that to non-water words. For this purpose, the average response to the six nouns, ocean, brook, stream, lake, flood, and water, was compared with the average response to the rest of List II. Although current had originally been included as a water word, it was excluded from the analysis of results. This was done in consideration of its obviously close relation to the unconditioned shock stimulus. Several subjects, especially in the Unaware group, gave unusually large GSRs to current, at the same time that they associated shock with it verbally. It was felt that such GSRs were overdetermined by this association, and the word was consequently rejected.

Tables 6, 7, and 8, Appendix C, present the mean individual and group differences between water word and non-water word responses. Only the Aware group showed significantly more generalization to water words than to non-water words. ($t = 3.73$, $P < .0005$), while the Control group showed a slightly greater, non-significant, response to non-water words. Table I shows that the Aware group difference was significantly greater than that of either of the other two groups.

The significance of this difference between the Aware and Unaware groups supports Hypothesis II, although the failure of the Unaware group to condition to a significant degree or to exhibit significantly greater generalization to

TABLE 1

INTER-GROUP COMPARISON OF GENERALIZATION-TEST DIFFERENCES
BETWEEN WATER WORDS AND NON-WATER WORDS

COMPARISON	Diff.	$t(X_1 \geq X_2)$	P
Aware-Controls	1.11	3.26	<.005
Unaware-Controls	0.84	**	n.s.*
Aware-Unaware	0.27	**	<.01

* Not significant

** U-test

water words makes it doubtful whether these data adequately test the hypothesis.

Generalization of Extinction Effects

In order to determine the general effect of the extinction series, the difference between overall generalization-test GSR and overall extinction-test GSR was first computed for each of the experimental groups and for the Extinction-control group. As may be seen from Tables 9, 10, and 11, Appendix C, both the Aware and Unaware groups showed a significant overall decrement of GSR between the first and second presentations of Word List II. The Control group did not decline significantly. When intergroup comparisons were made of these declines, however, there were no significant differences. The apparent conflict in these results suggests that the reduction in overall response level to the

extinction test was slight.

In order to afford a test of Hypothesis III, the difference in GSR between the generalization test and the extinction test was computed separately for water words and for non-water words for each subject. The individual subject differences between these decrements were then averaged by groups. This yielded a mean difference for each group between the extinction test decrement to water words and that to non-water words. These means were tested for the significance of their differences from zero, and intergroup comparisons were made.

Examination of Tables 12, 13, and 14, AppendixC, reveals that the Aware group showed a significantly greater average extinction decrement to water than to non-water words, while the Unaware and Control groups did not. The Control group showed a slightly greater non-significant, average decrement to non-water words. The intergroup comparisons in Table 2 show that this difference was significantly greater for the Aware group than for either the Unaware or the Control group, while the difference between the Unaware and Control groups was not significant.

Hypothesis III is supported by these data, although, as in the case of Hypothesis II, the apparent failure of the Unaware group to condition, or to generalize the effects of conditioning or extinction, makes it doubtful whether a

TABLE 2

INTER-GROUP COMPARISON OF DIFFERENCES BETWEEN EXTINCTION-
TEST DECREMENTS TO WATER WORDS AND TO NON-WATER WORDS

COMPARISON	Diff.	$t(X_1 \geq X_2)$	P
Aware-Controls	1.41	3.22	<.005
Unaware-Controls	0.94	**	n.s.*
Aware-Unaware	0.47	**	.025

* Not significant

** U-test

good test of the hypothesis has been afforded.

EVALUATION OF RESULTS

Probably the most important finding of this study is the failure of the Semantic Differential to correlate with semantic generalization. On the assumption that the Semantic Differential affords a reliable continuum of connotative difference for a series of verbal stimuli, the present results indicate that such a continuum bears no relationship to semantically mediated generalization. This, coupled with the finding of a possible relationship between semantic generalization and word-association frequency, suggests that the mediating relationships in semantic generalization are those which are built into the individuals habit patterns by repeated linguistic usage. The individually unique, affective similarity which is presumed to be measured by the Semantic Differential appears to be of secondary importance, if any.

The finding of a significant correlation between semantic generalization and word-association frequency data from two independent large samples appears to justify a more careful study of this relationship. In the present study, the words having the highest word-association frequencies to river were all water words, a relationship which is itself sufficient to mediate a high degree of generalization. The correlations found between word-association frequency and generalization may be entirely due to this fact. However,

further investigation is required in order to determine whether this is the case.

Hypotheses II and III are supported by comparison between the Aware and Unaware groups with respect both to mediated stimulus generalization and to generalization of extinction effects. However, as pointed out in the previous section of this paper, the failure of the Unaware group to exhibit significant conditioning or generalization raises doubt that these two hypotheses were adequately tested in the present study.

Reference to Tables 6-8 and 12-14, Appendix C, will reveal, however, that in both the generalization test and the extinction test all differences between groups are in the hypothesized direction. In both the generalization test and the extinction test, the mean difference between GSR to water words and to non-water words is negative for the Control groups. For both the Aware and the Unaware groups these differences are positive, while in each case the Aware group shows significantly more generalization than does the Unaware group. These regularities would seem to warrant further research along these lines, once the factors responsible for the failure of conditioning in the Unaware group have been clarified.

The results of the present study are in sharp conflict with those of studies by Diven, Haggard, and Lacey, et al.,

with respect to conditioning of the unaware subjects. While examination of Diven's published data suggests that his Unaware subjects may not have conditioned to the same extent as did his aware subjects, Haggard states specifically that no clear-cut difference occurred in his data. Lacey and his collaborators report that their unaware subjects showed a lower level of conditioning, but an equal degree of generalization, in comparison with their aware subjects.

The failure of the unaware subjects to condition in the present study is doubtlessly attributable to procedural differences between this and other studies. Two such consistent differences exist. First, the distraction afforded by the finger plunger task was more complex in this than in previous studies. This may have interfered with the rate of conditioning. However, a probably more significant difference lies in the fact that Diven, Haggard, and Lacey all preceded the critical word with the same word, at each presentation. This was not done in the present study. Instead, the critical word, river, was preceded by a different word at each presentation, in order that the pre-river words might serve as a control for conditioning. It is likely that this had the effect of decreasing the discriminability of the critical word for the unaware subjects.

Another problem, common to all the studies in this area, is that of why approximately 40% of the subjects in an experiment of this type fail to become aware of the word-shock re-

lation, while others volunteer the concept as early as the second conditioning trial. That this difference in concept formation is not due to intelligence differences is suggested by the fact that the Aware and Unaware groups in the present study were found to have almost identical average college entrance examination scores.

A possible answer is suggested by an examination of some of the hypotheses put forward by the unaware and partially aware subjects. When asked, at the end of the experiment, what had determined the occurrence of shock, several subjects appeared to have satisfied themselves with incorrect hypothesis, so that no further attempt was made to determine when the shock would occur. For example, Subject 24 volunteered after the fourth river-shock presentation that she was shocked every time the experimenter said stream. This hypothesis was repeated during later questioning.

Another subject, S. 53, although he failed to exhibit appreciable conditioning, responded quite differently to water words and non-water words in both the generalization and extinction tests. This subject stated that he thought he was receiving shock whenever his response to river or water was current. Typical Unaware group hypotheses were that the shock followed a regular time interval, that it occurred after a particular number of stimuli had been presented, that it occurred". . . every time I paused," or ". . . whenever you let me say 13 words before you said stop."

Nearly all subjects appeared to be attempting to formulate hypothesis which would enable them to anticipate the shock. However, some subjects who initially struck on incorrect or only partially correct explanations apparently were afforded insufficient opportunity, within six conditioning trials, to test the accuracy of these.

That a lack of accurate conceptualization does not preclude generalization, however, is revealed by examination of the GSR averages of Subjects 24, 53, and 56 in Tables 4, 7, and 13, Appendix C. While these subjects failed to show any marked evidence of conditioning to river, all three appear to have generalized more to water words than to non-water words. On the other hand, at least one aware subject, S. 7, who realized readily that river led to shock, gave a greater average GSR to pre-river words than to river, in the conditioning series. The apparent complexity of the relationship between conditioning, generalization, and formation of the concept, "river leads to shock," suggests the desirability of research into the relationship between the formation of anticipatory responses and the formation of verbal concepts.

One further observation invites discussion. The most effective inter-stimulus interval for conditioning is usually found to be approximately .5 second (36). This interval has also been found to hold for ordinary GSR conditioning (30). However, strong conditioning repeatedly has been shown to oc-

our in the present kind of situation when the inter-stimulus interval is as great as 20 seconds. That this conditioning is not dependent upon whether the subject forms a conscious set, the unconditioned stimulus to follow the conditioned stimulus, has been shown by studies already cited. Consideration of possible factors responsible for this unusual extension of the inter-stimulus interval suggests that not only may generalization be mediated by verbal processes, but also that these processes may mediate conditioning. Investigation of this aspect of verbal mediation appears to be lacking in the literature.

SUMMARY AND CONCLUSIONS

Various non-voluntary responses, when conditioned either to verbal or to non-verbal stimuli, exhibit generalization to other stimuli which are semantically related to the conditioned stimulus. Several studies indicate that this semantically mediated generalization frequently occurs in the absence of awareness by the subject of the relationship between the conditioned and unconditioned stimuli.

In the present study, the galvanic skin response was conditioned to a verbal stimulus and tested for generalization to a number of semantically related stimuli. The generalization of extinction of this response was also investigated. Forty-nine experimental subjects were employed, 32 of whom were aware of the conditioned stimulus-unconditioned stimulus relationship. The study was designed to test three hypotheses.

Hypothesis I predicted that semantically mediated generalization would be negatively related to the degree of connotative difference between the conditioned stimulus and the several generalization stimuli, as established by Osgood's Semantic Differential. Hypothesis II predicted that the aware subjects, as a result of the mediating function of their ability to verbalize the conditioned stimulus-unconditioned stimulus relationship, would exhibit greater generalization

than would the unaware subjects. Hypothesis III predicted that, for the same reason, the aware subjects also would exhibit greater generalization of extinction effects than would the unaware subjects.

The results clearly indicate the Hypothesis I is untenable. A non-hypothesized finding was that the degree of generalization was positively correlated with the magnitude of word-association frequency between the conditioned stimulus and the generalization stimuli. Hypotheses II and III are supported by the general trend of the data although it is doubtful that a decisive test of the hypotheses was afforded by the present study.

The study raised a problem for future investigation of the degree to which word association frequency may be utilized in predicting the degree of semantic generalization between verbal stimuli. Problems were also raised with respect to the relationship between conceptualization and conditioning.

The results appear to warrant the following conclusions:

1. No relationship exists between connotative differences between words, as measured by the Semantic Differential, and semantic generalization to such words.
2. Semantic generalization may occur as a function of word-association frequency, as measured by the Kent-Rosanoff Word Association Test.
3. Awareness of the signal-function of a conditioned stimulus may increase speed and strength of conditioning.

4. Awareness of the signal-function of a conditioned stimulus may increase the generalization of responses conditioned to such stimuli.

APPENDIX A

**KENT-ROSANOFF WORD-ASSOCIATION FREQUENCIES
BETWEEN GENERALIZATION STIMULI
AND RIVER**

Water	383
Stream	117
Lake	65
Flow	24
Brook	20
Boat	20
Ocean	17
Mountain	10
Current	8
Land	5
Fish	1
Island	1
Body	1
Sky	1
Tree	1
Hunt	0
Line	0
Sugar	0
Sand	0
Flood	0
Dinner	0
Demand	0
Ice	0
Table	0
Desert	0

APPENDIX B

FACTOR LOADINGS OF SEMANTIC DIFFERENTIAL SCALES

	Factor I (Evaluation)	Factor II (Potency)	Factor III (Activity)
1. good-bad	.88	.05	-.09
2. large-small	.06	.62	.34
3. beautiful-ugly	.86	.09	.01
4. hard-soft	-.48	.55	.16
5. sweet-sour	.83	-.14	-.09
6. strong-weak	.19	.62	.20
7. deep-shallow	.27	.46	.14
8. sharp-dull	.23	.07	.52
9. ferocious-peaceful	-.69	.17	.41
10. heavy-light	-.36	.62	-.11
11. relaxed-tense	.55	.12	-.37
12. hot-cold	-.04	-.06	.46
13. nice-awful	.87	-.08	.19
14. treble-bass	.33	-.47	.06
15. angular-rounded	-.17	.08	.43
16. fragrant-foul	.84	-.04	-.11
17. honest-dishonest	.85	.07	-.02
18. active-passive	.14	.04	.59
19. fast-slow	.01	.00	.70
20. rugged-delicate	-.42	.60	.26

APPENDIX C

**TABLES OF INDIVIDUAL AND GROUP RESPONSES DURING
CONDITIONING SERIES, GENERALIZATION
TEST, AND EXTINCTION TEST**

TABLE 3

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COMPARISON BETWEEN RIVER AND PRE-RIVER
WORDS FOR AWARE GROUP

	Mean river: GSR	Mean non- river GSR	Diff.
S	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_1 - \bar{X}_2$
2	2.67	*	--
5	1.00	0.68	0.32
7	3.64	6.80	-3.16
8	1.07	1.23	-0.16
9	1.48	1.01	-0.47
11	0.71	1.34	-0.63
13	1.42	1.19	0.23
14	2.14	1.04	1.10
15	1.04	0.09	0.95
16	3.90	1.30	2.60
17	2.66	2.45	0.21
19	2.54	0.90	1.64
20	4.93	0.92	4.01
22	1.79	1.03	1.76
23	0.80	0.32	0.48
25	0.72	1.13	-0.41
26	5.61	0.35	5.26
31	2.94	2.12	0.82
32	3.75	1.50	2.25
33	3.69	2.90	0.79
35	3.84	1.16	2.68
36	10.43	5.27	5.16
37	16.37	4.30	12.07
39	4.14	2.39	1.75
40	1.58	2.05	-0.47
42	6.51	4.08	2.43
43	1.75	2.94	-1.19
45	2.25	2.32	-0.07
47	3.92	3.17	0.75
48	2.25	1.17	1.08
49	6.29	1.84	4.45
54	2.26	2.30	-0.04

$$\bar{X}_D = 1.49$$

$$\sigma^2 = 7.29$$

$$t(\bar{X}_D \neq 0) = 3.07$$

$$P < .005$$

*Not obtained

TABLE 4

COMPARISON BETWEEN RIVER AND PRE-RIVER
WORDS FOR UNAWARE GROUP

	Mean river GSR	Mean pre- river GSR	Diff.
S	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_1 - \bar{X}_2$
3	0.87	1.16	-0.29
4	1.01	1.40	-0.39
6	0.70	0.80	-0.10
12	1.15	1.35	-0.20
18	0.74	0.74	0.00
21	0.54	0.14	0.40
24	2.02	0.33	1.69
28	0.91	0.77	0.14
38	0.96	0.94	0.02
41	0.46	1.73	-1.27
44	1.53	1.10	0.43
50	0.86	0.59	0.07
51	2.21	2.56	-0.35
52	2.12	1.31	0.81
53	0.05	0.67	-0.62
55	0.56	0.92	-0.36
56	2.63	2.31	0.32
$\bar{X}_D = 0.02$		$\sigma^2 = 0.41$	
$t(\bar{X}_D \neq 0) = 0.13$		$P < .05$	

TABLE 5

AVERAGE GSR OF EXPERIMENTAL AND CONTROL GROUPS TO FIRST PRESENTATION OF WORD LIST II (GENERALIZATION TEST)

AWARE GROUP		UNAWARE GROUP		GENERALIZATION-CONTROL GROUP	
S	Mean GSR	S	Mean GSR	S	Mean GSR
2	1.06	3	3.77	64	3.63
5	1.19	4	1.33	66	2.92
7	3.14	6	0.61	67	2.31
8	1.76	12	3.84	68	4.24
9	1.76	18	1.92	69	0.51
11	1.25	21	0.73	70	2.20
13	3.59	24	1.69	71	3.28
14	1.58	28	4.23	72	1.90
15	0.79	38	0.86	73	1.20
16	2.40	41	1.14	74	2.84
17	2.29	44	3.30	75	1.96
19	2.29	50	2.74		
20	1.12	51	1.34		
22	1.02	52	1.81		
23	0.69	53	5.13		
25	1.26	55	0.41		
26	2.54	56	3.28		
31	2.39				
32	2.78				
33	3.21				
35	1.01				
36	3.62				
37	5.65				
39	2.92				
40	2.75				
42	4.06				
43	3.93				
45	1.50				
47	1.52				
48	2.45				
49	0.80				
54	6.07				
$\bar{X} = 2.32$		$\bar{X} = 1.77$		$\bar{X} = 2.45$	
$\sigma^2 = 1.80$		$\sigma^2 = 2.18$		$\sigma^2 = 1.16$	

TABLE 6

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COMPARISON BETWEEN WATER WORDS AND NON-WATER WORDS FOR AWARE
GROUP (GENERALIZATION TEST)

S	Mean water GSR $\bar{X}_1$	Mean non- water GSR $\bar{X}_2$	Difference $\bar{X}_1 - \bar{X}_2$
2	2.15	0.73	1.42
5	1.62	1.03	0.59
7	3.66	2.92	0.74
8	1.92	1.71	0.21
9	1.71	1.78	-0.07
11	1.64	1.12	0.52
13	5.46	2.99	2.47
14	2.30	1.26	1.04
15	1.74	0.46	1.28
16	3.13	2.10	1.03
17	2.40	2.21	0.19
19	2.67	2.10	0.57
20	1.60	0.94	0.66
22	0.88	1.02	-0.14
23	0.38	0.81	-0.43
25	1.45	1.25	0.20
26	5.49	1.52	3.97
31	2.53	2.29	0.24
32	2.84	2.66	0.18
33	4.25	2.89	1.36
35	1.43	0.90	0.53
36	4.10	3.37	0.73
37	6.97	5.20	1.77
39	3.44	2.71	0.73
40	3.18	2.53	0.65
42	4.40	3.19	1.21
43	2.45	4.51	-2.06
45	1.73	1.44	0.29
47	1.88	1.44	0.44
48	4.18	1.90	2.28
49	0.77	0.79	-0.02
54	5.68	6.18	-0.50

$$\bar{X}_D = 0.69$$

$$\sigma^2 = 1.06$$

$$t(\bar{X} \leq 0) = 3.73$$

$$P < .0005$$

TABLE 7

COMPARISON BETWEEN WATER WORDS AND NON-WATER WORDS FOR UNAWARE GROUP (GENERALIZATION TEST)

S	Mean water GSR	Mean non- water GSR	Difference
	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_1 - \bar{X}_2$
3	2.93	4.12	-1.19
4	1.22	1.42	-0.20
6	0.72	0.61	0.11
12	3.76	3.78	-0.02
18	1.44	2.03	-0.59
21	0.67	0.74	-0.07
24	2.72	1.24	1.48
28	4.97	4.05	0.92
38	0.86	0.93	-0.27
41	0.91	1.28	-0.37
44	2.88	3.25	-0.57
50	3.09	2.31	0.78
51	1.19	1.33	-0.14
52	1.71	1.75	-0.04
53	9.55	3.32	6.23
55	0.07	0.53	-0.46
56	4.38	2.88	1.50
$\bar{X}_D = -0.42$		$\sigma^2 = 2.77$	
$t(\bar{X} \geq 0) = 1.01$		$P > .05$	

TABLE 8

COMPARISON BETWEEN WATER WORDS AND NON-WATER WORDS FOR GENERAL-
IZATION-CONTROL GROUP (GENERALIZATION TEST)

S	Mean water GSR	Mean non- water GSR	Difference
	$\bar{Y}_1$	$\bar{Y}_2$	$\bar{Y}_1 - \bar{Y}_2$
64	4.36	3.25	1.11
66	3.48	2.62	0.86
67	1.78	2.19	-0.41
68	2.70	4.88	-2.18
69	0.60	0.43	0.17
70	1.32	2.49	-1.17
71	2.78	3.49	-0.71
72	1.42	2.02	-0.60
73	1.30	1.21	0.09
74	2.69	2.93	-0.24
75	0.73	2.24	-1.51
$\bar{Y}_D = -0.42$		$\sigma^2 = 0.96$	
$t(\bar{Y} \geq 0) = 1.36$		$P > .10$	

TABLE 9

COMPARISON BETWEEN MEAN GENERALIZATION-TEST GSR AND MEAN EX-
TINCTION-TEST GSR FOR AWARE GROUP

S	Mean Generalization test GSR $\bar{X}_1$	Mean Extinction test GSR $\bar{X}_2$	Extinction test decrement $\bar{X}_1 - \bar{X}_2$
2	1.08	1.13	-0.07
5	1.19	1.25	-0.06
7	3.14	1.76	1.38
8	1.76	1.21	0.55
9	1.76	0.71	1.05
11	1.25	0.73	0.52
13	3.59	0.77	2.82
14	1.58	0.50	1.08
15	0.79	0.27	0.52
16	2.40	1.86	0.54
17	2.29	2.62	-0.33
20	1.12	0.59	0.53
23	0.69	0.28	0.41
25	1.26	0.60	0.66
31	2.39	3.48	-1.09
33	3.21	1.23	1.98
36	3.62	2.00	1.62
37	5.65	3.22	2.43
40	2.75	1.06	1.69
42	4.06	0.35	3.71
$\bar{X}_D = 1.00$		$\sigma^2 = 1.30$	
$t(\bar{X}_D \neq 0) = 3.93$		$P < .005$	

TABLE 10

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COMPARISON BETWEEN MEAN GENERALIZATION-TEST GSR AND MEAN EX-
TINCTION-TEST GSR FOR UNAWARE GROUP

S	Mean general- ization test GSR $\bar{X}_1$	Mean extinc- tion test GSR $\bar{X}_2$	Extinction test decrement $\bar{X}_1 - \bar{X}_2$
3	3.77	1.91	1.86
4	1.33	0.66	0.67
6	0.61	0.16	0.45
12	3.84	3.66	0.18
21	0.73	1.01	-0.28
24	1.69	0.35	1.34
28	4.23	4.28	-0.05
38	0.86	0.89	-0.03
50	2.74	1.68	1.06
52	1.81	1.82	-0.01
53	5.13	1.36	3.77
56	3.28	1.79	1.49
$\bar{X}_D = 0.87$		$\sigma^2 = 1.32$	
$t(\bar{X}_D \leq 0) = 2.63$		$P < .025$	

TABLE 11

COMPARISON BETWEEN MEAN GENERALIZATION-TEST GSR AND MEAN EX-
TINCTION-TEST GSR FOR EXTINCTION-CONTROL GROUP

S	Mean general- ization test GSR $\bar{X}_1$	Mean extinc- tion test GSR $\bar{X}_2$	Extinction test decrement $\bar{X}_1 - \bar{X}_2$
43	3.93	2.95	0.98
45	1.50	1.65	-0.15
47	1.52	2.79	-1.27
48	2.45	3.49	-1.04
49	0.80	0.79	0.01
54	6.07	3.37	2.70
$\bar{X}_D = 0.55$		$\sigma^2 = 2.77$	
$t(\bar{X}_D \leq 0) = 0.81$		$P > .05$	

TABLE 12

COMPARISON BETWEEN EXTINCTION-TEST DECREMENTS TO WATER WORDS
AND NON-WATER WORDS FOR AWARE GROUP

S	Mean Decrement to water words	Mean Decrement to non-water words	Diff. between water and non- water decrements
	D_w	D_n	$D_w - D_n$
2	0.71	-0.15	0.86
5	0.32	-0.09	0.41
7	2.67	1.22	1.45
8	0.78	0.51	0.27
9	0.73	1.20	-0.47
11	0.95	0.34	0.61
13	4.90	2.08	2.82
14	2.03	0.66	1.37
15	1.30	0.24	1.06
16	0.23	0.72	-0.49
17	1.08	-0.68	1.76
20	0.78	0.39	0.39
23	-0.12	0.60	-0.72
25	1.45	0.42	1.03
31	-0.90	-1.17	0.27
33	3.59	1.42	2.17
36	2.53	1.19	1.34
37	3.39	2.20	1.19
40	1.95	1.71	0.24
42	3.58	2.98	0.60

$$\bar{X} = 0.82$$

$$\sigma^2 = 0.83$$

$$t(\bar{X} \neq 0) = 3.93$$

$$P < .0005$$



TABLE 13

COMPARISON BETWEEN EXTINCTION-TEST DECREMENTS TO WATER WORDS
AND NON-WATER WORDS FOR UNAWARE GROUP

S	Mean Decrement to water words	Mean Decrement to non-water words	Diff. between water and non- water decrements
	D_w	D_n	$D_w - D_n$
3	1.58	2.05	-0.47
4	0.47	0.84	-0.37
6	0.59	0.45	0.14
12	0.05	0.31	-0.26
21	-0.71	-0.14	-0.57
24	1.84	1.05	0.79
28	-1.24	1.66	-2.90
38	-0.31	0.12	-0.50
50	1.61	0.52	1.09
52	1.45	-0.03	1.48
53	8.56	2.88	5.68
56	2.90	1.00	1.90
$\bar{X} = 0.35$		$\sigma^2 = 4.23$	
$t(\bar{X} \geq 0) = 0.58$		$P > .10$	

TABLE 14

COMPARISON BETWEEN EXTINCTION-TEST DECREMENTS TO WATER WORDS
AND NON-WATER WORDS FOR EXTINCTION-CONTROL GROUP

S	Mean Decrement to water words	Mean Decrement to non-water words	Diff. between water and non- water decrements
	D_w	D_n	$D_w - D_n$
43	0.25	1.35	-1.10
45	-0.91	0.19	-1.10
47	-1.60	-1.15	-0.45
48	-1.65	-0.58	-1.07
49	0.03	0.06	-0.04
54	2.95	2.73	0.22
$\bar{X} = 0.59$		$\sigma^2 = 0.35$	
$t(\bar{X} \neq 0) = 0.22$		$P > .10$	

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