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## Stimulus Generalization from Auditory Stimuli to Visual Stimuli in the Field of Verbal Behavior for Meaningful and Non-Meaningful Material

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STIMULUS GENERALIZATION FROM AUDITORY STIMULI TO  
VISUAL STIMULI IN THE FIELD OF VERBAL BEHAVIOR  
FOR MEANINGFUL AND NON-MEANINGFUL MATERIAL

by

David W. Thompson

A Thesis Submitted to the Faculty of the Graduate School  
of Loyola University in Partial Fulfillment of  
the Requirements for the Degree of  
Master of Arts

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1963

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## CHAPTER I

### INTRODUCTION AND STATEMENT OF THE PROBLEM

Stimulus generalization has long been a problem in psychology. Since the early 1900's when Pavlov found salivation occurring to stimuli other than the unconditioned stimulus (food), it has become a major concept in almost every experimental, theoretical system. Whether it was termed irradiation (Pavlov), primary and secondary stimulus generalization (Hull), induction (Skinner), or merely nondifferentiation (Woodworth and Schlosberg), it has nevertheless held the interest of psychologists for many years. Although Pavlov was the first to note this phenomenon, his theoretical structure, being basically physiological, has, by and large, been relegated to the background of experimental psychology, while the behavioral data of his, and others', studies remain. Hence, it is as a behavioral level concept that generalization is used in this thesis.

Even though the relatively simple behavioral approach is adapted to stimulus generalization, further qualifications and clarifications are needed. Definitions of this phenomenon, for example, are deceptively simple, for they raise more problems

than they solve. Underwood (1949), for instance, gives this definition. "When stimulus A gains power to elicit response B, other stimuli similar to A may also be shown to have some tendency to elicit B. This is stimulus generalization." Now, on the face of it, this seems to be a fairly innocuous statement, yet when such terms as "gains power," "elicits," and "similar" are examined, some confusion is certain to arise. How does a stimulus gain power? What, exactly, is meant by the word elicit? What standards are used for judging similarity and are the standards necessarily unidimensional? All these and more questions could be raised in response to such a definition.

A similar definition, and one which again does not answer these questions is that of Hovland (Stevens, ed. 1951). "This situation is similar to the type of set-up that produces stimulus generalization in conditioning experiments. Response is obtained to stimuli not generally used in the conditioning, and the response is greater to stimuli similar to the stimulus originally used than to those more remote."

A somewhat more detailed definition is offered by Hilgard (1956).

"A new conditioned stimulus, not previously reinforced, may elicit a conditioned response, the first time it is presented. The probability that it will do so is increased if it is similar to the conditioned stimulus which has been reinforced. Thus if a conditioned response is obtained to one tone, another tone, at a slightly different frequency, will also produce a conditioned response, with lesser magnitude

the further the separation of the tones. This process whereby a novel stimulus produces a response learned to another similar stimulus is known as generalization."

Here, although an example of stimulus similarity is given, a universal application of the concept is certainly lacking. Note also the qualification given to the response, attributing to it a "lesser magnitude", i.e. modifying the response quantitatively rather than qualitatively.

Finally, a definition by English and English (1958) provides a distinction (and in E's opinion, a useful distinction) between primary and mediated stimulus generalization. Here stimulus generalization itself refers to,

"... the fact that after an animal learns to make a certain response to a certain stimulus, certain other previously ineffective stimuli will also elicit the conditioned response. If the stimuli are perceptually similar, it is said to be a primary stimulus generalization. Mediated stimulus generalization refers to the case of stimuli, not perceptually similar, that participate in generalization because of the equivalence of the responses they evoke."

Here, although an attempt is made to qualify stimuli, in primary generalization as similar in terms of "perception," there would, no doubt, arise a cry of ambiguity from many psychologists. Mediated stimulus generalization, however, is defined in strictly observable terms, and in terms, not of the stimuli, but of the responses. That is, a stimulus is defined as generalized to, if and only if, it evokes the same or a similar response as the original stimulus. (This would seem to put the similarity of responses under the same restrictions as were mentioned in defining the



similarity of stimuli; however, E believes these restrictions can be overcome if the response is defined in terms of a physical system, as will be shown later.)

Despite the simplicity and apparent similarity in these definitions, one would not be correct in assuming that the concept of stimulus generalization has not been criticized. Hovland (1951) believes much needs to be done before any clear cut laws on the subject can be propounded:

"Work on the form of generalization gradients is seriously limited by the lack, at the present time, of adequate scales of stimulus similarity and response magnitude. Studies are also needed on the factors influencing the form of the gradient. One relevant factor is the strength of the unconditioned stimulus. The stronger the unconditioned stimulus, the wider the generalization."

Hull's (1943) definition of stimulus generalization, while similar to the others, is a bit broader. "The reaction involved in the original conditioning becomes connected with a considerable zone of stimuli other than, but adjacent to, the stimulus conventionally involved in the original conditioning; this is called stimulus generalization." Of this definition Lashley and Wade (1946) say, "It is merely a restatement of the ancient law of association by similarity; it provides no answer to the psychological problem of what constitutes similarity or how the generalized association is developed". Attacking the whole concept of stimulus generalization Lashley and Wade next turn to Hovland's definition, "To demonstrate irradiation in primary conditioning

the subjects must be inexperienced with respect to the stimulus dimension used, in order to rule out any tendency to identify a single stimulus as belonging in a familiar graded series or to use habits of relational thinking."

Continuing their attack of the generalization phenomenon on a more general level the authors add,

"Even with human subjects, conditioned to the sound of a bell, the senior author has obtained the conditioned reaction without further training, from the sound of a buzzer, of breaking glass, of clapping hands, from a flash of light, and from pressure or prick on the arm or face. The only dimension common to such stimuli is that all produce a sudden change in the environment. Such tests show that the conditioned reaction is initially undifferentiated: they do not tell what associations have been formed with the conditioned stimulus."

Lashley and Wade, citing other examples, turn next to the basics of generalization theory. "The fundamental assumption of Neo-Pavlovian theory, that in conditioning all aspects of a stimulus are associated with the reaction, is demonstrably false." The authors then conclude, "Psychological analysis of perceptual similarity has apparently reached an impasse. No general laws descriptive of the processes by which a recognition of similarity is reached have been formulated."

Lashley and Wade are rather pessimistic in their hope for an objective criterion of similarity, "Similarities in experience may exist for which no objective continuum is discoverable, as appears in the classification of odors, and in equivalencies across sensory modalities." However, they do admit the existence

of similarity and, anticipating English and English, a method of measuring it, hence, "Degree of similarity is a product of the activity of the organism, not a physical property." This will be the point of view taken in this thesis. That is, if a response (as defined by a physical system i.e. the psychogalvanometer) occurs in the presence of a stimulus because it has been conditioned in the presence of a different stimulus (different at least to the extent that different sensory organs are involved in the perception of each stimulus) then generalization will have been said to have occurred. There is no question here of similarity of stimuli, sense modality, or eliciting a response. The only question to be determined here is whether or not a response will occur to a stimulus because of S's previous experience with another stimulus. If it does, generalization has, by definition, occurred (the problem of how a stimulus, perceptually different from another stimulus, can be generalized to, will be discussed later). This frame of reference is summarized by Woodworth and Schlosberg (1954). "If the response remains the same, the new stimulus can be called equivalent to the old. It may not be equivalent in all respects, but it does elicit the same response." Again, the same authors point out, "In a somewhat different context a stimulus is said to be generalized if other stimuli can be substituted for it and elicit the same response. The original context here was Pavlov's study of conditioning."

A word might be said here concerning the relationship of

stimulus generalization and transfer of training. Experiments on transfer are typified by Yum (1931), Melton and von Lachum (1941), and Bruce (1933). For example, Bruce found that making an old response (using nonsense syllables) to new stimuli resulted in so-called positive transfer (the ratio of transfer being about 100:63) and that the more similar were the stimuli the greater was the positive transfer. Now, most authors would distinguish this type of phenomenon from stimulus generalization. This distinction is not clear to E! Woodworth and Schlosberg (1954) attempt to differentiate the two concepts by claiming some sort of achievement is accomplished in transfer experiments hence, "Generalization in this ordinary sense is an achievement, but in the Pavlovian sense it is no achievement but a primitive state of behavior, the only achievement being to advance out of this stage by aid of differential reinforcement." This distinction, in E's opinion is arbitrary. Whether one is an achievement and the other a primitive state is nothing more than a problem of semantics. The fact of the matter is that both types of phenomenon obey the same laws, are predictable using the same concepts, and are subject to the same effects of reinforcement contingencies. The only distinction between stimulus generalization and transfer of training that E is able to determine is that the former concept is usually used when the data are concerned with either animal behavior or autonomic responses, while the latter concept is reserved for data

concerned with human skeletal behavior. Whether this distinction is valid in view of the similarity of the laws of both phenomenon is therefore highly debatable.

Stimulus generalization experiments using stimuli of the same sense modality and the psychogalvanometer have usually relied on tonal qualities. Hovland (1937) studied the effects of conditioning and generalization of tones varying separately the frequency and the intensity of the tones. He chose four tones representing 25 j.n.d.'s (just noticeable differences) of cycles (153, 468, 1000, and 1967 cycles) and 50 j.n.d.'s of intensities (40, 60, 74, and 86 decibels above threshold). In both cases, after 16 pairings of the basal tone and shock, generalization gradients were plotted on the basis of recorded GSR's (in millimeters). In the case of frequency differences the GSR's for the four tones were found to be statistically significant; however, generalization was also evident in the form of a negatively accelerated curve. As to the intensity differences the results showed a uniform generalization gradient away from the basal intensity used in conditioning. This is the type of experiment Lashley and Wade would attack on grounds that it did not control the variable of the subjects previous experience with the stimulus dimension used, hence the subject's "tendency to identify a single stimulus as belonging in a familiar graded series or to use habits of relational thinking". They would also criticize the experiments on the

grounds that all the stimuli used produced a "sudden change in the environment" consequently it might not have been the properties of the stimuli themselves which elicited the GSR's.

Stimulus generalization studies varying, not the sense modality, but the formal and meaningful properties of stimuli have been performed by Cofer and Foley (1943), Riess (1940), and Riess (1946). In the initial experiment of Riess a printed stimulus word and a loud buzzer were paired until the GSR to the word was at least 3 times its level before conditioning had been initiated. Then a homophone and synonym for each conditioned word were presented 5 times each in random order. The results showed the GSR to be consistently greater to the synonym than to the homophone. In his latter experiment Riess used the same conditioning procedure but presented words representing homophonic, antonymic, and synonymic relationships to the conditioned words. He also divided his subjects into age groups of 7-9 years, 10-11.8 years, and those over 11.8 years. He found generalization of the GSR was greatest to the homophones, less to the antonyms, and smallest to the synonyms in the 7-9 year group: greatest to the antonyms, less to the homophones, and smallest to the synonyms in the 10-11.8 group; and greatest to the synonyms, less to the antonyms, and smallest to the homophones in the oldest group (over 11.8 years).

Stimulus generalization studies have even been used to explain the phenomenon of concept formation. Long (1940) trained 3-6 year old children to press a window through which a rectangu-

lar block of wood could be seen (reinforcement of the correct response coming in the form of a piece of candy). After learning of the correct response had been stabilized, spherical stimuli of various sizes, colors, and materials were contrasted with more angular objects and the cylindrical objects were usually chosen with little additional training. This would seem to measure "concept formation" adequately only if one were to define it in terms of a formal, undeterminant, unidimensional stimulus attribute. E believes, however, that most psychologists think of "concept formation" as a more involved process than responding to a concrete, observable stimulus on the basis of its similarity to the conditioned stimulus. That is, a judgment made on the basis of a concept is usually thought of as involving principles more abstract than are evident in this experiment.

Inter-sensory experiments on stimulus generalization, while rare, have been performed. One example of such an experiment is that of Wylie (1919). Wylie shaped avoidance responses on the part of 3 groups of rats, based on either conditioned sound, light, or shock stimuli. He found the avoidance response generalized to the other stimuli in terms of a small but consistent saving in the number of trials required to learn the response, despite the fact that no previous pairing of the conditioned stimuli had been given. It may be doubted whether this was stimulus generalization or merely a "sudden change in the environment" the rats were responding to. Bregden (1939) also did a study in inter-sensory sti-

ulus generalization; however, he paired his conditioned stimuli before the response was conditioned. Eight dogs were first given a bell and light pairing for 10 days, 20 times per day, resulting in 200 pairings of the bell and light. Then a flexion response was conditioned in 4 dogs by a bell-shock procedure while the same type response was conditioned in the other 4 dogs by a light-shock procedure. Control groups were given the same flexion procedure without previous bell-light pairing. After the flexion response had stabilized in both the experimental and control groups, the animals which had been given the bell-shock pairing were presented the light as a stimulus, while the animals which had been conditioned on a light-shock pairing were presented the bell as a stimulus. The experimental group (which had previously had the bell-light pairing) made a total of 78 responses to either the bell or the light, depending on which one had not preceded shock. The control (no previous bell-light pairing) group made a total of 4 responses to the conditioned stimulus which had not been paired with shock.

Here then lies a firm basis for defining stimulus generalization without encountering the problem of stimulus similarity. In effect, generalization would be said to have occurred if a response is made in the presence of a stimulus because of previous conditioning procedures involved with a different stimulus. Whether the response is made in the presence of the two stimuli because the stimuli are similar in one or another dimension or be-



cause the stimuli were paired previously in a spatial-temporal arrangement, as occurs in classical conditioning paradigms, is of no concern here. This definition is not circular, for two or more stimuli can be presented and the occurrence of the response noted or not, as the case may be.

On the basis of this definition then, the question which this study hopes to answer is this - will a response, conditioned to a spoken, meaningful (familiar) word, generalize to the written form of the word; and similarly, will a response, conditioned to a spoken, unfamiliar nonsense syllable, generalize to the written form of the nonsense syllable? If the response does generalize, it will be irrelevant whether it generalizes on the basis of some dimension of similarity, or because of previous spatial-temporal pairings of the two forms of the stimuli in the past experiences of the subjects. The problem is a purely, empirical one, and one which E feels has many implications in the fields of testing, education, interviewing, psychotherapy, etc. (see discussion chapter). The response (or reflex) chosen for this study is the GSR, since this response can vary both quantitatively and qualitatively, and because it is a response which a subject cannot, without great difficulty if at all, bring under voluntary control (and for other reasons to be discussed later).

To summarize then, the question which this experiment hopes to answer is, will a GSR, conditioned to the sound of a spoken, meaningful word, generalize to the visual form of the same word;

and will a GSR, conditioned to the sound of an unfamiliar nonsense syllable, generalize to the visual form of the same nonsense syllable?

## CHAPTER II

### PROCEDURE

#### Apparatus:

The galvanic skin response (GSR) has long been a phenomenon of study in psychology. Known variously as psychogalvanic reflex (PGR), skin resistance, palmar resistance, palmar conductance, electrodermal response (EDR), and skin potential, this phenomenon was first discovered in 1888 by Fere. Passing a weak current through electrodes placed on a subject's forearm, Fere noted the deflection of a galvanometer (also included in the circuit) when he presented such stimuli as the sound of a tuning fork, the sight of colored glass, or an odorous substance to his subjects. This galvanometer deflection was correctly interpreted by Fere as indicating an increased flow of electricity due to a decrease in bodily resistance. In 1890, two years later, Tarchanoff discovered a difference in electrical potential for any two areas of the body connected in circuit with a galvanometer. Tarchanoff neutralized this difference in potential by administering a weak, external current in opposition to the subjects' normal potential difference. A deflection on the galvanometer, from a basal point, could then be recorded upon presentation of a stimulus. However, the Tar-

chanoff method usually refers to merely attaching two electrodes to a subject and noting any deflections in a galvanometer after it has stabilized. Although both types of phenomenon have the same basic physiological interaction (generally agreed to be the secretory activity of the sweat glands due to the activation of sympathetic nerves) the Fere method is preferred in research due to the fact that it appears more reliable and because it allows E knowledge of the absolute level of a subjects's resistance as well as the momentary changes in resistance. General experiments involving the GSR and conditioning procedures are Cook and Harris (1937), Littman (1949), White (1952), Grant and Schiller (1953), and Wickens (1954).

The type of galvanometer used in this study, the Loyola Psychogalvanometer, was designed and built by V. V. Herr and L. F. Osborn (1953). For a general discussion of GSR circuits see Darrow (1930), Forbes and Landis (1935), and Flanders (1953). The Loyola Psychogalvanometer (Fig. 1) was built with the express purpose of controlling the amount of current passing through the subject. To insure constant current flowing through the subject when the psychogalvanometer was balanced, regardless of the basic resistance, a closed type bridge circuit was employed. This allows the comparison of one person's reflex with another and eliminates the danger an open bridge has of delivering so high a current to some subjects (with a low basic resistance) that they become aware of the current.

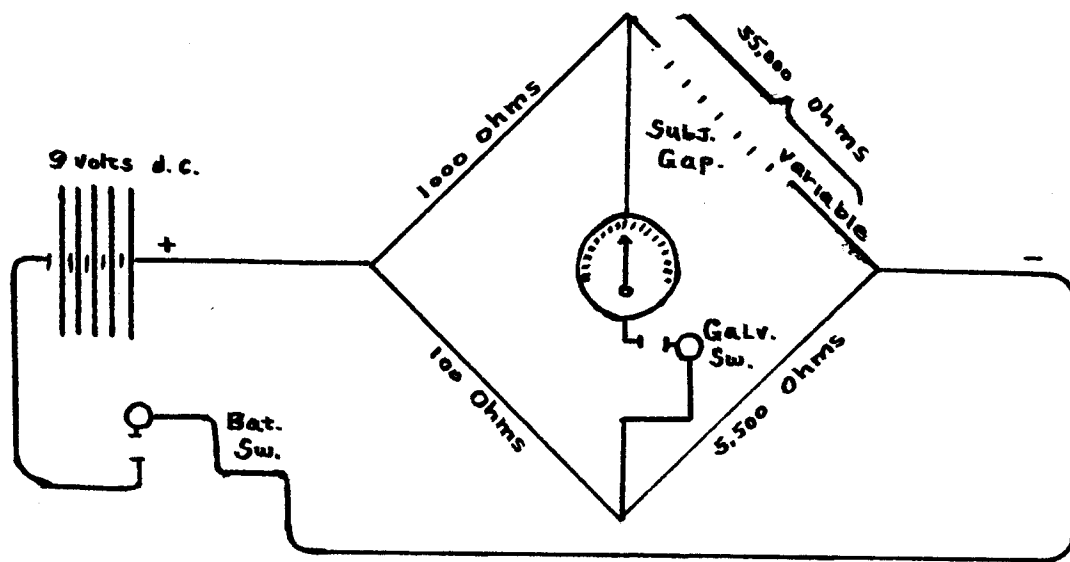
A problem arises in the construction of this type instrument, however, because of the fact that the moving-coil galvanometer has to be critically damped, or the swings of the beam will not reflect changes in current with the proper sequences or time relations. Having achieved a constant current through the subject, when the galvanometer is balanced, variations in voltage will occur, but within the ranges described in the following set-up, these do not cause any notable difficulty.

The moving coil is produced by the G-M Laboratories. It is of the d'Arsonval Type, very sensitive and yet very rugged, with a period of 4 sec., and sensitivity per mm. division of scale 160 mm. from mirror: 0.06 microamperes. Internal resistance of the moving coil is 100 ohms. External resistance needed for critical damping is 1000 ohms.

V. V. Herr further points out the fact that the unit is easy to mount, since the arms of the magnets have flanges on which the whole suspension hangs. The knob on top of the unit is adjustable for the zero point, up to 30 degrees either way. The total swing is in angular deflection 40 degrees, and in reflected light, 80 degrees, this last being rarely useable with photographic paper but very useful for visual recording.

The construction of the bridge (Fig.I) merely requires precision coils (load  $\frac{1}{2}$  watt) for the fixed arms, and equally graduated steps in the two variable resistors, steps of 5000 ohms for the master, and 500 for the vernier.

Figure I  
LOYOLA PSYCHOGALVANOMETER



Since current through the bridge is constant at all times, critical damping avoids all "free swings" of the coil due to its own proper period of  $\frac{1}{4}$ " and hence the deflections are true pictures of changes in the subject. Copper electrodes  $\frac{1}{2}$  X  $1\frac{1}{2}$  inches were immersed in 0.1 N saline solution, thereby minimizing the effects of any sweating by the subject. Total current through the bridge when balanced = 0.000160 amp. (160 microamps). The measured change in current through the subject for a drop of 350 ohms is one (1) microampere increase. Voltages across the subject vary with his R. If a subject had only 5,500 ohms of resistance, he would receive only 0.88 volts, whereas one who had 50,000 ohms would receive 8.0 volts. Mean R for this set-up is 30,000 ohms;

a subject with average resistance receives 4.80 volts, an optimum. The magnitude of the response was recorded in terms of a mm. deflection from the basic level of resistance.

The other two pieces of apparatus involved in the experiment were two electrodes in a circuit consisting of 3  $1\frac{1}{2}$  volt cells, in series, with a manually adjustable inductorium of the Harvard type between the cells and the electrodes, enabling E to regulate the amount of shock (although the coil setting was changed only once during the entire experiment); and an electrically operated tachistoscope (or memory drum). Both the shocking apparatus and the tachistoscope could be started and stopped by E by means of hidden foot pedal switches. That is, by depressing one foot pedal E was able to close the "shocking" circuit thereby sending current across the gap separating the electrodes which were attached to each subjects' forearm. When E's foot was lifted from the pedal the circuit was automatically broken. When E depressed the foot pedal controlling the tachistoscope, on the other hand, the circuit remained closed (even if the foot pedal was released) until it was depressed again, thereby enabling the tachistoscope to run at its own set time interval without continued control by E.

The subjects consisted of 10 full-time undergraduate students (5 men and 5 women) at Loyola University, ranging in age from 18-22.

**Material:**

A list was made up consisting of four nonsense syllables (FAP, POB, MEV, and ZUK) and four neutral words (Pencil, Pond, Swim, and Give). The four nonsense syllables were taken from Hull's (1933) study which showed that, of 320 selected nonsense syllables, these four evoked reports of meaningfulness less than 5% of the time; the four neutral words were taken from Smith's (1922) study which showed these four words evoked the smallest GSR's.

Assuming then that these eight items (four words and four nonsense syllables) were relatively neutral to the subjects, E made up 8 random lists of the eight items with the exception that the word 'Pencil' and the nonsense syllable 'FAP' appeared twice in each of the 8 lists i.e. a total of 16 times. The rationale behind the procedure was this. Under the guise of testing the effects of emotion on intelligence E would read aloud all 8 lists with a 5 sec. interval between each word or nonsense syllable. Every time the word 'Pencil' or the nonsense syllable 'FAP' was called out the subject received an electric shock. After the subject had heard all the lists (which included 16 'Pencil' - shock pairings and 16 'FAP' - shock pairings) the second part of the experiment, determining generalization from the sound stimulus 'Pencil' and 'FAP' to the written stimulus form of 'Pencil' and 'FAP', was started. Here, each subject was presented the list of eight items (including 'Pencil' and 'FAP') twice, once by E reading them



aloud again and once by having them appear singly, and in their written form, on the tachistoscope. There was about a 15 sec. interval between the presentation of each item this time, and each subjects' GSR to each item, as presented both orally by E and visually on the tachistoscope, was noted. To control for extinguishing effects half the subjects were presented the list orally first and on the tachistoscope last, while the other half of the subjects were presented the lists in the reverse order. The purpose of the second part of the experiment was designed to determine 1) if a GSR had been successfully conditioned to the spoken word 'Pencil' and to the spoken nonsense syllable 'FAP', 2) if the GSR had been successfully conditioned to these spoken items, had it generalized to the written word 'Pencil' and the written nonsense syllable 'FAP' and 3) if the GSR had generalized to the written forms, was the degree of generalization greater for the meaningful stimulus (Pencil) or for the non-meaningful stimulus (FAP).

The procedure, in more detail, is as follows. Upon entering the testing booth each subject was seated to the left of E and the shock producing electrodes were attached to his or her right forearm by means of self-tightening medical straps. The first and third fingers of the left hand were then immersed in the finger cups of the Loyola Psychogalvanometer. Each subject was told to assume as comfortable a position as possible since they would not be allowed to move during the experiment. The following instruc-

tions were then read:

"We are trying to determine the effects of emotion on intelligence. I am going to say some items, one every five seconds. Half of the items will be words with which you are familiar, half will be what we call nonsense syllables. A nonsense syllable consists of two consonants with a vowel between them. In all cases the vowel will be pronounced in its long vowel sound. For example, the nonsense syllable P-E-B would be pronounced PEB. The list of eight items will be presented eight times but each time it will be presented in a different order. Since we are trying to determine the effects of emotion on intelligence you will feel an electric shock every once in a while during the presentations of the list. At the end of all the presentations you will be asked to recall, verbally and without spelling, all the items you can remember. Ready?

Each list consisting of the four neutral words and four nonsense syllables was read in a random order except that each list contained the word 'Pencil' and the nonsense syllable 'FAP' twice. Hence, whereas each word and nonsense syllable was read a total of eight times, 'Pencil' and 'FAP' appeared sixteen times, and immediately following each vocal presentation of 'Pencil' and 'FAP' an electric shock was administered by means of the above-mentioned hidden foot pedal. At the end of all the auditory presentations each subject was asked to recall as many of the items as possible and E pretended to record their responses.

The following instructions were then read:

"This time you will be given the list both audibly, by my saying them, and visually on this tachistoscope. Here there will be a fifteen second interval between each item and the list will only be presented once audibly and once visually. Again, after these two presentations you will be asked to recall as many of the items as possible. Ready?

During the presentation of each list the subjects GSR's (in

mm.) were recorded for all the items presented, both audibly and visually, without any shock being administered. Each stimulus was presented after the GSR to the previous stimulus had stabilized.

Now it might be suggested that what E is doing is setting up the spoken word and nonsense syllable 'Pencil' and 'FAP' as conditioned stimuli, eliciting an anxiety response, and determining whether or not the anxiety response is elicited by the corresponding visual form of these same stimuli. Experiments correlating anxiety and the GSR have been done by Rackley (1930), Darrow (1936), Welch and Kubis (1947), Schiff, Dugan and Welch (1949), and Berry and Martin (1957). In the present study, however, this correlation is neither assumed nor disputed. Rather, the GSR is accepted as a response comparable to any other response an organism might make, except that in this case the response has the added advantage of being defined quantitatively and in terms of a physical system i.e. the Loyola Psychogalvanometer.

## CHAPTER III

### RESULTS

Before going to the specific results of this study, some comment is necessary on the unit of measurement to be used. Previous analyses of GSR results have shown the "basic level of resistance" to be of great importance in determining the magnitude of the temporary fluctuations of the galvanometer due to the presentation of stimuli. That is to say, a subject with a relatively high basic resistance will usually show a greater momentary variation on the galvanometer, when a stimulus is presented, than a subject with a low basic resistance. This, obviously, makes the comparison of different individual's GSR results somewhat awkward.

Many studies have been done on this problem i.e. Haggard and Garner (1946), Lacey (1947), Lacey and Siegel (1947), Jones and Haggard (1948), and Haggard (1949). Because of these, and other studies, there was a plea for the use of conductance scores, log conductance scores, square root of the conductance, ratio of resistance, etc. Probably the most widely accepted, but certainly not universally accepted, score transformation is that of Haggard

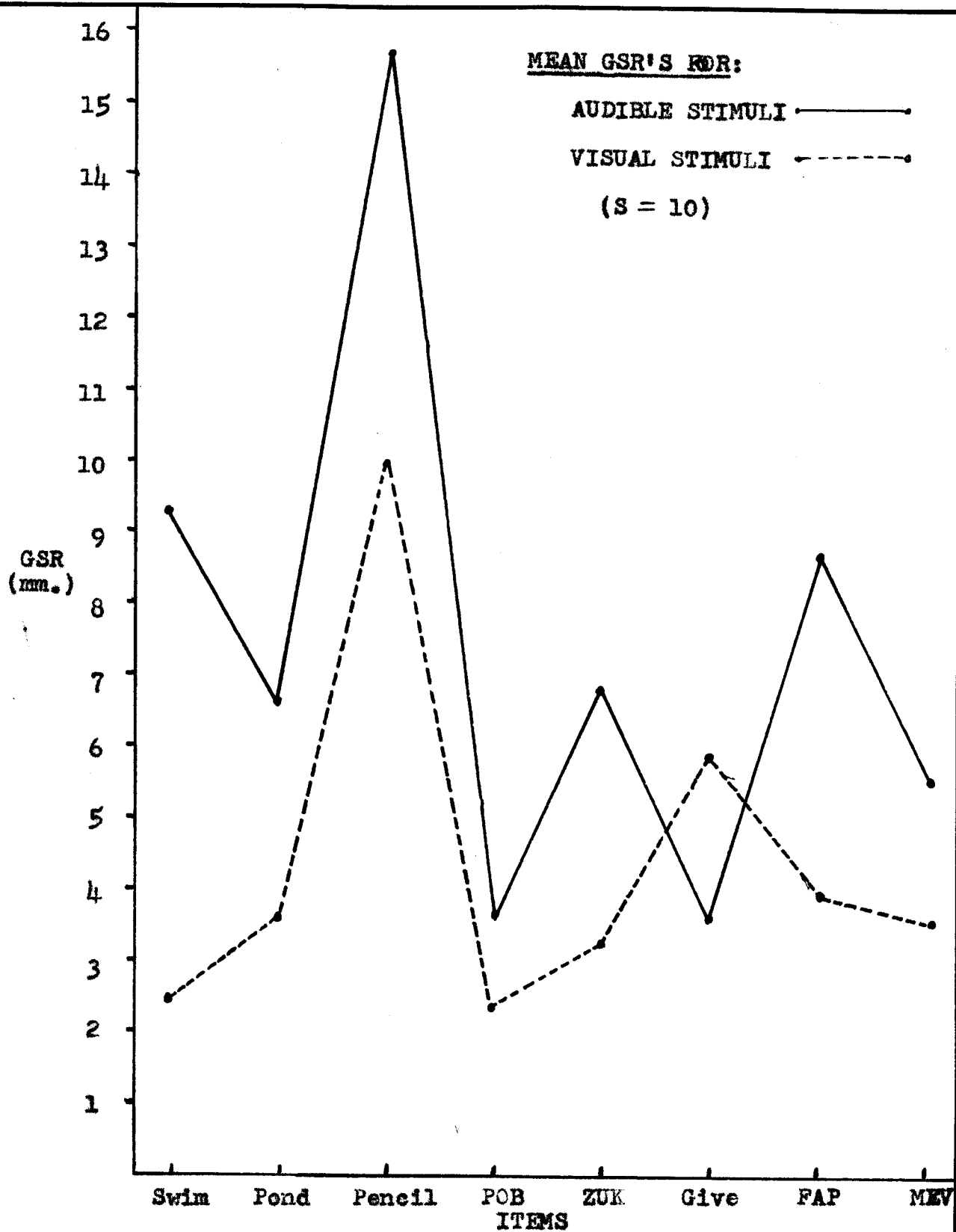
(1949). Using the criteria of simplicity, normality, and equality of units, Haggard argued for a score arrived at by dividing the log resistance change GSR plus an empirically determined constant by the level of skin resistance (basic resistance) and multiplying the result by 100 (to rid the score of fractions).

Fortunately, the controversy over the proper unit of measurement is not applicable to the present study, for the following reason. As mentioned above, the controversy has arisen because of the influence of the basic resistance levels upon the temporary conductance changes, making a comparison of different subjects unreliable because of the subjects' different basic resistance levels. In an experiment such as this one however, the comparison to be made is an intra-individual comparison, not an inter-individual one. That is, an individual's GSR under one set of conditions is being compared with his own GSR under a different set of conditions, both sets of conditions involving essentially the same basic resistance level since the same individual is being measured. No comparison is being made between one subject's GSR and another subject's GSR (which would probably involve different basic resistance levels). Furthermore, the GSR changes to be compared occurred within five minutes of each other, hence any change in basic resistance level, if any, of a given subject is of such minor magnitude that it would be properly termed irrelevant to the results. That is to say, in a generalization experiment such

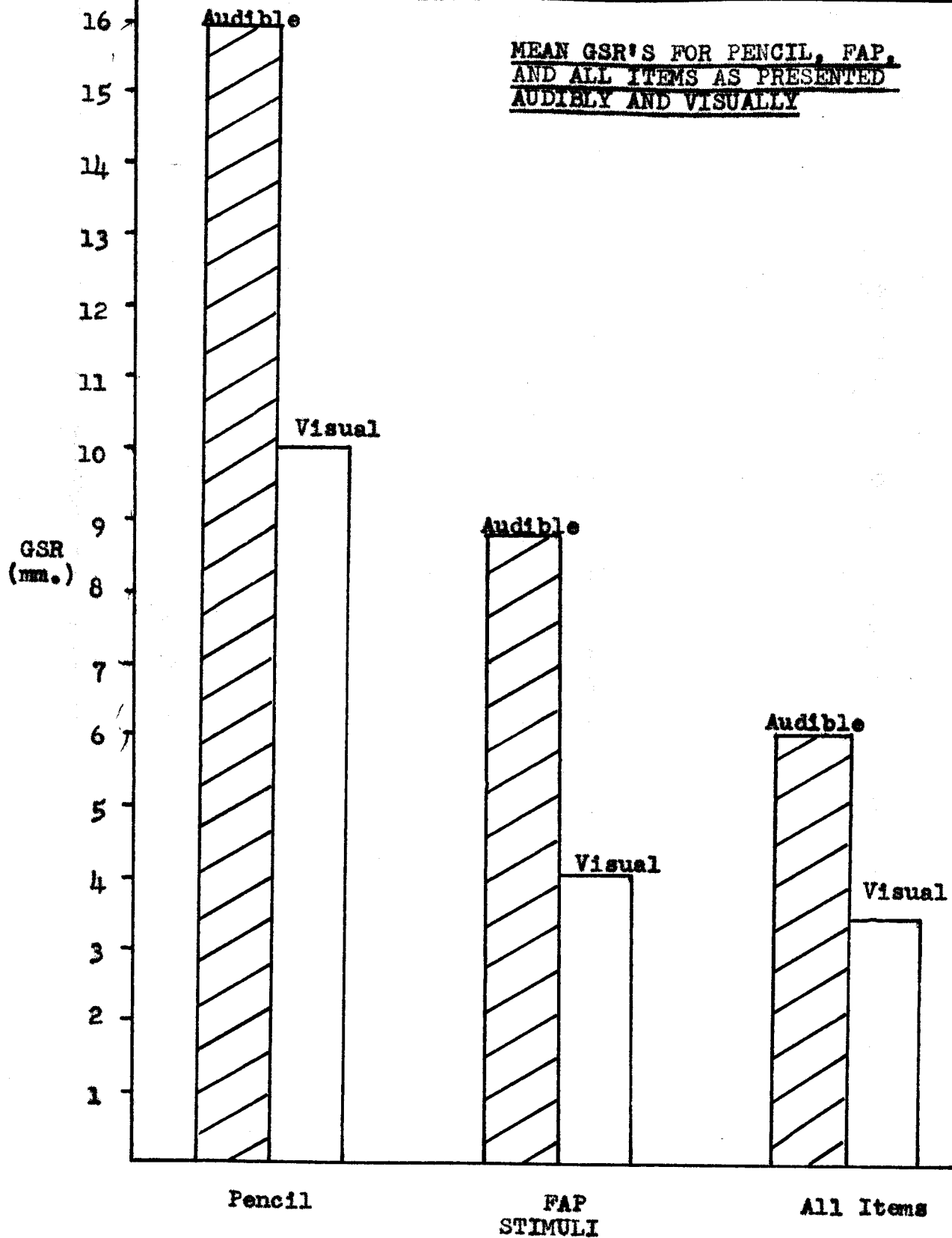
as this one, the comparison to be made is not between two or more individuals with differing basic resistance levels, but between the same individual, with the same basic resistance level, under two types of stimuli; hence the basic resistance level is not an uncontrolled variable. Any transformation of scores, therefore, would merely be a linear transformation not effecting the relative scores E is interested in. This same argument also holds for the group data shown, since each subject, with the same basic resistance level, is a part of each group compared. To summarize then, a transformation of basic data is not needed in this study because any comparison of scores always involves the same basic resistance level.

For the above reasons, and also because the data of the GSR are being treated as a response similar to any other response an organism makes, the results will be reported in millimeters (mm.). That is, mm. will be used since, as mentioned previously, the GSR, as a response, will be defined in terms of a physical system i.e. the Loyola Psychogalvanometer (the scale of this instrument being calibrated in mm.).

The results are shown in figures II and III. In figure II the GSR's for all the items are presented for both the audible and visual stimuli. It can be seen from this figure that Pencil, as presented audibly, evoked the largest mean GSR (15.8), followed by Swim (9.4), FAP (8.9), and Pond (6.6) in the audible series. Ex-



MEAN GSR'S FOR PENCIL, FAP,  
AND ALL ITEMS AS PRESENTED  
AUDIBLY AND VISUALLY





cept for the surprisingly high GSR to Swim these results would seem to indicate that conditioning to the audible stimuli Pencil and FAP was successful. That Swim produced such a large GSR can be explained, E feels, by the fact that it was the first word in the audible list which was used to determine the subjects' GSR; hence the large GSR is not a result of the specific word itself, but rather is a result of the fact that Swim was the initial stimulus of a procedure that had been previously accompanied by shock. In other words, Swim constituted a "sudden change in the environment" which Lashley and Wade (1946) spoke of as producing a generalized GSR. Furthermore, since the audible lists presented during the conditioning period were presented in random order, all the words and nonsense syllables became conditioned stimuli to a certain extent, due to their spatial-temporal pairing with Pencil and FAP, and more remotely, with the administered shock itself. It can also be seen from figure II that while both Pencil and FAP evoked relatively large GSR's, Pencil was more effective than FAP. E believes there are several reasons for this result. First, the items in figure II are presented in the order in which they were presented in the audible post-conditioning phase. It can therefore be seen that since Pencil occurred before FAP and was not shocked (shock was not administered while the GSR's were being recorded, obviously) any extinguishing effects would be expected to generalize to FAP. Also, one would expect a stimulus which is not

familiar to the subject, such as FAP, to require more conditioning trials to build up the stimulus as a conditioned "negative" one, as compared with the familiar stimulus Pencil.

As to the visual series, the order of presentation was as follows: Give - ZUK - MEV - Pencil - Swim - FAP - Pond - POB. Here it can again be seen that Pencil (10.1) evoked the largest GSR, followed by Give (5.9), FAP (4.1), and Pond (3.8). Again, it is noted that the word Give evoked a large GSR because of its initial position in the visual, GSR determining series (see the discussion above on the word Swim). Furthermore, the sound of the tachistoscope motor approximated somewhat the sound of the shocking instrument when shock was applied hence one would also expect a large GSR to the initial stimulus of the visual series until extinction had taken place relative to the motor of the tachistoscope (although buffer words might have been used to extinguish this effect E felt they would not have been explicable in terms of the instructions given to the subjects). Again one can see that while the visual stimulus Pencil evoked a relatively large GSR, the nonsense syllable FAP was not as effective. This result can in part, be explained by the fact that Pencil occurred before FAP in order of presentation (as in the audible series); but here, however, the GSR evoked by FAP is not as well differentiated from the other GSR's as it was when presented audibly. That is, while FAP evokes a smaller GSR in both the audible and visual series than Pencil,

its GSR can be clearly distinguished from the other GSR's in the audible series, whereas the GSR's of the other items in the visual series are almost all as large as FAP. Another interesting result seen from Figure II is that with the exception of the word Give (explained above) all the visual stimuli evoked lower GSR's than did the same stimuli presented audibly (to be discussed below).

Figure III contrasts the mean GSR's, for the ten subjects, of Pencil as audibly presented (15.8) and visually presented (10.1), the nonsense syllable FAP as audibly presented (8.9) and visually presented (4.1), and the mean of the means of all the audible stimuli (6.05) and the visual stimuli (3.59). Here, while it can be seen that there is an obvious difference between the stimulus conditions, a t-test (Table I) of the difference between Pencil as presented audibly and visually is not significant at the .10 level

Table I

t-test of the Difference Between  
GSR's to Audible and Visual Stimuli

AUDIBLE STIMULI

	Pencil	FAP	All items
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	Pencil	1.51	
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VISUAL STIMULI	Pencil		
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	FAP	1.90	
--	-----	------	--

	All items		2.00
--	-----------	--	------

( $t = 1.51$ ); similarly, for FAP a  $t$ -test shows the difference between the two conditions not to be significant at the .10 level ( $t = 1.90$ ); whereas for the stimuli as a whole the difference between visual and audible presentation is significant at the .10 level ( $t = 2.00$ ).

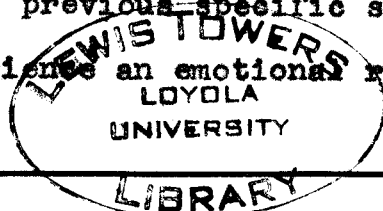
## CHAPTER IV

### DISCUSSION

Although the above mentioned t-tests do not appear significant E believes they could have been affected had two factors been increased. First, the number of stimulus-shock pairings (16), while adequate for the purpose of setting-up the previously neutral stimulus as a conditioned negative stimulus, is not, E believes, an adequate number of pairings to determine, absolutely, a generalization (or discrimination) response (since however, two conditioned stimuli were involved, resulting in a total of 32 electric shocks to each subject, it would appear doubtful that the subjects would accept an increase in this number). Second, had the intensity of the shock been increased, generalization to the visual stimulus might have been increased, for as Hovland (1951) points out, "The stronger the unconditioned stimulus, the wider the generalization". It should be pointed out that although all the subjects could verbally report which items they were being shocked on after the experiment, there was no noticeable behavioral change by most subjects while shock was being administered. The only criterion involved in the intensity of the shock adminis-

tered was that the subjects felt and reported feeling shock immediately after E administered it on a trial basis while reading the instructions. Now, whether these two factors would noticeably influence the relative GSR's is, of course, unanswerable (indeed, there is a possibility that each might well offset the effects of the other).

In any event, the t-tests do show certain trends which are confirmed by figures II and III. First, it is evident that the GSR has generalized from the audibly presented stimulus word Pencil to the visually presented stimulus word Pencil. However, it is also evident from figure III that there is a fairly large decrement in the GSR generalization to the two corresponding forms of both stimuli (Pencil and FAP). Hence we might say that for meaningful material there will be a response, nevertheless a relatively smaller one, to a stimulus presented in visual form as contrasted with the response to a corresponding stimulus presented audibly, if the audible stimulus was the one to which the response was originally conditioned. That is to say, if a spoken word is followed by punishment (aversive stimuli), a response of some sort will no doubt occur when the spoken word occurs again. This same response will also occur, but in a relatively smaller degree, when the printed (visual) form of the word is presented. For example, there are many individuals who, because of previous specific stimulus-punishment contingencies, will experience an emotional reac-



tion or commit a particular type of response when a "dirty" or "four letter" word is spoken. On the basis of this experiment, one would then predict that a similar emotional reaction or response will occur, albeit of a smaller magnitude, when the "four letter" word is presented in its written or printed form i.e. as a visual stimulus. Again, in association tests such as the Kent-Rosanoff or the Semantic Differential the stimulus word "man", if presented as a visual stimulus, might well evoke a relatively different response as contrasted with the response given to the word "man" presented as an audible stimulus. That this generalization, for meaningful material, will occur from the audible stimulus to its corresponding visual stimulus (or vice versa) is, of course, made on the assumption that differential reinforcement of the two forms of stimuli has not occurred. That is, if the visual form of the stimulus is followed by positive reinforcement and the audible form of the stimulus followed by negative reinforcement, obviously generalization will not occur. Indeed, this process is the exact opposite of generalization, namely discrimination.

As to the non-meaningful stimulus FAP, the evidence for generalization is somewhat lacking ( $t = 1.90$ ). That is, given a stimulus to which a subject is relatively unfamiliar (relatively, because the subject is familiar with the components which make up FAP i.e. the letters F-A-P), conditioning in the audible area does not seem to generalize to the corresponding stimulus in the visual

area. This lack of generalization is further verified by noting the slight difference between the GSR to FAP as visually presented and the mean of the GSR's for all the visually presented stimuli as shown in figure III.

These results raise the question of why a response to a familiar stimulus, such as the word Pencil, will generalize from one sense modality (audible) to another sense modality (visual), while this same generalization will not take place in relation to an unfamiliar stimulus (FAP). Although the resolution of this question is clearly beyond the scope of this paper, E would like to offer some suggestions. First, stimulus generalization from one sense modality to another cannot possibly be the result of stimulus similarity since, obviously, stimuli affecting different sense modalities must possess different formal qualities. The only alternative, E believes, is that the audible stimulus Pencil must have occurred, a number of times, in a close spatial-temporal relationship with the visual stimulus Pencil, resulting in a classical type conditioning procedure. That is to say, the word Pencil must have occurred, as both a visual and audible stimulus, in close succession, much as a bell and food are paired in order to use the bell as a conditioned reinforcer. E believes it is reasonable to assume that this pairing takes place in such situations as educational institutions where "reading aloud" pairs the visual and audible stimulus. If this pairing of the audible and visual form of the stimu-



lus has not occurred, then generalization will not take place, as was the case with FAP.

This hypothesis, that in order for generalization to occur between two dissimilar stimuli, the stimuli must have been paired spatially and temporally, has far reaching implications. If, for example, teaching machines, which use only visual stimuli, were used extensively in education, one would expect a large verbal repertoire to be built up by the student in relation to printed material, but a relatively small verbal repertoire in relation to audible stimuli. In other words, one would have students doing excellent work in reading and writing, but at the same time their ability to understand or carry on a conversation would be very limited. The only way this rather noxious situation could be avoided would be to implement an extensive program of pairing the audible stimulus with its visual counterpart.

Again, in close interpersonal relationships such as counseling and psychotherapy, where social intercourse is taking place on a strictly verbal level, certain implications may be noted. Since the goal of therapy is to modify or change a response pattern to specific stimuli, generalization from the verbal level to the concrete stimulus itself is generally assumed. That is, if the goal of a particular client and therapist is to modify the client's response pattern to his father, and since the client and therapist are dealing with each other only on a verbal level, generalization

from the stimulus word "father" to the actual father must be assumed. If the generalization is not taking place, one would expect the client's response to the stimulus word "father" to be quite different from his response to his actual father, hence therapy would be relatively ineffective here. For example, the client in therapy might "intellectualize" when speaking of his father. This, as most therapists know, means the client will gain little from therapy at this point. From the frame of reference used here, it is because the client is not generalizing from the verbal "father" to his actual father. If he were he would probably be experiencing an emotional upheaval, in which case, generalization and effective therapy, would be taking place. Indeed, one might say that therapy will be effective to the extent that generalization from the verbal level, which therapy deals with, to the actual, reality level, takes place. Also, in diagnostic work, one would expect some generalization and some differences in the responses given to items as asked audibly by an interviewer and as presented visually on an inventory such as the MMPI. (E apologizes for the inferential nature of these examples and realizes fully the necessity for further experimental confirmation.)

Another interesting conclusion which may be drawn from the results of this experiment is the fact that the subjects were responding, not to the analytic aspects of the stimulus, but rather to the stimulus as a whole. That is, although all the subjects were

certainly familiar with the component parts making up the word "FAP" (the letters F, A, and P), they were not familiar with this particular arrangement of the parts, hence the lack of generalization for the word FAP as compared with Pencil. This would seem to confirm Skinner's hypothesis of verbal behavior, that an individual reacts to the stimulus pattern as a whole rather than to its constituent parts.

Further confirmation of these conclusions stems from a comparison of the mean GSR's of all the audibly presented items as contrasted with the mean of all the visually presented items (figure III). For audible stimuli the mean GSR is almost twice that of the visual stimuli indicating again a differentiation of the two types of stimuli. Also, an interesting fact is that, with the exception of the word Give (explained above), all the audibly presented stimuli evoked larger GSR's than their visual counterparts, indicating generalization also occurred in terms of sound patterns (a dimension of stimulus similarity?).

## CHAPTER V

### SUMMARY

In order to test for generalization effects between audible stimuli and visual stimuli (and in terms of meaningful and non-meaningful stimuli) ten subjects were conditioned to the audible stimuli Pencil and FAP (nonsense syllable) by pairing them with shock. GSR's were then recorded for the stimuli as presented audibly and visually. The results showed that GSR's generalized, though with a rather large decrement, from the audible stimulus word Pencil to the visual stimulus word Pencil. However, generalization from the audibly presented nonsense syllable FAP to the visually presented stimulus FAP was not evident.

The implications of these results for the fields of education, counseling, psychotherapy, and diagnostic work were discussed.

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### APPROVAL SHEET

The thesis submitted by David W. Thompson has been read and approved by three members of the Department of Psychology.

The final copies have been examined by the director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated, and that the thesis is now given final approval with reference to content, form, and mechanical accuracy.

The thesis is therefore accepted in partial fulfillment of the requirements for the Degree of Master of Arts.

Qlv 7 1962  
Date

[Signature]  
Signature of Adviser