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REACTION TIME, THE GALVANIC SKIN RESPONSE AND RESPONSE FAULTS OF REPETITION AS A FUNCTION OF THE VARIABLES OF EMOTIONALITY, ENTROPY AND TRIALS

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INTRODUCTION

The technique of having a subject give the first word that occurs to him after the presentation of a stimulus word has been long employed in psychology. When psychology was a young science, European investigators used the word association technique to explore cognitive functioning in human beings. Later, in the early 1900's, Jung suggested the utilization of this technique to disclose areas of conflict, or "complexes," in individuals. Jung developed various indices of supposed conflict on the word association test, and the test has been an often used clinical tool since then. While many authors have accepted Jung's theoretical contributions, others, such as Laffal (1955), have questioned the validity of the technique.

Laffal suggested a unique re-interpretation of two of Jung's original conflict indicators, those of lengthened reaction time and response faults of recall. Laffal proposed that the associations to a stimulus word are distributed in a hierarchical form and that there might be a meaningful relationship between reaction time and response faults and the form of this response hierarchy. Hence he suggested that reaction time and response faults might reflect the response hierarchy form, or entropy, of particular words, rather than their emotional values, as was suggested by the Jungian interpretation of the word association test.

The purpose of this thesis is essentially to investigate

the Laffal view of the word association test. Specifically, the present study investigates reaction time, the galvanic skin response and response faults of repetition as a function of the variables of entropy, emotionality and trials.

History

The method of free association has been long employed in both psychological investigations and in clinical practice to expose areas of conflict or intrapersonal defense functioning. In the traditional method, a list of words is presented one at a time to a subject. The subject is instructed to respond with the first word that he thinks of after the completion of the stimulus word. The examiner records the subject's response word and his reaction time. After the entire list has been presented, each of the stimulus words is re-presented, and the subject is asked to give the same response that he gave on the first presentation of the list (Rapaport, Gill, & Schafer, 1946).

Jung reported the first clinical use of the test in 1910 (Jung, 1910), when he used it to uncover "complexes" of various sorts. The primary diagnostic indicators which he employed included: extended reaction time to respond; deviant relation of the response word to the stimulus word; and inability to recall the original association on the re-presentation of the list. The appearance of one or more of these signs when particular words were presented to the subject permitted the inference that the stimulus words had impinged upon some conflicted area of psychic functioning in

the individual. Thus the Jungian use of the word association test depended upon his tacit assumption that emotional arousal was upsetting and was manifested in his "complex indicators."

Of the indicators of conflict that were first employed by Jung, and of those others which have been developed and elucidated since then, two of the most often used are still extended reaction time to respond and inability to recall the original response on the representation of the list. An investigation of the traditional view of these conflict indicators was carried out by Laffal in 1955, essentially questioning the validity of the Jungian assumption that disruptive emotional arousal was responsible for lengthening reaction times on particular words.

In Laffal's experiment, a list of 100 words was presented to subjects in the usual free association method, one list presentation for association and a second runthrough for recall of the original responses. Laffal observed that the frequency of excessively long reaction times -- those over 2.6 seconds -- and the frequency of response faults of recall was significantly correlated with the number of different responses -- that is, the variability -- given by the entire group of subjects to those stimulus words.

Laffal felt that the implication of this was that long reaction times, instead of reflecting interference with the associative process due to the presence of disruptive emotional arousal, simply reflect the form of the associational

response hierarchy of the stimulus word. In other words, the possible associations to the long reaction-time words form shallow hierarchies within the cognitive structures of subjects; the near equality of habit strength of these several responses makes it difficult for one of them to be given very rapidly. In the case of stimulus words to which the subjects respond quickly, this would be due to the fact that the responses form a steep hierarchy, with the habit strength of the first response word being especially dominant, and with the associative strengths between the stimulus word and the remaining words in the response hierarchy diminishing rapidly.

To describe the hierarchy of responses to a stimulus word, Laffal utilized the concept of entropy developed by Shannon (Shannon & Weaver, 1949). This permitted the slope of a word's response hierarchy to be described by a single number. This number represented the entropy of the word and it depended upon the number of different responses given to a particular word by Laffal's subjects as a whole. Thus words to which Laffal's group of subjects as a whole gave few different responses had a low entropy value, while words to which the group as a whole gave many different responses had a high entropy value.

In 1960, the first innovation of the usual free association method appeared. This arose since Appelbaum (1960) felt that the ordinary word association test was limited by the subject's tendency to give popular responses, and he

felt that such responses gave little information regarding the subject's fears, wishes and needs. He felt that if subjects were deprived of the opportunity of giving such prosaic responses, more information might be obtained from those responses the subjects did give.

On the basis of this view, Appelbaum added a third trial to the word association test. On the second trial, the subject was asked to repeat his original response, while on the third trial, the subject was instructed to supply the first word that came to his mind that was different from the one he had given before. He was told to be as quick as possible, since his reaction times were to be recorded.

Appelbaum thought that the idiosyncratic response could often be inhibited by the subject on the first runthrough of the list. He felt, however, that requiring the subject to give a different association on the third trial would increase the likelihood that this new response would be idiosyncratic and revealing of the subject. Secondly, this "added association trial," as Appelbaum called it, would supply information about attitudes the subject has toward the stimulus word and might give information significant for prognosis or decisions regarding therapy.

A still further extension of the original free association technique, using many levels of free association to the same list of words, was introduced by Brody (1964). Brody selected words which had different response hierarchies; that is, the words differed from one another with respect to

the slope of the group of responses each elicited, plotted in terms of the frequency of each response the different words elicited versus the rank popularity of the words.

Fifteen orders of the list were presented to the subjects, and they were told that they could give any association they wished on each trial. The purpose of Brody's investigation was to observe the influence of anxiety on the forms of response hierarchies. He used subjects at different levels of anxiety and observed their performance on the word association task.

While it would be logical in the expanded form of the free association test -- that is, in the multiple free association method -- to utilize the same indicators of conflict, Brody made no such interpretations of his data, but rather limited his inferences to a theoretical discussion of the differences in word association performance by high and low anxious subjects.

Overview of the Present Experiment

The present study investigates reaction time as a function of the variables of emotionality, entropy and trials. The investigation of reaction time as a function of the first two variables attempts to clarify and elucidate the relationship that Laffal has suggested exists between reaction time and these variables, and the variable of trials has been added to supply information of a theoretical nature with respect to the first two factors.

Laffal has suggested that reaction time on the word

association test is a function of the stimulus word's response hierarchy, and less a function of the word's emotional value. One way to investigate this view is to select pairs of words ar different levels of entropy, one of the words being emotional and one of them being non-emotional. In this way, one can evaluate reaction time as a function of each of the variables separately and also as a function of their interaction.

Further elaboration of the relationship between the variables of emotionality and entropy, and the support or refutation of theoretical views of their operation, may be provided by examining reaction time over trials as a function of entropy and emotionality.

The present study, then, involved selecting two words at each of eleven levels of entropy, with one of the words at each level being emotional and the other word at that level being non-emotional. Each subject was presented with these twenty-two words on each of four trials, with instructions to give a different association for each word on each of the four trials.

If reaction time on the first trial is at least partially a function of the stimulus word's response hierarchy, then it would seem logical that in a multiple free association framework, the reaction times on successive trials would also reflect the stimulus word's entropy value.

If the crucial variable in determining reaction time and recall in word association is the form of a word's

response hierarchy and not its assumed emotional value, then in the multiple free association technique, words which have the same entropy value, regardless of their emotionality or non-emotionality, would be expected to yield identical functions if their reaction times across trials were plotted. If, however, there is actually some emotional arousal engendered by the presentation of particular stimulus words, reaction times would be expected to at least partially reflect the impact of this emotional arousal. Thus it would be predicted that the slope of plotted reaction times across trials of words which were controlled for their entropy values, but which differed in terms of their emotionality, would not be identical.

On the basis of the foregoing discussion, the present experiment will investigate:

1) Reaction time as a function of the variables of emotionality, entropy and trials, and as a function of the interaction of these variables over four trials.
2) The galvanic skin response as a function of the variables of emotionality, entropy and trials, and as a function of the interaction of these variables on the first two trials.
3) Response faults of repetition across four trials as a function of the variables of emotionality and entropy.
4) Reaction time, the galvanic skin response and response faults of repetition as a function of the

variables of emotionality, entropy and trials, when subjects have been divided into different groups on the basis of a manifest anxiety measure.

Hypotheses

Specifically, the following hypotheses are made with respect to the above. The rationale for these hypotheses will appear in the following section.

Ia) It is hypothesized that reaction time is a function of response entropy, and hence it is predicted that reaction time will vary as a function of entropy on both the first trial and over all four trials such that high entropy words will yield long reaction times and low entropy words will yield short reaction times. Statistically, this predicts a significant effect of the variable of entropy on the first trial and over all four trials.

Ib) It is hypothesized that reaction time in word association reflects the emotionality or non-emotionality of the stimulus word, such that emotional words will yield shorter RTs than non-emotional words both on the first trial and over all four trials. Statistically, this predicts a significant effect of the variable of emotionality

on reaction time on the first trial and over all four trials.

Ic) It is hypothesized that the emotional value of a stimulus word will interact with the form of its response hierarchy and thus alter the effective form of the response hierarchy and therefore the re-ction time to that stimulus word. Thus it is predicted that there will be an interaction of the variables of emotionality and entropy on the first trial. Since the emotional impact of particular words may diminish over trials, it cannot be predicted whether there will be an emotionality by entropy interaction over all four trials.

Id) It is also hypothesized that the instructions to the subject to deliver a different response on each trial than the response he has formerly given to a particular word will necessitate the subject's taking more time to deliver his response. Hence it is predicted that reaction time will show a general increase with successive trials. Statistically, this predicts a significant effect of the variable of trials on reaction time.

Ie) It is hypothesized that there will be an interaction between the variables of entropy and trials. Words with high entropy values, while showing an increase in reaction time over trials, will not show as great an increase in reaction time as a

function of trials as will words with low entropy values. Statistically, this predicts a significant interaction between the variables of entropy and trials. No other interactions are expected on the reaction time response measure.

IIa) It is hypothesized that words which have been pre-defined as emotional by a number of Psychology graduate students will yield larger galvanic skin response deflections on the first of the two trials on which the galvanic skin response is recorded than words which have been pre-defined as non-emotional by these students. Statistically, this predicts a significant effect of emotionality on the galvanic skin response.

IIb) It is also predicted that since the galvanic skin response reflects an increase in activation in the subject, and that such activation would accompany the search for an appropriate response, high entropy words, which would necessitate lengthened reaction times, would also yield greater galvanic skin response deflections than low entropy words. Statistically, this predicts a significant effect of entropy on the galvanic skin response.

IIc) It is anticipated that on the second trial of the experiment, when the galvanic skin response is again recorded, deflections to all words will be reduced as a function of the greater relaxation of

the subjects. Hence it is predicted that there will be a significant effect of the variable of trials on the galvanic skin response. No significant interaction effects are predicted for the variables of emotionality, entropy and trials on the galvanic skin response measure.

III) It is hypothesized that any condition which is associated with short reaction times on the first trial would also be expected to produce a greater number of response faults of repetition than a condition which is associated with lengthened reaction time on the first trial. Hence it is predicted that there will be more response faults on repetition for non-emotional than for emotional words, and for low entropy words than for high entropy words.

IVa) It is predicted that reaction time varies as a function of the usual state of the subject and hence the reaction times for the different anxiety groups will be different. Statistically, this predicts a significant effect of the anxiety level variable on reaction time.

IVb) It is also predicted that there will be a significant interaction between the variables of anxiety group and entropy such that highly anxious subjects will respond more rapidly to low entropy words and more slowly to high entropy words than non-anxious

subjects. This predicts a significant interaction between anxiety level and entropy.

IVc) Regarding the galvanic skin response as a function of the variables of emotionality, entropy and trials, when the subjects have been divided into different anxiety groups, it is predicted that there will be an effect of this division such that high anxious subjects will show greater reactivity than non-anxious subjects. No interactions are predicted between the anxiety groups variable and the variables of emotionality, entropy and trials on the galvanic skin response measure.

IVd) It is predicted that response faults of repetition will vary as a function of the anxiety level of the subjects. Hence it is predicted that there will be a significant effect of anxiety level on the response faults of repetition measure such that high anxious subjects will make more faults of repetition than will low anxious subjects.

Reaction Time and Response Faults

The present thesis will use learning theory as a framework for its predictions. Although the major view presented will be that of Hull, the empirical findings of Brody and Laffal will also be included.

In the Hullian view of word association, it may be assumed that particular stimulus words are linked with particular associative strengths to certain response words.

Thus a probability value may be assigned to the likelihood of any response's occurrence on the basis of the associative strength that has been built up between a particular stimulus word and each of the several possible response words. According to the associative strengths built up between a stimulus word and the various response words it has been linked with, these response words are distributed in a hierarchy, with the words most strongly associated with the stimulus word being highest in the hierarchy and with the less strongly associated responses forming a slope of response probabilities with diminishing magnitude, and hence with diminishing likelihood of being elicited.

On the first trial of a free association test, presumably the most strongly associated response word, having the highest effective reaction potential, will be elicited. Depending upon the magnitude of the effective reaction potential, the response will be made rapidly or slowly, and this in turn depends on the associative strength between the stimulus word and any word or words in the response hierarchy.

In regard to emotional and non-emotional words, and the differences in reaction time and response elicitation to these as stimulus words, Hull's concept of anxiety must be considered. Hull stated that anxiety acts as a drive. Since effective reaction potential equals drive times habit strength, and since anxiety acts as a drive, then anxiety will combine multiplicatively with the already extant habit strengths in a response hierarchy and will cause the more

probable responses to become still more probable relatively speaking. In other words, the introduction of anxiety as a drive factor will serve to steepen the gradient of possible responses in a given response hierarchy. On the basis of this, the Hullian prediction would be that under anxiety conditions, the steepening of the hierarchy would both make the most popular responses still more popular and would also reduce the number of possible associations accessible to the subject. Hence, emotional words, which may be assumed to introduce anxiety as a drive factor, would be expected to show this same steepening of response hierarchy. This leads to the prediction of shorter reaction times for emotional words than for neutral words if both words have the same initial response hierarchy.

On successive trials of free association, it would be predicted that emotional words, having caused the steepening of the response hierarchy, would show shorter reaction times but would show response faults of repetition sooner than neutral words, because the steepening of the hierarchy would reduce the number of different associations available to the subject for the emotional stimulus word.

According to Hull's postulation of anxiety as a drive, anxiety should combine in multiplicative fashion with <u>all</u> reaction potentials in the response hierarchy, making all hierarchies steeper, regardless of the specific habit strengths -- or initial forms -- of the hierarchies.

An investigation by Brody (1964) has presented evidence

incongruent with the Mullian formulation. Utilizing the 21 highest and 21 lowest valued words on Laffal's 1955 List of Uncertainty Values, and having high and low anxious subjects free associate to these words in a multiple free association paradigm, Brody found that the presence of anxiety in subjects tended to increase the uncertainty of High Uncertainty words, and tended to decrease the uncertainty of Low Uncertainty words. Stated otherwise, Brody found that if the response hierarchy of a group of responses was already steep, the introduction of anxiety made this hierarchy still steeper, while if the hierarchy was shallow, the introduction of anxiety made the hierarchy still more shallow.

The prediction that Brody's observation would lead to with regard to performance on multiple free association would be an interaction between the variables of emotionality and entropy. Hence emotional words with an initially steep hierarchy would show an even greater steepening of this hierarchy, while emotional words with an initially shallow hierarchy would show an even greater flattening of the hierarchy. Thus on successive trials, high entropy emotional words would show a shorter reaction time -- due to the reduced number of associations -- and would also show a greater number of response faults of repetition than would low entropy emotional words, the increased flattening of whose hierarchies would permit more easy multiple association.

In effect, the Laffal conceptualization is quite similar

to the Hullian approach to free association. According to Laffal's view, the words in an individual's repertoire of responses to a given stimulus are distributed in a hierarchical form. If this hierarchy is a steep one, and the most salient response is much more probable of being elicited than the successive responses in the hierarchy, then the subject will produce a response quickly on the first trial and, on later trials in multiple free association, this most probable response will again be the first to occur to the subject. Hence on later trials, the subject will be able, or will not be able, to develop a different response from the one formerly given depending on the form of the response hierarchy. If the hierarchy is steep, few if any responses other than the original one will be available to the subject and hence, words with such hierarchies would be expected to show a slightly increasing reaction time over trials and a greater number of faults of repetition than would words whose response hierarchies were initially shallow. In this latter case, where the form of the response hierarchy is initially shallow, it would take longer for an initial response to be developed, because several responses, all of approximately equal associative strength, may compete, until one is finally given. However, on successive trials, it would be easier, and indeed even more probable, that a subject could give a new association to a word whose response hierarchy is shallow. Hence the Laffal view, being an extension of the Hullian theorization, would predict response

faults of repetition and reaction time length both to be a function of response entropy, such that steep hierarchy words would show more repetition faults than words with shallow hierarchies, and words with steep hierarchies would show initially short reaction times, but would show increasing reaction times over trials, while words with shallow hierarchies would show initially long reaction times, but these reaction times would not lengthen appreciably over trials.

The most significant aspect of Laffal's view is that he ascribes the difference in reaction time and response faults of repetition primarily to the form of the response hierarchy for particular words, and he does not emphasize the impact of the variable of emotionality on reaction time and response faults in the free association test. Laffal would consider emotionality as an important factor only when the subject's performance deviates from what would be expected on the basis of the stimulus word's response hierarchy.

Application of Theory to Predictions

Hull's theoretical system and the empirical findings of several authors will now be applied to the present author's own predictions.

Regarding hypothesis (Ia), the Hullian view states that the responses in a hierarchy of responses are distributed on the basis of the associative strength between the original stimulus and any one response, these associative strengths depending upon the number of reinforced pairings of a

particular complex of stimulus and response. It is essentially the number of such pairings of stimulus and response that cause the responses to be distributed in hierarchical form. The response which has had the greatest number of reinforced pairings with the stimulus will be the most strongly associated, or dominant, response. Thus, depending upon the number of reinforced pairings each response has had with the stimulus, all the possible responses to a stimulus will be distributed in a hierarchy.

Reaction time would be expected to vary directly with the strength of association between the stimulus and the most salient response. If one of the response words is much more strongly associated with the stimulus word than any of the other response words -- i.e. in the case of a low entropy word -- the response will emerge quickly and the reaction time would be expected to be short. If none of the responses is clearly associated more strongly with the stimulus word than any of the other responses -- i.e. in the case of a high entropy word -- it would take a longer time for one response to emerge, and hence the reaction time would be lengthened. Hence the Hullian prediction for (Ia) would be that low entropy words would show short reaction times on the first trial of association, while high entropy words would show long reaction times on the first trial. The prediction that the entropy variable will be significant over trials assumes that the reaction time to respond to a word on any trial will be a function of the entropy of the word's response

hierarchy.

In the Hullian system, the responses in a response hierarchy are distributed on the basis of habit strength. The effective reaction potential, though, is seen as being dependent upon drive times habit strength. Hence the introduction of drive -- or emotionality -- would cause an increase in the effective reaction potential of all of the responses in a hierarchy, since the drive factor would combine with the already existing habit strengths of each response. This multiplicative combination of drive and habit strength would cause a steepening of the hierarchy, making the dominant responses in the hierarchy still more dominant relatively speaking. Hence emotional words, which can be assumed to introduce a drive factor, will cause the steepening of this word's response hierarchy in the individual. Thus the Hullian prediction with respect to hypothesis (Ib) would be that emotional words, causing this steepening of response hierarchy, would yield a more rapid initial response than non-emotional words, if both the emotional and non-emotional words had initially similar response hierarchies.

Because of the multiplicative combination of drive and habit strength, the Hullian framework would predict a significant effect of the interaction between entropy and emotionality, which agrees with the present author's own hypothesis (Ic). The entropy by emotionality interaction would be predicted because low entropy emotional words would have their response hierarchies extremely steepened, while

high entropy emotional words would not show such an appreciable steepening of their hierarchies. Non-emotional words, not having an added drive factor, would not show as extreme a difference in reaction times at the different levels of entropy, although non-emotional words would be expected to show shorter reaction times for low than for high entropy values.

On the basis of Laffal's experimental findings (1955), he would predict that the entropy variable would be significant on the first trial. Since he does not present his views regarding the difference between emotional and non-emotional stimulus words, it is not possible to state his predictions in this respect.

On the basis of Brody's (1964) investigations, one would predict a significant interaction effect between the variables of emotionality and entropy on the first trial, since Brody found that emotionality tended to make initially steep hierarchies still steeper and initially shallow hierarchies still shallower. Hence Brody's view would agree with hypothesis (Ic), predicting that low entropy emotional words would yield especially rapid reactions, while high entropy emotional words would yield especially extended reaction times on the first trial. Non-emotional words would be expected to show a less severe difference in reaction times, with low entropy words showing shorter initial reaction times than high entropy words.

Regarding reaction time as a function of the variable

of trials, in terms of the Hullian viewpoint, the fact that successive -- and different -- responses in a response hierarchy are less and less strongly associated with the original stimulus word would mean that it would take the subject longer to deliver a response on each successive trial of free association. Thus the Hullian prediction with respect to hypothesis (Id) would be that there would be a significant effect of the trials variable, regardless of whether the stimulus words were emotional or neutral, and regardless of their entropy values.

Contrary to the present author's hypothesis, and also to the Hullian theoretical position, are the findings of Bodin and Geer (1963). These authors found no increase in reaction times across multiple levels of free association, and hence they would predict that reaction time would not show a significant increase as a function of trials.

Since Bodin and Geer present data regarding only difference scores, and since they used depressed patients as subjects in their investigation, it is likely that the initial reaction times of their subjects were several seconds longer than the usual reaction times of normal subjects. Presumably, as their subjects warmed up to the tester and to the test situation, there was a tendency for their reaction times to become shorter. Hence the resulting reaction times across trials can be seen as the combination of two opposing tendencies -- on the one hand, for the reaction times to become longer with successive trials, and on the other hand,

for the subjects to relax and hence respond more quickly. Thus it is probable that reaction times do lengthen over trials, but that in Bodin and Deer's experiment, the two opposite tendencies cancelled out the effect of the trials variable.

Regarding the variable of emotionality across four trials, the Hullian position would be that the emotional stimulus words would be associated with a steepening of these stimulus words' response hierarchies, and emotional stimulus words would thus be expected to show essentially no change in reaction time on successive trials but more response faults of repetition, or a lengthening of reaction time on the second, third and fourth trials, while the subject searches for a response that he has not given before. Non-emotional words would be expected to show an increase in reaction time across trials, in a linear fashion. Hence it is possible that there could be an interaction between the variables of emotionality and trials.

The Hullian and Laffal views of hypothesis (Ie) -- regarding the interaction of the variables of entropy and trials -- would be essentially similar. This would be that, according to the form of the hierarchy of responses to a given word -- that is, the word's entropy value -- the ease or difficulty with which new associations to the stimulus word could be given would be determined. Hence high entropy words, with flat response hierarchies, would permit new associations to be made to the stimulus word on successive

trials more easily than low entropy words, with steep hierarchies; thus high entropy words would be expected to show less of an increase in reaction times across trials than low entropy words.

Regarding the present hypotheses with respect to the galvanic skin response as a function of the variables of emotionality, entropy and trials, the theoretical formulations presented in this thesis have not included any consideration of the measurement of arousal by the galvanic skin response. For the purposes of this investigation, it will be assumed that heightened autonomic activity, which can be measured by galvanic skin response deflections (Woodworth & Schlosberg, 1960), will be reflective of the arousal level of the subject. Since the galvanic skin response may be influenced by the alerting response of an individual; conflict in terms of a reaction tendency which is blocked; or either internal or external stress of the individual, it will not be suggested that the galvanic skin response will be an index specifically of the subject's "emotional" responsivity. The prediction is made, however, as stated in hypothesis (IIa), that words which have been judged as emotional by Psychology graduate students will yield larger galvanic skin response deflections than words which have been judged as non-emotional by these same graduate students, when the words are equated for the entropy of their response hierarchies.

It would be predicted, then, that the galvanic skin

response would vary as a function of the emotional value of stimulus words on the first trial.

Since the galvanic skin response also reflects general increases in activation in the subject, and such increases in activation would accompany cognitive effort or conflict, it would also be predicted, as hypothesis (IIb) states, that this dependent measure would vary as a function of the variable of entropy on the first trial.

In regard to the galvanic skin response measure as a function of the trials variable, two possibilities exist. First of all, the galvanic skin response seems to show adaptation, so that continued or repeated exposure to a stimulus reveals a reduction in the responsivity of the subject to the stimulus. From this viewpoint, it would be predicted that emotional words would lose their ability to elicit a galvanic skin response deflection from the subject on the second trial of word association. This would predict a significant effect of the trials variable on the galvanic skin response.

The other possibility in regard to the galvanic skin response as a function of trials is due to the fact that the galvanic skin response may also reflect blocked response tendencies of the subject. Since on the second trial, the subject's initial response word may occur to him and may have to be inhibited, he may show a galvanic skin response deflection equal to, or greater than, the deflection he gave on the first trial. In this latter case, there might either

be a significant effect of the trials variable or there might not be.

Regarding hypothesis (III) -- response faults of repetition as a function of the variables of emotionality and entropy, Laffal and Hull would predict these to be a function of the variable of response entropy, such that words with steep hierarchies would show a greater number of response faults of repetition than words with shallow hierarchies. This would be so because on later trials, the most salient response to the stimulus word would occur to the subject and, unless he could inhibit this response and go on to another one, he would repeat his already given response.

Hullian theory states that drive and habit strength combine multiplicatively to yield effective reaction potential. It is assumed that one of the basic correlates of anxiety is a certain level of drive. It is assumed that individuals who perform differently on scales of manifest anxiety, such as the Taylor Scale of Manifest Anxiety (1951), would differ in their degree of general drive or activation. On the basis of the multiplicative combination of drive and habit strength, it would be assumed that subjects at different levels of anxiety, having different amounts of drive to combine with the responses in their word response hierarchies, would perform differently on a word association test. Hence this predicts, as stated in hypothesis (IVa), that there would be a significant effect of the anxiety variable on reaction time.

Since the variable of entropy is essentially a way of describing the habit strengths of several response words with one stimulus word, it would be expected that the differing drive levels of subjects at different levels of manifest anxiety would interact with the entropy variable, such that high anxious subjects would show faster reaction times to low entropy words and longer reaction times to high entropy words than non-anxious subjects on the first trial. Thus, as stated in hypothesis (IVb), the Hullian view would predict an interaction between the variables of entropy and anxiety level.

Since the galvanic skin response reflects the level of activation of the subject, and since it is presumed that subjects at different levels of manifest anxiety have different degrees of activation, it would be predicted that the anxiety group variable would be significant, such that high anxious subjects would show greater galvanic skin response reactivity than non-anxious subjects.

It is felt that individuals who are placed into different groups on the basis of a manifest anxiety measure will have different states of general drive. It would be predicted that the drive in these individuals, depending on its degree, would combine with the habit strengths of the responses to stimulus words, and alter the response hierarchies in accord with the amount of drive present.

Thus it would be predicted that the response hierarchies would be steepened to a greater degree the greater the amount

of drive in the subject. Thus the high anxiety level group would have the steepest hierarchies -- and the fewest available responses; the low anxiety group would be expected to have the shallowest hierarchies -- and the greatest number of available responses. Hence, as stated in hypothesis (IVd), it would be predicted that response faults of repetition would vary as a function of the anxiety level of the subjects, such that high anxious subjects will make more faults of repetition -- since they will have fewer different responses available to them -- than will low anxious subjects.

METHOD

Stimuli

In selecting the words to be used in the present experiment, two variables were considered, the variables being those of emotionality and entropy. Initially, a Clinical Psychologist and the experimenter himself examined Laffal's 100-word list of Uncertainty Values, and selected therefrom forty words at various levels of entropy. Of the forty words, twenty were judged to be emotional and twenty were judged to be non-emotional. These forty words were typed on index cards and were then administered to a selection of ten Psychology graduate students, who were asked to rank the words in order from the most emotional to the least emotional. Ten of the eleven emotional stimulus words which were used in the experiment were taken from this ranking, and nine of the non-emotional words used were also taken from this ranking. The stimulus words which were not taken from Laffal's list of Uncertainty Values were obtained from the Kent-Rosanoff Word List and their entropy values were computed according to Senders (1958). The one emotional word which was not taken from Laffal's list, was taken from the Kent-Rosanoff Word List and was used because there was no emotional word at that particular level of entropy on Laffal's list. Similarly, in the cases where no non-emotional word could be found in Laffal's list to match the entropy value of an emotional word, a non-emotional word whose

entropy value did match that of the emotional word, was selected from the Kent-Rosanoff Word List and was used in the experiment. Of the original forty words which were ranked by the graduate students, emotional words were selected which did not have a mean rank of over 13, and non-emotional words were selected which did not have a mean rank of under 26. Words were selected at appropriate intervals of .50 on the entropy variable.

Twenty-two words were presented to each subject on each of four trials. These twenty-two words included eleven emotional and eleven non-emotional words, sampling entropy values from 5.50 to 0.62, at approximate intervals of 0.50. The mean entropy value for the emotional words was 3.14 and the standard deviation of the entropy values for the emotional words was 1.46. The mean entropy value for the non-emotional words was 3.16 and the standard deviation of the entropy values for the non-emotional words was 1.44. The stimulus words appear in Appendix A.

A 22 x 22 Latin Square was constructed to counterbalance the order of presentation of the stimulus words and to control for sequence as well as order of presentation. No restrictions were placed on the number of emotional or non-emotional words which could occur consecutively.

The order of word presentation for each subject was determined by selecting one pair of columns and one pair of rows from the Latin Square arrangement of the stimulus words. The selection of the first order of presentation for a

subject was made without restriction, except that it was one of the columns of the Latin Square which had not been used before. The second order of presentation was determined by selecting the row of the Latin Square which began with the eleventh word of the previously used column. The third order of presentation was the column whose order was exactly the opposite of the order on the first presentation. The fourth order of presentation was the row whose order was exactly the opposite of the order of the second trial.

The words were presented to the subject by tape recorder, one word being presented every 20 seconds, with a ready signal presented approximately two seconds before the stimulus word was actually presented. Each subject received four different orders of presentation of the twenty-two word list with the instructions being read to the subject in between trials.

On the first two trials of the experiment, the subject's galvanic skin responses to the stimulus words were recorded. Hence the first trial included the presentation of three additional words to permit the subject to become familiar with the word association procedure and the galvanic skin response procedure. The same three warm-up words were used for all subjects, but the order in which these words were presented was varied randomly for each subject.

After each subject had been run through the four trials of word association, he was given a short form of the Taylor Manifest Anxiety Scale (1951). The scale used in the present

investigation was obtained by personal communication with Mr. Gordon Gerrish (1964), who developed the scale. The scale items were all taken from the original 1951 Taylor Manifest Anxiety Scale and the 1953 revised Taylor Scale. However, the actual items used in the scale constructed by Mr. Gerrish were selected on the basis of several validation studies of the items on the Manifest Anxiety Scale. The scale devised and used was a true-false type inventory, consisting of a total of 45 items of which 20 were anxiety items, and was disguised as a Biographical Inventory. A discussion of the studies upon which the Biographical Inventory was based appears in Appendix B, and the Biographical Inventory itself appears in Appendix C.

The subject's word associations and reaction times to the 22 words were recorded on each of four trials, as was the subject's galvanic skin responses accompanying his verbal associations on the first two trials. Further, a measure of each subject's level of manifest anxiety was obtained at the completion of the four trials of word association. Thus the data was analyzable by either of two analysis of variance models. These models were, first, a completely Within Subjects design with the variables being emotionality, entropy and trials, and second, a Mixed design with anxiety level being the Between Subjects variable, and the Within Subjects variables being emotionality, entropy and trials. To test some of the hypotheses, the trials variable was dropped and the completely Within Subjects or the Mixed design analysis

of variance was carried out on the first trial only. Each of these two types of analyses was applied to the reaction time and the galvanic skin response data. Analyses of variance tables for these designs appear in Appendix D.

Subjects

The subjects used in this investigation were 22 undergraduate male volunteers from the University of Massachusetts. The subjects included both introductory Psychology students and students who were not enrolled in an introductory Psychology course, since the sign-up sheet for subjects said that a subject could choose between one hour's credit and one dollar for serving in the experiment. Eight of the subjects received one dollar for participating in the experiment, while 14 subjects received one hour of credit for participating in the experiment.

Procedure

The experiment was carried out in a square room approximately seven feet by seven feet. The subject was seated in a wooden chair on one side of the room. On a small table directly in front of the subject, there was a Wollensak model T-1500 tape recorder facing him. On the other side of the room, there was a Grass model 5D Polygraph and a table on which there was a Standard Electric Chronometer. The electric chronometer and the stimulus marker of the polygraph were each connected to separate single pole push-button momentary switches, both of which were in a block of wood on the experimenter's table. Between the subject and the

experimenter was an opaque screen which concealed the experimenter from the subject.

When the subject entered the room, he was seated in the subject's chair and was connected to the polygraph by means of finger electrodes. As the subject was balanced into the circuit, the experimenter explained the galvanic skin response procedure.

At this point, the experiment was begun by the experimenter reading the following instructions to the subject:

> A series of words is going to be presented to you by tape recorder. The words will be presented one at a time, one word every twenty seconds. There will be a signal just before each word is presented. You are to respond to each word with one other word. It does not make any difference what your word is, but it should be the first word that comes to your mind after the completion of the stimulus word. I want you to listen to the words carefully, and respond to them as quickly as you can, since your reaction times will be recorded. Are there any questions?

At this point, the experimenter turned on the tape recorder and took his seat at the experimenter's table. At the end of the stimulus-word presentation, the experimenter depressed the buttons for the stimulus marker and the chronometer. When the subject gave his response, the experimenter released the buttons. The reaction time was then recorded from the chronometer in hundredths of a second and the subject's reaction word was also recorded.

The first three words for each subject were to permit him to get used to the free association procedure. These words were randomized for each subject and were not part of

the twenty-two stimulus words of the actual experiment.

After the first trial had been completed, the tape recorder was stopped and the experimenter read the following set of instructions to the subject:

> Now the same series of words is going to be presented again, one word every twenty seconds. You are to respond with a word other than the word you gave on the first trial. For example, if the word was Bottle and you responded Soda, I want you to give a different response on this trial, for example, Glass. Respond as quickly as you can since your reaction times will again be recorded. Any questions?

After the second trial had been completed, the polygraph was turned off. The above instructions were used for the third and fourth trials, but the subject was told to give a different response than those he had given on either of the first two, or the first three, trials.

After the four trials of word association had been completed, the subject was given the anxiety scale.

RESULTS

Two dependent measures were recorded for each subject. These measures were reaction time of the subject's verbal responses over all four trials and the subject's galvanic skin responses accompanying his verbal responses on the first two trials. The subject's verbal responses were also recorded. On the basis of the number of responses the subject answered in the keyed direction on the short form of the Taylor Manifest Anxiety Scale, each subject was assigned an anxiety score. On the basis of these scores, the subjects were divided into three levels of anxiety. There were nine subjects in the first, or low level, anxiety group and their MAS scores varied from 2-6; seven subjects in the second, or medium, anxiety group, with MAS scores varying from 8-10; and six subjects in the third, or high level, anxiety group, with MAS varying from 11-16.

Analyses of variance were carried out for the reaction time measure and for the galvanic skin response measure separately on the first trial and over four or two trials, respectively. Each of these response measures was analyzed in each case as a completely Within Subjects design, that is, Subjects by Emotionality by Entropy or Subjects by Emotionality by Entropy by Trials. The dependent measures were analyzed again, using anxiety as a Between Subjects variable. An unweighted means analysis of variance was used to adjust for the different numbers of subjects in each of the anxiety

groups in the mixed analysis (Winer, 1962, p. 374). The reaction time response measure was analyzed as a Subjects within levels of anxiety by Emotionality by Entropy, but was not analyzed as a Subjects within levels of anxiety by Emotionality by Entropy by Trials. The galvanic skin response measure was analyzed as a Subjects within levels of anxiety by Emotionality by Entropy and was also analyzed as a Subjects within levels of anxiety by Emotionality by Entropy by Trials.

A reciprocal transformation was carried out on the reaction time data, thus transforming latency scores into speed scores. This also normalized the within cell distributions and reduced the cell variances. Thus the analyses of variance on the reaction time response data were done on the transformed speed scores.

Table 1 presents the analysis of variance for the reaction time measure on the first trial as a completely Within Subjects design. Table 2 presents the analysis of variance for the reaction time measure on the first trial as a Mixed design with one Between and two Within Subjects variables.

Both the completely Within Subjects and the Mixed design analyses of variance indicated that emotionality, entropy and the emotionality by entropy interaction were significant at the .01 level on the first trial. However, the Between Subjects variable of anxiety level was not significant.

The means for the reaction time measure on the first

Table 1

Within Subjects

Analysis of Variance of Reaction Time Measure

on the First Trial

Source	df	MS	F
Between Subjects	21	0.394	
Within Subjects	462		
Emotionality (Emo)	1	0.708	15.06*
Emo x Ss	21	0.047	
Entropy (Ent)	10	0.684	10.64*
Ent x Ss	210	0.064	
Emo x Ent	10	0.163	3.19*
Emo x Ent x Ss	210	0.051	

* p = .01

Table 2

Mixed

Analysis of Variance of Reaction Time Measure

on the First Trial

Source	df	MS	F
Between Subjects	21		
Anxiety (A)	2	0.153	0.068
Ss/A	19	2.236	
Within Subjects	462		
Emotionality (Emo)	1	0.637	13.00*
Emo x A	2	0.021	0.42
Emo x Ss/A	19	0.049	
Entropy (Ent)	10	0.652	10.34*
Ent x A	20	0.071	1.12
Ent x Ss/A	190	0.063	
Emo x Ent	10	0.171	3.28*
Emo x Ent x A	20	0.037	0.71
Emo x Ent x Ss/A	190	0.052	

* p = .01

trial are presented in Table 3. Because of the similar results on the RT measure on the first and over four trials, only the means over all four trials were plotted (Figures 1 and 2). Inspection of these figures will indicate the approximate form of the plotted reaction speeds on the first trial as a function of entropy, and the emotionality by entropy interaction. Inspection of the mean speed scores for the entropy variable in Table 3 indicates that hypothesis (Ia) is confirmed, since reaction speed is seen to vary as a function of the entropy variable. A trend analysis was carried out on the entropy variable on the first trial. Of the 6.347 units of variance attributable to the entropy variable, 3.358 units or 49% of the variance was linear. The F ratio for the linear trend was 52.22 and was significant at the .01 level. The quadratic trend in the data was also tested. It accounted for 0.365 units of variance and yielded an F ratio of 5.68, which was significant at the .01 level.

The mean speed score for emotional words on the first trial is 0.869, while the mean reaction speed for non-emotional words on the first trial is 0.944. This finding supports hypothesis (Ib) of the present investigation, that emotional words show longer reaction times than non-emotional words.

The significant interaction between the variables of emotionality and entropy confirms hypothesis (Ic). Reaction speed is greater for non-emotional words at both high and low entropy values, while reaction speed is greater for

Table 3

Means on the First Trial

Reaction Time Response Measure

(Reciprocals)

Emotional Words: 0.869

Non-Emotional Words: 0.944

Entropy:

Low 1	2	3	4	5	6	7	8	9	10	High 11
1.055	1.085	1.035	0.861	0.807	0.948	0.807	1.008	0.764	0.748	0.856

Emotionality x Entropy Interaction:

Entropy		
Emotional		Non-Emotional
	Low	
0.960	1	1.154
1.043	2	1.135
1.062	3	1.018
0.838	4	0.884
0.762	5	0.853
1.020	6	0.877
0.824	7	0.790
0.956	8	1.064
0.734	9	0.795
0.602	10	0.894
0.765	11	0.947
	High	

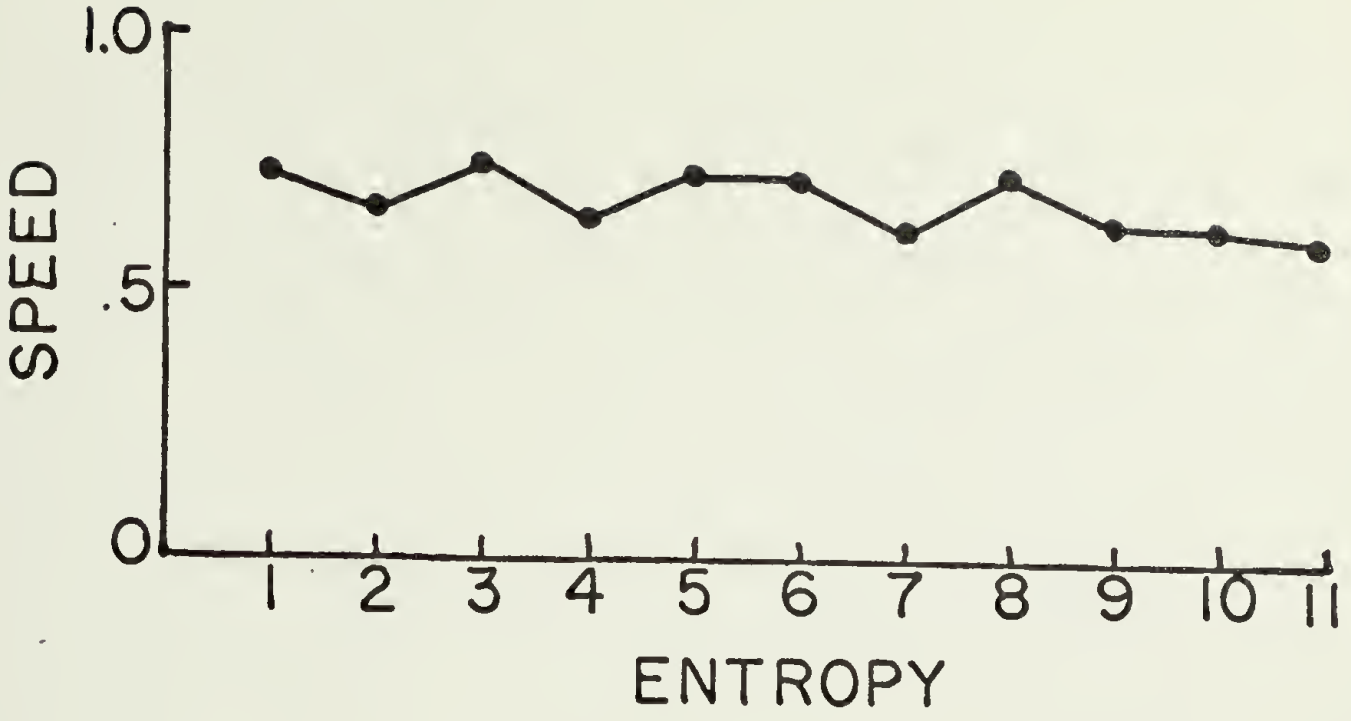

Fig. 1. Mean reaction speeds over all four trials as a function of entropy.

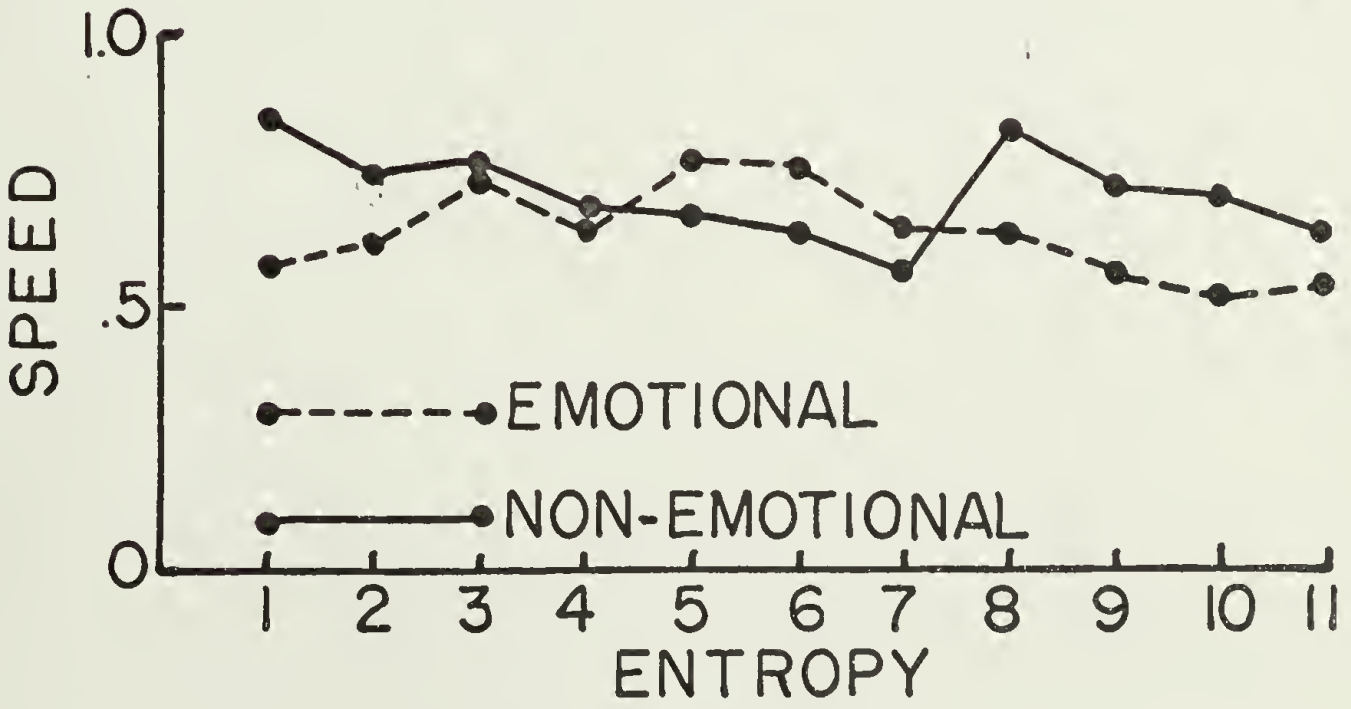

Fig. 2. Mean reaction speeds over all four trials as a function of emotionality by entropy interaction.

emotional words at the middle values of entropy.

A trend analysis was carried out on the emotionality by entropy interaction on the first trial. Out of the 1.635 units of variance attributable to the interaction, the linear by linear trend accounted for 0.110 units and yielded an F value of 2.15, which was not significant. The linear by quadratic trend accounted for 0.652 units of variance and yielded an F value of 12.78, which was significant at the .01 level.

Table 4 presents the analysis of variance for the reaction time measure over four trials as a completely Within Subjects design. Once again, emotionality, entropy and the emotionality by entropy interaction are significant at the .01 level, thus confirming hypotheses (Ia), (Ib), and (Ic) over all four trials. Table 5 presents the mean reaction speeds of emotionality, entropy and the emotionality by entropy interaction over four trials. This data appears plotted in Figures 1 and 2.

Inspection of the analysis of variance table indicates that the trials variable was significant at the .01 level, confirming hypothesis (Id). A trend analysis was carried out on this source of variance. Of the total 36.475 units of variance attributable to the trials variable, 30.801 units were linear, and yielded an F value for the linear component of 193.71. The quadratic trend in the data accounted for 5.43 units of variance and yielded an F value of 34.15, which was significant at the .01 level. The mean

Table 4

Within Subjects

Analysis of Variance of Reaction Time Response Measure

Over Four Trials

Source	df	MS	F
Between Subjects	21	1.562	
Within Subjects	1914		
Emotionality (Emo)	1	2.662	27.45*
Emotionality x Ss	21	0.096	
Entropy (Ent)	10	0.511	8.58*
Ent x Ss	210	0.059	
Trials (T)	3	12.158	76.03*
T x Ss	63	0.159	
Emo x Ent	10	0.668	11.94*
Emo x Ent x Ss	210	0.055	
Emo x T	3	0.002	0.04
Emo x T x Ss	63	0.056	
Ent x T	30	0.234	4.03*
Ent x T x Ss	630	0.058	
Emo x Ent x T	30	0.090	1.60
Emo x Ent x T x Ss	630	0.056	

* p = .01

Table 5

Means Over Four Trials

Reaction Time Response Measure

(Reciprocals)

Emotional Words: 0.643

Non-Emotional Words: 0.717

Entropy:

Low 1	2	3	4	5	6	7	8	9	10	High 11
0.721	0.687	0.755	0.666	0.737	0.713	0.616	0.722	0.644	0.619	0.603

Emotionality x Entropy Interaction:

Entropy		
Emotional		Non-Emotional
	Low	
0.590	1	0.854
0.624	2	0.752
0.728	3	0.784
0.641	4	0.690
0.794	5	0.679
0.771	6	0.655
0.635	7	0.596
0.631	8	0.814
0.589	9	0.723
0.537	10	0.701
0.562	11	0.644
	High	

reaction speeds as a function of the trials variable are plotted in Figure 4.

Inspection of the analysis of variance over four trials also indicates that there is a significant trials by entropy interaction, thus confirming hypothesis (1e). Inspection of the plotted data in Figure 3, however, suggests that reaction speed across trials did not vary meaningfully as a function of entropy level. Inspection of the plotted means indicated that trend tests were not appropriate and hence they were not carried out on the trials by entropy interaction.

Table 6 presents the mean reaction speeds for the trials variable and also for the trials by entropy interaction. The data in Table 6 appear in Figures 3 and 4.

Since neither the Between Subjects variable of anxiety itself nor any of the interactions between the Within Subjects variables and the anxiety variable were significant on the first trial, no Mixed design analysis of variance was carried out over all four trials on the reaction time measure.

The second dependent response measure which was obtained on each subject was that of the galvanic skin response to each of his verbal responses on the first two trials. The deflections which occurred as the subject responsed were recorded in centimeters.

Part of the analysis of variance of the galvanic skin response data was done by computer. This part was the completely Within Subjects and the Mixed design analyses over

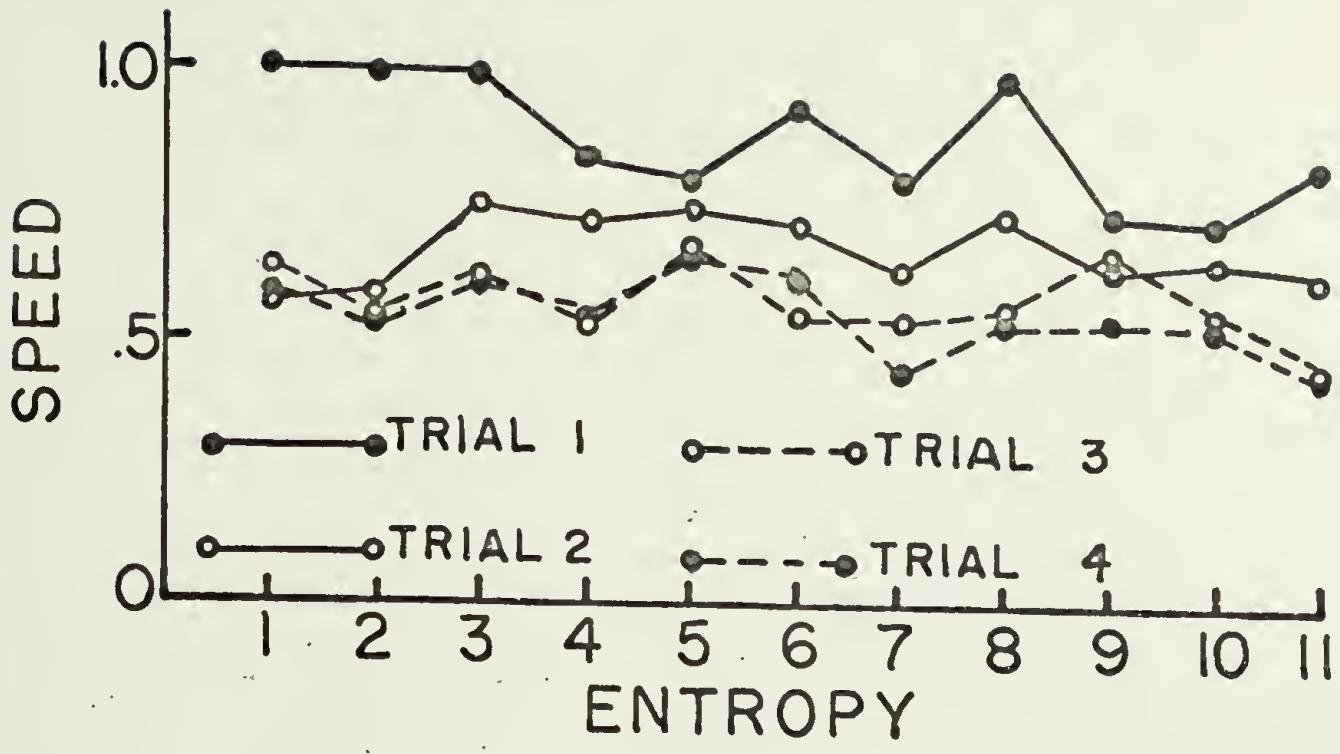

Fig. 3. Mean reaction speeds as a function of entropy by trials interaction.

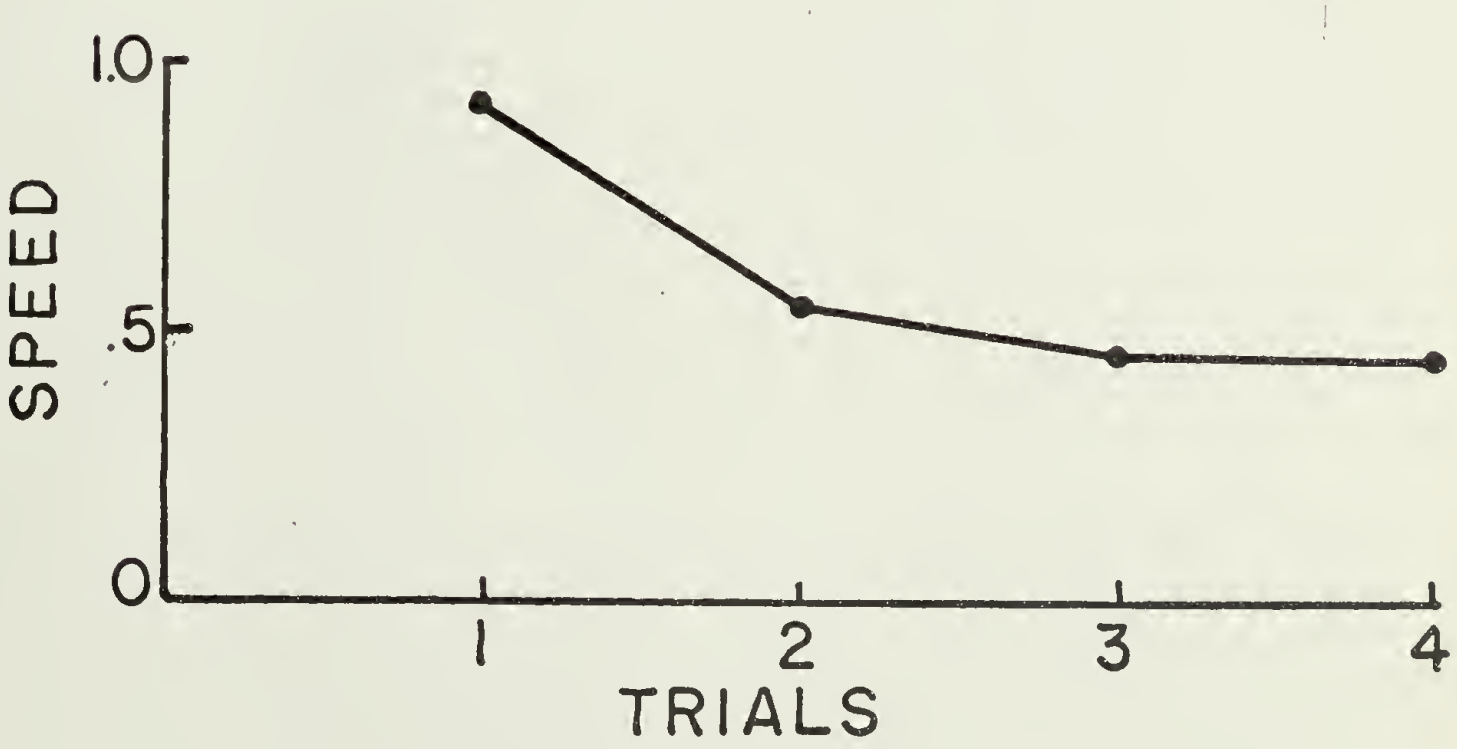

Fig. 4. Mean reaction speeds as a function of trials.

Table 6

Means Over Four Trials

Reaction Time Response Measure

(Reciprocals)

Trials:

1	2	3	4
0.908	0.669	0.586	0.559

Trials x Entropy Interaction:

	Trials:	1	2	3	4
Entropy					
Low	1	1.055	0.594	0.639	0.598
	2	1.085	0.598	0.536	0.530
	3	1.035	0.750	0.628	0.608
	4	0.861	0.701	0.535	0.567
	5	0.807	0.773	0.695	0.672
	6	0.948	0.714	0.591	0.601
	7	0.807	0.636	0.547	0.474
	8	1.008	0.746	0.585	0.551
	9	0.764	0.603	0.645	0.562
	10	0.748	0.641	0.556	0.532
High	11	0.856	0.604	0.494	0.459

two trials. For the purposes of these analyses, the subjects' scores were transformed into mhos conductance. However, when the author wanted to do the analyses for the first trial only, he realized that he did not have the transformed scores on each subject. Thus the analyses of variance for the galvanic skin response on the first trial was done on the original centimeter deflection scores. These scores were first all transformed into the same sensitivity and then a reciprocal transformation was done on the data.

With the second response measure, analyses of variance were carried out on the first and over two trials in each of two ways. Thus the galvanic skin response was analyzed as a Subjects by emotionality by entropy design, or as a Subjects by emotionality by entropy by trials design, and again as a Subjects within levels of anxiety by emotionality by entropy design, or as a Subjects within levels of anxiety by emotionality by entropy by trials design.

Table 7 presents the analysis of variance for the galvanic skin response measure on the first trial as a completely Within Subjects design. Table 8 presents the analysis of variance for this measure on the first trial as a Mixed design.

Inspection of the analysis of variance tables indicates that the only variable which is significant on the first trial is that of emotionality. The mean reciprocal deflection for emotional words is 0.626 centimeters, and the mean

Table 7

Within Subjects

Analysis of Variance of Galvanic Skin Response Measure on the First Trial

Source	df	MS	F
Between Subjects	21	2.409	
Within Subjects	462		
Emotionality (Emo)	1	3.622	19.47*
Emo x Ss	21	0.186	
Entropy (Ent)	10	0.200	0.84
Ent x Ss	210	0.238	
Emo x Ent	10	0.393	1.45
Emo x Ent x Ss	210	0.270	

* p = .01

Table 8

Mixed

Analysis of Variance of Galvanic Skin Response Measure on the First Trial

Source	df	MS	F
Between Subjects	21		
Anxiety (A)	2	3.253	1.40
Ss/Anxiety	19	2.320	
Within Subjects	462		
Emotionality (Emo)	1	3.622	19.06*
Emo x A	2	0.157	0.82
Emo x Ss/A	19	0.190	
Entropy (Ent)	10	0.200	0.81
Ent x A	20	0.165	0.67
Ent x Ss/A	190	0.246	
Emo x Ent	10	0.393	1.52
Emo x Ent x A	20	0.399	1.55
Emo x Ent x Ss/A	190	0.257	

* p = .01

reciprocal deflection for non-emotional words is 0.793 centimeters. Since, however, these means were obtained from reciprocals, the amounts of deflection are actually reversed; that is, emotional words yield a larger galvanic skin response deflection than non-emotional words. This finding confirms hypothesis (IIa), that words which are pre-defined as emotional yield larger galvanic skin response deflections than words which are pre-defined as non-emotional. The confirmation of this hypothesis (IIa) is most important, since the main reason for employing the galvanic response as a dependent measure was to have some operational statement of the emotional value of the stimulus words used.

Table 9 and Table 10 present the analysis of variance tables for the galvanic skin response over the two trials on which it was recorded. The variable of emotionality is significant over two trials.

While hypothesis (IIb) predicted that the galvanic skin response would vary as a function of entropy such that low entropy words would yield small galvanic skin response deflections and high entropy words would yield large deflections, no significant differences were found for different levels of entropy on the first trial, thus failing to confirm hypothesis (IIb). However, on the analysis of variance over two trials, the entropy variable was significant. The linear, cubic and quartic trends in this data were tested, but since each of these tests yielded an F ratio of less than 1, it can be inferred that the significance of the

Table 9

Within Subjects

Analysis of Variance of Galvanic Skin Response Measure

Over Two Trials

(Micromhos)

Source	df	MS	F
Between Subjects	21	800.611	
Within Subjects	946		
Emotionality (Emo)	1	0.880	5.50*
Emo x Ss	21	0.160	
Entropy (Ent)	10	0.610	2.43**
Ent x Ss	210	0.250	
Trials (T)	1	132.480	3.72
T x Ss	21	36.022	
Emo x Ent	10	0.246	1.32
Emo x Ent x Ss	210	0.185	
Emo x T	1	0.120	0.70
Emo x T x Ss	21	0.170	
Ent x T	10	0.029	0.32
Ent x T x Ss	210	0.093	
Ent x Emo x T	10	0.058	0.49
Ent x Emo x T x Ss	210	0.117	

* p = .05
** p = .01

Table 10

Mixed

Analysis of Variance of Galvanic Skin Response Measure

Over Two Trials

(Micromhos)

Source	df	MS	F
Between Subjects	21	800.611	
Anxiety (A)	2	234.578	2.43
Ss/A	19	96.263	
Within Subjects	946		
Emotionality (Emo)	1	0.113	4.70*
Emo x A	2	0.004	0.16
Emo x Ss/A	19	0.025	
Entropy (Ent)	10	0.094	2.73**
Ent x A	20	0.044	1.26
Ent x Ss/A	190	0.035	
Trials (T)	1	12.020	2.95
T x A	2	12.089	2.97
T x Ss/A	19	4.076	
Emo x Ent	10	0.035	1.33
Emo x Ent x A	20	0.020	0.74
Emo x Ent x Ss/A	190	0.027	
Emo x T	1	0.024	1.00
Emo x T x A	2	0.025	1.04
Emo x T x Ss/A	19	0.024	
Ent x T	10	0.004	0.32
Ent x T x A	20	0.010	0.76
Ent x T x Ss/A	190	0.013	
Emo x Ent x T	10	0.008	0.53
Emo x Ent x T x A	20	0.015	1.00
Emo x Ent x T x Ss/A	190	0.015	

* p = .05
** p = .01

entropy variable on the GSR was due to the impact of particular words and not the variable of entropy itself.

It was predicted in hypothesis (IIc) that, due to the greater relaxation of the subjects on the second trial, there would be a reduction in their overall galvanic skin responsivity, and hence that there would be a main effect of the trials variable. Inspection of the analysis of variance for the two trials on which the galvanic skin response was recorded indicates that the trials variable approached, but did not attain, significance. Hence hypothesis (IIc) is not confirmed.

Table 11 presents the means for the levels of the entropy variable over two trials. These means are plotted in Figure 5.

A further dependent variable thought by Jung, Rapaport and others to be reflective of emotional arousal and hence conflict on the word association test is that of response faults. Thus an attempt was made to observe response faults of repetition to see if they varied as a function of emotionality and entropy values of the stimulus words.

Table 12 presents the response faults of repetition as a function of the variables of emotionality and entropy.

Since the total number of response faults of repetition was so small, non-parametric rather than parametric tests were used to test their distribution.

To test the hypothesis that the number of response faults of repetition did not differ as a function of entropy

Table 11

Means on the Galvanic Skin Response Measure

Over Two Trials

(Micromhos)

Emotional Words	11.241	SD 4.297
Non-Emotional Words	11.180	SD 4.299

Entropy	Mean	SD
Low 1	11.14	4.29
2	11.17	4.30
3	11.11	4.19
4	11.42	4.39
5	11.27	4.32
6	11.17	4.33
7	11.18	4.29
8	11.15	4.33
9	11.20	4.32
10	11.20	4.33
High 11	11.25	4.32

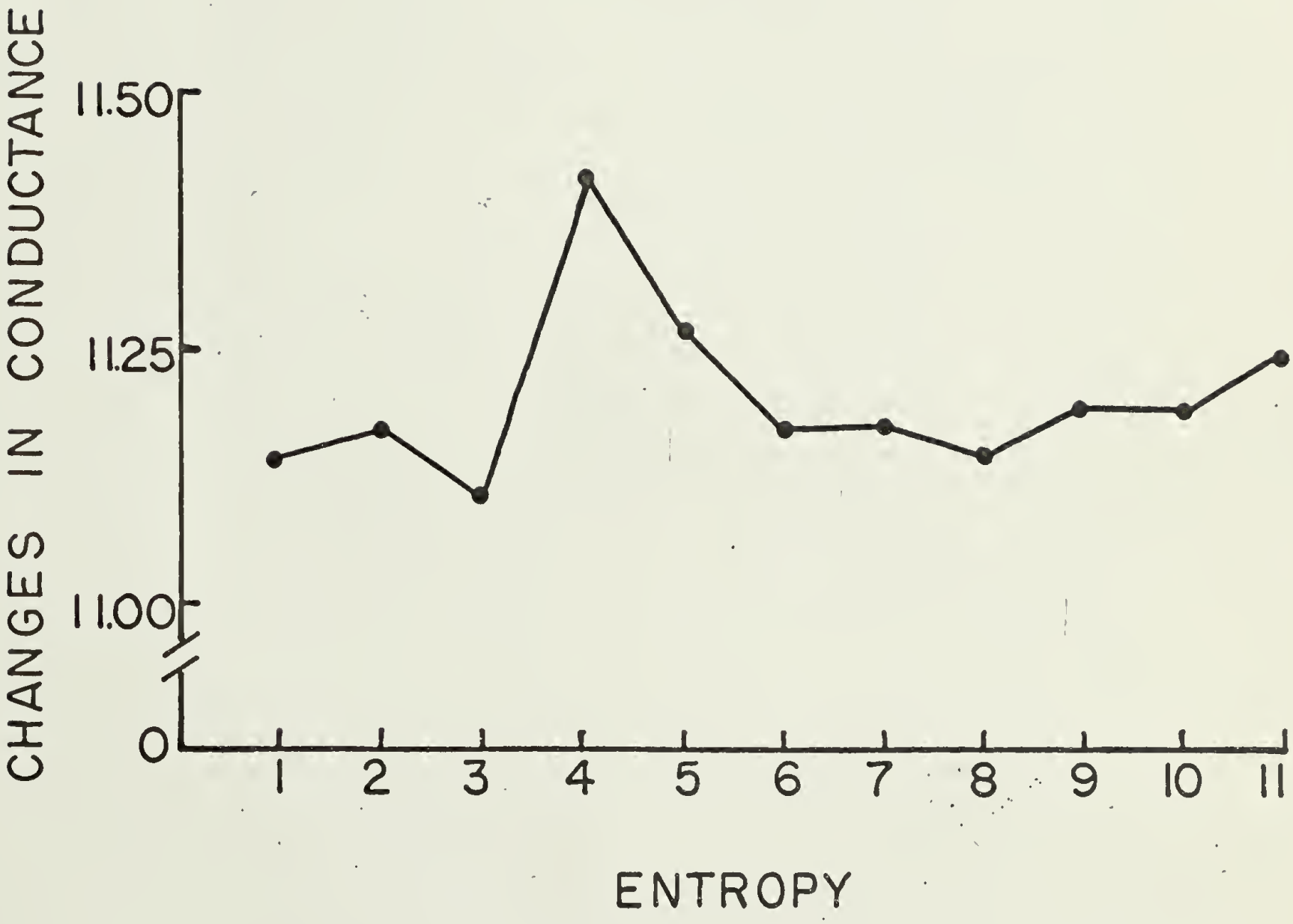

Fig. 5. Mean changes in mhos conductance over two trials as a function of entropy.

Table 12

Response Faults of Repetition

Entropy		Emotional	Non-Emotional	Mean
Low	1	4	0	2.0
	2	4	3	3.5
	3	4	3	3.5
	4	2	3	2.5
	5	2	5	3.5
	6	0	4	2.0
	7	9	1	5.0
	8	1	2	1.5
	9	3	2	2.5
	10	3	2	2.5
High	11	2	1	1.5
	Total	34	26	
	Mean	3.09	2.36	

level, Cochran's Q statistic (Siegel, 1956), based on the Chi-Square distribution, was computed. The Q value obtained (Q = 34.9, 21 df) was greater than the 1?.31 required for significance at the .05 level, indicating that the proportion of response faults made at each level of entropy was not the same (Figure 7). When the Q statistic was computed separately for emotional and non-emotional words, the non-emotional words were found not to show significant differences in the number of response faults made as a function of the entropy variable (Q = 11.5). However, emotional words did show a significant difference in the number of response faults as a function of the entropy variable (Q = 21.4). Hence there seemed to be an emotionality by entropy interaction such that emotional words were faulted more at lower and upper levels of entropy, while non-emotional words were faulted more in the middle levels of entropy. Inspection of this data in Figure 6 indicates that the results are not clear cut but that in any event, more faults of repetition are not made at the lower valued entropy words than are made at the upper entropy valued words. This fails to confirm one part of hypothesis (III).

There was no significant difference found in the number of response faults of repetition made as a function of the emotionality variable. Emotional words had a mean number of response faults of 3.0, while non-emotional words had a mean number of response faults of 2.3. Thus the second part of hypothesis (III) was not confirmed at a statistically

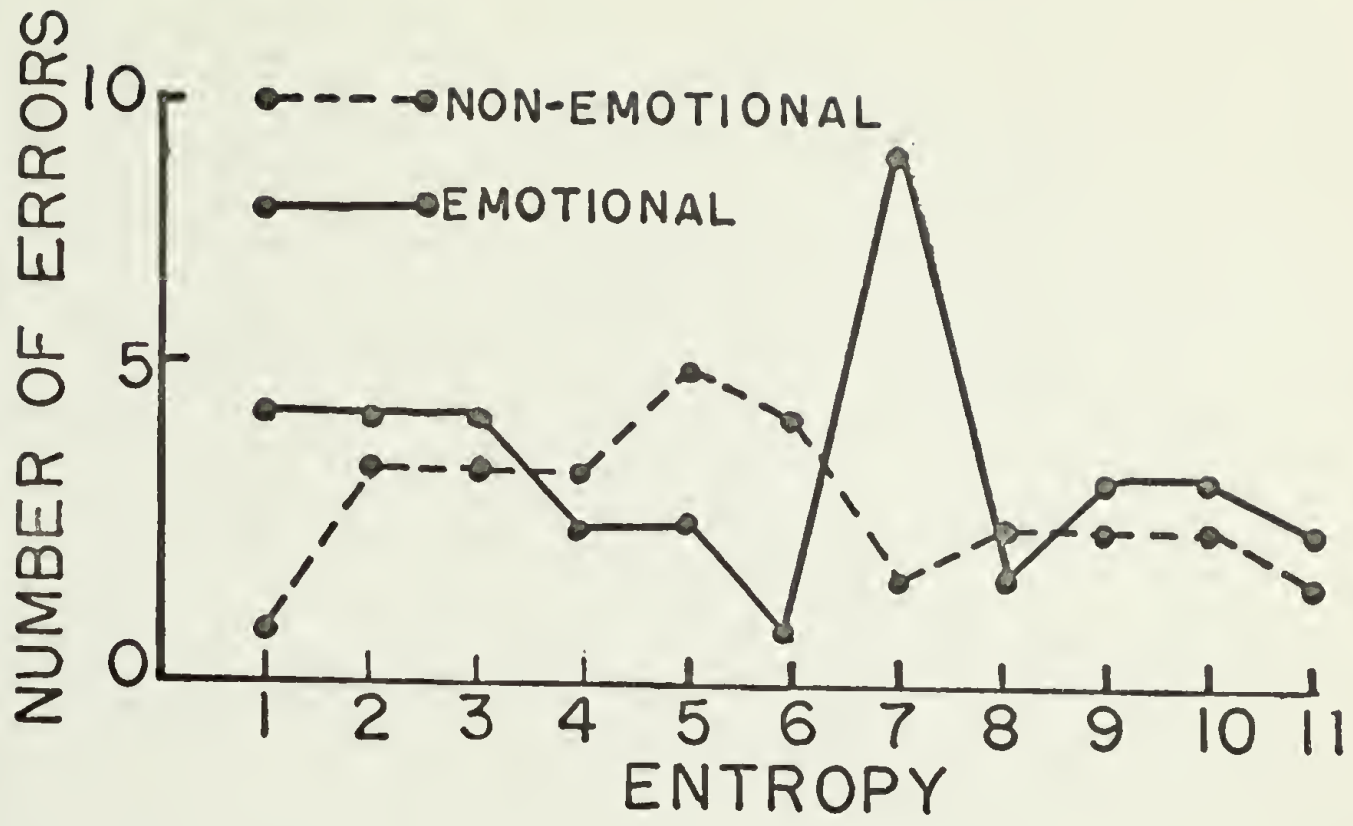

Fig. 6. Mean number of response faults of repetition as a function of the emotionality by entropy interaction.

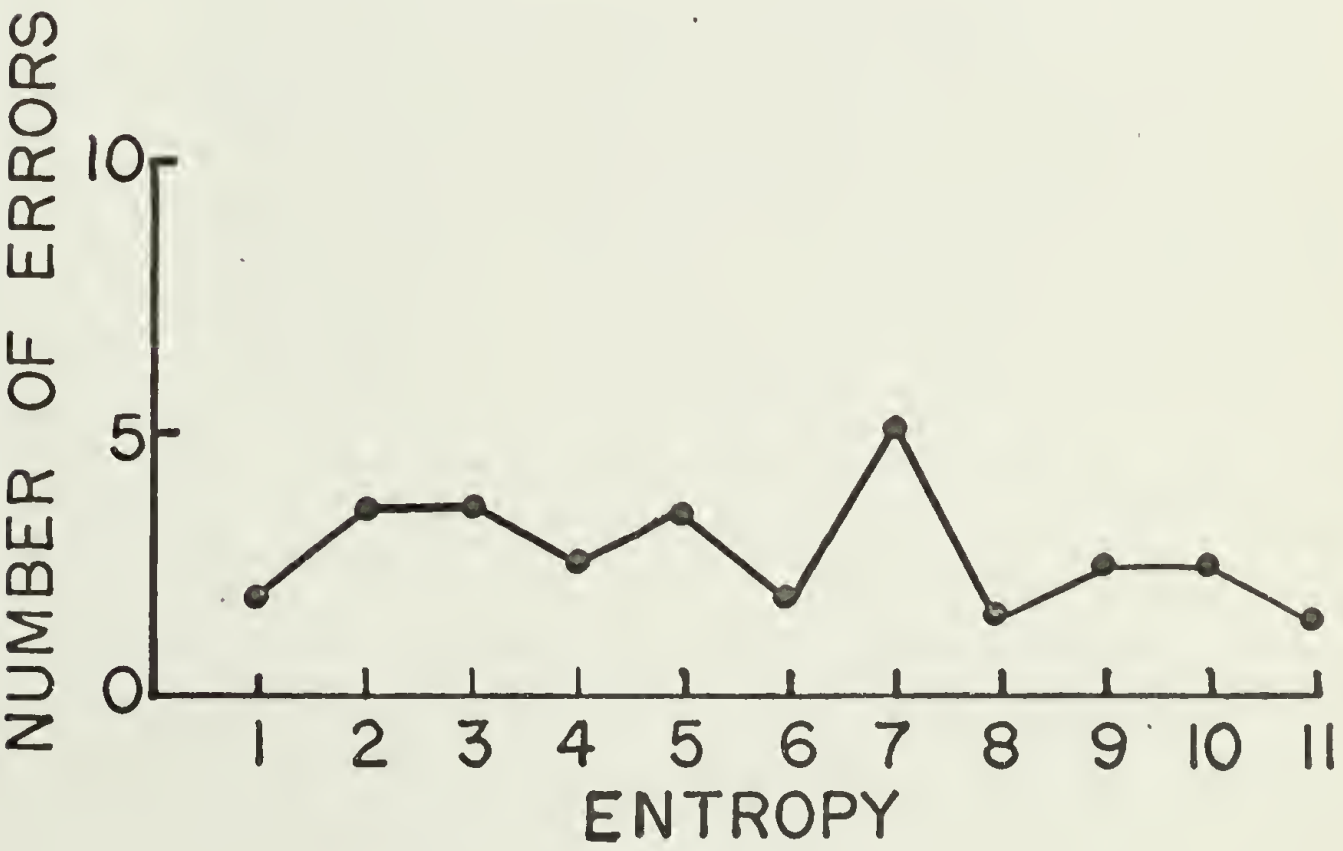

Fig. 7. Mean number of response faults of repetition as a function of entropy.

significant level.

Largely because of the empirical findings of Brody (1964), but also because of the theoretical concepts of Hull, it was generally hypothesized that the division of subjects into groups at different levels of anxiety on the basis of a short form of the Taylor Manifest Anxiety Scale would be associated with significantly different performances on the dependent measures of reaction time, the galvanic skin response and response faults of repetition.

It was predicted in hypothesis (IVa) that reaction time would vary as a function of the usual state of the individual and hence that reaction time in the present investigation would vary as a function of the level of anxiety of the subjects. Inspection of the analysis of variance table for the reaction time measure on the first trial when subjects have been grouped on the basis of anxiety scores indicates that the Between Subjects variable of anxiety level is not significant, hence failing to confirm hypothesis (IVa). Although there is no analysis of variance table for the reaction time measure over all four trials involving the division into anxiety groups, and hence no way of testing hypothesis (IVa) over trials, such an analysis of variance was carried out with the untransformed data and the anxiety variable was not significant.

Hypothesis (IVb) predicted a significant interaction between the variables of anxiety group and entropy on the reaction time measure. Inspection of the analysis of

variance in Table 2, however, indicates that this predicted interaction was not significant, and hence hypothesis (IVb) was not confirmed.

It was predicted in hypothesis (IVc) that the galvanic skin response would vary as a function of the division of subjects into anxiety groups such that high anxious subjects would show greater skin responsivity than low anxious subjects. Inspection of the analyses of variance tables for the galvanic skin response on the first and over two trials for the Mixed design analyses, Tables 8 and 10, indicates that the Between Subjects variable of anxiety level was not associated with differences in skin reactivity on either the first or over two trials. Hence hypothesis (IVc) was not confirmed.

The final dependent measure which was anticipated to vary as a function of anxiety level was that of response faults of repetition. Hypothesis (IVd) predicted that response faults of repetition would vary such that high anxious subjects would make more response faults of repetition than low anxious subjects.

When an analysis was carried out for response faults of repetition as a function of the different levels of anxiety, no significant differences between the groups were obtained. Thus hypothesis (IVd) was not confirmed.

Although no hypothesis in the present investigation was specifically relevant to Appelbaum's suggestion that successive trials on the word association test would yield more

idiosyncratic responses from subjects, an attempt was made to evaluate the validity of Appelbaum's contention in the present data.

It was felt that the greater number of different associations that were given by the twenty-two subjects on each trial, the greater would be the likelihood that these responses would be idiosyncratic and thus more revealing of the individuals who had given them. To investigate this, a test was run on the number of associations which were given on the first and second trials. Since the data may not have withstood the assumptions of parametric tests, the Sign Test (Siegel, 1956) was used. According to this test, the probability of occurrence of the obtained result was 0.001 on the basis of chance. The average number of different associations per word given by all the subjects on the first trial was 9.0, while the average number of different associations per word given by all the subjects on the second trial was 16.13. The average number of different associations on the third trial was 18.68 and on the fourth trial 18.76.

DISCUSSION

Relation of Results to Hullian Theory

On the basis of the present investigation, it appears that reaction time on the word association test is a function of several variables. Reaction time seems to reflect partially the emotional value of the particular stimulus word, the form of the response hierarchy of this word, or in other words its entropy value, and the interaction between the word's emotional value and its response hierarchy form.

On the first trial of a multiple free association test, which would be comparable to the traditional word association test, emotional words produce longer reaction times than non-emotional words, and also, reaction time increases with increasing entropy value, or in other words, as the response hierarchy becomes less steep.

There is also an interaction between the emotionality of the stimulus word and its entropy value such that at the lower and higher levels of entropy, emotional words yield longer reaction times than non-emotional words, while at the intermediate levels of entropy, non-emotional words yield longer reaction times than emotional words. Inspection of the emotionality by entropy interaction, which is plotted for the first trial in Figure 1 and for all four trials in Figure 2, indicates that emotional and non-emotional words yield clearly different reaction times at upper and lower values of the entropy variable on the first trial, but there

is no systematic difference between emotional and non-emotional words at the intermediate levels of entropy on the first trial. Over all four trials the results became clearer for all levels of entropy. Thus emotional words yield longer reaction times at the upper and lower levels of entropy over all four trials, while non-emotional words yield longer reaction times for intermediate levels of entropy over all four trials.

The Hullian theoretical position seems to fit with some, but not all, of this data. The finding which is most congruent with Hullian theory is that reaction time varied as a function of entropy -- the form of the response hierarchy of a stimulus word. This indicates that where a stimulus is associated with one response, that response may be evoked rapidly and easily. Where a stimulus is associated with several competing responses, it takes longer for one of the responses to be evoked.

A second finding of the present investigation which is congruent with Hullian theoretical formulations is that the trials variable was associated with a linearly increasing reaction time. According to the Hullian view, successive responses in a response hierarchy would be less strongly associated with the original stimulus word and hence, requiring the subject to develop a different association on each of several trials would require him to find words less and less strongly associated to the stimulus word, thus requiring his reaction time to increase. The linear increase in

reaction time as a function of trials indicates that it took subjects longer to produce a different response on each of four trials.

It appears that the other findings in the present investigation offer refutation of the Hullian position. First of all, emotional words yielded longer reaction times than non-emotional words. According to Hullian theory, the drive factor which is introduced by emotional stimulus words should combine with the response words to these stimulus words in a multiplicative fashion. This would mean that the effective reaction potentials of emotional stimulus words would be higher than the effective reaction potentials of non-emotional words. This would lead to the prediction that emotional words would yield shorter reaction times than non-emotional words. Since the present findings were the opposite of the Hullian prediction, they offer a refutation of it.

A further contradiction of the Hullian formulation is seen in the fact that in the emotionality by entropy interaction, the emotional words have clearly longer reaction times than the non-emotional words at <u>both</u> extremes of the entropy variable. The Hullian view would predict that the most extreme differences between emotional and non-emotional words should be at the lowest entropy values, and that even here, emotional words should yield shorter reaction times. At the lower levels of the entropy variable, where the words have already steep hierarchies, the introduction of the

drive factor of emotionality would steepen the hierarchy of the emotional word over that of the non-emotional word to a much greater degree than would be the case if both hierarchies were initially shallow, as is the case with high entropy words. Hence the Hullian prediction would be that with low entropy words, the effective reaction potentials of the responses to the emotional words would be increased and thus the emotional words would be expected to yield shorter reaction times than the non-emotional words. The finding of the present study -- that at <u>both</u> extremes of the entropy variable, emotional words yield longer reaction times than non-emotional words -- contradicts the Hullian position.

Although there was a significant entropy by trials interaction in the present study, inspection of the plotted means of this interaction indicates that reaction time across trials did not vary meaningfully as a function of entropy level (Figure 3). According to Hull, words with shallow response hierarchies should permit easier access to new associations on successive trials than words with steep hierarchies. Hence reaction times for different entropy levels plotted across trials should show an increase in reaction time for low entropy words and little or no increase in reaction time for high entropy words.

Inspection of the entropy by trials interaction means, plotted in Figure 3, does suggest a partial support of Hullian theory. Thus at the lower entropy values, the differences between the first trial means and the means on later

trials is considerable, implying a significant lengthening of reaction time across trials for low entropy words, and thus supporting the Hullian view. At the upper levels of entropy, the increase in reaction time as a function of the trials variable seems to be more gradual. However, since the Hullian view would have predicted little, if any, increase in reaction time over trials at the upper entropy values, the present investigation offers partial support and partial refutation of the Hullian viewpoint.

Inspection of the analyses of variance tables for the galvanic skin response on the first trial (Table 7) and over two trials (Table 9) indicates that the galvanic skin response measure somewhat resembles the reaction time measure as a function of the variables of emotionality and entropy.

The primary reason for employing the galvanic skin response as a dependent measure was to provide some operational distinction between the emotional and non-emotional words used in this investigation. The fact that the galvanic skin response did vary as a function of pre-defined emotional and non-emotional words seems to support the Hullian position. This is so in that it was assumed that the presentation of emotional words to the subject essentially caused an increase in the drive or activational state of his organism. The greater galvanic skin responsivity to emotional words than to non-emotional words suggests that this is so.

The fact that the galvanic skin response only showed significant variation as a function of the entropy variable

in the analysis over two trials, and did not vary signifi-cantly at all as a function of the entropy by emotionality interactions, seems to fit with the somewhat equivocal findings reported by other authors in investigations of the relationship between reaction time and the galvanic skin response. Thus Hathaway (1929) reported a +.60 correlation between the two measures. Hunt and Landis (1935), on the other hand, although also obtaining a positive correlation between the two measures, concluded that there is only a tendency for large galvanic deflections to accompany long reaction times. Finally, Crosland (1931), in an investigation of the galvanic skin response as a function of words presented in different sensory modes, reported practically no correlation at all between reaction time and the galvanic skin response.

Thus it appears that the relationship between reaction time and the galvanic skin response is not a perfectly clear one. It is possible that reaction time reflects the interference with adequate functioning which may be brought about by disturbing stimuli, whereas the galvanic skin response reflects the activation which is an accompaniment of the reaction to disturbing situations. This formulation has been similarly expressed by Epstein and Fenz (1962), who suggested that the galvanic skin response, according to their model, was a measure of activation, while reaction time on the word association test was a measure of the adequacy of performance.

Thus it seems possible that reaction time and the galvanic skin response both reflect some central state of the organism, and that because they reflect this same underlying response state, they are somewhat similar. The fact, though, that they represent measures of different aspects of this same reaction may account for the lack of absolute agreement in their manifestations.

Inspection of the galvanic skin response means over two trials (Figure 4) indicates that, with one exception, the mean galvanic skin response changes seem to increase linearly with increasing entropy. This finding offers support of the Hullian view inasmuch as the galvanic skin response, as a measure of activation, shows an increase where the subject must expend greater effort, as is the case where he was trying to select one response out of several with approximately equal associative strengths.

The present investigation found that response faults of repetition were more frequent for emotional words at lower and upper levels of the entropy variable and were more frequent for non-emotional words at intermediate levels of the entropy variable. By comparing the graphed response faults of repetition (Figure 5) with the plotted reaction speeds for emotional and non-emotional words as a function of entropy (Figures 1 and 2), it can be seen that emotional words at the extremes of the entropy variable are associated with both lengthened reaction time and more response faulting.

The present results fit only partially within the

framework of Hullian theory. This is so in that the Hullian prediction would be that the drive factor introduced by emotional stimulus words would be expected to steepen these words' response hierarchies, and thus reduce the number of different associations available to the subject, and would also make the effective reaction potential of the most salient response even greater than its entropy value would indicate. This would lead to the prediction that on successive trials, the originally given response would occur to the subject again, and that other associations would not occur easily; hence it would be anticipated that emotional words would be faulted more frequently than non-emotional words. And this was found to be true at both extremes of the entropy variable. However, the Hullian prediction would be that the steepening of response hierarchy and the consequent response faulting would be most evident on low entropy words, and that the least steepening, and hence the fewest faults of repetition, would be on the high entropy words. Since there is a tendency for emotional words to be faulted more frequently than non-emotional words at the upper levels of entropy as well as at the lower levels, it can be seen that the findings of this investigation do not completely support the Hullian position. Rather, as in Laffal's study, the response fault and reaction time data parallel each other.

The fact that there was no significant difference in the number of response faults of repetition for emotional

versus non-emotional words suggests that the psychoanalytic view may have something to offer with respect to interpretation of the content aspect of the word association test -- that is, in word association, emotional upset which is caused by particular words may lead to other kinds of breakdown in functioning than a stereotyping of response. Hence responses to traumatic or emotional words in word association may be deviant in terms of some other criterion; they may be clang associations or personal responses to the original stimulus word.

It had been anticipated that the dependent measures of reaction time, the galvanic skin response and response faults of repetition in the present investigation would vary significantly if the subjects were divided into groups at different levels of anxiety.

Inspection of the analyses of variance tables, however, indicates that neither the variable of anxiety level itself nor any of the interactions of the Within Subjects variables with the anxiety variable were found significant in this study.

The fact that the anxiety variable was not associated with significant differences in the data seemed to be a function of the variability of performance of the subjects within each of the different anxiety groups. This brings into question precisely what, and how validly, the scale employed was measuring. One of the most logical considerations for the apparent lack of consistency in performance of

individuals in the different anxiety groups is in the fact that the subjects were given the anxiety scale after they had completed the experiment. That is, after the subject had been run through four trials of word association in the experimental room, he was permitted to go outside, wash the electrode paste off his hands, and was then given the anxiety scale to fill out. Under such circumstances, it is quite possible that there might be some distortion in the responses given by the subjects from those that they might ordinarily give.

Another possibility is that the manifest anxiety scale which was employed tends to divide subjects not in terms of their anxiety level as much as it divides them in terms of the defenses they utilize. Thus individuals who score high on the test are anxious and are highly sensitized to their own discomfort, or are willing to report their anxiety. Individuals who score extremely low on the test, however, may be quite anxious also, but they either use denial heavily, or they are reluctant to report feelings of subjective discomfort. Thus it may be that high and low anxious groups are actually equally anxious but contain individuals who use different defensive styles. In the present investigation it can be conjectured that the group of subjects who manifested moderate anxiety was too small to permit statistically significant differences to be obtained between itself and the other two groups which may actually have been homogeneous.

Alternative approaches to the investigation of two of

the present measures -- reaction time and response faults -- might involve the selection and definition of Between Subjects groups on the basis of galvanic skin responsivity instead of on the basis of a self-report paper and pencil test. An approach which would permit some clarification of the operation of paper and pencil tests would be a procedure whereby some subjects took the test prior to the experiment proper and other subjects took the test after the experiment proper. Analysis could then observe whether or not there are changes in the significance of the Between Subjects variable as a function of when the measurement of anxiety level was obtained, before or after the experiment proper.

Implications for Clinical Applications

The overall implications of this research with respect to reaction time on the word association test are the necessity of considering both emotionality and entropy of stimulus words, as well as their interaction, in evaluating reaction time performance on the word association test.

It would seem advisable for lists of words that are to be used in clinical practice or diagnostic testing to be constructed with the knowledge of the stimulus word's entropy and emotional values. By sampling either emotional or non-emotional words, at either high or low entropy values, the clinician would be able to obtain more information regarding the client's functioning with respect to a normative frame of reference. Different interpretations or different hypotheses for further testing might be generated depending

upon the actual reaction time as compared with the reaction time which would be expected on the basis of particular words' entropy and emotionality values.

It should be mentioned that the content of a client's word associations is probably the most valuable source of information relevant to the decisions the clinician may be making, and that reaction time, alone or in conjunction with the response word content, should be considered no more than an ancillary source of data. However the clinician might wish to use the more structural aspects of the word association test, such as simply noting reaction time length and response faults of repetition or non-repetition, it would seem that a more precise information could be obtained by the clinician's being aware of the entropy and emotionality values of his stimulus words and of the way in which reaction time and response content may vary as a function of these factors and their interaction.

With respect to response faults per se, the fact that there was no significant difference in the number of response faults of repetition for emotional versus non-emotional words in the present study suggests that the psychoanalytic view may have something to offer with respect to interpretation of the content aspect of the word association test -- that is, more information may be obtained by interpreting the <u>actual</u> content of the subject's response word on this test than by simply noting whether it is an error or repetition or non-repetition. Thus the clinician may draw

inferences about conflicted areas in the subject's personality by some qualitative analysis of the subject's responses to various stimulus words.

It would seem that the decision to require the subject to repeat his first given responses or to develop new responses would depend upon the number of trials to be employed by the clinician. If one is to use only two trials, it would seem wise to require the subject to give the same responses he gave originally, and the clinician can drew tentative inferences about the subject's areas of conflict, depending upon the emotionality and entropy values of the words the subject has made response faults on. According to the ancillary findings in the present investigation -- that the number of different associations to a stimulus word tends to increase as a function of trials -- it appears that having the subject give a different association to the same stimulus word on each of several trials does elicit more personal and idiosyncratic responses, as Appelbaum (1960) suggested. Thus, if several trials are to be used, it would seem wiser to require the subject to continue giving different associations on each trial. In this latter case, the subject's inability to give a new response -- i.e. his making a response fault of repetition -- would be indicative of possible conflict in regard to that stimulus word; but also, as the subject is able to give different responses to the original stimulus word, more information can be obtained regarding the subject's attitudes and feelings about the word.

To derive the greatest benefit from the word association test in clinical usage, it would seem advantageous to present a list of words to the subject several times, as Appelbaum has suggested. The list should contain both emotional and non-emotional words, with either high or low entropy values, either touching on the major areas of conflict, or constructed to focus on particular conflicts. By presenting the list several times with the instructions that the subject give a different response on each exposure of the stimulus word than he has formerly given to it, one could both estimate his conflicts and obtain information regarding his attitudes and more distant associations to the stimulus word, which would permit formulation of long-range therapeutic direction or focus.

SUMMARY

Twenty-two male volunteer undergraduate students at the University of Massachusetts were used as subjects to investigate reaction time, the galvanic skin response and response faults of repetition as a function of the variables of emotionality, entropy and trials, as well as the anxiety level of the subjects.

The main purpose of the investigation was to note whether or not the crucial variable in determining reaction time length on the word association test was the form of the stimulus word's response hierarchy or its emotionality. Essentially, then, the investigation attempted to evaluate the import of the variables of emotionality, entropy and their interaction on reaction time. The galvanic skin response was recorded on the first two of the four trials of the experiment, in order to provide some operational statement of the emotional value of the stimulus words.

Predictions and hypotheses were generated from the theoretical view of Hull and from the empirical findings of Laffal and Brody.

Twenty-two words were presented to each subject in a different order on each of four trials. The orders of word presentation were determined by using one row and one column of a 22 x 22 Latin Square and then using the obverse of each of the row and column orders. The twenty-two stimulus words sampled eleven levels of entropy and each level of entropy

contained one emotional and one non-emotional word.

The subject's reaction times and verbal responses were recorded over all four trials and his galvanic skin responses were recorded on the first two trials.

In the reaction time analyses, on the first trial, emotionality, entropy and the emotionality by entropy interaction were all significant. These same sources of variance were significant when the analysis was carried out over all four trials. As well, the trials variable and the entropy by trials interaction were also significant. However, in none of the analyses was the Between Subjects variable of anxiety level significant.

In the galvanic skin response analyses, on the first trial, only the emotionality variable was significant. This was the most important confirmation, since the galvanic skin response was used as a second dependent measure primarily to provide an operational statement of the emotionality of the words employed. In the analysis over two trials, both emotionality and entropy were significant. Neither the trials variable nor the Between Subjects variable of anxiety level attained significance on the galvanic skin response analyses.

Finally, the number of response faults of repetition made by the subjects was investigated with non-parametric statistics. There seemed to be an interaction in the data such that emotional words at lower and upper entropy values were faulted more frequently than non-emotional words, while non-emotional words showed a tendency to be faulted more in

the middle entropy values than emotional words. Essentially, then, there was a parallel between response faulting and reaction time such that longer reaction times were associated with greater response faulting. There was no difference between the number of response faults made for emotional and non-emotional words.

The results of the present investigation were discussed in terms of the theoretical framework of Hullian theory. General conclusions were drawn which were relevant to the theoretical aspects of the word association test, and also implications for the clinical usage of the test were set forth.

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APPENDIX A

Stimulus Words Used in the Present Experiment

Emotional Words	Entropy Value	Entropy Level	Entropy Value	Non-emotional Words
Threat	5.37	High 11	5.50	Working
Spit	4.93	10	4.96	Forth
Disgust	4.55	9	4.44	Cabbage
Insane	3.91	8	3.74	Window
Punch	3.50	7	3.50	Muddy
Suicide	3.24	6	3.26	Ink
Virgin	3.15	5	3.07	Squeak
Thigh	2.33	4	2.46	Quart
Scissors	2.12	3	2.04	Orchestra
Shove	0.93	2	1.00	Table
Rip	0.62	Low 1	0.80	Garage
Mean	3.14		3.16	Mean
SD	1.46		1.44	SD

APPENDIX B

Development of the Anxiety Scale Used in the Present Study

The anxiety scale used in the present investigation was obtained by personal communication with Mr. Gordon Gerrish (1964), who developed the scale for use in his doctoral research.

The items on the scale were all taken from the original Taylor Manifest Anxiety Scale (1951) and the revised Taylor Scale (1953). However, the actual items used in the scale constructed by Mr. Gerrish were selected on the basis of several validation studies of the items on the Manifest Anxiety Scale.

The first study relevant to the validation of the Taylor Scale was by Hoyt and Magoon (1954). These authors had eight experienced psychological counselors select from lists of clients they had seen those they felt they knew well enough to rate on degree of manifest anxiety. On the basis of the counselor's ratings, the clients were assigned to one of three groups -- Low, Medium or High Anxiety. The subjects in the study were those students in the counselor's groups who had recently taken the Minnesota Multiphasic Personality Inventory.

Examination of the subjects' MAS scores indicated that for all the counselors, the mean MAS scores for the individuals whom they had judged High Anxious were higher than the

mean MAS scores for individuals judged as Medium or Low Anxious. For six of the eight counselors, the Medium Anxiety group individuals had mean MAS scores falling between those of the High and Low Anxiety groups.

Significant differences between the mean MAS scores were obtained between the High and Low Anxiety groups and between the High and Medium Anxiety groups, but not between the Medium and Low Anxiety groups.

The authors also noted which of the 50 Taylor Scale items were answered in the keyed direction by individuals in the High and Low Anxiety groups, in an attempt to see which of the Taylor items were functioning to discriminate between high and low anxious individuals in their sample. In order to reduce error variability and to obtain a reliable estimate of the discrimination value of each of the items, the authors divided their total sample of High and Low Anxious subjects into two groups of High Anxious and two groups of Low Anxious individuals. They then reported their findings in terms of whether a particular item was responded to differently in one or the other sample, in both samples or in neither sample.

On the basis of their item analysis, Hoyt and Magoon obtained approximately 30 of the original 50 Taylor Scale items which they felt validly discriminated High from Low Anxious individuals in their sample.

In another study, Buss (1955) attempted to extend Hoyt and Magoon's findings to a patient population.

In Buss's investigation, four psychologists rated 64 patients by approximately the same criteria of manifest anxiety as those employed by Hoyt and Magoon. The group of subjects used showed variability with respect to age, sex and diagnostic category, and Buss felt that these subjects broadly sampled the in-patient population. The subjects were interviewed by one psychologist and observed by three others, then all four psychologists rated the patient.

The interview ratings for the four psychologists for the patients were pooled. The Pearson product moment correlation between these pooled ratings and the Taylor Anxiety Scale was +.60. Hence the author concluded that the Taylor Scale has fair validity for diverse populations.

Buss then carried out an item analysis of the 50 Taylor Scale items. He divided his sample into High, Medium and Low Anxious groups on the basis of the pooled interview ratings, and then noted which MAS items discriminated between the High and Low Anxious groups of individuals.

Of the 16 items Hoyt and Magoon found to be significant in both groups of their divided sample, Buss found only nine items which were significant at the .05 level. Of the 14 items which Hoyt and Magoon found to significantly differentiate High from Low Anxious individuals in one or the other groups of their sample, Buss found only five to be significant in his sample.

The major conclusion drawn by Buss was that while the Taylor Manifest Anxiety Scale was somewhat valid for a

patient population, there was also some reduction in the number of items which were responsible for the discrimination between the two groups of High and Low Anxious subjects.

On the basis of the findings of the above investigations -- namely, that the majority of the 50 Taylor Manifest Anxiety Scale items lack validity -- Bendig (1956) suggested that a shortened form of the MAS, retaining only the valid items, might be more useful and clinically valid than the standard MAS.

The 20 most consistently valid items in the reports of Hoyt and Magoon and Buss were selected as a shortened form of the MAS. The 50 item MAS was administered to 744 college students and the papers were scored for the 20 item scale. The 20 item scale -- without the 30 nonvalid items -- was administered to 324 additional subjects. No significant differences were found for the scale means or standard deviations for the two methods of administration, nor were any sex differences evident. The median internal consistency of the MAS shows its reliability to be .82, while the similar reliability for the 20 item scale was .76. For 100 randomly selected subjects, who had taken the 50 item form of the MAS, scores were obtained: a) on all 50 items; b) on the 20 valid items; c) on the 30 nonvalid items. The reliabilities of the three scores were: a) .78; b) .76, and c) .48.

Bendig concluded that the 20 item version of the MAS: a) has eliminated from the standard MAS items of low internal consistency and validity; b) provides scores that are about

as reliable as the 50 item MAS and are highly related to scores on the standard form, and c) is more parsimonious of testing time and probably more valid than the longer MAS.

The scale which was constructed by Mr. Gerrish, and which was used in the present investigation as well, was the short version MAS devised by Bendig with filler items selected from the MMPI. The entire 45 item scale is presented in Appendix C, under the title of Biographical Inventory. The items which were found significant in the Hoyt and Magoon study have a single asterisk next to them, and the items that were found significant in both Hoyt and Magoon's study and in the Buss investigation are marked with two asterisks.

APPENDIX C

Biographical Inventory

1. I would rather win than lose in a game.
2. I am often the last one to give up trying to do a thing.
*3. I believe I am no more nervous than most others.
**4. I work under a great deal of pressure.
5. My hearing is apparently as good as that of most people.
**6. I cannot keep my mind on one thing.
7. I am against giving money to beggars.
*8. I am more sensitive than most other people.
**9. I frequently find myself worrying about something.
10. I am in as good physical health as most of my friends.
**11. I am usually calm and not easily upset.
12. At times I feel like smashing things.
13. I like a great deal of variety in my work.
*14. I feel anxiety about something or someone almost all the time.
*15. I am happy most of the time.
**16. I have periods of such great restlessness that I cannot sit long in a chair.
17. At times I feel like swearing.
*18. I have sometimes felt that difficulties were piling up so high that I could not overcome them.

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* Items which were significant in the Hoyt and Magoon study.
** Items which were significant in both the Hoyt and Magoon and the Buss studies.

19. I have difficulty in starting to do things.

20. Often I can't understand why I have been so cross and grouchy.

**21. I find it hard to keep my mind on a task or job.

**22. I am not usually self-conscious.

23. Once in a while I laugh at a dirty joke.

*24. I am inclined to take things hard.

25. I certainly have had more than my share of things to worry about.

**26. Life is a strain for me much of the time.

27. I practically never blush.

28. I like to visit places where I have never been before.

*29. At times I think I am no good at all.

30. I do not tire quickly.

*31. I am certainly lacking in self-confidence.

32. It makes me nervous to have to wait.

**33. I am a high-strung person.

34. Any man who is able and willing to work hard has a good chance of succeeding.

35. I am always careful about my manner of dress.

**36. I certainly feel useless at times.

37. I have taken a good many courses on the spur of the moment.

38. Sometimes at elections I vote for men about whom I know very little.

**39. I shrink from facing a crisis or difficulty.

40. I enjoy children.

**41. I sometimes feel that I am about to go to pieces.

42. I hardly ever notice my heart pounding and I am seldom short of breath.

43. I have a study and work schedule which I follow carefully.

44. I do not always tell the truth.

45. I have nightmares every few nights.

APPENDIX D

Analysis of Variance Tables for the Present Experiment

Table A1

Completely Within Subjects

Analysis of Variance on the First Trial

(RT and GSR)

Source	df	Numerical df
Between Ss	(n-1)	21
Within Ss	n(ab-1)	462
Emotionality (Emo)	(a-1)	1
Emo x Se	(a-1)(n-1)	21
Entropy (Ent)	(b-1)	10
Ent x Ss	(b-1)(n-1)	210
Emo x Ent	(a-1)(b-1)	10
Emo x Ent x Ss	(a-1)(b-1)(n-1)	210
Total	(abn-1)	483

Table A2

Mixed

Analysis of Variance on the First Trial

(RT and GSR)

Source	df	Numerical df
Between Ss	(n-1)	21
Anxiety (A)	(a-1)	2
Ss/A	a(n-1)	19
Within Ss	n(ab-1)	462
Emotionality (Emo)	(e-1)	1
Emo x Ss	(e-1)(n-1)	21
Entropy (Ent)	(b-1)	10
Ent x Ss	(b-1)(n-1)	210
Emo x Ent	(a-1)(b-1)	10
Emo x Ent x Ss	(a-1)(b-1)(n-1)	210
Total	(abdn-1)	483

Table A3

Completely Within Subjects

Analysis of Variance Over Four Trials

(BT)

Source	df	Numerical df
Between Ss	(n-1)	21
Within Ss	n(abc-1)	1914
Emotionality (Emo)	(a-1)	1
Emo x Ss	(a-1)(n-1)	21
Entropy (Ent)	(b-1)	10
Ent x Ss	(b-1)(n-1)	210
Trials (T)	(c-1)	3
T x Ss	(c-1)(n-1)	63
Emo x Ent	(a-1)(b-1)	10
Emo x Ent x Ss	(a-1)(b-1)(n-1)	210
Emo x T	(a-1)(c-1)	3
Emo x T x Ss	(a-1)(c-1)(n-1)	63
Ent x T	(b-1)(c-1)	30
Ent x T x Ss	(b-1)(c-1)(n-1)	630
Emo x Ent x T	(a-1)(b-1)(c-1)	30
Emo x Ent x T x Ss	(a-1)(b-1)(c-1)(n-1)	630
Total	(nabc-1)	1935

Table A4

Mixed

Analysis of Variance Over Two Trials

(GSR)

Source	df	Numerical df
Between Ss	(n-1)	21
Anxiety (A)	(d-1)	2
Ss/A	d(n-1)	19
Within Ss	n(abc-1)	946
Emotionality (Emo)	(a-1)	1
Emo x A	(a-1)(d-1)	2
Emo x Ss/A	(a-1)(n-1)/d	19
Entropy (Ent)	(b-1)	10
Ent x A	(b-1)(d-1)	10
Ent x Ss/A	(b-1)(n-1)/d	190
Trials (T)	(c-1)	1
T x A	(c-1)(d-1)	2
T x Ss/A	(c-1)(n-1)/d	19
Emo x Ent	(a-1)(b-1)	10
Emo x Ent x A	(a-1)(b-1)(d-1)	10
Emo x Ent x Ss/A	(a-1)(b-1)(n-1)/d	190
Emo x T	(a-1)(c-1)	1
Emo x T x A	(a-1)(c-1)(d-1)	2
Emo x T x Ss/A	(a-1)(c-1)(n-1)/d	19
Ent x T	(b-1)(c-1)	10
Ent x T x A	(b-1)(c-1)(d-1)	20
Ent x T x Ss/A	(b-1)(c-1)(n-1)/d	190
Emo x Ent x T	(a-1)(b-1)(c-1)	10
Emo x Ent x T x A	(a-1)(b-1)(c-1)(d-1)	20
Emo x Ent x T x Ss/A	(a-1)(b-1)(c-1)(n-1)/d	190
Total	(abcdn-1)	967

Table A5

Completely Within Subjects

Analysis of Variance Over Two Trials

(GSR)

Source	df	Numerical df
Between Ss	(n-1)	21
Within Ss	n(abc-1)	946
Emotionality (Emo)	(a-1)	1
Emo x Ss	(a-1)(n-1)	21
Entropy (Ent)	(b-1)	10
Ent x Ss	(b-1)(n-1)	210
Trials (T)	(c-1)	2
T x Ss	(c-1)(n-1)	21
Emo x Ent	(a-1)(b-1)	10
Emo x Ent x Ss	(a-1)(b-1)(n-1)	210
Emo x T	(a-1)(c-1)	1
Emo x T x Ss	(a-1)(c-1)(n-1)	21
Ent x T	(b-1)(c-1)	10
Ent x T x Ss	(b-1)(c-1)(n-1)	210
Emo x Ent x T	(a-1)(b-1)(c-1)	10
Emo x Ent x T x Ss	(a-1)(b-1)(c-1)(n-1)	210
Total	(abcn-1)	967

Approved by:

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