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An investigation of perceptual defence with controls for response-bias factors.

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AN INVESTIGATION OF PERCEPTUAL DEFENSE WITH CONTROLS FOR RESPONSE-BIAS FACTORS

by

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Abstract

The research reported here made use of an experimental design which enables one to distinguish between the effects of perceptual defense (which has been defined by Dixon as an unconscious discrimination of stimuli) and of response bias (defined by Ruiz and Krauss as the reluctance of a subject to verbalize his perception and recognition of emotion-arousing stimuli, even though he perceives and recognizes them as readily as he does non-emotive stimuli. The design allows for this distinction by comparing the detection and recognition thresholds for a list of words, for experimental subjects who are conditioned to be more anxious about these words, and control subjects who are not so conditioned. The 15 experimental subjects saw a disturbing motion picture in which the 9 critical words were prominently used; the 15 control subjects saw another, innocuous film, which did not have the critical words in it.

Experimental and control subjects--assigned to these groups randomly--first saw the appropriate film. Then they were tested, tachistoscopically, to determine the exposure-time required to detect that there was a

word on the screen, and to recognize correctly the word that was exposed. The 9 critical words that had occurred in the stressful film, and 9 neutral words (matched with the critical words for length, initial letter, and frequency of occurrence) that had not occurred in the film, were used. While the subjects were engaged in this tachistoscopic task, _E_ continuously measured their skin conductance, noting momentary, sharp rises in conductance (GSR's) within 5 sec. before or after their detection or recognition of a word.

The experimental subjects were slower to detect the critical words than the neutral words ($p < .005$); the control subjects were not. Both experimental and control subjects tended to recognize critical words more quickly than neutral words; this was significant for the experimental subjects ($p < .005$), but not for the control subjects. Experimental subjects had more GSR's for critical words than for neutral words at recognition level ($p < .005$); there was no significant difference at detection level.

It is concluded that the finding of slower detection of critical words by experimental subjects, is consistent with the hypothesis of perceptual defense;

it would not be predicted by the response-bias hypothesis. There is ambiguous evidence for a sensitization effect at recognition level.

Preface

This thesis was prepared under the direction of Dr. F. Auld, Professor of psychology at the University of Windsor. My first thoughts of appreciation go to Dr. Auld who generously donated a great deal of his time offering proposals and suggestions and guidance during the course of this research. I also wish to thank Dr. V. D. Cervin of the psychology department, and Fr. C. Vincent of the department of sociology and anthropology for their valuable suggestions and encouragement.

I would also like to express my sincere thanks to my wife for her assistance, patience and understanding in the couse of this research. Finally words of appreciation must be extended to all those subjects who kindly participated in the study.

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"Few findings in Psychology have generated more heat than the discovery that recognition thresholds depend upon the emotional connotation of that which is recognized" (Dixon, 1971, p. 179).

A generally accepted notion among psychologists today is that the relative ease or difficulty that one experiences in recognizing something depends upon the significance of the thing to the viewer. In other words, there is some type of selective process whereby we are consciously aware of some stimuli but unaware of other stimuli of equal presentation strength. The need to explain this selective process has stimulated much research and has led to much controversy; the explanation of the process is to this day a contentious, unsettled issue.

The proposition that stimuli can be registered by a person, without his being consciously aware of them is fundamental to this investigation. The phenomenon of registration without awareness has been experimentally demonstrated on many occasions. One of the earlier studies favouring this hypothesis was conducted by Lazarus and McCleary in 1951. In their paper (p.14) they coined the term "subception" and described it as a "process by which some kind of discrimination is made when the subject is unable to make a correct conscious discrimination".

In the present study one aspect of subception or subliminal perception was investigated. Using anxiety-provoking stimuli the E attempted to determine whether the selective process exhibited in subception occurs at the level of perception or of screening stimuli from awareness, or whether it is related to a process of selective verbalization. To be more specific, an attempt was made to determine whether the much-demonstrated selective process is the result of perceptual defense and blocking, or whether it is related to subsequent selective verbalization and response bias.

The concept of perceptual defense has a rather short history dating back to an experiment conducted by Bruner and Postman in 1947. Results from this initial investigation indicated that neutral words were recognized at significantly lower thresholds than were taboo or socially unacceptable words. The process responsible for this occurrence was labelled "perceptual defense" and was described as a "blocking of associations as a defense against anxiety-laden stimuli"(p.74). Later Ruiz and Krauss (1968, p.33) described the perceptual defense hypothesis as the belief that taboo words have larger recognition thresholds because some type of selective process is occurring to inhibit recognition of stimuli which are allegedly anxiety-provoking. Stimuli used in the original experiment by Bruner and Postman (1947) were conditioned to be anxiety-provoking by pre-experimental, life experiences. Subsequent investigators have conditioned stimuli to be anxiety-provoking (Lazarus and McCleary, 1951; Blum, 1954; Bootzin and Stephens, 1967).

Although the perceptual-defense hypothesis originated with Bruner and Postman, it is quite obvious that it has a counterpart in psychoanalytic theory. Cable (1969, p.331) defined perceptual defense as an unconscious mechanism of resistance to recognition of threatening stimuli. Thus it is readily see that Freud's defense mechanism, repression, is quite similar; and in fact this concept predates the concept of perceptual defense by a considerable number of years. For example, Freud wrote (1915, p.143): "The essence of repression lies simply in the function of rejecting and keeping something out of consciousness." Kline (1972, p.165) supports this similarity when he states that the raising of perceptual thresholds is simply an example of repression at work. As there does appear to be considerable overlap between the two concepts positive results of perceptual defense could certainly be taken as support for the psychoanalytic concept of repression.

As perceptual defense implies that the perceptual system differentially discriminates stimuli unconsciously on the basis of their emotional connotations, it is suggested that this would necessitate a three-stage sequence of events (Dixon, 1971, p.180):

(a) Registration without awareness.

(b) A preconscious discrimination between emotive and non-emotive stimuli.

(c) As a result of the above-mentioned discrimination, some effect upon recognition thresholds, precognition guesses, and autonomic responses.

The present investigation has taken these hypothesized steps into account in the design of this study.

A related term that is of some significance in any study of perceptual defense--"perceptual sensitization" or "vigilance"-- is in some ways the opposite of perceptual defense. "Perceptual sensitization" is defined as a process whereby the recognition thresholds are lowered for stimuli that are personally relevant to a particular individual. Bruner and Postman (1947) pointed out that "perceptual defense" and "perceptual sensitization" are not really contradictory, but rather that the occurrence of phenomena designated by one or the other of these concepts depends on the degree of emotionality of a particular stimulus. They further suggested that for some <u>S</u>s there is a critical degree of emotionality beyond which perceptual defense does not operate. If this critical stage is exceeded, the dangerous stimuli are met with the utmost alertness and speed.

Like "perceptual defense", the concept "perceptual vigilance" is also related to Psychoanalytic theory. If repressed psychosexual impulses, of which the individual is not aware, are always seeking an outlet, then everyone should at the unconscious level be sensitive to and responsive to cues relevant to these potentially threatening impulses (Blum, 1954, p.94). In effect then, contrary to Bruner and Postman's assertion that the two hypotheses are not contradictory, psychoanalytic theory views them as being opposing tendencies.

A third concept that is quite relevant to our present investigation is that relating to response bias. "Response bias" is defined as "that which occurs as a result of the stimulus activating a conflict which in turn affects the response probabilities" (Garner _et al_., 1956, p.151). Implied in this definition is the hypothesis that the difference in threshold level is the result of a process occurring in the response system, which inhibits the verbalization of emotion-laden words. This concept was initially introduced by Blum in 1955 as experimental findings led him to believe that perceptual defense is a two stage process. During the first stage the subliminal stimuli activate a conflict, while during the second stage this conflict differentially affects the Ss responses. Blum called this formulation the "stimulus-effect hypothesis". Subsequent studies broadened the scope of this hypothesis, and led Goldiamond and Hawkins (1958) to call the resulting new hypothesis the "response-bias phenomenon". This latter hypothesis suggested that taboo and neutral stimuli would be perceived at similar duration exposures but the verbalization of the taboo stimuli would be held back until the S was certain of their identification. This process would result in raised thresholds for taboo words; therefore this hypothesis obviates any need for a perceptual-defense hypothesis. A number of subsequent studies broadened the scope of response-bias still further and demonstrated that it would also occur as a result of previous experience (Goldiamond and Hawkins, 1958), of conflict (Brown, 1961), and of set (Postman, Bronson and Gropper, 1961). A number of investigators have concluded that perceptual defense effects may be due solely to verbal response inhibitions (Goldiamond, 1968; Persinger, 1965; Goldstein, 1962).

An impressive number of investigations have been conducted to increase our knowledge concerning the aforementioned hypotheses. To describe each of these experiments would require volumes. Histories of perceptual defense have been published by Brown (1961) and by Dixon (1971). As one can readily imagine the history of perceptual defense is marked by many controversies and disputed conclusions. Indeed Bootzin and Natsoulis (1965, p.461) observed that the history of perceptual defense "might well be characterized as a collective search for experimental procedures and designs to reveal the workings of perception unconfounded by other variables".

One of the earliest disputes was centred about the "word-frequency hypothesis". In 1949 McGuinnies demonstrated that emotionally-toned words required longer exposure times for recognition than neutral words did. He concluded that motivational forces must be involved in perception. This conclusion was criticized by Howes and Solomon (1950, p.229), who replicated the McGuinnies study. They found that after extracting the effects of the Thorndike-Lorge word count, the thresholds of emotion-laden words were similar to those of neutral words. Cowen and Beier (1954, p.177) supported this latter finding when they demonstrated that previous experience with a stimulus tended to lower the threshold for that stimulus. An extensive study of this subject was conducted by Weiner in 1955. He interpreted his results as demonstrating that in addition to word-frequency, word-meaning --and therefore motivation--is also an important determinant in perceptual behavior. Weiner's interpretation would appear to be generally accepted at this time.

Related to the problem of word-frequency is word-length. McGuinnies <u>et al</u>.,(1952) investigated the effects of word-length by comparing words of similar frequencies but of different lengths. They concluded that word-length is indeed a significant factor in determining recognition thresholds. Brown (1961) qualified this conclusion after performing a similar experiment. He found that word-length only affects thresholds where frequency is itself an important variable. In any event it is now common practice to control word-length in perceptual defense investigations to exclude possible confounding effects.

Still another process that must be considered is that of perceptual set.("Perceptual set" refers to the proposition that if a subject expects a certain type of stimulus, his expectation for this type of stimulus will increase and his recognition threshold for this kind of stimulus will ultimately drop.) This hypothesis was demonstrated by Freeman (1954), and he concluded that factors related to set are important determinants of perceptual thresholds. Subsequent studies have resulted in similar conclusions (Cable, 1969).

Another ~~process~~ that must be considered in any study of perceptual defense is "perceptual vigilance". This previously-described process was the subject of an experiment by Pustell (1956). He used electric shock to condition words to be anxiety-provoking. Results indicated that negative, anxious affect, even in the absence of positive, attractive components, could result in perceptual vigilance. He further concluded that moderately strong anxiety could function as a cue or signal which heightens perception. These findings were later supported by Osgood (1967).

A final area--one that is possibly the most controversial today--involves the dispute between those who believe in some type of response-availability theory and those who subscribe to a dynamic point of view. The former hypothesis is quite pervasive and includes the concepts of response bias and perceptual set. The latter hypothesis would embrace an explanation that implies " a supersensitive scanning mechanism which first scans visual stimuli and then inhibits full recognition of images likely to arouse anxiety (Goldstein, 1962, p.23). A focus of the present study is this controversy between the supporters of the perceptual-defense hypothesis and supporters of the response-bias hypothesis. During the last two decades a wide range of methodological approaches have been used to try to decide between the two hypotheses. Although many improvements have been evident, methodological criticisms still occur. This present study attempts to accomodate many of the recommendations that have resulted from previous studies.

Statement of Problem

The present study was designed to demonstrate perceptual defense under conditions in which the response-bias explanation is not reasonable. It was assumed that when stimuli to be recognized are made anxiety-provoking not by the general social experience of Ss, but by a special experimental manipulation, it did not make sense to explain the results by "response-bias". The major hypothesis was that Ss, for whom critical words had been paired with anxiety-provoking stimuli would have higher detection and higher recognition thresholds than Ss for whom these critical words had not been paired with anxiety-provoking stimuli. The critical words were words taken from a stressor film; the anxiety-evoking stimuli were the scenes in this film in which the critical words occurred. The higher thresholds were what was to be expected on the perceptual-defense hypothesis. A response-bias hypothesis would presumably not predict any difference in the thresholds of experimental and control Ss, because both groups were equally influenced by the response-availability factors.

To exclude an alternative explanation of negative findings, should there be no difference between the thresholds of experimental and control groups--namely, the contention that the critical words were not conditioned--it was decided to measure the S's electrical skin resistance continuously throughout the threshold measurement. If GSR data show that the critical words have been conditioned, such an alternative explanation would be untenable.

Design

The present, experimental investigation was designed to demonstrate perceptual defense under conditions in which the response-bias explanation would not be reasonable. The stimuli to be recognized were made anxiety-provoking not by the general social experience of the Ss but by a special experimental manipulation. The E arranged to make a list of critical words anxiety-arousing, through the inclusion of these words in a stressor film which the experimental Ss would see and control Ss would not see. Ss were randomly assigned to each of the two groups and both groups were balanced to ensure an equal number of males and females. All Ss were similarly treated except that a different film was presented to each group: A stressor film to the experimental group, a neutral film to the control group. Nine critical words were chosen from the sound track of the stressor film shown to the experimental group. Words matched for length, for initial letter, and for their Thorndike-Lorge word count with the critical words were included as comparison stimuli in the recognition-threshold tests, but, of course, were not included in the stressor film.

The film used in this investigation was one which portrayed actual scenes of automobile accidents, including gruesome, realistic scenes of traffic-related deaths and injuries. Use of this type of anxiety-provoking stimulus was believed to be an improvement upon past experiments which used socially-conditioned or experimentally-conditioned words. These socially conditioned words have been found to enhance the likelihood of response-bias effects (McGuinnies, 1949). Likewise this choice of stimuli was thought to be superior to the method whereby the words were conditioned to be anxiety-provoking by pairing them with electric shock. Lazarus <u>et</u> <u>al</u>., (1962, p.11) supported this conclusion when they stated that "where physical assault is utilized with human beings (e.g., electric shock or extreme cold), there is a complete confounding of the physical and psychological reasons for whatever effects are noted". The use of a film as a potential source of anxiety was explored by Lazarus (1962) who found that properly selected movies could have tremendous emotional impact upon

Ss and that therefore could serve as a stressor stimulus.

A number of previous investigations have used fixed exposure times to explore perceptual defense. Others have used only recognition thresholds to study this phenomenon. Rather than rely on detection or recognition threshold alone, both were measured in this investigation. A method of increasing exposure times until response occurred was believed to be more precise than using a single exposure time.

One final precaution was taken to limit the number of explanations that could result from the experimental data. Rather than take for granted that the conditioning of the critical words using a stressor film was effective, GSRs were continuously recorded. If findings on thresholds were negative a conclusion could still be made to the effect that they were negative even when conditioned. This inclusion was necessary in order to eliminate the alternative explanation that there was no conditioning.

Subjects

Serving as subjects for the experiment were 30 undergraduate students, enrolled in a first year psychology course. Eight female and seven male subjects comprised the experimental group while a like number made up the control group. All subjects had volunteered for the study. However, the subjects were all aware that grade points were received for participation in any approved experiment.

Each subject was initially contacted by phone at which time they were randomly assigned to be control or experimental subjects. Due to missed sessions one female subject had to be switched from the experimental group to the control group to ensure an equal number of male and female subjects in all categories.

Thirty-three subjects were used in all. Three subjects were used in the pilot study, 15 subjects in the experimental group and 15 subjects in the control group. All subjects appeared to be naive regarding the true purpose of the investigation.

Apparatus

Galvanic Skin Response

To measure and record GSR's, a Stoelting Dermograph (cat. #24210) was used. This unit consists of a chart drive to propel the chart paper forward at a constant rate of six inches per minute; a GSR recording galvanometer; a GSR amplifier; stainless steel finger electrodes; stimulus marker. There are two controls which were manipulated in recording a GSR: a sensitivity control and a centering control which is equipped with a micro-dial.

Tachistoscope

A Harvard Tachistoscope, Model T-2B-1, consisting of a two field exposure cabinet with a four channel integrated circuit, direct reading digital timer, and a solid state lamp driver switch was used to present word stimuli. A rollback attachment was used to present stimuli with as little interference and disruption as possible.

Resistance Box

An Elco resistance decade box, Model 1171, with a total resistance input of 100 kiloohms was used to calibrate the GSR chart. Additional single resistors were used if stronger resistances were needed to determine the basal resistance level.

Projector

A 16-mm. sound projector was used to present the films used in the experiment.

Stressor Film

This 28-min., 16-mm. film, with a sound track, produced in colour in 1961, depicts highway traffic accidents with resulting injuries and deaths in a shocking and realistic manner. The film is entitled "Mechanized Death" and was produced by the Ohio State Highway Patrol.

Neutral Film

The neutral film is also a 16-mm., colour film, with a sound track, lasting approximately 30 min. It relates the history of the automobile and the ways in which it has transformed the life of American people. There are no scenes of accidents and the film is portrayed from an historical viewpoint. The title of the film is "The Golden Age of the Automobile".

Material

Nine critical words were selected from the stressor film and were matched with words from the Thorndike-Lorge (1944) word-count list. These words were matched in regards to frequency of use, number of letters in the word, and initial letter of the word. Table 1 outlines the matched critical and neutral words and their frequency of use.

TABLE 1

List of Thorndike-Lorge Word-Count for Critical and Neutral Words

Critical Words	Frequency of use	Neutral Words	Frequency of use
Blood	100 per 1,000,000	Board	100 per 1,000,000
Think	100 per 1,000,000	Third	100 per 1,000,000
Driver	40 per 1,000,000	Deposit	41 per 1,000,000
Injury	24 per 1,000,000	Impose	23 per 1,000,000
Agony	24 per 1,000,000	Ankle	21 per 1,000,000
Time	100 per 1,000,000	Town	100 per 1,000,000
Fatigue	19 per 1,000,000	Faculty	22 per 1,000,000
Speed	50 per 1,000,000	Spare	50 per 1,000,000
Baby	100 per 1,000,000	Bank	100 per 1,000,000

Each of the words was typed on a roll of white paper that was placed in the tachistoscope in such a fashion that one word could be presented at a time. The words were typed in elite type with regular space and lower-case characters.

Recording blanks were prepared for use by the Experimenter to haster proceedings and to allow more freedom for the Experimenter to carry out the various tasks that had to be attended to.

Procedure

Three subjects were used in the pilot study to familiarize the E with the apparatus and to determine the most suitable words for the experiment-proper. Fourteen words were originally selected from the stressor film. These words were matched with neutral words insofar as frequency of use, word length, and initial letter were concerned using the Thorndike-Lorge word count. Each of the words was presented tachistoscopically and both detection and recognition thresholds were determined for each word. Comments from pilot study S's indicated that the number of words used during this stage of the investigation was too large;subjects complained of tiredness and sore eyes. In order to shorten the time taken for the experiment, the number of word stimuli was reduced to nine critical words and nine matched neutral words. The nine pairs of words were ultimately chosen because they exhibited the largest differential between the matched sets in regards to both threshold and GSR data.

In the experiment proper, the following procedure was followed for each S. After developing some degree of rapport with the S, he was seated in front of a viewing screen and read a written, prepared statement outlining the requirements of the experiment. (see appendix I) These instructions were prepared in order to minimize bias effects by the E between the various Ss. Following the reading of the written instructions, the pertinent film was presented using a 16-mm. projector (stressor film if experimental group; neutral film if control group).

Following the film presentation each S was asked for his impressions of the film. In addition he was asked three questions on traffic regulations, a procedure adopted to assist in disguising the true purpose of the investigation. Ss were then seated before the tachistoscope and GSR electrodes were attached to the palmar surface of the first and third fingers of their right hand. Electrode paste was applied to the electrodes prior to their placement on the S's fingers. Additional prepared statements were read at this time, briefly explaining the operation of the GSR apparatus and detailing the tasks required of the subject (see appendix I).

Following a short period in which the GSR apparatus was calibrated for that subject, the neutral and critical words were randomly presented on the tachistoscope. Duration of stimulus exposure was increased with each presentation, according to a systematic plan. When the S reported seeing something the exposure was called his detection threshold; when he correctly identified the word it was called his recognition threshold. Initial duration of stimulus presentation varied between 2 msec. and 10 msec., the initial value being randomly selected. Exposure time was increased by 2-msec. steps until detection occurred. Following a report of stimulus detection, the duration of stimulus presentation was increased in steps of 10 msec., until the S could correctly report which word was being presented. A 30-sec. delay was purposely allowed to ensure no carryover contamination in the GSR measurement. Each word was presented only once to reduce adaptation effects to critical stimuli. Eighteen words were presented to each S in this manner.

In recording GSRs to the various stimuli, E made a notation on the data sheet indicating where detection and recognition were reported. Upon completion of the experiment the S was thanked for his co-operation. Questions that would not lead to contamination of future Ss were answered and each S was notified that results of the experiment would be made available following completion of the study.

Results

Following the experiment, the raw threshold data and GSR data were assessed to ensure that they would meet the basic assumptions of parametric statistics. As doubts existed that these requirements were fulfilled a number of raw data transformation procedures were investigated in an attempt to bring the sample variance closer to equality. Ultimately a logarithmic transformation of threshold data was found to fulfill the requirements for parametric measurement. This transformation is suggested by Fechner's formula which states that "sensation is proportional to the logarithm of the stimulus"(Corso, 1967, p.264).

The method of GSR analysis and comparison is similar to that used by Dittes (1957). This method is outlined in Appendix II. The GSR data was also transformed to ensure equality of variance. As this intra-individual comparison was based upon proportions, a hyperbolic function transformation (tanh x, sin e) was performed.

A two-way analysis of variance was used to determine whether any interaction effects existed between the type of group (experimental and control) and the type of word (neutral and critical). A Student's t test was used for all group comparisons.

The results of this experiment can be discussed under three main headings: (a) The Galvanic skin responses to the stimulus words; (b) the comparison of detection thresholds and resulting implications; (c) the comparison of recognition thresholds and their resulting implications.

Galvanic Skin Response

The GSR was selected in this investigation to act as a measure of autonomic discrimination between the two sets of words. It was selected primarily because of the fact that it has been shown on many occasions to accompany affectively-charged stimuli, but also because of the ease and relative precision with which it can be used. (Lazarus *et al*., 1962)

The method of determining the presence and number of GSRs is outlined in Appendix II. Raw data in the form of proportions were tansformed using a hyperbolic function. To compare the transformed GSR scores between the two groups and between the two types of words, the Student's t test was used. Outlined in Table 2 is the mean transformed score for each group of Ss in the experiment.

TABLE 2

Mean of Transformed GSR Frequencies for Subjects in each Condition

	Neutral Words		Critical Words	
	Experimental	Control	Experimental	Control
Detection	.318	.298	.354	.332
Recognition	.360	.494	.645	.534

From the table it is observed that there is a higher proportion of GSRs to critical words in both groups at detection level. However the difference in the number of GSRs to neutral and critical words is not significant in either the experimental group ($.35 > p > .30$) or the control group($.30 > p > .25$). An analysis of the differences between the differences (i.e., experimental group difference versus control group difference) was also not significant ($p > .45$). Thus it would appear that there was little evidence of autonomic discrimination at detection level for either set of words.

At recognition level there was also a higher proportion of GSRs to the critical words in both groups. In the experimental group this difference favouring critical words was significant ($p<.005$). The same comparison in the control group was not significant ($.30>p>.25$), but a similar trend towards the critical words was exhibited. This finding, although not significant at the .05 level, does indicate that the critical words that were used seemed to evoke more GSRs even before they were conditioned. However it is to be noted that the difference between the differences in the two groups was significant ($p<.05$). These data would seem to indicate that there was some autonomic discrimination between the two sets of words. In addition, the data would support the hypothesis that critical words were conditioned by the stressor movie and further that the discrimination could be assumed to indicate that the critical words were conditioned to be anxiety-provoking.

Detection Threshold

Detection threshold is operationally defined as the lowest exposure time required for the S to declare that he has seen what appears to be the outline of a word, on the tachistoscope screen. Critical and neutral words were randomly presented to the S and were initially presented well below the detection level. A detection threshold was determined for each word. A t test was used to determine whether differences between the neutral word and critical word thresholds were significant. Outlined in Table 3 is the mean transformed score for each group of Ss in each experimental condition at detection level.

TABLE 3

Mean of Transformed Threshold Scores for Subjects in each condition at Detection Level

	Neutral Words	Critical Words
Experimental	1.3793	1.4550
Control	1.5028	1.4871

Analysis of the data revealed that there was a significant difference in the detection thresholds for the neutral and critical words in the experimental group ($t = 4.15$, $df = 14$, $p<.005$). This difference indicates that critical words were detected more slowly than neutral words in this group. This same comparison in the control group revealed no significant differences, and in fact it was found that there was a trend towards quicker detection of critical words ($t = .707$, $df = 14$, $.30>p>.25$). The difference between the differences (i.e., experimental group difference versus control group difference) was also significant (t = 1.72, df = 28, $p<.05$).

A two-factor analysis of variance was performed to investigate whether there were any significant interactions between the words and the experimental conditions at detection level. Table 4 presents a summary table of these calculations.

TABLE 4

Analysis of Variance: Detection Thresholds for Neutral and Critical Words in the Experimental and Control Groups

Source	df	MS	F
Group Effects	1	.0902	.6555
Error Effects	28	.1376	
Word Effects	1	.0132	4.25*
Interaction	1	.0311	10.03*
Error Effects	28	.0031	

*$p<.05$

Results indicated that there was a significant interaction effect between the type of group (control or experimental) and the type of word (conditioned or neutral). In this particular case it was found that control group Ss had lower thresholds for critical words than they did for neutral words. The experimental group exhibited the opposite tendency. In summary these findings point to the conclusion that there was a significant difference in the manner in which the types of words were reacted to by the two groups, at detection level.

Recognition Threshold

Recognition threshold has been operationally defined as the threshold level at which a S correctly identifies a tachistoscopically-presented word. Outlined in Table 5 is the mean transformed score for each group of Ss in each experimental condition at recognition level.

TABLE 5

Mean of Transformed Threshold Scores for Subjects in Each Condition at Recognition Level

	Neutral Words	Critical Words
Experimental	2.5672	2.4946
Control	2.5871	2.5510

Analysis of these thresholds reveals a number of findings that are different from what appeared in the detection-level data. It was found that the experimental group and the control group tended to recognize critical words more quickly than neutral words. This finding was significant for the experimental group (*t* = 4.68, *df* = 14, $p < .005$), but not for the control group (*t* = 1.71, *df* = 14, $.10 > p > .05$). However, the difference between the differences within the two groups was not significant (*t* = 1.077, *df* = 28, $.15 > p > .10$). This finding does not allow a conclusion suggesting any statistically significant difference between the recognition thresholds of the two groups. However, it is of interest to note that in the control group the critical words required a shorter exposure period for both recognition and detection thresholds. The experimental group differed somewhat in that detection thresholds for critical words were higher than those of neutral words. The results would suggest a difference in the mode of reacting to the two types of words for the experimental group.

A two-factor analysis of variance was carried out to investigate whether there were significant interaction effects between the variables at recognition level. Table 6 presents a summary table of these calculations.

Analysis of Variance: Recognition Thresholds for Neutral and Critical Words in the Experimental and Control Groups

Source	df	MS	F
Group Effects	1	.0218	.1219
Error Effects	28	.1789	
Word Effects	1	.0445	17.12*
Interaction	1	.0051	1.96
Error Effects	28	.0026	

*$p < .05$

This analysis verifies the previous findings in that there is a significant difference between reactions to neutral and critical words in both groups. However, there is no significant interaction effect which suggests that both groups reacted to words in similar fashion.

In summary, it must be concluded that the stressor movie did not differentiate the two groups on the two sets of words, on the recognition measure. A lower threshold for critical words was exhibited by both groups, but this discrimination was not significantly greater in the experimental group than it was in the control group.

Discussion

The important findings of this study may be summarized as follows: (a) There was evidence to demonstrate that neutral words taken from a stressor movie were conditioned to become anxiety-provoking stimuli; (b) There was clear evidence of perceptual defense unconfounded by response bias at detection level of stimulus presentation; (c) there was some evidence suggesting perceptual vigilance towards critical words by both the experimental and the control groups at recognition level. However the difference between the two groups was not significant and a sensitization or perceptual vigilance hypothesis was not unequivocally supported; (d) verbal response bias did not account for perceptual-defense effects at detection level. In effect, it appeared that the thresholds were a function not of what the subjects had to say, but rather of what they saw.

Of major concern in recent investigations has been the attempt "to distinguish experimentally between the contribution of perceptual defense and the contribution of response bias to differential accuracy in identifying anxiety-provoking and neutral words (Bootzin and Natsoulis, 1965). Most previous studies have used taboo words that were believed to be pre-socially conditioned to be anxiety-provoking. The use of these words introduced a number of confounding variables, not the least of which was a response-bias effect working against repeating these socially unacceptable words. This confounding of variables led to the introduction of experimental intervention in regards to conditioning experimental stimuli. Electric shock was employed to condition words, but again results seemed to have been ~~clouded~~ by many unwanted, uncontrolled physiological variables.

In the present investigation the E used a stressor film from which a number of anxiety provoking words were chosen from the soundtrack. Previous studies had employed the same procedure to condition words and had concluded that any properly-selected stressor film could have tremendous effect upon its viewers (Lazarus et al., 1962, p. 3). A stressor film used in this type of investigation has a number of advantages in that it eliminates the confounding effects that may occur when either taboo words or words that are conditioned by electric shock, are used. However, as it is difficult to determine beforehand whether the film you have selected is anxiety-provoking for the viewer, it must be demonstrated that the film is stressful.

To determine whether the words taken from the movie were conditioned to become anxiety-provoking three indicants of anxiety were examined. The first indicant centred about the type of comments that were made by the Ss following presentation of the stressor film. Such descriptive adjectives as "raw", "gruesome", "sickening", "gross", and "terrible", were representative of the many responses. This type of description did not follow the presentation of the neutral film. This reaction to the stressor film would certainly suggest that some negative affect resulted from viewing the film.

A second indicant that was used to detect the presence of film-induced anxiety was the comparison of the proportion of GSRs to neutral and critical words in each of the groups. There were no significant differences between the proportion of GSRs to critical words as compared to neutral words at detection level. This finding would initially seem to be contrary to findings that have demonstrated the occurrence of a

GSR reaction to subliminally-presented, stressful stimuli. One might account for this difference by concluding that the detection level as operationally defined in this study, was simply too far below recognition level to allow any differentiating effect by the viewer. However this conclusion is certainly doubtful in view of the fact that a significant threshold difference at detection level was found between the two sets of words in the experimental group. The inconsistency could of course be related to the insensitivity of the GSR recording apparatus. Considering that physiological fluctuations might be relatively subtle at this level, it is possible that a confounding of the effects of presentation of the critical words with either verbal responses, prior anticipations and expectations, or normal physiological fluctuations may have occurred.

Dixon (1971, p. 180) in summing up past research in this connection has stated that only GSRs recorded just prior to correct recognition are higher for emotive words as compared to matched, neutral words. Results from the present experiment would co-incide with Dixon's summation if we consider that detection thresholds were somewhat distant from the S's recognition threshold. Insofar as the detection threshold difference is concerned, perhaps one must look to the possibility that some critical level of arousal must be reached before the body physiologically reacts to it. This would appear to be logical if one believes that our perceptual awareness is more sensitive to change than are other physiological reactions, which must after all depend upon perceptual sensitivity. In any event it must be concluded that there was little evidence from GSR analysis at detection level that critical words were conditioned to be anxiety-provoking stimuli.

At recognition threshold a significant difference between the proportion of GSRs to neutral and critical words was found in the experimental group. This difference favouring the critical words was not found in the control group. This evidence is certainly in keeping with past experimental findings and supports the hypothesis that the stressor film conditioned critical words to be anxiety-provoking.

Threshold data further supports this hypothesis. At detection level it was discovered that thresholds were significantly higher for critical words as compared to matched neutral words in the experimental group. Again no comparable difference was found in the control group and in fact there were higher, yet insignificant thresholds for neutral words. This finding adds further support that the film had a significant effect upon its viewers. Coupled with the face validity of comments received after the film, and the differentiation of GSRs at recognition level, it seems reasonable to conclude that critical words taken from the stressor movie were conditioned to be anxiety-provoking for the experimental Ss.

Having confirmed that the critical words were conditioned the task was to determine the nature of the threshold differences and to investigate whether there was evidence for either perceptual defense or response bias. It has previously been mentioned that there was a statistically significant, higher detection threshold for critical words as compared to neutral words in the experimental group. No such difference was found in the control group and indeed the difference between the differences was also statistically significant. This result is consistent with the perceptual defense hypothesis. A response bias hypothesis would not predict any differences in the thresholds of experimental and control group Ss because both groups were equally influenced by the response availability factors. Thus the response bias hypothesis is insufficient to account for experimental and control differences. This finding leads one to a perceptual defense hypothesis. The question that still remains to be answered is why there should be perceptual defense effects at detection level when the words could not possibly have been consciously recognized. Before attempting to respond to this question it is imperative that the results at recognition level be discussed.

Recognition threshold data were quite similar for both the experimental and the control group. A tendency towards quicker recognition of critical words was shared by both groups. However, differences between the groups were not significant. As such the conditioning of the critical words would not seem to have been a strong enough factor to discriminate between the two sets of words in the two groups. This finding does not allow any conclusion in support of any of the relevant hypotheses. Indeed it would appear that the only conclusion that one can make from these data is that we are unable to differentiate among response bias, perceptual defense, and perceptual vigilance hypotheses at the recognition threshold level. Findings at recognition level, coupled with detection threshold results do suggest certain hypotheses, however.

Recalling that neutral words related to highway traffic and highway safety were employed, one must attempt to determine why subjects would exhibit perceptual defense effects when it was unlikely that the stimuli could be recognized. Further, why did they seem to become more alert to these same stimuli when they not only had to recognize them but had to repeat them aloud? These findings are contrary to those found by Blum (1955, p.14). He concluded that as psychosexual stimuli, (sexual and aggressive stimuli) are always actively trying to break through to consciousness, then everyone should at the unconscious level be sensitive and responsive to cues relevant to these potentially threatening impulses. In effect he concluded that perceptual vigilance operates at a level below conscious awareness. When these same impulses do begin to approach the surface, perceptual defense takes over. It is, of course, questionable whether the anxiety-provoking stimuli used in the present experiment can indeed be classed as psychosexual stimuli, as they are common, often-used, words.

However it has been demonstrated that these same words have been conditioned to be anxiety-provoking by pairing them with scenes of death and injury. The point that should be stressed from this comparison is that we are dealing with a completely different type of word and as such we cannot validly compare the results of this experiment to results from experiments using taboo words. Hypotheses must be formulated on the specific results that have occurred in this investigation.

The subject matter of the presented stressor film is certainly well publicized and emphasized by the various news media in our society. One cannot escape news relating to the automobile and indeed much time is spent within an automobile by a large portion of the population. Because of this continual media publicity, the automobile could become both a reinforcing and an aversive stimulus resulting in the gradual, often indiscernable development of an approach-avoidance conflict. If this is the case it is quite likely that the positive and negative feelings directed towards the automobile would be generalized to related stimuli. Relating this hypothesis to the present experiment suggests the following explanation.

As previously explained, there exists much doubt and uncertainty as to the exact identification of words at detection level. A dearth of information would certainly favour an avoidance tendency and thus one would also suspect that a perceptual-defense effect would not be surprising. With little information about the stimulus people are much more susceptible to disregard any ambiguous, negative cues. The problem arises, however, that these cues cannot be ignored for long, for they are in effect life-preserving cues. Indeed it is likely that natural selection via evolutionary survival has limited the extent to which normal people turn the blind eye to anxiety-provoking threats to their bodies and to their self-esteem. Thus as more cues are received from this type of stimulus, such stimuli become increasingly more difficult to block out. Ultimately as recognition level is approached one might become sensitized to the same stimulus that he had earlier attempted to block from consciousness.

Although the above mentioned explanation is quite speculative, it is possible that this may have occurred during the present investigation. Further research is obviously necessary to substantiate both the results and the speculations derived from this investigation.

A design employing a progressive series of threshold determinations, ranging from detection to recognition, would enable the E to determine whether there are significant trend effects or indeed whether there is a specific level at which one ceases to employ defenses and relies more heavily upon vigilant awareness and subsequent reaction.

In summary, it has been determined that words contained within the sound track of a stressor movie can be conditioned to become anxiety-provoking to a viewer. Evidence further suggests that these anxiety-provoking words have a significantly higher detection level than do matched, neutral words. As response-bias effects were not substantiated at this level, a perceptual defense explanation was supported.

At recognition level the data prohibited any specific conclusions. However, there did appear to be a trend towards recognizing critical words more quickly than neutral words.

The force of these findings is rather restricted because of the small number of Ss. In addition it must be explained that results do not suggest that a response-bias hypothesis has no relevance in studies of perceptual defense. This study employed words that were conditioned to be anxiety-provoking by virtue of their being presented along with stimuli that were threats to a S. As such results do not contradict findings from studies employing taboo words as stressor stimuli.

It is believed that with methodological improvements, much can be derived employing this type of design. Of significance in this respect is the choice of critical words from the stressor film. In this investigation words like "injury" and "blood" may have been anxiety-provoking before the presentation of the stressor film. Differences between the two groups may have been minimized if this actually was the case.

A variety of physiological measurements might be employed to ensure a more accurate assessment of indicants of anxiety. In addition these measurements should be recorded during the actual showing of the stressor movie to further determine its stress-inducing capacities.

Long-range effects of the conditioning could also be investigated by retesting the Ss some time after the initial presentation of the film. Information of this kind would not only be beneficial to determine the longevity of conditioning effects using a stressor film, but would add still further information relating to perceptual-defense effects. Further research incorporating modifications would appear warranted in order to add further understanding to the relevance of perceptual-defense and response-bias hypotheses in our continuing investigation of man's perceptual system.

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Appendix I

Instructions to the Subjects

This experiment involves perceptual ability and its relation to traffic safety. Specifically the experiment will consist of several parts which will all be associated to the skills that contribute to safe driving practices.

During the first part of this study we would like you to view a film on traffic safety. This film will last approximately thirty minutes, after which I will ask you a few questions on traffic safety. Following these questions we will proceed to the next stage of the experiment which involves a perceptual task. Instructions for this part of the experiment will be given following the film.

"Film Presentation"

Well, what did you think of the film? (record response)

Can you answer the following questions?

1) At 50 miles per hour what is the average stopping distance for a car? (258')

2) Within how many feet of a pedestrian cross-walk is it illegal to pass another vehicle? (100')

3) How many points must you accrue to lose your drivers license? (15)

The S is then seated before the tachistoscope.

I am now going to present a number of words to you on the tachistoscope. As you are probably aware I am able to present words at varying exposure durations and light intensities using this apparatus. The duration of stimulus presentation can range from 1-ms. to 10-sec. so you can readily imagine that words can be presented at speeds that make it unlikely that you will see the stimulus.

While I am presenting the words to you on the tachistoscope I am going to measure the changes in skin resistance or more familiarly, I am going to record GSRs to each stimulus. To do this I will attach electrodes to the fingers of your right hand. I am only interested in your GSRs so you need not be concerned about receiving any shock or other stimulation from this apparatus. I would request that you attempt to stay as stationary as possible during stimulus presentation as the equipment is quite sensitive and may pick up your movement.

I will now present a number of words ~~to~~ you at various durations. Your first task will be to let me know when you believe that I have presented a word to you. You need not recognize the word but only feel sure that you have seen the outline of a word on the tachistoscope screen.

Your second task will be to recognize the word that is presented to you. As the stimulus duration is increased you will be better able to recognize the word. You do not have to be positive in your identification. If you have even the faintest idea what the word may be, you may feel free to guess.

For all word presentations I will follow the same procedure. I will first alert you to look into the eyepiece. At that time you will be presented with a warning stimulus that will show you the exact location where a stimulus will be flashed. Following this warning there will be a two second darkened period before the stimulus that you must pay attention to, is presented. This pattern will be continued till you recognize the word, afterwhich a new word will be presented.

Are there any questions? To repeat, the first task is to let me know that you have seen the outline of what may be a word. Then as I continue presenting the word you are to tell me what the word is.

You may now peer into the eyepiece.

Appendix II

Method of GSR Analysis and Comparison

GSR electrodes were taped to the palmar surface of the first and third fingers of the right hand, of each S. A short period, in which the S was encouraged to relax, followed the reading of the instructions for this stage of the experiment. At this time the sensitivity dial was set, so that the marking pen would be centred on the GSR chart. A record of the dial settings was kept for each S.

Stimuli were presented on the tachistoscope, while continuous GSRs were being recorded. Notations on the GSR chart were made to differentiate the various phases of stimulus presentation. Sensitivity settings were adjusted as required but a record of any setting change was kept for each S. Following the experiment the GSRs were calibrated and compared in the following manner:

1)A resistance box was connected to the Dermograph. The sensitivity setting and centering setting were set at the same location that they were set at during the experiment.

2)The resistance box was manipulated to increase the resistance till the marker pen had returned to the centre or origin point on the chart paper. When this had been completed the reading on the resistance box revealed the basal resistance level. A GSR was scored whenever the record of conductance exceeded 3% of the basal resistance level (Dittes, 1957).

3)The centering dial was then adjusted till the marker pen was one centimeter above the origin point. The resistance box was then adjusted till the marking pen returned to the origin point. The difference between this new reading and the basal resistance level determined the ohmage required to raise the marking pen one centimeter from the origin point. Using this information we were able to determine the equivalent height of a 3% increase of resistance.

4)The number of GSRs were calculated for both critical and neutral words. A Student's <u>t</u> test was used to check for significant differences between the various experimental conditions.

Appendix III

Logarithmic Transformation of Raw Threshold Data for the Experimental Group

DETECTION THRESHOLD				RECOGNITION THRESHOLD				
Neutral Wds.		Critical Wds.		Neutral Wds.		Critical Wds.		
Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	
S #1: (female)								
-	-	39	1.5911	-	-	390	2.4624	
21	1.3222	42	1.6232	350	2.5441	130	2.1139	
19	1.2788	37	1.5682	210	2.3222	280	2.4472	
25	1.3979	36	1.5563	480	2.6812	300	2.4771	
25	1.3979	22	1.3424	290	2.4624	250	2.3979	
25	1.3979	25	1.3979	480	2.6812	1300	3.1139	
27	1.4314	39	1.5911	560	2.7482	220	2.3424	
22	1.3424	27	1.4314	610	2.7853	390	2.5911	
16	1.2041	37	1.5682	460	2.6628	260	2.4150	
22.50	1.3466	33.78	1.5189	430.00	2.6109	380.00	2.4845	X̄
S #2: (male)								
29	1.4624	37	1.5682	400	2.6021	230	2.3617	
11	1.0414	25	1.3979	290	2.4624	290	2.4624	
25	1.3979	27	1.4314	350	2.5441	210	2.3222	
22	1.3424	25	1.3979	190	2.2788	190	2.2788	
16	1.2041	39	1.5911	190	2.2788	230	2.3617	
22	1.3424	27	1.4314	230	2.3617	170	2.2304	
23	1.3617	26	1.4150	170	2.2304	210	2.3222	
23	1.3617	42	1.6232	260	2.4150	180	2.2553	
21	1.3222	25	1.3979	220	2.3424	190	2.2788	
21.33	1.3151	30.33	1.4727	255.56	2.3906	211.11	2.3193	X̄
S #3: (male)								
54	1.7324	22	1.3424	430	2.6335	230	2.3617	
14	1.1461	33	1.5185	180	2.2553	330	2.5185	
28	1.4472	26	1.4150	390	2.5911	230	2.3617	
13	1.1139	25	1.3979	370	2.5682	250	2.3979	
18	1.2553	42	1.6232	300	2.4771	340	2.5315	
15	1.1761	26	1.4150	220	2.3424	370	2.5682	
17	1.2304	20	1.3021	340	2.5315	220	2.3424	
17	1.2304	37	1.5682	190	2.2788	220	2.3424	
17	1.2304	39	1.5911	280	2.4472	220	2.3424	
21.44	1.2847	24.44	1.4637	300.00	2.4583	267.78	2.4185	X̄

DETECTION THRESHOLD				RECOGNITION THRESHOLD				
Neutral Wds.		Critical Wds.		Neutral Wds.		Critical Wds.		
Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	
S #4:(female)								
36	1.5563	23	1.3617	600	2.7782	470	2.6721	
11	1.0414	33	1.5185	640	2.8062	240	2.3802	
23	1.3617	19	1.2788	780	2.8921	330	2.5185	
16	1.2041	19	1.2788	500	2.6990	450	2.6532	
13	1.1139	20	1.2010	390	2.5911	380	2.5798	
12	1.0792	18	1.2553	580	2.7634	440	2.6435	
17	1.2304	14	1.1461	450	2.6532	560	2.7482	
14	1.1461	15	1.1761	1100	3.0414	470	2.6721	
14	1.1461	16	1.2041	610	2.7853	460	2.6628	
17.33	1.2088	19.67	1.2689	627.78	2.7789	422.22	2.6145	$\bar{X}$
S #5:(male)								
16	1.2041	18	1.2553	460	2.6628	290	2.4264	
15	1.1761	33	1.5185	620	2.7924	360	2.5563	
22	1.3424	12	1.0792	260	2.4150	250	2.3979	
13	1.1139	19	1.2788	490	2.6902	310	2.4914	
11	1.0414	13	1.1139	410	2.6128	220	2.3424	
17	1.2304	14	1.1461	480	2.6812	300	2.3617	
12	1.0792	12	1.0792	340	2.5315	350	2.5441	
13	1.1139	14	1.1461	230	2.3617	250	2.3979	
16	1.2041	12	1.0792	610	2.7853	310	2.4914	
15.00	1.1673	16.33	1.1885	433.33	2.6148	293.33	2.4455	$\bar{X}$
S #6:(male)								
13	1.1139	21	1.3222	730	2.8633	240	2.3802	
21	1.3222	16	1.2041	330	2.5185	640	2.8062	
15	1.1761	16	1.2041	290	2.4624	270	2.4314	
14	1.1461	31	1.4914	400	2.6021	300	2.4771	
10	1.0000	13	1.1139	170	2.2304	180	2.2553	
20	1.3010	09	0.9452	450	2.6532	660	2.8195	
11	1.0414	19	1.2788	230	2.3617	280	2.4472	
17	1.2304	16	1.2041	230	2.3617	250	2.3979	
16	1.2041	13	1.1139	240	2.3802	260	2.4150	
15.22	1.1706	17.11	1.2086	341.11	2.4926	342.22	2.4922	$\bar{X}$

DETECTION THRESHOLD				RECOGNITION THRESHOLD				
Neutral Wds.		Critical Wds.		Neutral Wds.		Critical Wds.		
Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	
S #7:(male)								
31	1.4914	13	1.1139	350	2.5441	210	2.3222	
13	1.1139	29	1.4624	370	2.5682	240	2.3802	
24	1.3802	15	1.1761	200	2.3010	240	2.3802	
11	1.0414	11	1.0414	150	2.1761	170	2.2304	
16	1.2041	15	1.1761	210	2.3222	140	2.1461	
06	0.7782	17	1.2304	230	2.3617	220	2.3424	
21	1.3222	18	1.2553	150	2.1761	230	2.3617	
11	1.0414	12	1.0792	190	2.2788	140	2.1461	
14	1.1461	14	1.1461	160	2.2041	180	2.2553	
16.33	1.1688	16.00	1.1868	233.33	2.3258	196.67	2.2849	$\bar{X}$
S #8:(female)								
29	1.4624	37	1.5682	700	2.8451	460	2.6628	
21	1.3222	46	1.6628	700	2.8451	490	2.6902	
37	1.5682	22	1.3424	450	2.6532	490	2.6902	
39	1.5911	31	1.4914	570	2.7559	450	2.6532	
34	1.5315	22	1.3424	570	2.7559	490	2.6902	
20	1.3010	42	1.6232	520	2.7160	780	2.8921	
17	1.2304	37	1.5682	550	2.7407	410	2.6128	
27	1.4314	29	1.4624	520	2.7160	430	2.6335	
24	1.3802	33	1.5185	510	2.7076	510	2.7076	
27.56	1.4243	33.22	1.5088	565.56	2.7484	501.11	2.6925	$\bar{X}$
S #9:(female)								
21	1.3222	14	1.1461	490	2.6902	540	2.7324	
24	1.3802	27	1.4314	560	2.7482	450	2.6532	
16	1.2041	10	1.000	480	2.6812	420	2.6232	
14	1.1461	13	1.1139	580	2.7634	380	2.5798	
09	0.9542	13	1.1139	510	2.7076	440	2.6435	
18	1.2553	08	0.9031	480	2.6812	430	2.6335	
09	0.9542	20	1.3010	540	2.7324	440	2.6435	
12	1.0792	14	1.1461	530	2.7243	390	2.5911	
21	1.3222	15	1.1761	480	2.6812	500	2.6990	
16.00	1.1797	14.89	1.1480	516.67	2.7122	443.33	2.6444	$\bar{X}$

DETECTION THRESHOLD				RECOGNITION THRESHOLD				
Neutral Wds.		Critical Wds.		Neutral Wds.		Critical Wds.		
Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	
S #10(male)								
14	1.1461	29	1.4624	1600	3.2041	610	2.7853	
18	1.2553	37	1.5682	100	2.0000	610	2.7853	
25	1.3979	29	1.4624	510	2.7076	490	2.6902	
26	1.4150	24	1.3802	590	2.7709	520	2.7160	
36	1.5563	30	1.4771	990	2.9956	490	2.6902	
36	1.5563	31	1.4914	1800	3.2553	990	2.9956	
43	1.6335	36	1.5563	2500	3.3979	640	2.8062	
29	1.4624	54	1.7324	840	2.9243	1900	3.2788	
39	1.5911	43	1.6335	580	2.7634	720	2.8573	
29.56	1.4460	34.78	1.5293	1056.67	2.8910	774.44	2.8450	$\bar{X}$
S #11(male)								
16	1.2041	24	1.3802	260	2.4150	270	2.4314	
13	1.1139	46	1.6628	380	2.5798	160	2.2041	
17	1.2304	25	1.3979	180	2.2553	300	2.4771	
13	1.1139	30	1.4771	270	2.4314	160	2.2041	
43	1.6335	20	1.3010	170	2.2304	200	2.3010	
22	1.3424	37	1.5682	570	2.7559	260	2.4150	
26	1.4150	36	1.5563	290	2.4624	160	2.2041	
12	1.0792	37	1.5682	140	2.1461	230	2.3617	
23	1.3617	23	1.3617	230	2.3617	360	2.5563	
20.56	1.2771	30.89	1.4748	276.67	2.4042	225.33	2.3505	$\bar{X}$
S #12(female)								
45	1.6532	64	1.8062	1300	3.1139	1200	3.0792	
58	1.7634	53	1.7243	1000	3.0000	760	2.8808	
33	1.5185	71	1.8513	930	2.9685	840	2.9243	
26	1.4150	56	1.7482	1300	3.1139	990	2.9956	
62	1.7924	42	1.6232	1400	3.1461	1400	3.1461	
83	1.9191	44	1.6435	830	2.9191	1500	3.1761	
36	1.5563	56	1.7482	1000	3.0000	910	2.9590	
67	1.8261	85	1.9294	1000	3.0000	1100	3.0414	
55	1.7404	50	1.6990	680	2.8324	720	2.8573	
51.66	1.6871	57.88	1.7526	1048.89	3.0104	1046.66	3.0066	$\bar{X}$

DETECTION THRESHOLD				RECOGNITION THRESHOLD				
Neutral Wds.		Critical Wds.		Neutral Wds.		Critical Wds.		
Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	
S #13: (female)								
66	1.8195	75	1.8751	260	2.4150	230	2.3617	
65	1.8129	79	1.8976	360	2.5563	250	2.3979	
61	1.7853	62	1.7924	140	2.1461	150	2.1761	
67	1.8261	71	1.8513	290	2.4624	240	2.3802	
74	1.8692	58	1.7634	210	2.3222	240	2.3802	
60	1.7782	73	1.8633	290	2.4624	250	2.3979	
81	1.9085	78	1.8921	300	2.4771	330	2.5185	
60	1.7782	69	1.8388	260	2.4150	330	2.5185	
67	1.8261	62	1.7924	230	2.3617	250	2.3979	
66.78	1.8227	69.67	1.8407	260.00	2.4020	252.22	2.3921	X̄
S #14: (female)								
58	1.7634	52	1.7160	160	2.2041	110	2.0414	
38	1.5798	56	1.7482	180	2.2553	90	1.9542	
56	1.7482	45	1.6532	130	2.1139	90	1.9542	
53	1.7243	55	1.7404	200	2.3010	110	2.0414	
44	1.6435	42	1.6232	200	2.3010	130	2.1139	
50	1.6990	55	1.7404	160	2.2041	140	2.1461	
45	1.6532	56	1.7482	200	2.3010	90	1.9542	
54	1.7324	54	1.7324	130	2.1139	140	2.1461	
42	1.6232	67	1.8261	240	2.3802	150	2.1761	
48.89	1.6852	53.56	1.7253	177.78	2.2416	116.67	2.0586	X̄
S #15: (female)								
26	1.4150	36	1.5563	180	2.2553	390	2.5911	
34	1.5315	30	1.4771	400	2.6021	130	2.1139	
37	1.5682	37	1.5682	130	2.1139	160	2.2041	
38	1.5798	31	1.4914	450	2.6532	170	2.2304	
30	1.4771	29	1.4624	240	2.3802	220	2.3424	
32	1.5051	33	1.5185	290	2.4624	780	2.8921	
38	1.5798	31	1.4914	380	2.5798	120	2.0792	
31	1.4914	59	1.7709	180	2.2553	290	2.4624	
30	1.4771	32	1.5051	340	2.5315	260	2.4150	
36.00	1.5139	35.33	1.5379	287.78	2.4260	280.00	2.3701	X̄

Appendix IV

Logarithmic Transformation of Raw Threshold Data for the Control Group

DETECTION THRESHOLD				RECOGNITION THRESHOLD				
Neutral Words.		Critical Wds.		Neutral Wds.		Critical Wds.		
Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	
S #1:(male)								
23	1.3617	13	1.1139	160	2.2041	330	2.5185	
15	1.1761	12	1.0792	190	2.2788	300	2.4771	
26	1.4150	21	1.3222	160	2.2041	200	2.3100	
18	1.2553	12	1.0792	220	2.3424	240	2.3802	
17	1.2304	11	1.0414	190	2.2788	120	2.0792	
30	1.4771	14	1.1461	240	2.3802	160	2.2041	
15	1.1761	15	1.1761	160	2.2041	220	2.3424	
19	1.2788	16	1.2041	240	2.3802	160	2.2041	
14	1.1461	15	1.1761	220	2.3424	240	2.3802	
19.67	1.2796	14.33	1.1487	197.78	2.2906	218.89	2.3217	X̄
S #2:(female)								
14	1.1461	17	1.2304	320	2.5051	120	2.0792	
13	1.1139	11	1.0414	270	2.4314	130	2.1139	
14	1.1461	15	1.1761	140	2.1461	150	2.1761	
15	1.1761	13	1.1139	130	2.1139	170	2.2304	
12	1.0792	12	1.0792	210	2.3222	120	2.0792	
14	1.1461	14	1.1461	190	2.2788	120	2.0792	
13	1.1139	14	1.1461	120	2.0792	090	1.9542	
15	1.1761	11	1.0414	200	2.3010	180	2.2553	
12	1.0792	10	1.0000	170	2.2304	090	1.9542	
13.56	1.1307	13.00	1.1083	194.44	2.2675	130.00	2.1024	X̄
S #3:(female)								
55	1.7404	66	1.8195	4700	3.6721	1500	3.1761	
71	1.8513	22	1.3424	1700	3.2304	830	2.9191	
41	1.6128	65	1.8129	1500	3.1761	1800	3.2553	
55	1.7404	24	1.3802	1600	3.2041	2500	3.3979	
28	1.4472	29	1.4624	1700	3.2304	1800	3.2553	
32	1.5051	19	1.2788	1500	3.1761	3300	3.5185	
35	1.5441	22	1.3424	1600	3.2041	2100	3.3222	
16	1.2041	20	1.3010	1800	3.2553	1700	3.2304	
18	1.2553	26	1.4550	1200	3.0792	2100	3.2222	
39.00	1.5445	32.56	1.4660	1922.22	3.2475	1958.89	3.2552	X̄

DETECTION THRESHOLD				RECOGNITION THRESHOLD			
Neutral Wds.		Critical Wds.		Neutral Wds.		Critical Wds.	
Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.
S #4: (male)							
19	1.2788	23	1.3617	440	2.6435	240	2.3802
28	1.4472	14	1.1461	500	2.6990	330	2.5185
25	1.3979	21	1.3222	310	2.4914	280	2.4472
25	1.3979	29	1.4624	270	2.4314	270	2.4314
18	1.2553	26	1.4150	220	2.3424	210	2.3222
34	1.5315	23	1.3617	320	2.5051	320	2.5051
13	1.1139	27	1.4314	350	2.5441	200	2.3010
20	1.3010	27	1.4314	290	2.4624	290	2.4624
16	1.2041	24	1.3802	430	2.6335	370	2.5682
22.00	1.3253	23.78	1.3680	347.78	2.5281	278.89	2.4373 X̄
S #5: (female)							
23	1.3617	23	1.3617	370	2.5682	130	2.1139
15	1.1761	10	1.0000	410	2.6128	160	2.2041
20	1.3010	17	1.2304	190	2.2788	180	2.2553
09	0.9542	20	1.3010	360	2.5563	170	2.2304
24	1.3802	13	1.1139	220	2.3424	190	2.2788
18	1.2553	22	1.3424	380	2.5798	190	2.2788
11	1.0414	12	1.0792	180	2.2553	210	2.3222
12	1.0792	20	1.3010	360	2.5563	180	2.2553
32	1.5051	33	1.5185	250	2.3979	250	2.3979
18.22	1.2282	18.89	1.2497	302.22	2.4609	184.44	2.2596 X̄
S #6: (female)							
250	2.3979	160	2.2041	3000	3.4771	2400	3.3802
300	2.4771	250	2.3979	1800	3.2553	2000	3.3010
360	2.5563	190	2.2788	3100	3.4914	1400	3.1461
310	2.4914	300	2.4771	1200	3.0792	1800	3.2553
320	2.5051	370	2.5682	2700	3.4314	1800	3.2553
290	2.4624	320	2.5051	1400	3.1461	2100	3.3222
210	2.3222	200	2.3010	980	2.9912	1000	3.0000
380	2.5911	260	2.4150	1200	3.0792	1800	3.2553
280	2.4472	190	2.2788	1100	3.0414	2300	3.3617
300.00	2.4723	248.89	2.3807	1831.11	3.2214	1844.44	3.2530 X̄

DETECTION THRESHOLD				RECOGNITION THRESHOLD				
Neutral Wds.		Critical Wds.		Neutral Wds.		Critical Wds.		
Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	
S #7:(male)								
49	1.6902	29	1.4624	630	2.7993	620	2.7924	
69	1.8388	29	1.4624	1600	3.2041	600	2.7782	
34	1.5315	43	1.6335	530	2.7243	630	2.7993	
45	1.6532	26	1.4150	670	2.8261	600	2.7782	
33	1.5185	29	1.4624	560	2.7482	470	2.6721	
31	1.4914	46	1.6628	720	2.8573	1900	3.2788	
55	1.7404	31	1.4914	670	2.8261	650	2.8129	
28	1.4472	35	1.5441	650	2.8129	600	2.7782	
36	1.5563	47	1.6721	510	2.7076	530	2.7243	
42.22	1.6075	35.00	1.5340	726.67	2.8340	733.33	2.8238	X̄
S #8:(female)								
21	1.3222	39	1.5911	320	2.5051	440	2.6435	
11	1.0414	21	1.3222	150	2.1761	210	2.3222	
19	1.2788	55	1.7404	420	2.6232	480	2.6812	
11	1.0474	35	1.5441	280	2.4472	370	2.5682	
19	1.2788	18	1.2553	320	2.5051	410	2.6128	
10	1.0000	18	1.2553	240	2.3802	180	2.2553	
21	1.3222	18	1.2553	220	2.3424	170	2.2304	
07	0.8451	16	1.2041	290	2.4624	190	2.2788	
09	0.9542	09	0.9542	230	2.3617	160	2.2041	
14.22	1.1205	25.44	1.3469	274.44	2.4226	290.00	2.4218	X̄
S #9:(male)								
52	1.7160	50	1.6990	170	2.2304	220	2.3424	
46	1.6628	55	1.7404	320	2.5051	160	2.2041	
47	1.6721	39	1.5911	140	2.1461	190	2.2788	
30	1.4771	30	1.4771	140	2.1461	130	2.1139	
29	1.4624	37	1.5682	170	2.2304	120	2.0792	
39	1.5911	34	1.5315	120	2.0792	160	2.2041	
37	1.5682	41	1.6128	120	2.0792	120	2.0792	
46	1.6628	17	1.2304	140	2.1461	280	2.4472	
39	1.5911	32	1.5051	160	2.2041	160	2.2041	
40.55	1.6004	37.22	1.5506	164.44	2.1963	171.11	2.2170	X̄

DETECTION THRESHOLD				RECOGNITION THRESHOLD				
Neutral Wds.		Critical Wds.		Neutral Wds.		Critical Wds.		
Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	
S #10:(male)								
26	1.4150	30	1.4771	220	2.3424	180	2.2553	
36	1.5563	28	1.4472	240	2.3802	160	2.2041	
22	1.3424	31	1.4914	180	2.2553	100	2.0000	
26	1.4150	33	1.5185	200	2.3010	180	2.2553	
25	1.3979	24	1.3802	200	2.3010	150	2.1761	
30	1.4771	26	1.4150	160	2.2041	290	2.4624	
39	1.5911	44	1.6435	210	2.3222	170	2.2304	
28	1.4472	21	1.3222	200	2.3010	200	2.3010	
32	1.5051	26	1.4150	160	2.2041	140	2.1461	
29.33	1.4608	29.22	1.4567	196.67	2.2901	174.44	2.2256	X̄
S #11:(male)								
31	1.4914	31	1.4914	410	2.6128	390	2.5911	
20	1.3010	21	1.3222	270	2.4314	340	2.5315	
53	1.7243	48	1.6812	480	2.6812	400	2.6021	
42	1.6232	24	1.3802	310	2.4914	340	2.5315	
23	1.3617	48	1.6812	510	2.7076	290	2.4624	
18	1.2553	19	1.2788	590	2.7709	1700	3.2304	
42	1.6232	14	1.1461	500	2.6990	550	2.7404	
43	1.6335	22	1.3424	440	2.6435	480	2.6812	
28	1.4472	29	1.4624	430	2.6335	470	2.6721	
33.33	1.4956	28.44	1.4207	437.78	2.6301	551.11	2.6714	X̄
S #12:(male)								
30	1.4771	32	1.5051	680	2.8325	590	2.7709	
36	1.5563	30	1.4771	700	2.8451	360	2.5563	
28	1.4472	27	1.4314	590	2.7902	340	2.5315	
30	1.4771	49	1.6902	1300	3.1139	320	2.5051	
32	1.5051	28	1.4472	390	2.5911	510	2.7076	
40	1.6021	29	1.4624	660	2.8195	710	2.8513	
57	1.7559	41	1.6128	710	2.8513	1000	3.0000	
49	1.6902	29	1.4624	490	2.6902	460	2.6628	
27	1.4314	79	1.8976	2700	3.4314	950	2.9777	
36.56	1.5492	38.22	1.5540	913.33	2.8850	582.22	2.7292	X̄

DETECTION THRESHOLD				RECOGNITION THRESHOLD				
Neutral Wds.		Critical Wds.		Neutral Wds.		Critical Wds.		
Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	Thres. in ms.	Log. Trans.	
S #13: (female)								
35	1.5441	40	1.6021	560	2.7482	820	2.9138	
39	1.5911	40	1.6021	950	2.9777	380	2.5798	
40	1.6021	46	1.6628	1800	3.2553	560	2.7482	
37	1.5682	33	1.5185	410	2.6128	850	2.9294	
39	1.5911	38	1.5798	400	2.6021	320	2.5051	
37	1.5682	39	1.5911	250	2.3979	1700	3.2304	
36	1.5563	42	1.6232	350	2.5441	320	2.5051	
29	1.4624	40	1.6021	620	2.7924	630	2.7993	
29	1.4624	33	1.5185	560	2.7482	360	2.5563	
35.67	1.5495	39.00	1.5889	655.56	2.7421	660.00	2.7519	$\bar{X}$
S #14: (female)								
37	1.5682	34	1.5315	550	2.7404	600	2.7782	
39	1.5911	38	1.5798	980	2.9912	280	2.4472	
32	1.5051	35	1.5441	530	2.7243	600	2.7782	
31	1.4914	32	1.5051	410	2.6128	580	2.7634	
24	1.3802	43	1.6335	610	2.7853	280	2.4472	
20	1.3010	27	1.4314	320	2.5051	600	2.7782	
34	1.5315	40	1.6021	420	2.6232	200	2.3010	
39	1.5911	22	1.3424	330	2.5185	550	2.7404	
24	1.3802	26	1.4150	360	2.5563	420	2.6232	
31.11	1.4822	33.00	1.5094	501.10	2.6730	456.67	2.6286	$\bar{X}$
S #15: (female)								
57	1.7559	41	1.6128	140	2.1461	120	2.0792	
46	1.6628	36	1.5563	120	2.0792	090	1.9542	
51	1.7076	45	1.6532	120	2.0792	100	2.0000	
58	1.7634	49	1.6902	210	2.3222	150	2.1761	
37	1.5682	48	1.6812	070	1.8451	190	2.2788	
45	1.6532	39	1.5911	090	1.9542	220	2.3424	
58	1.7634	50	1.6990	100	2.0000	260	2.4150	
50	1.6990	44	1.6435	210	2.3222	090	1.9542	
50	1.6990	31	1.4914	200	2.3010	200	2.3010	
50.22	1.6969	42.56	1.6243	140.00	2.1166	157.78	2.1668	$\bar{X}$

Appendix V

Hyperbolic Transformation of Raw GSR Data
Experimental Group

DETECTION THRESHOLD

S#	Neutral Words Proportion of GSRs	Neutral Words Hyperbolic Transformation	Critical Words Proportion of GSRs	Critical Words Hyperbolic Transformation
1	.11	.112	.33	.346
2	.22	.226	.22	.226
3	.33	.346	.56	.633
4	.22	.226	.11	.112
5	.22	.226	.11	.112
6	.00	.000	.00	.000
7	.44	.477	.67	.811
8	.11	.112	.22	.226
9	.00	.000	.00	.000
10	.22	.226	.33	.346
11	.00	.000	.33	.346
12	.89	1.422	.67	.811
13	.11	.112	.44	.477
14	.67	.811	.22	.226
15	.44	.477	.56	.633
$\bar{X}$		.318		.354

Hyperbolic Transformation of Raw GSR Data
Experimental Group

RECOGNITION THRESHOLD

S#	Neutral Words Proportion of GSRs	Neutral Words Hyperbolic Transformation	Critical Words Proportion of GSRs	Critical Words Hyperbolic Transformation
1	.22	.226	.33	.346
2	.22	.226	.44	.477
3	.11	.112	.22	.226
4	.00	.000	.33	.346
5	.22	.226	.33	.346
6	.22	.226	.22	.226
7	.56	.633	.78	1.046
8	.22	.226	.67	.811
9	.22	.226	.67	.811
10	.33	.346	.44	.477
11	.67	.811	.89	1.422
12	.44	.477	.67	.811
13	.22	.226	.44	.477
14	.67	.811	.67	.811
15	.56	.633	.78	1.046
$\overline{X}$		.360		.645

Appendix VI

Hyperbolic Transformation of Raw GSR Data
Control Group

DETECTION THRESHOLD

	Neutral Words		Critical Words	
S#	Proportion of GSRs	Hyperbolic Transformation	Proportion of GSRs	Hyperbolic Transformation
1	.33	.346	.11	.112
2	.33	.346	.22	.226
3	.33	.346	.22	.226
4	.33	.346	.11	.112
5	.22	.226	.11	.112
6	.33	.346	.44	.477
7	.11	.112	.44	.477
8	.22	.226	.33	.346
9	.56	.633	.78	1.046
10	.22	.226	.22	.226
11	.56	.633	.33	.346
12	.00	.000	.00	.000
13	.22	.226	.33	.346
14	.33	.346	.67	.811
15	.11	.112	.11	.112
$\bar{X}$		.298		.332

Hyperbolic Transformation of Raw GSR Data
Control Group

RECOGNITION THRESHOLD

S#	Neutral Words Proportion of GSRs	Neutral Words Hyperbolic Transformation	Critical Words Proportion of GSRs	Critical Words Hyperbolic Transformation
1	.44	.477	.33	.346
2	.00	.000	.44	.477
3	.33	.346	.67	.811
4	.67	.811	.33	.346
5	.22	.226	.44	.477
6	.67	.811	.44	.477
7	.56	.633	.56	.633
8	.44	.477	.67	.811
9	.67	.811	.22	.226
10	.00	.000	.33	.346
11	.89	1.422	.89	1.422
12	.00	.000	.00	.000
13	.44	.477	.44	.477
14	.67	.811	.67	.811
15	.11	.112	.33	.346
$\bar{X}$		.494		.534

Vita Auctoris

1940	Born in Sudbury, Ontario, to Walter and Constance Fellbaum.
1946	Educated at St. Paul's Separate Elementary School, Minnow Lake, Ontario.
1959	Graduated from Nickel District Collegiate, Sudbury, Ontario.
1965	Married to Laurette M. Dubreuil, Sudbury, Ontario.
1973	Graduated with degree of Hons. B.A., Laurentian University, Sudbury.
1974	Registered as full-time graduate student at the University of Windsor.