AN INVESTIGATION OF THE PHYSIOLOGICAL MEASUREMENTS OF ANXIETY IN STUTTERING BEHAVIOR

by

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# TABLE OF CONTENTS

**ACKNOWLEDGMENTS** ................................................ ii

**LIST OF TABLES** .................................................. v

**FIGURE** ............................................................ vi

**CHAPTER**

1. **INTRODUCTION** .................................................. 1

   Review of Related Literature .................................... 3

   Definition of Anxiety .......................................... 3

   Stuttering—Learned Behavior with Anxiety Antecedent ........ 5

   Joseph Sheehan—Approach-Avoidance Conflict ................. 7

   Wendell Johnson—Semantogenic/Diagnosogenic Theory .......... 9

   Other Learning Theorists—Anxiety Antecedent ............... 10

   Physiological Measurement Studies ........................... 13

   Heart Rate ....................................................... 14

   Respiration ...................................................... 15

   Biochemical Reactions ......................................... 16

   Pulse Rate and Skin Temperature ................................ 16

   Palmar Sweat and Psychogalvanic Response .................... 17

   Muscle Tension .................................................. 17

   Brain Waves (Electroencephalograms) ......................... 18

   Blood Volume (Plethysmography) ............................... 19

   Anxiety—Cause or Result ....................................... 19
<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>Analysis of Variance--Treatments, Groups, and Interaction</td>
<td>34</td>
</tr>
<tr>
<td>II.</td>
<td>Critical Difference of Means--Comparing Groups, Treatments, and Groups and Treatments</td>
<td>37</td>
</tr>
<tr>
<td>III.</td>
<td>Analysis of Critical Difference Table Comparing Treatment with Treatment by Group</td>
<td>38</td>
</tr>
<tr>
<td>IV.</td>
<td>Analysis of Critical Difference Table Comparing Group with Group by Treatment</td>
<td>38</td>
</tr>
</tbody>
</table>
FIGURE

Showing Relationship of Blood Volume to Habituation Expectancy, Speaking, and Homeostasis for Two Subject Groups (Stutterers are Shown When Stuttering and Not Stuttering) ....................... 39
CHAPTER I

INTRODUCTION

Stuttering is one of the most frustrating and elusive riddles in the area of speech disorders. Consequently, speech pathologists have been compelled to delve into the area of stuttering again and again to determine the etiology of it and the therapy for it. This search has produced few definite conclusions regarding stuttering.

Anxiety is refuted to be a very present factor in stuttering. Because it is deemed important to ascertain the extent of anxiety in stuttering and the effects of it on the individual experiencing it, the author became interested in measuring anxiety in some objective manner. It was thought that if an objective measurement technique could demonstrate that anxiety was indeed present during stuttering behavior, important implications for therapy of the disorder might result.

It is generally agreed among writers in speech pathology that successful therapy depends to a great extent upon the "reduction or removal of the anxiety factor" (West, Ansberry, and Carr, 1957).

Berry and Eisenson (1956) report that stutterers are "anxiety-ridden persons who concretize their anxieties and insecurities in their speech."

Van Riper (1965) describes some of the physiological
reactions that occur due to the anxiety the stutterer feels in anticipation of and in experience of the stuttering moment. The reactions are listed as irregular or abnormal heart, pulse, or breathing rate, along with dilation of the pupils.

Stutterers themselves report certain physiological responses they experience during stuttering to be associated with anxiety reactions. The stutterers list, among others, difficulty with breathing, nervousness, excessive perspiration, feeling of general bodily tension, and increased heart rate (Frasier, 1963).

Nevertheless, the presence of anxiety is subjectively reported and must be considered in this vein until more accurate, objective measurements can be obtained. Measurement of autonomic nervous system reactions by means of a polygraph unit is suggested to be the means productive of an accurate, objective measurement of anxiety before, during, and after the moment of stuttering.

The multitude of research data concerning stuttering covers a wide range of different types of studies (Adler, 1966). However, there is a paucity of current research available concerning anxiety in stuttering.

Modern theorists review stuttering in the light of learned behavior. These theorists advocate that stuttering is learned behavior with an antecedent of anxiety. Anxiety is the drive state which precipitates the
stuttering behavior.

Because of the evolution of this theory, interest is focused on defining, measuring, and assessing anxiety and its importance to the stutterer in his speech behavior.

**Review of Related Literature**

The following discussion will be concerned with the definition of anxiety, a report of stuttering as learned behavior with an antecedent of anxiety, and a report of research in physiological measurements of anxiety taken during stuttering. Adaptation studies involving situational and word induced anxiety will also be discussed.

**Definition of Anxiety**

Santostefano (1960) reports R. May's definition of anxiety as "apprehension cued off by a threat to anything which the individual holds essential to his existence as a personality."

Rosen and Gregory (1968) define anxiety as an "exaggerated state of fear that motivates a variety of behaviors, especially defense behaviors." These authors list the following physical signs as indicative of the presence of anxiety: sweating, tremors, nausea, heart palpitation, and/or irregular breathing.

Wolpe (1958) defines anxiety in terms of the activity of the sympathetic branch of the autonomic nervous system.
which results in increased heart rate and increased pulse rate. The autonomic nervous system arousals are the result of noxious stimuli in the environment causing the resultant fear and anxiety. Since the reactions or arousals experienced in anxiety are similar to those that are experienced when objective fear is a stimulus, Wolpe (1958) maintains that anxiety and fear are virtually the same responses.

Mowrer (1939) discusses anxiety as being basically anticipatory in nature and having great biological utility in that it adaptively motivated living organisms to deal with (prepare for or flee from) traumatic events in advance of their actual occurrence, thereby diminishing their harmful effects. Therefore, it might be concluded that the reduction of anxiety reinforces the behavior that brought about the reduction, whatever that behavior might be. The explanation can be generalized to stuttering behavior with reduction of anxiety being the reinforcing agent. The literature on stuttering refers to this as maladaptive reinforcement.

Anxiety is a learned reaction and must be present before stuttering can begin in an organism (Brutten and Shoemaker, 1967). Therefore, it will be necessary to discuss stuttering behavior from the standpoint of learned behavior with an antecedent of anxiety.
Many points of view are presented concerning the phenomenon of stuttering. It would seem that there are as many theories of the onset and therapy of the problem as there are theorists to postulate them (Johnson, 1958).

A learning theory views stuttering from the standpoint that it has its genesis in the young child's early nonfluencies which are seen as a normal and common phase of speech development (Van Riper, 1965).

In discussing stuttering as learned behavior, it is important to realize that a significant feature is the "stutterer's tendency to have difficulty with his speech whenever he expects to stutter, and to speak fluently when not 'thinking' about his speech" (Adler, 1966).

Adler (1966) proposes that the block has been represented as a reaction of struggle, conflict, anxiety, or fear of speech. This is termed the anticipatory struggle hypothesis by several researchers (Adler, 1966). The anticipatory struggle hypothesis is explained in terms of the stutterer's having difficulty with his speech because he expects to have difficulty with it (Adler, 1966).

The anticipation of failure is the basis of the hypothesis and can be answered possibly in three ways. The three ways are three different theories postulated
by three different men, Joseph Sheehan, George Wischner, and Wendell Johnson (Adler, 1966). It is necessary to discuss these theories individually according to each theorist.

**Joseph Sheehan—Approach-Avoidance Conflict**

Joseph Sheehan (1953) viewed the anticipatory struggle behavior primarily as a conflict between opposing drives to speak and to hold back from speaking. A vicious circle ensues so that when the stuttering response occurs, the fear is reduced thus releasing the feared word, and consequently reinforcing the stuttering (Sheehan, 1953).

Two central hypotheses are stated by Sheehan. These are as follows:

1. **Conflict Hypothesis**—the stutterer stops whenever competing approach and avoidance tendencies reach an equilibrium.
2. **Fear Reduction Hypothesis**—during the moment of stuttering, there must be sufficient reduction of fear, conflict and avoidance tendency to permit release of the blocked word. (Sheehan, 1953)

Sheehan and Voas (1954) offer the following hypothesis that the stutterer "caught in an approach-avoidance conflict would be expected to advance toward the feared goal only so long as the approach gradient is higher, and then to stop or oscillate at the point where the avoidance gradient becomes higher." The above explanation of the approach-avoidance conflict applies to stuttering behavior.
George Wischner—Stuttering
as Avoidance Learning

George Wischner (1950) formulated his theory chiefly around studies of adaptation and expectancy. Adaptation is defined as the reduction of frequency in stutterings with repeated readings of the same passage (Wischner, 1950). Expectancy is defined as the ability of the stutterer to predict very accurately on which words he will stutter.

Wischner (1950) assumed stuttering to be learned behavior; and therefore, asserted that some reward must function as a reinforcement. As a result of his studies, Wischner (1950) indicated that the reward consisted of a reduction in the stutterer's anxiety. Therefore, it can be said that the reduction in anxiety maladaptively reinforces the stuttering behavior.

Stuttering bears many earmarks of conditioned learning. The conditioned stimulus is postulated to be the adult's disapproval of the child's speech. The unconditioned response is the normal nonfluency. The conditioned response is the stuttering produced by the painful reactions. Consequently, the act of stuttering may be reinforced by a close temporal contiguity with anxiety reduction upon speaking (Wischner, 1950).

According to Mower, there are two separate and distinct kinds of learning:
(1) sign learning—process whereby the fear gets shifted from unconditioned stimulus to conditioned stimulus.

(2) solution learning—process whereby an organism acquires the correct, effective instrumental response needed to lessen or eliminate the fear. (Mower, 1968)

Mower (1968) reports that the instrumental avoidance training type of learning is what Wischner refers to when he describes stuttering as a learned anxiety reaction system. It is Wischner's hypothesis that the noxious stimulus that is encountered by the child elicits anxiety which leads to a disintegration of the child's speech in which the child seeks to avoid the noxious stimulus (Mower, 1968). Generalization occurs so that sounds, words, and situations become associated with noxious stimulation as well as do the disapproval reactions of parents and others. Avoidance of the noxious words and situations is reinforced by anxiety reduction as is the stuttering behavior that results (Mower, 1968).

Since stuttering is also punishing, it might be in line to explain how the same thing could also be rewarding. It would seem that it depends upon whether the punishment or reward is present first in a closely timed sequence of events. If the punishment is first, and the reward second, the difference will be in favor of the punishment. On the other hand, if the reward is first, and the punishment second, the difference will be in favor of the reward. It is hypothesized that in stuttering, the initial consequence
is probably rewarding due to the immediate reduction of
the unpleasant emotional state of anxiety during the
stuttering moment (Mower, 1968).

**Wendell Johnson—Semantogenic/ Diagnosogenic Theory**

Wendell Johnson (1963) proposes that stuttering does
not develop before the diagnosis is made, but after it.
He states that stuttering is associated with the attitudes
and reactions to it. Therefore, according to Johnson,
stuttering is a learned set of actions, reactions, and
attitudes (Adler, 1966). Dr. Johnson suggests that a
child becomes a stutterer only after he has been labeled
one (Sheehan, 1951).

Johnson (1959) discusses the child's responsiveness
to the mother's reactions to his speech. He feels that
the mother reacts to the ways in which the child responds
to her reactions through her posture, facial expression,
tone of voice, or choice of words. The child may interpret
any pointedly expressive actions as being indicative of
some degree of disapproval of some unidentified or more or
less clearly designated aspect of his speech. Therefore,
the child may react by rejecting the mother's reaction
through a display of indifference to it. Or, he may accept
the mother's reaction as being a valid one through a display
of concern over it. Varied responses may occur if the
child internalizes the concern or insecurity he experiences.
from the mother's disapproval. The child may respond by speaking less, or more hesitantly, and nonfluently, or with decreased spontaneity and expressiveness, or with increased muscular tension (Johnson, 1959).

Other Learning Theorists—Anxiety Antecedent

Bloodstein (1960) sees stuttering as essentially a reaction of struggle or avoidance performed in response to the anticipation of speech interruption—if not at its inception then at least in a so-called "secondary" stage of its development. The secondary stuttering is viewed as an anticipatory reaction of struggle or avoidance which has arisen through anxiety over primary stuttering. The anticipation is a conscious awareness of the ugly forewarning of danger by which many stutterers can actually predict when they will block. This conscious anticipation is demonstrated in stages ranging from mild to severe uneasiness and is reflected in an increased heart and pulse rate. Therefore, the avoidance of speaking can be interpreted as a sign of a strong emotional reaction to stuttering (Bloodstein, 1960).

Robinson (1965) reviews Murphy's and Fitzsimons' theory of stuttering behavior as arising from anxiety. The author states that Murphy and Fitzsimons view a conflict in interpersonal relationships to be at the core of the anxiety. Nevertheless, Murphy and Fitzsimons do
not consider stutterers to be neurotic. Rather, to them, stuttering is presumed to be a "learned, nonintegrative, self-defensive reaction to anxiety or fear of threatening circumstances with which the person feels incapable of coping" (Robinson, 1965).

Murphy and Fitzsimons list five general sources of the underlying anxiety:

(1) suppression or domination sufficient to threaten self autonomy,
(2) extreme and chronic inconsistency of adult handling,
(3) too many experiences characterized by derogation, belittling, or rejection,
(4) complete lack of external controls, and
(5) fears and guilt feelings generated by a child's reactions to the foregoing experiences. (Robinson, 1965)

Robinson (1965) concurs with some of the other theorists in reporting that in spite of the abnormality and additional problems connected with stuttering, the behavior is reinforced by its success in reducing the unpleasant emotion of anxiety. Even so, relief is temporary and the fear grows and stuttering behavior increases.

Stuttering behavior as a learned response to the stimulus of speech anxiety is proposed by Luper and Mulder (1964). These authors state that the problem becomes one of the learning theorists' S-R (stimulus response) bond or conditioned response. At first, the child's response is not yet conditioned to the "habit" stage (Hull's $sHr$).
However, it is soon occurring often enough to increase the habit potential. Paraphrasing Hull's theory of learning, Luper and Mulder (1964) state:

... the stimulus of anxiety leads to a response of excess tension in the speech musculature. Each time this particular pattern is repeated—the combination of anxiety, tension, and subsequent anxiety reduction—the possibility of excess tension becoming habitually attached to the stimulus of anxiety is increased.

The stuttering child must talk. Luper and Mulder (1964) report that for the stuttering child silence breeds anxiety. Many stutterers, showing a fear of silence, filibuster furiously in their speech to keep any pause from becoming dangerously long. Since most stuttering occurs initially, then silence plus initiation of speech becomes a conditioned cue for the painful experiences of anxiety and stuttering (Luper and Mulder, 1964).

Eugene Brutten and Donald Shoemaker (1967) agree that stuttering is learned behavior developing as a result of experience. These authors "accept the importance of negative emotion (fear, anxiety, stress, etc.) as a basic antecedent to stuttering" (Brutten and Shoemaker, 1967). Many other communication theorists concur with their theory.

Brutten and Shoemaker (1967) postulate a two-factor theory of the genesis of stuttering. They ascribe to Joseph Wolpe's theory in general that stuttering is initiated as speech disintegration in the primary charac-
teristics through classical conditioning. This constitutes factor one of the two-factor theory. However, these authors differ with Wolpe on the acquisition of the secondary characteristics of stuttering behavior. They maintain, instead, that the secondary characteristics are acquired through instrumental learning. This is the second factor of the two-factor theory advocated by Brutten and Shoemaker.

Physiological Measurement Studies

Physiological measurement of anxiety comes from the mechanical recording of the arousals of the autonomic nervous system. Van Riper (1965) reports that the arousals that can be measured by instruments are increased heart rate, abnormal breathing patterns, deviations in brain waves, vascular changes, and abnormal electrodermal and psychogalvanometer reflexes. Van Riper (1965) states that these are the physiological correlates of the stutterer's struggle or fear, i.e., anxiety.

Adler (1966) also reports that the physiological evidence of anxiety is found in an increase in palmar sweat reaction (moist hands), as well as increased perspiration in general, and irregularities of respiration. The fact that the stutterer fears stuttering and, hence, is often thrust into stressful situations, causes him to manifest these physiological reactions (Adler, 1966).

Heltman (1943) suggests that the "muscular tensions
and spasms during stuttering speech are very much like bodily manifestations in fear or in terror."

West (1958) cites some authorities who report that the physiological reaction differences in stutterers and nonstutterers are not significant. Others, at the same time, report that the differences in anxiety reactions are very significant (West, 1958).

There has been a multitude of experimental studies of the measurements of physiological reactions to stuttering. Thus, it is necessary to review these studies in depth.

**Heart Rate**

Golub (1953) states that on oral reading, the heart rate for stuttering groups and nonstuttering groups was not significantly different. However, after the reading, the heart rate of the stutterers did not drop back as rapidly to normal or in such a great amount as did the heart rate of the nonstutterers.

Travis, Tuttle, and Cowan (1936) in a study of the heart rate during stuttering found that the heart rate of stutterers varied more than the heart rate of the nonstutterers. These researchers suggested that the variability of heart rate in stutterers is the result of increased emotionality felt by the stutterer (Travis, Tuttle, and Cowan, 1936).
Respiration

Fossler (1930), using a pneumograph and laryngograph to measure disturbances in breathing during stuttering, found that stutterers had 52 percent more variability than "normals" in the time of inspiration of breath and 46 percent more variability than "normals" in time of expiration. These differences were found to be significant.

Van Riper (1936), using a pneumograph connected to a polygraph, found a high correspondence between expectancy and the occurrence of the stuttering block. This was reflected by the pneumograph recordings of high inspiration-expiration ratio variability during stuttering as well as during the expectancy of stuttering.

Within the limits of their study, Starbuck and Steer (1954) found that during successive oral readings of the same passage, adult stutterers demonstrated statistically significant respiratory alterations accompanying the adaptation effect. There was a significant reduction in both the number of complete thoracic breathing cycles and complete abdominal breathing cycles in this study (Starbuck and Steer, 1954).

Sedlacek (1947-48) and Robbins (1919) both noted changes in breathing in studies of stuttering attacks.
Biochemical Reactions

Johnson (1959) reports that Hill collected data that supposedly would distinguish stutterers from nonstutterers on the basis of differences in physiological reactions. While Hill was unable to definitely distinguish between the two groups utilizing measurements of physiological reactions, he did find degrees of physiological and biochemical reactions associated with stuttering to be comparable to those experienced in contending with threatening, frustrating or distressing situations (Johnson, 1959).

Pulse Rate and Skin Temperature

Sedlacek (1947-48) noticed several changes in the skin innervation in attacks of stuttering. These were vasomotor changes such as a flushed or pale face and profuse sweating on the upper lips, alae nasi and forehead. Sedlacek (1947-48) also reports that changes of skin temperature taken during stuttering showed a great disturbance of the sympathetic nerves. The pulse rate difference noted during stuttering implied a pathological irritation was occurring (Sedlacek, 1947-48).

Moore (1959) found that stutterers under an anesthesia-level hypnosis experienced more blocks when discussing unpleasant experiences, and that the blocks were accompanied by significant increases in pulse rate.
and significant decreases in blood sugar.

Robbins (1919) attempting to confirm Bluemel's theory of cerebral congestion as a cause of stuttering discovered that finger vasoconstriction (decreased blood volume) occurred during stuttering.

**Palmar Sweat and Psychogalvanic Response**

Brutten (1963), using palmar sweating as an indicator of the part anxiety plays in adaptation, discovered that palmar sweat scores decreased when related to disfluency reduction in stutterers; however, decrement in palmar sweat scores was not related to the disfluency adaptation of the nonstutterers. This finding is interpreted to mean that anxiety is primarily a factor working in conjunction with stuttering speech behavior and not a factor working in nonstuttering speech behavior (Brutten, 1963).

Using the psychogalvanic reflex as a dynamic test of sympathetic nerve function in stutterers, Imaseki (1964) found that the technique reflected the anxiety-tension the stutterers were experiencing during the stuttering behavior.

**Muscle Tension**

Sheehan and Voas (1954) studied muscle tension in relation to the approach-avoidance conflict. These researchers found that more tension occurred at the end of the block than at the beginning, concurring with previous
predictions made about the conflict theory. The increase in tension, it is felt, results from the fear-reduction which must occur during the moment of stuttering for the release to take place (Sheehan and Voas, 1954).

**Brain Waves (Electroencephalogram)**

Douglas (1952) informs that within limits of his study the stutterer may be differentiated from the nonstutterer on the basis of greater cortical reactivity in the dominant hemisphere to emotional stimuli. Knott, Correll, and Shepherd (1959), using an electroencephalographic investigation to evaluate "anxiety-proneness" from a neurological point of view, revealed statistically significant differences between stutterers and matched controls (nonstutterers), as well as between the stutterers themselves.

Donna Fox (1966) reports reduced synchronization and rhythm ratios of the electroencephalographic (EEG) analysis of stuttering subjects as compared to nonstuttering subjects. The greater variability of the trends of the data analyzed suggests that the stuttering behavior appears to be more disruptive to brain wave rhythms in stutterers than to rhythms in nonstutterers who mimic stuttering. The lack of consistency in findings that neurophysiological differences exist between stutterers and nonstutterers suggests that any differences are the result of specific
stuttering behavior, and that anxiety experienced by the stutterer probably causes the differences in the EEG's (Fox, 1966).

**Blood Volume (Plethysmography)**

A study conducted in the Soviet Union investigated vascular reactions at the moment of expectancy of pronouncing words "with and without stuttering; with and without emotional reactions (conscious and unconscious)" (Kurshev, 1968). Twenty adult stutterers and ten non-stutterers were used as subjects in this study. It was reported that "vasocostruction was noted in expectancy, appearing much more frequently in stuttering" (Kurshev, 1968).

**Anxiety--Cause or Result**

Most authorities doing research do not take a stand on whether anxiety is a causal or resultant factor in stuttering behavior, but rather they attempt to show that there is a correlation between the two (Santostefano, 1960). Therefore, it is suggested that more research is needed to clarify any relationship between anxiety and stuttering in order to subsequently derive a more successful technique of therapy (Santostefano, 1960).

**Adaptation Studies--Situational and Word Induced Anxiety**

In the present exploration of anxiety, a reference to
situational and word induced anxiety must be included. For, as Brutten and Shoemaker (1967) point out, stuttering is not a consistently occurring phenomenon. These authors further explain that not only do certain words present difficulty for the individual who stutters, but various speaking situations also constitute a factor leading to anxiety.

Sheehan (1953) discusses five levels of conflict. These are: "(1) word; (2) situational; (3) emotional content; (4) relationship; and (5) ego-protective." An analysis of the levels is subsequently made by Sheehan. He states that there is conflict at the word level "between the urge to speak the word and the urge not to speak the word" (Sheehan, 1953). The conflict at the situational level parallels the word level conflict, for there is ambivancy in approach to the feared situation. Emotional and verbal content of the words also creates a conflict which gives the stutterer difficulty in speaking apart from situational or word induced conflict. In terms of relationship, there is a close relationship between the occurrence of stuttering and the role the stutterer plays with his listener. As long as the stutterer is in the dominant role in the relationship, he usually remains fluent. However, if he finds himself in an inferior role, fluency usually dissolves. Stuttering can be a lifelong defense mechanism, keeping its possessor out of threatening
competition, and this explains the ego-protective level of conflict. Even though stuttering can be discussed in terms of all of the conflict levels, it should be remembered that the disorder manifests itself at the word level; so that in a fundamental sense, stuttering remains a "conflict between speaking and not speaking" (Sheehan, 1953).

Johnson (1963) proposes that stuttering comes to be expected. The expectation of stuttering is apprehensive, characterized by anxiety in some degree, ranging from very mild to quite severe. The anxious or apprehensive expectation "comes to be associated with and to be elicited by the sounds, words, listeners, and other cues or features of situations in relation to which stuttering has been experienced in the past" (Johnson, 1963). Danger signals associated with the stuttering function to perpetuate the vicious cycle of stuttering. When danger is anticipated, the stutterer avoids all that is associated with that danger, whether it be words, sounds, or situations. But, the avoidance he practices is the stuttering itself, thus, the vicious cycle. The more intense the anxiety, the more severe the avoidant responses. Thus, Johnson (1963) feels that if the anxiety could be weakened, "the frequency and severity of the avoidant reactions—of the stuttering, that is—" could be reduced. Therapy is advantageous, therefore, if it serves to reduce the concern and anxiety felt by the stutterer about his stuttering.
Van Riper and Hull (1963) demonstrate in a study conducted that during a situation held constant of variation, stutterers exhibited a progressive decrease in the frequency of blocks when reading a paragraph of narrative material aloud several times. However, with the introduction of new situations, the number of blocks increased significantly. In short, this study supports the importance of certain situations in stuttering behavior.

Shulman (1963) found in a study he conducted that adaptation (decrease in frequency of blocks through repeated readings of material over a period of time) was significantly greater in a simple audience situation, i.e., one listener, than in a complex audience situation, i.e., five unfamiliar listeners. Again, situation proves to be an important factor in stuttering behavior.

Dixon (1963) also found that the less complex or threatening the situation, the greater is the adaptation. She used an audience situation (five listeners); telephone situation; and examiner situation (examiner as the only listener) in her study.

The effects of word anxiety were explored in a study conducted by Arnold Golub (1963). Two word segments, one remaining constant and one varying, were used. Significantly greater adaptation occurred on the constant word segment readings than on the varying ones. In all instances of reading, the physical environment was kept constant.
Therefore, no situation factor entered the study.

Maribel Hopper Connett's study of the frequency of stuttering on specific speech sounds tends to demonstrate that certain sounds are stuttered upon more frequently than are others. The experimenter states that she feels that the sounds are those that the stutterer anticipates as being more difficult than others. Implications for therapy are suggested that the stutterer's attention not be directed to specific sounds in order to reduce the stuttering frequency, thus the stuttering occurrence (Connett, 1963).

Berwick (1963) conducted a study in which stutterers read to photographs of "easy" and "hard" listeners as well as to the blank, reverse side of the photographs. There was a significant increase of stuttering when the subject read aloud to the front-view photograph of the "hard listener." There was less increase in stuttering when the subjects read aloud to the front-view photograph of the "easy listener." Reading aloud to the back of the photograph produced some increase in stutterings, but the increase was not significant. The results of this study tend to support the theory that a relationship between listener and speaker is important in stuttering behavior.

The studies of situational and word induced anxiety lend support to a discussion of the importance of the
operation of these factors in stuttering behavior. In addition, there is an implication that if anxiety is reduced, the frequency of stuttering is, in turn, reduced.

Purpose and Scope of Thesis

From the standpoint of the inconsistencies in findings and scarcity of current research in measurements of anxiety reactions during stuttering behavior, plus the implied importance in view of therapy technique, this author was prompted to undertake an investigation of physiological responses occurring immediately prior to, during, and immediately after the moment of stuttering. The purpose of this thesis is to report findings obtained during polygraphic recordings of blood volume and two different measurements of skin temperature during stuttering and nonstuttering behavior.

Hypothesis

The null hypothesis tested was that no differences between groups or among conditions would be recorded when specific physiological measurements of stuttering and nonstuttering behavior were taken.
CHAPTER II

METHODS AND PROCEDURE

This chapter will be concerned with a discussion of the subjects, equipment, procedure of experimentation, and analysis of data that were used in the investigation reported.

Subjects

Two groups of subjects, an experimental group of stutterers and their matched normal controls, were used for this study. The two groups consisted of ten subjects each, seven males and three females per group.

A group of ten adult stutterers, seven males and three females, were matched according to sex, and as closely as possible by body weight, height, and age, with ten adult normal control subjects. The age range of the females for both groups was from twenty to twenty-three years, with a mean age of twenty-one years, three months. The age range of the males for both groups was from twenty-two to forty-two years with a mean age of twenty-seven years, five months. Nine members of the stuttering group had been diagnosed as secondary stutterers prior to this study. One member, not clinically diagnosed as a stutterer, nevertheless, exhibited secondary stuttering behavior as evaluated by two graduate students in speech pathology. Nine of the
stutterers had received therapy for their stuttering, ranging from four and one-half months to twenty-four years, with a mean amount of therapy of seven years, two months. All subjects were questioned about the possibility of their having heart trouble. No subject reported experiencing any disorder of the heart.

Equipment

Polygraph

A Grass Model 5D Polygraph with three channels: blood volume (reflectance Photoelectric Transducer, Model RPT1); two skin temperatures (Preamplifiers, Model 5P1, with PGR position of input selector used for measuring the resistance changes in thermistors resulting from changes in temperature connected); and two telethermometers (Model 43TD, calibrated with a base line of eighty-five degrees, a lower limit of seventy-five degrees, and an upper limit of ninety-five degrees) was used to record the physiological responses of the subjects. Six-inch, three-channel polygraph chart paper (Type C25-6"-1X5-G) was used in the unit. The chart speed was 2.5 mm/per second.

Words

Fifty words chosen with initial sounds that the stutterers had reported having difficulty with were printed in black ink on five-inch by seven-inch, white
index cards. A list of the words used in the experiment can be found in Appendix B.

**Additional Equipment**

A one-half-inch diameter green signal light, manually operated by the experimenter, was positioned before the subject as a warning for both word presentation and moment for the word to be spoken.

A twelve-inch square, black cloth was used to cover the hand to which the photoelectric transducer was attached. This was done to eliminate the ambient light from the fixtures in the laboratory used for the experiment.

A small metal stand was used to hold the index card on which the word was printed. It was of the type ordinarily used by students to hold a book open while studying.

Adhesive tape was used to attach the electrodes to each subject.

An Ingraham stop-watch was used for timing the expectancy and homeostatic periods.

**Experimental Environment**

The experiment was conducted in a class-room-sized laboratory located in the Psychology Building on the Texas Tech University Campus. The room was automatically heated and air-conditioned; therefore, the temperature was relatively constant. The experimenter was the only observer present and each subject was tested individually.
Most of the testing was accomplished during the spring-break vacation; consequently, hall noise was at a minimum.

**Procedure**

The subjects were contacted and scheduled for one and one-half hour sessions. No subject was told the extent or purpose of the study prior to the onset of the study.

Thirty minutes prior to the start of each session the console power of the polygraph unit and the tele-thermometers were switched on to allow adequate warm-up prior to experimentation.

The subject entered the room and was seated in an armed-chair behind a small wooden table. The polygraph unit was positioned behind a wooden partition in the room, partially out of the subject's sight.

During testing, the experimenter was seated across the table from the subject in a straight-backed chair, so that the polygraph chart paper was accessible for observation and making of notes. The signal light was located behind and three feet above the experimenter's head in a metal frame. The experimenter held the switch for the light, manually operating it with the left hand. A stopwatch was held in the experimenter's right hand. The stack of cards with the words printed on them rested face down in the experimenter's lap, awaiting presentation. A small, metal stand stood on the table before the subject.
to hold the card during the expectancy period.

The reflectance photoelectric transducer was attached with adhesive tape to the second finger of the left hand of each subject, being previously determined to be the most successful digit for measuring of blood volume. The photoelectric transducer is a lightweight surface recording device which monitors relative changes in vasomotor tone or pulsatile blood flow. The instruction manual (1969) states the following as the principle of operation of the reflectance photoelectric plethysmograph:

The photoelectric transducer operates on the principle that light is absorbed in tissue in relation to the amount of blood contained in its vascular bed. The reflecting optical system of the device directs a ring of light into the tissue which is dispersed, a portion of it being reflected out again. The returning incident light, upon striking a photocell, changes the electrical resistance of the photosensitive surface in proportion to the incident light intensity. Any variation in blood content of the tissue is therefore, exhibited in a change in photocell resistance, consequently producing a change in the voltage drop across the photocell. These voltage changes are then amplified sufficiently to drive the oscillograph pen to obtain a continuous recording of pulsatile blood flow in the tissue under observation.

An alligator clip, serving as a ground to produce a clearer reading, was attached to a piece of loose clothing on each subject.

One temperature electrode was attached with adhesive tape to the second finger, a low-blush area, of the right hand of each subject. The other temperature electrode was
attached with adhesive tape to the back of the neck, a high-blush area, of each subject.

The piece of black cloth was placed lightly over the left hand of each subject.

Each subject was instructed to become as comfortable as possible in the chair and remain as motionless as possible for the duration of the testing session.

After the electrodes were attached to the subject and the subject instructed to remain motionless, the polygraph pens and ink were switched on. A fifteen-minute habituation period was afforded each subject with the polygraph recording responses during this time.

During the habituation period the experimenter explained the procedure for the testing in the following manner:

"You will see a green light (turn signal light on) and at the same time a word will appear in this stand (indicate the metal stand in front of the subject). The light will remain on for a period of time. Observe the word. After you have said the word, the card will be removed. The light will remain off for a period of time. Then, the cycle will begin again in exactly the same manner. Do you have any questions?"

When the habituation period ended, the word presentation began. The experimenter switched on the light, presented the word, and started the stopwatch all at the same moment. The light remained on for thirty seconds with the word exposed. The word was spoken after the light was switched
off, then the word was removed, and the light remained off for thirty seconds.

During presentation of the word, with the light on, the signal marker on the polygraph automatically recorded the thirty-second period with a wide, black line on the chart paper.

When the light went off, the stopwatch was stopped, the word was spoken by the subject, the stopwatch started again, and the chart paper was marked by the experimenter according to whether the subject stuttered or did not stutter. This procedure was performed for each of the words in succession until all fifty had been used.

At the end of the testing period, each subject was unattached from the electrodes of the polygraph unit. Then, each was asked to comment on the experiment, giving impressions experienced while performing the task required of him.

**Analysis of Data**

The data from this study was analyzed by means of an analysis of variance, treatment by level design. Lindquist (1956) states the following concerning this type of analysis:

The treatments x levels design provides for direct control of inter-subject variations. In this design the treatments are administered to samples that have been "matched" with reference to a "control" variable or variables . . . . The principal advantage of this design over the simple-randomized design is that it provides a direct control of Type S errors . . . . Another
advantage of the treatments x levels design is that it permits a separate study of the treatment effects at different levels of the control variable . . . . The major purpose of the design is to increase the precision of the treatment comparisons by "matching" the treatment groups with reference to a "control" variable related to the criterion variable. In the generalized case of this design, involving a number of treatments, all available subjects (presumably either a random or a representative sample from some specified population) are divided into different groups or "levels," the numbers in these groups being in the same proportion as the numbers in the corresponding levels in the entire population.

A t test, between the means of two independent samples, was used to analyze the two conditions of habituation. A critical difference between means was used to determine where the significance was in the AOV.

Raw data was obtained from a count made of the responses of blood volume recordings after they were marked off into three sections: expectancy, word, and homeostasis, for each of the fifty words for each of the twenty subjects. A period of habituation was also marked off for both subject groups. It will be recalled that habituation took place over a period of fifteen minutes prior to presentation of the first word. The point selected for measuring habituation was arbitrarily determined and defined as a period extending for one inch beginning four inches back from the point at which the first card was presented. Samples of the recording for expectancy, word, homeostasis, and habituation are illustrated in Appendices C, D, E, F, and G, respectively.
Ten stuttered and ten not stuttered words were selected from the recorded material for each subject in the experimental group. Ten words were selected from the recorded material for each subject from the control group. The words chosen were all randomly selected by starting in the middle of the fifty words and counting both ways until ten of each type had been selected from the chart paper.

The operational measure was the number of millimeters of excursion made by the recording pen from which anxiety was to be inferred. For every word selected for inclusion in the analysis, all excursions of the pen were counted, totalled, and averaged. It is the average score for expectancy, for word, and for homeostasis that became the raw score to be used in the analysis. (Raw data summary is found in Appendix A).

A predetermined 5 percent level of confidence was chosen to be the level of significance necessary for this study.
CHAPTER III

RESULTS AND DISCUSSION

The results of the statistical analyses, along with appropriate tables to aid in interpretation and explanation of the findings, will be found in this chapter. Furthermore, a discussion section is included which suggests ramifications of this particular problem in terms of past and future research.

Blood Volume Results

An analysis of variance was made of the raw data obtained during the experiment. The F ratios of the analysis of variance among groups (G), and among treatments (A) were not significant at the predetermined 5 percent level of significance, as seen in Table I.

TABLE I

ANALYSIS OF VARIANCE--TREATMENTS, GROUPS, AND INTERACTION

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>M/S</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Among Subjects</td>
<td>1,604.01</td>
<td>29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Among Groups (G)</td>
<td>109.20</td>
<td>2</td>
<td>54.60</td>
<td>.99</td>
</tr>
<tr>
<td>Residual I</td>
<td>1,494.81</td>
<td>27</td>
<td>55.36</td>
<td></td>
</tr>
<tr>
<td>Within Subjects</td>
<td>70.81</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Among Treatments (A)</td>
<td>.42</td>
<td>2</td>
<td>.21</td>
<td>.19</td>
</tr>
<tr>
<td>Interaction (AG)</td>
<td>10.82</td>
<td>4</td>
<td>2.71</td>
<td>2.46*</td>
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<tr>
<td>Residual II</td>
<td>59.57</td>
<td>54</td>
<td>1.10</td>
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<tr>
<td>Total</td>
<td>1,674.82</td>
<td>89</td>
<td></td>
<td></td>
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</tbody>
</table>

* significant at 5.7 percent level
This means that there was no significant difference between the control group and the stuttering group with the data from the three treatments (Expectancy, Word, and Homeostasis) pooled. Nor was there a significant difference among the expectancy, the word, or the homeostasis treatments with the data from the groups pooled. Whereas, the interaction of groups by treatments was also not significant at the 5 percent level (F ratio 2.46 with 2.50 needed), it was so close to significance that a power test was made to determine the level of significance. Significance was found at the 5.7 percent level. Perhaps even one or two more subjects would have yielded significance at the 5 percent level. This means that when the groups are observed in terms of the interaction by treatments, there is an important difference.

In order to determine where the significance was among the various means of the groups by treatments interaction, a study of critical difference of means was made using the following formula:

\[ M_A - M_B = t_{.05} \times \sqrt{\frac{\sigma^2}{N}} \]

Where

\[ \sqrt{\frac{\sigma^2}{M_A - M_B}} = \sqrt{\frac{2(\sigma_w^2)}{N}} \]

and

\[ \sigma_w^2 = \text{the } M/S \text{ within } = 1.10 \text{ (from Table I)} \]
The critical difference was found to be 5.40. Table II shows where the significance was in terms of the interaction.

Tables III and IV were then derived to more clearly show what these mean differences really indicated. See page 37 for Table II, and page 38 for Tables III and IV.

It was discovered that for the control group when the expectancy treatment was compared with the word treatment, or with the homeostasis treatment; or the word treatment with the homeostasis treatment, no significance in the difference of means was found. Also, when the interaction of the three treatments were compared in the stuttering group when the subjects did not stutter, no significance was found in the difference of means.

However, when the interaction of the three treatments were compared in the stuttering group when the subjects stuttered, the comparison of expectancy with the word was found to be significant as was the comparison of the word with the homeostasis treatments. But, the expectancy treatment when compared with the homeostasis treatment in this group was not significantly different.

However, when the groups were compared in terms of the treatments, significance was found in all instances. Table IV shows that for the expectancy treatment when the control group is compared with the stuttering group when stuttering (S) or not stuttering (NS) or when the
<table>
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<td>11.00*</td>
<td>33.43*</td>
<td>1.67</td>
<td>14.80*</td>
<td>20.45*</td>
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<td></td>
<td>9.33*</td>
<td>19.33*</td>
<td>5.04</td>
<td>17.39*</td>
<td>14.37*</td>
<td>1.24</td>
<td>4.41</td>
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<td></td>
<td></td>
<td>28.66*</td>
<td>14.37*</td>
<td>8.06*</td>
<td>23.70*</td>
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<td>4.92</td>
</tr>
<tr>
<td>$A_2G_1$</td>
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<td></td>
<td></td>
<td>14.29*</td>
<td>36.72*</td>
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<td>18.09*</td>
<td>23.74*</td>
</tr>
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<td></td>
<td></td>
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<td>22.43*</td>
<td>9.33*</td>
<td>3.80</td>
<td>9.45*</td>
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<td>31.76*</td>
<td>18.63*</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>13.13*</td>
<td>18.78*</td>
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<td>$A_3G_2$</td>
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<td></td>
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<td></td>
<td></td>
<td>5.65*</td>
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$CD = 5.40$

* = Exceeds $CD$
### TABLE III
ANALYSIS OF CRITICAL DIFFERENCE TABLE COMPARING TREATMENT WITH TREATMENT BY GROUP

<table>
<thead>
<tr>
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<th>Expectancy with Word</th>
<th>Expectancy with Homeostasis</th>
<th>Word with Homeostasis</th>
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</thead>
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<tr>
<td>Control Group</td>
<td>3.29</td>
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<td>4.96</td>
</tr>
<tr>
<td>Stutterers (No stuttering)</td>
<td>5.04</td>
<td>1.24</td>
<td>3.80</td>
</tr>
<tr>
<td>Stutterers (Stuttering)</td>
<td>8.06*</td>
<td>4.92</td>
<td>12.98*</td>
</tr>
</tbody>
</table>

CD = 5.40
* = Exceeds CD

### TABLE IV
ANALYSIS OF CRITICAL DIFFERENCE TABLE COMPARING GROUP WITH GROUP BY TREATMENT

<table>
<thead>
<tr>
<th></th>
<th>Control with Stutterers(NS)</th>
<th>Control with Stutterers(S)</th>
<th>Stutterers(NS) with Stutterers(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expectancy</td>
<td>16.04*</td>
<td>25.37*</td>
<td>9.33*</td>
</tr>
<tr>
<td>Word</td>
<td>14.29*</td>
<td>36.72*</td>
<td>22.63*</td>
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<tr>
<td>Homeostasis</td>
<td>13.13*</td>
<td>18.78*</td>
<td>5.65*</td>
</tr>
</tbody>
</table>

CD = 5.40
* = Exceeds CD
stuttering group (NS) is compared with the stuttering group (S) that significance is found between all means. Also, for the word treatment and homeostasis treatment when the same groups are compared, all mean differences are significant.

The habituation condition was analyzed separately by means of a t test. A t test was made between the means of the control group and the means of the stuttering group, and the difference was significant at the 5 percent level.

The figure below graphically shows the relationship of the blood volume to habituation, expectancy, speaking, and homeostasis for the two subject groups, with the stuttering group shown when the subjects stuttered and when they did not stutter.

Fig.—Showing relationship of blood volume to habituation expectancy, speaking, and homeostasis for two subject groups (stutterers are shown when stuttering and not stuttering).
The reader will recall the situational and word induced anxiety discussed in Chapter I. Figure 1 presents a splendid example of the interaction of these two entities. One can see from both curves attributed to the stuttering group (Curves B and C) an increase in the amount of anxiety over that demonstrated for the control group (Curve A). However, the amount of anxiety was less for the stuttering subject on a word upon which he does not expect to stutter. It is therefore assumed that the anxiety demonstrated is precipitated by the situation (generally speaking a verbal situation) rather than anxiety attributed to a specific word. The figure obviously indicates also that a greater amount of anxiety occurs when the stutterer is confronted with a word on which he expects to stutter and ultimately on which he does stutter.

Another possible explanation for Curve B on which the stutterer does not stutter is that he expects to stutter, hence anxiety is present, but then, finally he does not stutter. The author assumes this to be a less likely assumption than the previous one proffered.

Habituation for the stutterers is the same when stuttering or not stuttering because both stuttered words and not stuttered words occurred on each individual stuttering subject's chart recording, and habituation was recorded only at the first of each session.
Temperature Results

It was impossible, with the existing equipment and procedures, to quantitatively analyze the data obtained from the two skin temperature measures. Appreciable changes in measurement were not found. An observation of the data revealed that anxiety was demonstrated in a lowered skin temperature on the fingers of some of the subjects who experienced anxiety more strongly than did others. One subject, Experimental Number Six, exhibited a finger skin temperature in the lowest range, below seventy-five degrees, during the entire experimental session.

Discussion

After participation in the experiment, each subject was given an opportunity to comment upon his impressions and feelings that he experienced during the experimental session. The following paragraphs contain the reports of the various comments made by the subjects.

Four of the experimental subjects reported that they suffered from asthma as compared to only one of the control subjects.

Seven of the ten experimental subjects reported that they had felt anxious just before they produced the word. One experimental subject reported that the "expectancy" time seemed extremely long to him.

Another experimental subject reported that she had
employed a "click" in the timed signal marker as a "pacer" to assist her in controlling blocks. And, she stated that if she had not used this device, she would have created her own rhythm technique in another manner. Still another subject stated that he deliberately ignored the rhythmic sound emitting from the polygraph unit to avoid identifying with it for a method of controlling blocks.

One experimental subject reported that if she thought about the word itself, she had more trouble in producing it; therefore, she attempted to make an association out of the word and contemplate that association. Another experimental subject stated that on some words he felt extremely anxious if that particular word were associated with a situation in which he had experienced a "bad time," i.e., stuttering behavior. Three of the experimental subjects reported that they experienced a degree of relief after each word was produced.

Only two out of ten control subjects reported that they experienced any anxiety connected with production of the words. All ten of the control subjects suggested that the words chosen for the experiment were "interesting." Only one of the control subjects reported an awareness of the rhythmic clicking produced by the machine.

It was noted that not one control subject accidentally stuttered or experienced a nonfluency during the experiment.

The hypothesis of the experiment was that no differences
in anxiety between groups or among conditions would be recorded when certain physiological measurements were obtained during stuttering and nonstuttering behavior. The significance of the analysis of the results suggests that this hypothesis can be rejected at the 5.7 percent level of confidence.

However, it should be noted that this experiment did not reveal whether or not anxiety is a causal or resultant factor in stuttering behavior. It did not originally set out to determine this factor.

Even so, the positive results in this experiment reveal that further investigation of the anxiety factor related to stuttering behavior is vitally important and necessary to further knowledge regarding the disorder and the therapy for it.
CHAPTER IV

SUMMARY AND CONCLUSIONS

The following chapter is a resume of the present study, including the purpose, procedure, results, and conclusions.

**Purpose**

The purpose of this study was to objectively and quantitatively determine whether anxiety was present during the expectancy period occurring prior to an actual stuttering moment or not.

**Procedure**

Twenty subjects, ten adult normal controls and ten adult experimentals were used in the study. The experimentals were all individuals who exhibited stuttering behavior. Fourteen males and six females participated in the study. The mean age for the males was twenty-seven years, five months. The mean age for the females was twenty-one years, three months.

Each subject was attached to three electrodes connected to a Grass 5D Polygraph unit. One electrode measured skin temperature on a finger (a low-blush area); another electrode measured skin temperature on the back of the subject's neck (a high-blush area). The third electrode, a photoelectric transducer for digital
plethysmography, measured blood volume and was attached to another finger.

Prior to presentation of the words to be spoken, each subject experienced a fifteen-minute habituation period.

Fifty words, one at a time, were presented to each subject, while he was attached to the polygraph unit. A thirty-second expectancy period was given during which the word was exposed and the subject had to anticipate production of it. Then, after the production of each word, a thirty-second homeostasis period was given before another word was exposed. Each word was presented simultaneously with a signal light. The light-word exposure time lasted for thirty seconds. The light was then extinguished and the subject spoke the word. Following the verbalization of the word, a period of homeostasis, lasting for thirty seconds, occurred before presentation of the next word.

The words used in the experiment were chosen after each stutterer submitted a list of initial consonant sounds reported to give him difficulty in speaking.

Physiological measurements of anxiety were obtained during the experiment being recorded by the polygraph unit on Grass six-inch chart paper. The chart paper was marked according to whether the subject stuttered on a word or did not stutter.
The data obtained in this study was analyzed by means of a treatment by level design analysis of variance and a t test.

Results

The F ratios of the analysis of variance among groups (G), and among treatments (A) were not significant at the predetermined 5 percent level. The F ratio of the analysis of variance of the interaction of groups by treatments was significant at the 5.7 percent level, determined by a power test. It was noted that perhaps two more subjects per group would have made the results significant at the 5 percent level.

A t test made between the means of the control group and the stuttering group for the habituation period was significant at the 5 percent level.

The hypothesis on which this study was based was as follows: No differences among groups, stutterers—stuttering and not stuttering, and nonstutterers or among conditions—expectancy, word, and homeostasis, are recorded when physiological responses of blood volume and two different skin temperature measures are obtained.

The data obtained in this study produced results so that the hypothesis can be rejected at the 5.7 percent level of confidence.

Due to the type of equipment used in this experiment,
no quantifiable measurements of skin temperature were sensitive enough for analysis. Nevertheless, observation revealed typical physiological responses of skin resistance to reactions of anxiety occurring during the stuttering behavior.

Conclusions

It should be noted that the number of subjects for both the control and experimental groups was small, and that the results of the experiment should be considered in view of that fact.

Still, even within the limitations of this study, the author felt that some conclusions could be reached:

1. It can be concluded that anxiety reactions are present during stuttering behavior, particularly in expectancy to stutter.

2. The anxiety reactions can be objectively measured and analyzed.

3. The present study tends to substantiate the theory that the stuttering block reduces the anxiety, thus reinforcing the stuttering behavior.

4. No cause or result position can be taken because of the results of this study regarding the relationship of stuttering behavior to anxiety, or vice versa.
5. More research into the relationship of anxiety and stuttering behavior is indicated by the present study, with possible implications for therapy.
BIBLIOGRAPHY

Books


**Articles and Periodicals**


APPENDIX

A. Summary of Raw Data

B. Words Used in Experiment

C. Representation of Blood Volume Excursion for the Stuttering Group Before, During, and After a Stuttered Word

D. Representation of Blood Volume Excursion for the Stuttering Group Before, During, and After a Not Stuttered Word

E. Representation of Blood Volume Excursion for the Stuttering Group During Habituation

F. Representation of Blood Volume Excursion for the Control Group Before, During, and After a Spoken Word

G. Representation of Blood Volume Excursion for the Control Group During Habituation
### APPENDIX A: SUMMARY OF RAW DATA

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<th></th>
<th>Expectancy</th>
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<th>Homoeostasis</th>
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<td></td>
<td></td>
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<tr>
<td>S1</td>
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APPENDIX C

$B_1$ EXPECTANCY (BEFORE STUTTERED WORD)

$C_1$ WORD (STUTTERED)

$D_1$ HOMEOSTASIS (AFTER STUTTERED WORD)
$B_2$ EXPECTANCY (BEFORE WORD NOT STUTTERED)

$C_2$ WORD (NOT STUTTERED)

$D_2$ HOMEOSTASIS (AFTER WORD NOT STUTTERED)
APPENDIX E

A\textsubscript{1} HABITUATION (STUTTERER)
B₃ EXPECTANCY (NON STUTTERER)
C₃ WORD (NON STUTTERER)
D₃ HOMEOSTASIS (NON STUTTERER)
A2 HABITUATION (NON STUTTERER)