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CHAPTER I

INTRODUCTION

Speech may be viewed as a chain of physiological events which succeed each other in time. The question of whether it is the phoneme or the syllable which forms the individual units or links of this chain is not of primary importance in this study. The primary factor considered is that each unit, regardless of its designation, has a duration during which specific movement or movements of the speech musculature must occur in order to produce a smooth, uninterrupted flow of speech. The units of speech at this level are not equal in duration and are subject to considerable variation within the same speaker under various conditions.

The sequential nature of speech is presented visually by means of the sound spectrograph. A speech sample recorded by sound spectrograph depicts time along the horizontal axis, frequency along the vertical axis and intensity by means of the relative shading of markings. It is easily seen from these records that duration of individual sound units is an important aspect of speech production. In addition, these records also demonstrate the difficulties involved in defining the true unit of speech. That is, consonants and vowels blend into each other in such a subtle fashion that, for the most part, it is impossible to assign any point of division between them. This, however, does not negate the fact that each phoneme does possess some characteristics which are unique to that phoneme.

Not only do sound units of short duration occur but apparently the perception of these units must also occur, as has been shown through delayed auditory feedback. In this technique a speaker's voice is amplified and fed back to him through earphones after a short time delay. Variable delay times have been employed. However, those within the range of 0.1 second to 0.25 second are typical. Black and Lee, making simultaneous reports of investigations carried out independently, described the effect of delayed auditory feedback in terms of disturbances in fluency, articulation, speech sound duration, fundamental frequency and sound pressure level.

Normal and stuttered speech under conditions of delayed auditory feedback were compared by Neelly. This investigation involved the question of an implied similarity between the speech disturbances of normal speakers under conditions of delayed auditory feedback and the speech disorder of stuttering. The speech of stutterers was also studied under conditions of delay and non-delay. He concludes:

> According to the measures used in this experiment, there are differences between stuttering behavior and speech behavior under conditions of delayed auditory feedback. The hypothesis that stuttering may be somehow related to a delay in auditory feedback . . . is not supported by the findings of this experiment.[1]

It is clear, however, that under conditions of delayed auditory feedback, a marked disturbance does occur in speech which apparently can be attributed to a temporary disorientation in the speech timing mechanism.

The maximum rate for speech sound production is stated by Stetson as 6 - 8 syllables per second or 10 - 12 consonants per second.[2] Miller, using the data presented by Hudgins and Stetson, arrives at a rate estimate of five syllables per second during conversational speech by subtracting two syllables

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[1]James N. Neelly, "A Study of the Speech Behavior of Stutterers and Nonstutterers under Delayed and Normal Auditory Feedback," Journal of Speech and Hearing Disorders, Monograph Supplement 7 (June, 1961), 81.

[2]R. H. Stetson, Bases of Phonology (Oberlin, Ohio: Oberlin College, 1945), p. 49.

from the original data to allow for breathing and change of articulatory position. He then estimated that the average syllable contains 2.5 speech sounds and computes an average rate of 12.5 speech sounds per second in speech at conversational speed.[1] Kelly and Steer recorded two minute extemporaneous speech samples from each of their subjects. Using voice activated instrumentation, their results are probably a more accurate measurement of speaking time than was the estimate given by Miller. Kelly and Steer found the average duration for syllables spoken by their subjects to be .154 second.[2] This corresponds to a rate of 6 - 7 syllables per second.

In addition to duration, speech sound units have another characteristic which makes articulation of speech sounds a unique behavior. Each sound of speech has a unique acoustical character. This difference is so outstanding that even a minimally trained speech therapist can detect the misarticulation of a single consonant sound in conversation.

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[1]George A. Miller, Handbook of Experimental Psychology, ed. S. S. Stevens (New York: John Wiley and Sons, Inc., 1951), p. 793.

[2]J. C. Kelly and M. D. Steer, "Revised Concept of Rate," Journal of Speech and Hearing Disorders, XIV (September, 1949), 225.

This character is achieved by specific movement and positioning of the articulating structures. Any slight deviation in movement or position may result in a change in the acoustical character of the sound produced. It follows, then, that in this special sense, speech sounds are antagonistic to each other. That is, they must follow each other in time and cannot occur simultaneously. Probably no other behavior requires movements which occur so rapidly and, at the same time, involves such abrupt changes in direction.

It is important to note the anticipatory nature of speech production with respect to abrupt directional changes coupled with rapid rate of production. The shortness of the intervals in question makes it seem highly improbable that a speaker consciously perceives one unit of speech before proceeding to the next unit. Yet, the speech musculature does, in fact, require a certain interval of time to produce each unit and the transitions between units. Since a change in the direction of movement occurs so rapidly, it follows that the neurological correlates of these muscular movements must also be in a state of rapid, precise fluctuation and that discrimination in terms of very short time intervals must be made if speech is to be produced appropriately. From this point of view, then, a speaker must discriminate time intervals which are appropriate to his production of speech sound units.

The duration of these discriminated intervals, though variable, would appear to be less than .20 second. Using the Kelly and Steer data given above, .154 second appears to be the average interval if the syllable is considered as the unit, while the Stetson data would indicate that .08 second (12.5 per second) is appropriate if the individual speech sound is used as the unit. If the nervous system fails to make these discriminations accurately, it can be conjectured that a piling-up, gapping, or some other disruption would occur in the sequential chain of physiological events. In other words, this could result in what is commonly called disfluency. Disfluency is defined by the Speech Foundation of America as follows:

> . . . refers to any kind of speech which is not smooth or fluent. All speakers talk disfluently at times, i.e., they hesitate or stumble in varying degree. All stutterers are disfluent but all disfluency is not stuttering. For instance "disfluency" could describe the developmental hesitations of a child learning to talk or the arrhythmic breaks in the speech of an adult, etc. Some clinicians use the term "nonfluency" originally introduced by Johnson who later, at the suggestion of Robert West, replaced it by the term "disfluency."[1]

Looking at speech in these terms it can be seen that

[1]Speech Foundation of America, Stuttering Words, A Glossary of the Meanings of Words and Terms as Used in Association with Stuttering and Its Treatment (Memphis: Speech Foundation of America, 1956), p. 13.

disfluency represents behavior which is variable. Some people hesitate, repeat sounds, and generally stumble a great deal while speaking; others do not. The point to be made is that disfluency is present to some degree in all speech. The question to be asked concerns the degree of disfluency present in all cases. In short, normal speech is imperfect speech.

Disfluency is not only variable, it can be quantified, i.e., instances of this behavior can be identified and counted. This procedure thus yields a measurement of disfluency which satisfies the requirements of experimental scientific study. Individuals may be ranked in terms of disfluency scores and various groups may be measured and compared.

Disfluency in the speech of young children has been a matter for investigation for some time. Quantitative data regarding repetitions of sounds, words, and phrases first pointed up the statistical nature of disfluency. This information has been of special interest in speech pathology because of the apparent similarity between disfluency and stuttering. Specifically, controversy has arisen with regard to the amount of disfluency present in the speech of young children who later develop stuttering and whether or not these children show excessive repetitions of the syllable type.

Recently, Johnson investigated disfluency in the speech of normal adult speakers and stutterers. He also measured speaking and reading rate and extended the definition of disfluency to include the eight categories of: (1) interjections of sounds, syllables, words, and phrases, (2) part word repetitions, (3) word repetitions, (4) phrase repetitions, (5) revisions, (6) incomplete phrases, (7) broken words, and (8) prolonged sounds. A more complete discussion of this study will be found in Chapter II of the present investigation.

Van Riper directly relates disorders of time or rhythm to the problem of stuttering. He says:

> One of the dimensions of speech is time. We speak sequentially. Sound follows sound, . . . Only when the timing of our sounds and syllables is so far off the standard that our speech is conspicuous, unpleasant, or unintelligible do we have a disorder of rhythm. In stuttering we have such a disorder.[1]

Eisenson also directly relates stuttering to a time factor. His perseverative theory of stuttering would indicate that the basic defect in stuttering is the tendency of speech responses to last for a longer than normal time, i.e., to perseverate. In discussing therapy he says:

> Most therapists who employ rate control usually ask their patients to speak more slowly rather than more rapidly. In this slower rate of speaking, we may be

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[1]Charles Van Riper, Speech Correction: Principles and Methods (4th ed; Englewood Cliffs: Prentice-Hall, Inc., 1963), pp. 22-23.

> helping the stutterer to adjust to his capacity for linguistic formulations and their articulatory expression. . . . At the modified, slower rate, the stutterer is afforded the time he needs for changing his mental and motor sets according to his inclinations.[1]

Most stutterers report, and certainly their stuttering behavior appears to support them, that they feel pressed for time during the act of stuttering. Sheehan writes:

> A basic feature of stuttering behavior is that the stutterer is under time pressure to a great extent. He comes to learn to dread pauses, and the room settles around him with awful stillness when he begins to speak. The stutterer's block always seems longer than it really is, both to the stutterer and to his listeners. . . . This finding is in a process of verification as a part of a program of research into the effects of time pressures on stuttering.[2]

An additional consideration forming the basis of this study is the probable relationship between the accuracy of time perception and the prevailing physiologic state of the organism. The perception of time is unlike perception of most other stimuli for which specialized end organs and mechanisms exist. Woodrow says:

> Time is not a thing that, like an apple, may be perceived. Stimuli and patterns of stimuli occupy physical

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[1] Jon Eisenson, (ed.), "A Perseverative Theory of Stuttering," Stuttering: A Symposium (New York: Harper and Brothers Publishers, 1958), p. 263.

[2] Joseph Sheehan, "Conflict Theory of Stuttering," ibid., p. 143.

> time; and we react to such stimuli by perceptions, judgments, comparisons, estimates, etc.[1]

Thus, time perception is a skill. The ordering of external and internal stimulations enables us to maintain orientation in time. Many attempts have been made to find relationships between the various biological rhythms and the ability to perceive time, but without success. A review of this line of research is presented in Chapter II of the present investigation.

However, it is implied that perceived time may be subject to the same kinds of distortions which exist in the perception of other types of stimuli. For example, the perceived brightness of a light is in part dependent upon the brightness of the background or the brightness of immediate past stimulation; the loudness of a tone is dependent upon the loudness of background noises. It can thus be postulated that the condition or physiological state of the organism may have an effect on the subjective experience of time at any given moment.

In summary, it appears that the perception of time, in terms of discrimination of short intervals, is related to

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[1]Herbert Woodrow, "Time Perception," Handbook of Experimental Psychology, ed. S. S. Stevens (New York: John Wiley and Sons, Inc., 1951), p. 1235.

disfluency of speech and to stuttering. It is the purpose of this investigation to study these relationships.

Statement of Purpose

It is the purpose of this study to assess the abilities of stutterers and nonstutterers in a time discrimination task and to investigate the possible relationship between disfluency of speech and the ability to discriminate between timed intervals of short duration. The time discrimination ability of stutterers and nonstutterers will be assessed under two conditions, anxiety and no-anxiety. Disfluency will be measured by analysis of tape-recorded speech samples according to the procedures set forth by Johnson.

The questions for which answers will be sought are: (1) Do stutterers differ significantly from nonstutterers in the ability to make liminal discriminations between timed intervals under the condition of no-anxiety?, (2) Do stutterers differ significantly from nonstutterers in the ability to make liminal discriminations between timed intervals under the condition of anxiety?, (3) For stutterers, do time discrimination scores under the condition of anxiety differ significantly from time discrimination scores under the condition of no-anxiety?, (4) For normal speakers, do time discrimination scores under the condition of anxiety differ significantly from time discrimination scores under the condition of no-anxiety?, (5) Is there significant relationship between time discrimination ability and disfluency of speech?

CHAPTER II

REVIEW OF THE LITERATURE

It was the purpose of this study to compare the time discrimination abilities of stutterers and nonstutterers and to investigate the possible relationship between disfluency and time discrimination ability. As indicated in Chapter I, the production of speech sounds at conversational speed involves articulator movements of very short duration accompanied by abrupt directional changes. It was suggested that the nervous system is required to discriminate between time intervals appropriate to the duration of individual speech sounds in order that speech may occur without interruption. The time intervals involved appear to fall within the range of .08 second to .154 second. It was also suggested that failure of the nervous system to discriminate accurately between time intervals falling within this range could result in disfluency of speech and possibly be associated with the problem of stuttering.

This chapter shall be limited to a discussion of time perception. The literature may be divided into two sections: (1) methods of measurement, and (2) factors affecting time perception.

Methods of Measurement

Measurement in the field of time perception may be affected by several factors. Some of these involve the inability to present two or more timed intervals simultaneously, the transitory nature of stimulation by timed intervals, the effects of other stimulations which may occur simultaneously with any given timed interval, and the direction of attention throughout the interval to be judged. The methods of measurement now available range from those appropriate for very long intervals to those appropriate for short intervals. In addition, some of the methods involve the ability of the subject to manipulate clock time units, while others require the subject to perform some act or operation in order to demonstrate the magnitude of their perception in terms of physical time. It is consistent with the purpose of this study to discuss various methods and techniques of measurement in time perception to enable the reader to understand the method used in this investigation.

The methods employed in time estimation experiments have been described by Bindra and Waksberg, Clausen, and by Wallace and Rabin. These methods are: (1) verbal estimation, (2) production, (3) reproduction, and (4) comparison (discrimination). Each of these will be discussed in detail.

In the method of verbal estimation, the subject is required to state in clock time units, usually seconds, his estimate of the duration of an interval presented by the examiner through some operative means such as two clicks of sound or flashes of light. The subject is unaware of the actual duration of the stimulus interval and usually is instructed not to use any obvious criterion, such as counting, in making his estimate. A warning signal of some type usually precedes the stimulus interval, insuring the subject's attention. This method has obvious advantages in the ease with which it can be used. However, an equally obvious disadvantage lies in the fact that fractions of seconds are not easily handled verbally.

Gulliksen employed the method of verbal estimation in his study of the effect of occupation of attention on ability to estimate time. The subjects were told in advance that they were engaged in a time estimation experiment and were assigned different activities for each of the eight, 200 second, stimulus intervals. The subjects were specifically instructed not to use counting, beating time, or marking off seconds as aids to estimation. In addition, they were asked to give their entire attention to the activity presented, then "look back and estimate time."[1] Siegman instructed his subjects not to use counting in making verbal estimations of intervals presented to them by means of the clicks made by a stop watch.[2] Stimulus intervals of 4 to 27 seconds were verbally estimated in a study by Schaefer and Gilliland. The subjects were instructed not to count or use rhythmical devices and to "report their estimates in seconds or fractions of a second."[3] In an experiment involving need-tension, Rosenzweig and Koht required subjects to estimate time spent in problem solving with no foreknowledge that a time estimation would be required.[4] Henrikson also informed his subjects that they would be required to estimate

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[1]Harold Gullikson, "The Influence of Occupation upon the Perception of Time," Journal of Experimental Psychology, X (February, 1957), 52.

[2]Aron W. Siegman, "Anxiety, Impulse Control, Intelligence, and the Estimation of Time," Journal of Clinical Psychology, XVIII (January, 1962), 104.

[3]Vernon G. Schaefer and A. R. Gilliland, "The Relation of Time Estimation to Certain Physiological Changes," Journal of Experimental Psychology, XXIII (July, 1938), 546.

[4]Saul Rosenzweig and Aase Grude Koht, "The Experience of Duration as Affected by Need-Tension," Journal of Experimental Psychology, XVI (December, 1933), 748.

time spent presenting an extemporaneous speech.[1] Longer time periods were employed in a study by Vernon and McGill. Subjects were confined for varying periods of time in an unlighted, sound treated chamber for a mean period of 54.25 hours and were informed in advance that a time estimation would be required of them.[2] Clausen employed the method of verbal estimation with schizophrenic patients. Using stimulus intervals of 5, 10, and 15 seconds, the investigator pressed a telegraph key which activated either a buzzer or a light signal. If the buzzer was employed to delineate the stimulus interval, Clausen classified it as a filled interval. If the light stimulation was used, the interval was classified as unfilled.[3] As will be discussed, this use of the term unfilled perhaps differs from the definition traditionally employed.

The method of verbal estimation, then, requires the subject to make a verbal estimate in clock time units of an

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[1]Ernest H. Henrikson, "A Study of Stage Fright and the Judgment of Speaking Time," Journal of Applied Psychology, XXXII (October, 1948), 533.

[2]Jack A. Vernon and Thomas E. McGill, "Time Estimation During Sensory Deprivation," Journal of Genetic Psychology, LXIX (July, 1963), 12.

[3]John Clausen, "An Evaluation of Experimental Methods of Time Judgment," Journal of Experimental Psychology, XL (December, 1950), 575.

interval presented operatively by the investigator. Comparison of these studies is made difficult by the introduction of variables which possibly have effects that are not clear. For example, the subject may or may not be informed that a time estimate is expected, he may or may not be required to perform some task during the interval to be judged, he may or may not be allowed to use counting devices, and finally, the intervals themselves may or may not be filled with some form of continuous stimulation, such as tone or light. Similar difficulties are encountered in the evaluation of studies employing the other methods of measurement in time perception.

The method of production is a reversal of the method of verbal estimation. The investigator states the duration of a desired interval to which the subject responds operatively by marking off his estimate of such an interval. A classic example of production is seen in a study by Falk and Bindra. In this study, the subjects were asked to mark off a 15 second interval by pressing and releasing a key which activated a time measuring device. During the interval the subjects looked at a color exposed on a memory drum and were instructed not to move about or otherwise occupy themselves.[1] In a study by

[1]John L. Falk and Dalbir Bindra, "Judgment of Time as a Function of Serial Position and Stress," Journal of Experimental Psychology, LXVII (April, 1945), 280.

Langer, Wapner, and Werner, time was perhaps filled for the subject. Each was blindfolded and placed on a movable cart. An electrically operated chronometer was connected to a button situated on the cart. The drive motor of the cart was activated by the same button and moved the cart toward an open stairwell. The subjects were tested individually and delineated their estimate of a five second interval by pressing and releasing the button.[1] As a part of a study by Gardner, subjects were not instructed with regard to how they were to estimate a one minute interval. A bell was struck twice by the subjects to mark off their estimate. The intervals were timed with a stop watch.[2] Hoagland, using one subject, required that a one minute interval be marked off by counting at an estimated one count per second.[3]

Both the method of production and that of verbal estimation involve the manipulation of clock time units. That

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[1]Jonas Langer, Seymour Wapner, and Heinz Werner, "The Effect of Danger upon the Experience of Time," American Journal of Psychology, LXXIV (March, 1961), 95.

[2]William A. Gardner, "Influence of the Thyroid Gland on the Consciousness of Time," American Journal of Psychology, XLVII (October, 1935), 699.

[3]Hudson Hoagland, "The Physiological Control of Judgments of Duration," Journal of Genetic Psychology, IX (March, 1933), 269.

is, the subject is required to verbalize an estimation of an interval or he is required to produce an interval, the length of which has been verbalized by the investigator. One of the aspects of time perception upon which there is high agreement is that the ability to deal verbally with clock time units is dependent upon cultural training.[1] Cohen says, "Temporal precision, however, is not necessarily of equal importance in all civilized countries."[2] Wallace and Rabin write, "The relationship of the personal experiences to conventional units of time is learned and depends upon the cultural setting from which a person originates."[3]

The final two methods of measurement in time perception do not depend upon clock time units. In the method of reproduction, both the stimulus and the response intervals are presented operatively. Typically, a standard interval is presented by the investigator. For example, this may be accomplished by two clicks of sound (an unfilled interval) or by a continuous

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[1]A. R. Gilliland and Dorothy Humphreys, "Age, Sex, Method, and Interval as Variables in Time Estimation," _Journal of Genetic Psychology_, LXIII (September, 1943), 175.

[2]John Cohen, "The Experience of Time," _Acta Psychologica_, X (May, 1954), 213.

[3]Melvin Wallace and Albert I. Rabin, "Temporal Experience," _Psychological Bulletin_, LVII (May, 1960), 231.

sound (a filled interval). The subject has at his disposal a means of creating a similar interval which he employs in an effort to reproduce the duration of the stimulus interval.

The reaction time of the subject probably places severe limitations on this method when very short intervals are studied. The subject simply is unable to move his hand rapidly enough to delineate time intervals that approximate the threshold for duration. In discussing this, Doehring says, "He cannot produce intervals shorter than 0.1 sec., since his maximal tapping speed is about 10 per sec."[1]

A study by Gilliland and Humphreys compared the methods of verbal estimation, production, and reproduction. Using eight intervals ranging from 9 to 180 seconds, they found no significant differences between these methods.[2] One-half the subjects were instructed to count the seconds, while the remaining subjects were specifically instructed not to count. Analysis of this variable revealed that time estimation errors were, "significantly smaller when the subjects were allowed to count."[3]

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[1]D. G. Doehring, "Accuracy and Consistency of Time-Estimation by Four Methods of Reproduction," _American Journal of Psychology_, LXXIV (March, 1961), 27.

[2]Gilliland and Humphreys, _Journal of Genetic Psychology_, LXIII, 126.

[3]_Ibid_.

Hawkes, Joy, and Evans compared the method of production with that of reproduction under conditions in which certain drugs were administered to subjects. They found that time estimates were correlated with certain physiological variables when the method of production was used, but not when the method of reproduction was employed. They concluded that fundamental differences may exist between these two methods.[1]

The method of comparison (discrimination) is described by Bindra and Waksberg as a variation of the method of reproduction. Two intervals are presented operatively by the experimenter. The subject compares these two durations and indicates which is longer than the other.[2] It should be noted that the method of discrimination does not require that clock time units be manipulated, nor is the subject required to delineate time intervals operatively. Typically, he is provided an answer sheet on which he indicates whether the second interval appeared longer or shorter than the first. The

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[1]Glen R. Hawkes, Robert J. T. Joy, and Wayne O. Evans, "Autonomic Effects on Estimates of Time: Evidence for a Physiological Correlate of Temporal Experience," Journal of Psychology, LIII (January, 1962), 191.

[2]Dalbir Bindra and Helene Waksberg, "Methods and Terminology in Studies of Time Estimation," Psychological Bulletin, LIII (March, 1956), 155.

discrimination method thus makes possible the use of a stimulus selection procedure for scoring, producing a total score for each subject in terms of correct or incorrect responses. Blakely used the method of discrimination and stimulus selection procedure in a study of the normative thresholds for durations. He concluded, "Discrimination was the keenest when the variables were compared with a standard of 0.6 second."[1] That is, his subjects were able to make finer discriminations (more correct responses) when a .6 second interval was paired with another interval than they could when a .3 second interval was paired with another interval.

The effect of intensity and quality of the stimulus on ability to discriminate timed intervals was studied by Henry. In this study, some of the pairs of intervals were equal in duration and some were unequal. Continuous tones were used to delineate filled intervals ranging from "30 msec. to nearly 1/2 sec. in length."[2] Each subject was required to indicate whether the two tones of each pair were equal or unequal. He

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[1]William A. Blakely, "The Discrimination of Short Empty Temporal Intervals," (unpublished Ph.D. dissertation, Dept. of Psychology, University of Illinois), p. 73.

[2]Franklin M. Henry, "Discrimination of the Duration of a Sound," Journal of Experimental Psychology, XXXVIII (December, 1948), 734.

concluded that the intensity with which the stimulus intervals are presented do not affect time discrimination ability.[1]

Cowles and Finan employed the discrimination method in a study of the time perception abilities of white rats.[2] Rats were confined in an ante-chamber for either 10 or 30 seconds before a screen was raised to allow them into the test chamber. The test chamber contained two exit doors through which the rats could leave. One of these exit doors led to food. Exit through the other door did not lead to reward. One door hid the reward for the 10 second interval and the other door hid the reward for the 30 second interval. Correct choices could always be made if the rat discriminated accurately between the two intervals. The authors conclude that white rats do have the ability to discriminate time intervals of these magnitudes.[3]

Anchor effects on time estimates by the method of discrimination was the subject of a study by Wallace and Rabin. The term anchor effect refers to the tendency of the subject

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[1] Ibid.

[2] John T. Cowles and John L. Finan, "An Improved Method for Establishing Temporal Discrimination in White Rats," Journal of Psychology, XI (April, 1941), 337.

[3] Ibid., 341.

to make a favored response. For example, .8 second might serve as an anchor for a given subject. If the difference between two timed intervals discriminated by him is less than .8 second, he will tend to err in the direction of .8 second when making his estimate and vice versa. The authors state, "These studies . . . demonstrate the anchor effect upon the estimation of very brief intervals (usually, fractions of a second to about two seconds)."[1]

An additional variable which must be accounted for with the employment of the method of discrimination is that of order. Only in discrimination are two stimulus intervals presented. Since these differ in duration and cannot be presented simultaneously, the ability of the subject to discriminate between them may be affected by the order in which this presentation occurs. The effect of order for longer intervals is not clear. However, for very short time intervals this effect can be eliminated by randomized order.[2]

An overview of all four of these methods indicates that basic theoretical differences exist between them. This would appear to be especially true with regard to the variable

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[1]Wallace and Rabin, Psychological Bulletin, LVII, 220.

[2]Woodrow, 1235.

of verbalization of clock time units. However, examination of the literature indicates that little consideration has been given to these possible differences. Bindra and Waksberg compared the methods of verbal estimation production, and reproduction and their theoretical uses as reported in the literature. They write, "Thus, one investigator uses the method of reproduction in the study of a problem while another employs the method of verbal estimation for the same problem."[1]

Filled and unfilled time must be considered with regard to all four of the methods of measurement. Unfilled time is defined as an interval delineated by some signal such as two clicks of sound or flashes of light with no stimulation continuing throughout the duration of the interval. Filled time however, may be used to refer to the physical characteristics of the interval or it may be used to refer to the activity of the subject during the interval to be judged. An immediate difficulty can be seen with regard to the question of application of this term to the subject or to the stimulus interval. The role of attention in each of these concepts is not clear. A more basic difficulty perhaps is the inability to establish

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[1]Bindra and Waksberg, Psychological Bulletin, LIII, 155.

any interval with assurance that it is, in fact, empty for the subject.[1,2]

Although filled versus unfilled time does not appear to be a significant variable with regard to an interval created for stimulation, in another application it does appear to have significance. Gulliksen secured time estimates from subjects engaged in various activities. He found that the type of activity engaged in by the subject did affect time estimation ability.[3] This, of course, applies to longer intervals.

If the terms filled and unfilled are defined strictly in terms of the stimulus intervals, little or no effect of this variable has been found. Woodrow referred to intervals of very short duration and stated that essentially the same results are achieved by the use of empty intervals, continuous tone, or continuous light.[4] Hawkes, Joy, and Evans report that equivalent results are achieved by the use of continuous tone, continuous light, or cutaneous stimulation.[5]

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[1]A. R. Gilliland, Jerry Hofeld, and Gordon Eckstrand, "Studies in Time Perception," Psychological Bulletin, XLIII (January, 1946), 166.

[2]Blakely, p. 2.

[3]Gulliksen, Journal of Experimental Psychology, X, 59.

[4]Woodrow, p. 1235.

[5]Hawkes, Joy, and Evans, Journal of Psychology, LIII, 184.

Another consideration with regard to measurement in time perception is that of sex. Generally, early studies in the field found significant sex differences. However, more recent studies appear to be in agreement that sex differences in time estimation do not exist. The situation is summed up by Gilliland, Hofeld, and Eckstrand drawing attention to the cultural effects on time perception. They say:

> It seems likely that the modern woman is called upon to make time estimates as often as men. Since time perceptions are primarily dependent upon learning the sexes probably do not differ in ability to estimate time.[1]

In summary, the following factors were considered in choosing a method of measurement to be used in this study: (1) the length of the intervals to be estimated, (2) the use of filled versus unfilled time, (3) the effect of cultural training, (4) the age of the subjects to be tested, and (5) sex.

As stated in Chapter I, the durations of interest in this study probably fall within the approximate range of .08 second to .154 second. The extreme shortness of these intervals raised serious questions with regard to the employment of the methods of verbal estimation, production, or reproduction. For these methods the performance criteria are that

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[1]Gilliland, Hofeld, and Eckstrand, Psychological Bulletin, XLIII, 168.

clock time units be verbalized or that physical movements occur to delineate intervals of these magnitudes. Information gathered from the literature indicated that subjects could not be expected to meet these criteria with regard to very short intervals.

With regard to filled versus unfilled time, the nature of speech would indicate that filled time would be most appropriate as time is filled for a speaker. Although a considerable amount of confusion was found in the literature with regard to filled time, studies employing very short intervals suggest that equivalent results are obtained with either approach.

The literature further indicated that the effect of cultural training on time estimation ability is probably a significant variable, though its greatest effect is probably seen with the use of verbal estimation and production since these methods involve clock time units. In any event, the degree of precision with which a person times his daily activities probably has some effect on his ability to estimate time.

There is general agreement in the more modern literature that sex and age have little or no effect on time estimation ability of the adult. Ability in this area is considered as a developmental process reaching maturity the early teenage. Indications are that estimation ability remains fairly constant in the adult.[1]

The method of discrimination, then, was chosen for use in this study. It was found to be appropriate in terms of the length of the intervals, avoidance of many of the difficulties involved in the use of filled versus unfilled time, and can satisfactorily be employed in terms of sex, age, and cultural training of subjects.

Factors Affecting Time Perception

The physiological processes have been of interest in the area of time perception for a number of years. Many attempts have been made to find some correlation between time estimation ability and one or more of the rhythmical physiological processes. Some theoreticians have placed great stress on the ability of man to estimate time without reference to external cues or stimulation. They have, therefore, been interested in finding some evidence of an internal time keeping mechanism. Hoagland feels that such an internal mechanism does exist as a chemical action of the central nervous system and that the internal temperature of the body exerts a controlling

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[1]Wallace and Rabin, Psychological Bulletin, LVII, 217.

influence on the speed of this mechanism.[1] However, other investigators have found no evidence of such a mechanism. Gardner was unable to show significant correlation between time estimation and several factors which included age, pulse rate, basal metabolism, and surgery when comparing several groups of patients with thyroid difficulty.[2]

Other investigators have been interested in the physiological processes in an attempt to find internal cues which are used in time estimation. Typical of these is a study by Schaefer and Gilliland. Using the method of verbal estimation and empty intervals, each subject made estimations of intervals ranging from 4 to 27 seconds in length. Measurements were also made of pulse rate, heart work, breathing work, and blood pressure changes. As a second part of the experiment, Schaefer and Gilliland had their subjects repeat the procedure following strenuous exercise. They concluded that no significant relationship exists between the five physiological processes studied and ability to estimate time and that changes in time estimation ability did not appear to be related to changes in physiological conditions through exercise.[3]

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[1]Hoagland, Journal of Genetic Psychology, IX, 284.

[2]Gardner, American Journal of Psychology, XLVII, 701.

[3]Schaefer and Gilliland, Journal of Experimental Psychology, XXIII (July, 1938), 551.

Comparing the developments in the field of space perception with that of time perception, Gilliland, Hofeld, and Eckstrand note that in the field of space perception certain cues have long been established as being direct cues used in that perceptual process. However, such is not the case in the area of time perception. They write:

> . . . no such list of cues has been discovered for time perception. In fact, almost the opposite is true. That is, we are hardly sure of any of the cues that are used in time perception.[1]

More recently, attention has turned to a search for factors which may affect the ability to make time estimations. Studies have been reported on the effect on time perception of danger (Langer, Wapner, and Werner), anxiety (Siegman), need-tension (Rosenzweig and Koht), stage fright (Henrikson), sensory deprivation (Vernon and McGill), muscular tension (Weybrew), drugs (Hawkes, Joy, and Evans), and organic brain damage (Davidson and Coheen).

Time estimation under conditions of danger was studied by Langer, Wapner, and Werner. Their blindfolded subjects were mounted on a wheeled cart or platform powered by an electric motor. The element of danger was introduced by the presence of

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[1]Gilliland, Hofeld, and Eckstrand, Psychological Bulletin, XLIII (January, 1946), 164.

an open stairwell. The platform could move only away from or toward the stairwell. The subject controlled the movement of the platform by means of a switch located on the railing. An electric timer was also controlled by this switch. Instructions were to press the operating switch, holding it in the operating position for an estimated 5 seconds. The subjects were instructed also that counting should not be used in making the estimates. In a second condition of the experiment, that of no-danger, the movement of the cart was away from the stairwell. The platform moved at a constant speed of 2 miles per hour and two starting distances were used; 15 feet from the stairwell and 20 feet from the stairwell. The authors conclude: "The major results of this study are that time is over estimated during danger and that the overestimation tends to increase as danger increases."[1]

Siegman used the method of verbal estimation and empty intervals bounded by sound clicks produced by a stop watch in his study of the effect of anxiety. His subjects judged the duration of two intervals; 5 seconds and 20 seconds. Anxiety was measured by the Taylor Manifest Anxiety Scale which had been previously administered to all subjects. Correlations

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[1]Langer, Wapner, and Werner, American Journal of Psychology, LXXIV, 96.

between the anxiety scores and the time estimate scores for each subject ranged from .589 for the 20 second interval to .326 for the 5 second interval.[1]

Rosenzweig and Koht defined two levels of need-tension by asking subjects to work an unsolvable puzzle. In one instance the subject was performing the activity for practice and in a second condition he was told that the puzzle was part of a test of intelligence. The subjects were asked to estimate the length of time spent working on the puzzles. They were not told at the beginning of the experiment that a time estimate would be required of them. The authors concluded that the ability to estimate time was affected by the degree of need-tension present in the situation.[2]

Falk and Bindra investigated the effect of stress on the ability to estimate time intervals. Measurements secured under rest conditions were compared with time estimation measurements secured as the subject was in a state of anticipation with regard to electric shock. In another part of the study, the effect of serial order on time estimations was studied. That is, time estimations were made in blocks of

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[1]Siegman, Journal of Clinical Psychology, XVIII, 104.

[2]Rosenzweig and Koht, Journal of Experimental Psychology, XVI, 755.

five judgments each. The experimental question involved a comparison between the blocks of judgments which came first in the series with those coming last. The subjects were arbitrarily divided evenly into two groups. The experimental group received (and expected) shock while the control group did not. Thus, in each block the experimental group made five estimations of a 15 second interval using the method of production and also made five estimations under the condition of stress. The results indicated that for the experimental subjects there was no significant difference between the stress and no-stress trials. However, the effect of stress on time estimation is clearly seen from the fact that though the serial gradients of the two groups have the same slope, the gradient of the experimental groups falls far below that of the control group.[1] That is, the time estimation ability of the experimental subjects apparently were under stress at all times during the experiment with regard to the electric shock.

Henrikson, using a questionnaire method, discovered that 95% of his students believed that the degree of stage fright present affected the speaker's estimation of time spent speaking.[2] The degree of stage fright was determined by the

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[1]Falk and Bindra, Journal of Experimental Psychology, LXVII, 282.

[2]Henrikson, Journal of Applied Psychology, XXXII, 533.

use of a ten point scale upon which each student ranked himself. This ranking procedure took place just prior to speaking as the student was given a card on which his speaking topic was listed. At the conclusion of the speech the student made an estimate of the time spent speaking. A stop watch was used to record the physical time which elapsed during the speech. Results indicated that the subjects tended to underestimate speaking time. However, no relationship between the degree of anxiety expressed and time estimation ability was indicated.[1]

Perhaps one factor to be considered in the evaluation of this study is that the subjects were informed of the experimental procedure before speaking. That is, they knew as they spoke that they would be called upon to make a time estimation. This perhaps creates a situation similar to the method of reproduction. It would appear that under such conditions, it would be difficult indeed not to observe time cues as one spoke.

Weybrew investigated the ability of subjects to estimate the duration of a 43 second interval while they gripped a dynamometer at various intensities. Five grip intensities were employed by each subject ranging from 0 to 2/3 of his maximum grip. The method used was that each subject maintained

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[1]*Ibid.*, 531.

his grip at the determined level until instructed to stop. He then estimated the interval during which the grip was held. The author concluded that the varying intensity of the hand-grip was associated with variations in time estimation ability.[1]

The question of time estimation ability during sensory deprivation has also received some attention in the literature. Vernon and McGill placed subjects in a dark, soundproof cubicle for periods ranging from 8 to 96 hours as a part of another investigation. No report is given regarding the emotional effect of this confinement. However, it is reported that all subjects estimated the duration of their confinement by external means such as the amount of food remaining or the degree of dryness of a towel which had been wet. It was concluded that there is a strong tendency to underestimate time under conditions of sensory deprivation.[2]

Hawkes, Joy, and Evans note that differences exist between the various methods of measurement in time perception. Specifically, they note that time estimates secured by the method of production depend in large measure upon internal or

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[1]Benjamin B. Weybrew, "Accuracy of Time Estimation and Muscular Tension," Perceptual and Motor Skills, XVII (August-December, 1963), 118.

[2]Vernon and McGill, Journal of Genetic Psychology, LXIX, 16.

physiological events, while time estimates secured by the method of reproduction appear to depend upon the external environment.[1] Since stimulation by drug affects the internal states, they hypothesized that time estimates by production would be affected by drugs while time estimates by reproduction would not. They conclude:

> It is concluded that duration judgments with the method of production, in which time estimates are based upon internal events (if external cues are not available), will correlate with respiration rate changes and perhaps with other indices of rhythmic physiological activity such as heart rate. Temporal judgments with the method of reproduction do not significantly correlate with autonomically influenced physiological variables.[2]

The possibility of a specific disorder involving time perception has been discussed by Davidson and by Coheen. A descriptive study is presented by Davidson in which case summaries are reviewed. He concludes that time agnosia exists as a specific disorder and lends his support to the assumption that man has some internal time-keeping or clock mechanism. Davidson does not present any experimental evidence.

Coheen found that patients with organic brain disease were unable to estimate time as accurately as did a group of normals. He first tested a normal group using the method of

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[1]Hawkes, Joy, and Evans, Journal of Psychology, LIII, 183.

[2]*Ibid.*, 191.

verbal estimation. Taking the most variable of these scores, Coheen established that for four intervals the normal subjects did not vary more than 100% of the stimulus interval. He then used this as a standard to evaluate the time estimation ability of subjects suffering from brain disease. In both instances the method of verbal estimation was used. He found that only 32% of the experimental subjects were able to make time estimation judgments which fell within the limits of the standard set by the normal subjects. As a part of the same study, Coheen retested the experimental subjects at a later date and achieved results which approximated the first test. He also tested a small number of patients after electric shock treatments and found that in the period immediately following shock the patients' time estimation responses were extremely variable. This variability decreased in later testing periods. Also as a part of this study, the time estimation ability of one 30 year old man was tested before and after prefrontal lobotomy. Coheen concluded:

> . . . we feel that we have demonstrated that in diffuse cortical disease, with its attendant deterioration, there are manifest varying degrees of time agnosia, at least roughly proportional to the degree of deterioration.[1]

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[1]Jack J. Coheen, "Disturbances in Time Discrimination in Organic Brain Disease," Journal of Nervous and Mental Disorders, CXII (August, 1950), 128.

Summary

In this chapter various methods of measurement used in time estimation experiments have been reviewed. Though fundamental differences between these methods appear to be indicated, Clausen and Hawkes, Joy, and Evans), investigators generally have treated them as if they were equivalent (Bindra and Waksberg). The character of the stimulus intervals (filled or unfilled) does not appear to affect time estimates. However, estimates of longer time intervals are affected by the manner in which the subject is occupied (Gulliksen).

Although no cue or sets of cues have been established as primary cues in time perception, some variables have been shown to have an effect on ability to estimate time. Among these are danger, anxiety, need-tension, sensory deprivation, muscular tension, drugs, and diffuse cortical disease.

CHAPTER III

METHOD AND PROCEDURE

The questions this study was designed to answer were: (1) Do stutterers differ significantly from nonstutterers in the ability to make liminal discriminations between timed intervals under the condition of no-anxiety?, (2) Do stutterers differ significantly from nonstutterers in the ability to make liminal discriminations between timed intervals under the condition of anxiety?, (3) For stutterers, do time discrimination scores under the condition of anxiety differ significantly from time discrimination scores under the condition of no-anxiety?, (4) For normal speakers, do time discrimination scores under the condition of anxiety differ significantly from time discrimination scores under the condition of no-anxiety?, and (5) Is there a significant relationship between time discrimination ability and disfluency of speech?

Subjects

Sixty subjects, equally divided into two groups, were utilized in this study. The experimental group consisted of thirty persons ranging in age from 14 to 46 years, with a median age of 20 years, who were considered by themselves and their environment to be stutterers. The group was composed of 28 males and 2 females.

A subject was accepted for the experimental group if he was receiving, or had received, speech therapy for stuttering or revealed a self-diagnosis of stuttering during the course of an initial interview. Other criteria were the absence of significant hearing loss and the absence of any additional clinical speech problem. The speech of each subject was evaluated during the initial interview and an audiometric hearing screening test was administered if more than one year had elapsed since the subject had received hearing screening services. The audiometric hearing screening test employed has been described by Newby. He writes:

> A technique referred to as the "sweep" test has been devised to enable individual screening at a rapid rate. In the sweep test the audiometrist sets the hearing-loss dial of the audiometer at a fixed level, usually 15 dB, and then "sweeps" from low through high frequencies, checking to see if the subject is responding at each frequency.[1]

Observations of speech were made individually in a conversational setting. The occurrence of any speech deviation,

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[1]Hayes Newby, Audiology: Principles and Practice (New York: Appleton-Century-Crofts, Inc., 1958), p. 208.

other than those associated with stuttering, felt by the experimenter to be of clinical signifance was noted and that subject eliminated from further participation.

The control group was matched with the experimental group according to age, sex, and employment status. Gilliland and Humphreys felt that the cultural training of an individual may be related to his ability in time perception.[1] In view of this, the subjects in this study were matched on the basis of occupation. Since most of the experimental subjects were students, matching on this factor was not difficult. Five of the experimental subjects were non-students. For each of these a control subject was found whose occupation compared with that of the experimental subject in terms of the amount of verbal output and the types of speaking situations encountered. For example, one of the experimental subjects was a building contractor with several employees. This subject was matched with a control subject of the same age and sex who supervised several employees in a retail store.

The age range of this group was 14 to 45 years with a median age of 20 years. Criteria for selection of the control group were similar to the experimental group except for an

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[1]Gilliland and Humphreys, Journal of Genetic Psychology, LXIII, 125.

absence of any clinical speech problem including stuttering.

In summary, the experimental subjects were stutterers who presented no difficulties of hearing or associated speech disorders and the control subjects were similar except for the absence of stuttering.

The Test Instrument

The test instrument employed in the measurement of time discrimination ability of each subject was the "Time" section of the Seashore Measures of Musical Talents.[1] This test consists of a disc recording from which 50 pairs of timed intervals can be presented. Each pair is followed by a pause to allow time for the subject to make a paper and pencil response. The intervals of each pair are presented consecutively. All the intervals are filled and consist of a continuous pure tone with frequency held constant at 440 cycles per second. A standard of .8 second is employed as the duration of one of the tones of each pair.[2] As the test progresses the difference in duration between the standard interval and the variable

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[1]Carl E. Seashore, Don Lewis, and Joseph G. Saetveit, Manual: Seashore Measures of Musical Talents (2d ed. rev.; New York: Psychological Corporation, 1960).

[2]Joseph G. Saetveit, Don Lewis, and Carl E. Seashore, Revision of the Seashore Measures of Musical Talents (University of Iowa Studies), LXV (October, 1940), 20.

interval becomes progressively smaller. These differences range from .30 second at the beginning of the test to .05 second at the conclusion.[1]

During the pause between the pairs of intervals, the subject indicated his response on an answer sheet of the IBM type. This form may be found in Appendix A. The subject indicated whether the second tone of each pair was longer (L) or shorter (S) than the first. Scoring of the test was facilitated by the use of a scoring key. The score for each subject was tabulated by counting the number of errors incurred in making the 50 choices.

Procedure

Each subject was seen individually for one interview. During this interview an attempt was made to put the subject at ease, to observe his speech behavior, and to record identifying information such as name, address, birthdate, level of education, type of occupation, and date of test. Inquiry was made regarding previous audiometric hearing tests and a screening test at the 15 decibel level was administered to those subjects whose hearing had not been audiometrically screened in the past year. A Beltone Audiometer (Model 10-A) was employed to test

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[1]Seashore, Lewis, and Saetveit, Manual . . ., p. 4.

by sweep check at the levels of 500, 1,000, 2,000, 4,000 and 8,000 cycles per second. Subjects who failed to respond at two or more frequencies in one ear or at a single frequency in both ears were eliminated from the study.

Following the hearing test, the time discrimination test was administered. The record disc used was H8-OP-4915 produced by the Psychological Corporation and was played on a 300 VC Record Player manufactured by the Audiotronics Corporation, North Hollywood, California. The subject was seated at a table six to eight feet from the record player and listened in a free-field situation. All testing rooms were judged by the investigator to be quiet enough for the experiment. It was felt that in no instance was the testing impaired by distracting noises.

A time discrimination test answer sheet and a copy of instructions were handed to the subject. The following instructions were read by the subject while the investigator prepared for the administration of the test. The printed instructions were:

> You are going to take a time test. When the record is played you will hear pairs of tones. As you listen to each pair of tones you will note that they are just alike except that one lasts longer than the other.
>
> You will judge whether the second tone of each pair is longer or shorter than the first. Remember - if the

> second tone is shorter, mark the space under the letter (S) on the answer sheet. If the second tone is longer, mark the space under the letter (L).
>
> There will always be a difference - so if you don't know, guess. Any questions? A few pairs of tones will be played so you will know what to listen for. Let's listen to a few for practice.[1]

The subject then listened to four pairs of tones chosen at random from the test. He was again reminded to judge on the basis of the second tone of each pair and to decide whether it was of a longer or shorter duration than the first. The instructions were discussed until the subject indicated understanding of the procedure. The entire test recording was then played without interruption. At the conclusion of the test, the answer sheet was collected from the subject.

Next, a recording was made of the speech of each subject. One purpose for making the recordings was to induce a state of anxiety within the subject. Instructions were designed to imply that each recording would be examined by a group of experts. A second purpose was to furnish the raw material for tabulation of speech disfluency. Two tasks were presented: to talk about a vocation and to tell a story in response to a stimulus picture. Recordings were obtained in the following manner, using a Wollensak Tape Recorder, Model 1570 and Scotch

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[1]A full set of instructions will be found in Appendix B.

brand, magnetic tape.

A card with printed instructions were given to the subject to read. The instructions were as follows:

> In the study of speech it is often necessary to make a recording of a person speaking. These recordings can then be examined by an expert or played for an audience to determine the effect of the speech on them. Speak right into the microphone so we can record all the details.
>
> You will talk about your vocation while it is recorded by the tape recorder. You may tell how you got your job, what sorts of things you usually do, why you chose this job, or anything else you would like to say. If you wish you may talk about a job you expect to have in the future. It is important that you talk the way you usually do. You will have a minute or so to plan what you want to say. Any questions?

Subjects not regularly employed were requested to discuss their part-time employment or any vocational interest. It was stressed that the investigator desired that the subject continue talking until he was stopped. The subject was then instructed regarding the techniques of making a tape recording. In most instances the experimental subjects were familiar with tape recorders. Most of the control subjects, however, had had no experience with tape recorders.

The subject was then given one minute to prepare his remarks. A stop watch was used to time activities. If the subject was unable to continue speaking for a full three minutes the investigator prompted him by asking questions appropriate to his interest. A full three minute speech sample was secured from each subject.

The second part of the speech sample immediately followed the first. A stimulus picture, card #10 from the Thematic Apperception Test,[1] and an additional instruction card were handed to the subject.

> Next - you will make up a dramatic story about this picture and tell your study aloud so it can be recorded. It is suggested that you begin by telling a story about what you see; then tell about the probable events leading up to the picture, and finally; tell about the course of events which will probably happen after the picture.
>
> You will have about a minute to prepare what you want to say. Any questions?

It was emphasized that a story about the picture was desired; not simply a description of the picture. The subject was allowed one minute preparation time, after which the recording began. Prompting questions were again employed if the subject failed to record a full three minute sample. Considerably more prompting was needed during this task than was needed during the first task.

Following the recording of the second part of the speech sample, the subject was given a second answer sheet and the time discrimination test was administered a second time.

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[1]H. A. Murray, Manual for the Thematic Apperception Test (Cambridge: Harvard University Press, 1943).

The printed instructions were:

> Now you will take the time test again. Remember - the tones will be heard in pairs. If the second of the two tones is shorter, mark the space under the letter (S). If the second tone is longer, mark the space under the letter (L). Ready? Go.

The same procedure, as earlier described, was followed, with the exception that sample pairs of intervals were not played prior to presentation of the test as a whole.

The final experimental task required the subject to read a 300 word passage (Appendix C). The printed instructions were:

> Read this passage of material as you ordinarily would. Remember to speak directly into the microphone.

The subject's reading, without practice, was recorded following the same procedure as described for the earlier recordings.

The entire experimental procedure took approximately 45 minutes for each subject.

Treatment of Data

The raw data of this study consisted of 120 completed time discrimination test answer sheets (2 for each subject) and 60 tape recorded speech samples. The treatment of these data were as follows:

1. Time discrimination tests. Identical procedures were used in the treatment of all time discrimination test data.

Each answer sheet was first examined to determine that each of the 50 items had been answered and that only one response was marked for each item. All the test data were acceptable with regard to these criteria.

Each answer sheet was then hand scored by means of the accepted scoring key. To facilitate further analysis of the data, the number of incorrect responses were tabulated and recorded as the raw score for each subject. There were two answer sheets (one for each test condition) for each subject. Care was taken to insure that scores were recorded accurately with regard to subject and condition.

2. Disfluency. The three part speech sample recorded by each subject was treated as a whole. Each recording was played for inspection on the same tape recorder used to collect the data. A Roby mechanical hand tally counter was used to facilitate the counting of words and disfluencies. Sections of the tape were replayed as necessary to insure accuracy.

The recordings were first monitored to determine the total number of words for each subject, including the 300 word reading passage. No word was counted unless it contributed to the smooth, continuous flow of intended thought. For example, the reading passage was counted as 300 words regardless of the actual number of words produced in the attempt to read the passage.

Each tape was monitored twice to determine the total number of disfluencies produced by each subject. The average of these two disfluency counts was employed in the calculation of the disfluency rate per 100 words.

Instances of disfluency were identified by means of the categories of disfluency described by Johnson.[1] However, no effort was made to tally disfluencies according to type, since the measure of interest in this study was simply the total number of disfluencies.

The category of <u>interjections of sounds, syllables, words, or phrases</u> included any material recorded by the subject which was extraneous to the continuous, smooth flow of speech whether it be in terms of the thought expressed or in terms of mechanical production.

The categories of <u>part word repetitions, word repetitions, or phrase repetitions</u> included all repeated material including repetitions of interjections or other types of disfluencies.

<u>Revisions</u> included instances in which a statement was begun, then revised into a different but complete thought.

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[1]Wendell Johnson, "Measurement of Oral Reading and Speaking Rate and Disfluency of Adult Male and Female Stutterers and Nonstutterers," <u>Journal of Speech and Hearing Disorders</u>, Monograph Supplement VII (June, 1961), 3-4.

The category of incomplete phrases included instances in which the revision did not involve the statement of a different, complete thought. Incomplete phrases or revisions were not counted as instances of interjections. However, if the original statement was repeated in whole or part, it was counted as one or more instances of repetition.

The category of broken words involved instances in which a word was interrupted for any reason, but then continued without repetition or revision.

The final category, that of prolonged sounds, involved any instance in which the investigator felt that the subject prolonged a sound unnecessarily.

The reliability of the investigator's ability to identify instances of disfluency was established in a pre-test situation. Speech samples were secured from five people, three normal speakers and two stutterers, according to the procedure outlined above. Two disfluency counts were made from these samples by the investigator. The second count followed the first by not less than a 30 day interval. The formula employed to determine reliability was: Index of agreement.[1] This index is found by dividing the number of disfluencies which occurred

[1] Ibid., 5.

on the same words in both counts by the square root of the product of the total number of disfluencies occurring in each count. The index of agreement for this pre-test study was found to be .95 which compares favorably with published reports of disfluency count reliability. Young reported an index of agreement of .97.[1] Sander used a slightly different formula and reported a self-agreement index of .96.[2]

A disfluency raw score was computed for each subject by calculating the rate of disfluency per 100 words using the formula; $R = W/100 \div D$. In this formula (R) equals rate per 100 words, (D) equals the total number of disfluencies, and (W) equals the total number of words. This result was then rounded to the nearest whole number.

The sixty disfluency scores resulting from the above procedure ranged from 1 to 109 disfluencies per 100 words. The median score of this distribution was 8.

To facilitate further analysis, the sixty disfluency scores were arbitrarily divided into nine disfluency groups.

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[1]Martin A. Young, "Predicting Ratings of Severity of Stuttering," Journal of Speech and Hearing Disorders, Monograph Supplement VII (June, 1961), 36.

[2]Eric K. Sander, "Reliability of the Iowa Speech Disfluency Test," Journal of Speech and Hearing Disorders, Monograph Supplement VII (June, 1961), 24.

Group I contained those subjects found to have the lowest rate of disfluency, while those with the highest rate were placed in Group IX. The numbers of cases falling into each group were as follows: Group I (8), Group II (11), Group III (7), Group IV (5), Group V (6), Group VI (5), Group VII (6), Group VIII (6), and Group IX (6).

Analysis of Data

The design of this study makes possible the use of analysis of variance as an aid in the examination of the data. The experimental design chosen was the two factor experiment with repeated measures on one factor. The models followed are those presented and discussed by Winer.[1] With regard to the over-all comparisons between stutterers and nonstutterers the represented variables were: (1) Groups (stutterers vs. controls) and (2) Conditions (test condition I vs. test condition II).

Examination of the data for simple effects was facilitated by employment of Student's t statistic.[2] The represented variables were: (1) stutterers vs. nonstutterers (test condition I only), (2) stutterers vs. nonstutterers (test condition II

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[1]B. J. Winer, Statistical Principles in Experimental Design (New York: McGraw-Hill Book Company, Inc., 1962), p. 302.

[2]*Ibid.*, p. 40.

only), (3) test condition I vs. test condition II (stutterers only), and (4) test condition I vs. test condition II (non-stutterers only).

To test for a possible relationship between disfluency of speech and the ability to discriminate time intervals the two factor analysis of variance design for repeated measures was also used. The represented variables were: (1) disfluency groups (group I vs. group II . . . vs. group IX) and (2) conditions (test condition I vs. condition II).

CHAPTER IV

RESULTS

In this study the ability of stutterers and nonstutterers to discriminate between paired time intervals was compared. Also, investigation of the possible relationship between disfluency of speech and time discrimination ability was made. Subjects were 28 male and 2 female stutterers matched with a like number of nonstutterers. Matching was on the basis of age, sex, and employment status. The median age of both groups was 20 years.

A test of time discrimination ability was administered twice to each subject. In test condition I, the no-anxiety condition, the administration of the time discrimination test was not associated with speaking, while test condition II was associated with speaking into a tape recorder. The speech samples, recorded in association with condition II, provided the raw data from which calculation of rate of disfluency was made for each subject.

The experimental questions for which answers were sought were: (1) Do stutterers differ significantly from nonstutterers in the ability to make liminal discriminations between timed intervals under condition I (no-anxiety)?, (2) Do stutterers differ significantly from nonstutterers in the ability to make liminal discriminations between timed intervals under condition II (anxiety)?, (3) For stutterers, do time discrimination scores under condition I differ significantly from time discrimination scores under condition II?, (4) For normal speakers, do time discrimination scores under condition I differ significantly from time discrimination scores under condition II?, and (5) Is there a significant relationship between time discrimination ability and disfluency of speech?

Table 1 summarizes the data obtained from the 60 subjects with regard to time discrimination ability. Included are the range, mean, and standard deviation for each group under each of the two conditions. The mean scores are presented in terms of the number of errors. The test consisted of 50 pairs of tones. Each pair was to be discriminated in terms of duration. The total possible score, therefore, was 50 errors.

It can be noted from Table 1 that the values under test condition I (no-anxiety) for each group exceed those achieved under test condition II (anxiety). That is, both stutterers and nonstutterers made a greater mean number of time discrimination errors and showed greater variability under the first test condition than they did under the second. Further consideration of the data for test condition I only indicates that the stutterers achieved the highest mean score and the greatest variability.

Table 1. The summary of the time discrimination test data of all subjects in terms of error scores, showing the range, mean, and standard deviation of each group for each of the two test conditions.

Groups	No-anxiety Condition			Anxiety Condition		
	Range	Mean	S.D.	Range	Mean	S.D.
Stutt.	5 - 35	13.73	6.90	2 - 22	10.77	4.95
Nonstutt.	1 - 24	10.03	4.38	2 - 18	9.67	4.25

Table 2 presents standardization data from the time discrimination section of the Seashore Measures of Musical Talents showing the standardization group, number of cases, mean, and standard deviation. Comparison of the data in Table 1 with that in Table 2 indicates that the distributions of time discrimination scores of this study are roughly comparable to the normative data available for this test of time discrimination.

Examination of the data presented in Table I reveals some disparity among the distributions of time discrimination scores with regard to form and homogeneity of variance.

Specifically, it can be seen from Table I that the range and standard deviation of the distribution of stutterers (test condition I) are somewhat excessive as compared to the other distributions. With regard to form, all four of the distributions show some tendency toward positive skewness. However, this skewness is somewhat greater for the distribution of stutterers (test condition I).

Table 2. Standardization data in terms of error scores from the time discrimination section of the Seashore Measures of Musical Talents.[1]

Group	N	Mean	S.D.
Grades 9 - 12	4316	9.70[a]	5.1

[a]This score converts to 40.3 correct responses as shown in the original data.

The question of acceptability of the forms of distributions subjected to analysis of variance techniques has been discussed by Lindquist, Walker and Lev, and by Winer. The conclusion which these discussions appear to point up is that the F-test is robust with regard to the shape of treatment distributions, especially in instances in which all the treatment distributions have a tendency to be of similar shape.

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[1]Seashore, Lewis, and Saeveit, Manual . . ., p. 10.

Walker and Lev discuss factors influencing the F-distribution. They conclude, ". . . if the distribution of the trait does not depart too radically from the normal, the distribution of the variance ratio will resemble the F-distribution under the experimental conditions described above."[1]

Winer includes both the form of distributions and homogeneity of variance in a discussion of the structural model for single factor experiments. He states:

> The magnitude of type I error is not seriously affected if the distributions depart moderately from normality or if the population variances depart moderately from equality; i.e., the test is robust with respect to the assumptions of normality of distribution and homogeneity of error variance.[2]

Lindquist refers to the work of Norton with regard to the form of the distribution and homogeneity of variance. He states:

> The results of the Norton study should be extremely gratifying to anyone who has used or who contemplates using the F-test of analysis of variance in experimental situations in which there is serious doubt about the underlying assumptions of normality and homogeneity of variance. Apparently, in the great majority of situations, one need be concerned hardly at all about the measures, so long as this distribution is homogeneous

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[1]Helen M. Walker and Joseph Lev, Statistical Inference (New York: Holt, Rinehart, and Winston, 1953), p. 228.

[2]Winer, pp. 61, 62.

in both form and variance for the treatment populations, and so long as it is neither markedly peaked nor markedly flat.[1]

With regard to the question of homogeneity of variance, Lindquist presents the test for homogeneity of variance by M. S. Bartlett. He concludes, "As previously noted, the usefulness of this test is quite limited. In view of the results of the Norton study, it is apparent that the test is needed at all only when the treatment groups are quite small."[2]

In view of the above, the present investigator feels that the distributions of time discrimination scores of this study are acceptable with regard to form of the distributions and homogeneity of variance. It would appear to be likely that differences between the present distributions on these two attributes affect the subsequent statistical analysis very little if at all. Therefore, in the subsequent discussion of the results of statistical analysis, consideration will be given to interpretation of the face value of the derived statistics.

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[1]E. F. Lindquist, Design and Analysis of Experiments in Psychology and Education (Boston: Houghton Mifflin Company, 1953), p. 86.

[2]Ibid., p. 88.

Analysis of the Data - Combined Effects

Table 3 presents data relating to the following questions: (1) Is there a significant difference between stutterers and nonstutterers with regard to the ability to discriminate between time intervals when the anxiety and no-anxiety test conditions are combined?, (2) Is there a significant difference between test condition I and test condition II when the data from stutterers and nonstutterers are combined?, and (3) Is there significant interaction effect? An analysis of variance for related measures design was employed to evaluate the data.[1]

The overall time discrimination ability of stutterers and nonstutterers was compared by analysis of variance. The result of this comparison is shown in the Between Subjects section of Table 3. The (F) statistic ($F = 4.61$) signifies that stutterers and nonstutterers do differ significantly in ability to discriminate time intervals (test conditions combined) at the 5% level of confidence.

For both test conditions, this difference lies in the direction of inferior discrimination ability on the part of stutterers.

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[1]Winer, p. 302.

This finding indicates that time discrimination ability may be a factor in stuttering behavior. As indicated in Chapter I, time discrimination ability appears to be one of the skills basic to adequate speech production and that lack of this ability could be reflected in disruptions in the on-going process of speaking.

Table 3. Results of an analysis of variance for 60 subjects using Winer's related measures design.

Source	SS	df	mf	F
Between Subjects	2345.70	59		
A. Groups	172.80	1	172.80	4.61*
Subj. W. Groups	2172.90	58	37.46	
Within Subjects	1206.00	60		
B. Conditions	83.33	1	83.33	4.51*
A x B	50.70	1	50.70	2.74
B x Subj. w. Gr.	1071.97	58	18.47	

*Significant at the .05 level

Also in Table 3, the result of the comparison between test conditions is presented (Within Subjects; B. Condition). The statistic ($F = 4.51$) was found to be significant at the .05 level of confidence, indicating that the two conditions of testing are significantly different from each other.

It can be seen from Table 1 that the direction of this difference for both stutterers and nonstutterers point toward test condition I (no-anxiety) as being the condition under which the greatest number of discrimination errors occurred.

The finding that the time discrimination ability of both stutterers and nonstutterers apparently increases in the presence of anxiety is not in agreement with theoretical considerations. This state of affairs will be discussed in detail in Chapter V. For the present, however, it should suffice to interpret this result to mean that the two conditions of testing were, in fact, different.

The remaining statistic shown in Table 3 ($F = 2.74$) was found to be not significant and indicates that the interaction effect need not be considered in the interpretation of the data from this table. This is interpreted to mean that each of those findings can be considered and interpreted as relatively independent findings.

A test involving combined data was also used as an aid in answering experimental question 5; Is there a significant relationship between time discrimination ability and disfluency of speech?

In order to answer this question, speech samples from each of the 60 subjects were examined and a disfluency score computed for each subject utilizing procedures previously described. The 60 disfluency scores were then arbitrarily divided into 9 disfluency groups. Group I contained those subjects found to have the lowest rate of disfluency, while those with the highest disfluency rate were placed in Group IX.

Table 4. Numbers of stutterers and nonstutterers falling into each of 9 disfluency groups.

	Disfluency Groups								
	I	II	III	IV	V	VI	VII	VIII	IX
Stutterers	0	1	3	1	2	5	6	6	6
Nonstutterers	8	10	4	4	4	0	0	0	0
Total	8	11	7	5	6	5	6	6	6

To test for possible relationship between the rate of disfluency and the ability to discriminate between timed intervals, an analysis of variance design for repeated measures was again employed.[1] The represented variables were: (1) disfluency groups (group I vs. group II vs. group III . . . vs. group IX) and (2) conditions (condition I vs. condition II).

The Between Subjects analysis of variance results shown in Table 5 indicate a lack of significant relationship between the rate of disfluency and the ability to discriminate time

[1]Winer, p. 320.

intervals. In other words, the time discrimination scores for the 60 subjects were divided into 9 groups according to the disfluency score achieved by each subject. Had the two sets of scores (disfluency and time discrimination) been significantly related, the time discrimination scores would have arranged themselves in an orderly fashion. Thus, a significant difference between groups could have been expected on the basis that the low time discrimination scores would have collected in some of the groups while the high discrimination scores would have collected in others. The F-value (F = .83) achieved in the Between Subjects analysis of variance as shown in Table 5 indicates that such a piling-up of time discrimination scores did not result from the arbitrary grouping of the disfluency scores. It is, therefore, concluded that a significant relationship between the disfluency scores and the time discrimination scores does not exist. In addition, this finding may shed some light on the question of the exact relationship between stuttering and disfluency of speech.

Table 5 Within Subjects analysis also shows, as did Table 3, that there is a significant difference between the two test conditions. The interaction effect is again shown to be not significant.

Table 5. Results of an analysis of variance for 60 subjects grouped according to disfluency scores.

Source	SS	df	ms	F
Between Subjects	2345.70	59		
A. Disfluency Groups	269.15	8	33.64	.83
Subj. w. Groups	2076.55	51	40.72	
Within Subjects	1206.00	60		
B. Conditions	83.33	1	83.33	4.15*
A x B	98.28	8	12.29	.61
B x Subj. w. Groups	1024.57	51	20.08	

*Significant at the .05 level as shown in Table 3.

Analysis of the Data - Simple Effects

In order to answer experimental questions 1 through 4, the means of the appropriate distributions were compared by use of Student's t statistic. Table 6 presents the results of these comparisons.

Experimental question 1 deals with the question of time discrimination abilities under the test condition of no-anxiety only. Specifically, this question is: Do stutterers differ significantly from nonstutterers in the ability to make liminal discriminations between timed intervals under condition I?

To answer this question, the mean score achieved by the group of stutterers under test condition I was compared with the mean score achieved by the nonstutterers under the same condition. As indicated by Table 1, the stuttering group achieved a mean score of 13.73 incorrect responses under test condition I while the nonstutterers' mean score was 10.03 for the same condition. Table 6 indicates that there is a significant difference between these means ($\underline{t}$ = 3.33). The critical value for $\underline{t}_{.01}$ (2,29) is 2.75.

Table 6. Results of comparisons between appropriate means of distributions of time discriminations scores of stutterers and nonstutterers.

Groups	Nonstutt. Cond. I	Nonstutt. Cond. II	Stutt. Cond. II	Nonstutt. Cond. II
Stutt: Cond. I	3.33[a]			
Stutt: Cond. II		.99		
Stutt: Cond. I			1.87	
Nonstutt: Cond. I				.23

[a]Significant at the .01 level.

Experimental question 2 is: Do stutterers differ significantly from nonstutterers in the ability to make liminal discriminations between timed intervals under the test condition of anxiety? To answer this question the mean for stutterers under test condition II (10.77) was compared to the mean for nonstutterers under condition II (9.67). The result of this comparison, as shown in Table 6, indicates that the difference between these two means is not significant (*t* = .99).

Table 6 also shows the result of the comparison between the mean achieved by stutterers under condition I (13.73) to that achieved by the same group of stutterers under condition II (10.77). This comparison relates to experimental question 3: For stutterers, do time discrimination scores under the condition of anxiety differ significantly from time discrimination scores under the condition of no-anxiety? The obtained value (*t* = 1.87) indicates that the difference between these two means is not significant at the .05 level of confidence.

Experimental question 4 involved a comparison between the means for nonstutterers only. The mean for the no-anxiety test condition was 10.03, while the mean score for the anxiety condition was 9.67. This difference, as seen in Table 6, was shown to be not significant (*t* = .23).

Experimental question 5: Is there a significant relationship between time discrimination ability and disfluency of speech?, was answered utilizing data presented in the between subjects analysis found in Table 5. This analysis indicates that no significant relationship exists between these variables.

CHAPTER V

SUMMARY AND CONCLUSIONS

The Procedure

In this study stutterers and nonstutterers were compared with regard to the ability to discriminate between paired time intervals. In addition, investigation was made of the possible relationship between time discrimination ability and disfluency of speech.

Sixty subjects were divided equally into experimental and control groups. The experimental group was composed of 30 teen-age and adult stutterers. The criteria for selection of the experimental subjects were: (1) the absence of significant hearing loss, (2) the absence of any additional clinical speech problems, and (3) the presence of a firm diagnosis of stuttering. A subject was considered to be a stutterer on presentation of evidence that he had been labeled a stutterer at a time prior to this investigation or if he so labeled himself during the initial interview of this study. Most of the experimental subjects had had diagnostic or therapeutic experience in a speech and hearing clinic. The stuttering group was composed of 28 males and 2 females whose median age was 20 years.

The control group also consisted of 30 subjects, matched individually with experimental subjects on the basis of age, sex, and employment status. Employment status was utilized as a matching factor in an attempt to equate subjects with regard to verbal output and the types of speaking situations they normally encountered. Criteria for selection of control group subjects were the same as for the selection of experimental subjects except that control group subjects were required to demonstrate the absence of any clinical speech problem.

Each subject was interviewed individually by the experimenter. During the single interview, each subject was tested twice with regard to time discrimination ability and a three part sample of his speech was tape recorded. The first administration of the time discrimination test (test condition I) was not associated with speaking. The second administration (test condition II) was associated with the tape recording of the three part speech sample.

Three sets of data were therefore secured from each subject for further processing. In addition to an answer sheet for the time discrimination test under each of two conditions, each subject's recorded speech sample was analyzed to determine a measure of his disfluency of speech. The disfluency measure used was the number of disfluencies which occurred per 100 words spoken. The speech sample for each subject was recorded immediately prior and immediately following the second administration of the time discrimination test. All data were processed by the investigator.

Discussion of Results

The procedure of this investigation with regard to time discrimination ability resulted in four distributions of time discrimination scores. These distributions were as follows: (1) stutterers (test condition I), (2) stutterers (test condition II), (3) controls (test condition I) and (4) controls (test condition II).

Before the data were analyzed to determine specific answers to the five experimental questions of this study, an over-all analysis of variance for related measures was performed. Grouping of the data thus made it possible to compare stuttering and nonstuttering subjects with regard to the ability to discriminate time intervals using the data of both test conditions combined. In addition, grouping of the data made it possible to compare the two test conditions using combined data of subjects.

Table 3, Between Subjects analysis, indicates that there is a significant difference between stutterers and nonstutterers in the ability to discriminate time intervals when the data is grouped with regard to test condition ($F = 4.61$). In this analysis, subjects were not acting as their own control. Each stutterer was matched with a nonstutterer of the same age, sex, and employment status.

Two explanations for this state of affairs might be offered: (1) That stutterers might differ from nonstutterers with regard to some kind of organic condition which also affects time perception ability. (2) That this significant difference between stutterers and nonstutterers can be accounted for on the basis of felt anxiety.

Wide divergence of opinion exists in regard to the question of organicity of stuttering. Robert West states, ". . . stuttering probably has one organic cause, so far not identified, and many precipitating factors."[1]

Eisenson, speaking for himself, presents his point of

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[1]Robert West, "An Agnostic's Speculations about Stuttering," Stuttering: A Symposium, ed. Jon Eisenson (New York: Harper and Brothers, Publishers, 1958), p. 174.

view as follows:

> A majority of stutterers (from 55 to 60 percent), he believes, are predisposed to a manner or oral language behavior called stuttering because they are constitutionally inclined to perseverate to an extent or degree greater than is the case for most speakers. A minority of stutterers (under 50 percent) include persons who at the moment of speaking are confronted with factors and influences that cause them to perseverate.[1]

Bloodstein clearly places more emphasis on the anxiety factor as a basis of stuttering when he states, "Stuttering, then, may be regarded as a habit of making elaborate preparations for speech on the assumption that it is a difficult and treacherous process."[2]

Johnson takes a very similar point of view when he writes, "Stuttering appears to be an anxiety-motivated avoidant response that becomes 'conditioned' to the cues or stimuli associated with its occurrences."[3] Johnson further clarified his point of view by writing:

> . . . to date no distinctive neurophysiological differences between persons classified as stutterers and those not so

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[1]Eisenson, p. 225.

[2]Oliver Bloodstein, "Stuttering as an Anticipatory Struggle Reaction," Stuttering: A Symposium, ed. Jon Eisenson (New York: Harper and Brothers, Publishers, 1958), p. 5.

[3]Wendell Johnson, "The Time, the Place, and the Problem," Stuttering in Children and Adults, ed. Wendell Johnson (Minneapolis: University of Minnesota Press, 1955), p. 23.

> classified have been unequivocally demonstrated. The findings of the present research program do not suggest that such differences exist.[1]

Although the exact nature of stuttering is still in considerable doubt, the finding of this study that there is a significant difference between stutterers and nonstutterers with regard to time discrimination ability tends to support the speculations of Van Riper, Eisenson, and Sheehan cited in Chapter I. That is, that there is some relationship between stuttering behavior and the so-called timing mechanisms of speech. It is concluded that time discrimination ability can be viewed as a factor in the problem of stuttering.

The Within Subjects analysis of Table 3 indicates that the two time discrimination test conditions (anxiety vs. no-anxiety) of this study were significantly different from each other ($F = 4.51$). This result essentially agrees with previously reported studies involving different test conditions. However, in those studies, measurement of time perception was made in terms of some form of estimation of time rather than in terms of discrimination between two timed intervals.

As shown in Chapter II, time perception ability as measured by the method of estimation has been shown to be

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[1]Ibid., The Onset of Stuttering (Minneapolis: University of Minnesota Press, 1959), pp. 254,5.

affected by several factors. Some of the factors which have been studied are danger, anxiety, need-tension, stage fright, sensory deprivation, muscular tension, drugs, and organic brain disease.

Interpretation of the present finding, however, is made difficult by the direction of the difference. Both stutterers and nonstutterers, it would appear, are less accurate in ability to discriminate time intervals when not anxious than they are when anxious. That is to say, the greater number of mean error scores were made under the no-anxiety condition of the study.

Since there appears to be no theoretical framework to assist in accounting for the direction of this difference, this result is interpreted to mean simply that time discrimination ability as tested by the method of discrimination does appear to vary or be affected by variation in test conditions.

Experimental question 5 will be answered first because it also involves grouped data rather than simple effects. The question is: Is there significant relationship between time discrimination ability and disfluency of speech?. In this study disfluency was defined in terms of 8 categories of behavior and a disfluency score was computed for each subject. The subject's score was the number of disfluencies per 100 words.

As indicated in Chapter IV, the grouping of subjects according to disfluency scores resulted in a mixing of stuttering and nonstuttering subjects. Table 4 indicates the extent of this mixing. As seen from this table, there appears to be an overlapping of stutterers and nonstutterers amounting to approximately 20% of each group. This finding is in agreement with that of Johnson who found a similar overlapping of subjects in his normative study of disfluency.[1] He concluded:

> The varying degrees of overlapping of the distributions of disfluency measures for the subjects classified as stutterers and those not so classified imply that the problem called stuttering is not to be adequately identified or defined solely by reference to speech disfluency, as such.[2]

Experimental question 5 was answered with the help of the data found in Table 5. The Between Subjects analysis of variance indicates that there were no significant differences among the disfluency groups with regard to the criterion measure of time discrimination scores ($F = .83$). That is to say, the time discrimination ability of the most fluent of the speakers was not significantly different from that of the least fluent speakers. Therefore, this question must be answered negatively. No significant relationship between time discrimination ability

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[1]Johnson, Journal of Speech and Hearing Disorders, Monograph Supplement 7, p. 8.

[2]*Ibid.*, p. 20.

and disfluency is indicated.

Since the same criterion measure was employed, this finding is taken to be further evidence that grouping of subjects according to disfluency measures involves selection factors which differ from the selection factors operating when the presence or absence of stuttering is used as the grouping principle. Therefore, the conclusion is reached that disfluency as defined by the 8 categories of behavior employed in this study is not an adequate basis for making distinctions between stutterers and nonstutterers.

In order to answer experimental questions 1 through 4, comparisons were made between appropriate individual distributions of time discrimination scores. Student's *t* was employed to test for significance. The results of these comparisons can be found in Table 6, Chapter IV.

Experimental question 1 can now be answered affirmatively ($t = 3.33$). Stutterers and nonstutterers were found to be significantly different with regard to time discrimination ability under the condition of no-anxiety (condition I). Inspection of Table 1 reveals that this difference lies in the direction of superior ability on the part of nonstutterers.

Experimental question 2, however, must be answered negatively ($t = .99$). Stutterers and nonstutterers do not appear to be significantly different under the anxiety test condition.

Negative answers were also found to experimental questions 3 and 4. Stutterers do not differ significantly from themselves when the two conditions of testing are compared. Neither do nonstutterers differ significantly from themselves when the conditions of testing are compared.

Considered together, these findings are taken to mean that stutterers and nonstutterers do differ with regard to time discrimination ability, but the conditions under which this occurs are not clear. It can be speculated that some factor or factors, such as test familiarity, operated to overcome the effect of anxiety or that the degree of anxiety felt by the subjects was actually greater in the first administration of the time discrimination test.

Summary of Findings

The results obtained in this study appear to indicate the following conclusions:

1. Stutterers and nonstutterers differ significantly from each other in ability to discriminate time intervals under some conditions of testing, but not others.

2. Neither group, stutterers or nonstutterers, differ significantly from themselves with regard to the ability to

discriminate time intervals when two conditions of testing are compared.

3. There is no significant relationship between disfluency of speech and the ability to discriminate time intervals.

4. There appear to be basic differences between disfluency of speech and stuttering. Significant differences between stutterers and nonstutterers with regard to the criterion measure of time discrimination disappear when the groups are divided according to disfluency scores.

Implications for Further Research

1. Further investigation of the conditions under which stutterers and nonstutterers differ with regard to time discrimination ability appears to be indicated.

2. It is suggested also that other methods of measurement in the area of time perception be investigated with regard to the problem of stuttering. The production method might be of special interest.

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APPENDIX A

Name ____________________ Place _______________ City ______________

Date ______________ Age _______ Last School Year Completed ________

TIME

	A		B		C		D		E	
	L	S	L	S	L	S	L	S	L	S
1.	''	''	''	''	''	''	''	''	''	''
2.	''	''	''	''	''	''	''	''	''	''
3.	''	''	''	''	''	''	''	''	''	''
4.	''	''	''	''	''	''	''	''	''	''
5.	''	''	''	''	''	''	''	''	''	''
6.	''	''	''	''	''	''	''	''	''	''
7.	''	''	''	''	''	''	''	''	''	''
8.	''	''	''	''	''	''	''	''	''	''
9.	''	''	''	''	''	''	''	''	''	''
10.	''	''	''	''	''	''	''	''	''	''

Score __________________

APPENDIX B

Instructions

I.

You are going to take a time test. When the record is played you will hear pairs of tones. As you listen to each pair of tones you will note that they are just alike except that one lasts longer than the other.

You will judge whether the second tone of each pair is longer or shorter than the first. Remember - if the second tone is shorter, mark the space under the letter (S) on the answer sheet. If the second tone is longer, mark the space under the letter (L).

There will always be a difference - so if you don't know, guess. Any questions? A few pairs of tones will be played so you will know what to listen for. Let's listen to a few for practice.

II.

In the study of speech it is often necessary to make a recording of a person speaking. These recordings can then be examined by an expert or played for an audience to determine the effect of the speech on them. Speak right into the microphone so we can record all the details.

You will talk about your vocation while it is recorded by the tape recorder. You may tell how you got your job, what sorts of things you usually do, why you chose this job, or anything else you would like to say. If you wish you may talk about a job you expect to have in the future. It is important that you talk the way you usually do. You will have a minute or so to plan what you want to say. Any questions?

III.

Next - you will make up a dramatic story about this picture and tell your story aloud so it can be recorded. It is suggested that you begin by telling a story about what you see; then tell about the probable events leading up to the picture, and finally; tell about the course of events which will probably happen after the picture.

You will have about a minute to prepare what you want to say. Any questions?

IV.

Now you will take the time test again. Remember - the tones will be heard in pairs. If the <u>second</u> of the two tones is shorter, mark the space under the letter (S). If the <u>second</u> tone is longer, mark the space under the letter (L). Ready? Go.

V.

Read this passage of material as you ordinarily would.— Remember to speak directly into the microphone.

APPENDIX C

Test Passage for Measurement of Reading Rate[1]

Your rate of speech will be adequate if it is slow enough to provide for clearness and comprehension, and rapid enough to sustain interest. Your rate is faulty if it is too rapid to accomplish these ends. The easiest way to begin work on the adjustment of your speech to an ideal rate is to measure your present rate in words per minute in a fixed situation which you can keep constant over a number of trials. The best method is to pick a page of simple, factual prose to be read. Read this page in your natural manner, timing yourself in seconds. Count the number of words on the page, divide by the number of seconds, and multiply this result by sixty to calculate the number of words per minute. As you attempt to increase or retard your rate, repeat this procedure from time to time, using the same reading material, to enable you to check your success.

A common accompaniment of rapid rate is staccato speech, in which the duration of words and syllables is too short, whereas in slow speech the words and syllables frequently are overprolonged. When the person with too rapid rate tries to slow down, he tends to make the error of keeping the duration of his tones short, and of attempting to accomplish the slower rate solely by lengthening the pauses between phrases and by introducing new pauses. On the other hand, the person who is working to speed up his rate tends to do this by shortening the pauses alone and retaining his prolonged tones. It is impossible at the present time to set down in rules the ideal relation between the duration of tones and pauses in speech. Further research is needed before this can be done with any great accuracy.

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[1]Grant Fairbanks, Voice and Articulation Drillbook (New York: Harper and Brothers, 1940), p. 144.