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THE EFFECT OF VARYING CONDITIONS OF REHEARSAL ON THE FREQUENCY OF STUTTERING

by

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M.G.R.

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CHAPTER I

THE PROBLEM AND ITS BACKGROUND

Introduction

The adaptation effect has been studied extensively and is a factor which must be explained in any theory of stuttering. Johnson defines it as "a decrease in stuttering, as measured with reference to its frequency or severity, that occurs when a stutterer reads the same passage a number of times."[1] Although much is known about this phenomenon, the reasons for it are still not totally understood and the contradictory results of some experimentation have not been resolved.

With few exceptions,[2] most investigations of adaptation

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[1]Wendell Johnson, "The Time, the Place and the Problem," in Stuttering in Children and Adults, ed. by Wendell Johnson (Minneapolis: University of Minnesota Press, 1955), p. 15.

[2]George Wischner, "Stuttering Behavior and Learning: A Program of Research," (unpublished Ph.D. dissertation, State University of Iowa, 1947), p. 165; George Wischner, "An Experimental Approach to Expectancy and Anxiety in Stuttering Behavior," Journal of Speech and Hearing Disorders, XVII, No. 2 (1952), p. 139; Maryann Peins, "The Adaptation Effect, Spontaneous Recovery and Consistency Effect within the Expectancy Paradigm in Stuttering," (unpublished Ph.D. dissertation, The Pennsylvania State University, 1958), p. 105; Eugene Brutten, "Palmar Sweat Investigation of Disfluency and Expectancy Adaptation," Journal of Speech and Hearing Research, VI, No. 1 (1963), p. 40; Thomas Besozzi and Martin Adams, "The Influence of Prosody on Stuttering Adaptation," Journal of Speech and Hearing Research, XII, No. 4 (1969), p. 818.

have been based on the subjects reading passages or word lists aloud or speaking spontaneously. Variations have been primarily in the reading material, time interval or social complexity of the situation.

The phenomenon known as adaptation has generally been defined and studied in relation to the massed oral performance of stutterers. The overall purpose of this study was to investigate whether oral readings are a necessary step in the decrease of stuttering through successive rehearsals. The degree of articulatory participation necessary to produce a decrease in stuttering in such rehearsal appears to have implications with respect to the explanation of the adaptation effect in various theories of stuttering.

One of the earliest theories to attempt to explain adaptation was advanced by Wendell Johnson. He saw the decrease in stuttering as due to an antecedent reduction in the anxiety elicited by the stimulus field. It was his contention that the anxiety reduction was the result of deconfirmation as related to the discrepancy between the anticipated and actual stuttering experienced. When discussing adaptation Johnson said, ". . . more and more talking leads to less stuttering because the stutterer gradually learns that in general his expectations are exaggerated and that speaking is nearly always not as bad as he thinks it will be."[1]

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[1]Wendell Johnson, "Stuttering," in Speech Handicapped School Children, ed. by Wendell Johnson and Dorothy Moeller (New York: Harper & Row, 1967), p. 260.

Wischner contends that stuttering behavior is a learned anxiety reaction system and that when anxiety is reduced the stuttering behavior is reinforced. Within this theory adaptation is viewed as similar to experimental extinction of conditioned and unconditioned responses, and the oral performance of the stutterer appears to be a necessary aspect of the decrease in stuttering.[1]

Brutten and Shoemaker believe that the frequency of the stuttering response can be reduced without a decrease in anxiety or a reduction in reinforcement. According to Brutten, adaptation is due to reactive inhibition which reduces the transmission in the neural network that ultimately serves the musculature. Reactive inhibition depends on the number of massed responses, the temporal interval between responses and the work load involved in the performance.[2]

Eisenson explains the adaptation effect as related to repeated oral readings (especially when they are successive) as primarily due to the reduction of the propositional value of the selection. At the same time, the repetition of the material establishes an articulatory and vocal set which approaches the type of automaticity one achieves when memorizing

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[1]George Wischner, "Stuttering Behavior and Learning: A Preliminary Theoretical Formulation," Journal of Speech and Hearing Disorders, XV, No. 3 (1950), p. 325.

[2]Eugene Brutten and Donald Shoemaker, The Modification of Stuttering (Englewood Cliffs, N. J., Prentice-Hall, 1967), p. 67.

material. Within the framework of the perseverative theory of stuttering, the combination of reduced propositionality and the establishment of an articulatory and vocal set will cause a decrease in the amount of stuttering.[1]

It may be seen that most theories of adaptation, with the possible exception of Eisenson's, imply that rehearsal conditions which eliminate or severely reduce articulatory participation should probably not cause a reduction in stuttering. This was the principal question in the present investigation.

Part of the present study was designed to yield data on the phenomenon Wischner called "expectancy adaptation" and its relationship to actual reading performance. According to Wischner, expectancy adaptation will result when subjects read material silently a number of times consecutively, while marking those words on which they would expect to stutter if they were called upon to read the passage orally. The frequency of the anticipated words decreases progressively with successive inspections and the course of the decrement is similar to the adaptation curve.[2]

The few investigators who have researched expectancy

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[1]Jon Eisenson, "A Perseverative Theory of Stuttering," in <u>Stuttering: A Symposium</u>, ed. by Jon Eisenson (New York: Harper, 1958), pp. 242-243.

[2]Wischner, "An Experimental Approach to Expectancy and Anxiety in Stuttering Behavior," p. 151.

adaptation have reported contradictory conclusions. Wischner was able to demonstrate results which closely resembled the adaptation curve.[1] Peins, in a doctoral study based on Wischner's work, was unable to show any adaptation pattern at all.[2] In a later investigation, Brutten,reported results on expectancy adaptation that approached a level of significance.[3] These studies will be more fully reported in Chapter II.

Statement of the Problem

The purpose of this study was to determine to what extent stuttering can be reduced by prior rehearsal of the reading material, either silently or with the elimination of selected aspects of the speech process.

1. When compared with the initial reading, there is no significant difference in the number of disfluencies experienced on oral reading of a passage following four successive oral readings of that passage.

2. There is no significant downward trend or convexity demonstrated in the measurement of stuttering moments for five consecutive oral readings of the same passage.

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[1] Ibid., p. 150.

[2] Peins, "The Adaptation Effect, Spontaneous Recovery and Consistency Effect within the Expectancy Paradigm in Stuttering," p. 42.

[3] Brutten, "Palmar Sweat Investigation of Disfluency and Expectancy Adaptation," p. 45.

3. There is no correlation between the frequency of stuttering on the first reading of five consecutive oral readings and the frequency of stuttering on the last oral reading.

4. There is no significant correlation between the frequency of stuttering on the final oral reading of a passage and the severity of stuttering ratings of the therapists.

5. There is no significant correlation between the reduction in the frequency of stuttering on the last oral reading of a passage and age.

6. When compared with the first reading of a normal adaptation series, there is no significant difference in the number of disfluencies experienced on oral reading of a passage following four successive markings of anticipated stuttering moments on four separate copies of that passage.

7. There is no significant downward trend or convexity demonstrated in the measurement of anticipated stuttering moments for four consecutive silent readings of the same passage.

8. There is no significant difference in the proportion of maximum anticipated stuttering moments of each individual (as indicated by his markings on four separate copies of a passage) and the proportion of the frequency of stuttering experienced on a final oral reading of that passage.

9. There is no significant difference in the proportion of expected stuttering moments on the fourth silent reading of a passage and the observed proportion of stuttering

frequency on the final oral reading of that passage.

10. When compared with the first reading of a normal adaptation series, there is no significant difference in the number of disfluencies experienced on oral reading of a passage following four successive readings of that passage using inaudible speech movements.

11. When compared with the first reading of a normal adaptation series, there is no significant difference in the number of disfluencies experienced on oral reading of a passage after listening to it four successive times on a tape recording.

12. There is no significant correlation between a subject's relative performance on the oral reading of a passage, after listening to tape recordings of that passage four times and his ability to judge correctly the "sameness" of the wording of the four tape recordings.

CHAPTER II

RELATED LITERATURE

Early Studies of the Adaptation Effect

The many studies at the University of Iowa were pioneering efforts in gaining knowledge about stuttering and included numerous investigations of the adaptation effect.

Wendell Johnson regarded the adaptation effect as a major object of stuttering research and encouraged varied investigations of it. His viewpoint was expressed in the following:

> One may look upon the adaptation effect as a kind of laboratory model of the improvement process, and as such it can readily be observed as affected by any specified condition. In this way the conditions associated with increase in improvement, as well as those associated with its retardation, or even its reversal, can be ascertained and appraised. Research of this sort tends, therefore, to yield findings that are of value not only in a theoretical but also in a most practical therapeutic sense, since anything one might mean by therapy for stuttering must necessarily involve the fostering of those conditions under which stuttering decreases in amount or severity.[1]

One of the earliest investigations, by Van Riper and Hull, concluded that repeated readings of materials caused a decrease in stuttering frequency in both severe and mild

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[1]Johnson, "The Time, the Place and the Problem," p. 22.

stutterers, with the latter, however, adapting more quickly.[1] In another early study, Johnson and Knott reported adaptation had taken place when stutterers read a passage successively ten times.[2] In an analysis of the data obtained by Johnson and Knott and by Maddox, Johnson and Inness concluded that significant adaptation was achieved when stutterers read the material five times consecutively.[3]

The Van Riper and Hull research was multifaceted and presaged later investigations. They found a significant increase in the frequency of stuttering occurred when the situation was changed by the introduction of a microphone or an unfamiliar group of adults.[4] Porter, who used an audience ranging from one to eight persons, and who also varied the reading material in each session, demonstrated that combinations of these two factors resulted in a progressive increase in

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[1]Charles Van Riper and Catherine Hull, "The Quantitative Measurement of the Effect of Certain Situations on Stuttering," in Stuttering in Children and Adults, ed. by Wendell Johnson (Minneapolis: University of Minnesota Press, 1955), p. 205.

[2]Wendell Johnson and John Knott, "Studies in the Psychology of Stuttering: I. The Distribution of Moments of Stuttering in Successive Readings of the Same Material," Journal of Speech Disorders, II, No. 1 (1937), p. 18.

[3]Wendell Johnson and Marjory Inness, "Studies in the Psychology of Stuttering: XIII. A Statistical Analysis of the Adaptation and Consistency Effects in Relation to Stuttering," Journal of Speech Disorders, IV, No. 1 (1939), p. 84.

[4]Van Riper and Hull, "The Quantitative Measurement of the Effect of Certain Situations on Stuttering," p. 203.

stuttering frequency on each reading.[1] Shulman reported that adaptation was significantly greater and more marked from reading to reading under simple audience conditions as compared with complex audiences.[2]

In Dixon's study, he varied the social situation by having his subjects read a passage five times consecutively to the experimenter, to an audience of five people, and lastly to a listener on the telephone. Prior to the experiment he had the subjects rank the order of difficulty of the three situations. The rankings of the majority of the subjects and the actual amount of difficulty experienced in each situation were in agreement. The greatest adaptation and the highest mean frequency of stuttering occurred in the audience situation, while the lowest frequency and least adaptation was demonstrated when reading in front of the researcher.[3] These findings appear to contradict the conclusions of Shulman and Van Riper and Hull with reference to the rate and amount of

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[1]Harriett von Krais Porter, "Studies in the Psychology of Stuttering: XIV. Stuttering Phenomena in Relation to Size and Personnel of Audience," Journal of Speech Disorders, IV, No. 4 (1939), pp. 323-333.

[2]Edward Shulman, "Factors Influencing the Variability of Stuttering," in Stuttering in Children and Adults, ed. by Wendell Johnson (Minneapolis: University of Minnesota Press, 1955), p. 215.

[3]Carmen Dixon, "Stuttering Adaptation in Relation to Assumed Level of Anxiety," in Stuttering in Children and Adults, ed. by Wendell Johnson (Minneapolis: University of Minnesota Press, 1955), p. 232.

adaptation in the simple and complex audience situations.[1]

Some research investigated the relationship of the length of the interval between repeated readings of the same material and the recurrence of stuttering (spontaneous recovery). Jamison found that after stutterers adapted to a reading passage, 4.5 hours was sufficient time for complete return of the stuttering response.[2] Jones, after achieving adaptation with his subjects on a reading passage, reported that a 24 hour interval showed complete spontaneous recovery of the stuttering response.[3]

Shulman's research found that there were no significant differences in stuttering adaptation when he used reading material of 200, 500 or 1000 words in length.[4]

Leutenegger's investigation demonstrated that increasing amounts of adaptation occurred with successive reading of the

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[1]Shulman, "Factors Influencing the Variability of Stuttering," p. 215; Van Riper and Hull, "The Quantitative Measurement of the Effect of Certain Situations on Stuttering," p. 203.

[2]Dorothy Jamison, "Spontaneous Recovery of the Stuttering Response as a Function of the Time Following adaptation," in Stuttering in Children and Adults, ed. by Wendell Johnson (Minneapolis: University of Minnesota Press, 1955), p. 248.

[3]E. Leroi Jones, "Explorations of Experimental Extinction and Spontaneous Recovery in Stuttering," in Stuttering in Children and Adults, ed. by Wendell Johnson (Minneapolis: University of Minnesota Press, 1955), p. 230.

[4]Shulman, "Factors Influencing the Variability of Stuttering," p. 216.

same material, regardless of whether the time delay which separated consecutive pairs of readings was 20 minutes, one hour, or 24 hours.[1] Frick's conclusions were different from Leutenegger's since he found no statistically significant recovery of stuttering frequency when there was a time delay of an hour after adaptation.[2]

In studying the amount of adaptation achieved with a combination of constant and varied word lists which were read successively, Golub found more adaptation effect on constant words (46 per cent) than on varying words (10 per cent).[3] Jones reported that when different passages were used, significant adaptation took place for each passage, but there was no transfer of adaptation from one piece of reading material to another.[4]

Newman investigated whether the adaptation effect could

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[1]Ralph Leutenegger, "Adaptation and Recovery in the Oral Reading of Stutterers," Journal of Speech and Hearing Disorders, XXII, No. 2 (1957), p. 286.

[2]James Frick, "Spontaneous Recovery of the Stuttering Response as a Function of the Degree of Adaptation," in Stuttering in Children and Adults, ed. by Wendell Johnson (Minneapolis: University of Minnesota Press, 1955), p. 254.

[3]Arnold Golub, "The Cumulative Effect of Constant and Varying Reading Material on Stuttering Adaptation," in Stuttering in Children and Adults, ed. by Wendell Johnson (Minneapolis: University of Minnesota Press, 1955), p. 244.

[4]Jones, "Explorations of Experimental Extinction and Spontaneous Recovery in Stuttering," p. 231.

also be achieved by stutterers through self-formulated, communicative speech in a series of successive speaking situations. The stimulus he used was a set of sketches which the subjects described orally. He reported that except for the fact that adaptation occurred on the third rather than the second trial, it was similar in pattern to oral reading adaptation and recovery.[1]

The above studies at Iowa consist of the major research that developed knowledge about the basic properties of the adaptation phenomenon. They laid the foundation for several theories, which will be discussed on subsequent pages, as to the causation of the adaptation effect.

Theories of Adaptation

Adaptation and Deconfirmation

Within Johnson's anticipatory avoidance theory of stuttering, adaptation is explained as a reduction of the stutterer's anxiety by a deconfirmation of his expectancies. When the stutterer finds the consequences of his stuttering are not as discomforting as anticipated he becomes less anxious and therefore stutters less.[2]

Johnson's explanation of the adaptation effect has been

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[1]Parley Newman, "A Study of Adaptation and Recovery of Stuttering Response in Self-Formulated Speech," Journal of Speech and Hearing Disorders, XIX, No. 4 (1954), p. 450.

[2]Johnson, "Stuttering," p. 259.

criticized on several points. Peins suggests that the theory does not resolve the lack of adaptation experienced by stutterers during the course of a conversation with friends. If Johnson's conclusion was true, that the greater the amount of talking the stutterer does, the more the deconfirmation of exaggerated fears, the latter part of the stutterer's conversation should show a reduction in stuttering frequency, which in reality does not happen.[1]

Brutten and Shoemaker, whose contributions to research in adaptation will be examined later in this chapter, criticized Johnson's theory for assuming that a reduction in anxiety is due to deconfirmation on the basis of the discrepancy between the expected and actual stuttering. They feel that in studies such as those of Dixon and Shulman the relationship between stuttering and the level of assumed anxiety must be questioned. They say:

> This support was tenuous, however, because anxiety was tautologically inferred from the magnitude of the stuttering rather than from an independent index of negative emotionality. In other words, the measured avoidant responses were used to describe the magnitude of both stuttering and anxiety. Consequently, these studies assumed, by definition, a perfect relationship between anxiety and stuttering.[2]

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[1]Peins, "The Adaptation Effect, Spontaneous Recovery and Consistency Effect within the Expectancy Paradigm in Stuttering," p. 12.

[2]Brutten and Shoemaker, The Modification of Stuttering, p. 66.

Adaptation and Experimental Extinction

Wischner promulgated another theory in which stuttering is a learned anxiety reaction system which is maintained by reinforcement. He attempted to view stuttering in the context of conditioning phenomena in learning research. Within this framework, he compared characteristics of the adaptation effect with those of experimental extinction. He said:

> An examination of the stuttering curve of adaptation and the curve of experimental extinction for either conditioned or unconditioned responses reveals that they tend to be of similar form. Both appear to be negative growth curves characterized by relatively more rapid rate of fall in the earlier as compared with the later trials.[1]

As evidence for his point of view, Wischner cited such studies as those conducted by Harris and Yensen where the maximum decrease in stuttering frequency occurred in the early trials, followed by a very gradual leveling off in the later readings. He also mentioned the results of Jones and Shulman as further support that stuttering adaptation and experimental extinction are related phenomena.[2]

One of the most difficult characteristics of experimental extinction for Wischner to explain was that it is the function of the number non-reinforced trials, and that the response decrement is greater the more reinforced trials that are given.

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[1]Wischner, "Stuttering Behavior and Learning: A Preliminary Theoretical Formulation," p. 59.

[2]Ibid., p. 49.

As he commented, "a most perplexing problem of stuttering behavior is that of identifying the reinforcing state of affairs."[1]

The reinforcing agent was clearly described when Wischner explained the mechanism operating to reinforce stuttering. He contended that "a feared word arouses anxiety tension and that the completion of the stuttered act is accompanied by reduction of anxiety with consequent reinforcement of stuttering behavior."[2] He reported that in an experiment where stutterers were asked to draw that which represented their behavior immediately before, during and after the moment of stuttering, the above cycle of events was clearly depicted by them.

This writer agrees with the criticism of Brutten and Shoemaker that the contention that stuttering is maintained by reinforcement after each stuttering moment, while adaptation results from non-reinforcement of the same moment, is an untenable position. They point out that the completion of the stuttering moment cannot be simultaneously reinforcing and non-reinforcing.[3]

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[1] Ibid., p. 60.

[2] Wischner, "An Experimental Approach to Expectancy and Anxiety in Stuttering Behavior," p. 152.

[3] Brutten and Shoemaker, The Modification of Stuttering, pp. 66-67.

Adaptation in Relation to Propositionality and Familiarity

Within the framework of Eisenson's perseverative theory of stuttering, the adaptation effect was related to reduced propositionality and increased familiarity of the reading materials. He stated:

> Successive utterances of any linguistic word-form content, whether it be in reading aloud or in self-formulated speaking, modifies the intellectual significance or propositional value of the utterance. . . . Our responses are different when we are required to read to search out and communicate meaning. In essence, mere reading aloud is subpropositional; reading for meaning is propositional. . . . Repeated or successive readings, . . . reduces the propositional value of the content.[1]

Eisenson and Horowitz reported an increase in stuttering when words were part of a reading passage as compared to a word list or a nonsense passage.[2] The results of research by Eisenson and Wells demonstrated that stuttering tended to increase in choral reading when the communicative responsibility of the individual was increased by having him think he would be heard individually.[3]

Eisenson questioned the assumption of adaptation studies

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[1]Eisenson, "A Perseverative Theory of Stuttering," p. 242.

[2]Jon Eisenson and Esther Horowitz, "The Influence of Propositionality on Stuttering," Journal of Speech Disorders, X, No. 2 (1945), p. 196.

[3]Jon Eisenson and Charlotte Wells, "A Study of the Influence of Communicative Responsibility in a Choral Speech Situation for Stutterers," Journal of Speech Disorders, VII, No. 3 (1942), p. 261.

that in the repetition of both reading passages and self-formulated speech the linguistic content was the "same" during each trial. He contended that repetition of a passage five or six times may cause the reader to slur, increase his reading rate, change the word stress, phonetically modify word forms or read from memory.[1]

Eisenson's interpretation of Newman's study considered that only the first trial of self-formulated speech was propositional, while subsequent trials consisted of recalling and evoking the linguistic content of trial one. According to Eisenson, there was greater reduction of stuttering in repeated readings than in repetition of self-formulated speech because the readings presented less deviation.[2]

Jakobovits believed that adaptation could be achieved when speech became less propositional through semantic satiation.[3] He said:

> Repeated presentation of the same words and speech situations, without further reinforcing the stuttering behavior, will result in semantic satiation of the negatively valenced cues associated with

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[1]Eisenson, "A Perseverative Theory of Stuttering," pp. 242-243.

[2]*Ibid.*, p. 241.

[3]Verbal satiation or semantic satiation is the lapse or radical change of meaning of a word due to its continued repetition. See Harold Peterson, Mary Beth Rieck and Rita Hoff, "A Test of Satiation as a Function of Adaptation in Stuttering," *Journal of Speech and Hearing Research*, XII, No. 1 (1969), p. 111.

> the words and the situation. The reduction in the intensity of this meaning response will be accompanied by less frequent and less severe stuttering.[1]

The relationship between adaptation and semantic satiation was investigated by Peterson _et al_. Although both adaptation and satiation were experienced by subjects after repeated oral readings, the two phenomena were not simultaneous. Furthermore, reduced meaningfulness, as measured by the semantic differential, was not significant in reducing stuttering frequency of the group. The investigators suggested that although adaptation and satiation are not the same phenomenon, they may have another factor in common which is still unknown.[2]

Wingate examined the effect of prosody on stuttering adaptation by having subjects read a passage five times successively under one condition and then read the same passage in the second condition, but with its punctuation different for each of the five readings. He found significantly less adaptation in the second condition which led him to formulate a two factor explanation of adaptation. The first factor consists of a general organismic adaptation to the situation while the second deals with the increasing familiarity with

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[1]Leon Jakobovits, "Utilization of Semantic Satiation in Stuttering: A Theoretical Analysis," _Journal of Speech and Hearing Disorders_, XXXI, No. 2 (1966), p. 109.

[2]Peterson _et al_., "A Test of Satiation as a Function of Adaptation in Stuttering," p. 115.

the prosody of the passage.[1]

Wingate reasoned that if adaptation were due to experimental extinction or a reduction of fear of words, there would be no difference in the results of the two conditions of his experiment. If rehearsal of words were the only factor involved, both conditions should show the same decrease in stuttering frequency.

The solution, according to Wingate, is that "the 'prosody' hypothesis affords a means of linking the 'familiarity' and 'rehearsal' interpretation of stuttering adaptation with the interpretation that stuttering adaptation reflects a decrease in propositionality." Although words have a certain amount of independent symbolic significance, their meaning is also affected by the context in which they are placed. This context involves the supra-segmental features of juncture, intonation and stress as well as the unique order of the words in the phrase and sentence.[2]

The "prosody" hypothesis suggested by Wingate agrees with and expands upon Eisenson's contention that the establishment of an articulatory-vocal set reduces stuttering. This interpretation of the perseverative theory would consider "familiarity"

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[1]M. E. Wingate, "Prosody in Stuttering Adaptation," Journal of Speech and Hearing Research, IX, No. 4 (1966), p. 550.

[2]*Ibid.*, p. 555.

to be motoric as well as semantic in nature. The corollary as stated by Eisenson says, "Stuttering increases as the speaker must modify his set--intellectual, linguistic-articulatory, and vocal--to immediate and changing speech situations."[1]

Adaptation and Reactive Inhibition

Brutten suggested that adaptation was the result of reactive inhibition, a response-generated barrier to behavioral repetition, which reduces the neural conductivity that mediates stimulus response chains. Within this framework, the frequency of stuttering can be reduced without necessarily a decrease in anxiety or a reduction in reinforcement. Reactive inhibition depends on the number of massed responses, the time interval between responses, and the work load involved in responding. Since it is not a learned inhibition, it has a transitory effect and dissipates following rest.[2]

Donohue had stutterers read orally fiction material continuously for three hours. This resulted in a decrease in the percentage of words stuttered over the three hours, as well as a decrease in the reading rate which she attributed

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[1]Eisenson, "A Perseverative Theory of Stuttering," p. 244.

[2]Brutten and Shoemaker, The Modification of Stuttering, pp. 67-68.

to fatigue which is a major factor in reactive inhibition.[1]

Brutten used the Palmar Sweat Index to measure anxiety during massed oral and silent readings of stutterers and non-stutterers. The stutterers showed a decrease in the Palmar Sweat Index as they adapted, which indicated a reduction in anxiety. The non-stutterers, who also manifested an adaptation effect, showed no change in their Palmar Sweat Index.[2]

Maxwell and Brutten, in an experiment which measured anxiety during adaptation and spontaneous recovery, found that there was no significant change measured in anxiety during adaptation or recovery in their subjects, all of whom were stutterers. They reasoned that spontaneous recovery is an integral part of the adaptation process and any factors considered antecedent to adaptation must be considered antecedent to recovery.[3]

Gray's investigation of the relationship of anxiety and fatigue to adaptation had stutterers read passages eight times each in two conditions while measuring the Palmar Sweat Index

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[1]Irene Donohue, "Stuttering Adaptation during Three Hours of Continuous Oral Reading," in Stuttering in Children and Adults, ed. by Wendell Johnson (Minneapolis: University of Minnesota Press, 1955), p. 266.

[2]Brutten, "Palmer Sweat Investigation of Disfluency and Expectancy Adaptation," p. 45.

[3]David Maxwell and Eugene Brutten, "A Palmar-Sweat Investigation of Stuttering Adaptation and Spontaneous Recovery under Two Levels of Audience Complexity," ASHA, VI, No. 10 (1964), pp. 416-417.

at selected intervals. There was no significant change in anxiety level throughout adaptation or during spontaneous recovery. The conclusion drawn by the investigator was that there was no necessary relationship between changes in anxiety level and these phenomena. Fatigue, as in the Donohue study, was a primary factor with reactive and conditioned inhibition[1] the major inhibitors.[2]

Brutten's hypothesis that stuttering adaptation was due to reactive inhibition attempted to explain the role of anxiety and reinforcement in the adaptation process. As measured independently by the Palmar Sweat Index, anxiety appears to be frequently present, in varying degrees, during stuttering moments. It can apparently remain at a stable level and is not crucial to the reduction of stuttering under conditions present in adaptation studies. Those theorists who believe stuttering is maintained by reinforcement following each disfluency and also that the adaptation effect is the result of non-reinforcement of the stuttering moment make the stuttering

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[1]"Stimuli closely associated with the cessation of a response a) become conditioned to the inhibition associated with the evocation of that response, thereby generating conditioned inhibition; conditioned inhibitions summate physiologically with reactive inhibitions against the reaction potentiality to a given response as positive habit tendencies summate with each other." See Clark L. Hull, Principles of Behavior (New York: Appleton-Century-Crofts, Inc., 1943), p. 300.

[2]Burl Gray, "The Relationship between Anxiety Level, Fatigue, and Stuttering Adaptation," ASHA, VI, No. 10 (1964), p. 416.

moment both reinforcing and non-reinforcing. The reactive inhibition hypothesis, which does not rule out the presence of anxiety or experimental extinction, does not find either necessary for the adaptation effect to occur.[1]

Expectancy Adaptation

As one reviews the varied approaches used by investigators of the adaptation effect, it becomes apparent that the overwhelming majority of studies manipulate word lists, reading passages or spontaneous speech of the oral performance of the subjects. The researchers were inclined to accept verbal performance as an intrinsic step in producing the adaptation phenomenon.

Wischner was the first to discuss the experiment on expectancy adaptation which dealt entirely with the subject's performance on a non-oral level. He sought to determine whether there was an expectancy adaptation curve similar to the one in stuttering adaptation, as well as the effect of imposing a time interval between successive silent readings of the same material.[2]

In the first condition of his experiment, he had the stutterers silently read a passage once on each of five successive days while they underlined words on which they expected

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[1]See p. 21.

[2]Wischner, "Stuttering Behavior and Learning: A Preliminary Theoretical Formulation," p. 165.

they would stutter if called upon to read the passage aloud to an audience. Four days after the completion of this condition, the same subjects silently read a second passage five times successively, while following the same instructions as in the first condition. Both parts of the experiment were given in the group situation.

Wischner's results showed that in both conditions the curves began at approximately the same level but there was no specific trend in condition 1. The results of the second condition demonstrated a progressive decrease in the number of words marked by the subjects in each succeeding silent reading, with the difference between readings one and five nearly significant at the .05 level.[1] In a reference to this experiment in a later article Wischner said:

> The results of this study suggest that under conditions similar to those which yield the stuttering adaptation phenomenon, one may also obtain an expectancy adaptation phenomenon. In a situation in which Ss never read the material aloud but only marked the words on which they expected to stutter were they called upon to read it orally, the frequency of anticipated words (markings) decreased progressively with successive inspections of the same material. The course of this decrement resembles very closely the course of decrement in overt stuttering obtained with successive oral readings of the same material.[2]

After he obtained the expectancy adaptation curve,

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[1] Ibid., p. 170.

[2] Wischner, "An Experimental Approach to Expectancy and Anxiety in Stuttering," p. 151.

Wischner reasoned that rehearsals (previous inspections) of oral reading materials should cause a greater reduction in stuttering frequency than when the same material was presented without any rehearsal. In two experiments, (the first using word lists and the second using reading passages) he investigated the effect of "rehearsal" and "non-rehearsal" conditions. During the first experiment, subjects in the rehearsal condition were instructed to read silently (only forming the words "with their lips") a list of fifty individually exposed words. After completing this task twice, they read the list of words five times orally. With a ten-minute interval between the conditions which were counterbalanced, the same subjects read another list of words orally five times for the second condition.

Two months later, a second experiment was conducted. This investigation had essentially the same design, expect that Wischner substituted 200-word reading passages for the word lists of the first experiment.

The results showed that the stuttering frequency was less for the first oral reading of the rehearsal condition in both experiments than for the first reading of the non-rehearsal condition. In neither experiment did the difference between the first oral reading trial values for both conditions reach statistical significance. In the first experiment the difference between the first oral trial values for both conditions was at the 13 per cent level. In the second experiment the difference between first oral trial values of the two conditions was at the 7 per cent level.[1]

Recently, Besozzi and Adams conducted an experiment in which the subjects read a passage orally five consecutive times in the first condition and they read a second passage orally on trials 1 and 5 and silently on trials 2, 3, and 4 in a second condition. They demonstrated statistically significant adaptation in both conditions, with much greater adaptation evidenced in the complete oral reading condition.[2]

Summary

This chapter has surveyed the research in adaptation from the 1930's to the present. The writer has discussed important investigations of various aspects of the adaptation phenomenon, the explanation of the adaptation effect by major stuttering theories and lastly the few studies dealing with expectancy adaptation.

Many of the studies on adaptation have explored its relationship to social complexity, time interval between each repetition of an oral performance, frequency of oral repetition of material, and the length of the oral passage as well as the effect of several of these variables simultaneously.

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[1]Wischner, "Stuttering Behavior and Learning: A Program of Research," p. 176.

[2]Besozzi and Adams, "The Influence of Prosody on Stuttering Adaptation," p. 818.

Most of the researchers have concluded that within the bounds of their investigations successive oral repetition of material causes a decrease in stuttering moments while increased social complexity increases the frequency of stuttering. The length of the material does not appear to have an effect on the frequency of stuttering but increases in the length of the time interval between oral reading of a passage does lessen the decrease in stuttering.

No major theory of stuttering has adequately explained the adaptation phenomenon. In this chapter the writer has included these explanations, the supporting research and the criticisms of each theory's interpretation of the adaptation effect.

The few studies that have dealt with expectancy adaptation and reduced oral participation in reading passages have not produced definitive results. As a matter of fact, when similar experiments on expectancy adaptation were performed by Wischner and Peins, the former demonstrated a trend toward expectancy adaptation which was nearly significant at the .05 level while the latter was unable to show any expectancy adaptation at all. When Wischner experimented with reduced oral participation through what he called "rehearsal" where his subjects formed the words "with their lips" before reading orally he found a trend toward reduced stuttering though it also was below the .05 level of significance. The present study investigates the effect, if any, prior rehearsal of reading material in the form of silent inspections and elimination of selected aspects of the speech process has on the frequency of stuttering.

CHAPTER III

METHODOLOGY

Subjects

The subjects in this study were 25 stutterers, 19 male and 6 female in the age range of 13 years to 47 years. The mean age of the group was 20.60 years and the median age was 16 years.

Each subject was diagnosed by the clinician at the facility and the experimenter as a stutterer. The clinician rated each one on a severity scale devised by Johnson. This seven-point rating scale begins with (1) no stuttering and ranges to (7) very severe stuttering.[1] Table 1 shows the age, sex and the severity rating for each subject. Table 2 gives the number and percentage of subjects at each level in Johnson's severity rating scale.

All subjects were undergoing therapy at the time of the investigation. Eighteen subjects were tested at the Speech Rehabilitation Institute in New York City, six at Sewanhaka High School, and one at the Alva T. Stamford Jr. High School,

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[1]Wendell Johnson, Frederic Darley and D. C. Spriesterbach, Diagnostic Manual in Speech Correction (New York: Harper & Brothers, 1952), p. 134.

TABLE 1

AGE, SEX AND THERAPIST'S RATING OF EACH SUBJECT'S STUTTERING SEVERITY

Subject	Age	Sex	Rating
1	35	M	Average
2	16	M	Mild
3	25	M	Mild
4	28	M	Mild
5	38	M	Average
6	34	M	Very Mild
7	47	F	Mild
8	24	F	Average
9	15	M	Severe
10	23	F	Very Mild
11	15	M	Mild
12	13	M	Mod. Severe
13	15	M	Average
14	19	M	Very Severe
15	16	M	Mild
16	16	M	Mod. Severe
17	15	M	Mild
18	13	M	Mod. Severe
19	17	M	Severe
20	19	F	Very Mild
21	14	M	Mod. Severe
22	14	F	Mod. Severe
23	14	F	Mod. Severe
24	16	M	Mild
25	15	M	Very Mild

TABLE 2

THE NUMBER AND PERCENTAGE OF SUBJECTS AT EACH RATING IN THE JOHNSON SEVERITY OF STUTTERING SCALE

Severity Rating	Subjects	Percentage
1. No Stuttering	0	0
2. Very Mild	4	16
3. Mild	8	32
4. Average	4	16
5. Moderately Severe	6	24
6. Severe	2	8
7. Very Severe	1	4
	25	100%

Long Island, New York

Each subject was paid a fee for his participation in the study when he had completed the four conditions.

Materials

Four different two-hundred word, factual reading passages were used in this experiment. Two of the selections, the "Rainbow Passage" and "Glass" were used by Peins in her doctoral dissertation. These passages had been made approximately equal in both reading ease and word weights. The two additional passages, "Roads" and "Sponges," were modified in order to equate them with Peins reading materials with respect to the above mentioned factors.[1]

The equating of all the passages for reading ease was accomplished by the use of the Rudolph Flesch formula. This formula estimates reading ease as a function of the number of words per sentence and the number of syllables per 100 words. The scores obtained for all passages were between 60 - 70 which is rated as "standard" and can also be considered to correspond to 8th or 9th grade level reading material.[2]

"Sponges" and "Roads" were modifications of materials in The Practice Workbook of Reading.[3] All selections, which are in Appendix A were used in all four conditions.

The two passages selected by the experimenter were both modified to conform exactly to the criterion used by Peins with regard to the distribution of Brown's word weights. Each word was given a weight from zero to four. The worth of each word was dependent on how many of the following characteristics it demonstrated: (1) one of the first three words

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[1]Peins, "The Adaptation Effect, Spontaneous Recovery and Consistency Effect within the Expectancy Paradigm in Stuttering," p. 31.

[2]Rudolph Flesch, "How to Test Readability" (New York: Harper Brothers, 1951), p. 4. The "Rainbow Passage" had a score of 68, the "Glass Passage" a score of 66, "Roads" a score of 62, and "Sponges" a score of 66.

[3]The Practice Workbook of Reading - Grade 4 (New York: Treasure Books, Inc., 1962), pp. 31, 62.

in a sentence; (2) initial sound a consonant except for the consonants (t), (ð), (h), (w), (m); (3) five or more letters in length; and (4) grammatical function of noun, verb, adjective or adverb. If a word did not meet any of these criteria it was given a weight of zero. The greater the number of the above characteristics contained in a word the greater the word weight value assigned to it.[1]

In this study, each passage had 32 zero-weight words, 55 one-weight words, 60 two-weight words, 43 three-weight words, and 10 four-weight words. This distribution matches exactly that of the two passages used in the Peins' study.

For part of the procedure of this investigation, it was necessary to have four tape recordings of each of the above four passages. Two Norelco Carry-corders were used. Each passage was taped by the experimenter on one of the recorders and then transferred to another tape by replaying it four times while recording it on the second. This procedure insured that all readings of each passage were exactly alike.

Procedure

Each of the facilities from which subjects were drawn provided a quiet room where the experiment was conducted. The furniture in each room consisted of a desk and several chairs. This arrangement was kept constant during every

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[1]Spencer Brown, "The Loci of Stuttering in the Speech Sequence," Journal of Speech Disorders, X, No. 2 (1945), p. 181.

session. The subject sat directly opposite the experimenter at the desk and was observed by her throughout all parts of each condition. The experimenter was the only listener present for all of the conditions. Each subject first met the experimenter briefly, prior to the first session, at which time the initial appointment was arranged.

All subjects participated in each of the four conditions of the experiment. The order in which the conditions were administered was decided independently, by chance for each subject through the use of a table of random numbers. The order of the passages to be used for each subject was also decided by chance (independent of the order of the conditions) by use of a table of random numbers.

Interval between Conditions

There was a time separation between the administration of each condition in order to eliminate any possible influence on the subject of any previously experienced condition. An adequate minimum interval between conditions, which were different from each other in both reading material and instructions, was considered to be 4.5 hours. The majority of subjects had an interval of 48 hours to a week between conditions.

Jamison found that complete recovery of the stuttering response when the same passage was used was accomplished 4.5

hours after adaptation to a reading passage.[1] In a study by Leutenegger, no significant differences in the amount of recovery of stuttering was demonstrated when the same passage was used where the time interval delays were 20 minutes, 1 hour or 24 hours.[2] Jones, using a different passage each day, found there was no transference of adaptation from one passage to another, although there was significant adaptation shown for each passage.[3]

Test Conditions

Condition I

The subjects read a passage aloud, five times successively while sitting opposite the examiner. Each of these readings was taped on a Norelco Carry-corder by the experimenter, as were all oral readings of passages in the other conditions. The subjects were instructed as follows as for this condition:

> Inside this folder is a reading passage. When I give you the signal open the folder and read the passage aloud. Make no effort to avoid stuttering, to control your stuttering, to "fake" or to use any method of voluntary nonfluency. Read at your normal rate, stuttering as much as you would

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[1]Jamison, "Spontaneous Recovery of the Stuttering Response as a Function of the Time Following Adaptation," p. 248.

[2]Leutenegger, "Adaptation and Recovery in the Oral Reading of Stutterers," p. 286.

[3]Jones, "Explorations of Experimental Extinction and Spontaneous Recovery in Stuttering," p. 230.

ordinarily. If you cannot pronounce a word, say it the way you think it should be said and continue reading.

When you finish reading the passage, look up and wait for the signal to begin again. You will read the passage several times in this manner until I stop you. Do you have any questions? Begin.

Condition II

The subjects read a second passage silently four times. As they read, they marked those words on which they felt they would stutter if they read the passage aloud, on a separate duplicated copy of the passage for each silent reading. The following instructions were given for the first part of Condition II:

We are interested in finding out how well you are able to predict on which words you will have difficulty in an oral reading situation. Think of the situation as that of reading the passage aloud to me. In this reading you would not make any effort to avoid stuttering, to control your stuttering, to "fake" or to use any method of voluntary nonfluency. You would be reading at your normal rate, letting yourself go and stuttering as much as you would ordinarily.

The material before you consists of a number of copies of the same passage. When I give you the signal turn the top sheet and begin to read the first copy silently to yourself. Underline each word on which you think you will stutter should you be called upon to read the passage orally to me. Do not re-read the material on this page. As soon as you have finished the first copy place it under the copies of the passage like this (demonstration) and go on to read the second copy, underlining the words on which you think you would stutter on this reading. You will follow the same procedure for the rest of the copies of this passage. Do you have any questions? Begin.

The fifth reading of Condition II, which immediately followed the completion of the first part, was an oral reading which was taped by the experimenter. The following instructions were given:

> Now I would like you to read the same passage aloud. When I give you the signal, open the folder and read the passage aloud. Make no effort to avoid stuttering, to control your stuttering, to "fake" or to use any method of voluntary nonfluency. Read at your normal rate, stuttering as much as you would ordinarily. If you cannot pronounce a word, say it the way you think it should be and continue reading. Do you have any questions? Begin.

Condition III

The subjects read a third passage four times using only inaudible speech movements. No phonation was permitted. Speech was produced by the movements of the lips, tongue and jaw. The experimenter observed the subjects very closely to insure that they performed uniformly in the four readings. The only "noise" was an occasional soft click or hiss during the production of a plosive or a fricative. The following instructions were given for this part of Condition III:

> Inside this folder is a reading passage. When I give you the signal open the folder and read the passage forming the words with your lips but not making any sound. I will demonstrate.

At this point the experimenter read the following paragraph using inaudible speech movements:

> Sugar cane, when it is growing, looks very much like corn. It is tall and has a jointed stalk. The leaves are long and blade-like. Sugar beets

look something like large white turnips.[1]

The experimenter continued the instructions as follows:

> Remember do not speak the words aloud; say them to yourself forming the words with your lips. I shall be watching you and shall call your attention to the fact if you are not doing so.
>
> When you finish reading the passage look up and wait for the signal to begin again. You will read the passage several times in this manner until I stop you. Do you have any questions? Begin.

The fifth reading of Condition III, which immediately followed the completion of the first part, was an oral reading which was taped by the experimenter. The following instructions were given:

> Now I would like you to read the same passage aloud. When I give you the signal you will begin. Make no effort to avoid stuttering, to control your stuttering, to "fake" or to use any method of voluntary nonfluency. Read at your normal rate, stuttering as much as you would ordinarily. If you cannot pronounce a word, say it the way you think it should be and continue reading. Do you have any questions? Begin.

All the subjects understood the instructions for the production of inaudible speech movements. There was no need of further demonstration or cautionary warnings on the part of the experimenter.

Condition IV

The subjects listened to a fourth passage on a tape

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[1]William A. McCall and Lelah Mae Crabbs, Standard Test Lessons in Reading (New York: Bureau of Publications Teachers College, Columbia University, 1961), p. 63.

recorder, four times. The preparation of the tape is described in the Materials section. Since the subjects were asked to listen for changes in the wording of any of the four taped readings, they were provided with a form (see Appendix A, Form for Judging Word Changes in Tape-Recordings in Condition IV) and a pencil to indicate their answers. The following instructions were given for this part of Condition IV:

> Listen carefully to four recordings of a passage. In front of you is a sheet of paper with the numbers one through four and a pencil. If you should hear any change in the wording in any of the readings of the passage check the box next to the passage number. If all the passages are the same check the box marked "no change" after you have heard all the recordings.

The forms were collected and the second part of Condition IV followed immediately. The subjects read aloud the passage they had heard on the tape recorder four times, while the experimenter taped it. The following instructions were given:

> Inside this folder is a reading passage. When I give you the signal open the folder and read the passage aloud. Make no effort to avoid stuttering, to control your stuttering, to "fake" or to use any method of voluntary nonfluency. Read at your normal rate, stuttering as much as you would ordinarily. If you cannot pronounce a word, say it the way you think it should be said and continue reading. Do you have any questions? Begin.

Identification of Stuttering Moments

The experimenter used the same criterion as Williams, Silverman and Kools to identify specific disfluencies while listening to the tape recordings of the four conditions.

> Identified as disfluencies were part-word repetitions, word repetitions, phrase repetitions, interjections of sounds and syllables, revisions, tense pauses (tension), and disrhythmic phonations.[1]

The task of identifying and marking the number of stuttering moments was begun after the observational reliability of the experimenter was checked. For details of the method see the next section, Observational Reliability of the Experimenter. The procedure of listening to and recording the number of disfluencies on all the tapes was repeated at least twice on separate occasions.

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[1]Dean Williams, Franklin Silverman and Joseph Kools, "Disfluency Behavior of Elementary School Stutterers and Nonstutterers," Journal of Speech and Hearing Research, XI, No. 3 (1968), p. 624.

The identification of disfluencies was a modification of one described by Johnson in a 1961 paper. Johnson deleted the categories of broken word and prolongation and added those of disrhythmic phonations and tensions. He defined the new categories as follows:

"Disrhythmic phonations, identified only with words, is that kind of phonation which disturbs or distorts the so-called normal rhythm or flow of speech. The disturbance or distortion may or may not involve tension . . . and may be attributable to a prolonged sound, an accent or timing which is notably unusual, an improper stress, a break, or any other speaking-behavior infelicity not compatible with fluent speech and not included in another category. Disrhythmic phonation is a within-word category.

Tension is a disfluency phenomenon judged to exist between words, part-words, and nonwords (i.e., interjections) when at the between-point in question there are barely audible manifestations of heavy breathing or muscular tightening. The same phenomena within a word . . . would place the word in the category of disrhythmic phonations."

Observational Reliability of the Experimenter

Prior to beginning the analysis of the tape recordings made by the subjects during the four conditions above, the reliability of the experimenter in observing stuttering moments was determined by the following method. The experimenter listened to a tape recording of a 200 word passage read by Subject #7 while she marked the number of words she judged to have been stuttered on a duplicated copy of the passage. After an interval of one week this procedure was repeated. The following formula was then used to test the observational reliability of the experimenter.

$$\text{Reliability} = \frac{C}{\sqrt{xy}}$$

where,

C = The number of common words marked as stuttered on both days

x = The number of words marked as stuttered on the first day

y = The number of words marked as stuttered on the second day

The experimenter's reliability was .93. This score is to be compared with the mean value of .72 that Tuthill reported for a group of experienced speech clinicians.[1]

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[1]Curtis Tuthill, "A Quantitative Study of Extensional Meaning with Special Reference to Stuttering," Speech Monographs, XIII (1946), pp. 81-98.

Plan of Analysis of Data

Measurement of Adaptation

The several methods used to measure the adaptation effect in stuttering are controversial and have produced varying results when applied to the same data. The advantages and limitations of each method were carefully considered in the choice of measurement selected for the present study.

The percentage measure, which is based on the percentage of reduction in the amount of stuttering experienced on an oral reading of a passage as compared with a prior reading of that same passage, has been the most commonly used method. Quarrington points out that the adaptation measures obtained by this method are negatively correlated with the frequency of stuttering on the initial reading. It would be valuable to define adaptation by a measurement that would be independent of initial status.[1]

Tate *et al*. discuss another limitation of this method which would apply to the present investigation. When group data are under consideration, the way to average percentage adaptation scores is not clear. They state:

> An unweighted mean is distorted by the scores of low-initial-frequency, high-percentage-adaptation subjects; a weighted mean all but buries the performance of such subjects. The matter is related of course, to the difficulty of working with

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[1]Bruce Quarrington, "Measures of Stuttering Adaptation," *Journal of Speech and Hearing Research*, II, No. 2 (1959), p. 106.

percentages having widely different bases.[1]

Another measurement of adaptation, which is seldom used, is called rank measure. Five successive readings of each subject are ranked from 1 to 5 on the basis of frequency of stuttering. The mean rank for each of the five readings is the measure of the group adaptation. The measure has the advantage of making use of the information from all the readings, while remaining independent of the initial frequency. It is also immediately amenable to analysis of variance by ranks. Its use, however, appears to be primarily limited to description of group adaptation, since it gives no general information regarding individual adaptation nor allows for a test of differences in group adaptation under changing conditions. A modification of this measure is applied to some of the data in this study and will be more fully described later in this section.[2]

Three other measures, which were rejected for this investigation, were the normal deviate measure, the residual measure and the trend measure. The first of these is not applicable to a group containing very mild stutterers or those who show very mild adaptation.[3] The residual measure does not

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[1]Merle Tate, Walter Cullinan and Ann Ahlstrand, "Measurement of Adaptation in Stuttering," Journal of Speech and Hearing Research, IV, No. 4 (1961), p. 324.

[2]Ibid., p. 322.

[3]Ibid., p. 335.

make use of all the information, and makes assumptions about homoscedasticity which Tate feels are difficult to justify.[1] The trend measure has the drawback of not being good for less than four readings.[2] Silverman and Williams say that all the above measures, except the rank measure, are tied to the frequency of stuttering.[3]

In addition to all these measures of adaptation, one may also test for group trend without attempting to measure the magnitude of this trend. To do this, Tate suggests ranking the mean ranks of each reading. Five ranks are obtained, r_1, r_2, r_3, r_4, and r_5. These form (assuming no ties) a permutation of the integers 1 through 5. Since there are 120 such permutations, the "downward permutation" 5, 4, 3, 2, 1 has under the null hypothesis of no downward trend the probability of $1/120 \approx .008$. This result is significant at the .01 level. Similarly, a permutation obtainable by interchanging two adjacent numbers in the downward permutation is significant at the .05 level.

This test, although valid, has the inadequacy of weighting

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[1] Ibid., p. 330.

[2] Ibid., p. 336.

[3] Franklin Silverman and Dean Williams, "A Proportional Measure of Stuttering Adaptation," Journal of Speech and Hearing Research, XI, No. 2 (1968), p. 444.

each individual's tendencies equally without consideration of the size of the individual differences between readings, A modification of this test is described later in this section.

Proportional Measure of Adaptation

The proportional measure of adaptation, suggested by Silverman and Williams, is used in this study. It is based on the proportion of the number of stuttering moments, for all readings, which occurs during each reading of a passage. This measure indicates the progressive reduction in stuttering of a member of a group as a progressive reduction in the proportion of the number of stutterings during a series of readings and it is very easy to compute.

Silverman and Williams delineate other advantages of the measure as follows:

> . . . it permits an evaluation of the course of adaptation from reading to reading; it is not influenced by the absolute frequency of stutterings (or disfluencies); and it permits a satisfactory test of the hypothesis that the difference in the degree of adaptation exhibited by the members of two or more populations is zero. However, it can only be used to compare groups of subjects who read passages the same number of times, and it permits no test of the "chance" hypothesis for the adaptation exhibited by individual subjects. The latter is not a limitation if only group adaptation is of interest.[1]

In the formula for the proportional measurement of adaptation, X_{ij} = the number of stuttering moments of the i^{th}

[1] Ibid., pp. 444-445.

subject on the j^{th} reading; n = the total number of readings and m = the total number of subjects.

$$P_{ij} = \frac{X_{ij}}{\sum_{j=1}^{n} X_{ij}}$$

P_{ij} = the proportion of stuttering moments of subject i on the j^{th} reading, out of his total number of stuttering moments on all of his readings.

The formula for the mean proportional measure is:

$$\bar{P}_j = \frac{\sum_{i=1}^{m} P_{ij}}{m}$$

In this mean proportional measure of stutters on the j^{th} treatment, $\bar{P}_j$ is substituted for $\bar{X}_j$; otherwise Tate's test for group trend is the same.

In the above measurement, P_{ij} is not, strictly speaking, a measure of adaptation because it decreases as the person's adaptation increases. There is an inverse relationship to stuttering adaptation.

The measurement of adaptation considered here, which is based on the Silverman and Williams formula, is: $A_{ij} = 1 - nP_{ij}$ where A_{ij} = the i^{th} person's adaptation on the j^{th} reading.

This measurement has all the advantages attributed to the Silverman and Williams formula and, moreover, is in the strict sense, a measure of adaptation.

For the test of the correlation between the initial frequency of stuttering and A_{ij}, the Spearman Rank-Order Correlation Coefficient (Rho) was used.[1]

Rank Test for Group Trend

As was mentioned earlier, Tate's rank test for group downward trend does not take into consideration the size of the individual differences between readings. In a modification of this test for group trend the mean proportions are substituted for the ranks. This modified test consists of ranking $\bar{p}_j$ instead of the mean ranks to get r_1, r_2, r_3, r_4, and r_5. The statistical analysis then procedes as described above.[2]

The S Statistic

The S statistic is used here for a test of monotonic downward trend of the adaptation curve and also for a test of the curve's convexity. The raw data are used to rank each subject's performance. The S statistic S_i for the i^{th} subject is calculated by comparing each rank of his five readings, adding one for those ranks which are in normal order, subtracting one for those which are in reverse order and adding zero when the ranks are equal. The final S statistic is the

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[1]N. M. Downie and R. W. Heath, Basic Statistical Methods (2nd ed.; New York: Harper & Row, 1965), pp. 206-208.

[2]See p. 43.

total sum $\sum S_i$.[1] This is then standardized by the following formula:

$$Z = \frac{|\sum S_i| - 1}{\sigma_{\sum S_i}}$$

where $\sigma_{\sum S_i}$ is the standard deviation of $\sum S_i$. (See Nonparametric Trend Analysis for values of $\sigma^2 \sum S_i)^2$. Since Z is nearly normally distributed, it is checked for significance as a normal deviate.

To test for convexity, the differences d_{ij} between the i^{th} subject's successive performances were calculated:

$$d_{ij} = X_{i(j+1)} - X_{ij}$$

The d_{ij} for each subject were then ranked and the S test for monotonic trend as described above was performed.

Measurement of Expectancy Adaptation

The proportional measure of adaptation, described earlier in this section, was applied to the raw data obtained from silent readings 1 through 4 in Condition II. The resulting means were ranked in order to test for downward trend. The S Statistic was used to test for convexity.

The results of the measurement of expectancy adaptation

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[1] George Andrew Ferguson, Nonparametric Trend Analysis (Montreal: McGill University Press, 1965), pp. 19-25.

[2] Ibid., p. 14.

in this study are compared with Peins' findings. The part of Peins' raw data which was selected consisted of four silent readings of a 200-word passage, which was equated with the passages used in the present study. There were 16 stutterers in her population. The comparison was made by finding the mean measure of the raw data of both studies and the proportional mean for both sets of data.[1]

Expectancy Compared with Occurrence of Stuttering

In order to compare the frequency of stuttering moments in oral reading 5 of Condition II with the frequency of expected stuttering moments of the 4 silent readings of Condition II, the proportional measure, described above was used.

Here $X_{ij}^{(2)}$ denotes the number of expected stutterings of the i^{th} person on the j^{th} reading of Condition II ($j = 1, 2, 3, 4$) and for $j = 5$ denotes the number of observed stuttering moments in reading 5 of that condition. The proportional measures $P_{ij}^{(2)}$ are calculated:

$$P_{ij}^{(2)} = \frac{X_{ij}^{(2)}}{\sum_{j=1}^{5} X_{ij}^{(2)}}$$

The difference Q_{i1} between the proportional measure of the i^{th} subject's observed stuttering moments and the greatest

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[1]Peins, "The Adaptation Effect, Spontaneous Recovery and Consistency within the Expectancy Paradigm in Stuttering," p. 128.

of the proportional measures of his expected stuttering moments is calculated:

$$Q_{i1} = P_{i5}^{(2)} - \underset{1 \leq j \leq 4}{\text{Max}} P_{ij}^{(2)}$$

The mean and variance of these differences are computed. A relatively small mean would indicate accuracy of the greatest prediction of stuttering during the silent readings.

A second comparison was made between the proportion of expected stuttering moments on reading 4, Condition II, and the proportion of actual stuttering on reading 5 of the same condition. The difference Q_{i2} between the proportional measure of the i^{th} subject's observed stuttering moments and the proportional measure of his expected stuttering moments on silent reading 4 of that condition is calculated:

$$Q_{i2} = P_{i5}^{(2)} - P_{i4}^{(2)}$$

The mean and the variance of these differences are computed. A relatively small mean would indicate accuracy of prediction of stuttering on silent reading 4 of the second condition.

The purpose of the procedures described in this section is to examine whether oral performance is in any way a continuation of the silent readings which were marked for expected stuttering moments. No formal test is made nor are these statistics used elsewhere in this study.

Difference between Conditions

In order to investigate the hypothesis that there is no significant difference in the number of nonfluencies experienced on oral reading of a passage following (a) four successive oral readings, (b) four successive markings of anticipated stuttering moments (c) four successive readings with "lip" movements only and (d) four successive listenings to a recording of the passage, as experimental conditions, the following tests were performed.

The frequency of disfluencies each subject experienced on the fifth readings in the four conditions were ranked. For each condition the mean rank, over the 25 subjects, was obtained.

The mean rank equals $\bar{r}_j = \dfrac{\sum_{i=1}^{25} r_{ij}}{25}$

If the null hypothesis is true each $\bar{r}_j$ will have an expected value of 2.5 and a variance of $\frac{1.25}{25}$, therefore we use the following formula to standardize the mean rank:

$$Z = \frac{\bar{r}_j^{*} - 2.5}{\sqrt{\frac{1.25}{25}}} = \frac{\bar{r}_j^{*} - 2.5}{\sqrt{.05}}$$

where * indicates the correction for continuity.

Since $\bar{r}_j$ is the mean of 25 independent variables, Z_j has an approximate standard normal distribution. If the magnitudes of the Z_j are less than 3.0 the null hypothesis that there is no difference between the conditions is not rejected and testing stops. If one of the Z_j is greater or equal to 3.0 we reject the null hypothesis at the .05 significance level. The derivation of the critical value 3.0 is detailed later in this section.[1] When the latter result is found we arrange the four mean ranks in ascending order. We then compare groups of three adjacent conditions in a way analogous to the test of all four conditions at once. This procedure is similar to that used in Duncan's New Multiple Range Test in parametric analysis of variance.[2]

If the null hypothesis about three conditions is true, each $\bar{r}_j$ has an expected value of 2 and a variance of $\frac{.667}{25}$. The critical value for the .05 level of significance is dependent upon the number of adjacent groups of three that must be tested. If significance is found again, the process is repeated with adjacent pairs of conditions. If once again the null hypothesis is true, each $\bar{r}_j$ now has an expected value of 1.5 and the variance is $\frac{.25}{25}$. The critical value for the .05 level of significance is again dependent upon the number of adjacent pairs to be tested.[3]

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[1]See p. 54.

[2]Allen L. Edwards, Experimental Design in Psychological Research (revised ed.; New York: Holt, Rinehart & Winston, 1963), pp. 136-140.

[3]See p. 54.

A further investigation was made by repeating the entire process described in this section, with the successive substitutions of readings 1, 2, 3, and 4 of Condition I (the normal adaptation series) for reading 5 of Condition I.

The calculation of the critical value when comparing four conditions at one time is as follows:

In each such comparison there are four normal deviates (Z_j). Since we have five such tests of four conditions i.e., corresponding to the five oral readings of the normal adaptation series, we have a total of 20 Z_j. The probability that any of the Z_j in absolute value $\geqq$ 3.0 is therefore $\leqq$ 20 times the probability that a particular $Z_j \geqq 3.0$, which is $\leqq$ 20 (.0025) = .05.

The calculation of the critical value when comparing three conditions at one time is as follows:

In each such comparison there are three normal deviates (Z_j). If we have k distinct tests of three conditions at a time then we have a total of 3k normal deviates. Therefore, we select a critical value c such that 3k times the probability a particular $/Z_j/$ is $\geqq$ c $\leqq$ .05.

In testing a pair of conditions we make use of the fact that two Z_j are equal and therefore either both or neither of them will be significant. Thus, if we have k distinct pairs to be tested we select a critical value c such that k times the probability that a particular $/Z_j/$ is $\geqq$ c is $\leqq$ .05.

Relationship between Oral Performance and Other Factors

In the section, Proportional Measure of Adaptation, a test of correlation between adaptation (A_{ij}) and initial frequency of stuttering was described.

In order to test the two hypotheses that there is no significant relationship between the adaptation performances of the stutterers of the group and (1) age level and (2) the severity of stuttering as rated by clinicians at the facilities, a correlation test between the above factors and A_{ij} was made.

In order to test the hypothesis that there is no significant relationship between the performances of the stutterers of the group and judgments of the "sameness" of the four tape recorded readings listened to in Condition IV, a correlation test was done between each subject's proportional measure of stuttering on Condition IV, reading 5 and his judgment of the "sameness" of the tape recordings. As a proportional measure we took the proportion of disfluencies on reading 5 of the condition out of the total number of disfluencies of all the fifth readings i.e., Silverman and Williams measure with the final readings of all conditions as base.

After ranking the above data, all correlation tests were made with the Spearman Rank-Order Correlation Coefficient.

CHAPTER IV

RESULTS OF THE ANALYSIS

The results of the analysis of the data are presented here in the same order in which they were discussed in Chapter III, in the section, Plan of Analysis of Data. The raw data of the study are in Appendix B.

Measurement of Adaptation

The Means and Proportional Means of Condition I

Table 3 shows a comparison of the mean frequencies of stuttering and the proportional mean frequencies of stuttering for Condition I (the normal adaptation series), readings 1 through 5, as well as their respective rankings as a measure of group adaptation. The number of stuttering moments of each subject, for each reading of Condition I, is presented in Appendix B, Table 11. Table 12 shows these data converted to mean proportions. The proportional means of .3074 for reading 1, .2238 for reading 2, .1691 for reading 3, .1506 for reading 4 and .1492 for reading 5, reveal a downward trend which is perfectly ranked from 5 to 1, and which is significant at the .01 level when the modification of the

TABLE 3

THE MEANS AND THE PROPORTIONAL MEANS OF THE STUTTERING MOMENTS OF FIVE CONSECUTIVE ORAL READINGS OF A PASSAGE (CONDITION I) AND THEIR RESPECTIVE RANKINGS

Reading	Mean	Rank	Mean Proportion	Rank
1	39.68	5	.3074	5
2	32.40	4	.2238	4
3	28.16	3	.1691	3
4	26.56	1	.1506	2
5	27.16	2	.1492	1

Tate's rank test for group trend is used.[1]

The mean frequencies of stuttering of the same five readings are 39.68 for reading 1, 32.40 for reading 2, 28.16 for reading 3, 26.56 for reading 4 and 27.16 for reading 5. The rankings are in the order of 5, 4, 3, 1, 2, which still indicates a downward trend which is significant at the .05 level.[2] On inspection of the raw data, it can be seen that the majority of subjects experienced less stuttering moments on reading 5 than on reading 4. Of those 11 subjects who demonstrated more stuttering on reading 5, there were 8 whose increase in stuttering was 3 or less. Subjects 19, 21, and 23, with a total increase of 42 stuttering moments among them,

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[1]See p. 45.

[2]Tate, et al., "Measurement of Adaptation in Stuttering," p. 322.

appear to have strongly influenced the results.

Table 4 shows the proportional mean frequencies of stuttering of each day's first oral readings during five consecutive readings for the experimental and control groups (sixteen subjects each) in Peins' study.[1] This was compared with the proportional mean frequencies of stuttering of the normal adaptation series in this present study. Both investigations used the same reading materials. The proportional means for readings 1 and 2 of the present investigation are .3074 and .2238 respectively. All proportional means for the first oral reading of each day in Peins' study are between .2981 and .2333 which is between the first two oral readings of Condition I of the present study.

TABLE 4

PROPORTIONAL MEAN FREQUENCIES OF STUTTERING OF THE FIRST READING OF FIVE CONSECUTIVE ORAL READINGS OF PEINS' CONTROL AND EXPERIMENTAL GROUPS ON THE PRE-TEST DAY AND THE FOUR TEST DAYS

	Control	Experimental
Pre-Test	.2981	.2613
Day 1	.2444	None
Day 2	.2333	None
Day 3	.2809	None
Day 4	.2698	.2700

[1]Peins, "The Adaptation Effect, Spontaneous Recovery and Consistency Effect within the Expectancy Paradigm in Stuttering," pp. 127-131.

The calculation of the mean from the raw data has been a commonly employed method of many adaptation studies. As can be seen from the results obtained here, the disproportionate effect of a small group of subjects with extreme scores may negate the performance of the rest of the group and thereby produce invalid results. It was for this reason that the method was rejected for the present study.

On inspection of the proportions obtained, using the Silverman and Williams formula, it is apparent that the greater the adaptation effect achieved, the smaller the resulting number, which is actually an inverse relationship to adaptation. In order to correct this, the formula $A_{15} = 1 - 5P_{15}$ is used in this study. A perfect adaptation is equal to 1. If no adaptation effect is achieved the result is 0. Reverse or negative adaptation has a negative value and means that the subject had more stuttering moments on reading 5 than his overall average of the 5 readings under consideration.

Table 5 presents the adaptation effect (A_{15}) achieved by each subject of the group in descending order. The greatest adaptation was demonstrated by Subject #6 with .7619. The lowest adaptation was demonstrated by Subject #21 who had a reverse adaptation of -.1037.

The S Statistic for Downward Trend and Convexity

The S statistic, when used as a test of monotonic downward trend of the adaptation curve and as a test of the

TABLE 5

ADAPTATION OF SUBJECTS ON THE FIFTH ORAL READING OF A PASSAGE (CONDITION I, READING 5) RANKED IN DESCENDING ORDER FROM THE HIGHEST TO THE LOWEST ADAPTATION

Subject	Rank	Adaptation	Subject	Rank	Adaptation
6	1	.7619	1	13	.2188
16	2	.6875	13	14	.2000
12	3	.5357	24	15	.1964
25	4	.4872	11	16	.1667
15	5.5	.4118	22	17	.1456
20	5.5	.4118	18	18	.1429
10	7	.3333	23	19	.1406
17	8	.3243	8	20	.1279
5	9	.3197	2	21	.0741
9	10	.2991	14	22	.0240
3	11	.2857	19	23	-.0065
4	12	.2308	7	24	-.0705
			21	25	-.1037

curve's convexity, is explained in detail in Chapter III, in the section Plan of Analysis. In a test of the downward trend of the five readings of Condition I, $\sum S_1 = -145$. Using the formula and tables described in Chapter III, we find:

$$Z = \frac{/-145/-1}{20.174} = 7.138$$

This result is highly significant at the .01 level in its indication of a downward trend. This finding is in agreement with the earlier results of the ranking of the proportional trend for the readings of Condition I.

The S statistic was also used to test the convexity of the curve of the readings of the first condition. The result shows $\sum S_i = 66$. Therefore

$$Z = \frac{66 - 1}{14.549} = 4.468$$

This is statistically significant at the .01 level for convexity which is vividly illustrated in Figure 1. It is easily discernible that the curve resembles the typical relatively smoothly decreasing, negatively accelerating curve of adaptation in oral reading with its sharpest decline in its initial portion.

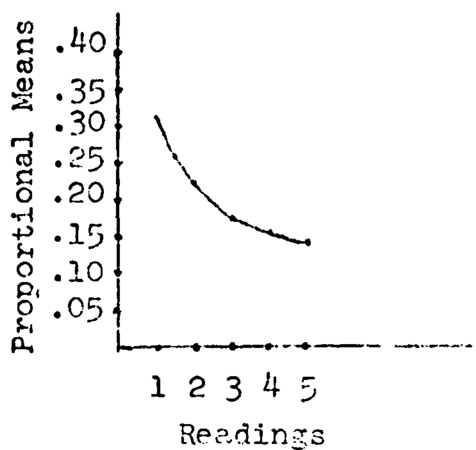

Figure 1. Proportional Means of Five Consecutive Oral Readings (Condition I)

<u>Correlation of Initial Stuttering and Adaptation on Final Reading</u>

When the correlation between adaptation (A_{15}) and initial frequency of stuttering (X_1) was tested using the Spearman Rank-Order Correlation Coefficient, it was found that $\rho = -.5579$.

To find the value of t for testing the significance of the difference between ρ and zero the following formula was used:

$$t = |\rho| \sqrt{\frac{(n-2)}{1-\rho^2}}$$

with n - 2 degrees of freedom

n = the number of subjects

ρ = the Spearman Rank-Order Correlation Coefficient

The value of t = 3.2239, which is statistically significant at the .01 level. The implications of the significant correlation of X_{11} and A_{15} will be discussed in Chapter V.

Measurement of Expectancy Adaptation

The Means and Proportional Means of the Markings of the Expected Stuttering Moments during Four Consecutive Silent Readings (Condition II)

Table 6 shows a comparison of the mean frequencies of the markings of the expected stuttering moments and the proportional mean frequencies of the markings of the expected stuttering moments during four silent readings of Condition II. Although the mean frequencies of the markings of the expected stuttering moments, which is calculated by using the raw data, is not the method of choice in this study, it was employed by Peins in her doctoral dissertation in measurement of expectancy adaptation. Her results are compared and her

TABLE 6

THE MEANS, AND THE MEAN PROPORTIONS, OF THE MARKINGS OF THE EXPECTED STUTTERING MOMENTS DURING FOUR CONSECUTIVE SILENT READINGS (CONDITION II) AND THEIR RESPECTIVE RANKINGS

Reading	Mean	Rank	Mean Proportion	Rank
1	12.40	1	.2866	4
2	13.48	3	.2523	3
3	14.76	4	.2416	2
4	13.40	2	.2194	1

raw data are converted to the proportional measures later in this section.[1]

The number of expected stuttering moments, underlined by each subject, for readings 1 through 4 of Condition II, is given in Appendix B in Table 13 along with Table 16 which presents these data converted to mean proportions. The means of 12.40 for reading 1, 13.48 for reading 2, 14.76 for reading 3 and 13.40 have a ranking of 1, 3, 4 and 2. These results indicate no downward trend and are not significant. As in Condition I, inspection of the raw data reveals how the high frequency of expected stuttering of certain subjects has negated the performances of others.

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[1]Peins, "The Adaptation Effect, Spontaneous Recovery and Consistency Effect within the Expectancy Paradigm in Stuttering," p. 128.

The proportional means for the same silent readings are .2866 for reading 1, .2523 for reading 2, .2416 for reading 3, and .2194 for reading 4. The proportional means of these readings are perfectly ranked from 4 to 1 and show a downward trend. As can be clearly seen in Figure 2, the curve goes straight down with a gentle slope. The results are statistically significant at the .05 level when the modification of Tate's test for group trend is used.[1] The probability of the downward permutation when there are four readings is under the null hypothesis $1/4! < .05$.

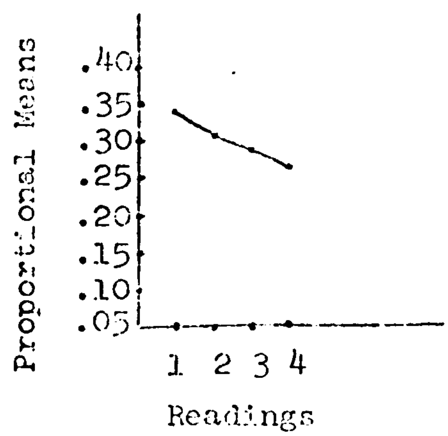

Figure 2. Mean Proportions of the Markings of the Expected Stuttering Moments during Four Consecutive Silent Readings (Condition II)

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[1] See p. 43.

The S Statistic for Downward Trend and Convexity

When the S test for downward trend was performed on the readings 1 through 4 of Condition II, $\sum S_i = -21$. This was normalized and we obtained:

$$Z = \frac{21 - 1}{13.178} = 1.518$$

Although the value here is somewhat high, it fails to reach statistical significance. However, in concert with the results of the modified rank test for group trend of the expected stuttering readings, it can be considered as evidence of a probable downward tendency.

When the S statistic was used as a test for the convexity of the curve of these same readings in Condition II, $\sum S_i = 1$. We then found that:

$$Z = \frac{1 - 1}{8.622} = 0$$

This shows no statistical significance.

Comparison of Expected Stuttering During Silent Readings with Peins' Results

In her doctoral dissertation, Peins found no trend toward an expectancy adaptation curve in any of the series of five successive silent readings, on four consecutive days, with a group of 16 stutterers. Her means, for the first four silent readings of Day 1, were 17.81 for reading 1, 16.93 for reading 2, 17.68 for reading 3 and 15.87 for reading 4. This is in agreement with the results obtained in this investigation for a comparable number of silent readings with a group of 25 stutterers, when the means were computed.

This writer converted Peins' raw data (the first four silent readings of Day 1) so that the means of the markings of expected stuttering moments of four consecutive silent readings could be computed by the proportional method of Silverman and Williams. The means were then ranked and the modified rank test for group trend was applied. As can be seen in Table 7, the resulting means are .3054 for reading 1, .2545 for reading 2, .2399 for reading 3 and .2194 for reading 4. There is a perfect ranking of 4, 3, 2 and 1 which is significant at the .05 level. These results mirror those obtained with the proportional method in the present study.[1]

TABLE 7

THE MEANS AND THE PROPORTIONAL MEANS OF THE MARKINGS OF EXPECTED STUTTERING MOMENTS OF FOUR CONSECUTIVE SILENT READINGS (PEINS' STUDY, DAY 1) AND THEIR RESPECTIVE RANKINGS

Reading	Mean	Rank	Mean Proportion	Rank
1	17.81	4	.3054	4
2	16.93	2	.2545	3
3	17.68	3	.2399	2
4	15.87	1	.2006	1

[1]See p. 64.

Inspection of Peins' raw data reveals that the expected stuttering moments of a minority of six subjects in the group are responsible for her no-trend conclusion. For silent readings 1 through 4 on Day 1, subject #3 scored 26, 27, 31 and 40; subject #6 scored 22, 24, 27 and 29; subject #8 scored 30, 31, 33 and 38; subject #11 scored 6, 7, 7 and 7; subject #15 scored 17, 14, 16 and 21; and subject #16 scored 17, 21, 27 and 25. Here again we see how the scores of a few subjects can strongly influence the results. They actually negate the performances of those subjects who adapt well, but who have a smaller absolute number of stuttering moments in each reading.[1]

Figure 3 graphically presents the very similar results obtained in both studies when the proportional method is used.

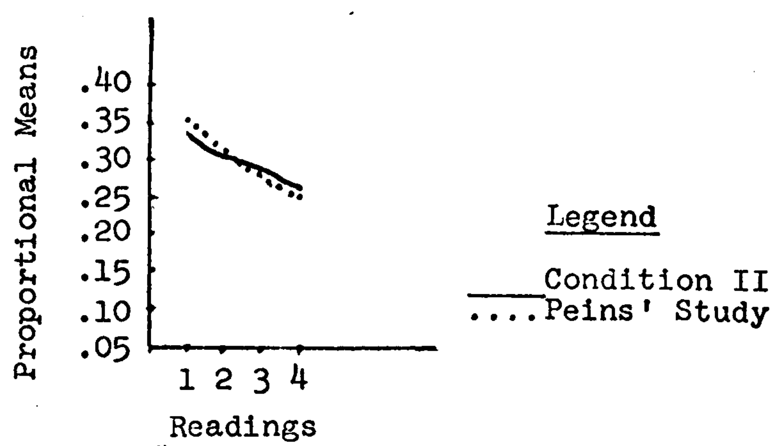

Figure 3. Comparison of the Mean Proportions of the Markings of Expected Stuttering Moments during Four Consecutive Silent Readings (Condition II) with a Similar Condition in Peins' Study, Day 1

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[1]Peins, "The Adaptation Effect, Spontaneous Recovery and Consistency Effect within the Expectancy Paradigm in Stuttering," p. 128.

Expectancy Compared with Occurrence of Stuttering

The five readings of Condition II were treated similarly to the five readings of Condition I, in order to ascertain how the frequency of stuttering expectancy in the four silent readings compared with the observed frequency of stuttering in reading 5 of Condition II.

Figure 4 shows a graph of the proportional means of Condition II, including oral reading 5. Inspection of this graph reveals that there is a gentle downward slope of .1468 for reading 1, .1310 for reading 2, .1279 for reading 3 and .1181 for reading 4. This is followed by a very sharp rise in oral reading 5 of .4762.

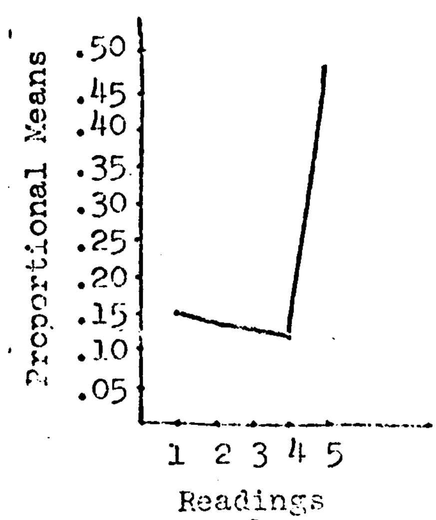

Figure 4. Mean Proportions of the Markings of the Expected Stuttering Moments during Four Consecutive Silent Readings and the Observed Frequency of Stuttering on the Fifth Reading of the Same Passage (Condition II)

A comparison for each subject was also made between the maximum of the proportional measures of his expected stuttering moments during the silent readings and his proportional measure of observed stuttering moments experienced in reading 5 of Condition II. For each subject Q_{11} was calculated. The mean of Q_{11} = .2971 and its variance is .0622.[1]

The smaller the mean of the difference of the proportions the greater is the accuracy of the predicted stuttering during the silent readings. If the mean were near zero it would indicate that the proportion of maximum expected stuttering moments for each subject during the silent readings and the proportion of disfluencies experienced in reading 5 of the second condition matched and therefore the observed frequency of stuttering moments was predicted correctly.

For this group the difference between a subject's frequency of stuttering on reading 5 of Condition II and his maximum expected stuttering was on the average 30 percent of the sum of his expected and observed stuttering. The only subject whose frequency of observed stuttering was less than expectation was #20 with proportional scores of .2121 on reading 1, .1818 on reading 2, .2121 on reading 3, .2424 on reading 4 and .1515 on oral reading 5.

Another comparison was made to ascertain the difference between the proportion of expected stuttering moments on

[1]See p. 51.

reading 4, Condition II and the proportion of observed stuttering on reading 5. For each subject Q_{12} was calculated. The resulting mean for Q_{12} was .3582 and its variance was .0577. The average difference between a subject's frequency of stuttering on reading 5 of Condition II and his expected stuttering moments on reading 4 of that condition was 36 per cent of the sum of all his expected and observed stuttering.[1]

Differences between the Oral Readings of the Conditions

Plan of Comparisons

The plan is to compare each of the successive oral readings of the normal adaptation series with the oral readings of the three other conditions. If significant difference is found in one of these tests, subgroups of three adjacent conditions are then tested. Again, if significance is found then subgroups of two adjacent conditions are tested.

Comparison of All Combinations of Four Readings

As is indicated by Tables 8 through 12, four of the five combinations of four readings have at least one reading whose Z_j (the standardized mean rank) is significant at the .05 level; i.e., the effect of the j^{th} condition is significantly high or low. Therefore the null hypothesis that the effects

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[1]See p. 51.

of all four conditions are not different is rejected. In one case, namely that of Condition I, Reading 2; Condition II, reading 5; Condition III, reading 5 and Condition IV, reading 5, there was no significant difference and the null hypothesis was not rejected. The means $\bar{r}_j$ of the ranks are graphed in Figures 5 through 9.

Comparison of Groups of Three Adjacent Readings

For each of the four combinations of four readings for which significant difference was found, subgroups of three adjacent conditions are tested. As can be seen from Figures 5 through 9 there are k = 5 such distinct groups. They are III_5, II_5 and IV_5; II_5, IV_5 and I_1; I_3, III_5 and II_5; I_4, III_5 and II_5; I_5, III_5 and II_5. This gives a critical value to be used of c = 2.95.[1] As is indicated by Tables 8 through 12 there are four groups of three adjacent readings where we are unable to reject the null hypothesis that the effects of the conditions are not different. They are III_5, IV_5 and II_5; I_3, III_5 and II_5; I_4, III_5 and II_5; and I_5, III_5 and II_5.

Comparison of Pairs of Adjacent Readings

In each of the groups of three where significant difference was found we test subgroups of two adjacent conditions. There are k = 5 such distinct pairs to be tested, namely

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[1]See p. 54.

TABLE 8

NORMAL DEVIATES IN COMPARISON OF FIRST READING OF NORMAL ADAPTATION SERIES (I_1) WITH ORAL READINGS AFTER INAUDIBLE SPEECH MOVEMENTS (III_5); MARKINGS OF EXPECTANCY OF STUTTERING MOMENTS (II_5); AND LISTENING TO TAPE-RECORDINGS OF A PASSAGE (IV_5)

Conditions Compared	Conditions and Readings			
	III_5	II_5	IV_5	I_1
III, II, IV, I_1	4.56	-0.09	1.34	3.13
II, IV, I_1		1.59	0.24	1.22
III, II, IV	3.18	7.35	2.33	
III, II	2.60	2.60		
	Summary of Results			
Line indicates no significant difference. Null hypothesis is not rejected for those conditions.	III_5	II_5	IV_5	I_1
		________	________	________

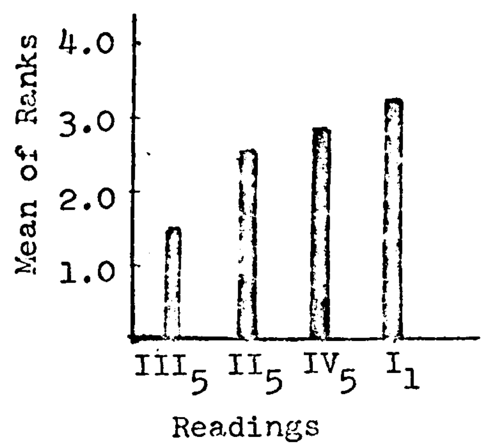

Figure 5. Mean of Ranks in Comparison of First Reading of Normal Adaptation Series (I_1) with Oral Readings after Inaudible Speech Movements (III_5); Markings of Expectancy of Stuttering Moments (II_5); and Listening to Tape-Recordings of a Passage (IV_5)

TABLE 9

NORMAL DEVIATES IN COMPARISON OF SECOND READING OF NORMAL ADAPTATION SERIES (I_2) WITH ORAL READINGS AFTER INAUDIBLE SPEECH MOVEMENTS (III_5); MARKINGS OF EXPECTANCY OF STUTTERING MOMENTS (II_5); AND LISTENING TO TAPE-RECORDINGS OF A PASSAGE (IV_5)

Conditions Compared	Conditions and Readings			
	III_5	I_2	II_5	IV_5
III_5, I_2, II_5, IV_5	2.50	1.16	1.16	2.50
	Summary of Results			
Line indicates no significant difference. Null hypothesis is not rejected for those conditions.	III_5	I_2	II_5	IV_5

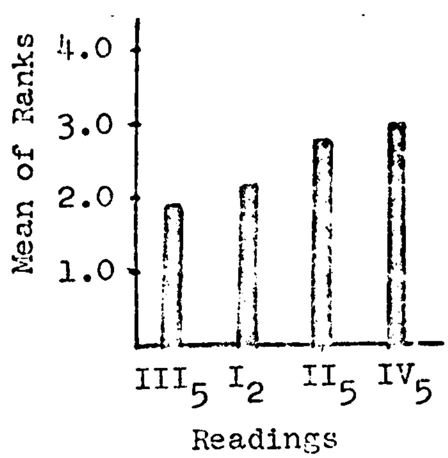

Figure 6. Mean of Ranks in Comparison of Second Reading of Normal Adaptation Series (I_2) with Oral Readings after Inaudible Speech Movements (III_5); Markings of Expectancy of Stuttering Moments (II_5); and Listening to Tape-Recordings of a Passage (IV_5)

TABLE 10

NORMAL DEVIATES IN COMPARISON OF THIRD READING OF NORMAL ADAPTATION SERIES (I_3) WITH ORAL READINGS AFTER INAUDIBLE SPEECH MOVEMENTS (III_5); MARKINGS OF EXPECTANCY OF STUTTERING MOMENTS (II_5); AND LISTENING TO TAPE-RECORDINGS OF A PASSAGE (IV_5)

Conditions Compared	Conditions and Readings			
	I_3	III_5	II_5	IV_5
I_3, III, II, IV	3.13	1.70	1.34	2.77
III, II, IV		7.35	3.18	2.33
I_3, III, II	2.82	0.24	3.18	
III, II		2.60	2.60	
I_3, III	2.00	2.00		
	Summary of Results			
Line indicates no significant difference. Null hypothesis is not rejected for those conditions.	I_3	III_5	II_5	IV_5
	________	________	________	________

(Lines in summary: one line under II_5–IV_5; one line under I_3–III_5.)

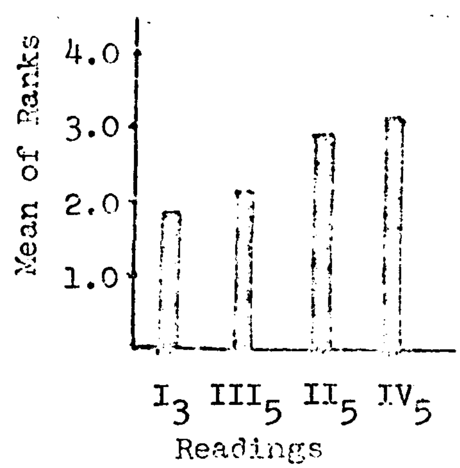

Figure 7. Mean of Ranks in Comparison of Third Reading of Normal Adaptation Series (I_3) with Oral Readings after Inaudible Speech Movements (III_5); Markings of Expectancy of Stuttering Moments (II_5); and Listening to Tape-Recordings of a Passage (IV_5)

TABLE 11

NORMAL DEVIATES IN COMPARISON OF FOURTH READING OF NORMAL ADAPTATION SERIES (I_4) WITH ORAL READINGS AFTER INAUDIBLE SPEECH MOVEMENTS (III_5); MARKINGS OF EXPECTANCY OF STUTTERING MOMENTS (II_5); AND LISTENING TO TAPE-RECORDINGS OF A PASSAGE (IV_5)

Conditions Compared	Conditions and Readings			
	I_4	III_5	II_5	IV_5
I_4, III, II, IV	4.02	1.61	2.15	3.49
III, II, IV		3.18	7.35	2.33
I_4, III, II	3.06	0.61	3.80	
II, IV			1.20	1.20
III, II		2.60	2.60	
I_4, III	1.40	1.40		

	Summary of Results			
Line indicates no significant difference. Null hypothesis is not rejected for those conditions.	I_4	III_5	II_5	IV_5
	________ (under I_4 and III_5)		________ (under II_5 and IV_5)	

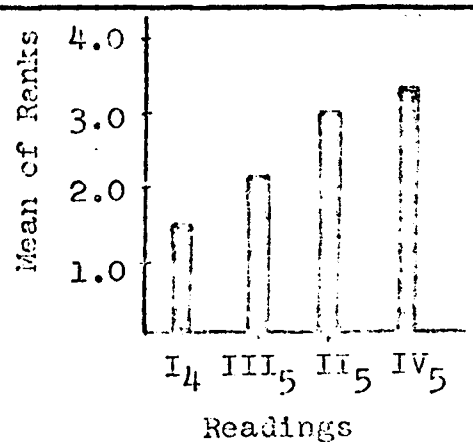

Figure 8. Mean of Ranks in Comparison of Fourth Reading of Normal Adaptation Series (I_4) with Oral Readings after Inaudible Speech Movements (III_5); Markings of Expectancy of Stuttering Moments (II_5); and Listening to Tape-Recordings of a Passage (IV_5)

TABLE 12

NORMAL DEVIATES IN COMPARISON OF FIFTH READING OF NORMAL ADAPTATION SERIES (I_5) WITH ORAL READINGS AFTER INAUDIBLE SPEECH MOVEMENTS (III_5); MARKINGS OF EXPECTANCY OF STUTTERING MOMENTS (II_5); AND LISTENING TO TAPE-RECORDINGS OF A PASSAGE (IV_5)

Conditions Compared	Conditions and Readings			
	I_5	III_5	II_5	IV_5
I_5, III, II, IV	3.49	1.52	2.06	2.95
III, II, IV		3.18	7.35	2.33
I_5, III, II	3.06	0.49	3.67	
II, IV			1.20	1.20
III, II		2.60	2.60	
I_5, III	1.60	1.60		

	Summary of Results			
Line indicates no significant difference. Null hypothesis is not rejected for those conditions.	I_5	III_5	II_5	IV_5

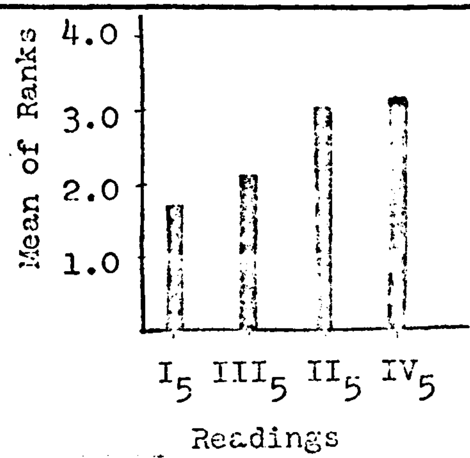

Figure 9. Mean of Ranks in Comparison of Fifth Reading of Normal Adaptation Series (I_5) with Oral Readings after Inaudible Speech Movements (III_5); Markings of Expectancy of Stuttering Moments (II_5); and Listening to Tape-Recordings of a Passage (IV_5)

III_5, II_5; II_5, IV_5; I_3, III_5; I_4, III_5; and I_5, III_5. This gives us a critical value of c = 2.60.[1] As is indicated by Tables 8 through 12 there are four combinations of two readings where we are unable to reject the null hypothesis that the effects of the conditions are not different. They are II_5, IV_5; I_3, III_5; I_4, III_5; and I_5, III_5.

Summary of Results of Comparisons

Directly under Tables 8 through 12 are schemata of the results of the four readings compared called Summary of Results. A line underneath the conditions indicates there was no significant difference found among them.

As can be seen from Table 8, the fifth readings of Conditions II and IV were not significantly different from Condition I, reading 1 (although their mean ranks were somewhat lower than Condition I, reading 1). Condition III, reading 5 was significantly lower than the other three readings.

As can be seen from Table 9, in the comparison of the conditions there was no significant difference found among the second oral reading of the normal adaptation series (I_2), oral reading after marking expectancy of stuttering moments (II_5), oral reading after inaudible speech movements (III_5) and oral reading after listening to tape-recordings (IV_5).

As can be seen from Tables 10, 11 and 12 in the comparison of the conditions the fifth reading of Condition III is

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[1]See p. 54.

not significantly different from the last three oral readings of the normal adaptation series. Also, Condition II is not significantly different from Condition IV, reading 5. However, each of the pairs I_3, III_5; I_4, III_5; I_5, III_5 is significantly lower than the pair II_5, IV_5.

There are several observations one can make about the above summaries. Firstly, there is certainly strong evidence that Conditions II and IV are at most as effective as one preparatory oral reading in reducing the frequency of stuttering and not as effective as Condition I, readings 3, 4 and 5.

Secondly, despite the failure to detect significant difference in the comparison of Condition I, reading 2 with the oral readings of Conditions III, II, and IV, the arrangement of the mean ranks in this comparison, taken together with the results of the other comparisons can be seen as evidence that Condition III, reading 5 is at least as effective as Condition I, reading 2 and probably somewhat better. Perhaps it is as effective as Condition I, readings 3, 4 and 5.

The fact that none of the readings 2, 3, 4 or 5 of Condition I were significantly different from Condition III, reading 5 (although Condition I, reading 2 had a higher mean rank than Condition III, reading 5 and readings 3, 4 and 5 of the first condition had lower mean ranks than Condition III) may be related to the fact that there is a flattening out of the adaptation curve[1] so that the difference between

[1]See p. 61.

successive readings decreases, i.e., differences between the last three readings of Condition I are not very great.

Relationship between Oral Performance and Other Factors

Test for Correlation between Adaptation and Severity Ratings

After ranking the relevant data the Spearman Rank-Order Correlation Coefficient was used to test for correlation between adaptation and the severity ratings of the therapists. The same procedure was followed as was used earlier in Chapter IV in the test for correlation between X_{11} and A_{15}. The results obtained were $\rho = -.4354$ and the value of t was 2.3197, which is significant at the .05 level.

Test for Correlation Between Adaptation and Age

After ranking the relevant data the Spearman Rank-Order Correlation Coefficient was used to test for correlation between adaptation and age. The results showed $\rho = .0589$ with the t value of .2829. Rho is not statistically significant and shows no correlation between adaptation and age.

Test for Correlation of Proportion of Stuttering Moments in Condition IV with Listening Errors

After ranking the relevant data the Spearman Rank-Order Correlation Coefficient was used to test for correlation between the subjects' judgement of "sameness" of tape-recordings they listened to in Condition IV and their relative oral performances on that condition. The results showed ρ = .0466 and t = .2236. This is not statistically significant. Whether the subjects judged wrongly or not showed no relationship to their performances on Condition IV, reading 5.

Some possible reasons for the results of the correlations with various factors will be discussed in Chapter V.

CHAPTER V

INTERPRETATION AND DISCUSSION

The purpose of the study was primarily to investigate the effect of rehearsal with varying degrees of articulatory participation upon the frequency of stuttering in the final oral performance. The results will be compared with those of other studies and will be discussed in relation to various theories regarding stuttering adaptation enumerated in Chapter II.

Measurement of Adaptation

The controversial nature of the measurement of the adaptation phenomenon was discussed in Chapter III, Plan of Analysis of the Data. This writer has become increasingly aware of the necessity of using a measure that is independent of the frequency of stuttering when the experimental group includes subjects who exhibit high and/or low frequencies of stuttering.

The sensitivity of the measure is also important as it can lead to changes in interpretations of data about adaptation. An example of this was Brutten's re-examination of Shulman's data regarding the effect of the length of the passage upon adaptation. By using the mean frequency of stuttering, rather than the percentage of adaptation, Brutten demonstrated that the length of the passage may have an effect on stuttering adaptation.[1]

In the present study, a comparison is made between the mean, based on the raw data, and the proportional mean, as measures of adaptation in a normal adaptation series, consisting of five successive readings of the same passage. Although the results were significant when the measurements were means (as has been true in many other studies), those subjects with very high frequencies of stuttering were shown to have a profound effect on the results. It may be surmised that if a group of subjects happened to include several very severe stutterers who did not adapt or showed minimal adaptation and a majority of relatively mild stutterers who adapted well, the mean frequency of stuttering may be below the level of significance due to the overwhelming effect of those subjects with extreme scores. The proportional measure overcomes this difficulty when used as a measure of group adaptation, since each score is related to the proportion of stuttering each subject experiences within the successive readings of the series, regardless of the absolute frequency of the stuttering moments.

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[1]Brutten and Shoemaker, The Modification of Stuttering, p. 70.

Expectancy Adaptation

Condition II was carefully constructed to replicate, in miniature, the design used by Peins to investigate the expectancy adaptation phenomenon. The instructions were similar to hers and the materials were equated for reading ease and word weight with the passages she used in her research. The mean age of 20.64 years and the median age of 16 years of the group in this study is slightly younger than Peins' group, whose mean age was 22.2 years and median age 21 years. Both groups consisted of relatively naive subjects who had participated in none, or very few, investigations of stuttering.[1]

When the results of Peins' study (the first four silent readings of Day 1) were compared with the four silent readings of this study, using her method of measuring expectancy adaptation (the means of the frequencies of stuttering), they were strikingly similar and both showed no trend toward adaptation. (See Tables 6[2] and 7[3])

When both sets of data were re-evaluated using the proportional method, each series of silent readings exhibited a negatively sloping adaptation curve and also a perfect

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[1]Peins, "The Adaptation Effect, Spontaneous Recovery and Consistency Effect within the Expectancy Paradigm in Stuttering," p. 33.

[2]See p. 63.

[3]See p. 66.

ranking from 4 to 1. (See Figure 3[1]) This writer is satisfied that the discrepancy between the results of the two studies is adequately explained by the difference in the methods of analysis. It is therefore concluded that an expectancy adaptation phenomenon was demonstrated in both studies.

Wischner, using the mean of the frequencies of expected stuttering moments, reported that he achieved a group expectancy curve in which the difference between the first and fifth inspections were not quite significant at the .05 level.[2] The comparison of the present study's findings with those of Wischner presents several obstacles. The materials he used, which are not available, were not equated with each other in any way and varied in length from 180 to 250 words. The experiment was done in a group situation with very sophisticated, test-wise subjects. In his dissertation he charted the number of studies in which his subjects participated. One of his subjects took part in 11 studies within a relatively short period of time.[3]

Expectancy Compared with Occurrence of Stuttering

Two comparisons were made to evaluate the discrepancy

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[1]See p. 67.

[2]Wischner, "Stuttering Behavior and Learning: A Program of Research," p. 168.

[3]*Ibid.*, p. 26.

between stuttering expectation as marked in the four silent readings of Condition II and the actual frequency of stuttering experienced on the final oral reading of that condition.[1]

The maximum of the proportional measures of each subject's expected stuttering moments during the silent readings was compared with his proportional measure of observed stuttering moments during Condition II, reading 5. The difference was found to be 30 per cent of the sum of the expected and actual stuttering moments.

There was a second comparison of the difference between the proportion of expected disfluencies on the fourth silent reading of Condition II and the proportion of observed stuttering moments on the fifth reading of that condition. It was found that the average difference was 36 per cent of the sum of all the expected and observed stuttering moments. Both comparisons show that the subjects tended to underestimate the amount of disfluencies they would experience on an oral reading of a passage.

Effect of Experimental Conditions

The present study was designed primarily to investigate the effect of several kinds of rehearsal on an oral reading performance of the same material.

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[1]See p. 68.

Effect of Silent Reading

The question in Condition II was whether a series of four non-oral readings would have any effect on the frequency of stuttering in the oral reading of the passage. No significant rehearsal effect was demonstrated in oral reading 5 after four silent readings in which expected stuttering moments were marked, although a limited effect is suggested by the data. When the oral reading of the second condition was compared with the first and second readings of Condition I (the normal adaptation series), there was no significant difference at the .05 level. Oral reading 5 of Condition II produced significantly more stuttering than readings 3, 4 and 5 of the first condition (Tables 8 through 12[1]).

In order to examine the results with regard to those theorists who explain the adaptation effect on the bases of reduced propositionality and "semantic" familiarity, the terms need to be defined. Propositionality was originally used by Hughlings Jackson while studying language disorders of aphasic patients. He stated:

> To speak is not simply to utter words, it is to propositionise. A proposition is such a relation of words that it makes one new meaning; not by a mere addition of what we call the separate meanings of the several words; the terms in the proposition are modified by each other. Single words are meaningless, and so is any unrelated succession of words. The unit of speech is a proposition. A single word is, or is in effect, a proposition, if other words in relation are implied. . . .

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[1]See pp. 72-76.

> Loss of speech is therefore the loss of the power to propositionise. It is not only loss of power to propositionise aloud (to talk), but to propositionise either internally or externally. . . .[1]

In discussing propositionality with reference to stuttering, Eisenson in his perseverative theory of stuttering contends that the stutterer experiences greater disfluency when he is unable to meet the demands of the speaking situation caused by a temporary breakdown or disorganization of propositional language usage. The linguistic disturbance is most noticeable when the stutterer has to formulate the language symbols which are the propositional units and evoke them orally, audibly and individually.[2]

Linguistic difficulty of the stutterer with propositional language has also been demonstrated on a written as well as an oral level. Eisenson suggests that the written language of the stutterer shows impairment in impromptu essay writing. He found that a group of fifteen stutterers wrote fewer words and made more errors characterized by repetitions and crossing out of words in this kind of writing than a control group of nonstutterers. Eisenson believes the poorer performance of the stuttering subjects in organizing and sustaining coherent thought demonstrated that they found it difficult to

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[1]Hughlings Jackson, "On Affections of Speech from Disease of the Brain," in Selected Writings of Hughlings Jackson, ed. by James Taylor, II (London: Hodder & Stoughton, 1932), pp. 159-160.

[2]Eisenson, "A Perseverative Theory of Stuttering," p. 238.

cope with the continuous changes in the written situation which were in keeping with the needs of the changing linguistic situation. This would be the same type of difficulty they would encounter in conversation.[1]

Familiarity has also been suggested as an important factor in the adaptation phenomenon. Noble defines familiarity as follows:

> Theoretically, the familiarity of a stimulus (or response) may be regarded as some function of its frequency of occurrence in an organism's history. Humans may experience familiarity with a verbal stimulus in a number of ways: through the special senses of vision or audition, by means of speech (spoken or implicit), or by writing. By these means familiarity may become a learned stimulus attribute. . . . Frequency of stimulation--including that which is response-produced, or proprioceptive--is a necessary condition of learning. . .[2]

The results of Condition II which were presented earlier in this section showing little reduction in the frequency of stuttering after four silent readings of the passage, precludes the explanation of the adaptation effect on the basis of the kind of familiarity which may be acquired without any degree of articulatory participation. This writer can attest to the careful reading and re-reading of the selected passage by each subject as he underlined the words on which he expected

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[1]Jon Eisenson, "Some Characteristics of the Written Speech of Stutterers," Journal of Genetic Psychology, L (1937), pp. 457-458.

[2]Clyde E. Noble, "The Meaning-Familiarity Relationship," Psychological Review, LXX, No. 2 (1953), p. 89.

to stutter on an oral reading performance.

In a study by Schlesinger, et al., the authors conclude that stuttering is related to information load and its occurrence is linked to points of relatively high uncertainty. They state:

> The phenomenon of adaptation seems to be in line with our hypothesis, since once a stutterer had come to know the text, each word in it becomes more predictable for him. The importance of such an account of various phenomena of stuttering lies in the fact that it links up stuttering with normal nonfluency which is also determined by information load.[1]

On the basis of the results reported for Condition II of this study familiarity with the text does not appear to be a sufficiently potent factor (if it is a factor at all) in producing the adaptation effect when familiarity is defined in terms of repeated silent reading of a passage.

Eisenson's contention that adaptation is related to the reduced propositionality and increased familiarity achieved through successive readings of the same material apparently has only assumed consecutive oral performances. Motoric familiarity achieved through oral repetition which establishes a vocal-articulatory set is eliminated during the silent readings of Condition II and may be the factor essential to achieving reduced stuttering moments on the oral reading of the passage. Certainly, if reduced propositionality and

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[1] I. M. Schlesinger, et al., "Stuttering, Information Load, and Response Strength," Journal of Speech and Hearing Disorders, XXX, 1 (1965), p. 35.

increased familiarity solely through re-exposures to the stimulus were the two chief factors in producing reduced stuttering frequency, one would expect more evidence of this tendency toward reduction to be apparent after a series of silent readings.

Adaptation and Auditory Stimulation

Condition IV of this study eliminated both verbal practice and visual stimulation from the rehearsal, prior to the final oral reading. In order to assure that each subject listened attentively to the four recordings of a passage, they were instructed to listen for any changes in the wording of any of the recordings. If they thought they heard such a change, they checked the passage number on a form which was provided. (See Appendix A)

The question in Condition IV was whether listening to a tape recording of a passage four times would have an effect on the frequency of stuttering in the oral reading of the passage. No significant rehearsal effect was demonstrated in oral reading 5 of Condition IV, although a limited effect is suggested by the data. When the oral reading of the fourth condition was compared with the first and second readings of Condition I (the normal adaptation series), there was no significant difference at the .05 level. Oral reading 5 of Condition IV produced significantly more stuttering than readings

3, 4 and 5 of the first condition (Tables 8 through 12[1]).

The evidence appears to support the conclusion that within the bounds of this study "rehearsal" solely through auditory stimulation to familiarize subjects with the material to be read orally did little to reduce the frequency of stuttering.

Ten subjects judged correctly that there were no differences in the four tape recordings of the passage they listened to in Condition IV. The remaining fifteen subjects "heard" differences in the wording of the passages, with two subjects actually checking that each passage had a change. It was of interest to see whether those subjects who judged wrongly experienced any difference in the proportion of disfluencies on the fifth reading of Condition IV as compared with their total number of disfluencies on all final readings of the other conditions. The results showed no statistically significant difference at the .05 level in the relative performance of those who judged wrongly on this condition.[2] It must therefore be concluded that the ability to judge correctly the "sameness" of the tape-recorded passages is not a factor which influences the frequency of stuttering on the final oral reading of the fourth condition.

One might speculate that at least some of the subjects

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[1]See pp. 72-76.

[2]See p. 79.

who judged wrongly may have been more anxious than those who heard no differences. Since there was no independent measure of anxiety in this study, it is beyond the scope of this investigation to draw any conclusions as to whether anxiety played a role in the judgments of any of the subjects in Condition IV.

Adaptation and Inaudible Speech Movements

Condition III of this study was constructed to allow subjects to have the visual stimulation of reading the selected passage, along with the additional practice of inaudible speech movements. The only difference between Condition I (the normal adaptation series) and Condition III was the elimination of all audible sound during the first four readings of the latter condition. This was very carefully controlled by monitoring of readings by the experimenter.

Figure 5[1] showed that when Condition III, reading 5 was compared with the first reading of the normal adaptation series it was significantly lower in stuttering moments than Condition I, reading 1. Actually, it had the lowest frequency of stuttering followed by the fifth readings of Conditions II and IV in ascending order and lastly Condition I, reading 1 with the highest frequency of stuttering.

The results of a comparison of the fifth reading of

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[1] See p. 72.

Condition III with the remaining readings of the first condition showed no statistically significant difference between the oral reading of Condition III and readings 2, 3, 4 and 5 of Condition I. Figure 6[1] indicated that the second reading of Condition I (the normal adaptation series) had a higher mean rank (more stuttering moments) than Condition III, reading 5. Figures 7 through 9[2] showed that readings 3, 4 and 5 of the first Condition had lower mean ranks (less stuttering moments) than the oral reading of Condition III. The last three readings of the normal adaptation series had very small differences as was revealed in Table 3[3] (proportional means of the first condition) and Figure 3[4] which graphically illustrated the relatively smoothly decreasing, negatively accelerating curve of Condition I with its sharpest decline in the initial portion.

Although the comparison of Condition I, reading 2 and the final readings of Conditions II, III, and IV failed to show significant difference there is other evidence to be considered. Firstly, there is the arrangement of the ranks in

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[1]See p. 73.

[2]See pp. 74-76.

[3]See p. 57.

[4]See p. 68.

Figure 6[1] which shows Condition III, reading 5 to have the lowest frequency of stuttering moments followed by Condition I, reading 2 and then Conditions II and IV in ascending order. Secondly, in Tables 10 through 12[2] Condition III, reading 5 showed no significant difference in comparison with the last three readings of the normal adaptation series while the fifth readings of Conditions II and IV were significantly different from those readings. In the arrangement of the ranks in Figures 7 through 9[3] the final oral readings of Conditions II and IV show the highest frequencies of stuttering while the final three readings of the normal adaptation series show the lowest frequencies of stuttering moments. The evidence certainly appears to indicate that the amount of disfluency experienced when reading a passage after four rehearsals using inaudible lip movements is probably somewhat less than the second reading of the normal adaptation series since this third condition also shows no significant difference when compared with the final three readings of Condition I.

The last three conditions of the study exposed the subjects to a passage an equal number of times prior to an oral

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[1]See p. 73.

[2]See pp. 74-76.

[3]See pp. 74-76.

performance. Where Condition IV only allowed auditory stimulation and Condition II allowed silent reading stimulation, Condition III was the only one which permitted limited articulatory participation. This factor appears to have been crucial to achieving the "rehearsal effect."

"Rehearsal," as employed in this study, is the subject's successive exposure to a passage (which may not necessarily take the form of oral repetitions) prior to a final oral reading of the passage. The "rehearsal effect" is measured in terms of the amount of disfluency the subject experiences on the oral reading of that passage.

The experimenter closely observed the subjects during Condition III and listened to their spontaneous remarks at the completion of the session. The subjects were either totally free of disfluencies or had only minor, infrequent hesitations during the entire rehearsal period. Even the most severe stutterer experienced few disfluencies. The spontaneous remarks of the subjects after completion of Condition III were primarily to report surprising fluency during the entire condition which pleased them very much.

In a recent study, Frank had subjects read a passage orally six successive times in one condition and five times in unison with the experimenter plus a sixth oral reading alone in the second condition. On the sixth reading of the experimental condition, stuttering reached a level which was not significantly different from the mean frequency of stuttering found in the last reading of the control condition which was a normal adaptation series. The average number of disfluencies during this last reading of the experimental condition was significantly lower than in the first reading of the traditional adaptation series.[1]

The choral rehearsal in Frank's study and the inaudible speech movement rehearsal of the present investigation produced significant reductions in stuttering. During any normal adaptation series rehearsal of speech movements contributes to the adaptation effect. This active articulatory participation (regardless of the amount of disfluency experienced during rehearsal) appears to be an essential part of the adaptation procedure.

Nearly all theories which explain adaptation, including Johnson's deconfirmation theory, Wischner's experimental extinction theory and Brutten's reactive inhibition theory assume reduction of stuttering in adaptation results from repeated stutterings. The reduction of disfluencies in oral reading after four successive readings using inaudible speech movements seriously questions these theories. The possibility is put forth that rehearsal using active speech movements rather than repeated stuttering causes the reduction of stuttering in the adaptation effect.

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[1]Arthur Frank, "The Frequency of Stuttering Following Repeated Fluent Readings," (unpublished M. S. thesis, Brooklyn College, 1970), p. 33.

No theory of adaptation explains the course followed by the four readings using inaudible speech movements and the oral fifth reading of the third condition. The fluency exhibited from the first reading must be accounted for in some other way. Eisenson's theory may have application in that familiarity through repetition of an articulatory set may be the reason the final reading showed no statistically significant difference from readings 4 and 5 of Condition I (the normal adaptation series). In the fifth readings of Condition II (where the subjects had only visual exposure to the passage) and Condition IV (where they had only auditory stimulation) there were no significant differences demonstrated from readings 1 and 2 of Condition I.

Another explanation may be that the entire performance of Condition III may be related to strong kinesthetic feedback along with the elimination of incorrect auditory feedback. There are some studies which suggest that the elimination of auditory feedback reduces stuttering frequency.

Soderberg theorized that stutterers have a disturbed speech-auditory loop, which creates an auditory perceptual defect.[1] A number of investigators have reported varying degrees of improvement in speech fluency when frequencies up to about 800 Hz. have been filtered out with a masking

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[1]George Soderberg, "Delayed Auditory Feedback and Stuttering," Journal of Speech and Hearing Disorders, XXXIII, No. 3 (1968), p. 260.

noise of 100dB.[1] In explaining the results of the present study, one must take into account the better than usual performance of the stutterers during reading 5 of Condition III compared with reading 5 of Condition II and IV. The role of kinesthetic feedback, which unlike auditory feedback has not been investigated in the stuttering literature, may be a factor in the degree of carryover of reduced nonfluencies in the oral performance of the stutterers.

Although it is beyond the scope of this investigation, experimentation which will explore the relationships of auditory feedback and kinesthetic feedback to each other should prove to be most fruitful.

Adaptation and Other Factors

The results of the correlation between each subject's initial stuttering and his adaptation score showed a highly significant, negative relationship. Although Silverman and Williams' proportional measure is independent of the absolute frequency of stuttering when testing group adaptation, the proportional scores of individuals have a linear relationship and are not independent.[2]

Since the relationship between initial stuttering and adaptation was a negative one, it is not surprising that the

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[1] *Ibid.*, pp. 260-263.

[2] Silverman and Williams, "A Proportional Measure of Stuttering Adaptation," p. 445.

results of the correlation between the severity ratings of the therapists and adaptation should also be negative and significant at the .05 level. One would expect that the therapist's rating would more closely reflect the stutterer's initial performance, rather than the reduced stuttering of his adapted reading.

There appears to be no relationship between our measure of adaptation and the age of the subject. However, because our measure seems to be related to the initial frequency of stuttering, the question of correlation between adaptation and age needs further study. It points to the need for future research to devise statistical methods which will complement those which we use now.

Recommendations for Future Research

The expectancy adaptation curve was demonstrated to have a significant downward trend, but no convexity. A study is recommended that would measure the effect of a greater number of massed silent readings. A comparison could then be made between the courses of the expectancy adaptation curve and the curve of stuttering adaptation.

A second study is recommended which would have a design comparable to that of Condition III. The only difference would be that half of the subjects would have reduced kinesthetic feedback during the rehearsal portion of the experiment. Reduced kinesthesia is very difficult to produce, but might be accomplished through hypnotic suggestion or drugs. The purpose of this investigation would be to explore whether kinesthetic feedback is necessary to producing the "rehearsal effect" after rehearsals of the material with inaudible speech movements.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The present study explored the effect of varying articulatory participation on the reduction of stuttering frequency. The results of the investigation were considered in relation to the explanations advanced for stuttering adaptation.

Summary of the Procedure

There were 25 subjects, who participated in four conditions which were separated by a minimal interval of 4.5 hours. They read four different 200-word passages which were equated for reading ease and word-weight. Both the order of the conditions and the order of the passages were determined by chance, independently for each subject. The four conditions consisted of (a) five consecutive oral readings; (b) four consecutive silent readings followed by an oral reading; (c) four consecutive readings using inaudible speech movements followed by an oral reading and (d) listening to four tape recordings of the same passage followed by an oral reading of the passage.

Summary of the Results

1. There was a significant difference in the number of disfluencies experienced on the oral reading of a passage following four successive oral readings of that passage.

2. Downward trend and convexity were both demonstrated at the .01 level of significance for five oral readings of the same passage.

3. There was a correlation which was significant at the .05 level between the frequency of stuttering on the first reading of five consecutive oral readings and the frequency of stuttering on the last oral reading.

4. There was a correlation which was significant at the .05 level between the frequency of stuttering on the last oral reading of five consecutive oral readings of a passage and the severity of stuttering ratings of the therapists.

5. There was no significant correlation at the .05 level between the reduction in the frequency of stuttering on the last oral reading of five consecutive readings of a passage and age.

6. When compared with the first reading of a normal adaptation series (Condition I) there was no significant difference at the .05 level in the number of disfluencies experienced on the oral reading of a passage following four successive markings of anticipated stuttering moments on four separate copies of that passage.

7. There was a difference in the results obtained in the measurement of anticipated stuttering moments when the data of four consecutive silent readings were calculated using the means and the proportional means. The measurement using the means demonstrated no expectancy adaptation. The measurement using the proportional means demonstrated expectancy adaptation that when ranked was significant at the .01 level.

8. There was no significant downward trend or convexity demonstrated in the measurement of anticipated stuttering moments for four consecutive silent readings of the same passage. The value for the downward trend was high but did not reach statistical significance. In concert with the results of the modified rank test for group trend which was significant at the .01 level, it may be considered evidence of probable downward tendency.

9. In a comparison of the maximum of the proportional measure of each subject's expected stuttering moments during the silent readings and his proportional measure of observed stuttering moments in the oral reading which followed, the difference was 30 per cent of the sum of the expected and observed stuttering moments.

10. In a comparison of the difference between the proportion of expected disfluencies on the fourth silent reading of the second condition and the proportion of observed stuttering moments on the oral reading which followed, the average difference was 36 per cent of the sum of all the expected and observed stuttering moments.

11. When compared with readings 3, 4 and 5 of a normal adaptation series (Condition I) there was no significant difference in the number of disfluencies experienced after four readings using inaudible speech movements.

12. When compared with readings 1 and 2 of a normal adaptation series (Condition I) there was no significant difference in the number of disfluencies experienced after four successive listenings to a tape recording of that passage.

13. There was no significant correlation at the .05 level between a subject's ability to judge correctly that there were no differences in the wording of four tape recordings of a passage he heard and his disfluencies on the final reading of that passage as compared with his total number of disfluencies on all final readings of passages in the other conditions.

Conclusions

1. The expectancy adaptation effect can only be shown by the use of a measure which is independent of the frequency of stuttering such as the proportional means, so that subjects with high and/or low frequencies of stuttering do no invalidate the results.

2. The lack of stuttering adaptation shown after (a) four silent readings and (b) listening to a tape recording of a passage four times appears to dispute the theory of decreased propositionality and familiarity with content as causes of

the adaptation effect.

3. Amount of stuttering in oral reading of a passage after four readings using only inaudible speech movements is not significantly different at the .05 level from amount of stuttering in the final three readings of a normal adaptation series.

4. Subjects need not experience disfluency during inaudible speech movement rehearsal to have the final oral reading of that passage show no significant differences at the .05 level from the final reading of the normal adaptation series.

5. The "rehearsal effect" may be due to increased familiarity through the establishment of an articulatory set or reduction of incorrect auditory feedback and strong kinesthetic feedback or a combination of both conditions.

APPENDICES

APPENDIX A

READING PASSAGES AND FORMS

I Reading Passage 1

ROADS

Pioneer builders of roads in our huge country, made trails through wild forests to new frontiers. They followed rivers and valleys as they went across the continent from the Atlantic to the Pacific Ocean. Many decades later came more builders of roads for the fast, modern automobiles. They were most eager to make well paved highways along the shortest possible line of march between towns and hamlets. They cut down many of the trees and dug up the wild flowers. They even cut away hills and cut away mountain areas so huge modern automobiles might have easy ways to travel. Instead of beautiful woodlands having trees and wild flowers, advertising billboards, hot dog stands, and gas stations were everywhere.

Now, once more, everyone is trying to make America's highways more beautiful. Many of the business owners are helping in this work. The wild flowers, tall grass, big trees, all are being planted along wide highways. Instead of picking wild flowers, tots are protecting nature's gift by leaving everything for others to enjoy. Instead of carelessly tossing away picnic bags, boys and girls are cleaning up by throwing trash in barrels. Children are helping adults keep both roadsides and woodlands clean.

II Reading Passage 2

RAINBOW PASSAGE

When the sunlight strikes raindrops in the atmosphere, they act like a prism and form a rainbow. The rainbow is a division of white light into various beautiful colors. These take the shape of a long round arch, with its path towering above, and its two extremities apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no human ever finds it. When a man looks for something beyond his reach, his friends say he is looking for the pot of gold at the end of the rainbow.

Throughout the centuries people have explained the rainbow in various ways. Nations have accepted it as a miracle without physical explanation. For certain groups it was a token that there would be no more general floods. The Norsemen considered the rainbow as a bridge over which the gods passed from earth to their dwelling in the sky. Aristotle thought that the rainbow was caused by reflection of the sun's rays by the rain. The difference in the rainbow depends considerably upon the size of the water drops, and the width of the colored band increases as the size of the drops increases.

III Reading Passage 3

SPONGES

Sponges you use each day are sea animal skeletons which come from many tiny animals grown together. Although they must always live in water, these tiny sea animals can't swim, but grow fast against shells, rocks or the sea bed.

Sponges of many types are discovered inhabiting all sections of the earth. The finest of sponges are from the Mediterranean where they grow in extremely deep water and are gathered by divers. Practically all that are now used in the United States come from huge fisheries in both Florida and the Bahamas.

Off the Florida reefs, pointed, long forked poles are used to harpoon big sponges. Two men go out by boat, where one man fishes for sponges while the other rows. The fisherman looks through a glassbottomed bucket. When he sees worthwhile sponges, he will let down his harpoon and spear them. They are masses of tiny jellylike animals having various colors.

For several days sponges are allowed to decay and then are immersed in warm water and beaten. The remaining skeletons are washed and hung up to dry. Many of the sponges are offered for sale at Tarpon Springs, Florida, which is the greatest shipping port for sponges.

IV Reading Passage 4

GLASS

A diamond weighing a pound may cost a million dollars, while a pound of glass may cost less than twenty cents. Yet measured in terms of the value to the human race, glass is one of the most important materials we have, and it is worth far more than any rare gem ever discovered. When the physicist and the chemist have finished discovering all the many kinds of glass that can be made, it will be worth even more.

Glass, before science took it in hand, was just glass. Now it has been developed in dozens of new forms and endowed with a hundred new talents. Tough glasses which retard the flow of heat are made into bricks and many implements. Resistant glasses are molded into vacuum tubes and insulators. New and surprising varieties of glass show unexpected abilities when shaped into frying pans, fireproof cloth, and even into springboards for diving pools.

An inch cube of glass is so strong that it can support a heavily loaded freight car, though such a task would strain a similar cube of almost any other material. A glass window only one inch thick can be so made that it will stop a bullet.

Form for Judging Word Changes in
Tape-Recordings in Condition IV

There has been a change in the wording of the passage in:

Reading 1.

Reading 2.

Reading 3.

Reading 4.

No change in any of the readings.

APPENDIX B

BASIC DATA

TABLE 13

FREQUENCY OF EXPECTED STUTTERING MOMENTS DURING FOUR SILENT READINGS AND STUTTERING MOMENTS DURING THE FIFTH ORAL READING OF THE SAME PASSAGE (CONDITION II)

Ss	Readings					Ss	Readings				
	1	2	3	4	5		1	2	3	4	5
1	4	2	2	4	7	13	7	6	7	9	31
2	10	10	9	10	23	14	78	99	107	110	156
3	2	1	1	1	6	15	6	7	11	8	21
4	3	2	0	1	6	16	2	2	2	2	21
5	5	8	5	5	33	17	3	4	2	3	11
6	3	3	1	2	6	18	2	1	1	0	8
7	29	30	31	28	76	19	31	36	66	49	86
8	26	26	17	16	49	20	14	12	14	16	10
9	6	7	6	5	28	21	10	13	16	20	83
10	5	5	5	3	26	22	0	0	0	0	32
11	17	14	13	11	21	23	3	2	2	1	43
12	15	8	6	4	19	24	23	37	32	23	41
						25	6	2	13	4	15

TABLE 14

FREQUENCY OF STUTTERING MOMENTS DURING FIVE CONSECUTIVE ORAL READINGS (CONDITION I); AN ORAL READING OF A PASSAGE AFTER FOUR READINGS USING INAUDIBLE SPEECH MOVEMENTS (CONDITION III); AN ORAL READING OF A PASSAGE AFTER LISTENING TO A TAPE-RECORDING OF THE PASSAGE FOUR TIMES (CONDITION IV)

Ss	Con. I Readings					Con. III Readings	Con. IV Readings	Ss	Con. I Readings					Con. III Readings	Con. IV Readings
	1	2	3	4	5	5	5		1	2	3	4	5	5	5
1	12	8	5	2	5	3	7	13	57	56	43	33	36	32	36
2	19	15	15	17	15	17	24	14	188	173	169	175	171	157	180
3	7	3	1	1	2	5	6	15	39	24	11	16	12	24	32
4	13	4	11	5	6	3	5	16	18	14	8	5	3	12	27
5	35	31	28	33	20	32	38	17	13	13	4	2	5	5	4
6	7	7	2	4	1	3	2	18	11	6	7	5	6	8	19
7	67	74	79	81	82	56	77	19	85	64	53	44	62	59	53
8	42	39	28	33	30	39	35	20	11	5	6	8	4	7	13
9	31	26	19	16	15	29	31	21	93	69	67	64	83	80	77
10	18	11	7	3	6	16	22	22	41	33	31	26	27	34	29
11	18	18	14	15	13	17	22	23	39	32	18	17	22	38	50
12	60	28	22	17	13	13	33	24	54	47	50	37	36	38	45
								25	14	10	6	5	4	10	18

TABLE 15

PROPORTIONAL MEASURES OF STUTTERING MOMENTS DURING FIVE CONSECUTIVE ORAL READINGS OF THE SAME PASSAGE (CONDITION I) AND THEIR DIFFERENCES

Ss	Readings								
	1		2		3		4		5
1	.3750		.2400		.1563		.0625		.1563
		-.1250		-.0938		-.0938		.0938	
2	.2346		.1852		.1852		.2099		.1852
		-.0494		0.0000		.0247		-.0247	
3	.5000		.2143		.0714		.0714		.1429
		-.2857		-.1429		0.0000		.0714	
4	.3333		.1026		.2821		.1282		.1538
		-.2308		.1795		-.1538		.0256	
5	.2381		.2109		.1905		.2245		.1361
		-.0272		-.0204		.0340		-.0884	
6	.3333		.3333		.0952		.1905		.0476
		0.0000		-.2381		.0952		-.1429	
7	.1749		.1932		.2063		.2115		.2141
		.0183		.0131		.0052		.0026	
8	.2442		.2267		.1628		.1919		.1744
		-.0174		-.0640		.0291		-.0174	
9	.2897		.2430		.1776		.1495		.1402
		-.0467		-.0654		-.0280		-.0093	
10	.4000		.2444		.1556		.0667		.1333
		-.1556		-.0889		-.0889		.0667	
11	.2308		.2308		.1795		.1923		.1667
		0.0000		-.0513		.0128		-.0256	
12	.4286		.2000		.1571		.1214		.0929
		-.2286		-.0429		-.0357		-.0286	

TABLE 15 (Continued)

Ss	Readings							
	1		2		3		4	5
13	.2533		.2489		.1911		.1467	.1600
		-.0044		-.0578		-.0444	.0133	
14	.2146		.1975		.1929		.1998	.1952
		-.0171		-.0046		.0068	-.0046	
15	.3824		.2353		.1078		.1569	.1176
		-.1471		-.1275		.0490	-.0392	
16	.3750		.2917		.1667		.1042	.0625
		-.0833		-.1250		-.0625	-.0417	
17	.3514		.3514		.1081		.0541	.1351
		0.0000		-.2432		-.0541	.0811	
18	.3143		.1714		.2000		.1429	.1714
		-.1429		.0286		-.0571	.0286	
19	.2760		.2078		.1721		.1429	.2013
		-.0682		-.0357		-.0292	.0584	
20	.3235		.1471		.1765		.2353	.1176
		-.1765		.0294		.0588	-.1176	
21	.2473		.1835		.1782		.1702	.2207
		-.0638		-.0053		-.0080	.0505	
22	.2595		.2089		.1962		.1646	.1709
		-.0506		-.0127		-.0316	.0063	
23	.3047		.2500		.1406		.1328	.1719
		-.0547		-.1094		-.0078	.0391	
24	.2411		.2098		.2232		.1652	.1607
		-.0313		.0134		-.0580	-.0045	
25	.3590		.2564		.1538		.1282	.1026
		-.1026		-.1026		-.0256	-.0256	

TABLE 16

PROPORTIONAL MEASURES OF EXPECTED STUTTERING MOMENTS DURING FOUR SILENT READINGS OF THE SAME PASSAGE (CONDITION II) AND THEIR DIFFERENCES

Ss	Readings						
	1		2		3		4
1	.3333		.1667		.1667		.3333
		-.1667		0.0000		.1667	
2	.2564		.2564		.2308		.2564
		0.0000		-.0256		.0256	
3	.4000		.2000		.2000		.2000
		-.2000		0.0000		0.0000	
4	.5000		.3333		0.0000		.1667
		-.1667		-.3333		.1667	
5	.2174		.3478		.2174		.2174
		.1304		-.1304		0.0000	
6	.3333		.3333		.1111		.2222
		0.0000		-.2222		.1111	
7	.2458		.2542		.2627		.2373
		.0085		.0085		-.0254	
8	.3059		.3059		.2000		.1882
		0.0000		-.1059		-.0118	
9	.2500		.2917		.2500		.2083
		.0417		-.0417		-.0417	
10	.2778		.2778		.2778		.1667
		0.0000		0.0000		-.1111	
11	.3091		.2545		.2364		.2000
		-.0545		-.0182		-.0364	
12	.4545		.2424		.1818		.1212
		-.2121		-.0606		-.0606	

TABLE 16 (Continued)

Ss	Readings						
	1		2		3		4
13	.2414		.2069		.2414		.3103
		-.0345		.0345		.0690	
14	.1980		.2513		.2716		.2792
		.0533		.0203		.0076	
15	.1875		.2188		.3438		.2500
		.0313		.1250		-.0938	
16	.2500		.2500		.2500		.2500
		0.0000		0.0000		0.0000	
17	.2500		.3333		.1667		.2500
		.0833		-.1667		.0833	
18	.5000		.2500		.2500		0.0000
		-.2500		0.0000		-.2500	
19	.1703		.1978		.3626		.2692
		.0275		.1648		-.0934	
20	.2500		.2143		.2500		.2857
		-.0357		.0357		.0357	
21	.1695		.2203		.2712		.3390
		.0508		.0508		.0678	
22	.2500		.2500		.2500		.2500
		0.0000		0.0000		0.0000	
23	.3750		.2500		.2500		.1250
		-.1250		0.0000		-.1250	
24	.2000		.3217		.2783		.2000
		.1217		-.0435		-.0783	
25	.2400		.0800		.5200		.1600
		-.1600		.4400		-.3600	

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