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The Adaptation Effect in Bilingual People who Stutter: An Examination of the Oral-Motor Rehearsal Theory

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THE ADAPTATION EFFECT IN BILINGUAL PEOPLE WHO STUTTER: AN EXAMINATION OF THE ORAL-MOTOR REHEARSAL THEORY

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An Abstract of the Thesis Presented
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The present study provided further information about stuttering among bilingual populations and attempted to assess the significance of repeated oral-motor movements during an adaptation task in two bilingual adults. This was accomplished by requesting that bilingual people who stutter to complete an adaptation task of the same written passage in two different languages. Explored was the following research question: In bilingual speakers who stutter, what is the effect of altering the oral-motor movements by changing the language of the passage read during an adaptation task?

Two bilingual adults were each requested to complete an adaptation task consisting of 10 readings in two separate conditions. Participants 1 and 2 completed two conditions, each of which contained a separate passage. Condition B consisted of an adaptation procedure in which the participants read five successive readings in English followed by five additional successive readings in Language 1 (L1). Following the completion of the first randomly assigned condition, the participant

was given a rest period of 30 minutes before beginning the remaining condition and passage. Condition A consisted of an adaptation procedure in which the participants read five successive readings in L1 followed by five additional successive readings in English.

Results across participants, conditions, and languages indicated an atypical adaptation curve over 10 readings characterized by a dramatic increase in stuttering following a change of language. Closer examination of individual participants revealed differences in stuttering and adaptation among languages and conditions. Participants 1 and 2 demonstrated differences in adaptation and stuttering among languages. Participant 1 demonstrated an increase in stuttering following a change in language read in Condition B and a decrease in stuttering following a change in language read in Condition A. It is speculated that language proficiency contributed to the observed differences in stuttering following a change of language. Participant 2 demonstrated an increase in stuttering following a change in language read in Condition A and a minimal increase in stuttering following a change in language read in Condition B. It is speculated that a change in the oral-motor plan contributed to the increase in stuttering in Condition A. Collectively, findings from this exploratory study lend support to an interactive effect between language proficiency and a change in the oral-motor plan contributing to increased stuttering following a change of language during an adaptation task.

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I equate this process to walking in what appears to be a dark tunnel and you're not quite sure if the ground will continue to be there with each step. It was everyone else around me who could see the ground beneath my outstretched foot and encouraged me to keep walking. Thank you.

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INTRODUCTION

Research investigating stuttering began to be abundant in the speech-language pathology literature in the 1930's. Early investigations in stuttering research appeared in a series of articles entitled "Studies in the Psychology of Stuttering" authored by Wendell Johnson and various collaborators (e.g., Johnson & Knott, 1937; Johnson & Inness, 1939; Harris, 1942). These early investigations attempted to explore the nature of stuttering by examining its dynamic parameters. For example, studies at this time revealed circumstances in which the frequency of stuttering was reduced or absent, such as the reduction in stuttering observed with successive oral readings of the same material (e.g., Johnson & Knott, 1937; Van Riper & Hull, 1955). This type of stuttering reduction has been known as the "adaptation effect." A 50% reduction in the frequency of stuttering is typically seen after five readings of the same material with the greatest decrease occurring between the first and second readings (e.g., Johnson & Knott, 1937; Van Riper & Hull, 1955; see Appendix A). The decrease in the frequency of stuttering generally reaches a plateau after the fifth reading, with additional readings producing little or no effect (Fierman, 1955; Johnson & Inness, 1939).

Following the documentation of the adaptation effect, the literature explored factors that can alter the amount of adaptation taking place. These factors have included how the manipulation of the testing situation and the manipulation of the reading material can alter the amount of adaptation and stuttering that occurs (see Appendix B). Based on research results defining factors that affect the adaptation effect, a theory has been developed suggesting that the rehearsal of the oral-motor

plan during successive readings contributes to the adaptation effect (Bloodstein, 1972; Frank & Bloodstein, 1971; Max & Caruso, 1998; Max, Caruso, & Vandevenne, 1997; Wingate, 1966). According to this theory, the adaptation effect is a result of enhanced ease in the serial ordering of speech movements through rehearsal and/or learning of the motor plan after successive readings. Practice allows greater coordination of movements of the oral articulators with respiration and phonation. This theory is supported by the fact that adaptation is often greatest when material is orally read, held constant, and read in succession.

The adaptation effect has been one of the most heavily investigated phenomena in the stuttering literature (Bloodstein, 1995). The warranting of such attention has been argued by Prins and Hubbard (1990) who stated, "Factors that help to explain the adaptation of stuttering could be important in understanding the nature of the disorder and its treatment" (p. 494). Bloodstein (1995) has suggested that, "Knowing what causes them [i.e., adaptation] would give us deeper insight into the causes of other changes in the frequency of stuttering" (p. 327). Further, recent research in brain imaging has found unusual neural activations located in the supplementary motor area of people who stutter. This finding suggests that stuttering involves both the motor system and the planning phase of speech-motor production (e.g., Ingham et al., 1996). In other words, stuttering may occur during the planning of speech and the output of speech. Thus, it may be speculated that an adaptation task, which requires successive readings of the same material, provides an opportunity for enhancement of the planning of speech-motor productions through rehearsal of the oral-motor plan.

The purpose of this study is to investigate the relationship between the oral-motor rehearsal theory and the adaptation effect in bilingual people who stutter. Chapter one is a review of research that has examined factors that can alter the amount of adaptation taking place during an adaptation task. Additionally, this review examines the relationship between the factors affecting the adaptation and the oral-motor rehearsal theory of stuttering adaptation, thus providing a sufficient background in the relationship between the adaptation effect and the oral-motor rehearsal theory to support a rationale for the present study. The rational is discussed further in Chapter one. Chapter two is describes the method. Chapter three describes the results. Chapter four and five offers interpretations and suggests future research directions.

Chapter 1

REVIEW OF THE LITERATURE AND RATIONAL

Johnson and Knott (1937) published the first known study of the adaptation effect in a series of articles entitled "Studies in the Psychology of Stuttering." Of interest in their study was the distribution of moments of stuttering across successive readings of the same material for both individuals who stutter and groups of stutterers. The authors found that people who stutter, as a group, do not demonstrate a tendency to stutter on the same words. These findings were also seen in a select number of individual subjects, in that stuttering did not occur consistently on the same words. The authors found numerous instances for 15 of the 21 subjects when stuttering did not occur on the same words throughout the adaptation task. Johnson and Knott reasoned that because stuttering was not consistently observed for individual stutterers on every recurring word or phoneme over successive readings, no mechanical or phonetic disability existed among people who stutter. If a mechanical or phonetic disability did exist, "... stuttering on these words should occur consistently in all the readings" (p. 19). The authors concluded that assumed reactions to stimuli or the biological condition of the organism might be the catalyst to stuttering.

Factors Affecting Adaptation

Varying the Situation

Although Johnson and Knott (1937) offered the first published study of the adaptation effect, Van Riper and Hull (1955) documented the adaptation effect two years prior in 1935; however, it wasn't until 1955 that Van Riper and Hull's findings

were published in Stuttering in Children and Adults. Van Riper and Hull found that adaptation for severe stutterers was more gradual, requiring more readings to reach a plateau, than the adaptation of mild stutterers. Subjects were found to exhibit more stuttering when reading to an audience. Additionally, fewer moments of stuttering were found when the subjects read the same passage backwards after a plateau was reached. The authors concluded that adaptation was not due to the content of the passage or the meaning of the words themselves; rather, more likely, it was a result of situational factors.

Numerous investigators continued to explore the effect of audience size on adaptation (e.g., Dixon, 1955; Porter, 1939; Shulman, 1955; Siegal and Haugen, 1964). Porter (1939) investigated the effects of increasing audience size while simultaneously changing the reading material. Porter progressively increased the number of audience members and used a different passage following each reading. Adaptation was not found to be statistically significant. A progressive increase in the percentage of stuttering occurred over five readings. The result was an increase of approximately 6.4 times the amount of stuttering on the fifth reading as on the first reading. As observed by Porter (1939), changing the reading material between readings appeared to eliminate any adaptation that normally had been associated with increasing audience size. Further studies examining the effect of changing the reading material during an adaptation task will be addressed at a later point in the literature review.

Shulman (1955) found that a progressive increase of audience size reduced the amount of adaptation. Although adaptation was found with and without an audience,

Shulman found approximately 2.5 times less adaptation over five readings when an audience was present as compared to when an audience was not present. In contrast, Dixon (1955) found greatest adaptation to occur when an audience was present and least adaptation to occur when only the examiner was present. Contrasting findings between Dixon (1955) and Shulman (1955) might be attributed to methodological differences. Shulman had the audience successively increase by one individual beginning after the *first* reading, thus both the control condition and the audience condition had only the examiner present at the first reading. As a result, the mean percentage of words stuttered in the first reading were comparable in both the control and audience conditions. However, Dixon maintained a consistent audience of five individuals across all readings in the audience condition. This resulted in the mean percentage of words stuttered in the first reading of the control condition being different from the percentage of words stuttered in the first reading of the audience condition. The first reading of the control condition had only the examiner present, whereas the first reading of the audience condition had five audience members present. Differences in the use of audience members could possibly lead to a difference in the mean percentage of words stuttered, thus affecting the amount of adaptation. This assumption, however, is not supported by findings of Siegal and Haugen (1964), who found initial audience size did not affect the amount of adaptation.

Siegal and Haugen (1964) replicated and extended Shulman's (1955) study by including a *decreasing* audience group. The authors hypothesized that greatest adaptation should take place when the reading material is held constant during

successive readings and the audience size is systematically decreased. Subjects involved were assigned to an increasing or decreasing audience group. Subjects in the decreasing audience group participated in an experimental condition that included five individuals present at the first reading and was decreased by one with each successive reading. Subjects in the increasing audience group participated in an experimental condition that included one audience participant at the onset of reading and that increased by one with each successive reading. Subjects exposed to the increasing and decreasing audience size also participated in a control condition involving only the examiner present. In the experimental conditions of increasing and decreasing audience size, the first reading revealed no significant difference in frequency of stuttering between the two groups. The authors concluded that an initial audience size of 5 to 1 has no effect on stuttering frequency. Results indicated the subjects exposed to the increasing and decreasing audience size displayed similar amounts of adaptation in the control condition, which included only the examiner. However, differences in the amounts of adaptation were found in the experimental conditions. The authors' hypothesis was borne out; greater adaptation occurred during the decreasing audience condition than during the increasing audience condition. Post-hoc analysis revealed that similar amounts of adaptation took place for subjects participating in the decreasing audience condition and the control condition. The authors concluded that decreasing the audience size had no greater effect on adaptation than did reading to a single listener.

Shulman (1955), Wingate (1972), and Kroll and Hood (1976) examined other situational factors effecting adaptation. Shulman (1955) revealed that when the time

interval between successive readings of the same material was reduced, the amount of adaptation was greater and occurred more rapidly than when the time interval between readings was prolonged. For instance, when readings were performed with no time interval, adaptation was seen after the second reading and the subjects demonstrated a total mean adaptation of 46% after five readings. However, when a time interval of 24 hours existed between readings, adaptation was only minimally observed at the fourth reading and the total mean adaptation was 11.9% after the fifth reading. Moreover, a time interval of 15 minutes between readings was found to produce a total mean adaptation of only 19.1%.

Wingate (1972) conducted another study examining the effect situational factors have on adaptation. Wingate hypothesized that adaptation is due to psycho-physiological factors and thus subjects should be vulnerable to circumstances that could be expected to have an arousing effect. Following the first reading in an adaptation task, Wingate presented to eight subjects alarming audio and visual stimuli lasting three seconds. The audio stimuli consisted of a warble tone ranging from 45dB to 95dB, and the visual stimuli consisted of a light bar with four 375-watt photoflood lamps. Results indicated that a presentation of loud audio and visual stimuli after the first reading increased the frequency of stuttering occurring between the first and second readings. This finding contrasted sharply with numerous adaptation studies documenting the greatest decrease in stuttering frequency occurring after the first reading. The author concluded, "...alarm stimuli occasioned a brief organismic arousal which counteracted the usual 'calming down' that can be assumed to occur during the first reading in a standard adaptation series" (p. 549).

Kroll and Hood (1976) investigated the effects of a priori knowledge regarding the nature of the reading task and information value of the reading material on adaptation. The information values of the passages used were scored according to a cloze procedure that measures the amount of information in a passage. The authors reasoned that subjects might be able to form a "gestalt" of the experimental procedures if the author presented the subject with a set of five identical passages rather than presented the subject with a new identical passage for each reading. Kroll and Hood found more stuttering on the first reading when the subjects were given five identical stapled copies of the passage than when they were presented with a new sheet of paper. Those subjects who were not aware of the nature of the experiment, meaning they did not have all five readings handed to them at once, displayed more stuttering on the second reading when they were presented with a new sheet of paper, thus not presenting the typically observed reduction in the frequency of stuttering on the second reading. Additionally, the authors found that adaptation was greater when the reading material was rated low in information value. In light of the findings on a priori knowledge, Kroll and Hood proposed that past research on differences in adaptation curves between stutterers and nonstutterers must be examined carefully in regard to task presentation to the subjects.

Varying the Material

At the same time situational parameters were being examined relative to the adaptation effect, linguistic parameters also were being investigated. These parameters, such as the use of successive self-formulated speech samples in adaptation tasks, could be regarded as comparable to the reading material used in

adaptation studies relative to the linguistic involvement of each production. Harris (1942) published the first study examining the hypothesis of adaptation transfer to spontaneous speech. That is, if the person who stutters is only adapting to the testing *situation*, should not this "increased fluency" appear in spontaneous speech during an adaptation task? Many studies have not found a distinct relationship between adaptation during reading and in spontaneous speech (e.g., Harris, 1942; Kroll & Hood, 1974). Studies have attempted to arrive at self-formulated speech while still maintaining the "successive" degree seen in reading tasks. For example, Harris found prior readings using topic stems before a conversational situation did not produce a statistically significant reduction in stuttering frequency.

In another study of adaptation in spontaneous speech, Newman (1954) investigated if adaptation can occur in spontaneous speech alone. The control condition consisted of five consecutive oral readings while the experimental condition involved subjects producing progressively more complete, self-formulated descriptions of a geometric shape. Stuttering severity was determined by using a subjective rating scale every 10 seconds during reading and spontaneous speech. The author found self-formulated speech to have a slightly greater severity of stuttering throughout the descriptions, although both spontaneous speech and the oral reading tasks demonstrated an adaptation curve.

Casting doubt on Newman's (1954) findings, Kroll and Hood (1974) argued that Newman used general subjective ratings of stuttering severity rather than a precise frequency count of stuttering behaviors. Kroll and Hood evaluated stuttering severity using a tabulation of each moment of stuttering and each specific type of

stuttering in a control condition and an experimental condition. The control condition required the subjects to read a 100 word passage five consecutive times, wheras the experimental condition involved a spontaneous speech task requiring each subject to describe the same stimulus picture five consecutive times. Kroll and Hood found significant adaptation in the control condition; however, spontaneous speech revealed a relative mean consistency of 20% of total stuttering across all five trials, thus no adaptation occurred. Kroll and Hood were doubtful of previous research that found a relationship between adaptation and spontaneous speech, proposing that many of the previous studies did not use a methodology that was representative of a "genuine spontaneous or self-formulated speech task" (p. 228).

In addition to discussing manipulating the level of linguistic formulation in adaptation tasks, research has examined how the manipulation of the reading material can alter the amount of stuttering adaptation. As described earlier in this paper, Porter (1939) found that changing the reading material between trials, when an audience was present, eliminated any amount of adaptation that had normally been reported with only the variable of increasing the size of the audience (e.g., Shulman, 1955; Siegal & Haugen, 1964). Numerous other studies also have found a strong relationship between reading the same material and significant stuttering adaptation (e.g., Johnson & Inness, 1939; Soderberg; 1969; Wischner, 1952).

Johnson and Inness (1939) demonstrated the significance of eliciting adaptation using repeated readings of the same material instead of a single reading of continuous material. Johnson and Inness asked subjects to read five identical passages containing 180 words and then read a 900-word passage without stopping. The 900-

word passage was later divided into five 180-word segments to aid in the comparison to the five identical passages. Results revealed a 19% adaptation rate during continuous reading and a 48% adaptation rate when reading five identical passages. Although adaptation was seen in both conditions, approximately 2.5 times greater adaptation was observed when subjects read five identical passages. The authors concluded that adaptation was more strongly associated with the word content of reading material than with the speaking situation. Although a reduction in the percentage of stuttering during three hours of continuous readings has been found (Donohue, 1955), Bloodstein (1995) states that only a reduction between 10 to 20 percent during continuous reading has been the average.

Wischner (1952) and Soderberg (1969) further investigated how the reading of different passages affected the amount of adaptation. When Wischner (1952) had subjects read five identical passages and five differing passages, they demonstrated approximately 43% and 10% adaptation respectively. Approximately four times greater adaptation was found when subjects read five identical passages. The effect of changing the reading material was also demonstrated by Soderberg (1969), who examined stutterers, "inferior speakers," and "superior speakers." Subject descriptions of "inferior speakers" and "superior speakers" were university students who did not stutter, but who were labeled "good" or "bad" speakers based on instructor ratings of articulation, pronunciation, and fluency during speaking assignments. All subjects read five identical passages and five different passages. The author found greatest adaptation in the stuttering group during identical readings of approximately 31%. Further, when the passages were different, the stuttering group

did not display any adaptation, in that similar amounts of stuttering occurred on each passage.

In addition to noting how important the consistency of the reading material is in stuttering adaptation, the literature also reports that adaptation has been found in the reading of word lists (Golub, 1955) and that adaptation is reduced when the prosodic features of the repeated passage have been changed (Wingate 1966). In a study of adaptation to word lists, Golub (1955) asked subjects to read word lists composed of 100 words. Half of these words re-occurred with each delivery and the other half were new words dispersed among the 100 words. Golub found a 46% adaptation rate among re-occurring words and only a 10% adaptation rate among new words. In another study, Wingate (1966) examined how using the same passage but altering the meaning of the passage by differing the punctuation, affected adaptation. Wingate developed five passages that were different in the placement of punctuation; specifically, each passage contained the same words, but when punctuated differently, told a different story. Wingate found a 42.5% reduction in stuttering when the subjects read the same passage as opposed to only a 23.5% reduction when the passages were punctuated differently. Although a 23.5% reduction in stuttering is a considerable amount of reduction, the amount of stuttering adaptation was nearly halved when the punctuation was altered.

Thus, reading material has been shown to be an important component in stuttering adaptation; however, not yet discussed in this review are the aspects of the material directly related to adaptation. Because Golub (1955) found adaptation could be achieved when only word lists were read, Wingate (1966) reasoned the adaptation

effect involved a component other than simply reading a group or list of words repeatedly. He stated, "If adaptation was only to the rehearsal of words, adaptation would have been similar in both (prosodic) conditions" (p. 554). Hence, it appears that although reading the same passage or words is critical in achieving adaptation (e.g., Golub, 1955; Johnson & Inness 1939; Soderberg, 1969; Porter, 1939; Wischner, 1952b), equally important is the consistency in the manner in which the words are said (Wingate, 1966). Wingate concluded that motor-linguistic elements are a factor in stuttering adaptation in that the reader becomes increasingly proficient at executing the "patterning" of the particular motor sequences of words. Familiarization of not only the repeated words in the passage, but also the elements of stress and intonation, produces greater fluency. Similarly, Eisenson (1958) concluded "repeated readings establish an articulatory and vocal set that approaches automatic" (p. 240). This establishment of an "articulatory and vocal set" not only includes the coordination of articulation, phonation, and respiration of the *words* used in a repeated passage, but also the coordination of articulation, phonation, and respiration of the *prosody* in the passage. These early attempts to explain the nature of the adaptation effect are later used to support the oral-motor rehearsal theory of the adaptation effect (Bloodstein, 1972).

Eisenson's conclusion was further supported by the findings of Frank and Bloodstein (1971) who designed an experiment to see if adaptation was primarily a function of repeated *stuttering* on the material or repeated *reading* of the same material. The authors were interested in determining if adaptation was possibly occurring because the subject was adapting to his/her own stuttering or because the

subject was adapting to the reading material. The control condition was initially completed and the authors obtained a baseline adaptation curve from a group of subjects. For the experimental condition, the authors had subjects read in unison with an examiner on five readings during which little or no stuttering occurred. A sixth reading was performed independently by the subjects and was compared to the sixth reading in the control condition. The authors found the amount of stuttering at the sixth reading, in both conditions, to be nearly equal. In other words, after subjects read in unison with the examiner, the amount of stuttering increased at the sixth reading to approximate the same amount of stuttering at the sixth reading during the control condition. The subjects exhibited the same amount of stuttering at the sixth reading whether or not stuttering appeared in prior readings. These results indicated that the adaptation effect appeared to be primarily a result of repeated reading rather than repeated stuttering. The authors argued that "the adaptation effect appears to be related to the rehearsal of the motor plan" (p. 523).

Frank and Bloodstein's (1971) study was replicated and extended by Max, Caruso, and Vandevenne (1997) by having Dutch subjects read four additional independent readings after the sixth reading. Results were in agreement with the findings of Frank and Bloodstein. Further, Max and his colleagues found the frequency of stuttering to be stable across the additional independent readings. The authors concluded that the stabilization of the frequency of stuttering in the additional readings further supported the theory of the rehearsal of the oral-motor plan because an increase in stuttering was not observed when the subjects performed independent readings. If a progressive increase in stuttering had been found after unison readings,

it would not support any rehearsal that had taken place in prior readings because an increase in stuttering was found. However, a progressive increase in stuttering was *not* found following unison rehearsal. What was found was a stabilization of stuttering frequency, thus supporting the view that rehearsal had already occurred when the readings were done in unison.

Varying the Manner of Production

It has been demonstrated thus far that adaptation is greatest when the material is held constant and when readings follow the same oral-motor sequencing. However, the interaction between phonation and oral-motor sequences has yet to be discussed. When readings are done at whisper, the oral-motor movements are repeated, but the interaction between phonation and articulation is absent. Bruce and Adams (1978) investigated whether or not adaptation occurs when subjects follow the same oral-motor sequencing among words but do not use phonation. The authors had subjects complete a control condition including a typical adaptation task read aloud and an experimental task involving a total of five readings during which subjects read aloud the first reading, whispered on the second, third, and fourth readings, and read aloud on the fifth. Bruce and Adams found a typical adaptation curve of 65.3% during the control condition, whereas the experimental condition yielded an adaptation curve of only 39.3%. The adaptation curve was nearly halved when participants read in a whisper on readings two, three, and four. Further, the authors found an increase in the percentage of stuttering on the fifth reading during whispered readings that was comparable to the percentage of stuttering on the second reading in the control condition. It was as if the whispered practice elicited no benefit. The authors agreed

that whispered practice did not inhibit adaptation or facilitate adaptation, but practice reading aloud was superior to whispered speech in promoting adaptation. Bruce and Adams concluded that repeated readings that require the subject to coordinate respiration, articulation, and phonation, as seen in oral reading, would produce significantly greater adaptation. Interestingly, Moss (1976) found similar adaptation with vocal rehearsal; however, Moss' findings contrasted with Bruce and Adams' results in that lipped and whispered conditions were also sufficient in producing significant adaptation effects. In summarizing these findings, Bloodstein (1995) stated, "All we can say for sure is that adaptation requires some type of active rehearsal. The more closely such rehearsal approaches the stutterer's ordinary speech the more unequivocal appears to be its benefit" (p. 335).

Acoustic Findings of Adaptation

Under the established hypotheses that coordination among phonation, articulation, and respiration must exist for the greatest adaptation to occur, many studies have examined acoustical parameters during adaptation tasks (e.g., Max & Caruso, 1998; Prins & Hubbard 1990; Yoshiyuki & Ramig, 1987). By examining the acoustical parameters of adaptation, one might be able to find underlying acoustical characteristics common only to the adaptation effect. Studies have investigated whether the adaptation effect produces different acoustical findings compared to the effects of other fluency-enhancing conditions, whether differences exist during adaptation in the acoustical parameters between stutterers and nonstutterers, and whether acoustic parameters change as the subjects progress through an adaptation task (e.g., Andrews, Howie, Dozsa, & Guitar, 1982; Brayton & Conture, 1978;

DiSimoni, 1974; Horii & Ramig, 1987; Prins & Hubbard 1990; Ramig, Krieger, & Adams, 1982; Max & Caruso, 1998). It is reasonable to assume that increased fluency found during the adaptation effect might be the result of changes in the acoustics of the oral mechanism similar to acoustic changes that have been found in other fluency-inducing conditions (e.g., Andrews, Howie, Dozsa, & Guitar, 1982; Brayton & Conture, 1978; DiSimoni, 1974; Janssen & Wieneke, 1987; Ramig, Krieger, & Adams, 1982). Horii and Ramig (1987) found both stutterers and nonstutterers had increased durations of utterances between pauses and no change in the fundamental frequency of voice over six readings. They did find that stutterers used longer mean pause duration and consequently had longer total speaking time and lower speaking time ratio during adaptation tasks. The authors concluded that the adaptation effect might have explanations that are unique from other fluency-enhancing conditions. Similarly, Prins and Hubbard (1990) did not find acoustic changes in repeated readings that resembled changes reported in therapy or other fluency-enhancing conditions. The authors concluded that the adaptation effect occurs without a change in the surface parameters of speech. Prins and Hubbard reasoned that adaptation occurs primarily because the "speaker's central capacities for motor-linguistic organization allow him or her to profit from practicing the passage" (p. 502).

Max and Caruso (1998) examined changes in the acoustical parameters of perceptually *fluent* speech during adaptation. The authors hypothesized that the increase in fluency during repeated readings may be viewed in the framework of motor learning. Motor learning, as opposed to motor practice, would place more focus on the *learning* process underlying improvements in speech motor skill

resulting from repeated practice of the same sequences of articulatory and phonatory movements. Further, the authors argued that if adaptation is a process of motor learning, adjustments in speech production should be consistent with adjustments for learning of *nonspeech* motor acts, such as typing. This was found to be the case. Max and Caruso found a significant increase in articulation rate and a significant decrease in word and vowel durations when the first and last readings were compared. Subjects increased their speed of production during *fluent* utterances. Just as increased speed of performance was found between the first and fifth readings, the authors noted research that found an increase in speed of performance in *nonspeech* motor acts (e.g., Sage, 1984; Shea & Morgan, 1979; Stelmach, 1969). Findings by Max and Caruso highlight that "different mechanisms underlie improvements in speech fluency during repeated readings as compared to other fluency-enhancing conditions" (p. 1275), which have generally demonstrated a slowing of speed of performance to achieve fluency.

Careful examination of the oral-motor rehearsal theory as an explanation of the adaptation effect requires experimental manipulation of certain variables known or presumed to be associated with stuttering and the adaptation effect. Thus far, this review has concentrated on Max and Caruso's (1998) investigations of changes in acoustical parameters during adaptation tasks, with little attention to interactions between oral-motor movements and linguistic factors during adaptation. One promising avenue of research for examining these interactions is the investigation of adaptation in bilingual speakers who stutter.

Bilingualism and Stuttering

Research examining stuttering in bilingual speakers is scarce. Moreover, a review of research examining the adaptation effect in bilingual people who stutter revealed only one case study. Jankelowitz and Bortz (1996) requested an adult who spoke English and Afrikaans to read five successive identical passages in both English and Afrikaans. The authors found the subject exhibited more adaptation in Afrikaans than English; however, no specific data were provided that indicated the degree of adaptation in each language. Other studies have examined the relationship between stuttering and bilingualism by investigating the phonetic differences across languages (e.g., Bernstein Ratner & Benitez, 1985; Jayaram, 1983) and second language acquisition eliciting stuttering (e.g., Dale, 1977; Karniol, 1992). Conclusions concerning the prevalence of stuttering in separate languages spoken by the same individual often have been borne out in these investigations. Travis, Johnson, and Shover (1937) first investigated the relationship of bilingualism and stuttering and found a higher prevalence of stuttering in bilinguals than in monolinguals. Nevertheless, Jayaram (1983) found monolinguals who stuttered had a higher frequency of stuttering than bilinguals. Although some studies have reported that subjects believe they stutter equally in both languages (Bernstein Ratner & Benitez, 1985), other studies have found subjects not equally disfluent in both languages (e.g., Bernstein Ratner & Benitez, 1985; Dale, 1977; Nwokah, 1988). Although it has been demonstrated that *individuals* can stutter in both languages and more in one language than another, the same results have not been reported for *groups* of bilingual people who stutter (Nwokah, 1988). It can be seen that research

involving small groups has revealed inconsistencies concerning bilingualism and stuttering. Nevertheless, collectively, studies have demonstrated that stuttering in bilingual speakers can occur in both languages and such speakers may exhibit a higher frequency of stuttering in one language over another.

Summary of Literature Review

Research suggests that repeated oral reading of the same material allows greater coordination among the oral articulators, respiration, and phonation. It has also been demonstrated that the oral-motor rehearsal theory is supported, in that adaptation is often greatest when the material is orally read, held constant, and read in succession. Additionally, the adaptation effect has produced increased fluency in such a way that is not consistent with acoustical surface parameter changes found in other fluency-inducing conditions, thus allowing for alternative explanations. Although the reviewed studies have suggested the rehearsal or learning of the oral-motor plan is a contributing factor to the adaptation effect, no study was found that examined the adaptation effect by isolating the oral-motor component in bilingual people who stutter. By examining stuttering in bilingual people, one can isolate the oral-motor movements during an adaptation task and assess the contribution of repeated oral-motor movements to the adaptation effect. This is accomplished through manipulating the oral-motor movements during an adaptation task while the meaning of the reading material is held constant by having bilingual people who stutter complete an adaptation task using the same written passage in two different languages.

Rationale

As noted earlier, the purpose of this study is to investigate the relationship between the oral-motor rehearsal theory and the adaptation effect in bilingual people who stutter. Additionally, this study will attempt to more clearly define the contribution that repeated oral-motor movements have on producing an adaptation effect. The degree to which the present study's data coincide with those reported in the literature informs our understanding of the extent to which the bilingual adaptation task in the present study tests the oral-motor rehearsal theory of the adaptation effect.

The hypothesis of this study is that the percentage of adaptation will decrease following the inclusion of a reading in a different language. This would suggest that a change in the oral-motor movements during an adaptation task affects the amount of adaptation occurring. Support for the oral-motor rehearsal theory of adaptation is demonstrated if results indicate a magnitude of change that is greater than the magnitude of change found in previous studies that have examined the effect of variables (e.g., situational) that did not include a change in the oral-motor plan.

The present study examined the oral-motor rehearsal theory of adaptation by experimentally manipulating the oral-motor movements of a passage read while holding the meaning of the passage constant. This investigation was carried out through the exploration of the following research question:

> In bilingual speakers who stutter, what is the effect of altering the oral-motor movements by changing the language of the passage read during an adaptation task?

Specifically, this question will be addressed in three parts, formulated as such:

1) Is an adaptation effect observed following a change in the language of the passage read?

2) Is a change in the percentage of stuttering observed immediately following a change in the language spoken?

3) Is a significant difference observed in the percentage of adaptation between English and Language 1?

Chapter 2

METHOD

Participants

Two bilingual adults who stutter served as participants for this study following approval of research with human subjects. For purposes of this study, bilingualism is defined as speaking two or more languages proficiently.

Participants were recruited at an annual convention of the National Stuttering Association and a stuttering support group in Montreal, Canada. The examiner did not identify specific participants or languages prior to attending each function. One participant was determined to be proficient in English and Polish and the other was determined to be proficient in English and French. Each participant met the following selection criteria: at least 18 years of age; first language was not English; demonstrated developmental stuttering; demonstrated stuttering while reading aloud; demonstrated a decrease of at least five stuttered moments from Reading 1 to Reading 6 (Frank & Bloodstein, 1971); reported no history of hearing, neurologic, or communication disorders other than stuttering; and spoke and read at least two languages proficiently. For purposes of this study, language proficiency in English was defined as a score of 90% or greater on a cloze procedure (Taylor, 1953) and the reported use of each language in both spoken and written form at least once a month.

Participant Screening

A screening of participants was performed to determine if participants were eligible for participation in the experiment. Participant screening took approximately 20 minutes. The screening included the following procedures:

1. Background questionnaire

A background questionnaire comprised of 25 questions was completed by the participants (see Appendix D). This questionnaire was used to determine the participant's history of bilingualism, stuttering, hearing, neurologic status, and the presence of other existing communication disorders.

2. Cloze test

The cloze procedure (Taylor, 1953) required the participant to analyze a written passage in English consisting of 30 partially completed words (see Appendix C). The participant was required to write the missing letters to complete the word. The cloze test of language proficiency was scored according to the "contextually-appropriate method" (Laesch & van Kleeck, 1986, p. 176). This method required the participant to provide a missing word in the text that is semantically and grammatically correct (Oller, 1979). The contextually-appropriate method was chosen because it has been demonstrated to accurately assess second language ability (Oller, 1972). Language proficiency on the cloze procedure was assessed by calculating the percent of correct responses on the test with a score of at least 90% correct responses representing language proficiency. Language proficiency in the language other than English was determined by self-disclosure of the participant.

3. Stuttering severity

Participants were administered the Stuttering Severity Instrument for Children and Adults (Riley, 1994; see Appendix C) to determine severity of stuttering in English and the presence of stuttering during a reading task.

Participant 1

Participant 1 was recruited at an annual convention of the National Stuttering Association. Participant 1 was a 54-year-old female who displayed a "moderate" stuttering severity rating. She was born in Germany to Polish speaking parents and is of Polish ethnicity. As a child, she was exposed to Polish from her interactions with her immediate family, who spoke Polish in the home. Additionally, she claimed that her use of the Polish language was "wishy-washy Polish." Additionally, Participant 1 spoke Portuguese for a short time in grammar school and in her interactions with friends.

At the age of 14, Participant 1 was exposed to English in the United States of America and has been speaking English for 40 years in the United States of America. She began to speak English everyday in high school and in interactions with her friends at that time. Participant 1 has received eight formal years of instruction in English including instruction at the college level. She currently speaks English and Polish everyday and reads Polish texts approximately once a month. Currently, she reported that she feels more comfortable speaking English, and believes she stutters more in Polish. Participant 1 reported that she began to stutter at 7 years of age and

stutters in all languages. Participant 1 had 0 errors of 30 possible answers on the cloze test of English proficiency. Her proficiency in Polish was determined by self-disclosure.

Participant 2

Participant 2 was a 25-year-old male who displayed a "mild" level of stuttering severity. He was born in Syria and identified Arabic as his ethnicity. As a child, Participant 2 spoke Arabic with his parents, friends, and teachers. At 14 years of age, he was first exposed to English in Syria through formal instruction and began to speak English everyday when he moved to Montreal at 22 years of age. Participant 2 has lived in an English and French speaking society for the past 3 years while attending an English speaking university. He currently speaks English and French everyday, reads English texts everyday, and reads French texts approximately three times per week. Additionally, he believes his proficiency in French includes strengths in understanding French grammar and reading French texts. Participant 2 feels more comfortable speaking English and believes he stutters more while speaking French. Participant 2 reported he began to stutter at 3 years of age and stutters in all languages. He had two errors on the cloze test of English proficiency resulting in a 93% score. His proficiency in French was determined by self-disclosure.

Procedure

The entire procedure took place in a location that was free of distraction, was convenient for the participant, and where only the examiner and participant were present. Both participants performed tasks requiring the use of English and their respective alternative language (L1). Participant 1 completed tasks in English and

Polish (L1) at an annual National Stuttering Association convention in the United States. Participant 2 completed tasks in English and French (L1) in Montreal Canada.

Reading Sets

In anticipation of more participants, an attempt was made to counterbalance the procedures in terms of order of language and passages read. However, because only two participants were tested, only the passages were counterbalanced. Thus, Participant 1 began with The Toothbrush in English for the first five readings, followed by the same passage in L1 for Readings 6-10. Participant 2 also completed the first five readings in English and the second five readings in L1 while reading The Spider's Home (see Table 1).

Following the completion of the first reading set, the participants were given a rest period of 30 minutes before beginning the second reading set. During the rest period, testing procedures were terminated and the participant was free to do whatever he/she wishes. Following the completion of the rest period, testing resumed with the second reading set.

Participant 1 and Participant 2 began the second reading set following the 30-minute rest period. Participant 1 began with The Spider's Home in L1 for the first five readings, followed by the same passage in English for Readings 6-10. Participant 2 also completed the first five readings in L1 and the second five readings in English while reading The Toothbrush (see Table 1). All readings in both reading sets were performed successively.

Table 1. Reading Sets

	Participant 1	Participant 2
Set 1	Readings 1-5 English Readings 6-10 L1 The Toothbrush	Readings 1-5 English Readings 6-10 L1 The Spider's Home
Set 2	Readings 1-5 L1 Readings 6-10 English The Spider's Home	Readings 1-5 L1 Readings 6-10 English The Toothbrush

Passages

Participants were asked to read two passages, the first of which was randomly assigned using a 2x2 matrix design (see Table 1). For each reading set, participants were asked to perform 10 successive readings of "The Spider's Home" (Shipley & McAfee, 1998) or 10 successive readings of "The Toothbrush" (Shipley & McAfee, 1998; see Appendix E) totaling 20 readings for both reading sets. The English versions of "The Spider's Home" and "The Toothbrush" contained 167 words and 151 words respectively. The French versions of "The Spider's Home" and "The Toothbrush" contained 164 words and 192 words respectively. The Polish versions of "The Spider's Home" and "The Toothbrush" contained 127 words and 141 words respectively. Native speakers of French and Polish, who are also proficient in English, translated the "The Spider's Home and The Toothbrush" into French and Polish. Following the completion of the first randomly assigned passage, the participant was given a rest period of 30 minutes before beginning the remaining passage.

Participant 1 was randomly assigned to begin testing procedures reading "The Toothbrush." Following the rest period, Participant 1 read "The Spider's Home." Participant 2 was randomly assigned to begin testing procedures reading "The Spider's Home." Following the rest period, Participant 2 read "The Toothbrush."

The two passages were equated with respect to the measure of readability (Flesch, 1951) and word weights (Brown, 1945) to control for fluency disruption on the basis of reading and linguistic difficulty. Measures of readability considered average sentence length and average word length in syllables. Measures of word

weights considered initial sound, grammatical function of the word, and word length. "The Spider's Home" and "The Toothbrush" were found to be neutral at 85.83 and 90.15 respectively for readability and 1.35 and 1.48 respectively for word weights. Using Flesch's procedure, analysis of readability found both passages to be at a sixth grade reading level.

No rest periods were given between successive readings within each reading set. No information was given to participants regarding the nature of the experimental tasks other than "You will be asked to read aloud short passages" until the testing procedure was complete. The examiner asked the participants to read aloud the text placed in front of them. At the end of each reading, the examiner presented the participant with the same passage on a new sheet of paper and asked the participant to read the passage again. Testing procedures were audio and videotaped using a Panasonic AG 188 videocassette recorder.

Data Analysis

Fluency Analysis

Frequency counts of stuttering from all readings were performed by the examiner using both the audio and videotaped recordings. For purposes of this study, stuttering was defined as repetitions of sounds, syllables, one syllable words, prolongations of sounds, and stoppages of airflow and/or voicing in speech (Peters & Guitar, 1991). Stuttering frequency counts were performed on typed copies of passages by playing back the recorded samples as many times as was necessary. To aid in the comparison of stuttering frequency counts between passages and languages, all data will be presented as percentage of stuttered words as opposed to number of

stuttered words. Percentages of adaptation were computed for readings 1 through 5, 1 through 6, 6 through 10, and 1 through 10 in each reading set. Additionally, percentages of stuttering were computed for readings 5 and 6 in each reading set. Calculations for percentages of adaptation and stuttering were computed for individual participants. Percentages of adaptation were calculated using the following formula: 100(A-B)/A, where A equals the number of occurrences of stuttering in a prior reading and B equals the number of occurrences of stuttering in any subsequent reading (Ham, 1986). Percentages of stuttering were calculated using the following formula: 100(A/W), where A equals the number of stuttering occurrences within the reading and W equals the number of words within the reading.

Research Questions

The data analysis for research Question 1 involved computing the percentage of adaptation for Readings 6 through 10 in both reading sets for both participants. The percentages of adaptation in the present study were compared to the percentage of adaptation means found in the literature (see Appendix A).

The analysis for research Question 2 involved computing the change in the amount of stuttering between Readings 5 and 6 in both reading sets for each participant. Percentages of stuttering in Readings 5 and 6 were determined followed by a computation of the factor by which stuttering changed (the multiplicative change) between Readings 5 and 6. Data were presented as a multiplicative change to aid in the comparison to data from previous studies exploring the affect that material changes or situational changes have on adaptation (see Appendix B). The difference in the percentage of stuttering on Readings 5 and 6 in both reading sets will suggest

the degree of influence a change in the oral-motor movements might have on the amount of adaptation.

The data analysis for research Question 3 included the calculation of mean percentage of adaptation in English and L1 across both reading sets for each participant.

Reliability

Intra-judge reliability was determined by having the examiner conduct a second total stuttering frequency count on the first reading of each language within each reading set for both participants. Intra-judge reliability was found to be .97. It should be noted that the first judge does not speak or understand French or Polish and determined frequency counts solely on visual and audible information. Inter-judge reliability was determined by a including a second judge who is only proficient in English, a graduate student in speech-language pathology, currently enrolled in a graduate class in fluency disorders, and trained in analyzing stuttering. To assess inter-judge reliability, the second judge performed stuttering frequency counts on the first reading of each language within each reading set for both participants. Inter-judge reliability was found to be .92. Additionally, an inter-judge reliability judgment was conducted on a Polish reading as a way of assessing whether or not a non-Polish speaker could reliably identify stuttering in a language that the first judge did not speak. A native speaker of Polish, who was currently a graduate student in speech-language pathology and trained in analyzing stuttering, performed reliability measurements. Inter-judge reliability on one randomly selected Polish reading was found to be 1.0. Inter-judge reliability judgments on French readings were not

performed because the examiner did not have access to a qualified native speaker of French. Both intra-judge and inter-judge reliability measures for total stuttering counts were obtained using the Sander (1961) Agreement Index, a/(a+d), in which a = total agreements and d = total disagreements of a given reading.

Chapter 3

RESULTS

Table 2 summarizes adaptation percentages for readings performed and summarizes the change in stuttering frequency between Readings 5 and 6 across participants, reading sets, and languages. Figure 1 displays the mean percentage of stuttered words during Readings 1 to 10 across participants, reading sets, and languages. A mean adaptation percentage of 82.3% was obtained between Reading 1 and Reading 5. A mean adaptation percentage of 86.5% was obtained between Reading 6 and Reading 10. A mean adaptation percentage of 79.4% was obtained between Reading 1 and Reading 10. The factor by which stuttering percentage changed from Reading 5 to Reading 6 was computed and resulted in a factor increase of 8.6 times more stuttering on Reading 6. This factor increase on Reading 6 resulted in an increase of 34.6% stuttered words from Readings 1 to 6.

Table 2. Adaptation Percentages and Factor Change Across Participants, Reading Sets, and Languages

Reading	Outcome
1-5	82.3% reduction in stuttering
6-10	86.5% reduction in stuttering
1-10	79.4% reduction in stuttering
5-6	8.6 times more stuttering

Participants 1 and 2

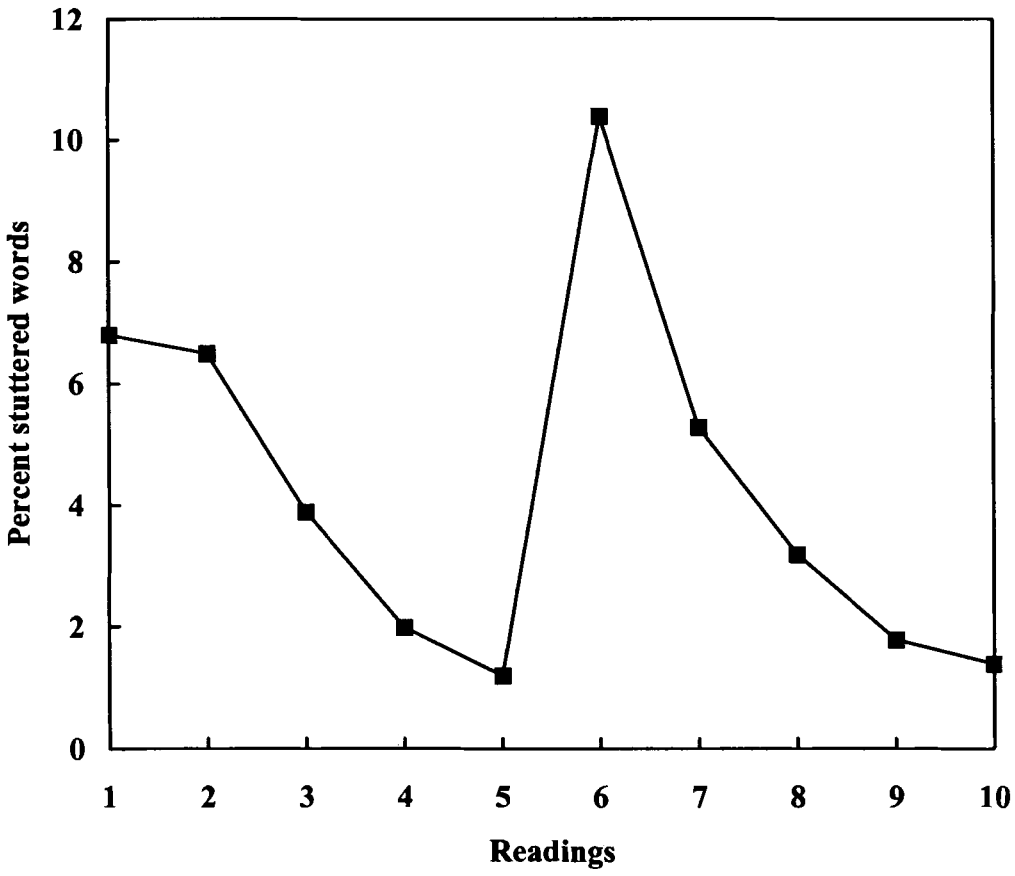

Figure 1. Mean percentage of stuttered words in repeated readings across participants, reading sets, and languages. A change in the language read occurred at Reading 6.

Question 1

1) Is an adaptation effect observed following a change in the language of the passage read?

Participant 1

Participant number 1 completed the first reading set in which "The Toothbrush" was read followed by second reading set in which "The Spider's Home" was read. Figure 2 displays adaptation curves for the first and second reading sets. Table 3 summarizes adaptation percentages in terms of reading set, language read, and readings performed. Percent of stuttered words in the first reading set for Readings 6-10 read in L1 are as follows: 26.9%, 15.6%, 9.9%, 4.9%, and 2.1% resulting in a total adaptation percentage of 92.1% for Readings 6-10 in the first reading set (see Table 3).

Table 3. Adaptation Percentages, Participant 1

Reading Set	Language	Readings	Adaptation Percentage
1	English	1-5	* No Adaptation
1	Switch	1-6	86.8% increase in stuttering
1	L1	6-10	92.1% reduction in stuttering
1	English, L1	1-10	40.0% reduction in stuttering
2	L1	1-5	75.0% reduction in stuttering
2	Switch	1-6	87.5% reduction in stuttering
2	English	6-10	* No Adaptation
2	L1, English	1-10	87.5% reduction in stuttering

* Adaptation did not occur due to limited amounts of stuttering.

Participant 1

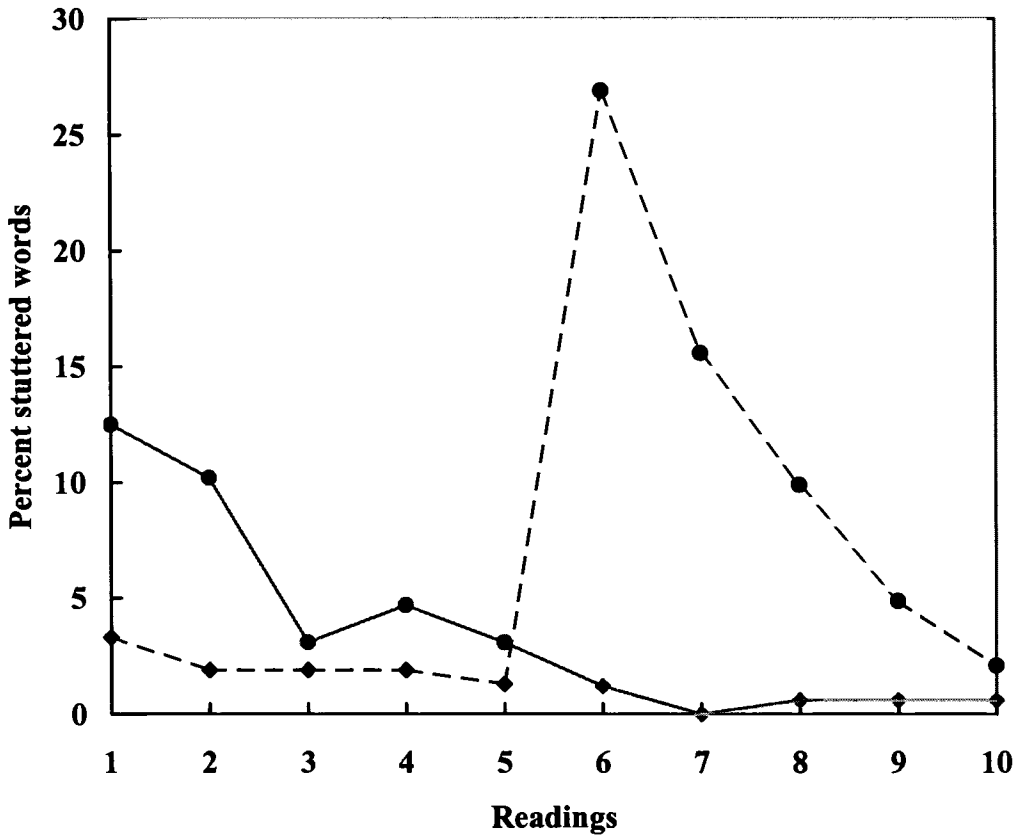

Figure 2. Percentage of stuttered words in repeated readings under two reading sets and languages. Set 1 (dashed line) was completed first and represents Readings 1-5 in English (diamonds) and 6-10 in L1 (circles). Set 2 (solid line) was completed second and represents Readings 1-5 in L1 (circles) and 6-10 in English (diamonds).

A total adaptation percentage of 92.1% demonstrates an adequate amount of adaptation when compared to mean adaptation percentages found in select literature (see Appendix A). Percent of stuttered words in Set 2 for Readings 6-10 read in English are as follows: 1.2%, 0%, 0.6%, 0.6%, and 0.6% (see Table 3). Readings 6-10 in Set 2 did not reveal a decrease of stuttering by at least five words, thus adaptation could not be achieved (Frank & Bloodstein, 1971).

Participant 2

Participant 2 completed Set 1 in which the "The Spider's Home" was read followed by Set 2 in which "The Toothbrush" was read. Figure 3 presents adaptation curves for Readings 6-10 in Set 2 and Set 1. Table 4 summarizes adaptation percentages in terms of reading set, language read, and readings performed. Percent of stuttered words in Set 1 for Readings 6-10 read in L1 are as follows: 1.8%, 0.6%, 0.6%, 1.8%, and 1.2% (see Table 4).

Table 4. Adaptation Percentages, Participant 2

Reading Set	Language	Readings	Adaptation Percentage
1	English	1-5	87.5% reduction in stuttering
1	Switch	1-6	62.5% reduction in stuttering
1	L1	6-10	* No adaptation
1	English, L1	1-10	75% reduction in stuttering
2	L1	1-5	100% reduction in stuttering
2	Switch	1-6	27.7% increase in stuttering
2	English	6-10	83.3% reduction in stuttering
2	L1, English	1-10	76.9% reduction in stuttering

* Adaptation did not occur due to limited amounts of stuttering.

Participant 2

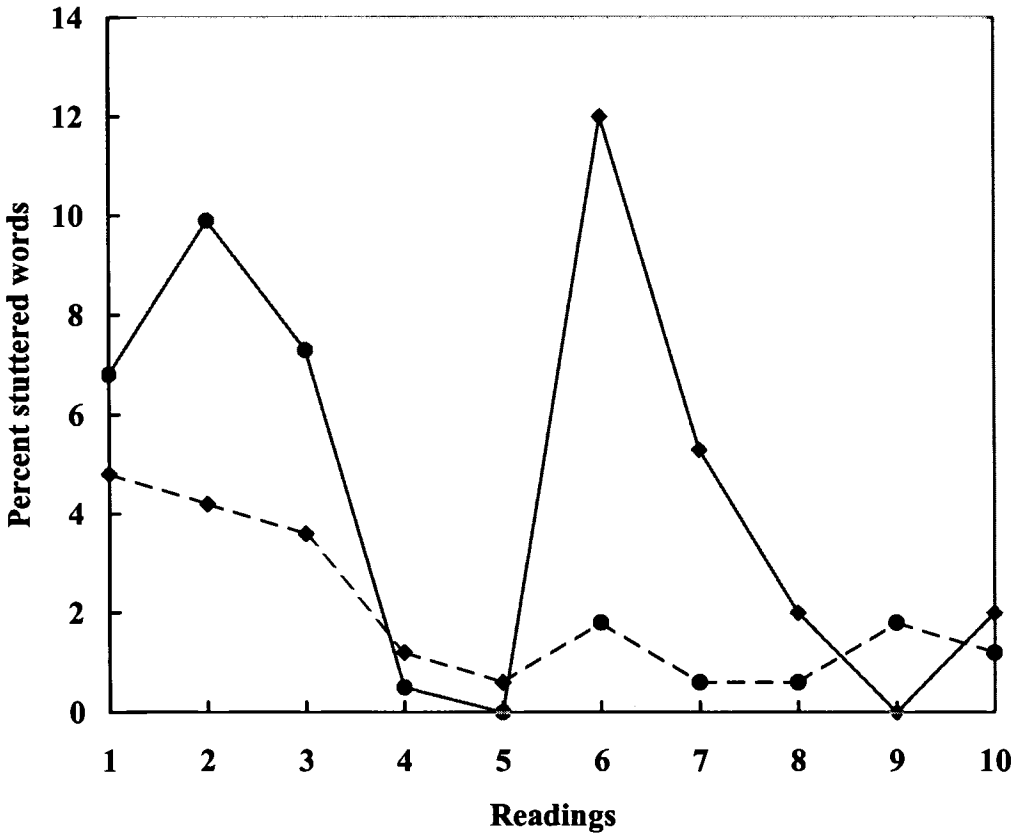

Figure 3. Percentage of stuttered words in repeated readings under two reading sets and languages. Set 1 (dashed line) was completed first and represents Readings 1-5 in English (diamonds) and 6-10 in L1 (circles). Set 2 (solid line) was completed second and represents Readings 1-5 in L1 (circles) and 6-10 in English (diamonds).

Readings 6-10 in Set 1 did not reveal a decrease of stuttering by at least 5 words, thus adaptation could not be achieved (Frank & Bloodstein, 1971). Percent of stuttered words in Set 2 for Readings 6-10 read in English were as follows: 12.0%, 5.3%, 2.0%, 0%, and 2.0% resulting in a total adaptation percentage of 83.3% for Readings 6-10 in Set 2 (see Table 4). A total adaptation percentage of 83.3% demonstrates an adequate amount of adaptation when compared to mean adaptation percentages found in select literature (see Appendix A).

Question 2

2) Is a change in the percentage of stuttering observed immediately following a change in the language spoken?

Participant 1

Table 5 summarizes the change in stuttering frequency that occurs between Readings 5 and 6 in Sets 1 and 2. Participant 1 completed Set 1 followed by Set 2. Readings 5 and 6 in Set 1 revealed 1.3% and 26.9% percentage of stuttered words respectively. To aid in the comparison to results in previous literature, the factor by which stuttering frequency changed from Reading 5 to Reading 6 was computed. As Participant 1 began to read L1 at Reading 6 in Set 1, an increase of 20.7 times the amount of stuttering occurred. When this result was compared to previous studies, which reported the effect of an experimental change altering the immediate amount of stuttering (see Appendix B), far greater stuttering was observed between the experimental change of reading in L1 for Participant 1 as compared to previous experimental changes affecting the immediate amount of stuttering. Contrastingly,

Readings 5 and 6 in Set 2 revealed 3.1% and 1.2% of stuttered words respectively. As Participant 1 began to read English in Set 2, the percentage of stuttering continued to decrease in Reading 6 and revealed a decrease of 2.5 times the amount of stuttering. When this result was compared to previous studies, which reported the effect of an experimental change altering the immediate amount of stuttering (see Appendix B), less stuttering was observed following the experimental change of reading in English for Participant 1.

Table 5. Factor Change from Reading 5 to 6, Participant 1

Reading Set	Language	Comparison	Outcome
1	English-L1	5-6	20.7 Times more stuttering
2	L1-English	5-6	2.5 Times less stuttering

Participant 2

Table 6 summarizes the change in stuttering frequency that occurred between readings 5 and 6 in Sets 1 and 2. Participant 2 completed Set 1 followed by Set 2. Readings 5 and 6 in Set 1 revealed 0.6% and 1.8% percentage of stuttered words respectively. To aid in the comparison to results in previous literature, the factor by which stuttering frequency changed from Reading 5 to Reading 6 was computed. As Participant 2 began to read L1 at Reading 6 in Set 1, an increase of 3 times the amount of stuttering occurred. When this result was compared to previous studies, which reported the effect of an experimental change altering the immediate amount of

stuttering (see Appendix B), greater stuttering was observed between the experimental change of reading in L1 for Participant 2 as compared to previous experimental changes affecting the immediate amount of stuttering. Moreover, Readings 5 and 6 in Set 2 revealed 0% and 12% stuttered words respectively. As Participant 2 began to read English at Reading 6 in Set 2, an increase of 12 times the amount of stuttering occurred. When this result was compared to previous studies (see Appendix B), far greater stuttering was observed following the experimental change of reading to English for Participant 2.

Table 6. Factor Change from Reading 5 to 6, Participant 2

Reading Set	Language	Comparison	Outcome
1	English-L1	5-6	3 Times more stuttering
2	L1-English	5-6	12 Times more stuttering

Question 3

3) Is a difference observed in the percentage of adaptation between English and Language 1?

Participant 1

English

Participant 1 completed Set 1 followed by Set 2. In Set 1, she read the English version of "The Toothbrush" for Readings 1 to 5 and demonstrated 0% adaptation because she did not exhibit a decrease of at least 5 moments of stuttering (Frank &

Bloodstein, 1971). In Set 2, she read the English version of "The Spider's Home" for Readings 6-10 and demonstrated 0% adaptation because she did not exhibit a decrease of at least 5 moments of stuttering (Frank & Bloodstein, 1971). Mean adaptation percentages were computed across both Sets resulting in 0% adaptation in English.

Language 1

In Set 1, Participant 1 read the L1 version of "The Toothbrush" for Readings 6 to 10 and demonstrated 92.1% adaptation. In Set 2, she read the L1 version of "The Spider's Home" for Readings 1 to 5 and demonstrated 75% adaptation. Participant 1 demonstrated similar amounts of adaptation across both sets when L1 was read. Mean adaptation percentages were computed across both sets resulting in 83.6% adaptation in L1.

Participant 2

English

Participant 2 completed Set 1 followed by Set 2. In Set 1, he read the English version of "The Spider's Home" for Readings 1 to 5 and demonstrated 87.5% adaptation. In Set 2, he read the English version of "The Toothbrush" for Readings 6-10 and demonstrated 83.3% adaptation. Participant 1 demonstrated similar amounts of adaptation in English across both sets when English was read. Mean adaptation percentages were computed across both sets resulting in 85.4% adaptation in English.

Language 1

In Set 1, Participant 2 read the L1 version of "The Spider's Home" for Readings 6 to 10 and demonstrated 0% adaptation due to limited amounts of

stuttering. In Set 2, he read the L1 version of "The Toothbrush" for Readings 1 to 5 and demonstrated 100% adaptation. Participant 2 demonstrated greater adaptation and percentages of stuttering when L1 was read during the first five readings of an adaptation series than when L1 was read during the last five readings. Mean adaptation percentages were computed across both sets resulting in 50% adaptation in L1.

Chapter 4

DISCUSSION

The purpose of this study was to examine the oral-motor rehearsal theory of stuttering adaptation by attempting to define more clearly the contribution that repeated oral-motor movements have on producing an adaptation effect. To achieve this purpose, the primary investigation in this study was to determine the effect on adaptation of experimentally manipulating the oral-motor movements by changing the language of the passage read during an adaptation task. Of interest in this investigation was determining whether (a) an adaptation effect is observed following a change in language spoken, (b) a change in the immediate amount of stuttering is observed following a change in the language spoken, and (c) differences exist in the percentage of adaptation between languages spoken.

Across Participants, Reading Sets, and Languages

Results across participants, reading sets, and languages, show adaptation curves were for Readings 1 to 5 and Readings 6 to 10; this is consistent with previous studies that have reported adaptation percentages (see Appendix A). Although the adaptation percentages of the two participants in the present study were considerable in comparison to groups of people who stutter, substantial variations in adaptation can characterize individuals during adaptation tasks (Newman, 1963). Of particular interest in this study, an atypical adaptation curve was found for Readings 1 to 10 (see Figure 1) when compared to previous literature that examined adaptation over ten readings (e.g., Fierman, 1955). In previous studies that examined adaptation over ten readings, a plateau occurred after the fifth reading with additional readings producing

little or no effect (e.g., Fierman, 1955; Johnson & Innes, 1939). Contrastingly, in the present study, a dramatic increase in the amount of stuttering was observed at Reading 6, which likely reflects the manipulation of the language of the passage read. The increase of stuttering at the sixth reading is substantial when compared to previous research that reported a change in the amount of stuttering following an experimental change (see Appendix B).

One speculation for the increase in stuttering at the sixth reading is that the increase may be due to a disruption of the previously rehearsed oral-motor sequence with the participants having begun a new adaptation task using a new oral-motor sequence at Reading 6. Such an interpretation lends support to the oral-motor rehearsal theory. Although initial inspection of Figure 1 lends support to the speculation that a change in the oral-motor sequencing increases the amount of stuttering, careful evaluation of individual differences suggests other possible interpretations.

A second speculation for the increase in stuttering at the sixth reading is that it may be related to the linguistic differences between the languages read by the participants. Possible influences that could affect the percentage of stuttering when the language change occurred include the syntactic or phonological properties of the language read, the participants' proficiency of the language read, and the participants' differing amount of stuttering in the language spoken (e.g., Jayaram, 1983; Bernstein Ratner & Benitez, 1985; Nwokah, 1988; Jankelowitz & Bortz, 1996).

A third speculation for the increase in stuttering at the sixth reading may point toward arousal. Possible arousal influences inducing greater stuttering in bilingual

speakers may include cultural expectations for fluency and/or a cultural stigma toward disfluent speech in one language more than another language (e.g., Wischner, 1952; Wingate, 1972; Dale 1977). It is possible that when an unanticipated change in language occurred at Reading 6, an increase in stuttering partially occurred due to the participants' personal cultural experiences with that given language.

Regarding the two adaptation curves (Figure 1), it is interesting to note that the percentage of stuttered words at Reading 5 approximated the same percentage of stuttered words at Reading 10. This observation might indicate that the mean amount of stuttering at the end of a series of readings (Readings 5 and 10) is not dependent on the amount of stuttering in previous readings (Readings 1 to 4 & 6 to 9). This observation is consistent with the work by Frank and Bloodstein (1971) who found stuttering to be reduced to the same extent regardless of how much stuttering previously occurred. It is also interesting to note the difference in the percentage of stuttered words between Reading 6 and Reading 1 (Figure 1). This result could be due to the small sample size or it may highlight individual differences that may exist between participants, languages, and/or reading sets. It should be acknowledged that substantial variations in adaptation can characterize individuals during adaptation tasks (Newman, 1963). Thus, the next two sections discuss results of individual participants including differences in stuttering and adaptation across languages and reading sets.

Participant 1

The findings for Participant 1 demonstrated the variability in the percentage of stuttered words and adaptation percentages in each language under Sets 1 and 2

(Figure 2). Participant 1 read "The Toothbrush" in Set 1 (English, Polish) followed by "The Spider's Home" in Set 2 (Polish, English). In Set 1, Participant 1 demonstrated a high degree of adaptation in L1 (Polish) on Readings 6-10 following a change in the language read. The amount of adaptation seen in Polish is considered adequate (greater than 31%) when compared to previous studies that documented the adaptation effect (see Appendix A). Contrastingly, in Set 2, no adaptation was seen in English on Readings 6-10 following a change in the language read. In other words, Set 2 represented an adaptation curve that was similar to an adaptation task without experimental manipulation and performed over 10 readings (Fiermann, 1955). In order for a distinguished second adaptation effect to occur in Set 2, an increase in stuttering at Reading 6 would have had to occur.

Participant 1 demonstrated a dramatic increase in the amount of stuttering on Reading 6 when she began to read Polish. This increase is substantial when compared to previous studies examining the effect of experimental change on adaptation (see Appendix B). Despite this finding, which might reflect oral-motor changes, Participant 1 demonstrated a slight *decrease* in the amount of stuttering when she began to read English in the opposite set. These findings are in contrast with the overall group findings (Figure 1), which indicated an increase in percent stuttering at Reading 6. Further, this participant's contrasting results in Set 1 and 2 at Reading 6 cast doubt on the assumption that a disruption in the oral-motor rehearsal is directly related to the increase in stuttering observed at Reading 6 in Set 1. If a change in the oral-motor plan was a primary contributor to an increase in the amount of stuttering, an increase in stuttering should have also been seen in Set 2 when the participant

began to read English. Thus, it appears that linguistic factors, such as language proficiency, may have contributed to the increased stuttering seen at Reading 6 in Set 1. This assumption is supported by the participant's description of her Polish as "wishy-washy," which may be interpreted as a less formal or underdeveloped use of the Polish language. Moreover, despite Polish being her native language, her proficiency in English may be greater due to longer use and greater exposure to English in an English speaking country. Additionally, one might speculate that an increase in stuttering at Reading 6 was partially related to arousal from a possible cultural stigma toward stuttering and/or her history of her stuttering while speaking Polish. Unfortunately, it is not known if Participant 1 was exposed to greater ridicule or cultural stigma while speaking Polish as a child as compared to speaking English as an adult.

Participant 1 demonstrated far greater adaptation in Polish than in English. Participant 1 reported that she felt more "comfortable" speaking English than Polish. If the self-report of "comfortable" is interpreted in terms of language proficiency, these results would be in agreement with the findings of Jankelowitz and Bortz (1996) indicating that greater adaptation is seen in the less proficient language. Further, it can be seen that Participant 1 demonstrated greater stuttering in Polish during the reading task. This finding would be in agreement with "The Difference Hypotheses" proposed by Nwokah (1988), which states that bilingual people who stutter, who are disfluent in both languages, often show different patterns of stuttering in one language than in the other.

Participant 1 demonstrated similar amounts of stuttering in the final readings of each language across reading sets. As previously stated, results in Figure 1 show the mean percent of stuttered words across participants at Reading 5 approximated the same percentage of stuttered words at Reading 10. Similar findings also were observed for Participant 1 in that the final readings in each language at Readings 5 and 10 approximated the same percent stuttered words in the opposite reading sets. It appears that differences in the initial amount of stuttering in each language did not alter the final amount of stuttering in the last readings of the adaptation series. This finding supports the speculation that a "less" proficient language can adapt to a similar level as a "more" proficient language when successive oral readings of the same material is allowed.

Results from Participant 1 do not support the speculation that a change in the oral-motor plan directly contributes to an increase in the amount of stuttering. The findings from Participant 1 point toward language proficiency as possibly contributing to the increased stuttering following a change in the language read.

Participant 2

The findings for Participant 2 reveal the variability in the percentage of stuttered words and adaptation percentages in each language and reading set (Figure 3). Participant 2 read "The Spider's Home" in Set 1 (English, French) followed by "The Toothbrush" in Set 2 (French, English). In Set 2, Participant 2 demonstrated a high degree of adaptation in English on Readings 6-10 following a change in the language read. The amount of adaptation seen in English is considered adequate (greater than 31%) when compared to previous studies that documented the

adaptation effect (see Appendix A). Contrastingly, no adaptation was seen in L1 (French) on Readings 6-10 following a change in the language read. This finding is opposite that of Participant 1 who demonstrated a high degree of adaptation in L1 (Polish) and no adaptation in English. Although a minimal increase in stuttering occurred at Reading 6, a distinguished second adaptation effect did not occur for Participant 2 in Set 1 because a decrease of at least five stuttered moments from Readings 6 to 10 did not occur (Frank & Bloodstein, 1971).

Participant 2 demonstrated similar amounts of stuttering in the final readings of each language across reading sets despite differences in initial amounts of stuttering in each language across reading sets. The final readings in each language at Readings 5 and 10 approximated the same percent stuttered words in the opposite reading sets. It appears that differences in the initial amount of stuttering in each language did not alter the final amount of stuttering in the last readings of the adaptation series. This finding was also seen in Participant 1 and supports the speculation that if varying degrees of proficiency exist between two languages, both languages can adapt to a similar level when successive oral readings of the same material is allowed.

Participant 2 demonstrated a dramatic increase in the amount of stuttering on Reading 6 when he began to read English; however, only a minimal increase in the amount of stuttering occurred when he began to read French on Reading 6 in the opposite reading set. It is not clear if this minimal increase in stuttering at Reading 6 in Set 1 reflected the change in the experimental procedures or a plateau of stuttering often seen on later readings during an adaptation task. There is, however, evidence to

suggest this minimal increase in stuttering does not reflect involvement of a change in the experimental procedures because a second distinguished adaptation curve was not observed on Readings 6 to 10. In order for a second distinguished adaptation curve to exist, a decrease of at least five moments of stuttering would have been seen on Readings 6 to 10. Furthermore, an increase of only two moments of stuttering was seen on Reading 6. The same increase and amount of stuttering was also seen at Reading 9 when a change of language *did not* occur. This indicates that a change of language at Reading 6 may not have contributed to an increase in the amount of stuttering.

The role of a change in the oral-motor plan contributing to increased stuttering at Reading 6 may be most apparent in Set 2 when Participant 2 began to read English. A dramatic increase in the amount of stuttering occurred as he began to speak English, despite possible greater proficiency in English. This increase in stuttering is substantial when compared to previous studies examining the effect of experimental change on adaptation (see Appendix B). As previously stated, Participant 2 felt more "comfortable" speaking English, believed he stuttered less while speaking English, and has spoken English longer than French. These findings lend support to the speculation that an increase in stuttering was related to a change in the oral-motor plan.

Participant 2 demonstrated adaptation in English and French. However, upon closer examination, he demonstrated similar amounts of adaptation in English across reading sets and unequal amounts of adaptation in French across reading sets. Participant 2 demonstrated a considerable amount of adaptation in French while

performing Set 2, but demonstrated no adaptation in French while performing Set 1. Greater adaptation appeared not to be necessarily related to the languages spoken in the study, as was seen for Participant 1, but rather related to the *reading set* performed. One possible factor may account for this discrepancy and is recognized as a limitation of the study. As Participant 2 began Reading 1 in Set 2, he questioned the grammar of the typed passage, specifically, the perfect past tense on three words. The passage was later examined by a graduate student in French and was found to be correct. Perhaps this circumstance during testing led to an increase of stuttering on Reading 1 and thus, created the opportunity for greater adaptation to occur. If this was the case, less adaptation may have been seen in French across reading sets and greater adaptation in English across reading sets.

Comparisons between Participant 1 and Participant 2

Participants 1 and 2 present differences between stuttering frequency and order of reading sets performed, and stuttering frequency and language proficiency. It might be expected that the frequency of stuttering on the initial readings of each language across reading sets should be similar because both passages were found to be equal in terms of word weights and readability. However, this expectation was not found to be consistent across reading sets. Participant 1 demonstrated a discrepancy in the amount of stuttering between the two initial readings in Polish within Sets 1 and 2. On the initial Polish readings, Participant 1 demonstrated 26.9 percent stuttered words (Reading 6) in Set 1 and 12.5 percent stuttered words (Reading 1) in Set 2. The order in which Participant 1 completed the reading sets might have may have accounted for the differences in stuttering between initial Polish readings. Perhaps

greater stuttering occurred in the first condition (Set 1) because she was not yet able to develop a sense of the experimental procedures (Kroll & Hood, 1976), as she was able to do for the second condition (Set 2).

This same relationship between the order in which the reading sets were completed and frequency of stuttering was not demonstrated by Participant 2. On the initial English readings, Participant 2 demonstrated 4.8 percent stuttered words (Reading 1) in Set 1 and 12.0 percent stuttered words (Reading 6) in Set 2. Participant 2 demonstrated a higher percentage of stuttered words following a change of language in the reading set completed *second.* This finding indicates that Participant 2 exhibited greater stuttering following a change of language despite having a possible sense of the experimental procedures.

Contrasting findings were found between Participant 1 and 2 in terms of the frequency of stuttering at Reading 6 and language proficiency. Participant 1 demonstrated a dramatic increase in stuttering on Reading 6 in a language in which she may have been less proficient (Polish); however, Participant 2 demonstrated a dramatic increase in stuttering on Reading 6 in a language in which he may have been more proficient in (English). This finding indicates that language proficiency may or may not play a role in the observed increased stuttering at Reading 6 for bilingual people who stutter. Contrasting findings between participants regarding the role of language proficiency and the role of the oral-motor plan support a speculation that an interaction may exist between language proficiency and a change in the oral-motor plan contributing to the increased stuttering at Reading 6.

Chapter 5

CONCLUSIONS

The present study examined the oral-motor rehearsal theory of stuttering adaptation using a new methodological design. This study may provide a foundation for future research addressing the oral-motor rehearsal theory of stuttering adaptation and provide research directions addressing stuttering among bilingual populations.

When results were viewed across the two participants, reading sets, and languages, a change in the oral-motor plan appeared to contribute to increased stuttering at Reading 6. However, when results of individual participants were examined, a change in the oral-motor plan at Reading 6 did not result in an increase in stuttering under both reading sets for each participant. An increase of stuttering at Reading 6 appeared inconsistently related to a change in the oral-motor plan. At times, the increase in stuttering at Reading 6 appeared related to the participant's proficiency of the language and at other times the increased stuttering appeared related to a change in the oral-motor plan. It is speculated that the observed increased stuttering following a change of language may be a result of an interactive effect between a change in the oral-motor plan and the participant's degree of language proficiency. For example, the greatest increase in stuttering may occur when the participant begins a new oral-motor plan in the least proficient language. Due to this possible interaction, future research should detail results of individual participants as well as group results, as variations in adaptation are known to occur for individual participants.

The experimental design in the present study attempted to change the oral-motor plan during successive readings without changing the meaning of the passage read. However, the meaning of the passage read could only remain constant following a change in language if the reader was equally proficient in both languages used. In other words, the more closely a participant has balanced proficiency in each language, the stronger an association may be made between increased stuttering at Reading 6 and a change in the oral-motor plan. A recognized limitation of this study was no objective measurement of proficiency of both languages used. Future research examining bilingual populations should consider obtaining accurate measurements of proficiency in each language examined, specifically for people who are multilingual and people who might be less proficient in their first language, as was seen in the present study.

Bilingual people who stutter often present as a very heterogeneous population, thus limiting the ability to draw conclusions from data reported in the literature. In light of this, future research should place great importance on obtaining a thorough history of stuttering and language use and consider possible interactive affects between stuttering and the languages spoken. In doing so, future research may be able to examine more homogenous populations of bilingual people who stutter. For example, future research should consider: a) differences that may exist between bilinguals who learn one language followed by another language (consecutive bilingualism) and bilinguals who learned both languages from birth (simultaneous bilingualism), b) the possible influential role of culture and a participant's history of stuttering within a culture or language, and c) differences that may exist between

individuals who are bilingual and individuals who are multilingual. In examining these variables in subgroups of bilingual people who stutter, we may gain insight on how these variables affect performance on clinical tasks.

This study presented data from only two bilingual people who stutter and generalization of these results is cautioned. Although inter-judge reliability between the first judge and a native speaker of Polish was high during a reading task, future research examining the reliability of clinicians assessing stuttering in languages other than their own is warranted.

Data from this exploratory study offered interesting insights about stuttering among bilingual populations, the adaptation effect, and the oral-motor rehearsal theory. A unique methodological design was used to examine the oral-motor rehearsal theory of stuttering adaptation. This design may help provide a foundation for future research examining the oral-motor rehearsal theory and linguistic relationships between stuttering and bilingualism.

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APPENDICIES

APPENDIX A

ADAPTATION PERCENTAGE FOUND IN SELECT LITERATURE

Source	Percentage of Adaptation	Number of Readings
Bruce & Adams (1978)	65.3%	5
Brutten (1963)	46.6%	5
Dixon (1955)	39%*	5
Fierman (1955)	54%*	5
Frank & Bloodstein (1971)	42.3%*	6
Gray & Karmen (1967)	50%*	5
Horii & Ramig (1987)	57%*	6
Johnson & Innes (1939)	48.0%	5
Kroll & Hood (1974)	42%*	5
Kroll & Hood (1976)	40.5%	5
Max, et.al (1997)	63.4%	6
Prins & Hubbard (1990)	41.8%	5
Prins (1968)	47.0%	5
Shulman (1955)	52.0%	5
Siegal & Haugen (1964)	34.7%	5
Soderberg (1969)	31%*	5
Wingate (1986)	65.0%	5
Wingate (1972)	66%*	5
Wingate (1966)	42.2%	5
Mean	48.5%	
Standard Deviation	17.5%	

* Denotes approximate value

APPENDIX B

EXPERIMENTAL CHANGE AFFECTING THE IMMEDIATE AMOUNT OF STUTTERING

Source	Experimental Change	Outcome
Golub (1955)	Presentation of 50 new words at 2nd reading. Comparison of new words and old words on the 2nd reading of the 100-item word list. Increase in stuttering on new words.	1.48 Times more stuttering
Kroll & Hood (1976)	Presentation of a prori knowledge of procedures. Comparison of 1st readings in both conditions. Increase without a prori knowledge	1.26 Times more stuttering
Max, et al. (1997)	Change from unison to independent readings. Comparison of readings 5 and 6. Increase when performed independently.	13.02 Times more stuttering
Seigal & Haugen (1964)	5 audience members vs. 0 audience members. Comparison of 1st readings. Increase with 5 audience members present.	1.29* Times more stuttering
Shulman (1955)	Addition of 1 audience member at 2nd reading. Comparison of 1st and 2nd reading. Decrease following addition of 1 audience.	1.03 Times less stuttering
Soderberg (1969)	Presentation of new passage at 2nd reading. Comparison of 1st and 2nd reading in condition. Decrease with new passage.	1.03* Times less stuttering
Wingate (1966)	Presentation of new passage with different punctuation at 2nd reading. Comparison of 2nd reading in each condition. Increase with new punctuation.	1.06 Times more stuttering

* Denotes approximate value

APPENDIX B

EXPERIMENTAL CHANGE AFFECTING THE IMMEDIATE AMOUNT OF STUTTERING (Continued)

Source	Experimental Change	Outcome
Wingate (1972)	Presentation of audio & visual alarm at 2nd reading. Comparison of 1st and 2nd reading in condition. Increase with audio & visual alarm.	1.01* Times more stuttering
Wischner (1952)	Presentation of new passage at 2nd reading. Comparison of 1st and 2nd reading in condition. Decrease with new passage at 2nd reading.	1.36* Times less stuttering
Van Riper & Hull (1955)	Read the same passage backward. Comparison of final reading and 1st reading of backward passage. Increase when read passage backward.	2.53 More words stuttered

* Denotes approximate value

APPENDIX C

CLOZE TEST

You must complete the missing letters in each word.

Example: English is the native or official language on one-tenth of the land area of the world. It i___ spoken in N____h America, Great B____ , Australia, a___ New Zealand.

The house I live in is not very big, but it is comfortable. There i_____ a gard_____ in fr_____t of t_____ house. Wh_____ you o_____ the fr_____ door, y_____ are in_____ the li_____ room. Wh_____ you wa_____ through t_____ living r_____, you en_____ t_____ kitchen. T_____ backyard i_____ through t_____ kitchen do_____.

Th_____ are thr_____ bedrooms a_____ one ba_____ in t_____ house. Y_____ reach th_____m through t_____ door nea_____ the ki_____.

Stuttering Severity Instrument-3 (Riley, 1994): A protocol for determining presence and severity of stuttering through the elicitation and analysis of spontaneous speech. This analysis will be conducted during spontaneous speech prior to the testing procedures.

APPENDIX D

BACKGROUND HISTORY

Where were you born?

What is your ethnicity?

What is your parent's native language?

As a child, what language did your parents speak to you?

As a child, what language did you speak most at home?

As a child, what language did you speak with friends?

As a child, what was the language of instruction at school?

How many years have you spoken English?

At what age were you first exposed to English?

At what age did you first have formal instruction in English?

At what age did you begin to speak English every day?

How many years of formal English instruction have you had?

How many years have you lived in an English speaking country?

How many years have you lived in the United States?

How many years have you attended English-speaking schools?

What schools in the United States have you attended?

How often do you read English text? (books, newspapers, magazines)

How often do you read your native language text?

How often do you speak your native language?

Do you feel equally comfortable using both languages? If not, which one?

How old were you when you began to stutter?

Have you ever received speech therapy for your stuttering?

Do you stutter the same amount in both languages? If not, which language do you stutter more in?

Do you have a history of a communication disorder other than stuttering?

Do you have a history of a hearing disorder?

Have you ever been hospitalized for a neurological injury?

If yes, please describe.

APPENDIX E

READING PASSAGES

The Spider's Home

A spider is an amazing animal. It can build its own home and it doesn't even have to buy wood or a saw. Before the spider begins to build, it looks for the perfect spot. The spider likes to live in a grassy area where lots of insects can get caught in its web. Then the spider eats the insects for dinner. The spider also has to figure out which way the wind is blowing. The wind has to be on the spider's back before it is able to make its house.

After it finds a good place to live, it is ready to spin its webs. The spider has glands in its stomach that produce a silky liquid. It leaps from one side of the house and is carried by the wind to the other side. As it travels through the air, the liquid comes out. As soon as the liquid hits the air it becomes solid, making a fine, tough thread.

The Toothbrush

Did you know that the toothbrush was invented in a prison? One morning in 1770, a man in an English jail woke up with a new idea. He thought it would be better if he could use a brush to clean his teeth, rather than wipe them with a rag. At dinner he took a bone from his meat and kept it. Then he told the prison guard about his idea. The guard gave him some bristles to use for the brush. The prisoner made holes in the bone and stuffed the bristles into the holes. It was a success! The prisoner was so excited about his new invention that he went into the toothbrush making business when he got out of jail.

For more than 200 years we have used toothbrushes similar to the one the prisoner invented. Toothbrushes are not made out of bones anymore. They come in all kinds of colors and sizes. The next time you brush your teeth, think about the prisoner in England who invented the toothbrush.

APPENDIX F

SAMPLE LETTER TO PARTICIPANTS
(To be printed on department letterhead)

Dear Participant,

I would like to introduce myself and tell you about a project I am conducting. My name is David Evans and I am a graduate student in Communication Sciences and Disorders at the University of Maine. I am doing a Master's thesis project studying the oral-motor processes of bilingual adults who stutter.

I am conducting a project in which you will provide written responses about your language use and your history of stuttering. The project will also involve you reading short passages out loud, which will be audio and videotaped. If you choose to participate, you will remain anonymous and will be reimbursed $10.00 for your time. You will be able to discontinue your participation in the project at anytime without consequence.

Your participation in this project will require no more than approximately one hour of your time and can be scheduled at your convenience.

If you are interested in learning more about this project, please call me at (207) XXX-XXX. Thank you for your interest and I look forward to hearing from you soon.

Sincerely,

David L. Evans
Graduate Student

APPENDIX G

INFORMED CONSENT

The Adaptation Effect in Bilingual People who Stutter

David Evans is interested in certain aspects of the speech and language of bilingual adults who stutter, ages 18 years and older. The project involves audio and video recordings of spontaneous speech and oral readings.

If I participate, I will be asked to:

1) Respond in writing to questions about my speech, ethnicity, language use, and language learning process.

2) Complete a brief test of English proficiency.

3) Read aloud short passages with only the examiner present.

4) Complete a 30-minute break from testing.

The complete session, including the 30-minute break, will take approximately one hour. There are no known risks to me and participation in the project is voluntary. I may discontinue my participation in testing at any time without consequence. My identity will remain confidential and the information obtained from me (tapes and data) will be used only by David L. Evans, Nancy E. Hall, Ph.D., and a research assistant. All tapes and data obtained from me will be stored in a locked office for 10 years following the projects completion, after which the information will be destroyed.

I may request the original audio and videotapes used in data collection following the completion of the project by writing my request below my signature.

I understand that by signing this form, I am agreeing to participate in the proposed study and will receive $10.00 for reimbursement of my time. If I choose to discontinue my participation, I will still be reimbursed $10.00.

I may request to obtain resource information about stuttering, stuttering treatment, and stuttering organizations.

My participation in this project will provide valuable information about stuttering among bilingual populations, which may help in understanding the oral-motor mechanisms of stuttering.

David Evans has described to me what is going to be done, how it is going to be done, the risks and benefits involved, and will be available at (207) 581-2006. A copy of this form will be made available to me.

Signature _____ Age _____ Date _____

BIOGRAPHY OF THE AUTHOR

David L. Evans was born in Boulder, Colorado on October 25, 1974. He was raised in Boulder, Colorado and graduated from Fairview High School in 1993. He attended the University of Colorado at Boulder and graduated in 1998 with a Bachelor's degree in Communication Disorders and Speech Science. He moved to Maine and entered the graduate program of the Communication Sciences and Disorders department in the fall of 1999. While a graduate student at the University of Maine, David co-authored a scholarly publication in *College and University.*

After receiving his degree, David will initiate a clinical fellowship year in speech-language pathology. He intends on pursuing a Doctorate of Philosophy in Speech-Language Pathology. David is a candidate for the Master of Arts degree in Communication Sciences and Disorders from the University of Maine in May, 2002.