THE IMPACT OF SYLLABLE STRUCTURE COMPLEXITY ON STUTTERING FREQUENCY FOR BILINGUALS AND MULTILINGUALS WHO STUTTER

by

CHISAOKWU ATURUCHIUKA ONONIWU

(Under the Direction of Anne Cordes Bothe)

ABSTRACT

The purpose of this study was to investigate the relationships between language dominance and the frequency of stuttering, and between syllable structure complexity and the frequency of stuttering, in bilingual and multilingual adults who stutter. Three adults who stuttered completed three speaking sessions each. Speech samples were obtained during monologue and oral paragraph readings in English and in another language. Reading passages contained controlled syllable complexity patterns. Individual data analyses showed that two of the three participants stuttered more in their non-dominant language. No consistent relationship was found between syllable structure complexity and stuttering frequency. This study replicated some previous findings that persons who stutter will stutter more in their non-dominant language; it is also consistent with previous findings of inconsistent results in this area. The lack of a consistent relationship between syllable structure complexity and stuttering frequency contradicts previously published suggestions as to the importance of phonological variables in stuttering. Future research should examine functional brain involvement when speaking several languages to determine the fundamental nature of stuttering and to serve as an aid to developing clinical implications.

INDEX WORDS: Stuttering; syllable structure; bilingual; multilingual; language dominance
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THE IMPACT OF SYLLABLE STRUCTURE COMPLEXITY ON STUTTERING FREQUENCY FOR BILINGUALS AND MULTILINGUALS WHO STUTTER

by

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Maureen Grasso
Dean of the Graduate School
The University of Georgia
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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>iv</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>vii</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>viii</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>CHAPTER</td>
<td></td>
</tr>
<tr>
<td>1  REVIEW OF THE LITERATURE</td>
<td>4</td>
</tr>
<tr>
<td>Stuttering Frequency for Bilinguals Who Stutter</td>
<td>4</td>
</tr>
<tr>
<td>Issues Raised by Bilingual Stuttering Research</td>
<td>7</td>
</tr>
<tr>
<td>Method of Phonological Complexity Analyses</td>
<td>10</td>
</tr>
<tr>
<td>Results of Phonological Complexity Analyses</td>
<td>16</td>
</tr>
<tr>
<td>The Present Study</td>
<td>24</td>
</tr>
<tr>
<td>2  METHOD</td>
<td>27</td>
</tr>
<tr>
<td>Participants</td>
<td>27</td>
</tr>
<tr>
<td>Materials</td>
<td>30</td>
</tr>
<tr>
<td>Procedures</td>
<td>33</td>
</tr>
<tr>
<td>Data Analysis</td>
<td>37</td>
</tr>
<tr>
<td>3  RESULTS</td>
<td>41</td>
</tr>
<tr>
<td>Individual Data</td>
<td>41</td>
</tr>
<tr>
<td>Group Data</td>
<td>59</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table 1: Language families, languages, and stuttering frequency for literature review ..................................................11
Table 2: Calculated phonological complexity with use of four factors (see text) for literature review ..........................................................13
Table 3: Phonological complexity ranking for each language in the literature review ................................................17
Table 4: Language structure classifications and stuttering frequency for literature review ..........................................................18
Table 5: Rhythmic patterns, stress patterns, and weight-factors in weight sensitive stress in languages in literature review ..................................................21
Table 6: Participants’ characteristics and language history .......................................................................................29
Table 7: Interjudge agreement results for stuttering variables .......................................................................................39
Table 8: Intrajudge agreement results for stuttering variables .......................................................................................39
Table 9: Calculated phonological complexity estimates with use of four factors (see text) for English, Igbo, and Shanghainese ..................................................66
LIST OF FIGURES

Figure 1: YJ’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness in monologue averaged across both sessions .................................................42
Figure 2: YJ’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness in monologue for each session ........................................................................43
Figure 3: YJ’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness for three levels of syllable structure (simple, moderately complex, complex) in reading averaged across both sessions ...........................................................44
Figure 4: YJ’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness for three levels of syllable structure (simple, moderately complex, complex) in reading for each session .................................................................................45
Figure 5: JC’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness in monologue averaged across both sessions .........................................................47
Figure 6: JC’s stuttering frequency (in percent syllables stuttered, %SS) in monologue for each session ..................................................................................................................48
Figure 7: JC’s speech naturalness in monologue for each session ....................................49
Figure 8: JC’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness for three levels of syllable structure (simple, moderately complex, complex) in reading for each session .................................................................................50
Figure 9: JC’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness in monologue for each session .........................................................49
naturalness for three levels of syllable structure (simple, moderately complex, complex) in reading for each session.................................................................51

Figure 10: JC’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness in the dominant language for three levels of syllable structure (simple, moderately complex, complex) in reading for each session.................................................................52

Figure 11: EL’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness in monologue averaged across both sessions.......................................................................55

Figure 12: EL’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness in monologue for each session...............................................................................56

Figure 13: EL’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness for three levels of syllable structure (simple, moderately complex, complex) in reading averaged across both sessions.................................................................57

Figure 14: EL’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness for three levels of syllable structure (simple, moderately complex, complex) in reading for each session...............................................................................58

Figure 15: YJ’s, JC’s, and EL’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness in monologue averaged across both sessions ........................................60

Figure 16: YJ’s, JC’s, and EL’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness in monologue for each session .................................................................61
INTRODUCTION

Stuttering is a disorder of speech-motor production that affects speakers of essentially all ages in racial, ethnic, and cultural groups worldwide. Its cause is unknown, but several researchers have developed theories of its origin based on the finding that children usually begin to stutter at approximately the same time that they start to apply different linguistic patterns across syllables during the development of spoken language (Packman, Code, & Onslow, 2007). It is also known that the prevalence of stuttering is greater for bilingual speakers than for persons who are monolinguals (Eisenson, 1984; Howell, Davis, and Williams, 2009; Karniol, 1992; Mattes & Omark, 1984; Shames, 1989; Stern, 1948; Travis, Johnson & Shover, 1937).

The general goal of the research conducted for this thesis was to combine two ideas, the phonologic complexity of speech and knowledge of more than one language. Howell et al. (2009) conducted a study to examine the effects of stuttering when children were exposed to two languages from birth and when the second language was introduced during pre-school years. They found that (a) when stuttering occurred, it was usually present in both languages; (b) children had a higher chance of stuttering when they were exposed to two languages from birth than when exposed to two languages at a later age; (c) children who were bilingual since birth had a lower chance of recovery. Likewise, Au-Yeung, Howell, Davis, Charles, and Sackin (2000) found that children who acquired both languages between birth and age six stuttered more than individuals who learned the second language after age seven.
Brain imaging studies (e.g., Kim, Relkin, Lee, & Hirsch, 1997) have shown that the brain organization is different when a second language is learned early than when a second language is learned at a later age. For example, both languages are represented in common areas of the brain when language is acquired early, whereas the language representation is more dispersed in the brain when the second language is introduced at a later age. Starkweather’s demands and capacity model of stuttering (Starkweather, 1987) may also suggest that learning two languages concurrently results in functional excessive demands, suggesting that children who stutter may need to first master one language before learning the second language. Contrarily, Au-Yeung et al. (2000) conducted an online survey on several individuals who stuttered and found that learning two languages concurrently did not result in more stuttering; their methodology was weak, however, and the results should be used with caution.

Some may speculate that certain aspects of the phonological system of each language (e.g., syllable, stress, rhythmic patterns) may impact stuttering differently. The Covert Repair Hypothesis (Kolk & Postma, 1997; Postma & Kolk, 1993) states that individuals who stutter have an impaired internal monitor for the phonological encoding of speech. This impaired internal monitor for speech output results in specific dysfluency errors. Packman and Kuhn (2009) also state that the complexity of spoken language should be taken into account in order to understand the complexity of stuttering.

Chapter 1 further explores the impact of bilingualism on stuttering by reviewing several studies that attempted to determine whether bilinguals stutter more in the native, dominant language, more proficient, or primary language (referred to for the purposes of this review as “L1,” but see the discussion of this terminology in Chapter 1) or in the non-native, non-
dominant, less proficient or secondary language (again, referred to as “L2” but see later discussions). Chapter 1 also presents the results of analyses of the literature that were conducted to examine the effects of linguistic and phonological patterns on stuttering frequency for the bilingualism and stuttering research studies. Chapter 2 then presents the methods for the present research study, which were developed in response to the literature review and analyses in Chapter 1. It was hypothesized that the more complex syllable structures would result in more stuttering in a manner that might begin to inform the apparently conflicting information about stuttering in persons who are bilingual. Chapter 3 presents results from the three participants who participated in this study. Chapter 4 provides a summary and interpretation of the results with clinical implications for bilinguals and multilinguals who stutter.
CHAPTER 1

REVIEW OF LITERATURE

Stuttering Frequency for Bilinguals Who Stutter

Several studies have made efforts to examine the effects of bilingualism on stuttering, both for individuals and for groups of adults and children. Some of the conclusions drawn from these studies are contradictory, however, as discussed in the following section. One complexity that emerges in attempting to review these studies is that they do not use or include a standard means for identifying a speaker’s first or best language, something that is often not at all straightforward to determine. In the following sections, the standard abbreviation “L1” is used, therefore, to refer to the language that the research being reviewed described as the speakers’ first, native, or more proficient language. Similarly, “L2” is used to refer to the language that was classified as the speakers’ second, non-native, or less proficient language.

Studies showing a greater frequency of stuttering in L1

Several studies have reported more stuttering in the speakers’ first, native, or more proficient language. Dale (1977) investigated the stuttering frequency of four teenage males during spontaneous speech. The teenagers were both proficient in English (L2) and Spanish (L1), but were forced to speak Spanish in the home. Spanish was considered their primary language (L1), although no language proficiency test was given to confirm the assumption. The parents of the teenagers reported that stuttering was present only in L1 and not L2, indicating that stuttering was greater in L1. Stuttering was informally observed and no measures were taken; hence, the results should be interpreted with caution. Other problems with Dale’s (1977) study, which also
characterize many studies in this area, include no measure for identifying language proficiency, no operational definition of stuttering, and no measurement of stuttering frequency or severity.

Likewise, Jayaram (1983) examined the phonetic influences and stuttering frequency during oral reading and spontaneous speech for 10 bilingual speakers who stuttered and spoke Kannada and English. A language proficiency test was given to determine that Kannada was the primary language (L1), and English was the secondary language (L2). The individuals stuttered more in L1 and on words containing nasals and voiceless consonants (especially voiceless stops and voiceless fricatives) during reading and spontaneous speech in both languages.

Reardon (2000) investigated the stuttering frequency of 40 bilinguals who stuttered with an age range of 8 to 34 years of age who spoke an Indian language (L1) and English (L2) during spontaneous speech. The Indian language(s) spoken was not specified in the study. The results indicated that the individuals stuttered more in their mother tongue (L1). A limitation in the study was the low stuttering interrater reliability for both L1 and L2.

**Studies showing a greater frequency of stuttering in L2**

Other studies appear to have obtained the opposite results. Bernstein Ratner and Benitez (1985), for example, investigated the dysfluency patterns of an adult, bilingual stutterer who spoke English and Spanish, during spontaneous speech. No tests were given to determine language proficiency, but L1 was the native language (Spanish), and English was the non-native language (L2). The results revealed that the subject stuttered more in L2 during spontaneous speech and that vowel-initiated words in Spanish resulted in the greatest amount of stuttering.

Jankelowitz and Bortz (1996) also examined an adult male who spoke both Afrikaans and English during oral reading and spontaneous speech. A language proficiency test was given and
revealed that the individual was more proficient in English (L1) than in Afrikaans (L2). The results also showed that the participant stuttered more in L2 during spontaneous speech.

Roberts (2002) investigated four stuttering bilinguals who spoke both French and English during monologue and oral reading. Two were balanced bilinguals and two were French-dominant speakers. Well-established self-rating proficiency questionnaires were given to determine language proficiency. Stuttering frequency was higher in the L2 in both reading and spontaneous speech for the French-dominant speakers and stuttering frequency was equivalent for the balanced bilinguals. The study did not include statistical analyses for significance testing for stuttering frequency. It is possible that the differences seen were by chance and not due to language differences. The small number of participants also makes it difficult to generalize the findings.

More recently, Lim, Lincoln, Chan, and Onslow (2008) conducted a study on 30 English and Mandarin stuttering adult bilinguals. Subjects were classified as either English-dominant, Mandarin-dominant, or balanced bilinguals based on a language dominance assessment. They found that stuttering was greater in L2 for both English-dominant and Mandarin-dominant speakers during spontaneous speech, however, stuttering was equivalent for the balanced bilinguals.

Studies showing an equal frequency of stuttering in L1 and L2

Thirdly, there are studies that have reported equal stuttering in two languages. The balanced bilinguals in the Lim et al. (2008) study and the Roberts (2002) study had an equal amount of stuttering in L1 and L2. The methodology of several of these studies was problematic, but those weaknesses alone do not appear to be sufficient to explain the results. Additionally,
Nwokah (1988) studied 16 bilingual individuals who stuttered that spoke Igbo and English. Igbo was considered the L1, although a language proficiency test was not given to confirm this assumption. The results showed that stuttering was greater in L2; however the difference was not significant for both spontaneous speech and oral reading and the participants were not entirely homogenous. Their perception of stuttering was defined as the amount of words stuttered per minute. This excludes stuttering behaviors such as syllable repetitions and revisions of words that directly contribute to stuttering frequency.

Lastly, Karniol (1992) studied a male child who had been exposed to several languages at an early age, but only spoke Hebrew and English. Stuttering was present in Hebrew, but disappeared entirely at a later time. The child moved to several locations and did not produce speech at a point. Stuttering appeared in both languages but disappeared in both languages as the child began to speak again. Van Borsel, Meirlaen, Achten, Vingerhoets, and Santens (2009) conducted a case study on a bilingual individual after a whiplash trauma and found that the patient stuttered more in her native language (Dutch) than in English. Both Karniol’s (1992) and Van Borsel et al.’s (2009) studies fail to demonstrate a reliable relationship between stuttering and bilingualism because several factors could have contributed to the findings. Alternatively, these studies may provide further evidence that cognitive overload may impact stuttering frequency.

**Issues Raised by Bilingual Stuttering Research**

In summary, the findings do not reveal a clear pattern for a greater stuttering frequency in L1 or L2. It is imperative for bilingual stuttering researchers to include the use a measure for identifying language proficiency, an operational definition of stuttering, and measurement data
of stuttering frequency. It is possible that individuals who are not proficient in a language may experience an increase in stuttering. Furthermore, operational definitions of stuttering and stuttering rates provide a useful means for identifying research validation and reliability.

The discrepancy in the stuttering and bilingualism data could be attributed to the methodology and/or the phonological complexity of each language. Several studies did not use formal measure for identifying language proficiency (e.g. Bernstein Ratner and Benitez, 1985), and measurement data for stuttering frequency (e.g. Dale, 1977). Many of the studies are examined at the individual level rather than the group level. It is possible that stuttering may manifest differently in languages or in phonological systems that are similar or dissimilar. The study of stuttering in bilinguals may provide scientific and clinical information about its development, but this has been a limited area of research.

Efficacy data for treating bilingual persons who stutter is critical because over 50% of the world’s population is bilingual (De Houwer, 1998). It is important to examine the effects of bilingualism and stuttering to answer the following questions: (1) does each language impact stuttering differently; (2) are there certain aspects of a language system that may contribute to stuttering frequency; (3) should children who stutter learn a second language at a later age to reduce their chances of stuttering and increase their chances of recovery, and if so, what language should be the focus of treatment; (4) should children initially learn the language that results in less stuttering to reduce their demands on speaking?

The learnability theory explains how a language learner acquires a language. According to the components of the learnability theory, children must receive more complex input of a language system in order to increase their competence of that language (Pinker, 1995; Wexler,
For example, stuttering is more likely to occur on consonants than on vowels (Griggs & Still, 1979; Kalinowski, Dayalu, Stuart, Rastatter, & Rami, 2000), consonant-vowel sequences are universally simpler (Selkirk, 1982) which may therefore produce less stuttering, and children who persist in stuttering have a greater deficiency in consonant sequences (which includes consonant clusters) than those who recovered early (Paden & Yairi, 1996). In addition, persons who stutter are more likely to stutter on stressed syllables than on unstressed syllables (Prins, Hubbard, & Krause, 1991), and rhythmic pattern may reduce stuttering (Azrin, Jones, & Flye, 1968; Jones & Azrin, 1969; Prins & Hubbard, 1992); therefore languages containing rhythmic patterns may result in less stuttering. The possibility exists, in other words, that the apparently conflicting differences in stuttering by language proficiency could be explained by differences between the speakers’ particular languages themselves. None of the studies of bilingualism and stuttering described above examined the phonological complexities of the relevant language. Such phonological complexity analyses are complex, for several reasons, as discussed below.

Assessing phonological complexity

Gierut (2007) discusses the use of epistemic, ontological, and functional perspectives in describing phonological complexity. Phonological complexity from an epistemic perspective is
simply a description of the language system such as the sound patterns. The ontological perspective is the hierarchical organization of a language system such as segmental and prosodic features at the word and sentence levels. A functional perspective is the rule of a language such as sound inventories and sound constrained. These perspectives are distinct and independent. That is, complexities at the epistemic perspective do not imply complexities at the functional perspectives and vice versa. Additionally, Maddieson (2006) suggests that the vowel inventory of each language is not necessary when analyzing language complexity.

The epistemic and functional perspectives were used for identifying phonological complexities of each language for the stuttering and bilingualism studies. Viewing some analyses as a study in their own rights, the independent variables in this pilot study were the linguistic and phonological patterns of each language, and the dependent variable was the frequency of stuttering in each language. The hypotheses assessed was that stuttering would occur more in languages with a more phonologically complex system and less in a language with a less phonologically complex system, or that familiarity or proficiency with a language is not the only relevant variable.

Method of Phonological Complexity Analyses

Seven languages were represented in the studies described above: Afrikaans, English, French, Igbo, Kannada, Mandarin, and Spanish. Stuttering frequency comparisons in all studies were made between English and one of the above languages. Some of the studies in the literature review included an oral reading passage, but all studies included a spontaneous speech sample. For this reason only spontaneous speech samples were included in the present analyses; all oral reading samples were excluded. Van Borsel et al.’s (2009) study was excluded from the analyses.
because stuttering was of sudden onset following the brain injury and it is unclear as to whether the neurological damage may have caused the stuttering rate to increase. The Karniol (1992) study failed to demonstrate any relationship between stuttering and bilingualism because several factors could have contributed; therefore the study was also excluded in the phonological complexity analyses. Four different comparative analyses were used to determine if any linguistic and/or phonological patterns contributed to stuttering frequency. The first linguistic analysis was the comparison of the language family for each stuttering and bilingualism study.

Language family comparison

The language families were compared to determine if an increase in stuttering was a result of an extreme change from one language family to another and would therefore increase the complexity created by their combination.

Table 1: Language families, languages, and stuttering frequency for literature review

<table>
<thead>
<tr>
<th>Study</th>
<th>Language Family</th>
<th>Languages</th>
<th>Stuttering Frequency (L1, L2, or Equal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jankelowitz &amp; Bortz (1996)</td>
<td>Indo-European</td>
<td>Afrikaans (L2), English (L1)</td>
<td>L2</td>
</tr>
<tr>
<td>Roberts (2002)</td>
<td>Indo-European</td>
<td>French (L1), English (L2)</td>
<td>L2 &amp; Equal (for the balanced bilinguals)</td>
</tr>
<tr>
<td>Jayaram (1983)</td>
<td>Dravidian</td>
<td>Kannada (L1), English (L2)</td>
<td>L1</td>
</tr>
<tr>
<td>Lim et al. (2008)</td>
<td>Sino-Tibetan</td>
<td>Mandarin, English</td>
<td>L2 &amp; Equal (for the balanced bilinguals)</td>
</tr>
<tr>
<td>Bernstein Ratner &amp; Benitez (1985)</td>
<td>Indo-European</td>
<td>Spanish (L1), English (L2)</td>
<td>L2</td>
</tr>
<tr>
<td>Dale (1977)</td>
<td>Indo-European</td>
<td>Spanish (L1), English (L2)</td>
<td>L1</td>
</tr>
<tr>
<td>Reardon (2000)</td>
<td>NA</td>
<td>Not specified</td>
<td>L1</td>
</tr>
</tbody>
</table>
For instance, switching from a more complex language family to a less complex family may be hypothesized to result in less stuttering, whereas switching from a less complex to a more complex language family may result in more stuttering.

Four-factor phonological analysis

Four factors were combined to create a means of comparing phonological complexity across languages: (1) the total number of consonant phonemes in the languages, (2) the number of syllable structures allowed, (3) the maximum number of consecutive phonemes per syllable, and (4) tonal patterns in each language. Scales for each factor were forced to 0-100 by setting the largest obtained value equal to 100 and then calculating the percentage for all others. For example, if the maximum number of tonal patterns in any language was four, then the language with four final patterns scored 100 (4/4). If another language had three tonal patterns, then it would result in a score of 75 (3/4). Because there was no reason to weight factors differentially, the mean of the four factors was used. Each language was then ranked from more phonologically complex to less phonologically complex based on the mean score, between 0 and 100. Table 2 summarizes the stuttering frequency of each language spoken in the studies.
Table 2: Calculated phonological complexity estimates with use of four factors (see text) for literature review

<table>
<thead>
<tr>
<th>Study</th>
<th>Language</th>
<th>Consonant Phonemes</th>
<th>Consonant Phonemes Adjusted (out of 100)</th>
<th>Syllable Structures</th>
<th>Syllable Structures Adjusted (out of 100)</th>
<th>Maximum Consecutive Phonemes (per syllable)</th>
<th>Maximum Consecutive Phonemes Adjusted (out of 100)</th>
<th>Tonal Patterns</th>
<th>Tonal Patterns Adjusted (out of 100)</th>
<th>Total (out of 400)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All studies</td>
<td>English</td>
<td>24</td>
<td>88.89</td>
<td>16</td>
<td>100</td>
<td>3</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>288.89</td>
</tr>
<tr>
<td>Jankelowitz &amp; Bortz (1996)</td>
<td>Afrikaans</td>
<td>15</td>
<td>55.56</td>
<td>10</td>
<td>62.50</td>
<td>3</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>218.06</td>
</tr>
<tr>
<td>Roberts (2002)</td>
<td>French</td>
<td>19</td>
<td>70.37</td>
<td>8</td>
<td>50.00</td>
<td>2</td>
<td>66.67</td>
<td>0</td>
<td>0</td>
<td>187.04</td>
</tr>
<tr>
<td>Nwokah (1988)</td>
<td>Igbo</td>
<td>27</td>
<td>100</td>
<td>2</td>
<td>12.50</td>
<td>1</td>
<td>33.33</td>
<td>3</td>
<td>75</td>
<td>220.83</td>
</tr>
<tr>
<td>Jayaram (1983)</td>
<td>Kannada</td>
<td>24</td>
<td>88.89</td>
<td>5</td>
<td>31.25</td>
<td>2</td>
<td>66.67</td>
<td>0</td>
<td>0</td>
<td>186.81</td>
</tr>
<tr>
<td>Lim et al. (2008)</td>
<td>Mandarin</td>
<td>22</td>
<td>81.48</td>
<td>5</td>
<td>31.25</td>
<td>2</td>
<td>66.67</td>
<td>4</td>
<td>100</td>
<td>279.40</td>
</tr>
<tr>
<td>Bernstein Ratner &amp; Benitez (1985)</td>
<td>Spanish</td>
<td>19</td>
<td>70.37</td>
<td>9</td>
<td>56.25</td>
<td>3</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>226.62</td>
</tr>
<tr>
<td>Reardon (2002)</td>
<td>Not Specified</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Dale (1977)</td>
<td>Spanish</td>
<td>19</td>
<td>70.37</td>
<td>9</td>
<td>56.25</td>
<td>3</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>26.62</td>
</tr>
</tbody>
</table>

Individual data obtain from: Clark, (1990); Donaldson (1993); Frawley (2003); Sridhar (1990)
The third method for analyzing language complexity included the comparison between consonant inventory complexity, syllable structure complexity, and tonal complexity for each language. Haspelmath, Dryer, Gil, & Comrie (2005) divided several world languages into a genetic and area category and looked for patterns across the divisions. Each phonological complexity category is classified in terms of the consonant inventories, vowel inventories, tonal system, stress patterns, rhythmic patterns, etc. For the purposes of this analysis the consonant inventory, syllable structure complexity, and tonal complexity were compared for each language.

The consonant inventory complexity was classified as either small (6-14 consonants), moderately small (15-18 consonants), average (19-25 consonants), moderately large (26-33 consonants), and large (greater than 34 consonants). Syllable structure complexity was grouped into three groups: simple, moderately complex, and complex. Simple syllable structures consisted mainly on CV or V syllables shapes, moderately complex structures consisted of mainly CVC or CCVC syllable shapes, and complex syllable structures consisted of mostly CCCV or VCC syllable shapes. The tonal complexity was either categorized as no tone present, a simple tone (basic contrast such as high or low), and complex tone (beyond basic contrast).

Stress and rhythmic analysis

The last analysis performed was the stress and rhythmic pattern of each language. Each language was categorized in terms of their stress location, weighted factors on weight-sensitive stress, and rhythmic types using the findings from Haspelmath et al. (2005). Stress location for each language was categorized as: fixed stress (stress on the same syllable), no fixed stress (weight-sensitive stress), initial stress (stress on the first syllable), second stress (stress on the
second syllable), third (stress on the third syllable), antepenultimate stress (stress on the third to last syllable), penultimate stress (stress on the second to the last syllable), and ultimate stress (stress on the last syllable).

Languages containing a fixed stress location were further analyzed to determine the weight factors that influenced the stress patterns. These weight factors are classified as no weight (no role of syllable weight), long vowel (long vowels are heavy for stress), coda consonant (closed syllables are heavy for stress), long vowel + coda (long vowels and closed syllables are heavy for stress), prominence (other factors that are heavy for stress), lexical (lexical stress or diacritic weight), and combined (a combination of two of the above factors determine weight total). The five categories for rhythm type are: trochaic (every odd syllable from the left or right), iambic (even syllables from the left or right), dual (both trochaic and iambic), undetermined (secondary with a different pattern from the other rhythm types), and absent (no rhythmic stress).

Based on the research findings that individuals are more likely to stutter on stressed syllables than unstressed syllables (Prins et al., 1991), it could be assumed that languages having “more stress” could be considered complex and languages containing “less stress” could be considered less complex. Data for both stress and rhythmic patterns are not provided for all languages, however, and are not classified in terms of complexity. The lack of data for a particular language is either due to a lack of stress and/or rhythmic pattern in the language or the language may be ancient or extinct (Haspelmath et al., 2005). In addition, there are several factors that may influence stress that are not explicitly stated therefore it is difficult to determine which language is more complex; therefore common trends and/or patterns the stress and rhythmic patterns across languages were compared and examined.
Results of Phonological Complexity Analyses

Differences in language families and phonological complexity patterns were analyzed to examine their effects on stuttering frequency for bilingual individuals who stutter. A complete analysis could not be performed for the Reardon (2002) study because the language(s) spoken were not specified.

Language family differences

Table 1 displays the language families for the stuttering and bilingualism studies. Each language spoken belongs to either the Indo-European language family, Niger-Congo family, Sino-Tibetan family, or the Dravidian family. As illustrated, Spanish, Afrikaans, Mandarin and French were spoken for the four studies that found a greater frequency of stuttering in L2. These languages are all a part of the Indo-European language family, with the exception of Mandarin. The language families vary for studies that showed a greater frequency of stuttering in L1 and for studies that showed an equal amount of stuttering in L1 and L2. There is no obvious relationship between the frequency of stuttering and the language family difference. Stuttering frequency in L1 and L2 varies across the language families and speaking across different language families does not impact stuttering.

Four factor phonological complexity

The four phonological factors were combined to obtain a total score out of 400 and were then compared to English. Table 2 displays the combined totals for the four phonological factors of each study and Table 3 displays the ranking system of the languages from the total number accumulated out of 400.
The results of the analysis showed that English was the most phonologically complex language while Kannada was the least phonologically complex language. English was the L2 for all studies that had a greater amount of stuttering in L2, excluding Jankelowitz & Bortz (1996). Stuttering did not always occur more in the L2 where the phonological system was more complex. Spanish and Kannada were spoken for the studies that demonstrated a greater amount of stuttering in L1. Kannada was the least phonologically complex language; therefore the results of the phonological complexity analysis do not confirm the hypothesis that the more phonological complex languages results in more stuttering. In addition, the results should have shown an equivalent phonological complexity for English, Mandarin and French given that the bilingual individuals who spoke these languages had an equal amount of stuttering in both L1 and L2. This was not the case, providing further evidence to disapprove the hypothesis.

Three factor phonological complexity

Table 4 displays the phonological complexities of the languages through the phonological classification system from Haspelmath et al. (2005). There was no data for Afrikaans for all three factors; therefore it was placed into the category based on the data obtained from the four factor analysis of phonological complexity. English had an average consonant inventory size, complex syllable structure, and no tones present.
Table 4: Language structure classifications and stuttering frequency for literature review

<table>
<thead>
<tr>
<th>Study</th>
<th>Stuttering Frequency (L1, L2, or Equal)</th>
<th>Language</th>
<th>Consonant Inventory Complexity</th>
<th>Syllable Structure Complexity</th>
<th>Tonal Complexity</th>
</tr>
</thead>
<tbody>
<tr>
<td>All studies</td>
<td></td>
<td>English</td>
<td>Average</td>
<td>Complex</td>
<td>No Tone</td>
</tr>
<tr>
<td>Jankelowitz &amp; Bortz (1996)</td>
<td>L2</td>
<td>Afrikaans (not indicated)</td>
<td>Moderately Small</td>
<td>Complex</td>
<td>No Tone</td>
</tr>
<tr>
<td>Roberts (2002)</td>
<td>L2 &amp; Equal (for the balanced bilinguals)</td>
<td>French</td>
<td>Average</td>
<td>Complex</td>
<td>No Tone</td>
</tr>
<tr>
<td>Nwokah (1988)</td>
<td>Equal</td>
<td>Igbo</td>
<td>Large</td>
<td>Simple</td>
<td>Simple</td>
</tr>
<tr>
<td>Jayaram (1983)</td>
<td>L1</td>
<td>Kannada</td>
<td>Average</td>
<td>Complex</td>
<td>No Tone</td>
</tr>
<tr>
<td>Lim et al. (2008)</td>
<td>L2 &amp; Equal (for the balanced bilinguals)</td>
<td>Mandarin</td>
<td>Moderately Large</td>
<td>Moderately Complex</td>
<td>Complex</td>
</tr>
<tr>
<td>Bernstein Ratner &amp; Benitez (1985)</td>
<td>L2</td>
<td>Spanish</td>
<td>Moderately Large</td>
<td>Moderately Complex</td>
<td>No Tone</td>
</tr>
<tr>
<td>Dale (1977)</td>
<td>L1</td>
<td>Spanish</td>
<td>Moderately Large</td>
<td>Moderately Complex</td>
<td>No Tone</td>
</tr>
<tr>
<td>Reardon (2000)</td>
<td>L1</td>
<td>Not specified</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

For the four studies that showed a greater frequency of stuttering in L2, all four languages had a greater number of consonants, with the exception of Afrikaans where the consonant inventory is smaller. The language structures for French and Afrikaans are complex similar to
English, while Mandarin and Spanish are moderately complex. When comparing these four languages to English, Mandarin is the only language with a tonal system.

Kannada and Spanish were the languages that resulted in an increase in stuttering as compared to English (L2). Kannada is similar to English for consonant inventory complexity, syllable structure complexity, and tonal complexity. Spanish, on the other hand, differs from English in terms of its consonant inventory complexity and syllable structure complexity with a larger number of consonants and a less complex syllable structure.

Individuals who spoke English in addition to either French (balanced bilinguals in Roberts, 2002), Mandarin (balanced bilinguals in Lim et al., 2009), or Igbo had an equal amount of stuttering in the languages they possessed. Igbo has a larger consonant inventory than English, a simpler syllable structure than English, and a three pattern tonal system. Mandarin and French differ from English in terms of the consonant inventory and syllable structure (as seen above from greater stuttering frequency in L2 phonological complexity analysis). When using the phonological complexity classification system for the three variables, Mandarin is the most complex, but did not result in more stuttering; therefore it does not confirm the hypothesis that languages spoken with more complex linguistic structures results in more stuttering. In summary, there does not appear to be a clear trend between phonological complexity and stuttering when using the phonological complexity classifications from Haspelmath et al. (2005). In addition, the results do not support the hypothesis that a more phonologically complex language system results in more stuttering.
Rhythmic and stress patterns

Table 5 displays the rhythmic and stress patterns of the languages spoken. There is no rhythmic pattern data for Afrikaans, Igbo, Kannada, and Mandarin. The absence of data for the certain languages is either due to: a lack of stress and/or rhythmic pattern in the language, the language being ancient, or the language being extinct.
Table 5: Rhythmic patterns, stress patterns, and weight-factors in weight-sensitive stress for languages in literature review

<table>
<thead>
<tr>
<th>Study</th>
<th>Stuttering Frequency (L1, L2, or Equal)</th>
<th>Language</th>
<th>Stress Location</th>
<th>Rhythm Type</th>
<th>Weight Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>All studies</td>
<td></td>
<td>English</td>
<td>No fixed stress</td>
<td>Trochaic</td>
<td>Long vowel + coda</td>
</tr>
<tr>
<td>Jankelowitz &amp; Bortz (1996)</td>
<td>L2</td>
<td>Afrikaans (not indicated)</td>
<td>No Data</td>
<td>No Data</td>
<td>No Data</td>
</tr>
<tr>
<td>Roberts (2002)</td>
<td>L2 &amp; Equal (for the balanced bilinguals)</td>
<td>French</td>
<td>No fixed stress</td>
<td>Undetermined</td>
<td>Lexical</td>
</tr>
<tr>
<td>Nwokah (1988)</td>
<td>Equal</td>
<td>Igbo</td>
<td>No Data</td>
<td>No Data</td>
<td>No Data</td>
</tr>
<tr>
<td>Jayaram (1983)</td>
<td>L1</td>
<td>Kannada</td>
<td>No Data</td>
<td>No Data</td>
<td>No Data</td>
</tr>
<tr>
<td>Lim et al. (2008)</td>
<td>L2 &amp; Equal (for the balanced bilinguals)</td>
<td>Mandarin</td>
<td>No fixed stress</td>
<td>No Data</td>
<td>Lexical</td>
</tr>
<tr>
<td>Bernstein Ratner &amp; Benitez (1985)</td>
<td>L2</td>
<td>Spanish</td>
<td>No fixed stress</td>
<td>Trochaic</td>
<td>Combined</td>
</tr>
<tr>
<td>Dale (1977)</td>
<td>L1</td>
<td>Spanish</td>
<td>No fixed stress</td>
<td>Trochaic</td>
<td>Combined</td>
</tr>
<tr>
<td>Reardon (2000)</td>
<td>L1</td>
<td>Not specified</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Data are present for English, French, Mandarin, and Spanish and all contain a language system without a fixed stress pattern and a trochaic rhythm type, with the exception of French that has an undetermined rhythm type. All languages vary in terms of the weight factors in weight-sensitive stress. The only clear pattern evident is for languages that resulted in a greater amount of stuttering in L2 or an equal amount of stuttering between L1 and L2. For these
studies, a lexical pattern was present in the language. The results demonstrate that there is no clear pattern for the rhythm and stress pattern and these factors may not influence the stuttering frequency.

Discussion and implications of the pilot study

The review of the literature presented in this chapter does not clearly indicate if individuals are likely to stutter more in L1 or L2. Several studies found a greater frequency of stuttering in L1, L2 or an equal amount of stuttering in L1 and L2. The phonological complexity analyses were conducted to further investigate if the language family and phonological complexity could account for the differences in the bilingualism and stuttering data. A phonological complexity scheme was developed for each of the languages in the bilingual stuttering data to determine if such factors would contribute to stuttering frequency. It was hypothesized that languages with a more phonologically complex systems would result in more stuttering and less phonologically complex languages would result in less stuttering. Overall, the four analyses performed for the stuttering and bilingualism data revealed no relationship between stuttering and the language families and phonological complexity. That is, the phonological complexity of each language does not appear to influence stuttering frequency. The discrepancies in the bilingualism and stuttering findings do not appear to result from these factors. These findings are contrary to Logan and Conture (1995) and Melnick and Conture (2000) who state that the amount of stuttering may differ according to the different levels of linguistic complexity of a language.

If stuttering frequency differences found in bilingual individuals who stutter cannot be explained on the basis of phonological complexity, then the other methodological issues raised in
assessing these studies may need to be re-evaluated. The issue of language proficiency or
dominance, for example, should be considered. Dale (1977) did not provide subjects with a
language proficiency or dominance test and stuttering was informally observed, and Nwokah
(1988) did not provide a measure of language proficiency for the participants. The Lim et al.
(2008) and Roberts (2002) studies found consistent patterns for balanced bilinguals when given
an accurate language proficiency or dominance test. Stuttering frequency was equal in the two
languages (French and Mandarin) when compared to English. Although there was an equal
amount of stuttering in both the Lim et al. (2008) study and the Roberts (2002) study, it cannot
be assumed based on two studies that all individuals who are balanced bilinguals (as determined
by a language proficiency or language dominance test) will stutter equally in L1 and L2. It is
possible that an individual may stutter more in the less proficient or dominant language,
therefore it is necessary to perform some form of language proficiency or language dominance
test.

Another issue is that the methods for assessing stuttering frequency in each language
differed across each study. Several studies counted the number of stuttered words whereas other
studies counted the percent of syllables stuttered, making it difficult to compare across studies.
Perhaps if a consistent measure of stuttering rate was used, the findings would differ. Another
limitation includes the categorization of L1 and L2 for all of the studies. Languages were
categorized as L1 if they were the native or proficient language and L2 if they were the non-
native, non-dominant, or secondary language. For studies in which a language proficiency or
language dominance test was not given, or that stated that the individual was equally proficient
in L1 and L2 without the administration of a formal or informal language dominance or language
proficiency test, it was assumed that the L1 was the native language. These categorizations are flawed and may have led to inaccurate findings. That is, the native language is not always the dominant language (see Table 6 in the present study). Bilinguals may be more proficient in the non-native language because an individual may have the ability to speak, read, write, and easily understand the language when spoken by others. There was not enough information provided in the articles regarding the languages spoken to categorize the languages appropriately; hence, this language classification was used. It is important to note that an individual may not be proficient in his non-native language, which may influence the frequency of stuttering.

A major limitation of the phonological complexity analyses is the accuracy of the four factor phonological complexity analysis. The four factor analysis is not an accurate measure of overall phonological complexity; rather it reflects small portions of phonological complexity. More research is needed to determine what bilingual factors may contribute to stuttering onset and recovery and how similarities or differences of two languages may impact stuttering. This information will be useful for clinical practice when assessing and treating bilingual individuals who stutter because if certain languages may exacerbate stuttering or increase stuttering susceptibility, they should be learned at a later time. Perhaps a more promising method of identifying if phonological complexity impacts stuttering frequency is to provide individuals with speaking tasks that are more or less phonologically complex or to develop experimental tasks rather than depending on descriptive data.

**The Present Study**

The research project described in the remainder of this thesis was designed to address several of these issues. In particular, syllable structure complexity was chosen to compare
phonological complexity across languages because the results of the phonological complexity analyses revealed no means of directly comparing phonological complexity between rhythmic, stress, and tonal patterns. That is, languages that do not exhibit a specific type of rhythmic, stress, or tonal pattern would require an oral reading passage that is artificially loaded with such patterns. The major issue of artificially creating rhythmic, stress, or tonal patterns is the ability to provide a reliable model for the participant and training the participant to produce the correct model. Participants would need multiple attempts of reading the same passage to produce the correct model. It is likely that persons who stutter may experience adaption effects during oral reading tasks that may alter stuttering behaviors (Hall & Evans, 2004).

Additionally, information about the individuals’ language ability was not provided for all studies in the literature review. Information needed to draw appropriate conclusions about stuttering frequency across two languages are: (a) language sequence—the sequence in which each language is learned, (b) language proficiency—the ability to read, write, speak, and understand a language, and (c) language dominance—a multi-component construction that includes language exposure, frequency of use, level of comfort in language, language loss, etc.

The general purpose of the research project, therefore, was to investigate the relationship between syllable structure complexity and the frequency of stuttering in bilingual and multilingual adults who stutter. The specific aims of this project were to: (1) identify whether language dominance has an effect on the frequency of stuttering and to (2) identify if a relationship exists between syllable structure complexity and stuttering frequency. The research project ultimately serves to provide information about: (a) the etiology of stuttering, (b) suggestions for the language that should be the focus of treatment, and (c) suggestions for
learning the language that results in less stuttering to reduce demands on speaking. The specific hypotheses of the experiment were: (1) more stuttering will occur in the non-dominant language and (2) production of more complex syllable structures would lead to an increase in stuttering frequency in one language. The syllable structure complexity and language serve as the independent variables, and the frequency of stuttering serves as the dependent variable.
CHAPTER 2

METHODS

Participants

Three adults who stuttered and who are also bilingual or multilingual served as participants in this study. Participants were included in this study if they met the following criteria: (a) thirteen years of age or older, (b) self-report of having stuttered since childhood, (c) stuttering rate of more than 3% syllables stuttered (%SS) in at least one 3-minute monologue in English or any other language during the first session as assessed by at least one graduate clinician who has undergone training in the Stuttering Measurement System (SMS), (d) self-report of oral reading ability in English, (e) no hearing impairments, and (f) no history of neurological damage or current diagnosis of any speech and/or language disorder other than stuttering.

Participant YJ

YJ was a 27-year-old multilingual (Shanghainese, Mandarin, and English) female graduate student at the University of Georgia. She was diagnosed with stuttering at the University of Georgia Speech and Hearing Clinic by the researcher and two graduate students of speech-language pathology. She reported that her stuttering had begun at age three. She was currently receiving speech therapy for stuttering at the University of Georgia Speech and Hearing Clinic. She had not received past treatment for her stuttering.
Participant JC

JC was a 25-year-old bilingual (English and German) male graduate student at the University of Georgia. He was diagnosed with stuttering at the University of Georgia Speech and Hearing Clinic by the researcher and two graduate students of speech-language pathology. He was currently receiving treatment for his stuttering at the University of Georgia Speech and Hearing Clinic. He reported that his stuttering had begun in early childhood. He received past treatment for his stuttering which resulted in minimal improvements.

Participant EL

EL was a 62-year-old bilingual (Igbo and English) male and a college graduate. He was diagnosed with stuttering by the researcher and two graduate students of speech-language pathology at the University of Georgia. He reported that his stuttering had begun in early childhood. He received past treatment intermittently for his stuttering which resulted in significant improvements in stuttering. He had not received any treatment for his stuttering within the last six years and reported that this counteracted the progress made from treatment.

Information necessary to meet the inclusion criteria were obtained by Experimenter 1 (a graduate student of speech-language pathology and author of this research project) as described in detail below. Informed consent was obtained from all participants in accordance with the Institutional Review Board of the University of Georgia. A summary of all the participants’ characteristics and language history results can be seen in Table 6.
Table 6: Participants’ characteristics and language history

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age/Sex</th>
<th>Highest education</th>
<th>Languages spoken</th>
<th>Native language</th>
<th>Age English was learned</th>
<th>Age non-English language was learned</th>
<th>Preferred language by self report</th>
<th>Dominant language (from Dunn &amp; Fox Tree’s, 2009 language dominance questionnaire)</th>
<th>Language with greatest stuttering frequency by self report</th>
</tr>
</thead>
<tbody>
<tr>
<td>YJ</td>
<td>27, F</td>
<td>College</td>
<td>English, Mandarin, Shanghainese</td>
<td>Shanghainese</td>
<td>12</td>
<td>Shanghainese-birth</td>
<td>Shanghainese</td>
<td>Shanghainese</td>
<td>English</td>
</tr>
<tr>
<td>JC</td>
<td>25, M</td>
<td>College</td>
<td>English, German</td>
<td>English</td>
<td>*from birth</td>
<td>German-23</td>
<td>English</td>
<td>English</td>
<td>German</td>
</tr>
<tr>
<td>EL</td>
<td>62, M</td>
<td>College</td>
<td>English, Igbo</td>
<td>Igbo</td>
<td>6</td>
<td>Igbo- **from birth</td>
<td>English</td>
<td>English</td>
<td>English</td>
</tr>
</tbody>
</table>

*JC reported age 3; but was only exposed to English only from birth
** EL reported age 2; but was exposed primarily to Igbo from birth
Materials

Instruments for assessment

Prior to experimental session one assessment, a questionnaire was administered by phone (see Appendix D) to establish the participant’s qualification for the experiment. An assessment for bilinguals who stutter should include a language history as well as speech samples in each language that allows judgments about speech rate and moments of stuttering (Roberts & Shenker, 2007). A language history and stuttering questionnaire (see Appendix B) were obtained during the first session to collect information on language use for both languages, age of acquisition for both languages, language comfort for both languages, and possible fluency loss for either language due to environmental alternations. A follow-up discussion was conducted when necessary to obtain further information pertaining to the responses. The language history bilingual questionnaire from Dunn and Fox Tree (2009) was used for establishing language dominance. The combined questions used in Dunn and Fox Tree’s (2009) bilingual dominance scale were divided into single questions. Two additional questions were obtained from the language history questionnaire in Li, Sepanski, and Zhao (2006).

All hearing screenings were conducted in a sound-attenuated booth in the University of Georgia Hearing Clinic with an audiometer that delivers tones at 20 dB hearing levels at 500, 1000, 2000, and 4000 Hz (American National Standards Institute, 1989). Normal hearing levels were defined as a hearing level at 20 dB for all the above frequencies bilaterally.

Instruments for speech sampling

Each experimental session was recorded with use of the Sony Handycam DCR-TRV 280 and the Sony Digital 8 audio-videotape located in a therapy room at the University of Georgia.
Speech and Hearing Clinic. The use of audio-visual recordings is necessary for reliable judgment of stuttering for off-line measurements (Cordes, 1994). Stuttering frequency, speech rate, and naturalness were collected off-line using the SMS program, a tool that allows for accurate measurements of speech rate and stuttering (Ingham, Bakker, Kilgo, & Moglia, 1999). Research suggests that judges will need instruction to rate speech naturalness because it is probable that accented speech may alter speech naturalness ratings (Mackey, Finn & Ingham, 1997).

Instructions from Martin, Haroldson, and Triden (1984) for rating speech naturalness were given to Experimenters 2 and 3 (see Appendix F for descriptions). The SMS program was set to summarize data at 5-second intervals with a pause control time at 1.3 seconds for all spontaneous speech and oral reading tasks. SMS was terminated at the end of each 3 minute run for monologues and was terminate at the completion of the oral reading passage for oral reading tasks. Naturalness ratings were collected after each 30 seconds of speech time for oral reading tasks and 60 seconds for monologues.

The oral reading passages were devised using only words of specified syllable structure complexity levels. Syllable structure complexity was chosen to compare phonological complexity across languages due to the results of the phonological complexity analyses. The type of syllables structures levels that were intended to be read by all speakers were as follows: (1) a passage containing simple syllable structures (CV, VC, or V) in English, (2) a passage containing moderately complex syllable structures (CVC, CVCC, CVCC, CCVC, CCVCC) in English, (3) a passage containing complex syllable structures (CCCV, CCCVC, CCCVCC, CCCVCCC, VCC, or VCCC) in English, (4) a passage containing simple syllable structures (CV, VC or V) in the participant’s non-English language, and (5) a passage containing
moderately complex syllable structures (CVC, CVCC, CVCC, CCVC, CCVCC) in the participant’s non-English language.

Experimenter 1 created stimuli for the English passages, and native speakers were hired to create stimuli for passages in German and Shanghainese. Passages created in German and Shanghainese were unable to include all simple, moderately complex, and complex syllable structures due to language constraints. That is, oral reading passages in German and Shanghainese were only able to contain a simple syllable structure or a moderately complex syllable structure, unlike English where all syllable structures could be created for the oral reading passages. All passages contained similar amounts of simple and compound sentences to minimize syntactic complexity. Written instructions for oral reading passages were provided for each participant at the beginning of each session (see Appendix G). Each reading passage was displayed on a typed sheet of paper in a Times New Roman font size of 18 that was centered vertically across the page.

Experimenters

Experimenter 2 (a graduate student of speech-language pathology) and Experimenter 3 (a graduate student of speech-language pathology) were responsible for counting speech data for the experimental sessions. Both experimenters were required to undergo training in the Stuttering Measurement System (SMS) because research shows that experience and training may impact the reliability and accurate judgments of stuttering (Cordes, Ingham, Frank & Ingham, 1992; Cordes & Ingham, 1999). Experimenters 2 and 3 counted speech data off-line by viewing the audio-visual recordings. Both experimenters were blinded to the hypotheses. Experimenter 1 was responsible for collecting data for first experimental session assessment and experimental
assessment, for directing participants through the tasks, and for all analyses after Experimenters 2 and 3 had generated the data.

**Procedures**

Experimenter 1 determined the experimental criterion requirements based on the information obtained during the first experimental session. The experimental sessions included the completion of the oral reading tasks and spontaneous speech samples for both languages. One 3-minute monologue in each language was collected first followed by the oral reading tasks during each experimental session.

A within subjects group design was used to conduct the experiment. Each participant completed three experimental sessions. The stages of the experiment were created by the manipulation of independent variables reviewed in Chapter 1: syllable structure complexity and language. Stuttering behaviors have been found to change from one day to the next therefore judgments about speech samples should not be based solely on one speech sample (Roberts & Shenker, 2007). Multiple speech samples during spontaneous speech and oral reading were collected in each language to make accurate judgments. All speech samples were collected within the clinic. Each experimental session lasted no longer than two hours.

**Experimental session one**

The informed consent process was completed first, including a follow-up discussion to further explain the purpose of the experiment (see Appendix I for experimental procedures for each session). Participants completed a case history questionnaire that included the language history, stuttering history, and past medical history which was filled out by Experimenter 1 after filling out the informed consent. Experimenter 1 collected and reviewed the questionnaire to
ensure research qualification. A hearing screening was conducted immediately after reviewing the questionnaire or after the participant provided documentation of an audiology evaluation within the past year that revealed normal hearing. The hearing screening was conducted at the University of Georgia Hearing Clinic by Experimenter 1.

Next, a 3-minute monologue in English and a 3-minute monologue in the participant’s non-English language was videotaped and audiotaped. The language order in which the monologues were collected was randomized across participants. The topic of conversation included previous events that occurred in the participant’s life, personal stories, and/or any topic of participant’s choice. The participants were required to discuss similar topics in both languages. Speech performance were derived from on-line speech samples by Experimenter 1 using the SMS program to obtain data on the %SS for the establishment of experimental participation. Potential participants would have been dismissed from the experiment during the first session if a stuttering frequency of 3% SS or greater was not obtained in one language through on-line speech data counts. Experimenter 1 reviewed the questionnaire and completed a follow-up discussion after the participant met the stuttering rate criteria for experimental participation.

Experimental session two

At the beginning of the next session, the experimenter explained the procedures of the experimental tasks and the participants were given written instructions of the tasks as well (see Appendix G for oral reading passage instructions). Three-minute monologues were again recorded in English and in the participant’s non-English language. Participants YJ and JC were presented with three English passages (approximately 100 syllables in length) and one non-
English passage which were referred to as one set. The participants read 2 to 5 sets of passages in English (one of each for the three syllable complexity levels, 2 to 5 times each) and 2 to 5 sets of passages in the non-English language, for a total range of 6 to 15 passage readings in English and a range of 2 to 5 passages in the non-English language per participant. Participant EL was presented with three reading passages and was required to read 2 to 5 sets of passages in English due to his inability to read in a non-English language. The passages were counterbalanced so that participants read passages in either English or in the non-English language first. The order of passage presentation was randomized within languages. That is, the passages occurred in one language in a randomized order of syllable structure complexity followed by the second language in a randomized order of syllable structure complexity. This order of presentation was selected to prevent cognitive overload from switching between languages. The participants were not told of the order in which passage readings would occur. The participants were asked to read each passage silently before reading the passage aloud to become familiar with the passage, because the word combinations used in passages are not typical patterns of everyday reading materials.

Opportunities for a break were provided after completing one set of passage readings. The experimenter instructed the participants when to begin each passage reading. Each participant was required to read each passage with no more than two reading errors. A reading error was defined as any occasion where one word is substituted for the target word or when a consonant is deleted within the target word. For examples, if the participants said “this is” instead of “it is”, this resulted in one reading error or if participants deleted the plural–s in “cars” and produced “car”, this resulted in one reading error. Repetitions and prolongations of syllables
or words were not counted as reading errors. The experimenters monitored the participants’ reading to document reading errors for the passage written in English and informed the client to discontinue reading the passage when three or more reading errors were made. The participants were required to reread the passage at a later time and were provided with as many opportunities as needed to attain two or fewer reading errors. The participants were not instructed to read any of the passages silently a second time when they were required to reread a passage aloud due to three or more errors. The experimenter monitored the participants’ reading errors in English and the participants were instructed to monitor their own reading errors in the non-English language. The participants were required to verify if three or more reading errors occurred after reading the non-English passage.

The participants were required to read a supplemental reading passage such as a book and/or magazine article or take a break when switching from one language to another to reduce cognitive overload. Similar procedures were applicable in the occasion where participants were required to reread one passage consecutively to complete the reading trials with three or fewer errors in one language before proceeding to the reading trials in the second language. The participants were paid ten dollars at the end of the experimental session and signed a receipt of payment form for their participation (see Appendix J for payment procedures).

Each session was recorded and the experimenter obtained off-line speech data which were used for the results of the study. The experimenters were not required to speak or become familiar with the languages spoken because several studies have shown that clinicians can accurately identify moments of stuttering in an unfamiliar language (e.g., Einarsdóttir & Ingham, 2009; Humphrey, 2004;).
Experimental session three

Procedures for the third experimental session remained the same as experimental session two, except the participants were presented with a different set of passages that contained the same syllable structure complexity and syntactic complexity as described above.

Data Analysis

Dependent variables

Stuttering frequency is the primary dependent variable for this study. Stuttering is defined perceptually as occasions in which a trained and experienced listener judges a behavior to be stuttered according to some exceeded threshold between what the listener considers to be normal and stuttered speech (Cordes & Ingham, 1994). These behaviors include, but are not limited to, part or whole word repetitions, prolongations, or revision. Secondary behaviors are also included as stuttered (e.g., audible or inaudible signs of struggle or tension to produce speech). Stuttering frequency is defined as the average %SS per minute of speech time in each spontaneous speech sample or oral reading passage. Speech rate is defined as the mean number of syllables per minute of speech time and speech naturalness is defined perceptually as the combination of such features as the speaker’s prosody, speaking rate, and fluency levels (Perkins, 1973) and is measured on a nine-point rating scale, where a score of one corresponds to highly natural speech and a score of nine corresponds to highly unnatural speech (Martin, Haroldson, & Triden, 1984).

Independent variables

The independent variables of this study are the syllable complexity and language. The syllable complexity is grouped into three levels which are simple, moderately complex, and complex structures (Haspelmath et al., 2005). Simple syllable structures are defined as syllables
containing CV, VC, or V structures; moderately complex structures are defined as syllables containing CVC, CVCC, CVCC, CCVC, CCVCC structures; complex syllable structures are defined as syllables containing CCCV, CCCVC, CCCVCC, CCCVCCC, VCC, or VCCC structures.

Interjudge and intrajudge agreement data for stuttering frequency measurements

Two types of reliability are important for measuring stuttering variables: interjudge and intrajudge reliability. To establish reliability of all speech data, audio-visual recordings of the oral readings tasks were re-analyzed. All recordings were rated by Experimenter 2, and 25% percent of the recordings were rated by Experimenter 3 to establish interjudge reliability (i.e., stuttering frequency, speech rate, and speech naturalness that were originally judged by Experimenter 2 were recounted by Experimenter 3 independently for 25% of the recordings). Percent syllables stuttered values that differed by more than 20% were evaluated by Experimenter 1 and recounted by the judges. Of the twenty-five percent that was interjudged, 5% needed to be recounted a third time until the 20% criteria was met. These counts were usually within a range of 1-2%SS, but required recounting due to the low percent of stuttering that occurred in the samples. The average between the two judges was computed and used for data analyses for those samples that were re-rated. Table 7 displays the interjudged reliability data for speech rate and speech naturalness.

To address intrajudge reliability, 25% of the recordings were randomly selected (Hakim & Ratner, 2004; O’Brian, Packman, Onslow, & O’Brian, 2004) and recounted by the same experimenter using the same SMS procedures. The experimenter analyzed the off-line speech data a second time approximately three weeks apart from the original date of counting.
period between stuttering counts has been suggested to obtain accurate judgments (Guitar, 2005). The experimenter did not have access to the original counts during recounts. The speech data that were used for analyses were the average of Experimenter 2’s ratings. Percent syllables stuttered values that differed by more than 20% were evaluated by Experimenter 1 and recounted by the judge. Of the twenty-five percent that were rejudged by the same rater, 1% required a third recount until the 20% criteria was met. Table 8 displays the intrajudge reliability data for speech rate and speech naturalness.

Table 7: Interjudge agreement results for stuttering variables

<table>
<thead>
<tr>
<th></th>
<th>Speech naturalness within +/- 1</th>
<th>Speech naturalness within +/- 2</th>
<th>Syllables per minute (SPM) within 5%</th>
<th>SPM within 10%</th>
<th>SPM within 20%</th>
<th>SPM within 30%</th>
</tr>
</thead>
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<td>Percentage of data (%)</td>
<td>97%</td>
<td>100%</td>
<td>40%</td>
<td>64%</td>
<td>80%</td>
<td>100%</td>
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Table 8: Intrajudge agreement results for stuttering variables

<table>
<thead>
<tr>
<th></th>
<th>Speech naturalness within +/- 1</th>
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<tbody>
<tr>
<td>Percentage of data (%)</td>
<td>100%</td>
<td>100%</td>
<td>85%</td>
<td>89%</td>
<td>93%</td>
<td>100%</td>
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</table>
**Language dominance**

Current level of bilingualism was rated based on the acquired composite score from the twelve questions of the language history questionnaire (see Appendix B for questionnaire). The questions incorporate the combined input and output of a language such as age of acquisition, use of language, language preference, etc. to establish language dominance. The language with the highest composite score was labeled as more dominant and the language with the lowest composite score was labeled as least dominant (see Appendix C for the scoring rubric of the language dominance questionnaire). In addition, a correlational analysis was conducted between composite scores and stuttering frequency to determine relationships that may exist between language dominance and stuttering frequency.

**Speech data**

**Individual analyses.** Stuttering frequency was graphed for each participant for each of the trials created by the two languages and levels of phonological complexity. These displays were used to inform any further individual or group analyses. The t test was used to assess data for the complexity levels that the language allowed.

**Group analyses.** Data were assessed using the t test as a means to test for the possible relationship between stuttering frequency and language dominance during monologue. The results of all trials for the group data are presented in Figure 15 and Figure 16. Significance tests were conducted with an alpha level of .05.
CHAPTER 3
RESULTS

The hypotheses of the experiment were: (1) that more stuttering would occur in the non-dominant language and (2) that production of more complex syllable structures would lead to an increase in stuttering frequency in one language. Obtained data are presented in the following section for each participant.

Individual Data

Participant YJ

Language dominance. YJ’s language dominance assessment results revealed a composite score of 21 in Shanghainese and a score of 11 in English, indicating Shanghainese as her dominant language and English as her non-dominant language. YJ speaks and reads fluently in English, Shanghainese (her native language), and Mandarin. She began to learn English at age 12, but reported that she does not feel comfortable speaking in English at all times and with multiple speakers. Mandarin was the language spoken in school and Shanghainese is the language spoken at home since the age of 3. YJ reported that she prefers to speak Shanghainese and does not feel that she has lost any fluency in a particular language. She reported a greater amount of stuttering in English.

Speech variables in monologue condition. YJ completed one monologue for each language, in each session. Figure 1 displays the average stuttering frequency and speech naturalness ratings of the monologues in each language for the two sessions combined. As shown, YJ stuttered more in her non-dominant language than in the dominant language during
monologue. Speech naturalness ratings were also higher (worse) in her non-dominant language, which was consistent with the stuttering rate. That is, the more she stuttered, the less natural her speech was rated.

Figure 1: YJ’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness in monologue averaged across both sessions.

Figure 2 presents similar information for each session separately. As shown, stuttering frequency was greater during both sessions in the non-dominant language. Speech naturalness ratings were also consistent between sessions for the dominant language but were inconsistent between sessions for the non-dominant language. During the third session, there was a greater amount of stuttering in the non-dominant language; however speech naturalness ratings were rated lower than the second session where stuttering was less.
Figure 2: YJ’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness in monologue for each session.

Speech variables in oral reading tasks. Figure 3 and Figure 4 show stuttering frequency and speech naturalness during oral reading for both languages and for simple, moderately complex, and complex syllable structures in English (YJ’s non-dominant language). Because Shanghainese does not allow passages to be composed solely of moderately complex and complex syllable structures, comparisons between languages could only be examined for the simple syllable structure.

Fidelity and reliability of oral reading passages. YJ attained two or fewer reading errors during all oral reading trial in both English and Shanghainese and was not required to reread any passages.
Figure 3: YJ’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness for three levels of syllable structure (simple, moderately complex, complex) in reading averaged across both sessions.

As shown, YJ’s stuttering frequency was very low for passages with simple syllable structure in both languages. Speech naturalness ratings were also similar in both languages with a rating of 1.07 in the non-dominant language and a rating of 1.05 in the dominant language.

Figure 3 shows a positive relationship between stuttering frequency and syllable structure complexity in the non-dominant language with a %SS of 0, 0.19, and 0.69 respectively, suggesting that YJ stuttered more when the syllable structure was more complex. As shown in Figure 4, however, this finding was not consistent across sessions.
Figure 4: YJ’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness for three levels of syllable structure (simple, moderately complex, complex) in reading for each session.

Figure 4 shows a positive relationship between stuttering frequency and syllable structure complexity during session two, but there were no eventually no differences between syllable structure levels in session three. Figure 4 also shows that there was not a considerable difference in stuttering frequency between the second and third sessions. This provides further indication that stuttering appears to be consistent when reading a simple syllable structure passage in the non-dominant or dominant language and when repeating the task on a different day.

Individual statistical analyses were not performed to determine statistically significant differences between stuttering frequency and language dominance because of the low stuttering frequency levels. However, stuttering frequency was not descriptively significant between languages in the simple syllable structure, showing a stuttering frequency of 0 %SS with all 7
trials in the non-dominant language, and a stuttering frequency of 0 %SS in 9 of 10 trials in the dominant language (see Appendix K).

YJ’s summary data for comparisons between monologue and oral reading. YJ’s overall findings indicate that more stuttering occurs in the non-dominant language during monologue as hypothesized. Monologue findings are also consistent with YJ’s self-report in Table 6 which indicate that she stutters more in English (the non-dominant language). On the contrary, oral reading findings reveal that YJ stutters equally in both languages. These results suggest that language dominance may not impact stuttering when reading for this speaker. Oral reading results also indicate that more complex syllable structures may lead to a slight increase in stuttering.

Participant JC

Language dominance. Language dominance assessment results revealed a composite score of 26 in English and a score of 1 in German; indicating English as JC’s dominant language and German as his non-dominant language. JC speaks and reads fluently in English and German. He reported that his proficiency in German is better in writing and reading than speaking. He began to learn English (his native language) at age 3 and German at age 23. English is JC’s language preference and is the primary language spoken in school and at home. JC reported that he does not feel that he has lost any fluency in a particular language, and reported a greater amount of stuttering in German.

Speech variables in monologue condition. JC completed one monologue for each language, in each session. Figure 5 displays JC’s average stuttering frequency and speech naturalness from the monologues in each language for the two sessions combined. His stuttering
was severe in both languages, but he stuttered almost twice as much in his non-dominant language as in his dominant language (16.8 %SS vs. 9.4 %SS). Speech naturalness ratings for both languages were consistently at 9; reflecting facial grimaces, fixed open-jaw position while attempting to speak, and other secondary characteristics.

Figure 5: JC’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness in monologue averaged across both sessions.

Figure 6 compares JC’s monologue stuttering rate between the two sessions while Figure 7 displays his speech naturalness rates for both sessions.
Figure 6: JC’s stuttering frequency (in percent syllables stuttered, %SS) in monologue for each session.

As shown, JC’s stuttering frequency was lower in the non-dominant language during the third session than during the second, but the overall pattern is of more stuttering in the non-dominant language. Speech naturalness ratings of 9 were consistent across sessions for both languages.
Figure 7: JC’s speech naturalness in monologue for each session.

Speech variables in oral reading tasks. Figure 8 displays stuttering frequency and speech naturalness during oral reading for each language and all sessions. German only allowed for passages to be composed solely of moderately complex syllable structures, therefore Figure 8 reflects comparisons to be made across languages in the moderately complex syllable structures. Comparison across syllable structure complexity could only be examined for the three syllables structure levels in English.
Figure 8: JC’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness for three levels of syllable structure (simple, moderately complex, complex) in reading averaged across both sessions.

For the moderately complex syllable structure, JC stuttered more during reading in the non-dominant language. Figure 8 shows no relationship between stuttering frequency and syllable structure complexity in the dominant language, because stuttering was very low in this task. Speech naturalness ratings were lower than 2 across all syllable structures.

Figure 9 displays the stuttering frequency and naturalness rating during oral reading across sessions and syllable structure complexity. Language dominance impacts stuttering frequency when reading a passage composed of moderately complex syllable structures. Speech naturalness ratings were related to the amount of stuttering in both sessions and in both
languages with a range of 8 to 9 for the non-dominant language and a range of 1 to 2.5 in the dominant language.

Figure 9: JC’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness for three levels of syllable structure (simple, moderately complex, complex) in reading for each session.

Due to the discrepancy in stuttering frequency between the two languages, Figure 9 does not allow for accurate visual judgments for the stuttering rate and syllable structure complexity rating in the dominant language. Figure 10 was composed to further analyze the stuttering rate across the syllable structure levels in the dominant language.
Figure 10: JC’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness in the dominant language for three levels of syllable structure (simple, moderately complex, complex) in reading for each session.

As shown, there is a minor but positive relationship between stuttering frequency and syllable structure complexity during the second session. The dominant language stuttering rate for the second session was 0.31, 0.54, and 1.39 %SS respectively. On the contrary, session three results do not show a positive relationship between stuttering rate and syllable structure complexity. The overall stuttering rate between the two sessions were all within 2%SS or below across the syllable structure levels. Naturalness ratings were consistent with the stuttering rate throughout all sessions.

A two-tailed t test was conducted to determine if the stuttering frequency differences seen in the moderately complex structure were statistically significant across languages. The results showed a statistically significant difference between stuttering frequency and language
dominance, \( t = -10.222, \ p < .05 \). The mean for the non-dominant language was 15.63 \%SS with a standard deviation (SD) of 4.53 and 0.59\%SS in the dominant language with a SD of 0.38.

Fidelity and reliability of oral reading passages. JC attained two reading errors or fewer during all oral reading trial in both English and German and was not required to reread any passages.

JC’s summary data for comparisons between monologue and oral reading. JC’s overall findings indicate that more stuttering occurred in the non-dominant language during monologue as hypothesized. Monologue findings are also consistent with JC’s self-report in Table 6 which demonstrate that he stutters more in the non-dominant language (German). Oral reading findings also reveal that JC stutters significantly more in the non-dominant language. These results reveal that language dominance does impact stuttering during oral reading as hypothesized. Oral reading results also indicate that syllable structure complexity does not impact stuttering. That is, more complex syllable structures do not always result in more stuttering.

Interestingly, the difference between JC’s English and German composite language dominance scores was large. His composite score of 26 in English and composite score of 1 in German shows that JC is much more proficient in English than in German. The only question that resulted in a score of 1 for German is the minimal amount of schooling he received in German (questions 10 in Appendix G). The substantial difference in stuttering frequency between the two languages may reflect the level of language dominance. That is, JC may stutter more in German because he is much less proficient in German than English.
Participant EL

Language dominance. Language dominance assessment results revealed a composite score of 23 in English and a score of 14 in Igbo, indicating English as EL’s dominant language and Igbo as his non-dominant language. EL speaks and reads fluently in English and speaks fluently in Igbo (his native language), but he is unable to read in Igbo. He reported that he felt comfortable speaking Igbo with Igbo speaking persons rather than English. He began to learn English at age 6 and Igbo at age 2. English is EL’s language preference with non-Igbo speakers and is the primary language spoken at work. He uses both English and Igbo to speak at home. EL reported that he does not feel that he has lost any fluency in a particular language, and reported a greater amount of stuttering in English.

Speech variables in monologue condition. EL completed one monologue for each language, in each session. Figure 11 displays EL’s average stuttering rate and speech naturalness ratings of the monologues in each language for the two sessions combined.
Figure 11: EL’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness in monologue averaged across both sessions.

EL stutters more in the dominant language. Speech naturalness ratings also corresponded to the stuttering rate. Figure 12 compares the stuttering frequency and speech natural rates for both sessions.
Figure 12: EL’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness in monologue for each session.

As shown, EL stuttered more in the dominant language than in the non-dominant language in both sessions. Speech naturalness ratings for both languages ranged from 7 to 7.15 during the second session and 2.7 to 5 during the third session, which were associated with the stuttering frequency (the greater the %SS, the less natural the speech was rated).

Speech variables in oral reading tasks. Figure 13 displays stuttering frequency and speech naturalness ratings during oral reading for the dominant language. No oral reading data is present for EL’s non-dominant language because of his inability to read in his non-dominant language. The figure reflects comparisons to be made in English for simple, moderately complex, and complex syllable structures during both sessions.
Figure 13: EL’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness for three levels of syllable structure (simple, moderately complex, complex) in reading averaged across both sessions.

EL stuttered with a similar stuttering frequency across syllable structure levels; indicating that syllable structure complexity does not impact stuttering. Speech naturalness ratings were consistent with stuttering frequency. Figure 14 divides stuttering frequency and speech naturalness ratings during oral reading into individual sessions and syllable structure complexity.
As shown, there is small positive correlation between stuttering frequency and syllable structure complexity during the second session; however the results for the third session reveal a constant pattern of stuttering frequency across the syllable structure levels. It can be presumed that syllable structure complexity does not impact stuttering rate when reading passages composed of simple, moderately complex, and complex syllable structures. Speech naturalness ratings were also consistent with stuttering rate in all sessions with a range of 1.05 to 2.65.

Fidelity and reliability of oral reading passages. EL attained two reading errors or fewer during all oral reading trials in English and was not required to reread any passages.

EL’s Summary Data for Comparisons between Monologue and Oral Reading. EL’s overall findings indicate that stuttering occurs more in the dominant language during monologue.
Monologue findings are also consistent with EL’s self-report in Table 6, indicating that he stutters more in the dominant language (English). Oral reading findings reveal that syllable structure complexity does not impact stuttering in English.

**Summary of Individual Data**

Data for the three participants are inconsistent. Two of the three participants produced more stuttering in the non-dominant language than in the dominant language, during both monologue and oral reading. Speech naturalness ratings were generally correlated with stuttering rate for all participants with the exception of JC where his secondary behaviors were so severe and resulted in high speech naturalness ratings throughout. Both monologue findings and self-report of stuttering are consistent across all subjects. That is, subjects were able to accurately identify the language which resulted in more stuttering. When comparing the current results to Table 6, all subjects stuttered more in the non-native language. The results of YJ’s oral reading trials was the only evidence showing that more complex syllable structures led to an increase in stuttering.

**Group Data**

Group statistical analyses were performed where direct comparisons were possible for the monologue condition. The data were not sufficient to perform group statistical tests across the complexity levels in each language because (a) the non-English languages did not allow for all syllable structure levels to be composed for the oral reading passages, and (b) JC’s stuttering was too severe to draw conclusions about the relationship between stuttering frequency and syllable structure complexity in English. Figure 15 displays stuttering frequency and speech naturalness
ratings for all participants in both sessions while Figure 16 displays stuttering frequency and speech naturalness ratings for all participants in each session.

Figure 15: YJ’s, JC’s, and EL’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness in monologue averaged across both sessions.
Figure 16: YJ’s, JC’s, and EL’s stuttering frequency (in percent syllables stuttered, %SS) and speech naturalness in monologue for each session.

As shown, there was a greater amount of stuttering in the non-dominant language. A two-tailed t test was conducted to determine if these differences were statistically significant. The results showed no statistically significant difference between stuttering frequency and language dominance in monologue, \( t = -1.136, p = .307 \). The group mean for the non-dominant language was approximately 9%SS with a SD of 7.67 and approximately 6%SS in the dominant language with a SD of 5.07. Speech naturalness ratings were consistent with stuttering frequency.
CHAPTER 4
DISCUSSION

The general purpose of the research project reported in this thesis was to investigate the relationship between syllable structure complexity and the frequency of stuttering in bilingual and multilingual adults who stutter. The specific aims of the project were (1) to determine whether language dominance had an effect on the frequency of stuttering, and (2) to determine whether a relationship existed between syllable structure complexity and stuttering frequency. The research project was conducted to ultimately provide information about (a) the etiology of stuttering, (b) suggestions for the language that should be the focus of treatment, and (c) suggestions for learning the language that results in less stuttering to reduce demands on speaking. The specific hypotheses of the experiment were (1) more stuttering would occur in the non-dominant language, and (2) production of more complex syllable structures would lead to an increase in stuttering frequency in one language.

Summary of Results

Findings from the individual data reveal more stuttering in the non-dominant language for two subjects and more stuttering in the dominant language for one subject. The findings from the group data in this research project show an equal amount of stuttering in both the non-dominant and dominant language. This result is consistent with past research conducted by Lim et al. (2008), Nwokah (1988), Roberts (2002). Participants were also able to accurately identify the language which resulted in the most stuttering. This corroborates the findings by Jankelowitz and Bortz (1996), stating that participants are aware of stuttering behaviors within each
language. The results of this research project do not support the fact that a relationship exists between language dominance and stuttering frequency. However, the difference between JC’s English and German composite language dominance score was substantial; indicating that JC is much more proficient in English than in German (unlike the other two participants that had a more distributed composite score between the two languages). JC was also the only participant who did not use his non-dominant language (German) on a regular basis. That is, he did not use German to speak while at school or at work as the other participants. These results may suggest that major differences in language dominance may impact stuttering frequency whereas minor differences in language dominance or individuals who are balanced bilinguals are more likely to have an equal amount of stuttering in both languages. All research studies that have included balanced bilinguals in their studies have confirmed this notion that balanced bilinguals stutter at the same frequency in both languages (e.g., Lim et al., 2008; Roberts, 2002).

The increase in stuttering found in the non-dominant language for participant JC during monologue and reading may be due to excessive demands on the speech function required to translate and/or find the appropriate word combinations in the non-dominant language. The participants were required to speak and read in two languages in the same session, requiring language switching. Because participant JC does not speak in his non-dominant language as regularly as the other participants, switching may have resulted in a cognitive overload. In fact, language switching has been found to have significant effects on processing speed (Hernandez, Dapretto, Mazziotta, & Bookheimer, 2001; Krauthammer & Bolgar, 1968; MacNamara & Kushnir, 1971; Soares & Grosjean, 1984). Switching between languages involves increased general executive processing and may account for the stuttering differences between the two
languages. Furthermore, these results may be explained by Meuter and Allport’s (1999) study that found that naming in the non-dominant language requires active inhibition or suppression of the stronger competitor language and that language-switching cost is consistently larger when switching to the dominant from the non-dominant.

The phonological analysis conducted to identify potential relationships between syllable structure complexity and stuttering frequency showed that phonological complexity did not predictably impact stuttering in this study. There was some suggestion in these data of an inconsistent increase in stuttering with production of more complex syllable structure, although this difference was not substantial enough to draw any conclusions about the contribution of phonological complexity on stuttering. Linguistic or phonological complexity of a language system has been hypothesized to influence stuttering frequency (Logan & Conture, 1995; Melnick & Conture, 2000). The discrepancy in stuttering between two languages for participant JC cannot be explained merely by syllable structure complexity. Similarly, Jankelowitz and Bortz (1996) stated that if bilinguals do not possess competent linguistic skills, it would lead to disfluency rather than stuttering. The results of this study, therefore, do provide further support for the possibility that linguistic competency or sequence of language learning (rather than current language dominance) does affect stuttering rate. All three participants stuttered more in the language that was learned at a later age. According to Kim et al. (1997), the brain organization differs when two languages are learned at birth than when learned at a later age. Perhaps the discrepancies in the literature review are related to the age of language acquisition or exposure rather than to phonological complexity or language dominance alone.
The stuttering rate was usually higher in the non-dominant language during both sessions, although the stuttering rate was not constant from each session. This provides evidence that stuttering has the tendency to fluctuate from each day or task and that multiple speech samples are needed to explain the complexity of the disorder (Yaruss, 1998). Some may postulate that factors such as SPM could have impacted the findings because the oral reading passages were not typical of everyday reading materials and may have required the participants to reduce their rate of speech to read the passage accurately. The syllable rate produced during all syllable structure levels appeared to be constant in this study, however, and was not directly related to the stuttering frequency in this particular study. Speech naturalness ratings were positively correlated with stuttering frequency, with the exception of subject JC, who displayed significant secondary features associated with stuttering that resulted in consistently high speech naturalness ratings.

Finally, the results from this study were also evaluated using the four factor phonological analyses developed for the review of previous publications that was presented in Chapter One. Scales for each factor were forced to 0-100 by setting the largest obtained value equal to 100 and then calculating the percentage for all others (see Table 9 for further details). As shown in Table 9, English was the most complex, resulting in a composite score of 288.89. In the current research project, one of three participants stuttered less in English, providing further evidence that more complex phonological systems do not result in more stuttering.
Table 9: Calculated phonological complexity estimates with use of four factors (see text) for English, Igbo, and Shanghainese

<table>
<thead>
<tr>
<th>Language</th>
<th>Consonant Phonemes</th>
<th>Consonant Phonemes Adjusted (out of 100)</th>
<th>Syllable Structures</th>
<th>Syllable Structures Adjusted (out of 100)</th>
<th>Maximum Consecutive Phonemes (per syllable)</th>
<th>Maximum Consecutive Phonemes Adjusted (out of 100)</th>
<th>Tonal Patterns</th>
<th>Tonal Patterns Adjusted (out of 100)</th>
<th>Total (out of 400)</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>24</td>
<td>88.89</td>
<td>16</td>
<td>100</td>
<td>3</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>288.89</td>
</tr>
<tr>
<td>Igbo</td>
<td>27</td>
<td>100</td>
<td>2</td>
<td>12.50</td>
<td>1</td>
<td>33.33</td>
<td>3</td>
<td>60</td>
<td>205.83</td>
</tr>
<tr>
<td>Shanghainese</td>
<td>24</td>
<td>88.89</td>
<td>5</td>
<td>31.25</td>
<td>2</td>
<td>66.67</td>
<td>5</td>
<td>100</td>
<td>286.81</td>
</tr>
</tbody>
</table>

Individual data obtain from: Clark, (1990); Frawley (2003)
Methodological Limitations

The stuttering frequency differences cannot be explained on the basis of phonological complexity because of other methodological issues that may have influenced the findings. A major limitation of this research project is the small number of subjects that participated in the study and the languages spoken by the participants. Data could be interpreted on an individual level, although group data were difficult to draw conclusions from because of the lack of reading stimuli available across all languages. The use of a research design with multiple subjects may be used to maximize external validity or the generalization of these findings to other bilinguals and multilinguals who stutter. This will rule out the factor of chance and ensure that the syllable structure complexity produced a change in stuttering rate.

The participants were required to monitor reading errors in the non-English language and provided the experimenters with the total amount of errors made after reading the non-English oral reading passage. Although all participants reported the total amount of reading errors after reading each passage, it is likely that reading errors may have been undetected unconsciously. The experimenters were also required to monitor reading errors in the non-English language to confirm the total amount of reading errors reported, though it was a challenging task particularly when the experimenters were not familiar with the language spoken. An area for improvement will be to include a native speaker of the language spoken to monitor reading errors or perhaps a family member who is familiar with the language spoken.

Factors such as the stimuli created for the oral reading task may have contributed to the findings. The oral reading passages were approximately 100 syllables in length, and perhaps this short length may have resulted in reduced stuttering. Thus, an area for improvement for this
study may be the use of an oral reading passage consisting of 200-300 syllables in length.

Another factor related to the stimulus created is whether the nature of the task influenced the stuttering rate exhibited. This research project consisted solely of syllable structure complexity to explain the complexity of a language. Perhaps when examining phonological complexity, the combination of syllable structure, rhythmic patterns, and stress patterns should be assessed to explain stuttering behaviors based on past findings that demonstrate a relationship between rhythmic patterns, stress patterns, and stuttering rates.

Issues about language dominance criteria might be raised with respect to the outcomes used for this project. Dunn and Fox Tree’s (2009) language dominance scale is a fairly new tool to assess language dominance and therefore its validity could be questioned.

**Clinical Implications**

The study failed to provide evidence for the language that should be the focus of treatment. Conversely, the findings are clinically important and suggest that Speech-Language Pathologists (SLPs) should assess the language dominance and evaluate stuttering in both languages in bilinguals and multilinguals who stutter, because stuttering frequency may differ between two languages. Thus, it is the SLP’s professional responsibility to determine (a) the language in which the individual is required to speak more often and (b) if the individual wishes to use the language which results in less stuttering.

On the other hand, self-report findings indicated that the language in which an individual prefers to use is not always the language that results in less stuttering (see Table 6). A follow-up discussion was performed to determine why participant EL preferred to use the language that resulted in more stuttering. He stated this for two reasons: because he is here in a foreign land
and the medium of communication is mainly English, and the nature of his job requires continuous use of English. He stated that he would prefer to use Igbo if he were living in an Igbo-speaking country. This may suggest that learning the language that results in less stuttering does not always reduce demands on speaking.

**Suggestions for Future Research**

The cause of stuttering is not known, but it is possible that the increase in stuttering in the non-dominant language found in this study demonstrates a relationship between language input. JC’s stuttering results differ from the other participants possibly because of the large discrepancy between his English and German language dominance composite score. If the stuttering difference is due to his level of dominance, an area of research would be to determine the extent of language dominance an individual must exhibit between two languages to produce significant differences in stuttering.

In this research project, the combined phonological complexity constraints that these tasks imposed on the subject were not studied. It would be important for future research to investigate which element of language contributes most to stuttering frequency. For example, a research design may include a more natural, general reading passage in two languages that are similar in length, syntactic complexity, and semantic complexity rather than phonological complexity alone. The passages may then be further analyzed by identifying which words and/or word combinations resulted in a greater amount of stuttering. This analysis would allow for determining if stuttering occurs more on phonologically complex words, words containing a specific stress patterns, etc. Additionally, research to examine why stuttering occurs more when two languages are acquired between birth and age six than when the second language is acquired...
after age seven is warranted to determine whether stuttering frequency is related to age of language acquisition or language exposure (Au-Yeung et al., 2000).

Another area of research is the use of brain imaging techniques to study the involvement of the brain while speaking two languages. The participants were asked to state what factors they felt contributed to stuttering rate while speaking two languages during a follow-up interview after experimental participation. Two participants stated that translating words or word combinations and substituting words from the non-native language into the native language was a challenging task that required more cognitive processing. That is, in an attempt to find a word or words in the native language, it resulted in a longer time to process their speech. Perhaps the cognitive process required to internalize what one should say in the native language may cause delay and perhaps more stuttering. To date, several studies (e.g., Wu et al., 1995; De Nil, Kroll, Kapur, & Houle, 2000; Salmelin, Schnitzler, Schmitz & Freund, 2000) have examined the effects of the brain during oral reading tasks and have shown differences in brain activation when compared to controls. Differences is functional brain involvement while performing different speaking tasks in several languages in bilinguals or multilinguals who stutter is an area of further investigation.
REFERENCES


APPENDIX A

INFORMED CONSENTS

Adult Informed Consent

I, __________________________, agree to take part in a research study titled “The Impact of Syllable Structure Complexity on Stuttering Frequency For Bilinguals and Multilinguals Who Stutter”, which is being conducted by Chisa Ononiwu, a master’s student in the Department of Communication Science and Special Education at the University of Georgia (706-542-7389), under the supervision of Dr. Bothe in the Department of Communication Sciences and Special Education at the University of Georgia (706-542-0436). My participation is voluntary; I can refuse to participate or stop taking part at any time without giving any reason, and without penalty or loss of benefits to which I am otherwise entitled. I can ask to have information related to me returned to me, removed from the research records, or destroyed.

The purpose of this study is to investigate the relationship between syllable structure complexity and stuttering. The researcher hopes to learn something that may help bilinguals and multilinguals stutter less. Benefits associated with my participation include increasing the understanding of stuttering and a referral to treatment if I ask for that information. The entire experiment will be conducted over a course of three separate days in which I will be compensated $10 at the completion of each experimental session. I will be permitted two months to complete all three sessions. If I decide to withdraw from the study, I will be paid $10 for each experimental session I’ve attended. There are circumstances where I may not be required to participate further. These circumstances are: (a) an inadequate proficiency level in English and in
another language as judge by the researcher, (b) not meeting the stuttering frequency criteria to participate in the study and (c) an inability to read in English. If I do not meet the above requirements to participate in the research study, I will be paid $10 for my attendance.

The experiment will be held at the University of Georgia Speech and Hearing Clinic on the fifth floor of Aderhold Hall. I will be asked to participate in three sessions (one session per day). Each session will last no more than two hours. If I volunteer to take part in this study, I will be asked to do the following things: fill out some questionnaires related to my language and history of stuttering, speak for several minutes about a topic of my choice in two languages during each session, and read several passages in two languages.

While speaking, I will be videotaped and audiotaped. My speech sample will be recorded in a clinical setting and analyzed at a later time for research purposes. I will either allow all data and videotapes to be kept for one year so the researcher can watch and do analyses or I will give permission to the researcher to keep all data and videotapes for five years after completing the study for future research related to this project.

- I want all data and videotapes to be destroyed after one year _____________(initials).
- I give permission to the researcher to keep all data and videotapes for five years after completing the study for future research related to this project. __________ (initials).

No discomforts or stresses are expected during this experiment are expected. A risk that may arise is the access to my personal information such as name, age, phone number, address, etc. The experimenter will create an alphanumeric participation code to sustain my confidentiality. All personal information, data, and videotapes will be stored in a secured location. The only people who will know that I am a research subject are members of the
research team. No individually-identifiable information about me, or provided by me during the research will be shared with others without my permission, except if necessary to protect my rights or welfare (for example, if I were injured and needs physical care) or if required by law.

In order to process the payment for my participation, the researcher needs to collect my name and signature on a separate payment form. This completed form will be kept at the Institute of Behavioral Research accountant office at the University of Georgia. The researcher connected with this study will protect my private information and will keep this confidential by storing in a secured location. However, the researcher is not responsible once my name and signature leave the office for processing of my payment.

The researcher will answer any further questions about the research, now or during the course of the project, and can be reached by telephone at (706) 542-7389. I may also contact Dr. Bothe, Department of Communication Sciences and Disorders, at (706) 542-0436. I understand the procedures described above. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

_________________________     _______________________  ______
Name of Researcher    Signature    Date

Telephone: _________________

Email: _________________

_________________________     _______________________  ______
Name of Participant    Signature    Date

Please sign both copies, keep one and return one to the researcher. Additional questions or problems regarding your rights as a research participant should be addressed to The Chairperson,
Institutional Review Board, University of Georgia, 612 Boyd Graduate Studies Research Center, Athens, Georgia 30602-7411; Telephone (706) 542-3199; E-Mail Address IRB@uga.edu

Parental Permission Form

I, _________________________, agree to allow my child to take part in a research study titled “The Impact of Syllable Structure Complexity on Stuttering Frequency for Bilinguals and Multilinguals Who Stutter”, which is being conducted by Chisa Ononiwu, a master’s student in the Department of Communication Science and Special Education at the University of Georgia (706-542-7389), under the supervision of Dr. Bothe in the Department of Communication Sciences and Special Education at the University of Georgia (706-542-0436). I do not have to allow my child to take part in this research study if I do not want to. My child’s participation is voluntary; my child can refuse to participate or stop taking part at any time without giving any reason, and without penalty or loss of benefits to which he/she otherwise entitled.

I can ask to have information related to my child returned to me, removed from the research records, or destroyed. The only people who will know that my child is a research subject are members of the research team. No individually-identifiable information about my child, or provided by my child during the research will be shared with others without my permission, except if necessary to protect my child’s rights or welfare (for example, if my child were injured and needs physical care) or if required by law. No discomforts or stresses are expected during this experiment. If my child takes part in this study, he/she will be asked to do the following things: participate in three sessions (one session per day) lasting no longer than two hours per session, fill out some questionnaires related to his/her language and history of
stuttering, speak for several minutes about a topic of his/her choice in two languages during each session while being videotaped, and read several passages in two languages.

The purpose of this study is to investigate the relationship between syllable structure complexity and stuttering. The researcher hopes to learn something that may help bilinguals and multilinguals stutter less. Benefits associated with my child’s participation will include increasing the understanding of stuttering and referral to treatment if I or my child asks for that information. The entire experiment will be conducted over a course of three separate days in which my child will be compensated $10 at the completion of each experimental session. My child will be permitted two months to complete all three sessions. If I decide to withdraw my child from the study, my child will be paid $10 for each experimental session he/she attended. There are circumstances where my child not be required to participate further. These circumstances are: (a) an inadequate proficiency level in English and in another language as judge by the researcher, (b) not meeting the stuttering frequency criteria to participate in the study and (c) an inability to read in English. If my child does not meet the above requirements to participate in the research study during the first session, my child will be paid $10 for his/her attendance.

The experiment will be held at the University of Georgia Speech and Hearing Clinic on the fifth floor of Aderhold Hall. While speaking, my child will be videotaped and audiotaped. My child’s speech sample will be recorded in a clinical setting and analyzed at a later time for research purposes. A risk that may arise is the access to my child’s personal information such as name, age, phone number, address, etc. The experimenter will create an alphanumeric participation code to sustain my child’s confidentiality. All personal information, data, and
videotapes will be stored in a secured location. I will either allow my child’s data and videotapes to be kept for one year so the researcher can watch and do analyses or I will give permission to the researcher to keep my child’s data and videotapes for future research for five years after completing the study for future research related to this project.

- I want my child’s data and videotapes to be destroyed after one year

_____________________(initials).

- I give permission to the researcher to keep my child’s data and videotapes for five years after completing the study for future research related to this project _________ (initials).

In order to process the payment for my child’s participation, the researcher needs to collect my child’s name and signature on a separate payment form. This completed form will be kept at the Institute of Behavioral Research accountant office at the University of Georgia. The researcher connected with this study will protect my child’s private information and will keep this confidential by storing in a secured location. However, the researcher is not responsible once my child’s name and signature leave the office for processing of my child’s payment.

The researcher will answer any further questions about the research, now or during the course of the project, and can be reached by telephone at (706) 542-7389. I may also contact Dr. Bothe, Department of Communication Sciences and Disorders, at (706) 542-0436. I understand the procedures described above. My questions have been answered to my satisfaction, and I agree to allow my child to participate in this study. I have been given a copy of this form.

_________________________     _______________________  __________
Name of Researcher    Signature    Date
Telephone: ________________
Email: ____________________

_________________________     _______________________  __________
Name of Parent or Guardian   Signature    Date

Please sign both copies, keep one and return one to the researcher. Additional questions or problems regarding your child’s rights as a research participant should be addressed to The Chairperson, Institutional Review Board, University of Georgia, 612 Boyd Graduate Studies Research Center, Athens, Georgia 30602-7411; Telephone (706) 542-3199; E- Address IRB@uga.edu

Minor Assent Form

Dear Participant,

You are invited to participate in my research project titled, “The Impact of Syllable Structure Complexity on Stuttering Frequency for Bilinguals and Multilinguals Who Stutter”. Through this project I am learning about stuttering behaviors in people who speak two languages. I hope to learn something that may help bilinguals and multilinguals stutter less.

If you decide to be part of this, you will allow me to collect some information about your language and stuttering. You will also allow me to collect speech samples in each language that will be videotaped and audiotaped. These tapes will be stored in a secured location and may be used for future research purposes. You will speak for several minutes about any topic of your choice and read several passages in two languages. You will allow me to record your speech sample in the clinical setting and analyze it at a later time for research purposes. I will not use your name on any papers that I write about this project.
The entire experiment will be conducted over a course of three separate days in which you receive $10 at the completion of each experimental session. You will be permitted two months to complete all three sessions. Each session will last no more than two hours. You will be paid $30 at the completion of the experiment. If you decide to withdraw from the study, you will be paid $10 for each experimental session that you’ve attended.

If you want to stop participating in this project, you are free to do so at any time. You can also choose not to answer questions that you don't want to answer. If you have any questions or concerns you can always ask me or call my teacher, Dr. Bothe at the following number: 706-542-0436.

Sincerely,
Chisa Ononiwu
Department and Communication Sciences and Special Education
(706) 542-7389
I understand the project described above. My questions have been answered and I agree to participate in this project. I have received a copy of this form.

____________________________
Signature of the Participant/Date

Please sign both copies, keep one and return one to the researcher. Additional questions or problems regarding your rights as a research participant should be addressed to The Chairperson, Institutional Review Board, University of Georgia, 612 Boyd Graduate Studies Research Center, Athens, Georgia 30602-7411; Telephone (706) 542-3199; E-Mail Address IRB@uga.edu
APPENDIX B

LANGUAGE HISTORY AND STUTTERING QUESTIONNAIRE

Participant Number ___ ___ ___ ___

Age __________________________

Today’s Date _________________

Language History

Please answer the following questions to the best of your knowledge.

1.) At what age did you first learn English ________ ?

2.) At which age did you first learn [non-English language] ________?

3.) At what age did you feel comfortable speaking in English? (If you still do not feel comfortable, please write “not yet.”)__________

4.) At what age did you feel comfortable speaking in [non-English language]? (If you still do not feel comfortable, please write “not yet.”)__________

5.) Which language do you predominately use at home?

   English ________ [non-English Language] ________ Both ________

6.) When doing math in your head (such as multiplying 243 × 5), which language do you calculate the numbers in? ________________

7.) If you have a foreign accent, which language(s) is it in? ________________

8.) If you had to choose which language to use for the rest of your life, which language would it be? ________________
9.) How many years of schooling (primary school through university) did you have in English? 
_______

10.) How many years of schooling (primary school through university) did you have in [non-
    English language]? __________

11.) Do you feel that you have lost any fluency in a particular language? __________
    If yes, which one? _______ At what age? _______

12.) What country/region do you currently live in? ______________

13.) If there is anything else that you feel is interesting or important about your language
    background or language use, please comment below:

14.) Do you have additional questions that you feel are not included above? If yes, please write
    down your questions and answers on separate sheets.

Stuttering

1.) Do you stutter in English? _____ Yes _____ No

2.) Do you stutter in [non-English Language]? _____ Yes _____ No

3.) Do you feel like you stutter more in one language than the other? _____ Yes _____ No
    If so which language do you feel like you stutter more in?
    Language _________________________________
APPENDIX C

SCORING RUBRIC FOR LANGUAGE DOMINANCE

Questions 1 and 2 Scoring: 0–5 yrs = +5, 6–9 yrs = +3, 10–15 yrs = +1, 16 and up = +0
Total: English _______ Second Language _______

Questions 3 and 4 Scoring: 0–5 yrs = +5, 6–9 yrs = +3, 10–15 yrs = +1, 16 and up = +0, “not yet” = +0
Total: English _______ Second Language _______

Question 5 Scoring: if one language used at home, +5 for that language; if both used at home, +3 for each language
Total: English _______ Second Language _______

Question 6 Scoring: +3 for language used for math; +0 if both
Total: English _______ Second Language _______

Question 7 Scoring: if one language is listed, add +5 to the opposite language of the one listed; if both languages are listed, add +3 to both languages; if no language is listed, add nothing
Total: English _______ Second Language _______

Question 8 Scoring: +2 for language chosen for retention
Total: English _______ Second Language _______

Questions 9 and 10 Scoring: 1–6 yrs = +1, 7 and more yrs = +2
Total: English _______ Second Language _______
Question 11 Scoring: −3 in language with fluency loss; −0 if neither has lost fluency

Total: English _______  Second Language _______

Question 12 Scoring: +4 for predominant language of country/region of residence

Total: English _______  Second Language _______

Composite score

English ____________  Second Language ___________

Dominant Language ________________
APPENDIX D

TELEPHONE HISTORY SCRIPT AND QUESTIONNAIRE

“Hello, my name is Chisa Ononiwu. I am conducting a research study under the direction of Dr. Bothe in the Department of Communication Sciences and Special Education at the University of Georgia. This research study is about stuttering in bilinguals and multilinguals. I want to find out if there are differences in stuttering behaviors for people who speak two languages. This study will help me learn something that may help bilinguals and multilinguals stutter less. The experiment will be conducted in three experimental sessions which will be conducted on three separate days. You will be given up to two months to complete three sessions. If you choose to participate, you will be given $30 for completing the experiment. I have obtained your name/contact information from ________________________.

I would like to ask you some question to determine if you might qualify for this study. This should only take 10-15 minutes of your time. You do not have to answer any questions you do not want to answer. You may stop this interview at any time. If you qualify for this study, you will be asked to perform some speaking tasks in two languages to determine if you qualify for this study. After that, you will perform several more speaking tasks and language tasks to examine your stuttering.

If you do not qualify for this study, the information you give me today will be destroyed immediately. Do I have your permission to proceed?” _____ Yes _____ No

If “NO”: “Thank you for your time. If you have any questions regarding this study, please call me at 706-542-7389. If “Yes”. “Great. You have agreed to answer a few questions to
determine if you qualify for a stuttering research experiment. Is that correct?” _____ Yes _____
No

Participant Name _________________________________
Participant ID __ __ __ __
Participant Age __________
Phone # _________________________________
Gender   M or    F

Questions
1.) Do you stutter? _____ Yes    _____ No    If no, discontinue interview.
2.) Have you stuttered since childhood or have you stuttered since the age of 9? _____ Yes _____ No    If no, discontinue interview.
3.) Do you speak English and at least one other language? _____ Yes _____ No    If no, discontinue interview.
4.) Are you able to read out loud in English? _____ Yes _____ No    If no, discontinue interview.
5.) Have you ever had any brain damage or brain injury at any point in your life? ____ Yes _____ No    If yes, discontinue interview.
6.) Do you have a current diagnosis of any speech or language disorder? _____ Yes _____ No    If yes, discontinue interview.
7.) Do you have any hearing loss that you know of? _____ Yes _____ No    If yes, discontinue interview.
“Thank you for answering my questions today. You do/do not qualify to participate in this research study. (If qualified to participate) I would like to arrange a convenient place and time to meet to discuss the study and obtain your consent to participate. Are you interested in participating in this study?” _____ Yes _____ No If “No”. “Thank you for your time. If you have any questions regarding this study, please call me at (706) 542-7389.” If “Yes”. Great.

You just agreed to participate in several speaking tasks to determine if you qualify for this stuttering experiment. Is that correct?” _____ Yes _____ No If “Yes”. “Okay, now we will schedule your first session. What date and time work for you?”.

_____Date and time scheduled: ________________________ “Great. I will need your address to send a parking pass. After I send this information, I will dispose of the document that contains your address.”

“I look forward to meeting you on ____________________. If you have any questions regarding this study, please call me at 706-542-7389 or email me at chisa@uga.edu. If you have additional questions or problems regarding your rights as a research participant, please contact The Chairperson, Institutional Review Board at the University of Georgia at (706) 542-3199.”

Address: ____________________________

____________________________________

_____________________________
APPENDIX E

RECRUITMENT FLYER FOR RESEARCH PARTICIPATION

The Department of Communication Sciences and Special Education at the University of Georgia is looking for bilinguals and multilinguals who stutter to participate in a research study.

Purpose of Study

• To learn about speech behaviors in bilinguals and multilinguals who stutter.

What will I do?

• Participate in three sessions that will last no more than two hours.
• Read several passages and provide a speech samples in two languages

How much will I be paid?

• You will be paid $30 for completing three sessions.

You must meet the following criteria to participate

• 13 years of age or older
• A person who stutters and has stuttered since childhood
• Ability to speak and read in English
• No current diagnosis of any speech and/or language disorder other than stuttering
• No hearing impairment or past neurological damage

If you meet the above criteria to participate, please contact Chisa Ononiwu in the Department of Communication Sciences and Special Education at the University of Georgia by phone (706-542-7389) or via email (chisa@uga.edu) for further information.
APPENDIX F

INSTRUCTIONS FOR RATING NATURALNESS

Your task is to rate how natural or unnatural each speech sample sounds. You will be required to provide speech naturalness ratings every 30 seconds for oral reading tasks and every minute for monologues. If the participant reads the entire passage in less than 30 seconds, please rate and document the speech naturalness for period of time that the participant read.

If the speech sample sounds highly natural to you, please provide a rating of “1” within the SMS program. If the sample sounds highly unnatural, please provide a rating of “9” within the SMS program. If the sample sounds somewhere between highly natural and highly unnatural, input the appropriate number on the scale. Do not hesitate to use the ends of the scale (1 or 9) when appropriate.

Do not let the participant’s accent influence your naturalness ratings even if it is different from your own accent or dialect. Make your ratings based on the combination of prosody, speaking rate, and stuttering severity independent of the accent.
APPENDIX G

INSTRUCTIONS FOR ORAL READING PASSAGES

Experimenter

Each participant will read 4 different passages that will be divided equally into two separate stacks. The 4 passages will equal one set. The entire set of passages will be read 2 to 5 times in one experimental session. In other words, the participant will read a total of 8 to 20 passages per session. Before reading each passage aloud, the participant will be required to read each passage to his or herself silently. After the participant reads the passage silently, the participant will then read the passage aloud when he or she is instructed to start. Your task is to say “begin reading” for each passage that will be read aloud. The participants should also be given opportunities for a break after completing one set of passage readings.

Each participant will be required to read each passage with no more than two reading errors. Please note that a reading error and a stuttering event are different. A reading error is when the participant substitutes a different word for the target word (e.g., “this” instead of “it”) or deletes any letter in a word (e.g., “car” instead of “cars”). The participants must pronounce ALL letters in a word. A stuttering event is when a participant repeats a word or phrase and/or prolongs any sound (e.g., “it---it” or “gooooooing”). You will also be provided with the same reading passages as the participant. Your task is to monitor the participant’s reading and to document reading errors. When 3 or more errors are made, please ask the participant to discontinue reading the passage and place that passage aside (within the same stack) for the participant to reread at a later time. The participant will then move on to read the next reading
passage. The participant must read every passage within one stack with 2 or less reading errors before moving on to the next stack. The participant will be given as many opportunities as needed to attain two or less reading errors.

When the participant has to reread a passage aloud due to 3 or more reading errors, the participant will not be required to read that passage silently a second time. It is possible that the participant may have to reread 1 passage consecutively to complete the readings for that stack. If this occurs, the participant will be required to read a supplemental reading passage such as a book and/or magazine for approximately one minutes between each reading trial. The participant will then reread the passage again until 2 or fewer errors are attained. Participants should also read a supplemental reading passage or take a break when switching from one language to another.

Participant

You are going to perform two different speaking tasks today. For the first task, you will be asked to speak for 3 minutes about any topic of your choice. This can include topics about your family, recent events in your life, current news, jobs, politics, etc. You will speak for 3 minutes in one language followed by 3 minutes in your second language while being videotaped. When speaking, the experimenter will not respond. In other words, it will appear as if you’re speaking to yourself. Please speak at your normal rate, and be sure not to use any speaking techniques that could reduce stuttering.

The second task will involve reading several passages. Before you begin the task, the experimenter will ask you to read each passage silently to yourself. These passages will be displayed on several sheets of paper. After you are done reading each passage silently, the
experimenter will inform you when to begin reading each passage aloud. You will be asked to read one passage at a time. Please try to read each passage as best and as natural as you can without any errors and without use of speaking techniques that could reduce stuttering. The passages may contain several plural words such as “straps” or “ends” and possessives such as “Anne’s” or “Frank’s”. Please be sure to pronounce every letter of each word. If you make multiple errors, it is okay. You will be asked to place the sheet of paper aside and come back to it at a later time. You will be given the opportunity to take as many breaks as needed during the task. Do you have any questions?
APPENDIX H

ORAL READING PASSAGES

English Simple Syllable Structure Passage 1

You may see my key or you may show me the ox. My key may be in the inn at eight. If my shoe is by the sea or by Ed, we may see it. As for my ox, it may die off by the sea. Ed may buy two if you say so. If you say no, Ed may buy us eight or we may go out to eat. We may add to it or we may eat at the inn. She saw my key at the sea. I may see my tie in my shoe. We know why the tie is at sea.

English Simple Syllable Structure Passage 2

We see the way Sue is, so we know why Sue is so shy. If we lay on it at two or if we see the ax, Sue may buy us eight. Ed or Sue may go to the bay in May to see me. I am too shy to see Ed. Sue is up to see it all the way. If it is no lie, Ed may see my tie or my high shoe. He may buy an ox to eat. Tea or oat is all he may buy, so I know. Sue is so odd, so she may buy it in the day.

English Moderately Complex Syllable Structure Passage 1

Fred was mad that his pet had been caught, which was not fun for him. Now, Bob must change his plans for his pet. Fred can make ten for Bob, but there have been six here. Fred will not sleep this night. His mom will sit his shoes right here. This will help him sleep. His mom gave Dad ten mice, but Dad had seen some frogs last night. More food will keep his frog slim, but this can make Fred fat. Dad said Fred can feel good then. Dad will brag with Mom for his thought, but mom does not like when Dad does that.

100
English Moderately Complex Syllable Structure Passage 2

Frank can run for six, but Bob can run for ten. Frank will soon trip from much rain. Frank got food from his job, but then fell with his cake. His mom saw his scab. His dad cheered when his son won. Frank got wet when Bob swam. His hair was flat. Bob can fix his flat hair, but Frank must get his brush. Bob bled when his dog bit him, but his dad ran from him with fear. Frank was sad that his pet bit Bob. Frank will make this stop, but Bob must bring his pig. His pig can dig deep.

English Complex Syllable Structure Passage 1

Anne’s old strap, elf scrub, and ant split. Its end split straight and Anne’s aunt screamed. Elm screamed and stripped its old ink strap end. Anne’s aunt strives east. Earl earns old screws and scrubs. Anne’s strict aunt owns strings, stamps, and scrubs. Elm owns eggs and art. Old eggs splash straight and ants split east. Split screens and act old. Ask Elm’s old elf and scream. Ink art sprays and Earl owns eggs. Scrub Elm’s east and Anne’s ears straight. Earl scrubs east. Split Elm’s eggs and strap Anne’s end. Stray east and strip its screw. Anne’s ink earns its own split.

English Complex Syllable Structure Passage 2

Shanghainese Simple Syllable Structure Passage 1

我老欢喜吃（东西）。但是我老瘦。

我啊不大晓得我为什一直老瘦。

我每次去看我（个）爸爸，伊就对我笑。

为什嘎瘦呀？（东西）不大多吃，是伐？

没没。我吃了老多。但是我就一直老瘦额。

我现在是19岁。我看别额19岁健硕。

我啊要好好锻炼锻炼，所以我可以看起来伐大瘦。

Shanghainese Simple Syllable Structure Passage 2

我一开始到了大学，我啊伐晓得大学会的搞了(卡)难。

我第一年还可以。事体伐大多。每个课都老简单。

每个礼拜可以回到屋里。第一年来大学过了老好。

我现在是在读大学三年级。我已在老难过。

自已做了太吃力了。每个课考难读。个礼拜一直在读书。

每天都有考试。
German Moderately Complex Syllable Structure Passage 1


German Moderately Complex Syllable Structure Passage 2

APPENDIX I

PROTOCOL FOR EXPERIMENTAL SESSIONS

Experimental Session 1

Step 1: The participant will fill out an informed consent.

Step 2: The participant will fill out a language history and stuttering history questionnaire.

Step 3: The experimenter will review the questionnaire.

Step 3: The experimenter will conduct a follow-up discussion to explain experimental procedures if necessary.

Step 4: The experimenter will perform a hearing screening.

Step 5: The experimenter will record two 3-minute monologues (one monologue per language) for research qualification.

Step 6: The experimenter will inform the participant whether he or she qualifies to participate in the research study. If the participant does not qualify, the experimenter will pay the participant $10.

Step 7: The experimenter will schedule the second and third experimental sessions if the participant qualifies.

Experimental Session 2

Step 1: The experimenter will explain all experimental tasks to the participant.

Step 2: The experimenter will record two 3-minute monologues (one monologue per language).

Step 3: The experimenter will present written instructions for the oral reading passage task to the participant.
Step 4: The participant will read one passage silently and one passage aloud while being videotaped. The experimenter will prompt the participant to begin reading the passage aloud and will ask the participant to reread the passage if 3 or more reading errors are made. This step will be repeated for each passage until 2 or less reading errors are made for each passage.

Step 5: The experimenter will pay the participant $10 for research participation.

Experimental Session 3

Step 1: The experimenter will explain all experimental tasks to the participant.

Step 2: The experimenter will record two 3-minute monologues (one monologue per language).

Step 3: The experimenter will present written instructions for the oral reading passage task to the participant.

Step 4: The participant will read one passage silently and one passage aloud while being videotaped. The experimenter will prompt the participant to begin reading the passage aloud and will ask the participant to reread the passage if 3 or more reading errors are made. This step will be repeated for each passage until 2 or less reading errors are made for each passage.

Step 5: The experimenter will pay the participant $10 for research participation.
APPENDIX J

RECEIPT FOR PAYMENT

I ________________________________ (name) participated in the research study titled “The Impact of Syllable Structure Complexity on Stuttering Frequency for Bilinguals and Multilinguals Who Stutter” under the direction of Dr. Anne Bothe in the Department of Communication Sciences and Special Education. I received _________ (dollars) for my participation in the research study.

_________________________ _________________________ _________
Name of Participant Signature Date
## APPENDIX K

### RAW DATA

**Participant YJ**

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