ANALYSIS OF STUTTERING BEHAVIORS IN ADULT STUTTERING SPEAKERS: APPLICATION OF THE LIDCOMBE BEHAVIORAL DATA LANGUAGE TAXONOMY

by

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ABSTRACT

Stuttering is a complex behavioral disorder. Previously, vague and unreliable terminology for classifying stuttering behaviors has limited progress in delineating this intricate disorder. However, with the introduction of the Lidcombe Behavioral Data Language (LBDL) taxonomy, objective terminology has greatly improved reliability and the opportunity to examine stuttering behaviors across large populations, replicate previous research, and compare individuals across geographical regions. The purpose of the current study was to examine the distribution and characteristics of stuttering moments across a large sample of adult stuttering speakers to explore the possibility of subgroups or subtypes of stuttering. The notion of subtypes in stuttering has been discussed across a wide range of stuttering literature, and would have significant impact on the diagnosis, prognosis, treatment, and ultimately, prevention of stuttering. Archived speech samples from 95 individuals were used in the current study. A reading passage and conversational monologue were collected from each participant. Each speaking sample was analyzed and each stuttered moment was assigned one of the five core stuttering categories from the LBDL taxonomy. Results of the study indicated significant differences existed with respect to the relative distribution of stuttering among the subcategories of the LBDL across speaking tasks. A significant difference was also observed between the core stuttering categories during the reading task. The type of speaking task did not affect overall stuttering frequency. Regardless of speaking task,
fixed posture-inaudible was the most frequently occurring type of stuttering moment in adult stuttering speakers. Means and standard deviations were reported for all stuttering frequencies across categories. A small subset of participants displayed stuttering behaviors as solely repeated movements or solely fixed postures. The results of the current study confirm the LBDL taxonomy is objective and reliable, and support the notion of subtypes in stuttering, specifically as a) predominantly repeated movements, b) predominantly fixed postures, and c) mixed type.
# TABLE OF CONTENTS

ABSTRACT .......................................................................................................................... iii

LIST OF TABLES .................................................................................................................. vii

LIST OF FIGURES .............................................................................................................. viii

INTRODUCTION .................................................................................................................. 1

   History of Stuttering Moment Taxonomies ................................................................. 3
   The Lidcombe Behavioral Data Language Taxonomy ............................................... 8
   Summary ...................................................................................................................... 16
   Purpose ......................................................................................................................... 17

METHOD ............................................................................................................................... 19

   Participants ....................................................................................................................... 19
   Data Collection .............................................................................................................. 19
   Data Analysis ................................................................................................................ 20
   Classification of Stuttering Moments ......................................................................... 21
   Stuttering Frequency ................................................................................................... 21
   Reliability ...................................................................................................................... 22
   Statistical Analyses ..................................................................................................... 24

RESULTS ............................................................................................................................... 27

   Participant Characteristics ......................................................................................... 27
   Stuttering Frequency by Task ................................................................................... 28
   Distribution of Stuttering Moments: Monologue Task ............................................ 29
   Distribution of Stuttering Moments: Reading Task .................................................. 32
   Repeated Movements versus Fixed Postures ........................................................... 34
   Distribution of Stuttering Moments by Percentage .................................................. 37

DISCUSSION ......................................................................................................................... 42
Experimental Questions ........................................................................................................42
Clinical Implications ........................................................................................................46
Directions for Future Research ......................................................................................55
Limitations ........................................................................................................................59
Conclusion .........................................................................................................................60

APPENDICES

A: TRAINING PROCEDURES FOR THE APPLICATION OF THE LBDL TAXONOMY ..............................................................61
B: INTERJUDGE RELIABILITY: READING TASK .........................................................62
C: INTERJUDGE RELIABILITY: MONOLOGUE TASK .................................................63
D: INTRAJUDGE RELIABILITY: READING TASK ........................................................64
E: INTRAJUDGE RELIABILITY: MONOLOGUE TASK ...............................................65

REFERENCES ......................................................................................................................66
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Johnson’s (1959) First Classification System for Stuttered Speech</td>
<td>4</td>
</tr>
<tr>
<td>2. Conture’s Within-word and Between-word Classification Taxonomy for Stuttered Speech</td>
<td>7</td>
</tr>
<tr>
<td>3. The Lidcombe Behavioral Language Data Taxonomy</td>
<td>9</td>
</tr>
<tr>
<td>4. Predominant Core Stuttering Category for Participants via Percent Range</td>
<td>38</td>
</tr>
<tr>
<td>5. Training Procedures for the Application of the Lidcombe Behavioral Data Language Taxonomy</td>
<td>61</td>
</tr>
<tr>
<td>6. Interjudge Reliability: Reading Task</td>
<td>62</td>
</tr>
<tr>
<td>7. Interjudge Reliability: Monologue Task</td>
<td>63</td>
</tr>
<tr>
<td>8. Intrajudge Reliability: Reading Task</td>
<td>64</td>
</tr>
<tr>
<td>9. Intrajudge Reliability: Monologue Task</td>
<td>65</td>
</tr>
</tbody>
</table>
### LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mean number of stuttered moments across the monologue and reading tasks</td>
<td>30</td>
</tr>
<tr>
<td>2. Distribution of stuttered words across the monologue and speaking task, as categorized by the LBDL taxonomy</td>
<td>31</td>
</tr>
<tr>
<td>3. Distribution of stuttered words across the reading task, as categorized by the LBDL taxonomy</td>
<td>33</td>
</tr>
<tr>
<td>4. Mean percentage and standard error of stuttering moments across the monologue task by core stuttering category</td>
<td>35</td>
</tr>
<tr>
<td>5. Mean percentage and standard error of stuttering moments across the reading task by core stuttering category</td>
<td>36</td>
</tr>
<tr>
<td>6. Dominant core category: Reading task</td>
<td>39</td>
</tr>
<tr>
<td>7. Dominant core category: Monologue task</td>
<td>41</td>
</tr>
</tbody>
</table>
INTRODUCTION

The importance of a reliable classification system for categorizing stuttering behaviors is critical for the identification of specific patterns, or subtypes, of stuttering, and to examine any subsequent etiological implications. Although various terminologies have been used over the years, stuttering has historically been thought of as a disorder that encompasses repeated movements, fixed articulatory postures, and superfluous (secondary) behaviors. While nearly all stuttering moments result in a stoppage in the forward flow of speech, the heterogeneity of the specific moments of stoppage is large. Consequently, agreement on a definition for stuttering has eluded researchers for many years. Bloodstein (2008) stated, “Most of us believe we know what stuttering is, yet a great deal of disagreement generally results when we try to define it” (p. 1). One of the historical problems with defining stuttering is that the true etiology of the disorder remains unknown, and the broad diversity of theories has been quite remarkable. There is little consensus for a parsimonious etiological theory of stuttering. For that reason, in lieu of a widely accepted definition of stuttering, descriptions of the behavioral characteristics of stuttering have had to be sufficient. However, even the specific behaviors that constitute stuttering are not well defined or widely agreed upon.

In 1980, Guitar provided what would become a broadly accepted definition of stuttering. He stated “Stuttering is characterized by an abnormally high frequency or duration of stoppages in the forward flow of speech. These stoppages usually take the
form of a) repetitions, sounds, syllables or one-syllable words, b) prolongations of sounds, c) blocks of airflow or voicing in speech” (p. 13). Yet despite this broadly accepted definition, a reliable way for classifying stuttering behaviors continued to elude researchers and professionals until the recent introduction of the Lidcombe Behavioral Data Language (LBDL) program taxonomy (Onslow, Gardner, Bryant, Stuckings, & Knight, 1992; Teesson, Packman, & Onslow, 2003). Developed as part of a stuttering treatment program, the LBDL taxonomy categorizes stuttering moments into three categories composed of seven descriptors based on the motoric origin of stuttering behaviors. Previously, making any quantitative comparisons about stuttering frequency and type across people who stutter proved extremely challenging, affecting the reliability of stuttering moment classification for professionals treating the disorder and researchers studying various aspects of stuttering. Therefore, the motivation among professionals to subtype stuttering is strong not only in clinical settings but in the research domain as well (Lu, Chen, Ning, et al., 2010), driven by the compelling need to understand stuttering, facilitate diagnostic accuracy, and increase treatment effectiveness (Yairi, 2007). However, without a universally accepted definition of stuttering or knowledge of etiology, previous stuttering taxonomies have lacked objective behavioral criteria to examine the delineation of any possible subgroups of this complex disorder.

Current criteria for diagnosing and classifying stuttering behaviors according to the Text Revision of the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV-TR) (American Psychiatric Association, 2000) states that an individual must have a disturbance in the normal fluency and time patterning of speech, characterized by one or more of the following: 1) sound/syllable repetition, 2) broken
words, 3) sound prolongations, 4) interjections, 5) audible or silent blocking, 6) circumlocutions, 7) monosyllabic whole-word repetition, and 8) words produced with an excess of physical tension (APA, 2000) and that the disturbance in fluency must interfere with academic or occupational achievement, or social communication (APA, 2000). However, this criterion carries forth the traditional problems associated with identifying and classifying stuttering behaviors: a lack of objectivity. This, along with inconsistencies in previous stuttering taxonomies, is outlined below.

**History of Stuttering Moment Taxonomies**

Historically, overlapping and vague terminology has resulted in limited progress being made in evaluating types of stuttering behaviors. An effective classification system would have an extremely positive impact on research and treatment advancements. In order to understand the difficulty with using previous taxonomies for comparative purposes, an understanding of the history and complexity of describing the different types of stuttering behaviors must be reviewed.

*Johnson’s Data Language*

Johnson (1959) provided one of the first classification systems for stuttered speech. He and his colleagues at the University of Iowa collected tape-recorded speech samples of both stuttering and nonstuttering adults and children in order to analyze their speech disfluencies. To conduct a systematic analysis of the speech characteristics, Johnson classified types of speech disfluency into eight categories. These categories are presented in Table 1.
### Table 1

*Johnson’s (1959) First Classification System for Stuttered Speech*

<table>
<thead>
<tr>
<th>Disfluent Speech Behavior</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Prolonged sounds</td>
<td>“mmmmmmy name is…”</td>
</tr>
<tr>
<td>2. Broken words</td>
<td>“I was g- (pause) –oing home”</td>
</tr>
<tr>
<td>3. Part-word repetitions</td>
<td>“M-m-my dog”</td>
</tr>
<tr>
<td>4. Word repetitions</td>
<td>“can can can we go”</td>
</tr>
<tr>
<td>5. Phrase repetitions</td>
<td>“I was, I was going”</td>
</tr>
<tr>
<td>6. Interjections</td>
<td>“uh”, “er”, “um”, “well”</td>
</tr>
<tr>
<td>7. Revisions</td>
<td>“I was- I am going”</td>
</tr>
<tr>
<td>8. Incomplete phrases</td>
<td>“She was- she arrived after him”</td>
</tr>
</tbody>
</table>
In a study examining Johnson’s disfluency categories as a means to describe early stuttered speech, Onslow et al. (1992) found that clinicians who specialized in stuttering showed little agreement in use of the categories. Only 32.5% of the disfluencies were assigned a common category by sophisticated listeners using Johnson’s classification system. One of the proposed reasons for the disagreement is that Johnson’s categories do not distinguish between normal disfluencies and stuttered speech, especially in the early years of speech development (Onslow et al., 2002). This is important because Johnson’s data language has historically not only served as a widely used taxonomy for stuttering, but has also been a basis for research that has described the disfluencies that occur in normally speaking children (DeJoy & Gregory, 1985; Wexler & Mysak, 1982; Yairi, 1981, 1982; Yairi & Clifton, 1972). In a study by Yairi and Lewis (1984), comparing preschool children who stutter and do not stutter, it was found that in short speech samples, every disfluency category that occurred in the speech of stuttering children also occurred in the speech of control children. The results of both studies highlight the multifaceted nature of stuttering and how difficult it is to classify and separate stuttering behaviors from normal disfluencies, as well as the importance of an objective and reliable classification system for clinical and research purposes.

Conture’s Between-word and Within-word Classification System

Johnson’s taxonomy for describing stuttering moments remained essentially unchanged for four decades. A significant extension of Johnson’s classification system for stuttered speech was presented by Conture (1982). Conture further devised a system that categorized stuttering movements into the two broad subclasses of “within-word”
and “between-word” disfluencies. The fundamental idea behind these two categories was that the within-word disfluencies encompassed characteristics of “true” developmental stuttering, whereas between-word disfluencies were more characteristic of ‘normal’ speech. Examples of these categories are presented in Table 2.

This classification scheme went a long way in addressing the issues of stuttered speech vs. ‘normal’ disfluencies in speech. However, Conture’s classification system of within-word and between-word categories continued to carry forward many of the ambiguities from Johnson’s original classification. An example of this inconsistency is apparent by the discrepancy in categorization of monosyllabic word repetition, as Conture lists monosyllabic words in both the within-word and between-word categories. Additionally, Cordes and Ingham (1995) point out “substantial evidence does exist that both stuttering and normal disfluencies may occur within, across, and between words” (p. 382), making it difficult to classify disfluencies as being in one category or the other, and that “relatively few (disfluencies) can unambiguously be described as within-word or between-words, and much less exemplars of single disfluency types” (p. 384). Consequently, despite Conture’s attempt to move forward by developing a new classification system, he was lacking critical elements in distinguishing what separated stuttering disfluencies from normal disfluencies and objective criteria for quantitatively classifying stuttering behaviors consistently between listeners.

Based on the two previous commonly-used taxonomies in stuttering, it is easy to recognize that a great deal of work was still needed to further advance stuttering classification, and the magnitude of developing an effective classification system becomes evident. Without a reliable way to classify stuttering moments, if there are
Table 2

Conture’s Within-word and Between-word Classification Taxonomy for Stuttered Speech

<table>
<thead>
<tr>
<th>Disfluency Type</th>
<th>Within-Word</th>
<th>Between-Word</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sound/Syllable Repetitions</td>
<td>X</td>
<td></td>
<td>“See the b-b-b-baby”</td>
</tr>
<tr>
<td>Sound Prolongation</td>
<td>X</td>
<td></td>
<td>“Mmmmmmore” or “T- (pause while holding articulatory posture) –oday)</td>
</tr>
<tr>
<td>Broken Word</td>
<td>X</td>
<td></td>
<td>“I was g- (pause) –oing)”</td>
</tr>
<tr>
<td>Monosyllabic whole-word repetitions</td>
<td>X</td>
<td>X</td>
<td>“He-he-he is here”</td>
</tr>
<tr>
<td>Multisyllabic whole-word repetitions</td>
<td>X</td>
<td>X</td>
<td>“She really-really is here”</td>
</tr>
<tr>
<td>Phrase Repetition</td>
<td>X</td>
<td></td>
<td>“I was- I was there”</td>
</tr>
<tr>
<td>Interjections</td>
<td>X</td>
<td></td>
<td>“I will, um, you know, be late”</td>
</tr>
<tr>
<td>Revisions</td>
<td>X</td>
<td></td>
<td>“She is- she was here”</td>
</tr>
</tbody>
</table>
subtypes of stuttering, and if they are “lumped together” differently from one study to the next as a consequence of unreliable or variously used classification systems, conflicting results are obtained, inaccurate conclusions are made, and studies cannot be replicated (Ambrose, Cox, & Yairi, 1997). Researchers need a reliable and consistent way to identify and categorize different types of stuttering moments in order to recognize patterns that may be associated with etiology, objective diagnostic criteria, and ultimately, treatment. Professionals need a reliable and consistent way to identify, classify, and measure change in patients across settings, time, and geographical regions. Furthermore, the ability to reliably examine the complex characteristics of stuttering behavior and the intricate way the behaviors distribute themselves in each stuttering individual may further our understanding of this complex disorder. Therefore, a clear and objective stuttering type taxonomy is vital for reliable classification and future research.

The Lidcombe Behavioral Data Language Taxonomy

Arguably the most effective stuttering taxonomy to date was developed recently as part of a stuttering treatment program, providing researchers with objective terminology and greatly improved reliability for classifying stuttering (Teesson et al., 2003). The LBDL taxonomy classifies stuttering moments into three categories composed of seven descriptors. Two of these categories refer to specific motor movements associated with stuttered word production, and are the ‘core’ of the stuttering taxonomy. The third category describes common accessory (or superfluous) behaviors often associated with stuttering. The LBDL taxonomy is outlined in Table 3.
Table 3

*The Lidcombe Behavioral Data Language Taxonomy*

<table>
<thead>
<tr>
<th>Disfluency Type</th>
<th>Core Category</th>
<th>Accessory Category</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Repeated Movements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Syllable Repetition</td>
<td>X</td>
<td></td>
<td>“He-he-he is here”</td>
</tr>
<tr>
<td>Incomplete Syllable Repetition</td>
<td>X</td>
<td></td>
<td>“b-b-b-baby”</td>
</tr>
<tr>
<td>Multisyllabic Unit Repetition</td>
<td>X</td>
<td></td>
<td>“She really-really is here”</td>
</tr>
<tr>
<td>2. Fixed Postures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed Posture Inaudible</td>
<td>X</td>
<td></td>
<td>“I was g- (pause) –oing)”</td>
</tr>
<tr>
<td>Fixed Posture Audible</td>
<td>X</td>
<td></td>
<td>“Mmmmmore”</td>
</tr>
<tr>
<td>3. Superfluous Behaviors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verbal</td>
<td>X</td>
<td></td>
<td>“um, eh, hmm, throat clearing”</td>
</tr>
<tr>
<td>Nonverbal</td>
<td>X</td>
<td></td>
<td>“muscle tension”</td>
</tr>
</tbody>
</table>
One of the most significant distinctions of the LBDL taxonomy from previous taxonomies is the LBDL taxonomy uses behaviorally based terminology (i.e., syllable repetition vs. incomplete syllable repetition describes the exact motoric behavior being displayed, as opposed to previously ambiguous terminology such as sound/syllable repetition) to describe stuttering moments. Because current stuttering definitions are based on behavioral characteristics and not etiology, the terminology used to describe stuttering moments also need to be behaviorally based (i.e., depict the specific observable movement that is occurring). It is the universal existence of involuntary speech movements that characterizes stuttering; therefore, a behaviorally based description of these movements provides the most unambiguous and objective criteria for an objective, reliable classification system of stuttering.

Core Stuttering Categories: Repeated Movements and Fixed Postures

The focus of the LBDL taxonomy on the core features of stuttering (fixed postures and repeated movements) emphasizes the fact that stuttering is a motor speech disorder, which is a vital distinction that was not addressed in previous classification systems. Previous taxonomies classified all stuttering and stuttering-like behaviors equally, whether they had a speech motor component (i.e., b-b-b-boy) or a language component (hmm, um, er.). Although the language components are considered a part of stuttering when combined with the speech motor behaviors, the language components also occur as part of normal speech. In contrast, stuttering movements that are motoric (repeated movements and fixed postures) in origin are involuntary and generally do not occur as part of normal disfluencies. Therefore, the motor-based stuttering behaviors are
considered ‘core’ components of stuttering (repeated movements and fixed postures), and are essential in detecting the presence of stuttering from normal disfluencies for an accurate diagnosis. However, since interjections, revisions, and phrase repetitions are still considered to be both a part of stuttering and normal disfluencies, these characteristics are accounted for in the LBDL taxonomy subcategory of verbal superfluous behaviors.

Because the focus of this study is to identify the distribution of stuttering moments, only the core categories are being examined. Fixed postures (audible and inaudible) and repeated movements (syllable repetition, incomplete syllable repetition, multisyllabic unit repetition) are motoric in origin, and essential to the diagnosis of stuttering. The addition of superfluous behaviors can compound the severity and complexity of the disorder from individual to individual; however, the presence or absence of superfluous behaviors does not affect the diagnosis of stuttering. Superfluous behaviors do not affect the count of stuttering frequency, nor do they depict when a stuttering moment has occurred. Therefore, in an attempt to delineate the manifestation of stuttering behaviors and characteristics in adult stuttering speakers, the focus of this study will remain on the core movement categories in an attempt to dissect through the many variable characteristics associated with stuttering, and reveal the pattern of behaviors at the heart of the disorder.

_LBDL Reliability_

Recently, in a study examining the effectiveness of the LBDL treatment program, the inter- and intrajudge reliability of the LBDL taxonomy was evaluated (Teesson et al.,
Researchers recruited inexperienced and experienced listeners to evaluate 15 speech samples, each 10 seconds in length. The speech samples consisted of 5 preschool children, 5 school-age children, and 5 adults. The listeners were given the instructions to classify each stuttering moment using the LBDL taxonomy. Results found a consistently higher rate of intrajudge agreement across descriptors for the experienced listeners ($M = 84.7\%$, range = 77.3\% - 92.7\%), as analyzed through pairwise comparisons. Additionally, an analysis of interjudge agreement was conducted on the 10 judges in each group. If 9 out of 10 judges agreed on the classification of a stuttering behavior, the agreement percentage using pairwise comparisons was 80\%. If only 8 out of 10 judges agreed, the percentage dropped to 64\%. Similar to the results examining intrajudge agreement, the group of experienced judges had a consistently higher agreement percentage than the inexperienced listeners ($M = 75\%$, range = 68.3\% - 84.2\%), compared to ($M = 63.7\%$, range = 55.1\% - 74.2\%). Behaviors with the highest interjudge reliability were multisyllabic unit repetitions, and behaviors with the lowest interjudge reliability were fixed postures with audible airflow. The stuttering behavior assigned most frequently by the experienced judges was incomplete syllable repetition. Due to the complex nature of stuttering and different training backgrounds and experience levels of the sophisticated listener judges, an intrajudge reliability of 84.7\% and interjudge reliability of 75\% (between 8-9 judges out of 10 agreed on assignment of a stuttering moment to a category) is significantly improved from reliability of previous classification systems (i.e., Johnson’s taxonomy had a reliability agreement of 32.5\% in a study by Onslow et al., 1992). Given the brief introduction and training to the LBDL taxonomy in the study above, it is presumed that individuals who are educated in the
identification of stuttering moments and trained in the use of the LBDL taxonomy by a Lidcombe certified professional would achieve a 90% reliability agreement in the assignment and identification of stuttering features through application of the LBDL taxonomy.

Prior to the introduction of the LBDL, a comparison of stuttering characteristics and delineation of stuttering was extremely difficult. Yet with the vast improvement in stuttering classification reliability that the LBDL taxonomy provides, researchers can further explore the basic characteristics of stuttered speech. The current study results, identifying stuttering distribution characteristics and exploring the possibility of stuttering subtypes, can lay the foundation for significant contributions to the field of stuttering when combined with future research studies; leading researchers one step closer to understanding the etiology and development of this intricate disorder.

Subgroups in Stuttering

The notion of subgroups in stuttering has been widely discussed throughout the literature. Several researchers have suggested that the heterogeneous characteristics of individuals who stutter highlight the need for a delineation of subtypes (Riley & Riley, 2000; Watson & Freeman, 1997; Yairi, 2007). Many different ideas on how to divide stuttering into subgroups have been proposed, including differentiation by neuroanatomy (Lu et al., 2010), and genetic liabilities (Ambrose et al., 1997). A more complete review of the variables to consider when subtyping stuttering can be found in a series of articles titled *Subtyping stuttering I: A review* (Yairi, 2007) and *Subtyping stuttering II: Contributions from language and temperament* (Seery, Watkins, Mangelsdorf, & Shigeto,
However, although previous research agrees that subtyping stuttering is necessary to further our understanding of this complex disorder, some of the basic questions regarding the identification of stuttering behaviors necessary for subtype differentiation have been overlooked, primarily the behavioral characteristics that constitute stuttering and their presentation over the lifespan. Previous studies have tended to focus primarily on the characteristics of childhood stuttering behaviors and the effect of other domains relevant to speech and language development (i.e., linguistic, motoric, genetic, psychosocial) (Seery et al., 2007), without focusing on first identifying behavioral phenotype of stuttering. Without knowledge of objective stuttering behaviors and characteristics, attempts to subtype stuttering in relation to comorbid developmental variables fall short. Research cannot determine the cause (neuroanatomical or genetic) of stuttering when in fact the effect, or presentation of stuttering behaviors, is not universally or objectively defined. Although these variables that co-occur in stuttering will eventually be essential to further our understanding about this disorder, stuttering needs to have a behavioral phenotype before other developmental domains and their influences can be considered for subtypes.

**Reading vs. Monologue Speaking Tasks**

Researchers and clinicians have often used both reading and monologue tasks as a standard measure to assess fluency, due to the different cognitive, motor, and linguistic demands associated with each speaking task (Bloodstein & Ratner, 2008). Often, individuals who stutter exhibit variable speech fluency for different speaking situations (Van Riper, 1982). Therefore, when examining the distribution of stuttering behaviors
and examining universal stuttering characteristics, it is essential to see how these characteristics present in individuals across different speaking tasks.

Each type of speaking task presents the speaker with different challenges. In the monologue task, the speaker must generate the linguistic message, requiring a more complex cognitive-linguistic load. It has been theorized that this internally mediated (i.e., from memory) movement sequences engage neural pathways that are distinct from externally (i.e., visual) mediated movement sequences (Rothwell, 1994); meaning that completely different neural pathways may be activated during different types of speaking tasks. Additionally, in a monologue task, the speaker is given the freedom to generate any linguistic message, which can allow the stuttering speaker to avoid certain words or sounds upon which they anticipate stuttering. They are free to choose vocabulary, and often have a vague conversational topic, reducing the pressure of the speaking situation.

It is also important to note that during a monologue task, the speaking demands are different than an actual conversational task. In a monologue, the speaker is able to freely dictate their linguistic message without the cognitive demand of listening to a conversational partner and generating a socially appropriate response in a timely manner.

During the reading task, a speaker must allot cognitive resources to decoding the language of the passage they are reading, as well as produce all words and phonemes required. This can be problematic when an individual encounters a sound or word that they often have difficulty speaking fluently. This is one possible reason that could explain why there was a significant difference between fixed postures and repeated movements during the reading task. If an individual could not avoid a certain word or sound, they may be more prone to a fixed posture (i.e., difficulty initiating the sound or
word) than repetition. Additionally, reading ability is extremely variable across individuals and requires a completely different skill set than speech alone.

When examining the behavioral characteristics of stuttering and considering the use of behavioral characteristics as a means to distinguish subtypes, it is essential to consider the presentation of stuttering behaviors across speaking situations. Due to the differences in task demand across speaking situations, a person who primarily exhibits fixed postures while in a conversational monologue may display an increased amount of repeated movements during a reading task. Therefore, the current study will examine the consistency of stuttering behaviors in individuals across speaking tasks while considering the use of subtypes in stuttering.

**Summary**

With the introduction of the LBDL taxonomy, there is increased opportunity for future research assessing the basic characteristics of stuttered speech. Given the improved ability to objectively and reliably classify stuttering behaviors, researchers and clinicians are able to provide consistent labels to different types of stuttering behaviors across research and clinical settings. Furthermore, researchers now have the opportunity to analyze the frequency of stuttering moment distribution across large sample sizes, geographical regions, families, and time. This allows researchers to identify any distributional patterns, including the most (and least) common stuttering behaviors expressed in adults.

By analyzing the frequency distribution of stuttering moments through objective criteria, many questions in stuttering can be addressed. Primarily, researchers can
examine the possibility of stuttering further being divided into subgroups depending on clusters of movements. As Duffy (2005) differentiates the perceptual clusters in the motor speech disorder of dysarthria, he uses the “notion of subtypes as a vehicle for discussing the shared features, as well as the remarkable variability among speech problems caused by different involuntary movements” (pp. 217-218). Just as dysarthria is a motor speech disorder that encompasses subgroups based on perceptual differences in irregular speech motor patterns, ‘stuttering’ may also become a term encompassing subcategories based on patterns of stuttering moment distribution. Ambrose et al. (1997) stated:

Because stuttering is a complex behavioral disorder, without known physiological or biochemical indicators, the possibility that various subtypes with different etiologies may exist cannot be dismissed. The identification of traits or characteristics of stuttering consistent with genetic transmission is thus essential to further understanding of the etiology and development of the disorder. (p. 567)

**Purpose**

Specifically, the purpose of the current study is to:

1. Identify the distribution ratio of different types of stuttering moments and any subsequent movement patterns across adult stuttering speakers using the core categories of the LBDL taxonomy.

2. Identify the most frequent core category of stuttering when each participant is classified solely by their predominant type of stuttering (repeated movements vs. fixed postures).

3. Identify whether stuttering always includes a combination of repeated movements and fixed postures, or whether stuttering can be subtyped as a)
predominantly fixed postures; b) predominantly repeated movements; or c) always as a mixed type.

(4) Determine if type of speaking task effects frequency and type of stuttering behavior.

**Hypothesis**

It was hypothesized that there would be a relatively equal distribution of different stuttering moments across adult stuttering speakers, without a statistically significant difference among stuttering type categories. It was also hypothesized that when stuttering is classified solely into the two core categories of repeated movements and fixed postures, there would not be a significant difference in the occurrence of one category over the other, nor would stuttering present as solely fixed postures or repeated movements in any participants. Lastly, it was hypothesized that no statistically significant difference would be observed on stuttering frequency or presentation between speaking tasks.
METHOD

Participants

Participants for this study were originally videotaped for their participation in previous stuttering studies or treatment programs conducted by Michael Blomgren, Ph.D., at The University of Connecticut and The University of Utah. All participants were diagnosed with persistent developmental stuttering as assessed through case history (onset before 8 years of age), self-report, and a subsequent stuttering frequency of 2% or greater averaged from a reading task and a speaking task. Authorization to conduct anonymized analyses of the previously recorded participants was granted through The University of Utah Institutional Review Board (IRB # 00034014).

In an attempt to minimize possible treatment effects, only participants who had not received formal stuttering therapy within 1 year of the recording sample were included in the study. Formal therapy was defined as that provided by a speech-language pathologist with the goal of reducing or altering stuttering behavior. All participants reported and exhibited normal or corrected-normal vision, normal hearing, and normal language, voice, and speech articulation.

Data Collection

Preliminary background information was gathered through participant intake forms, with more thorough case history information gathered on the day of participation.
Each participant was audio and video recorded with only one researcher and participant present in the room. Participants were seated for all speaking tasks. Audio and video signals were collected using either a tripod-mounted VHS video camera (Panasonic AG-188) or a tripod-mounted digital camera (Canon Elura). The cameras were situated approximately 2.5 m from each participant and positioned to obtain a clear video image of the participants’ head, neck, and upper torso. Participants were asked to (1) read a short reading passage and (2) speak in a conversational monologue for approximately 5 minutes or 350 words. Each speaking sample was then transcribed and stuttering moments identified by a trained listener.

**Data Analysis**

Analysis of stuttering disfluencies was conducted by first transcribing the conversational monologue produced by each participant from the video recording. The primary researcher then identified and classified each moment of stuttering during the conversational monologue and reading passage for each participant using the LBDL taxonomy developed by Teesson et al., (2003). The data from the hard copies of each transcript and reading passage were then transferred into an excel worksheet to calculate an exact percentage of stuttering (rounded to two decimal places) for each category within the LBDL taxonomy (syllable repetition, incomplete syllable repetition, multiunit repetition, fixed posture- inaudible, fixed posture- audible). Once all the percentages were calculated, the data was entered in a statistical program for analysis (GB-STAT version 9.0).
Classification of Stuttering Moments

Each stuttering moment was assigned a category using the LBDL taxonomy. The title of each LBDL taxonomy category provides an operational definition for each type of stuttering behavior that may fall within the category (i.e., ‘syllable repetition’ refers to a stuttering behavior when one syllable is repeated; ‘multisyllabic unit repetition’ is when more than one syllable is repeated) by defining the behavioral characteristics of the stuttered moment. Additionally, the LBDL taxonomy uses the ‘core’ features of stuttering for classification, including repeated movements (syllable repetition: “he-he-he”; incomplete syllable repetition: “b-b-b-boy”; multisyllable unit repetition: “really-really”), and fixed postures (audible: “mmmmore”; inaudible: “I (pause) was going”). The ‘accessory’ features of stuttering are also included in the category of superfluous behaviors (verbal and nonverbal). Examples and categorization of the LBDL Taxonomy are shown in Table 3.

Stuttering Frequency

Throughout the monologue and reading passage, each type of stuttering moment was assigned to a type of core stuttering category using the LBDL taxonomy (syllable repetition, incomplete syllable repetition, multisyllabic unit repetition, fixed posture with audible airflow, and fixed posture without audible airflow). The overall percentage of each stuttering moment category was then calculated as (overall % = [# of stuttered words in a stuttering category/ total number of words stuttered] x 100). For example, when the number of syllable repetitions in the reading passage was calculated, all the identified syllable repetitions were added and then divided by the total number of words
stuttered in the passage and multiplied by 100, giving the percentage that syllable repetitions represented out of the total percent stuttering for that passage. This calculation was done for all five core stuttering categories, including syllable repetition, incomplete syllable repetition, multiunit syllable repetition, audible fixed postures and inaudible fixed postures.

After all the individual stuttering moments were identified for each participant across both speaking tasks, the overall percentage of stuttering for both the reading passage and monologue was calculated. The total percentage of stuttering was calculated for each task by adding all the different categories of stuttering moments for a total over the number of words for each task (overall % = [total number of disfluencies/ total number of words] x 100). This was conducted for both the reading passage and the monologue from each participant. The overall percentage from the monologue and reading passage was then averaged for each participant to generate an overall stuttering frequency score and determine their eligibility for the study (minimum 2% frequency of stuttering average across tasks).

Reliability

Training

Michael Blomgren, PhD., an ASHA certified speech-language pathologist with expertise in the application of the LBDL program, trained the primary researcher in how to identify stuttering moments according to the LBDL taxonomy. A step-by-step training procedure can be located in Appendix A. In order to re-evaluate reliability for the current study, LBDL taxonomy categories were assigned by both Dr. Blomgren and the primary
researcher to the reading passage and monologue for 5 participant videos. The researcher was considered trained in the application of the LBDL when a 90% or greater agreement criterion was achieved between Dr. Blomgren and the researcher.

*Interjudge Reliability*

Interjudge reliability was conducted by the researcher and another graduate student in the Department of Communication Sciences and Disorders who had been trained in application of the LBDL by both the primary researcher and Dr. Blomgren following the protocol outlined in Appendix A. The second researcher was considered trained in the application of the LBDL taxonomy when a 90% reliability (or greater) was reached across five stuttering speaker participant videos with both trainers. A random number generator was then utilized to select 10 additional study participants (10% of the total study participants) to assess interjudge reliability. Reliability was calculated on an overall percentage of stuttering for each task. The standard error of measurement for identification of stuttering in the interjudge reliability assessment of the reading and monologue speaking tasks were 1.3% and .83%, respectively. A Hoyt’s Analysis, which provides a correlation measure of the consistency of rater’s judgments, was utilized for interjudge comparisons across speaking tasks. For all measures of consistency, a correlation coefficient of $r = .99$ was achieved for both the reading and monologue speaking tasks. The results indicated 99% agreement between interjudge identification of speech disfluencies across speaking tasks. A comparison of the specific stuttering categories within the reading and monologue tasks can be found in Appendices B and C, respectively.
**Intrajudge Reliability**

Intrajudge reliability was conducted by the same researcher re-analyzing 10 randomly selected participants (10% of the participant videotapes) via a random number generator. Reliability was calculated on an overall percentage of stuttering for each task. The standard error of measurement for identification of stuttering in the intrajudge reliability assessment of the reading and monologue speaking tasks were 1.3% and .95%, respectively. A Hoyt’s Analysis was again utilized to determine intrajudge reliability.

For all measures of consistency, a correlation coefficient of \( r = .99 \) was achieved for both the reading and monologue speaking tasks. The results indicated 99% agreement between intrajudge identification of speech disfluencies across speaking tasks. A comparison of the specific stuttering categories within the reading and monologue tasks can be found in Appendices D and E, respectively.

**Statistical Analyses**

**Stuttering Frequency by Stuttering Moment Type**

The mean and standard deviations were calculated and reported for group frequency scores on the five individual stuttering categories, specifically the categories of syllable repetition (SR), incomplete syllable repetition (ISR), multisyllabic unit repetition (MSR), fixed postures-audible (FP-A), and fixed postures-inaudible (FP-I). A one-way ANOVA was performed on the group data to determine whether significant differences exist among the stuttering-type categories with respect to frequency of stuttering. If the one-way ANOVA determines that significant differences do exist between stuttering
categories, a Scheffe *post-hoc* comparison will be conducted to determine which
categories are statistically significant from each other.

*Stuttering Frequency by Core Stuttering Category*

Further analysis compared the two ‘core’ categories of the LBDL taxonomy:
repeated movements and fixed postures. Each participant was categorized in either the
‘repeated movements’ or ‘fixed postures’ category, based on the type of stuttering
behaviors that predominated. The calculation of stuttering moments within a category
was done as:

\[
\text{Repeated Movements} = \frac{(SR + ISR + MSR)}{\text{total # of words stuttered}}
\]

\[
\text{Fixed Postures} = \frac{(FP-I + FP-A)}{\text{total # of words stuttered}}
\]

This computation was made for both the reading passage and monologue. Sample
data for Participant 1’s reading passage is presented as: \(SR = 3/131, ISR = 6/131, MSR = 1/131, FP-I = 26/131, FP-A = 3/131\). Therefore, when calculating the total words
stuttered, all the numerators were added \((3 + 6 + 1 + 26 + 3 = 39)\) to get the total number
of words stuttered throughout the reading passage. Then, the numerators in the repeated
movement subcategories of SR, ISR, MSR \((3 + 6 + 1 = 10)\) were added and divided by the
total number of words stuttered \((10/39 = 25.64\%)\). This gave the total for the repeated
movement category. The process was then repeated but instead, the subcategories of FP-
A and FP-I \((26 + 3 = 29)\) were added and divided by the total number of words stuttered
\((29/39 = 74.35\%)\). Therefore, sample Participant 1 was classified in the fixed postures
category, as 74.35% stuttered words were fixed postures. After each participant was
classified as being in the repeated movement or fixed posture category for each speaking
task, the total number of participants in each group were added and an independent \(t\)-test determined if there was a statistically significant difference between the two groups.

In addition to reporting in which category each participant was classified (repeated movements or fixed postures) based on the majority of their stuttering moments, the percentage of stuttering for each category was presented. In the example given above, the participant had a fixed posture majority in the range of 70-79%, with a specific percentage of 74.35%. By reporting the percent majority across participants, it can be identified if the majority of participants have a relatively equal distribution of stuttering moments (i.e., 50-59% majority) or whether participants tend to have a strong representation of one category (90-99% majority) over the other.

After classifying each participant by their predominant core stuttering category, an analysis was done to identify whether stuttering presents in adults as solely repeated movements or solely fixed postures, or whether stuttering always presents in combination. The calculation of stuttering moments within a category was calculated as:

\[
\text{Repeated Movements} = \frac{\text{SR} + \text{ISR} + \text{MSR}}{\text{total # of stuttered words}}
\]

\[
\text{Fixed Postures} = \frac{\text{FP-I} + \text{FP-A}}{\text{total # of stuttered words}}
\]

If the total percentage for participant of stuttering in a category was 0\%, the participant was recorded as having stuttering present as solely one category. If a participant has any percentage above zero in both categories, that participant was recorded as having stuttering presentation as ‘combined.’ An independent \(t\)-test determined if a statistically significant difference between the two groups existed with respect to stuttering presentation.
RESULTS

Participant Characteristics

Video recordings were collected and analyzed for a total of 95 study participants. Participants ranged in age from 18 to 76 ($M = 34.06$, $SD = 13.79$). The participants consisted of 10 females and 69 males. Although it is acknowledged that males are overrepresented from the traditional 3:1 male-to-female prevalence ratio (Guitar, 2006), the overrepresentation occurred due to the fact that many of the participant videos were drawn from previous studies in which only males were included. However, it has been suggested throughout the stuttering literature that the sex ratio of stuttering increases as children get older (Bloodstein, 1995), and that in adult persistent stutterers, the male-to-female ratio is estimated to a range of 4-6 males to every 1 female (Ambrose et al., 1997). This data indicates that the current study has only a slight overrepresentation of male participants. The ethnic diversity of the participants is as follows: 82% Caucasian, 7% Asian, 5% Hispanic, 4% African American, and 2% other. The ethnic characteristics of the participants reflect the population from which the sample was drawn.

The recordings for each participant contained an approximately 350 word ($M = 360.05$; $SD = 148.83$; range = 87 to 770) conversational speaking task and an approximately 150 word ($M = 159.18$; $SD = 40.28$; range = 131 to 229) reading task. The variability in sample size across the conversational monologue task was a result of speaking rate and stuttering severity across the 5-minute recording. Conversational
topics generally included participant’s hobbies, family, careers, recent books/movies, or vacations. The reading passages were either the “The Rainbow Passage” (Fairbanks' *Voice and Articulation Drillbook*, p. 127) or “The Grandfather Passage” (Darley, Aronson, & Brown, 1975). Out of the original 95 participants, 79 displayed stuttering behaviors greater than or equal to the required 2% criteria averaged across both speaking and reading tasks and were included in the study. Sixteen participants did not meet the 2% stuttering behavior criteria averaged across both tasks and were not included in the study. Results presented below were obtained from the remaining 79 participants.

**Stuttering Frequency by Task**

Overall, the total mean percentage of words stuttered during the conversational monologue task was 15.8% (*SD* = 13.44). The average number of words stuttered on the monologue task was 45.5 out of an average of 360.05 total words. The range of words stuttered in the monologue task varied from 2.6% to 61.3%. The total number of stuttering moments analyzed across the 79 participants during the conversational monologue was 3,591.

The mean percentage of stuttered words across the reading tasks by all participants was 14.4% (*SD* = 15.36). The average number of words stuttering during the reading task was 23.4 out of an average of 159.8 total words. The percentage stuttered on the reading task ranged from 0% to 63.9%. The participants who did not display any stuttering behaviors during the reading task were only included in the study if their stuttering behaviors on the conversational monologue were above 4.0%, bringing their stuttering average to 2.0% or greater. The total number of stuttering moments analyzed
across participants in the reading task was 1,847. These data are presented in Figure 1.

A correlated groups (paired) t-test was run to determine whether a statistically significant difference existed between the mean percentage of stuttering words across the two types of speaking tasks (reading, monologue). Results found that type of speaking task did not affect the mean percentage of stuttered words ($t[79, 79] = 1.2, p = .25$).

**Distribution of Stuttering Moments: Monologue Task**

The distribution of stuttering moments during the conversational monologue as assessed using the LBDL taxonomy were as follows: 19.4% ($SD = 15.74\%$) of all stuttered words were syllable repetitions (SR); 19.0% ($SD = 16.1\%$) of all stuttered words were incomplete syllable repetitions (ISR); 10.0% ($SD = 14.3\%$) of all stuttered words were multisyllabic unit repetitions (MSR); 21.2% ($SD = 21.3\%$) of all stuttered words were fixed posture-audible (FP-A); and 30.4% ($SD = 25.9\%$) of all stuttered words were fixed posture-inaudible (FP-I). These data are presented in Figure 2.

A one-way ANOVA was performed on the data to determine whether significant differences existed among the five different types of stuttering moments during the monologue task. A significant main effect was identified ($F[4, 394] = 11.2, p < .0001$) between stuttering moments. A Scheffe *post hoc* comparison indicated that the stuttering category of fixed posture-inaudible (FP-I) was significantly more frequent compared to the stuttering categories of syllable repetition (SR) ($p < .05$), incomplete syllable repetition (ISR) ($p < .01$), and multisyllabic unit repetition (MSR) ($p < .01$). A
Figure 1. Mean number of stuttered moments across the monologue and reading tasks. (Monologue task: $M = 15.77\%$, $SD = 13.44\%$), (Reading task: $M = 14.38\%$, $SD = 15.36\%$). No statistically significant difference was observed on the total number of words stuttered between speaking tasks.
Figure 2. Distribution of stuttered words across the monologue speaking task, as categorized by the LBDL taxonomy. Examples of the LBDL taxonomy categories include SR (“he-he-he”); ISR (“b-b-boy”); MSR (“really-really”); FP-A (“mmmore”); and FP-I (“I (pause) was going”). The mean for the FP-I was significantly higher than the means for SR, ISR, and MSR ($p < .05$); and the mean for FP-A was also higher than the MSR ($p < .05$).
significant difference ($p < .05$) was also identified between the categories of multisyllabic unit repetition (MSR) and fixed posture-audible (FP-A).

**Distribution of Stuttering Moments: Reading Task**

The distribution of stuttering moments during the reading task as assessed using the LBDL taxonomy was as follows: 10.53% ($SD = 17.28\%$) of all stuttered words were syllable repetitions (SR); 18.35% ($SD = 21.37\%$) of all stuttered words were incomplete syllable repetitions (ISR); 7.34% ($SD = 12.06\%$) of all stuttered words were multisyllabic unit repetitions (MSR); 19.62% ($SD = 21.30\%$) of all stuttered words were fixed posture-audible (FP-A); and 39.02% ($SD = 33.20\%$) of all stuttered words were fixed posture-inaudible (FP-I). These data are presented in Figure 3.

A one-way ANOVA was performed on the data to determine whether significant differences existed between the five different types of stuttering moments during the monologue task. A significant main effect was identified ($F [4, 394] = 24.5, p < .0001$) between stuttering moments. A Scheffe *post hoc* comparison indicated that the stuttering category of fixed posture-inaudible (FP-I) was significant from all the other stuttering categories of syllable repetition (SR) ($p < .05$), incomplete syllable repetition (ISR) ($p < .01$), multisyllabic unit repetition (MSR) ($p < .01$), and fixed posture-audible (FP-A) ($p < .01$). A significant difference was also identified between the categories of multisyllabic unit repetition (MSR) and fixed posture-audible (FP-A) ($p < .05$), as well as multisyllabic unit repetition (MSR) and incomplete syllable repetition (ISR) ($p < .05$).
Figure 3. Distribution of stuttered words across the reading task, as categorized by the LBDL taxonomy. Examples of the LBDL taxonomy categories include SR (“he-he-he”); ISR (“b-b-b-boy”); MSR (“really-really”); FP-A (“mmmore”); and FP-I (“I (pause) was going”). The mean for the FP-I was significantly higher than the means for SR, ISR, MSR, and FP-A categories ($p < .05$). The mean for FP-A was significant from the MSR ($p < .05$) category; and the MSR and ISR categories were also significant from each other ($p < .05$).
Repeated Movements versus Fixed Postures

Within the LBDL taxonomy, the stuttering movements of syllable repetitions, incomplete syllable repetitions, and multisyllabic unit repetitions are under the core category of repeated movements, and the stuttering movements of fixed posture-inaudible and fixed posture-audible are under the core category of fixed postures. In addition to reporting the individual category percentile means above, the mean percentages of the subcategories were combined to get the mean percentages of the core groups of repeated movements and fixed postures. For the conversational monologue task, the mean percentage of stuttering movements for the repeated movement category was 48.45\% (SD = 29.35\%). The mean percentage of stuttering movements of the fixed posture category for the conversational monologue was 51.52\% (SD = 29.15\%). These data are presented in Figure 4.

A correlated groups (paired) t-test (t [79, 79] = -0.47, p = .64) was run to determine whether a statistically significant difference existed between the mean percentages of core stuttering categories (repeated movements and fixed postures) in the monologue task. Results found that there was no significant difference between the core stuttering categories during the monologue task.

For the reading task, the mean percentage for the repeated movement category was 36.23\% (SD = 30.37\%), and the mean percentage for the fixed postures category was 58.64\% (SD = 32.29\%). These data are presented in Figure 5.

A correlated groups (paired) t-test (t [79, 79] = -3.4, p < .001) was run to determine whether a statistically significant difference existed between the mean
Figure 4. Mean percentage and standard error of stuttering moments across the monologue task by core stuttering category (Repeated Movements: $M = 48.45$, $SD = 29.35$; Fixed Postures: $M = 51.52$, $SD = 29.15$). No significant difference was observed between the two core stuttering categories.
Figure 5. Mean percentage and standard error of stuttering moments across the reading task by core stuttering category (Repeated Movements: $M = 36.23$, $SD = 30.37$; Fixed Postures: $M = 58.64$, $SD = 32.29$). A significant difference ($p < .05$) was observed between the means.
percentages of core stuttering categories (repeated movements and fixed postures) in the reading task. A significant difference was observed between the core stuttering categories (repeated movements vs. fixed postures) for the reading task.

**Distribution of Stuttering Moments by Percentage**

In order to determine whether some individuals who stutter exhibited solely one type of stuttering movement versus a combination of movements (i.e., repeated movements or fixed postures only), each study participant was classified as being in either the ‘repeated movement’ or ‘fixed posture’ category. Each participant was classified based on the percentage of stuttering in the core categories. For example, a person who had 38% repeated movements (SR + ISR +MSR) and 62% fixed postures (FPI + FPA) was classified in the fixed posture category because the majority of their stuttering movements occurred in this category. The range of percentages that qualified a participant for one core category versus the other was from 51-100%. In order to identify the number of individuals who had a strong majority of stuttering moments in just one core category or solely stuttering movements in one core category, the distribution of percentage majorities was outlined. The results are presented in Table 4.

Within the reading task, there were 12 participants who displayed 100% of their stuttering moments in only one of the two core categories. Six participants displayed 100% repeated movements during the reading task and 6 participants displayed 100% fixed postures during the reading task. These data, in addition to the rest of the participant’s distribution by dominant core category, are displayed in Figure 6.
Table 4

**Predominant Core Stuttering Category for Participants via Percent Range**

<table>
<thead>
<tr>
<th>Core Category</th>
<th>100%</th>
<th>99-90%</th>
<th>89-80%</th>
<th>79-70%</th>
<th>69-60%</th>
<th>59-50%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading Task</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repeated Movements</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>6*</td>
</tr>
<tr>
<td>Fixed Postures</td>
<td>6</td>
<td>8</td>
<td>13</td>
<td>7</td>
<td>11</td>
<td>1*</td>
</tr>
</tbody>
</table>

*8 participants had 50% stuttering in both categories and were not included in the chart
**4 participants in the reading task had 0% stuttering

<table>
<thead>
<tr>
<th>Core Category</th>
<th>100%</th>
<th>99-90%</th>
<th>89-80%</th>
<th>79-70%</th>
<th>69-60%</th>
<th>59-50%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monologue Task</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repeated Movements</td>
<td>4</td>
<td>3</td>
<td>8</td>
<td>7</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Fixed Postures</td>
<td>0</td>
<td>10</td>
<td>6</td>
<td>10</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>
Figure 6. Dominant core category: Reading task. Participants were classified according to their dominant core stuttering category by percent the dominant category was observed. For example, 6 participants displayed 100% of their stuttering categories as Repeated Movements during the reading task.
In the monologue task, the distribution of stuttering movements was similar across both categories. Four participants displayed 100% of their stuttering movements as repeated movements during the monologue task, whereas no participants displayed 100% of their stuttering moments as fixed postures during the monologue task. These data, in addition to the rest of the participant’s distribution by dominant core category, are displayed in Figure 7.

A Pearson Product Moment Correlation (PPMC) was used to further assess if the relative amounts of fixed posture stuttering and repeated movement stuttering were correlated between the speaking tasks. There was a significant correlation between the relative percentage of repeated movements between the reading and monologue speaking tasks ($r = .54, p < .01$). This correlation may be considered moderate. There was also a significant correlation between the relative percentage of fixed postures between the reading and monologue speaking tasks ($r = .59, p < .01$). This correlation may also be considered moderate. Overall, these findings indicated that while the stuttering type composite scores (repeated movements and fixed postures) were correlated between the speaking tasks, there was also substantial variability between the tasks. This variability may be indicative of the varying cognitive/linguistic demands of the two speaking tasks on different stuttering speakers.
Figure 7. Dominant core category: Monologue task. Participants were classified according to their dominant core stuttering category by percent the dominant category was observed. For example, 10 participants displayed 99-90% of their stuttering categories as Fixed Postures during the monologue speaking task.
DISCUSSION

The purpose of the current study was to examine the distribution of stuttering moments across a large sample of adult stuttering speakers to explore the possibility of subgroups or subtypes of stuttering, to identify the most and least frequently occurring types of stuttering behavior, and to identify whether significant differences exist between stuttering moment categories. The notion of subtypes in stuttering has been previously discussed across a wide range of stuttering literature, and would have significant impact on the diagnosis, prognosis, treatment, and ultimately, prevention of stuttering. Historically, vague terminology for reliably classifying stuttering behaviors has limited progress in delineating this multifaceted disorder. However, with the introduction of the LBDL taxonomy, objective terminology has greatly improved reliability and the opportunity to examine stuttering behaviors across large populations, replicate previous research, and compare individuals across geographical regions.

Experimental Questions

Distribution of Stuttering Behaviors Across Speaking Tasks

The category of stuttering that occurred most often, regardless of speaking task, was fixed posture-inaudible (FP-I). In the reading task, the FP-I category was statistically significant from all other categories, and in the monologue task, the FP-I category was significant from all categories except fixed posture-audible (FP-A). The
category that occurred least frequently across both speaking tasks was the multiunit repetition (MSR), which was significantly lower in the reading task than all categories except syllable repetition (SR). However, in the monologue task, the category of MSR was only statistically less than the two fixed posture categories, FP-I and FP-A. Therefore, the only significant differences between the five categories of the LBDL were found when each category was compared to the category that occurred most frequently (FP-I), or the category that occurred least frequently (MSR) within the given task. The categories of syllable repetition (SR), incomplete syllable repetition (ISR), and fixed posture-audible (FP-A) were not ever found to be significant from one another. This finding allows us to reject the null hypothesis that no significant differences would occur among the LBDL stuttering categories, as significant differences in the amount of stuttering per category were identified.

Repeated Movements vs. Fixed Postures

Each participant was classified as being in the repeated movement (RM) or fixed posture (FP) category based on their predominant type of stuttering. This was accomplished by adding the total number of stuttering moments within each core category (i.e., SR + ISR + MSR = RM; FP-A + FP-I = FP) and determining which core category (RM or FP) consisted of more than 50% of the stuttering moments in each individual and was therefore the dominant core stuttering category. For the conversational monologue speaking task, a significant difference was not identified between the two stuttering categories (RM and FP). However, a significant difference was found between the categories in the reading task, with fixed postures (FP) occurring
significantly more than repeated movements (RM). This finding allows us to reject the null hypothesis, which stated a significant difference would not be found between groups when participants were classified solely by RM or FP.

**Stuttering Presentation**

It was hypothesized that no participant would display stuttering behaviors in only one core category, that stuttering always presents as a combination of repeated movements and fixed postures; however, this hypothesis was rejected due to a small subgroup of participants who displayed 100% of their stuttering moments in the core category of either repeated movements or fixed postures. Twelve participants displayed stuttering behaviors solely as repeated movements (RM) or fixed postures (FP). Furthermore, many participants displayed a strong majority of their stuttering moments in one core category. This finding provides additional support for the previously discussed notion of distinct subgroups or subtypes of stuttering. When combined with the many neuroanatomical differences already identified in stuttering vs. nonstuttering speakers in previous research, this finding has important implications for future research. Specifically, if researchers can replicate the finding that a percentage of individuals who stutter display solely stuttering moments in one core category, neuroimaging techniques can be used to identify whether neuroanatomical or speech activation pattern differences exist among the different presentations of stuttering. If differences do exist between the subgroups of stuttering speakers, the notion of unique, but related, distinct types of stuttering cannot be ignored.
The importance of using a conversational monologue task in conjunction with a reading task to assess fluency is confirmed by the results of this study. A significant difference was found between occurrence of the core stuttering movements (repeated movements and fixed postures) during the reading task; however, no significant difference was found during the monologue task. One suggested hypothesis for the difference between speaking tasks is the unique demands associated with each task. A more detailed examination of individual task demand can be found in the Introduction.

In a recent study by Lu et al. (2010), neural substrates for atypical planning and execution of word production were examined. The study sought to address whether speech disfluencies were a result of a dyssynchrony between the cognitive-linguistic formulation of a speech plan and/or the motor execution of the linguistic plan (Howell, 2002, 2004; Howell & Sackin, 2002). Essentially, the study examined whether stuttering could result from a breakdown in the different phases of speech planning and execution, which would consequently affect the occurrence of stuttering across speaking tasks due to the differences in task demands. The results of the study lead Lu et al. to suggest a classification of individuals who stutter based on whether the disfluencies were a result of aberrant planning or execution function and state, “brain-based classification has the potential for subtype investigation of stuttering speakers and clinical diagnosis” (p. 154). Therefore, when considering classification of an individual into a subgroup of stuttering, it is important to consider the presentation of stuttering behaviors across different speaking tasks.
Clinical Implications

Distribution of Stuttering Moments

The results of the current study can neither confirm nor reject the possibility of subgroups in stuttering; however, evidence is provided that supports the notion of subgroups in stuttering. Further in-depth analysis is needed to identify whether specific patterns exist in relation to the severity of stuttering, placement of stuttering within a word or sentence, and phoneme characteristics of stuttered moments. However, broad observations can be made that support the notion of examining stuttering as a disorder that includes certain subtypes. First, in the reading task, there were 12 participants (15% of the total participants) who exhibited 100% of their stuttering movements in one core stuttering category (RM or FP). In the monologue task, 4 participants (5% of the total participants) exhibited stuttering behaviors as 100% of a core category. On the other hand, in the reading task, 15 participants (19% of the total participants) and 14 participants (17% of the total participants) displayed stuttering behaviors in both core categories equally with exactly 50% of their stuttering behaviors in each core category. Therefore, although stuttering does present as solely one core category in some individuals, it is important to note that the two core categories also present in relatively equal amounts in some stutterers.

The presentation of stuttering behaviors in solely one core category suggests that perhaps stuttering can occur in a ‘pure’ form, related to, but unique from mixed typical developmental stuttering in an extremely small subset of individuals who stutter. However, although this subset presents unique opportunities for future research, when considering the possibility of subgroups in stuttering and the given the moderate
correlation of stuttering moments across speaking tasks, it is more feasible to classify stuttering in subtypes that relate to the majority, for example, who display predominantly fixed postures or predominantly repeated movements. Additionally, the high percentage of participants who display a near-even distribution of stuttering moments could be evidence for a subgroup of mixed type. Therefore, it is proposed that a possible division of stuttering using behavioral characteristics for subtypes would consist of the categories a) predominantly repeated movement type, b) predominantly fixed posture type, and c) mixed type.

The proposed behavioral criterion for classifying an individual who stutters into one of the three proposed subtypes can be compared to mapping a behavior on to a normal bell curve. The individuals whose stuttering behaviors present as 50/50 (repeated movements and fixed postures) would be the center of the bell curve and constitute mixed type. The individuals whose stuttering behaviors fall on either end of the bell curve of over 85 and less than 15 (the repeated movements and fixed posture behaviors display an inverse relationship to each other) would fall into the subcategory of predominantly fixed postures or predominantly repeated movements, depending on which behavior occurs 85% or more of the time. Therefore, individuals who fall in the traditional 'normal distribution' part of the curve would be 'mixed type' and everyone one standard deviation above (and consequently, below) would fall into a predominant subtype. This way to assess subcategory classification could then be charted across speaking situations for each individual.

If subgroups or subtypes of stuttering were defined by the type of movement displayed by the individual who stutters, it could be argued that 85% is a valid criterion
to categorize an individual who stutters as being primarily in either the repeated movements subtype or fixed posture subtype. In behaviorist intervention models, the occurrence of a behavior with 80-90% of the time often indicates ‘mastery’ of a particular behavior, and the proposed criteria of 85% presentation of a specific stuttering behavior is consistent with this viewpoint. Although the measurement of stuttering behaviors is not the same as a measurement of a learned behavior, it is similar in the fact that a behavior is being measured. Therefore, the occurrence of a specific behavior 85% of the time across different speaking situations with different stimuli can suggest the behavior is happening with enough frequency or consistency to not be random. Therefore, when considering a specific stuttering behavior is happening 85% of the time, its frequency of occurrence may be grounds for categorization into a specific subgroup.

*Childhood Stuttering Characteristics*

When considering the notion of subtypes in stuttering and the previous difficulties developing a reliable classification system, it is essential to understand how stuttering behaviors transform from childhood and expand into persistent developmental stuttering in adulthood. The complex interaction of “overt and covert characteristics” (Yairi, 2007, p.168) and their variable presence in individual stuttering patterns has been recognized for many years. Predominantly, childhood stuttering consists of repeated movements and revisions, with the age of onset most commonly between 2-5 years old (Bloodstein & Ratner, 2008), a time of enormous language development and acquisition. Additionally, many children who exhibit disfluencies at a young age often recover from their stuttering behaviors due to the phenomena of spontaneous recovery. In a longitudinal study by
Yairi and Ambrose (1999), 74% of children who exhibited stuttering-like behaviors (mean age of onset 32.98 months) outgrew their period of disfluency in an average of 1-3 years postonset. Yet for those children whose disfluencies continued to develop into persistent developmental stuttering, recent research discovered that heterogeneity is evident at the time of onset in relation to predominant disfluencies (prolongations vs. repetitions) (Yairi & Ambrose, 2005; Yaruss, LaSalle, & Conture, 1998). However, when examined more carefully, several predominant patterns of characteristics (i.e., subtypes) may emerge among children who stutter (Seery et al., 2007). Considering the results of the current study, which identified dominant patterns of stuttering presentation (i.e., predominantly repeated movements, predominantly fixed postures, and mixed type) in adult stuttering speakers, if these patterns can be traced from childhood throughout one’s lifespan, important research implications can be derived. Neuroimaging studies can provide insight as to whether the neuroanatomical differences between childhood and adult stuttering speakers are a result of possible brain plasticity from years of stuttering, or whether the differences in stuttering speakers are apparent at time of stuttering onset. Additionally, since many children outgrow their period of disfluency, what is the ‘trigger’ for the children who develop persistent developmental stuttering? Ambrose et al. (1997) suggest that the two developmental paths of stuttering are due to genetic influences, and further research is needed to determine whether specific behaviors are present in children who develop persistent developmental stuttering that are absent in children who exhibit spontaneous recovery of their disfluencies.
Genetic Influences in Stuttering

Previously, the idea that genetic factors may play a critical role in the development of stuttering characteristics, including the possibility of stuttering subtypes, has only been briefly discussed in the literature (Ambrose et al., 1997). Yet recently in a study by Ambrose et al., different genetic liabilities for stuttering were observed within two subsets of children who stutter (those who develop persistent stuttering vs. those with spontaneous recovery). Ambrose et al. suggest that this unrecognized heterogeneity may explain previously ambiguous or contradictory characteristics of speech, and other variable parameters of children who stutter. By identifying these various patterns of childhood stuttering, researchers can provide evidence-based grounds for modifying traditional viewing of stuttering as a unitary disorder (St. Onge, 1963) toward recognition of subgroups (Ambrose et al.).

A better understanding of the genetic influence on stuttering development and presentation could have significant impact on the diagnosis, prognosis, treatment, and ultimately, prevention of stuttering. If stuttering patterns are identified in the current study across a large population of adult stuttering speakers, it could have significant impact on future researchers attempting to delineate specific subgroups, or types, of stuttering. Ambrose et al. (1997) stated:

The almost unanimous treatment of stuttering as a homogeneous disorder has hampered past research efforts on genetic factors in stuttering. Other areas of research concerning stuttering, especially its development, have attempted repeatedly to identify different possible types (Bloodstein, 1961; Preus, 1981; Van Riper, 1971), but without clues as how to divide the population of individuals who stutter may be divided, evidence of different causes, types, and development is clouded. (p. 578)
Neuroanatomical Differences in Stuttering vs. Nonstuttering Speakers

In recent years, numerous studies have examined neuroanatomical differences of adults who stutter and those who do not, and accumulating evidence supports the conclusion of dysfunctional neural interactions in stuttering speakers (Lu et al., 2010). Many different areas of the brain have been implicated in adults who stutter, including the basal ganglia, anterior insula, cingulated gyrus, frontal, prefrontal, speech motor planning, limbic, auditory, and other subcortical areas (Alm, 2004; Braun et al., 1997; De Nil, Kroll, Kapur, & Houle, 2000; Fox et al., 1996; Ingham et al., 2000; Watkins, Smith, Davis, & Howell, 2008). In other studies examining the motor execution of stuttering speakers, aberrant coordination among the articulatory, laryngeal, and respiratory systems was revealed during both stuttered and stutter-free speech (Loucks, & De Nil, 2006; Loucks, De Nil, & Sasisekaran, 2007; Max, Caruso, & Gracco, 2003; Namasivayam, & van Lieshout, 2008). Additionally, many studies have identified cerebral laterality differences between stuttering and nonstuttering speakers, as increased right hemisphere activation during linguistic tasks has been documented in stuttering speakers (Blomgren, Nagarajan, Tianhao, & Alvord, 2003; Cimorell-Strong, Gilbert, & Frick, 1983).

Traditionally, studies using neuroimaging techniques to identify differences in stuttering speakers have been conducted on adult stuttering speakers. Yet in a study by Chang, Erickson, Ambrose, Hasegawa-Johnson, and Ludlow, (2008), anatomical abnormalities were found in the left hemisphere of children who stuttered; whereas in adults who stuttered, the anatomical differences were found in the right hemisphere (Jäncke, Hanggi, & Steinmetz, 2004). These results might suggest that stuttering begins as a neurophysiological abnormality in the left hemisphere, and the anatomical changes
in adult stuttering speakers are possibly a result of brain plasticity or a compensatory strategy after many years of stuttering. Additionally, in a study examining the linguistic factors related to the speech planning process, altered neuroanatomical activation patterns in the areas of semantics, phonology, and syntax were observed in both child and adult stuttering speakers (Cuadrado & Weber-Fox, 2003; Kleinow & Smith, 2000; Ratner & Sih, 1987; Sasisekaran, De Nil, Smyth, & Johnson, 2006; Weber-Fox, 2001; Weber-Fox, Spencer, Spruill, & Smith, 2004). Therefore, since the current study identified ‘clusters’ or ‘patterns’ of stuttering characteristics in adult stuttering speakers, it is important to consider the implications of the research by Yairi et al. (1997) finding that heterogeneity is apparent at the time of stuttering onset, as well as the research of Chang et al. (2008), discovering that neuroanatomical differences exist between childhood and adulthood.

The greatest implications of the current study may be identified in the subset of participants who displayed 100% of their stuttering moments as one core category. These participants may provide the most support for the notion of subtypes or subgroups of stuttering. Previous brain imaging studies have provided accumulating evidence of widely distributed neural differences between stutterers and nonstutterers (Brown, Ingham, Ingham, Laird, & Fox, 2005; De Nil et al. 2008; De Nil et al., 2000; Fox, Ingham, Ingham, Zamarripa, Xiong, & Lancaster, 2000; Ingham et al., 2000; Ingham et al., 2004; Neumann et al., 2003; Wu et al., 1995). Therefore, a comparison between stutterers who display different types of stuttering behaviors (i.e., 100% RM or 100% FP) would become compelling evidence for the separation of stuttering into subgroups, especially considering the research by Lu et al. finding that disfluencies could occur as a result of a neurophysiological breakdown in either the cognitive-linguistic planning of a
speech message or the motor execution of the linguistic message. Therefore, if the core
categories of stuttering were found to be correlated with differences in neuroanatomical
activation patterns, the evidence for subgroups or subtypes of stuttering would be
irrefutable.

Ultimately, whether different anatomical differences are apparent from childhood
or develop in adulthood, or if different abnormalities are found to be associated with
different types of stuttering movements, this may provide evidence for the notion that
stuttering moment subcategories may be viewed as distinct types of stuttering. For
example, an adult stuttering speaker who has predominantly fixed postures may have a
slightly different neuroanatomical functioning or speech activation patterns than an adult
who has primarily repeated movements. From a neuroanatomical perspective, these
manifestations could be considered as related, but unique, disorders. Therefore, the
current study results are significant for identifying the different subsets of adult stuttering
speakers who can be categorized as ‘predominantly repeated movements,’
‘predominantly fixed postures,’ or ‘mixed type.’ Additionally, further neuroanatomical
analysis of the predominant patterns of stuttering characteristics in adult stuttering
speakers can provide insight to the origins of the disorder. Duffy (2005) states,
“Knowledge of neuroanatomy and neurophysiology is the foundation for differential
diagnosis and management of motor speech disorders” (p. 17). For example, in
dysarthria subcategories, the stuttering behaviors of ‘repeated movements’ and ‘fixed
postures’ are classified in different subtypes of dysarthria because they are contradictory
types of muscle movements (quick repetitions vs. clonic fixation). The separation of
characteristics into subcategories helps clinicians easily identify and target the abnormal
speech behaviors in therapy, as well as identifying the neuroanatomical origin of the disorder. In stuttering, these behaviors are combined into one disorder, with the neuroanatomical origin still unknown. Therefore, by examining any differences in neuroanatomical activation patterns and structures among different subgroups of adult stuttering speakers based on behavioral characteristics, researchers may better be able to understand the etiology of stuttering and, consequently, its development and manifestation from childhood to adulthood. In other words, if neuroanatomical differences are responsible for the presentation of different types of stuttering, it is possible that influencing factors appear in combination in individuals who present both types of stuttering and in isolation in individuals who present with solely one core category. Furthermore, it is important to consider that future research may uncover that stuttering may be the result of more than one disorder (Ambrose et al., 1997), especially considering the comorbidity of speech and language problems in individuals who stutter (Hall, Yamashita, & Aram, 1993; Homzie, Lindsay, Simpson, & Hasenstab, 1988; Janssen, Kraaimaat, & Brutten, 1990; Wolk, Blomgren, & Smith, 2000; Yairi, Ambrose, Paden, & Throneburg, 1996; Yaruss & Conture, 1996).

Treatment Efficacy

Because stuttering is a broad term that encompasses a complex and extremely variable interaction of characteristics, a critical piece to effective therapy is identifying what treatment techniques may be relevant for the characteristics expressed by certain individuals. By examining the distribution of stuttering behaviors across adults and potentially identifying perceptual subcategories of stuttering, clinicians can develop and
employ techniques that are more successful with different ‘types’ of stuttering in an
efficient manner. For example, if a client was referred under the potential subcategory of
‘repetitive stuttering,’ a clinician may then be able to identify that working on ‘reduced
articulatory pressure’ probably will not be a very effective fluency strategy to target with
that individual. Additionally, when seeing the subcategory ‘repetitive stuttering,’ a
clinician might be able to recognize certain concomitant behaviors are often associated
with a particular subtype and therefore additional strategies may be incorporated into
treatment. By having specific background information regarding a person’s stuttering
characteristics, a clinician can identify potential problem areas to observe and evaluate
during the initial consultation and customize a treatment plan with specific fluency
facilitating techniques in a potentially more efficient manner then previously. Treatment
could become more efficient, reflecting “research findings, current economic conditions,
and emerging health policies” (Ambrose et al., 1997, p. 578), reducing treatment time and
cost while providing client’s therapy based on best-practice policies.

Directions for Future Research

The Lidcombe Behavioral Data Language Taxonomy

The LBDL taxonomy has shown to be a marked improvement in the reliability
and objectivity for classifying stuttering moments. However, due to the complex nature
of stuttering and its variable presentation, complications with classification still exist.
One such complication is often seen with fixed posture stuttering moments.
Characteristics of a fixed posture often include muscular tension either with or without
audible airflow (i.e., audible is voiced, “vvvvvvan”; inaudible is not voiced, (pause)
hat”). However, depending on the duration of a fixed posture moment, an individual may run out of airflow. This may result in the repetition of a sound, leading to a combination of stuttering movements within one stuttering moment. An example would appear as “mm-mm-mm-mom,” with the ‘mmm’ first being an audible prolongation, and the dashed representing breaks in the airflow. According to the LBDL taxonomy, this type of stuttering moment would fit criteria for both a FP-A and an ISR. This ambiguity regarding classification can lead to lower reliability between researchers, clinicians, and families, depending on the type of classification each individual decides is most prominent and therefore warrants the primary label. Although this overlap between stuttering moments does not occur often (it is estimated a combination of stuttering movements occurs on 10% or less of all stuttering moments), it can occur between any combination of stuttering movements according to the subgroups of the LBDL taxonomy.

One solution proposed here is to expand the LBDL taxonomy to include a ‘combination’ or ‘ambiguous’ category, in which the individual applying stuttering moment classification can provide two labels to the same stuttering moment (i.e., ISR/FPI). This would eliminate disputes or discrepancies between individuals classifying the same stuttering moment who both have valid evidence to classify a moment as one category or the other. Additionally, it is proposed that each stuttering moment labeled as a ‘combination’ would be counted in the frequency tally only once. The proposed solution would increase specificity during stuttering analysis while not affecting the frequency count traditionally used to determine stuttering severity.
**Fixed Posture- Inaudible**

The category of fixed posture inaudible is the only stuttering subgroup in which voicing, or an audible iteration, is not the identifying factor of a stuttering moment. Consequently, any stuttered moment that is visible and without voicing is classified under this subgroup. However, when analyzing the stuttering moments of the current study participants, multiple types of inaudible stuttered moments were observed. Traditionally, the fixed posture core category is characterized by a clonic fixation of the articulatory musculature in which the initiation of the target word is delayed. Yet it was observed that many silent stuttered moments consisted of a groping of the articulatory musculature, which would have resulted in a type of stuttered repetition if voicing was added. In these instances, there was no fixation of the musculature typically observed in a fixed posture; rather, many times, repetition was seen in the musculature without any sound being produced. Due to these observations, it is suggested that an additional category be added in the form of ‘silent repetition’ in order to distinguish stuttering moments in which the musculature is clonic versus repetitive in nature, which ultimately could be found to be a result of differences in neuroanatomical activation patterns/functioning. This is especially true when considering if a pattern exists between type of stuttering behavior and characteristics of the stuttered phoneme, as discussed below.

**The Effect of Place, Manner, and Voicing on Stuttering Moments**

Further research is needed to examine whether correlational patterns exist between type of stuttered moment and characteristics of the stuttered phoneme, and to identify whether certain sounds are more conducive to a specific type of stuttering
category. For example, the phoneme /p/ is a voiceless bilabial stop, requiring pursing of the lips and a buildup of intraoral pressure before releasing. Therefore, it may be hypothesized that this particular phoneme is prone to fixed posture inaudible, as there is no associated voice (making it inaudible) and the pursing of the lips with intraoral air pressure may be conducive to a clonic fixture of the articulatory muscles (fixed posture). However, it may also be argued that different classes of sounds are more conducive to different types of stuttering. Stop consonants cannot be prolonged, possibly leading to the majority of stuttering behaviors surrounding stops to be in the repeated movement category. Fricatives, on the other hand, are created by constricting the oral cavity to create friction on the escaping airflow. Therefore, these sounds would appear to be more susceptible to fixed postures. Furthermore, the nature of voicing alone can also lead to distinctions between categorizing sounds. Since certain sounds are never voiced, it is assumed these sounds should be categorized as fixed posture inaudible. By identifying if specific patterns exist between the type of stuttering behavior and sound the stuttering occurs on, further research can be conducted examining the breakdown in specific motor production patterns, assisting in stuttering diagnosis, treatment-efficacy, and subtype discrimination.

_Stuttering Moments and Severity_

More research is needed to identify whether certain types of stuttered moments are associated with different severity levels. Due to the dynamic nature of stuttering, a criteria for establishing severity is not universally defined. The Stuttering Severity Instrument 3 (SSI-3) (Riley, 1994) takes into account the frequency of stuttered moments,
the average duration of the 3 longest stuttered moments, and physical concomitants. However, others argue that frequency of disfluencies, especially of certain types, is satisfactory for classifying severity (Van Riper, 1971). Despite which way the severity is determined, if correlational patterns exist between presentation of stuttering moments and severity, identifying the type of stuttering moments earlier in development may aid in diagnosis and treatment efficacy.

**Limitations**

The current study had several limitations. First, the data were analyzed by one researcher. Although interjudge reliability was found to be 99%, only 10% (10) of the study participants were analyzed by a second researcher. An additional researcher could have provided a stronger evidence for the use of the LBDL taxonomy as well as identifying patterns or subgroups within the data.

A second limitation identified by this study related to the ambiguous nature of some of the stuttered moments. Although these ambiguous stuttering moments occurred infrequently, when they occurred, the researcher used her best judgment to assign a LBDL taxonomy category to the most prominent movement observed. However, due to the complex and dynamic nature of stuttering and the variable presentation across individuals, this limitation is thought to be unavoidable.

The third limitation identified was the slight overrepresentation of male participants in the study. This was due to the fact that the participant videos were drawn from previously conducted studies in stuttering in which only males participated. Lastly, there was a large amount of variability on the number of words spoken during the 5
minute span for the conversational monologue across participants. In future studies, this can be controlled for by analyzing stuttering moments across an exact number of spoken words.

**Conclusion**

The results of this study support the notion of stuttering as a disorder composed of distinct subtypes. When combined with future neuroimaging studies, these results could have significant implications for the delineation of stuttering, diagnosis, and treatment efficacy. Additionally, the LBDL taxonomy provides an objective and reliable way to classify stuttering moments for researchers and professionals to compare across treatment clinics and replicate studies.
Table 5

Training Procedures for the Application of the Lidcombe Behavioral Data Language Taxonomy

1. The trainer reviews the terminology in the LBDL taxonomy with the trainee.

2. The trainer determines 10 videos of individuals who stutter to be analyzed.

3. Each participant’s monologue is typed into a transcript (10 videos).

4. All 10 participant videos are reviewed together (trainer and trainee) with a hard copy of the transcript.

5. The video is stopped as each moment of stuttering occurs and the behavioral characteristics of the stuttered moment are discussed.

6. In tandem, the trainer and trainee classify each moment of stuttering according to the LBDL taxonomy.

7. Repeat for all 10 training videos.

8. The trainee then analyzes 10 additional participant videos and classifies all of the stuttering moments according to the LBDL taxonomy.

9. Each video independently analyzed by the trainee is then reviewed by the trainer and trainee together to check for interjudge reliability.

10. Once a 90% interjudge reliability is observed across a minimum of 10 participant videos, the trainee is considered ‘trained’ in the application of the LBDL to classify stuttering moments.
# APPENDIX B

## INTERJUDGE RELIABILITY: READING TASK

### Table 6

*Interjudge Reliability: Reading Task*

<table>
<thead>
<tr>
<th>Subject #</th>
<th>Total Percent Stuttered</th>
<th>SR</th>
<th>ISR</th>
<th>MSR</th>
<th>FP-A</th>
<th>FP-I</th>
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Table 7

Interjudge Reliability: Monologue Task

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APPENDIX D

INTRAJUDGE RELIABILITY: READING TASK

Table 8

*Intrajudge Reliability: Reading Task*

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APPENDIX E

INTRAJUDGE RELIABILITY: MONOLOGUE TASK

Table 9

Intrajudge Reliability: Monologue Task

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