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Stuttering in Signed Languages

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Stuttering in Signed Languages

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Dedication

I would like to dedicate my Master's Report to my parents, Karen and Seth, and my brother, Ross. Their infinite love, support, and encouragement have made all of this possible, and there are no words to explain how much I love them for that and so much more. They truly are the greatest family in the entire world…

To my mom, Karen – I thank you for being my biggest fan. You were the one who first introduced me to the wonderful world of speech-language pathology, and I thank you for always having my best interests at heart. You always seem to know what's best for me, even if I don't know it yet, and you truly are the definition of a best friend. Our daily phone calls mean more to me than you know, and knowing that you stand beside me in everything I do is the greatest feeling in the world. You are the best mom in the entire world, and I hope to one day be as incredible as you. I love you very much!

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Hook 'em Horns!

Abstract

Stuttering in Signed Languages

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Little is known about stuttering in signed languages. Although disfluencies are known to occur in deaf users of signed languages, there has been little research suggesting that these disfluencies can be termed "stuttering". Because signed language studies is an emerging field and there are many answers that remain unknown, debate over the appropriate terminology for disfluencies in signed languages persists. While one argument is that stuttering is characterized by disfluencies in oral speech alone, a second argument is that the "stuttering" label can be extended to deaf signed language users as a result of similar neurological activations associated with oral speech and sign. Although not the primary purpose of this report, labeling disfluencies in signed languages as "stuttering" could have several advantages, such that the stuttering label could help individuals qualify for services, and determine the most appropriate ways to go about treating the disorder, clinically.

There are several neuropsycholingustic theories which attempt to explain the etiology of stuttering. In this report, I will analyze each of these and suggest ways in which they can be adapted to stuttering in signed languages. The purpose of this report is

to explore the idea of stuttering in signed languages and provide a framework and rationale for future studies of similar interest and intent. An examination of stuttering in signed languages will increase our general knowledge and awareness of stuttering, and suggest an alternative modality for which stuttering can be treated clinically.

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Section 1: Introduction

Researchers have identified stuttering as a complex, multifactorial disorder that affects 1% of the population (Riaz et al., 2005). Although stuttering is prevalent in today's society, we know little about the etiology and mechanisms underlying the disorder. Thus, it is not surprising that there is no standard definition of stuttering.

According to Ham (1990), the absence of a widely accepted definition of stuttering affects the way we conduct evaluations and therapy. For example, the National Stuttering Association (NSA) defines stuttering as a communication disorder involving disruptions, or "disfluencies" in a person's speech (2014). This definition can be compared to the definition proposed by Felsenfeld, Kirk, Zhu, Statham, Neale, and Martin (2000), which defines stuttering as a developmental disorder of speech production that usually emerges in childhood, characterized by chronic disturbances in a speaker's ability to produce smooth, forward-moving speech.

Although a standard definition of stuttering is crucial for clinical purposes, Perkins (1990) found that the absence of a formal definition of stuttering seems not to preclude our ability to appropriately label disfluent speech as "stuttering". In other words, the presence or absence of a universal definition does not hinder the recognition of certain types of disfluent speech as stuttering.

To address the absence of a formal definition of stuttering, Ham (1990) conducted a study in which 563 participants provided approximately 704 definitions of stuttering. The responses fell into six different categories (Non-defining Descriptors, Repetitious Speech Production, Other Specific Fluency Disruptors, Physical/Neurological Problems, Word/Sentence Formation Problems, & Other Responses). Furthermore, each category was divided into 2-10 subcategories. Ham suggests that although the public has a general

understanding of what stuttering in speech looks and sounds like, the need for a clear and comprehensive definition of stuttering remains. Clinically, the absence of a standard definition hinders the way we look at evaluation and therapy.

In this report, I use the working definition proposed by the American Speech-Language-Hearing Association (ASHA; 1997-2014), which states that stuttering is characterized by disruptions in the production of speech sounds, also called "disfluencies." I chose this definition because ASHA is the national professional, scientific, and credentialing association for more than 166,000 speech-language pathologists, audiologists, and affiliates, and as such can serve as a proxy for the profession as a whole. Advances in our understanding of disfluency in sign can inform our general understanding of language and speech in any mode. The aim of this report is to carefully review the current state of research on fluency disorders as related to both spoken language and signed languages, and to further our understanding of stuttering in signed languages. In addition, possible future research directions of clinical relevance will be discussed. To begin, a brief overview of fluency disorders is provided in the following section.

Section 2: Brief Overview of Fluency Disorders

Fluency disorders, or disfluencies, vary greatly from person to person (Bloodstein & Bernstein-Ratner, 2008) with regard to frequency, duration, type, and severity. Primary behaviors of stuttering include repetitions of whole words (She-she-she is nice), repetitions of sounds and syllables (Sh-sh-sh-she is nice), sound prolongations (Shhhhhhe is nice), and blocks/inaudible prolongations ([Sh]- - - -She is nice). Secondary behaviors are typically reactions to stuttering that are reinforced by their internal consequences which may serve to reduce the stuttering abnormality or prevent or delay its occurrence (ASHA; 1999). In contrast to primary behaviors, secondary behaviors are considered to be learned, and individuals who use secondary behaviors may or may not be aware of their presence. Secondary behaviors co-occur with stuttering-like disfluencies and manifest in several different ways, but are often observed as eye closure, excessive lip, neck, or jaw tension, and tapping of fingers or feet. The etiology of stuttering remains unknown; however, there is strong support for heritability (Cox, Kramer, & Kidd, 1984a). Previous research indicates that more than 25% of children who stutter have a parent who also stutters, more than 40% have an affected member in their immediate family who stutters, and more than 70% have stuttering in their immediate or extended family (Byrd, 2013). Older children and adults who stutter are more likely to do so during bidirectional communication with someone perceived to have equal or greater communication skills, as well as during the production of content rather than function words. Young children stutter more often on function words rather than content words, specifically “and”, as function words occur more frequently at the beginning of utterances in children (Byrd, 2013). Several neuropsycholinguistic hypotheses and theories, such as the Cerebral Dominance Theory (Travis, 1931), Holistic Processing

Theory (Byrd, Conture, & Ohde, 2007), Demands-Capacities Model (Adams, 1990), and the Approach Avoidance Conflict (Sheehan, 1953), address the etiology and further development of stuttering. The Cerebral Dominance Theory suggests that stuttering is the result of conflict between the right and left hemisphere, while the Holistic Processing Theory explains that stuttering may relate to inability of completing the process of phonological encoding within a timeframe commensurate with rate of activation. The Demands-Capacities Model argues that a deterioration of fluency reflects an imbalance between a child's capacities for fluency and the demands placed on those capacities, whereas the Approach-Avoidance Conflict holds that stuttering is hesitancy in a situation wherein the person wants to speak but also wants to avoid stuttering. These four theories will be explained in greater detail later in this report with their applicability to signers.

Research strongly suggests that children who stutter are more likely to exhibit co-existing phonological delay or disorder when compared to their nonstuttering peers (Louko, Edwards, & Conture, 1990; Paden & Yairi, 1996, Blood, Ridenour, Qualls, & Hammer, 2003). The prevalence of articulation or phonological disorders among individuals who stutter seems to be considerably greater than the 2% to 6% that would be expected in the general population (Beitchman, Nair, Clegg, & Patel, 1986). According to Bloodstein, there is hardly a finding more thoroughly confirmed in the whole range of comparative studies of stutterers and nonstutterers than the tendency of stutterers to have functional difficulties of articulation, immature speech, and the like (1987:219-220).

Due to the central role of phonological disorders and their relation to stuttering in this report, the remainder of this section will provide a brief overview of phonological disorders with their applicability to stuttering.

To review, the concept of phonological disorders is based on the idea that phonology is a part of the language system. Children with phonological disorders have

speech production problems that are specific to deficits in knowledge of phonological rules; they have underlying faulty phonological representations, which are called phonological processes (Roseberry-McKibben & Hedge, 2011). Phonological processes can be divided into three categories: substitution, assimilation, and syllable structure (Roseberry-McKibben & Hedge, 2011). Phonological processes are important to the discussion at hand, as Louko et al., (1990) report differences in the amount of processes between stutterers and those who are normally fluent. This study will be discussed in greater detail later in this section.

The three phonological processes (substitution, assimilation, and syllable structure) will be described below (Flahive & Hodson, 2010; Pena-Brooks & Hedge, 2007; Vihman, 2004), so as to provide a basis of understanding for the discussion to follow. As a reference, a chart of the International Phonetic Alphabet (IPA) is located on page 23.

Substitution processes occur when one class of sound is substituted for another. Examples of substitution processes are gliding, stopping, and backing. Gliding occurs when a liquid consonant (“r”, “l”) is produced as a glide (“w”, “y”). For example, “lamp” is produced as “yamp”, and “ring” is produced as “wing”. In stopping, a fricative (“s”) or affricate (“ch”) is produced as a stop (“t”). Examples of stopping include producing “to” instead of “shoe”, or “node” instead of “nose”. Backing is when a posteriorly placed consonant (“g”, “k”) is produced instead of an anteriorly placed consonant (“t”, “d”). In other words, velars are substituted for alveolars. For example, “but” is produced as “buck”, and “dumb” is produced as “gum”.

In assimilation processes, sounds are changed by the influence of neighboring sounds. Examples of assimilation processes are reduplication, consonant harmony, and voicing assimilation. Reduplication occurs when a pattern is repeated. For example,

“water” is produced as “wawa” and “bottle” is produced as “baba”. Consonant harmony can also be termed regressive assimilation or progressive assimilation. Regressive assimilation occurs due to the influence of a later occurring sound on an earlier sound. For example, “duck” is produced as “guck”, and “zip” is produced as “bip”. During progressive assimilation, the opposite is true, and an earlier occurring sound influences a later sound. For example, “kik” for “kiss”, and “bup” for “but”. Voicing assimilation can be devoicing (e.g. “”pik” for “pig”) or voicing (e.g. “bad” for “pad”).

Syllable structure processes affect the structure of entire syllables, not just certain sounds. Final consonant deletion, consonant-cluster reduction, and metathesis are all examples of syllable structure processes. Final consonant deletion occurs when the final consonant is omitted (e.g. “be-” for “bed”). Consonant-cluster reduction is when a consonant or consonants in a cluster are deleted. For example, “-peed” for “speed”, and “bes” for “best”. Metathesis, or spoonerism, is the production of sounds in a word in reversed order. Examples of metathesis are “peek” for “keep” and “lickstip” for “lipstick”.

How are these phonological processes relevant to the discussion of stuttering? Research has found that children who stutter are more likely to exhibit phonological disorders. Louko, Edwards, & Conture (1990) compared the phonological processes exhibited by children who stutter to those exhibited by their normally fluent peers. Subjects were 60 children: 30 who stutter (28 males, 2 females), with a mean age of 4; 4, and alike number of age- and sex-matched normally fluent children with a mean age of 4; 6. Those who stutter were referred by their parents, speech-language pathologists, or daycare/nursery school personnel. Attempts were made to recruit the normally fluent children from the same schools as the stuttering children; however, 6 of the normally 30 fluent children were recruited through local newspaper advertisements. Each child was

audio- and videotaped in one recording session lasting approximately 30 minutes, while informally interacting with his/her mother. Based on observations, the child was placed in one of two phonological categories: Normal Phonology (the child exhibited no phonological processes or exhibited only age-appropriate phonological processes) or Disordered Phonology (the child exhibited at least one "atypical" phonological process). The 30 stutterers exhibited more phonological processes than their normally fluent peers. In specific, the stutterers, as a group, exhibited a total of 18 different phonological processes, while their normally fluent peers exhibited 11. In addition, the mean number of phonological processes per child was greater for the stutterers than for the normally fluent peers; however, this difference was not statistically significant. Results of this study support previous research which indicates that children who stutter are more likely to exhibit speech sound errors than their normally fluent peers.

Through a longitudinal study, Paden and Yairi (1996) sought to examine early phonological differences between young children whose stuttering persisted and those who recovered from early stuttering. 36 children between the ages of 26-65 months were participants in this study: 12 children (7 males, 5 females) whose stuttering persisted, 12 children (7 males, 5 females) who recovered early and 12 children (8 males, 4 females) who recovered later. Participants were assessed by means of the revised version of the Assessment of Phonological Processes (Hodson, 1986) soon after they were identified as exhibiting stuttering. Participants were referred by a wide network of sources, such as pediatricians, nurses, day care centers, speech-language pathologists, and parents responding to newspaper ads. The overall mean percentage of error scores and error scores on specific phonological patterns showed that the persistent group differed significantly from normally fluent control subjects matched by age and sex. Scores of the two groups who recovered and their matched controls, however, did not differ

significantly. The comparisons between children who recovered from and persisted in stuttering demonstrated that the persistent group achieved poorer scores on tests of phonological proficiency.

Blood, Ridenour, Qualls, and Hammer (2003) conducted a study using a mailed survey to determine the percentage of children who stutter with co-occurring non-speech disorders (i.e. learning disabilities, literacy, and attention deficit disorders), speech disorders, and language disorders. The respondents from a nationwide sample included 1184 Speech-Language Pathologists. Of the 2628 children used in reference who stuttered, 62.8% had other co-occurring speech disorders, language disorders, or non-speech-language disorders; 12.7% were due to phonological disorders. Results suggest that a majority of children who stutter have at least one co-occurring speech, language, or non-speech-language problem, with the most frequent concomitant disorder being that of phonology.

In the following section, I will address the negative affect often associated with stuttering, one of the various underlying elements affiliated with this complex disorder in addition to overt disfluent output.

NEGATIVE AFFECT ASSOCIATED WITH STUTTERING

Stuttering can have a significant impact beyond a person's speech production to the person's overall quality of life. Although originally used to explain covert stuttering, or avoidance strategies used to hide an overt stutter, the Iceberg Analogy by Joseph Sheehan (2003) describes the internal battle individuals who stutter experience on a daily basis. This analogy explains that the tip of the iceberg is the part that is above the surface, similar to the overt speech behaviors visible to the listener, which represents the mechanical and physical act of stuttering. The tip of the iceberg is very small when

compared to the portion below the water line. In people who stutter, the portion below the line consists of the emotional aspects associated with stuttering, such as shame, fear, anxiety, and denial.

People who stutter often experience associated internal feelings as a result of their disfluencies. Such feelings may cause conflicting body images, as well as negative emotions such as anger, guilt, and shame. Individuals who stutter have also been known to limit their social interactions, as well as avoid certain speaking situations in an effort to conceal their stuttering; therefore, adversely affecting social identity construction (Byrd, 2013).

Recent studies further suggest that anxiety may play a mediating role in stuttering disorder, determined by interplay between variables such as communication attitude and apprehension (Blood, Blood, Tellis, & Gabel 2001; Messenger, Onslow, Packman, & Menzies, 2004; Ezrati-Vinacour & Levin; 2004; Mulcahy, Hennessey, Beilby, & Byrnes, 2008). This will be discussed in greater detail below.

Blood, Blood, Tellis, and Gabel (2001) examined the communication apprehension, or anxiety, and self-perceived communication competence of individuals who stutter. Participants included 39 adolescents who stutter and 39 controls who do not stutter, all between the ages of 13 and 18 years who were recruited in two ways: (1) Parents of children who stutter seen at the Pennsylvania State University Speech and Hearing Clinic were contacted to explain the nature of the study and requesting their child's participation, and (2) letters were mailed to Speech-Language Pathologists in school systems across Pennsylvania, Ohio, New Jersey, and Maryland, requesting their participation in a study of the communication attitudes of adolescents who stutter. Two standardized communication measures were used: The Personal Report of Communication Apprehension (PRCA-24) (McCroskey, 1984) and the Self-Perceived

Communication Competence (SPCC) Scale (McCroskey & McCroskey, 1988). Both assessments instruct students to complete items based on their experiences and attitudes toward communication. The PRCA is a 24-item self-report scale designed to measure an individual's fear, anxiety, or apprehension about speaking to one or more individuals, using a 5-level ordinal scale (strongly agree, agree, undecided, disagree, strongly disagree). The SPCC is a self-evaluation, 12-item scale that measures the individual's communicative competence on a ratio scale from 0 to 100. Participants estimated their communication competence in four settings (public speaking, meetings, group discussions, and interpersonal conversations) with three communication partners (strangers, acquaintances, and friends). Blood et al. (2001) found that adolescents who stutter reported significantly poorer self-perceived communicative competence and significantly higher levels of communicative apprehension than did their nonstuttering peers.

To determine whether expectancy of social harm is associated with speech related anxiety in those who stutter, Messenger et al., (2004) used tests of anxiety (The Fear of Negative Evaluation Scale - FNE and The Endler Multidimensional Anxiety Scales-Trait – EMAS-T) to answer the following questions about adults who stutter: (1) Do stuttering and control groups differ in fear of being evaluated negatively in social contexts, and (2) do the groups have differential expectancy effects in social compared to non-social situations? The FNE measures the fear of being evaluated negatively in social situations. It is comprised of 30 true-false questions that deal with apprehension about evaluation of oneself by others, the expectation that such evaluations would be negative, and the distress over such negative evaluations. The EMAS-T distinguishes anxiety related to perceived social threat from that of physical threat. The EMAS-T is a 60-item inventory consisting of 15 responses designed to elicit information about predisposition to anxiety

in four situations: (1) Social Evaluation, (2) Physical Danger, (3) New/Strange Situations, and (4) Daily Routines. A five-point scale where "0" = "very much" and "4" = "not at all" is required for each of the 15 statements. Stuttering participants were recruited from the treatment waiting list of a speech pathology clinic at a Sydney Metropolitan Hospital. All stuttering participants reported beginning to stutter in early childhood, in a manner consistent with developmental stuttering, or stuttering that is not due to any other acquired factor. Any potential participant who stuttered who reported receiving treatment for stuttering and/or anxiety during the previous 12 months was excluded from study. A total of 39 participants who stutter ranging in age from 19 years to 52 years, and 39 nonstuttering controls ranging in age from 19 years to 58 years, were recruited for the study. Through evaluation of the data as accumulated by the FNE and EMAS-T, results indicated that those who stutter differed from those who do not in their expectation of negative evaluation; however, the authors note that further research is recommended to verify the existence of these effects and to establish the extent to which they are clinically significant.

In their study, Ezrati-Vinacour and Levin (2004) employed several measures of self-reports to quantify general anxiety and social communicational anxiety in individuals who stutter. Participants included 94 adult males (47 who stutter and 47 normally fluent speakers) between the ages of 18 and 43 who were recruited through clinics for stuttering treatment. Anxiety was measured through the Trait State Anxiety Inventory (STAI) (Spielberger et al., 1970), Speech-Situation Checklist (SSC) (Brutten, 1973), and Task-Related Anxiety (TRA) (developed for purpose of study). The Trait Anxiety questionnaire of the STAI, adapted to Hebrew, was used, and consists of 20 descriptive statements of emotional conditions. The respondents were asked to relate the applicability of each statement to themselves according to a four-level frequency scale (rarely,

sometimes, often, usually). The SSC is a questionnaire used to evaluate situations that may arouse negative feelings. It lists 51 situations (e.g. ordering food in a restaurant, talking on the phone) that usually raise negative emotions in people who stutter. The items are scored from 1-5, corresponding to "not at all", "a little", "a fair amount", "much", and "very much", respectively. The purpose of the TRA is to evaluate anxiety level after performing four tasks (two speech and two non-speech): (1) conversation concerning personal information, (2) reading a passage aloud, (3) silent reading of a passage, and (4) listening to a recorded passage. Anxiety was measured on a continuum ranging from "extremely anxious" to "not at all anxious". Data from all three questionnaires were collected in a single session in the following four stages: (1) All participants were asked to rate their feelings of anxiety, (2) Participants were asked questions and read a neutral passage taken from a book of humorous short stories in order to produce 600 syllables for analysis of stuttering and assessment of severity, (3) All participants completed Trait Anxiety Inventory and Speech Situation Checklist in random order, and (4) All participants filled in a personal information questionnaire that included background characteristics that were used to match the two groups of participants. Findings suggest that people who stutter are more anxious than normally fluent speakers, and that anxiety is a personality trait of people who stutter.

Mulcahy, Hennessey, Beilby, & Byrnes (2008) examined the relationship between anxiety, attitude toward daily communication, and stuttering symptomatology in adolescent stuttering. Participants included 19 adolescents who stutter and 18 fluent speaking controls, all between the ages of 11 and 18. Each participant completed the State and Trait Anxiety Inventory (STAI) (Spielberger, 1983), the Fear of Negative Evaluation (FNE) scale (Watson & Friend, 1969), and the Overall Assessment of the Speaker's Experience of Stuttering Teen Version (OASES-T) (Yaruss & Quesal, 2006).

The STAI and FNE were described above. The OASES-T is used to obtain information from participants regarding their attitude toward communication in daily situations. This assessment tool contains four sections, which include the respondent's general knowledge of, their reactions to, and quality of life as a result of their speaking ability. The teen version differs from the adult version in terms of alternative wording on certain items with simpler vocabulary being used. Results of this study as indicated by the STAI, FNE, and OASES-T suggest that anxiety is significantly associated with difficulty with communication in daily situations for adolescents who stutter, but not for their typically fluent peers. This highlights the psychosocial concomitants of chronic stuttering in adolescents, and suggests that stuttering is a disorder that features psychosocial conflict regardless of its surface features.

Studies have also found that people who stutter make career choices as a result of their stuttering, and are perceived less positively when performing in certain careers (Byrd, 2013). Klein and Hood (2004) examined the impact that stuttering has on job performance and employability. The method involved administration of a 17-tem survey that was completed by 232 people who stutter, age 18 years and older. The first page of the survey consisted of identification information, where participants were asked to give information such as gender, age, ethnicity, education, and a self-rating of stuttering severity. The second page consisted of seven questions asking participants how they feel about the impact of stuttering in the workplace in general, and ten questions concerning judgments about their personal experiences in the workplace. A five-point Likert scale, ranging from "strongly agree" (1) to "neutral" (3) to "strongly disagree" (5) was then analyzed. Results indicated that more than 70% of people believed that stuttering decreases one's chance of being hired or promoted. Furthermore, more than 33% believed that stuttering interferes with job performance, and 20% actually turned down a

job or promotion because of their stuttering. These statistics suggest that people who stutter believe stuttering to be a handicap in the workplace.

Craig and Calver (1991) sought to investigate perceptions of fluency of persons treated with a fluency shaping technique called smooth speech. Smooth speech is a prolonged speech variant within a behavior therapy context. Four separate studies were conducted. The first study showed that virtually all those treated were satisfied with their fluency treatment. The second study demonstrated considerable opportunity for job promotion and upgrade in occupations for individuals completing a smooth-speech program. The third study compared employer perceptions of their employers' speech between a group who had received treatment for stuttering and a non-treatment control. The employers' perceptions of the treatment group were significantly enhanced, whereas no significant change occurred in employers' perceptions for the control group. The last study explored possible determinants of relapse in a population of treated stutterers. The third study, which looked at employers' perceptions of stutterers' speech before and after treatment, consisted of two groups whose careers demanded speech skills (e.g. management, secretarial, and clerical positions). The first group included 38 stutterers successfully treated in a smooth speech program, while the second group was a waiting list control and consisted of 20 stutterers employed in positions requiring speech skills. Both groups were asked to provide the names of immediate employers who were aware that they were seeking therapy. Those employers who agreed to participate were forwarded a 10-item Likert questionnaire designed to assess the communicative effectiveness of the employee who stutters. Two examples of the questions asked were "Is your employee's speech acceptable for the work environment?" and "Does your employee communicate face to face effectively?" The results supported the possibility that treatment for stuttering can significantly enhance employers' perceptions of

stutterers' speech. This is important if such people are to compete in vocations demanding communication and speech skills, as an employer could conceivably be a very exacting judge of speech quality.

Although no studies have looked at whether such findings can be applied to individuals who stutter in signed languages, based on what we do know (as will be discussed later), there is reason to believe there would be similar reactions in regard to individuals who stutter in sign. In the following section, I will provide a brief overview of signed languages as context for the subsequent discussion of stuttering in signed languages.

Section 3: Brief Overview of Signed Languages

As Speech-Language Pathologists, our caseloads often include clients who are deaf and in the process of developing communication skills through both oral and manual means. According to the Individuals with Disabilities Education Act (IDEA), deafness is defined as "a hearing impairment that is so severe that the child (or individual) is impaired in processing linguistic information through hearing, with or without amplification." Furthermore, it is important make the distinction between degrees of hearing loss, specifically "hard-of-hearing" and "deaf". In hearing culture, hard-of-hearing is more valued and indicates that the person is closer to being hearing and is more capable of interacting on an equal basis with other hearing people. "Deaf" is viewed more negatively and usually carries the implication that the person is difficult to communicate with, or may not speak at all. Thus, a deaf person is more likely to be avoided if he calls himself "Deaf" (Padden, 1980). Among Deaf people, however, the distinctions between hearing loss are not considered important for group relations. "Deaf" is not a label of deafness as much as a label of identity with other Deaf people (Padden, 1980).

Without the knowledge of communication disorders in signed languages, our clinical abilities are limited to the oral population. The remainder of this section will provide a brief overview of signed languages (with examples drawn from American Sign Language), so as to lay the groundwork for the comparison of signed languages to speech production in the sections to follow.

To begin, language is defined as a code or system of symbols used to express concepts formed through exposure and experience. This system of symbols, in turn, provides a mechanism for social interaction and communication (Roseberry-McKibbin & Hedge, 2011). American Sign Language (ASL) is a language conveyed through manual

and non-manual movements in front of the signer's body (in this report, most examples of signed language linguistic features will be drawn from the research on ASL, the signed language used in North America, but there is every reason to believe that similar linguistic structures and mechanisms exist in other signed languages). Signed language is a highly structured linguistic system with all of the grammatical complexity of spoken language, as well as rules for individual signs and signed sentences (Klima & Bellugi, 1979). Signed languages are rule-governed languages, in which linguistic roles, such as tense marking, plurality, and morphological markers, are expressed through visible gestures (Paul & Quigley, 1990). Said differently, signed languages have their own rules of grammar which relate to the major components of language, such as pragmatics (social use), semantics (meaning), syntax (structure or language), and phonology (sound system). The components of signs in ASL, for instance, include hand shapes, the locations around the body where signs are made, the movements of the hands and arms, and the orientation of the hands (Hickok et al., 2001).

Signed languages share important phonetic characteristics with spoken language, such as duality of patterning, or sequentially combining meaningless units to form linguistic utterances. Duality of patterning refers to the ability to form discrete meaningful units from discrete non-meaningful segments. In other words, it notes that the smallest meaning-carrying units are made up of meaningless smaller units (List, 1989). In spoken language, this can be thought of as the combination of phonemes (basic unit of sound) to form morphemes (the smallest unit of meaning). For example, the phonemes /d/, /a/, /g/ do not hold any linguistic meaning; however, when combined, they form the word "dog". The same holds true in signed languages. The four major parameters of signs, which will be discussed later in this report, are hand configuration, place of articulation, orientation, and movement. While each parameter is meaningless in itself,

they are combined in various ways to form linguistic signs. Thus, signed languages have duality of patterning.

In the next section, I will discuss how speech and sign are produced, and then explain how the neuropsycholinguistic theories of stuttering in speech can be applied to stuttering in signed languages.

Section 4: Stuttering in Speech and Sign

This section will compare and contrast stuttering in speech to stuttering in sign. I will begin with a brief explanation of relevant aspects of how speech and sign are produced, and then lead into how breakdowns, or disfluencies, might occur in each modality. As previously mentioned on page 3, the Cerebral Dominance Theory (Travis, 1931), Holistic Processing Theory (Byrd, Conture, & Ohde, 2007), Demands-Capacities Model (Adams, 1990), and Approach-Avoidance Conflict (Sheehan, 1953) are four different approaches to explain the etiology of stuttering in spoken language. This section will explore the idea that these theories are not necessarily exclusive to spoken language, and can be extended to sign.

SPEECH PRODUCTION

Speech production is a dynamic process that is possible through the collaboration of several internal systems. The vocal tract structures include two basic systems: the upper airway system and the lower airway system. The upper airway system involves the vocal tract (above the larynx), whereas the lower airway system involves the bronchial and lung systems (below the larynx; Tatham & Morton, 2011). Respiration is the exchange of gas between an organism and its environment, and is the basic energy source for speech production (Hixon, Weismer, & Hoit, 2008). The respiratory system is used primarily for breathing, and inputs air through the nose and mouth, and the pharyngeal tube leading to the larynx. When inhaling, air flows from the larynx to the trachea and bronchial tubes, which carry it deep into the lungs where oxygen is exchanged into the blood for transporting to wherever it is needed in the body. When exhaling, air direction is reversed, taking carbon dioxide exchanged from the blood up and out through the nose and mouth (Tatham & Morton, 2011).

The exchange of gas during respiration is accomplished in the lungs (Roseberry-McKibben & Hedge, 2011). The bronchi are tubes that extend from the lungs upward to the trachea (Zemlin, 1998). During inhalation, the air goes through the larynx to the trachea to the lungs, which expand. During exhalation, the air goes upward again through the trachea, which extends from the larynx (Roseberry-McKibben & Hedge, 2011).

Commonly known as the voice box, the larynx lies at the top of the trachea and houses the vocal folds, which are membrane-like structures that spread across the airway in the larynx. Although the primary function of the vocal folds is to prevent solid objects like food from entering the trachea and lungs (i.e. airway), the control of the vocal folds extends considerably beyond this basic function (Tatham & Morton, 2011). The vibration of the vocal folds allows for phonation, or the production of speech (Jiang, Lin, & Hanson, 2000). The vocal folds adduct, or move toward midline, and abduct, or move away from midline, as they vibrate. Vocal fold control enables languages to use sounds based on vocal fold vibration, and introduce more subtle effects of changes in the voice quality to convey mood and emotional feelings (Tatham & Morton, 2011). The intrinsic laryngeal muscles are primarily responsible for controlling sound production (Hixon et al., 2008).

Once the vocal folds are set into motion, the sound travels up through the vocal tract. As the laryngeal tone travels upward past the larynx, it is resonated by various structures such as the pharynx, oral cavity, and nasal cavity (Roseberry-McKibben & Hedge, 2011). Resonation is the process by which the voice is modified when some frequency components are dampened and others are enhanced (Roseberry-McKibben & Hedge, 2011). The pharynx, or throat, is part of the upper airway, which is modified by the position of the tongue in the mouth (forward or back) and the vertical positioning of the larynx in the neck (high or low; Pena-Brooks & Hedge, 2007). The nasal cavity,

which is important for the production of the nasal phonemes /m/, /n/, and /ng/, is separated from the oral cavity when the soft palate, or velum, is relaxed and lowered (Roseberry-McKibben & Hege 2011).

According to the Source-Filter Theory, the vocal tract is visualized as a series of linked tubes: the oral cavity, pharynx, and nasal cavity. These linked tubes provide the variable resonating cavity that helps produce speech (Seikel, King, & Drumright, 2005). The Source-Filter Theory states that energy from the vibrating vocal folds (the source) is modified by the resonance characteristics of the vocal tract (the filter; Behrman, 2008).

Articulation refers to the movement of joined anatomic parts and the production of speech sounds that result from such movements (Roseberry-McKibben & Hedge, 2011). Consonants are commonly described according to the place, voice, and manner of production.

The place of articulation refers to where in the oral cavity the sound is produced. For example, the place of articulation is alveolar when the tip of the tongue touches the alveolar ridge, which extends from the hard palate, and is located directly behind the teeth. Examples of alveolar sounds include /t/, /d/, /s/, /z/, and /n/. Labio-dental sounds are those which are produced when biting down on the bottom lip, for example, when producing /f/ and /v/. Bilabial sounds are when the top and bottom lips come together to produce a sound, as noted when producing /p/, /b/, and /m/. Velar sounds are when the back of the tongue comes in contact with the velum, or soft palate, so as to produce the /g/ and /k/ sounds.

The manner of articulation refers to the configuration and interaction of the articulators when making a speech sound. For example, the manner is a stop, or plosive, when there is occlusion of the vocal tract, and air flow stops completely. Examples of stops include /p/, /b/, /d/, /t/, /k/, and /g/. Fricatives, on the other hand, are produced when

there is continuous friction at the place of articulation, as the air is forced through a narrow constriction. Examples of fricatives include /s/, /z/, /f/, and /v/. Nasal sounds (/m/, /n/, /ng) occur when there is occlusion of the oral tract, but air passes through the nose. Nasals are produced by lowering the velum to keep the velopharyngeal port open, which allows for the sound produced by the vibrating vocal folds to pass through the nasal cavity.

Voicing refers to whether the vocal folds are vibrating when a consonant is produced. For example, /b/, /z/, /d/, /v/, and /g/ are all voiced sounds, compared to their cognate pairs, or sounds that are identical in every way (i.e. place and manner) except voicing, /p/, /s/, /t/, /f/, and /k/, which are all voiceless.

In phonology, minimal pairs are words or phrases which have distinct meaning, but differ in only one phonological element. For example, “bin” and “pin” are minimal pairs because they have the same place and manner, but differ on the voicing component of the initial consonant. “Mice” and “nice” are minimal pairs because they have the same manner and voicing, but are produced in different places in the oral cavity. Last, “ban” and “man” are minimal pairs because they have the same place and voicing, but different manners of articulation.

The chart below illustrates The International Phonetic Alphabet (IPA), which provides a visual breakdown of how specific speech sounds, or phonemes, are produced, by place, (horizontal axis), manner (vertical axis), and voicing (per each category, voiceless sounds are on the left, while voiced sounds are on the right).

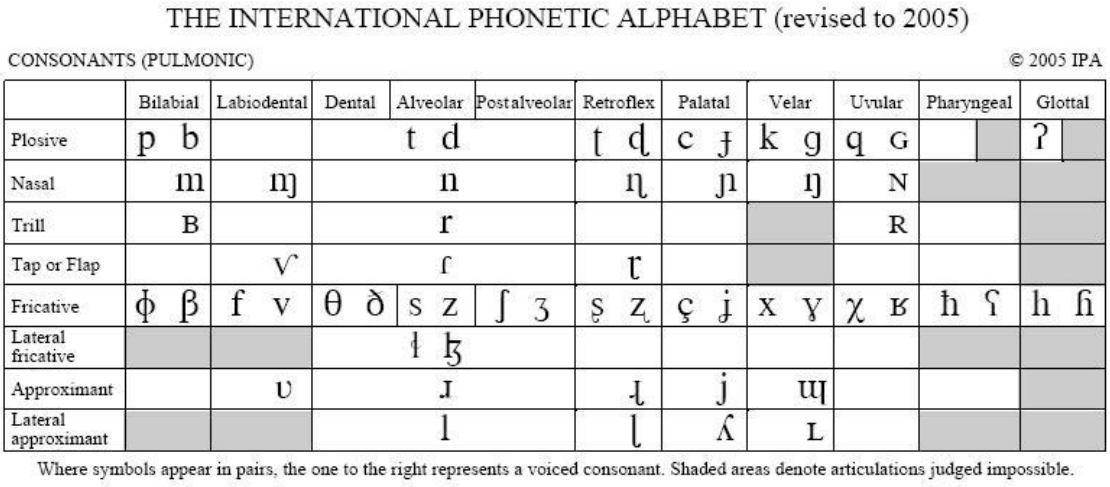

Figure 1: International Phonetic Alphabet

Now let us turn to the production of signed languages.

SIGN PRODUCTION

Analogous to speech production, sign production has specific parameters which help organize and make up the language. These parameters include the space which is ordinarily used, the relation of the hands, place of articulation, and movement of the hand configurations (Bellugi & Fischer, 1972). The majority of the information in this section was obtained from Bellugi and Fischer (1972) and is descriptive of American Sign Language, specifically. For more information about sign production, see Sandler (1989), Emmorey (2001), and Belvins (2004).

According to Bellugi and Fischer (1972), ASL is produced primarily by the hands, although the face and bodily movements play a role, as well. The space used in signing can be focalized, or contained, by establishing the boundaries in which signs do and do not exist. The base plane, or bottom boundary, is about at the level of the hands when clasped together in front of the body; very few signs are made below the waist. On the opposite end of the spectrum, very few signs are made above the level of the top of

the head; therefore, the space is an area bounded by the top of the head and the waist (Bellugi & Fischer, 1972).

If we consider the relation of the hands in signing, some signs are made with one hand, while others are executed with two hands. The hands can be stationary or set in motion, and come in contact with various parts of the body. Similarly, hand configurations play a large role in the semantics of American Sign Language, and there are several different hand configurations. Examples include palm open and fingers spread apart (e.g. FLIRT, TREE[1]), middle finger bent down from open hand (e.g. FEEL, SICK), and the hand held in a tapered "0" (e.g. TEACH, NUMBER) (Bellugi & Fischer, 1972).

When considering the types of movement involved in signing, some are quite simple and direct (e.g. the hand contacts some part of the body), though very few signs have such simple motion (Bellugi & Fischer, 1972). Some signs are made by brushing against the area of contact (e.g. bread, week), twisting the wrist after making contact (e.g. APPLE, COW), or moving away in a slight arc before making contact with another location (e.g. YESTERDAY).

As previously mentioned, oral speech is a set of modulations of the stream of air which passes through the oral, nasal, and pharyngeal cavities. Signed languages can be thought of as a set of modulations of the hands and fingers in relation to the top half of the body and the space in front of it (Bellugi & Fischer, 1972).

PHONOLOGICAL ENCODING IN AMERICAN SIGN LANGUAGE

Research has found that deaf American Sign Language users exhibit phonological encoding skills, or retrieve and organize segments to form words, in a similar manner as hearing individuals. An overwhelming amount of research (Brocklehurst, 2008; Arndt

[1] As no written form of ASL exists, the term "gloss" refers to transcribing signs on paper (using approximate English translations). Typical glossing practice shows signs written out in capital letters.

and Healy, 2001; San Jose-Robertson, Corina, Ackerman, Guillemin, and Braun, 2004) has also found that phonological encoding plays a large role in stuttering, which will be addressed in great detail when discussing the Holistic Processing Theory on page 31.

While spoken words are sequential arrangements of speech segments, signs are simultaneous combinations of various hand configurations, types of movements, and places of articulation (Bellugi & Fischer, 1979). Bellugi and Fischer (1972) explain this in more detail, using the three phonemes /p/, /a/, and /t/. These three phonemes can be rearranged to produce the words "pat", "tap", and "apt". In other words, oral speech allows for the rearrangements of sounds to produce different words. ASL, on the other hand, allows for the same hand position to be used for a variety of signs; however, they are considered distinct from others as a result of hand placement. Bellugi and Fischer's (1972) example differentiates between the signs for HOME and FLOWER. HOME is produced by holding the dominant hand in a "0" position, touching the cheek near the mouth, moving away in a small arc, and touching the upper cheek. If we maintain the same hand position and touch one side of the nose, and then move away slightly to touch the other side of the nose, the resulting sign is FLOWER. Similar to articulation in speech, which is characterized by place, manner, and voicing, the meaning of a sign can change by altering but one dimension. For example, take the signs for MOTHER and FATHER. They have the same hand orientation and shape, but they come in contact with different parts of the body (MOTHER comes in contact with the chin; FATHER comes in contact with the forehead).

Because FLOWER and HOME in the first example and MOTHER and FATHER in the second example have the same hand shape and palm orientation, and only differ by placement, such characteristics are comparable to minimal pairs in speech. For another example, consider the signs for MY and PLEASE. MY is produced by laying the palm of

the dominant hand on the chest, while PLEASE is producing by laying the palm of the dominant hand on the chest, while moving in a circle. Both signs have the same palm orientation and placement; however, they differ in movement. To complete this point, consider the signs for PLEASE and SORRY. As the sign for PLEASE was described above, the sign for SORRY is produced the exact same way; however, the hand shape is an "S" rather than a closed 5.

As previously mentioned, there are phonological processes in American Sign Language similar to that of spoken language. For example, some sign variations can be analyzed as the result of four phonological processes: movement epenthesis, hold deletion, metathesis, and assimilation (Valli & Lucas, 1995; see Liddell & Johnson, 1989). Phonological processes in ASL may influence how parts of signs are produced or the order in which they are produced.

Before discussing the four phonological processes in sign, it is important to discuss the Movement-Hold Model (Reading, 2000), which is a proposed model of characterizing the underlying structure of signs in ASL. One fundamental claim about the structure of signs in the Movement-Hold Model is that signs consist of hold segments and movement segments, both of which are produced sequentially (Liddel & Johnson, 1989, discussed in Valli & Lucas, 1995). Information about the handshape, location, orientation, and non-manual signals is represented in bundles of articulatory features, which are similar to the features that make up sounds of spoken languages. To clarify, signs are either in a steady state (hold) or a period of transition (movement), and can change throughout the production of individual signs. Holds are defined as periods of time during which all aspects of the articulation bundle are in a steady state; movements are defined as periods of time during which some aspect of the articulation is in transition. It is important to note that more than one parameter can change at once, which

takes place during the movement segment. If we consider the sign for UNDERSTAND, the place and manner remain the same throughout the sign, but the hand shape changes. Therefore, the sign for UNDERSTAND has a movement segment. As another example, the sign for WEEK begins with a hold with the right and left hand. The right hand then moves across the left hand. Thus, the movement of the sign is in the location of the active hand. The Movement-Hold Model allows for the level of detail needed for the adequate description of sign structure and of sign processes in ASL. It demonstrates that the fundamental structure of signed languages is parallel to the fundamental structure of spoken languages (Valli & Lucas, 1995). The Movement-Hold view (while not necessarily the last word on these matters) can be thought of as a description of something very much like internal syllable structure within ASL signs.

The four American Sign Language phonological processes under examination here can be described by reference to the Movement-Hold model.

Movement epenthesis refers to the process of adding a movement segment. Signs occur in sequence, which means that the segments that make up signs occur in sequence. Movement epenthesis occurs when a movement segment is added between the last segment of one sign and the first segment of the next sign. Take, for example, the signs FATHER and STUDY. The basic form of both of these signs is a hold with internal movement. When the two signs occur in sequence, however, a movement is inserted between the two holds (Valli & Lucas, 1995).

Similar to with movement epenthesis, hold deletion eliminates holds between movements when signs occur in sequence. In other words, successive signs remain in motion. For example, the signs for GOOD and IDEA are both composed of a hold, a movement, and a hold. When the two signs occur in sequence, a movement is inserted between the last segment of GOOD and the first segment of IDEA, so as to eliminate the

last hold of GOOD and the first hold of IDEA. This phonological process gives the illusion that the two individual signs flow in one smooth movement. Therefore, the internal "syllable" structure of GOOD IDEA is hold-movement-movement-movement-hold (Valli & Lucas, 1995).

Similar to spoken language, metathesis is the process of changing place (location) in the internal structure of some American Sign Language signs. There are several signs that allow segments to change place; for example, the sign for DEAF. While maintaining the same hand shape and orientation, DEAF is often produced by touching the cheek and then the jaw; however, the location feature of the first and last segment might be reversed, touching the cheek and then the jaw. Similarly, signs for HOME and RESTAURANT, amongst several others, follow this same process (Valli & Lucas, 1995).

Assimilation means that a segment takes on the characteristics of another segment near it, usually the one just before it or after it. This concept can be compared to assimilation in spoken language, during which, for example, a non-nasal sound can be produced as a nasal due to surrounding nasal phonemes (e.g. “a” in “man”). When signing the pronoun “I”, the signer quite simply points to himself with his index finger. When the signs occur in sequence, however, the hand shape often changes to match the hand shape of another sign in the sequence. For example, in signing I INFORM, the hand shape for “I” changes from a 1 to a 0 because of the hand shape for INFORM.

The following section will provide information regarding the etiology of stuttering. Five theories which seek to address to etiology of stuttering will be discussed, along with rationales as to how these theories can be applied to signed languages.

Section 5: Etiology of Stuttering

There is still much that remains unknown about stuttering including, of course, the question of what causes individuals to stutter. Although it is known that genetics play a role in the etiology of stuttering, the etiology itself continues to warrant further investigation (Ambrose, Cox, & Yairi, 1997). There are at least five historically significant theories regarding the causes of stuttering, which will be addressed in the remainder of this section.

THEORY 1: CEREBRAL DOMINANCE THEORY

The Cerebral Dominance Theory (Travis, 1931) assumes that stuttering is the result of a conflict between the right hemisphere and left hemisphere for control of the structures used for speaking. This theory suggests that cerebral dominance may be affected with change in handedness, so as to say that left-handed people usually have dominance in the right hemisphere. According to the Cerebral Dominance Theory, people who stutter are less likely than their fluent peers to have developed unilateral cerebral dominance. This theory posits that these people stutter because of their lack of unilateral cerebral dominance (Silverman, 2004). This theory is questionable in its stated form, but the manner in which language is processed in the brains of people who stutter continues to be explored (Roseberry-McKibben & Hedge (2011).

Before comparing the neurological representation of spoken language to signed languages, it is important to first discuss general cerebral characteristics and neurological activation sites. The human brain is divided into two hemispheres, the left hemisphere and the right hemisphere, which are structurally similar but functionally different (Brookshire, 2007). The left hemisphere is specialized for language, thinking, and reasoning tasks, while the right hemisphere is responsible for visuo-spatial tasks.

Furthermore, the human brain has four lobes, including the frontal lobe, parietal lobe, occipital lobe, and temporal lobe (Brookshire, 2007). The left inferior frontal gyrus of the frontal lobe, also known as Broca's area, is responsible for fluent oral speech production, or output. Damage to this area results in disfluent speech; however, comprehension remains intact. The superior posterior temporal gyrus of the temporal lobe, also known as Wernicke's area, is responsible for the comprehension, or input, of speech. Damage to this area results in the inability to comprehend speech; however, individuals with damage to Wernicke's are still able to produce fluent speech (Chandrasekaran, 2013).

Research studies of language and brain functions have suggested a division of lateralization between the cerebral hemispheres for linguistic and nonlinguistic processes (Paul & Quigley, 1990). Research has found that signed and spoken languages share the abstract properties of language, but differ radically in their outward form; spoken languages are encoded in acoustic-temporal changes (variations in sound over time), while signed languages rely on visual spatial changes to signal linguistic contrasts (Hickok et al., 2001). According to Campbell, MacSweeney, and Waters (2007), the specialization of cortical networks for language processing does not appear to be driven either by the acoustic requirements for hearing a spoken language or by the articulatory requirements. Instead the specialized requirements of language processing itself, including compositionality, syntax, and the requirements of mapping coherent concepts onto a communicable form, determine the final form of the specialized language circuits in the brain.

Neuropsychological studies have been useful in mapping where signed languages are processed in the brain, confirming that signed languages have brain activation faculties parallel to that of spoken language (Woll, 2009). With this knowledge, there is reason to believe that our current knowledge and understanding of stuttering in spoken

language can be extended to include that of signed language. Although differences between signed and spoken language are observed in right hemisphere activation, it is unknown whether these differences are the result of compensating for left hemisphere differences, or if they are due to atypical emotionality during speech that has developed over time. Perhaps, these same differences would be observed in signers who stutter, as well. If this conjecture lends itself to be true, such knowledge can facilitate additional research and generate implications that can be applied clinically.

THEORY 2: HOLISTIC PROCESSING THEORY

The Holistic Processing Theory (Byrd, Conture, & Ohde, 2007) suggests that developmental stuttering may relate to difficulty completing the process of phonological encoding within a timeframe commensurate with the rate of activation. There is a mismatch between the completion of the phonological spell-out and activation of the motor program, which results in the execution of an underspecified motor plan. The person who stutters then repeats the underspecified plan until the complete plan is accessed and/or the incomplete plan is abandoned. Simply put, the Holistic Processing Theory says that there is a delay in retrieval of the phonological form of the word due to holistic processing, which results in a sound repetition, prolongation, or block until the plan is accessed or abandoned (Byrd, 2013).

Arndt and Healy (2001) conducted a survey study to determine the number of children who stutter with verified and suspected concomitant phonological and language disorders. A systematic sampling plan was used to obtain survey responses from 241 ASHA-certified school-based Speech-Language Pathologists from ten states that were considered to have similar state verification criteria for fluency, articulation/phonology, and language disorders. Respondents were asked to provide information concerning

verified and suspected concomitant disorders in children who stutter. The Speech-Language Pathologists reported on 467 children who stutter. Of that total, 262 (56%) children had a fluency disorder, 205 (44%) of whom had a verified co-occurring phonological and/or language disorder. 66 (32%) of these 205 children were reported to have what they referred to as a verified phonological disorder, 72 (35%) presented with a language disorder, and 67 (33%) presented with a phonological and language disorder. This study was an important first step in examining, in a systematic manner, co-occurring disorders of school-age children who stutter. The data provide meaningful information for clinicians because children with fluency disorders and co-occurring phonology and/or language disorders may require different assessment and/or treatment programs than children with only fluency disorder (Blood et al., 2003). This survey showed that a large percentage of preschool through high school students possessed a verified fluency disorder and/or language disorder. The findings are consistent with the possibility that stuttering and phonological difficulties are most likely to co-occur in those children whose stuttering persists (Paden & Yairi, 1996), and, thus, in support of the Holistic Processing Theory.

Byrd, Conture, and Ohde (2007) investigated the holistic versus incremental phonological encoding processes of young children who stutter through the use of a picture-naming priming paradigm. Holistic processing has been defined as processing at the syllable or global unit of speech (Walley, 1988), while incremental processing has been defined as the processing of the word as individual sounds from beginning to the end of the word (i.e. left to right). This paradigm allowed for experimental manipulation of the speed of the covert linguistic planning processes that lead to participants' overt speech and language production. Participants included 52 monolingual 3-year-old and 5-year-old children who stutter and speak Standard American English. These children were

matched for age and gender with the same number of children who do not stutter. Participants were referred by their parents, speech-language pathologists, or daycare, preschool, or school personnel. Fluent controls were recruited by word of mouth or through a newspaper advertisement. The participants named pictures during three auditory priming conditions: neutral (participants were presented with a neutral prime 600 ms prior to picture presentation), holistic (participants were presented the holistic prime 600 ms prior to picture presentation), and incremental (participants were presented with an incremental prime 600 ms prior to picture representation). For each condition, participants were shown the same set of 12 target pictures one at a time in a randomized order. Primes were "incremental" if they were composed of only the initial sound segment of the word and the first two to six glottal pulses of the vowel transition. In comparison, primes were "holistic" if they included a portion of the initial transition and all of the nucleus and final transition to allow for the processing of the global shape of the syllable unit of speech. As the participants' ages increased from three to five years old, they shifted from being significantly faster in the holistic priming condition to being significantly faster in the incremental priming condition. This suggests that children who stutter are delayed in making the developmental shift in phonological encoding from holistic to incremental processing, a delay that may contribute to their difficulties establishing fluent speech, which is supportive of the Holistic Processing Theory.

As previously mentioned, the Holistic Processing Theory characterizes stuttering as an error in phonological encoding within a timeframe commensurate with rate of activation. Through illuminating the neural systems involved in American Sign Language generation to differentiate processing stages related to, amongst others, phonological encoding, Jose-Robertson, Corina, Ackerman, Guillemin, and Braun (2004) studied sixteen right-handed, congenitally deaf signers (10 women, 6 men; age 20-19 years of

age), all of whom were children of deaf parents and fluent in ASL. Results suggest that phonological encoding does, in fact, occur in American Sign Language. Analysis revealed bilateral activation of sensorimotor areas and association cortices in the temporal, parietal, and occipital lobes evidencing left hemisphere involvement in ASL. This demonstrates that, regardless of modality, disfluencies as a result of errors in phonetic planning can be localized to disturbances in the left hemisphere, both in the production of oral speech and sign. Furthermore, Emmorey (2006) suggests that the phonological system of signed language appears to overlap with phonological systems of spoken languages in sign and speech production in brain imaging studies. On this basis, we have reason to believe that the mechanisms underlying stuttering in signed languages can be understood within the framework of the Holistic Processing Theory.

THEORY 3: DEMANDS-CAPACITIES MODEL

The Demands-Capacities Model (Adams, 1990) is a multifactorial model which analyzes the internal and external factors that influence the production of fluent and non-fluent speech in children. Further, the Demands-Capacities Model explains that a deterioration of fluency reflects an imbalance between a child's capacities (i.e. tendencies, strengths, weaknesses, and perceptions) for producing fluency and the demands (e.g. rapid rate of speech) placed on those capacities by the child and/or child's environment (Starkweather, Gottwald, & Halfond, 1990). In other words, children have developing capacities for speaking fluently, and as they get older and a greater capacity for fluent speech is required of them, the demands for fluency also increase. The demands and capacities for fluent speech stay in balance the majority of the time; however, when the demands exceed the child's capacities, a period of increased normal disfluency may result. According to the Demands-Capacities Model, stuttering develops when the

demands chronically outweigh the child's capacities for fluency. If the demands are reduced, thus providing the capacities an opportunity to "catch up", the child will most likely experience increased fluency, and may even recover from stuttering. The Demands-Capacities model suggests that the communication partner modify his or her output, such as using a slower rate, increasing the use and length of pausing, reducing demands, minimizing interruptions, increasing silence, and modeling disfluencies. All of these modifications help minimize demands placed on the child, which enhances fluency.

The idea for organizing the data into two major categories (demands for fluency and capacities for fluency) was developed as the solution for the role of language in the development of stuttering, as three facts about stuttering and language did not seem to fit well together: (1) Stuttering is likely to occur at locations that are linguistically demanding (e.g. long words/complex sentences); (2) as a group, people who stutter are a little behind in language development; (3) some children who are linguistically superior begin to stutter, sometimes on linguistic forms that they are just beginning to use, and sometimes the stuttering episodes correspond with spurts of language development (Starkweather & Gottwald, 1990). In other words, both linguistically inferior and linguistically superior children are at risk for stuttering. This statement is supported by the notion that, although both groups have significantly different language skills, both groups share an environment that demands their language performance.

How might this apply to signers? By definition, the Demands-Capacities Model explains that stuttering increases with productions of greater complexity. The relation between demands and capacities would seem to be modality-independent. It stands to reason that, similar to what happens in spoken language, the interaction between environmental and/or internal demands and capacities of the child can lead to fluency breakdowns in signed languages. This may occur in several ways. For example, there

can be high demands that exceed inferior capacities, abnormally high demands that exceed normal capacities, or normal demands that exceed inferior capacities, all of which can result in disfluent speech as well as disfluent signs.

THEORY 4: APPROACH-AVOIDANCE CONFLICT

The Approach-Avoidance Conflict (Sheehan, 1953) suggests that stuttering behavior is hesitancy or holding back in a situation which calls for going ahead, that results in an interruption in the forward flow of speech. In other words, stuttering results from a conflict between a desire to speak and a desire to avoid speaking due to fear of stuttering. The cause of "holding back" may be due either to learned avoidances or unconscious motives. According to the Approach-Avoidance Conflict, fluent speech is possible when the drive or desire to speak is stronger than the drive to avoid speech. When the drive to avoid speech is the stronger of the two, the person does not talk at all; however, when the two drive states are equal in strength, stuttering results. Because the avoidance is based on fear, stuttering is to be treated as a fear problem.

Speech is a sequence of movements, and stuttering is a breakdown in the sequence (Sheehan, 1953). Whatever the involvements of the disorder, the point at which the breakdown occurs must bear a relation to these involvements. The breakdown occurs early in the sequence, but seldom prevents initiation of the sequence. In other words, stuttering is a disorder of release, of going partway, and then stopping (Sheehan, 1953).

According to Sheehan (1953), if stuttering is a form of conflict, it should vary systematically as follows: Stuttering should be increased by (a) a heightening of the avoidance drive through an increase in the penalty upon which fear and avoidance are based and (b) by a lowering of the approach drive. Consequently, stuttering should be

decreased by (a) a reduction in the avoidance drive and (b) an increase in the approach drive.

Sheehan (1953) proposed five distinct levels at which conflict may occur in stuttering: word-level, situation-level, emotional content level, relationship level, and ego-protective level. At the word level, the conflict is between the urge to speak the word and the urge to not speak the word. At the situation level, there is a parallel conflict between entering and not entering a feared situation. The stutterer's behavior toward, for example, using the telephone, illustrates this conflict. Conflict due to the emotional content of words, apart from their phonetic properties, involves unconscious motivation for avoidance. For example, when describing a traumatic experience, it is the emotional and verbal content that is involved, not the situation or the words in and of themselves. The occurrence of stuttering is in part a function of the relationship between the stutterer and listener. As previously mentioned, some people who stutter experience no stuttering when they play a dominant role (i.e. talking to an infant), but stutter when talking with someone perceived to be of greater dominance (e.g. one's boss). At the ego-protective level, stuttering serves as a lifelong defense mechanism. Through the stuttering, certain aspirations may be abandoned, which might involve threat of failure or success.

Sheehan (1953) proposed two independent conflicts which together make up the approach-avoidance conflict. The first conflict is in regard to speaking. The conflict of speaking suggests that there is an approach tendency for speaking, since it is socially demanded. Since speaking entails the risk of stuttering, however, there is an avoidance tendency based on this elicited fear. The second conflict is in regard to not speaking. The conflict of not speaking suggests that there is an approach tendency for not speaking, because silence becomes an attractive alternative to stuttering; however, this alternative is also feared. In a situation which calls for speech, not speaking or not being able to speak

is a threat in itself. Consequently, there is an avoidance tendency for speaking as well as an approach tendency for not speaking. As movement towards either of the feared goals is approached, the alternative goal becomes more distant, hence less alarming and more attractive. The individual will then turn and approach the other goal until it becomes too feared (Sheehan, 1953).

Successful treatment requires gaining a mastery over fear and finding expression of whatever needs, feelings, and tendencies have been trapped within the symptom (Sheehan, 1953). Simply put, the overall treatment objective is to get the person who stutters to approach more and avoid less. This can be accomplished in several different ways, such as practicing techniques across situational hierarchy, self-disclosure, and voluntary stuttering. According to Sheehan (1953), the primary symptoms of stuttering can equally be attributed to the Approach-Avoidance Conflict. Repetition and prolongation may represent oscillating and stopping, respectively, near the point of equilibrium between desire to speak and avoid.

Although there is no documentation regarding the Approach-Avoidance Conflict in deaf individuals, it is likely that this theory can be equally applicable to signed languages. As research has found that signed language and spoken language are activated by the same brain regions, similar neural processes are likely to occur across modality. Therefore, similar means of choosing what words and phrases to use and when, would be present in stuttering in signed languages. Similarly, deaf individuals who stutter could find themselves in the same position of desiring to speak but also fearing stuttering.

THEORY 5: COVERT REPAIR HYPOTHESIS

Another hypothesis that is worth discussing is the Covert Repair Hypothesis (Postma & Kolk, 1993). According to this hypothesis, all speakers experience occasional

errors in their phonetic plan due to mis-selection of phonological units. If errors are detected, they can be repaired, resulting in disfluent speech. In other words, disfluencies are the by-product of the speaker's attempt to repair errors in phonological encoding. Whereas a normally fluent speaker can generally successfully repair defective speech plans within one or two attempts, people who stutter try to reformulate an erroneous speech plan, and require many attempts before finally succeeding. Furthermore, slow language encoding increases the numbers of phonological encoding errors in the speakers' speech plans (Brocklehurst & Corley, 2010).

The Covert Repair Hypothesis attributes stuttering-like disfluencies to covert repairs of language encoding errors, under the notion that speech plans are frequently prepared in advance of their overt articulation and stored in an articulatory buffer for anything up to a few seconds before being articulated (Brocklehurst & Corley, 2010). During this time, the speaker can inspect these plans internally and cancel and reformulate them if necessary (Levelt, 1989). If an error is perceived, thus resulting in the speech plan to be cancelled before the onset of overt articulation, a silent pause or "block" may result while the plan is reformulated (Brocklehurst & Corley, 2010). Situations may occur, however, when overt articulation of the first phonemes, syllables, or words of a plan may have already begun before the error is detected. In such cases, the speaker stops, retraces to a suitable point and starts again. This results in the repetition of the preceding phoneme(s) and/or word(s). Depending on the number of reformulations needed before the correction is achieved, the number of iterations (i.e. consecutive repetitions) can vary. The extent of the disfluency resulting from a repair depends on the speed with which the error can be detected and the repair initiated. It has been argued that if this hypothesis is true – if people who stutter have more internal errors in their speech plan than people who don't, we should expect to see that some of these errors go

undetected and, therefore, we should also expect to see more errors in the sounds within words produced across persons who stutter, but we don't. Repeatedly unsuccessful attempts at covert repair result in a much greater degree of disruption over time (Brocklehurst, 2008). Repetition of continuants may occur without breaks in between, producing symptoms of prolongation rather than repetition (Brocklehurst & Corley, 2010). According to Brocklehurst (2008), errors do not normally disrupt the flow of speech; however, error repairs do. Recently, the Covert Repair Hypothesis has receded in significance, as data supporting this view are equally (or more) supportive of the Holistic Processing Theory (Brocklehurst, 2008).

SUMMARY OF THEORIES

To recap, there are multiple theories to describe the onset and development of stuttering. Within this report we have reviewed five in detail. First, neurologically through right versus left hemisphere processing differences that compromise sign selection and formulation (Cerebral-Dominance Theory). Second, slowed phonological encoding that delays the selection and subsequent execution of individual signs and the related movements (Holistic Processing Theory). Third, changes in the person's internal capacities and/or environment can lead to enhanced signing fluency or can make it more challenging for the child to sign fluently (Demands-Capacities Model). Fourth, the impact of awareness of the signing deficiencies that leads the person to avoid and struggle against future difficulties, which in turn further exacerbates the disruptions in the person's signing (Approach-Avoidance Conflict). Fifth, the Covert Repair Hypothesis (Postma and Kolk, 1993), for which there is a growing body of conflicting evidence, but has played a fundamental historical role in the development of our understanding of

stuttering. It seems clear that any of the hypotheses regarding the etiology of stuttering would seem to apply to signed languages as well.

The following section will examine various aspects of the phenomenon of fluency disorders in signed languages. What does it look like? What has prior research revealed about its nature?

Section 6: Fluency Disorders in Signed Languages

There is little research focusing on stuttering-like disfluencies in signed languages. What do we know?

To start, we might wish to let go of the notion that audition plays a role in stuttering. According to Bloodstein and Bernstein-Ratner (2008), it seems likely that audition is not critical to stuttering, and stuttering and deafness may be two relatively rare conditions with a genetic influence that seldom co-occur. According to Wingate (1970), there are several arguments which support the notion that audition does not play a role in stuttering. Foremost is the fact that stuttering often occurs in the effort to initiate speech, in which instance no auditory feedback is operative. A second limitation is posed by evidence that the locus of stuttering is related to certain language dimensions, such as word length, familiarity, and type (grammatical class).

When comparing the concept of stuttering in spoken language to that of signed language, the distinction between language difference and language disorder comes into play. A language difference is a rule governed language style that deviates in some way from the standard usage of the mainstream culture, whereas a language disorder is a significant discrepancy in language skills compared to the normative standards for age or developmental level (Paul, 2007). There are several characteristics of signed language that are not observed to any significant degree in spoken language, and vice versa. For example, someone unfamiliar with signed language may characterize the use of facial expressions as a type of disorder, though anyone familiar with signed language knows that facial expressions play a fundamental role in signed language. This can make it harder to figure out just what stuttering in signed languages might "look like", as we shall see.

THE APPEARANCE OF STUTTERING IN SIGNED LANGUAGES

With all of the information discussed thus far, a central question remains: What does stuttering in signed languages look like? The answer is far from clear. There have not been any documented studies that provide concrete descriptions of stutter-sign through direct observation, as each of the studies that have been reported rely on second-hand reports. Regardless, assumptions can be made based on various accounts, such as informal observation and extending our knowledge of stuttering in speech to stuttering in signed language. Silverman and Silverman (1971), Montgomery and Fitch (1988), and Whitebread (2004) identify three core behaviors of stuttering in ASL using the Van Riper (1982) classifications: repetitions, prolongations, and blocks. According to Yairi and Ambrose (2005), there are eight types of disfluencies found in stutter-sign, five of which are consistent with oral stuttering: repetition, prolongation, fluidity, hesitation, and muscular tension. Involuntary interjections are categorized as "other disfluency", in addition to two phonological characteristics, including failure of fluency at onset and phonological complexity. According to Yairi and Ambrose (2005), failure of fluency at onset and phonological complexity would most likely be exhibited in the first phonetic utterance in a sign or finger-spelled word, similar to oral stuttering. Categorizations of disfluency are still necessary for determining a diagnosis and treatment (Yairi & Ambrose, 2005).

Section 7: Studies of Stuttering in Signed Languages

The existence of stuttering in the deaf and partially deaf population has been documented in some previous research (Bloodstein, 1969; Silverman & Silverman, 1971; Montgomery & Fitch, 1988; Whitebread, 2004; Cosnys, Van Herreweghe, Christiaens, & Van Borsel, 2009; Quinto-Pozos, Forber-Pratt, & Singleton, 2011). However, these studies relied upon respondents' ability to identify manual disfluency using categories borrowed from spoken language research, rather than describe characteristics unique to signed languages. Although these studies have shed light on the idea of stuttering in signed languages, they do not provide concrete data involving direct examination of signers. Regardless, they are extremely important sources of knowledge, and will be discussed in detail below.

In one of the earliest documented studies regarding stuttering in American Sign Language, Silverman and Silverman (1971) aimed to discover whether behavior comparable to stuttering ever occurs in the manual communication of the deaf. Letters were sent to 78 residential school teachers of the deaf, inquiring whether they have ever observed such behavior by manual communicators. Thirty-three of the 78 responded, 13 of whom gave positive responses for observing stuttering-like disfluencies in sign. Their responses seemed to suggest that disfluencies, including repetitions of signs, repetition of the first letter of a finger spelled word, involuntary extra movements, and hesitations, are more likely to occur during fingerspelling than during "regular" signing. While this study does support the notion that stuttering-like disfluencies occur in ASL, greater detail regarding the specific questions asked of the respondents, the type of questionnaire used (i.e. multiple choice, scale, or free response), and background information of the signers used in reference, would have made these findings much stronger.

Montgomery and Fitch (1988) conducted a study to determine the prevalence of stuttering in oral communication only, manual communication only, and both oral and manual communication in the hearing-impaired school-age population across the country. Survey forms were sent to 150 schools across the country. These surveys requested demographic information concerning the school and the person completing the form, as well as the age of the stutterer, sex, age of onset of hearing loss, age of onset of stuttering, information regarding secondary characteristics, and the communication mode in which dysfluency was expressed (oral, manual, both) . Seventy-seven survey forms (51%) of the 150 forms sent were returned, which represented 9,930 hearing-impaired students. A total of 12 children (9 boys, 3 girls, age 5-18 years) were reported to be stutterers. Of the 12, all but one were congenitally deaf. Three of the children were reported to be disfluent only in the oral mode, six only in the manual mode, and three were reported to be disfluent in both the oral and manual modes. Although this study highlighted the idea of stuttering in ASL, it did not provide any information regarding what these disfluencies may look like.

Through interviews with ten faculty members at Gallaudet University about individuals presumed to stutter in ASL, Whitebread (2004) collected data on possible behaviors present in manual stuttering. The interviews consisted of three parts: (1) A summary of basic stuttering information, during which participants were provided with a brief description of stuttering symptoms and the nature of stuttering, (2) a presentation of a list of symptoms of stuttering and examples, and (3) three pre-prepared questions: 1. Do you think the examples of stuttering provided are adequate given the nature of the disfluency described? 2. Do you know any Deaf persons who are “healthy” (in that they are not diagnosed with cerebral palsy, Tourette’s syndrome, or any other neurological disorder) who exhibit symptoms similar to these? 3. Can you think of any other

symptoms that could be related to a stuttering disorder in ASL? The eight characteristics of stuttering used in this study included the following: Inconsistent interruptions in signs and fingerspelling, symptoms most often begin at the beginning of a sign gesture, hesitation of sign movement, repetition of sign movement, exaggerated/prolonged signs, unusual body movements completely unrelated to linguistic communication, fluidity of the sign, and inappropriate muscle tension associated with the sign. Each of the ten participants indicated that they had observed stuttering-like disfluencies in ASL users. Although these findings provide an interesting and reasonable starting point for future research, the study could have been stronger had Whitebread used a different approach.

For example, the bulk of the manuscript focused on providing a comprehensive overview of stuttering, rather than explaining the study itself. Although Whitebread provides the first study to generate a list of what stuttering in sign MIGHT look like, he did not actually confirm the presence or absence of these symptoms in stutter-sign. In fact, these symptoms are even referred to as "hypothetical" symptoms throughout the manuscript. A key part of the study included asking participants whether they knew of anyone who exhibited any of the hypothetical generated symptoms while they were signing. If we were to take this same question and change the modality and apply it to oral stuttering, we would end up with some odd data. Asking participants whether they know of anyone who exhibits, for example, sound repetitions, would likely result in an overwhelming number of "yes" responses, as disfluencies are a common part of speech. The specific elements that characterize stuttering (i.e. frequency, type, severity) are what separate typical disfluencies from stuttering-like disfluencies. This is just one reason why we need to conduct studies which look at the actual person exhibiting disfluencies (in speech or sign), rather than relying on second-hand reports.

In a study conducted by Cosyns, Van Herrewedghe, Christiaens, and Van Borsel (2009), a questionnaire was distributed to 66 participants familiar with both Flemish Sign Language and Flemish Sign Language users. The questionnaire sought to determine whether participants had ever noticed disfluencies in deaf or hard of hearing individuals, and whether they could select the specific type of disfluency from a list. Of the 66 individuals, 13 responded, nine of whom reported to have observed disfluencies in Flemish Sign Language users. Of the seven characteristics of stutter-sign provided by this study, the most commonly observed characteristic reported amongst the 13 respondents was involuntary interjections ("um", "uh"), followed closely by poor fluidity (i.e. rhythm, smoothness), repetitions ("I-I-I-I am fine"), and unusual body movements. It is hard to know what to make of these data, though. The participants had no special knowledge of disfluency or stuttering in typical (non-disordered) production (they were not speech-language pathologists, for instance). This lack of familiarity with stuttering proved significant when, amongst the four most commonly reported stuttering-like sign disfluencies (involuntary interjections, repetitions, poor fluidity, repetitions, and unusual body movements) repetition was the only disfluency consistent with spoken stuttering-like disfluencies. Although everyone exhibits disfluencies at times, not everyone has stuttering-like disfluencies, and there is no way to determine which types of disfluencies were used in reference from the present study.

A common limitation amongst the three studies discussed thus far (Silverman & Silverman, 1971; Whitebread, 2004; Cosyns et al., 2009), is that none of the participants reporting the presence of stuttering-like disfluencies in signed languages were speech-language pathologists (SLPs), who as a group have specific training in the area of stuttering. Although the participants were familiar with the Deaf community, there is no

information regarding their abilities to appropriately distinguish typical disfluencies from stuttering-like disfluencies.

There is also the issue of language familiarity. Einarsdottir and Ingham (2009) aimed to determine whether stuttering judgment accuracy is influenced by familiarity with the stuttering speaker's language. 10 native Icelandic Speech-Language Pathologists were selected due to their high levels of experience in assessing and treating stuttering, while 10 native English speaking SLPs from the US were selected from a list of clinicians provided by the Stuttering Foundation. The stimulus material (on DVDs) was developed from audiovisual recordings of 20 Icelandic preschool children previously diagnosed as stutterers and referred for treatment. The two SLP groups judged the same samples on two separate occasions separated by approximately two months. They were instructed to watch and listen to each DVD alone without discussing with others or asking others about their judgments. Results indicated that experienced SLPs were shown to be highly accurate in recognizing stuttering and nonstuttering exemplars from young children who stutter speaking in an unfamiliar language. The findings suggest that judgments of occurrences of stuttering in children who stutter are not generally language dependent. Granted that the languages of comparison used in this study were all oral languages, it still highlights the fact that SLPs may be in a position of unique expertise to recognize the common tendencies and manifestations of stuttering, whether or not they are familiar with the language of interest. It would be tempting to extend this to judgments about signed language stuttering, but it cannot be assumed that these tendencies and manifestations are the same across modality. Therefore, it is recommended that future research address whether or not such extensions can be made across modality.

Quinto-Pozos, Forber-Pratt, and Singleton (2011) sought to determine whether communication disorders exist in ASL and how they can be characterized. The descriptions of disfluency included additional characteristics not documented by Whitebread (2004), such as lack of emotional or grammatical facial expression and alternating hand dominance. Examiners held four focus groups (three in ASL, one in English), as well as 1 one-on-one interview in ASL. The participants consisted of 22 adults (7 deaf, 15 hearing) who work at bilingual-bicultural (ASL-English) schools for the Deaf. The experiences of these educators and language professionals were discussed and analyzed qualitatively using a combination of grounded theory and Moustakas' (1994) modified van Kaam approach, analyzing data through grouping, reducing, clustering, and identifying themes and creating a textural-structural description for each participant. Results strongly suggest the presence of communication disorders in children using ASL. Unfortunately, little information regarding the children used in reference was discussed (e.g. the environment in which they grew up, or whether they had deaf or hearing parents). As previously mentioned, such information could distinguish characteristics of a language difference from a disorder. According to Woll (2009) when a language is not restricted to manipulations of the vocal tract and to auditory perception, it is free to recruit any parts of the body capable of rapid, variegated articulations that can be readily perceived and processed visually. For example, raising one's eyebrows after a statement suggests that a yes/no question is being asked, whereas lowering one's eyebrows suggests that a wh-question is being asked. But why should lack of emotional or grammatical facial expressions be a characteristic of stuttering in ASL?

Stuttering occurrence is closely linked to the prosodic dimension of speech production (Wingate, 1979). In other words, stuttering affects overall prosody. In ASL, grammatical facial expressions are prosodic markers, showing intonation and stress.

Therefore, if stuttering affects prosody, and prosody in ASL is shown through facial expressions, it can be assumed that lack of facial expressions is a characteristic of stutter-sign.

While the nature of stuttering-like disfluencies in signed languages continues to be investigated, research has increased our general knowledge and awareness of stuttering-like disfluencies in signed languages, and provided a basis for what these behaviors may look like. All of the studies conducted thus far looking at stuttering in signed languages rely primarily on retrospective second-hand reports, which exclude confounding variables and detailed data necessary for scientific analysis; however, these studies provide the foundation for the development of categories and descriptions of stuttering-like disfluencies that can be used in future research.

Much of what we know about signed languages and where in the brain it is processed comes from lesion studies. In the following section, I will discuss various lesion studies which suggest that signed language, just like spoken language, is processed in similar regions of the left hemisphere.

Section 8: Cerebral Activation Sites of Signed Language

Throughout the years, there has been much controversy regarding where signed languages are processed in the brain. Many of the studies, and much of what we know today about whether signed language is processed by the same neural regions as spoken language, comes from the field of neuropsychology, in the form of lesion studies. One common consequence of brain damage is termed aphasia, or dysfunction of the comprehension and formulation of language caused by disturbances to specific brain regions (Chandrasekaran, 2013). Aphasia is most often caused by lesions to the left hemisphere. According to Chandrasekaran (2013), aphasia occurs not only in languages based on auditory signals, but also visual-motor (signed languages) and written modes. Aphasia can compromise multiple aspects of language including syntax (grammatical structure of sentences), lexicon (collection of words that denote meaning), and morphology (combination of phonemes, or individual sounds, into meaningful word units) (Chandrasekaran, 2013). Recent studies have produced evidence that signed languages, like spoken languages, are processed mainly in the left hemisphere (Hickok, Bellugi, & Klima, 1988). Therefore, if signed language processing is left dominant, signed language aphasia, like spoken language aphasia, should follow left but not right-hemisphere damage (Marshall Smulovitch, Thacker, and Woll, 2004), and there is now considerable evidence that this is the case (Hickok, Love-Gefen, & Klima, 2002). Furthermore, symptoms of signed language aphasia are generally consistent with those found in spoken language impairments. The following studies look at individuals with signed language aphasia and examine the effects such lesions have on the production of signed language.

Marshall, Atkinson, Smulovitch, Thacker, and Woll (2004) reported on a single case investigation of a deaf man ("Charles") with signed language aphasia following a left cerebrovascular accident (CVA). The participant, a 56-year-old Deaf man who had a CVA when he was 54, was right-handed before the stroke. A CT scan revealed extensive change involving the left posterior frontal and parietal lobes, and was consistent with an extensive left middle cerebral artery territory infarct, known to result in aphasia. Charles' signing following his stroke was hesitant and unstructured, and showed groping behaviors when he struggled to achieve the correct form of signs. There were also frequent episodes when he seemed unable to access signs. Observation suggested that Charles had sign anomia, which was substantiated through three picture naming assessments. The first aimed to differentiate any naming problem from possible premorbid vocabulary limitations. The second explored the influence of familiarity on sign production, and investigated whether production could be cued. The final assessment investigated whether naming was influenced by iconicity. Anomia, or a deficit in sign word retrieval, was a prominent feature of his aphasia, and this showed many of the well-documented characteristics of speech retrieval. For example, sign retrieval was sensitive to familiarity (easier retrieval for higher frequency words), it be cued, and there were both semantic and phonological errors.

Chiarello, Knight, and Mandel (1982) reported signed language aphasia in a 65-year-old prelingually deaf woman who was fluent in ASL before suffering a left parietal CVA. The patient presented with clear signs of aphasia, such as greatly reduced sign output, severe anomia, and the production of literal and verbal paraphasias. Finger-spelling, except in the presence of a written English stimulus, was impossible.

Section 9: Diagnosis of Stuttering in Speech and Sign

Up to now, this report has taken the position that, with the exception of modality, stuttering in spoken language and stuttering in signed language are essentially the same phenomenon (i.e., there is ONE stuttering mechanism that occurs at some point during the language formulation stage, which occurs before the output reaches actual modality). As a result, I propose that stuttering in signed languages can be diagnosed and treated in exactly the same manner as we do spoken language stuttering, granted that speech-language pathologists completing the assessment be fluent in the appropriate form of signed language.

In general, there are five specific elements to assess during a speech disfluency analysis (Byrd, 2013). These include duration of disfluencies (measurement of the length of the stuttering moment), clustering of disfluencies (disfluencies that occur adjacent to one another), iterations of disfluencies (the number of times the repetition is repeated), secondary behaviors (the number of disfluencies accompanied by secondary behaviors out of the total number of disfluencies), and frequency of disfluencies (the number of total disfluencies and stuttering-like disfluencies). According to Bloodstein and Bernstein-Ratner (2008 for review), the human ear is unable to adapt to disfluent speech, and signals that this speech is "not right". Research shows that listeners may have different tolerance thresholds for different forms of disfluencies. Part-word repetitions (e.g." b-b-baby") and sound prolongations are judged abnormal at lower frequencies (as low as 2% of words spoken), whereas whole-word repetitions and schwa interjections must reach at least 5% to evoke judgments of disfluent or stuttered speech (Roseberry-McKibben & Hedge, 2011). According to Bloodstein and Bernstein- Ratner (2008),

stuttering in spoken languages generally occurs in 5-10% of words, increasing to 50% in cases of greater severity.

A variety of tasks and speaking contexts are used during stuttering assessments to extract/highlight stuttering moments. One such task is an automatic speech task, during which the client is instructed to recite unchangeable content, such as the ABC's or counting to 20. These automatic tasks are particularly critical if the client has become more adept at avoiding their stutter. An additional task which is difficult for people who stutter is saying their name, as their name is also unchangeable, and there is no way of avoiding it without providing a pseudo-name. This poses an additional threat to deaf individuals who stutter, as unlike hearing individuals who introduce themselves by their first names only, Deaf people normally introduce themselves by their full names, and it is not unusual to also add which city or state they are from (Padden, 1980). This increases the length and complexity of the unchangeable content, which could result in greater severity of stuttering. Through successive monologues and narratives in diverse settings with diverse conversation partners, analyses can be made in reference to a variety of factors including, amongst others, speech rate, reaction to disfluencies, and communicative intent (Byrd, Coalson, and Bush, 2010).

There are several diagnostic tools used to evaluate the negative affect associated with stuttering. The Communication Attitude Test for Preschool Children who Stutter (Kiddy-CAT; Vanryckegham & Brutten, 2006), for example, is designed for children under the age of six. According to Vanryckeghem and Brutten (2006), the Kiddy-CAT enables effective assessment of the attitude of preschool and kindergarten children in regard to their communication skills through yes/no questions. The test involves 12 questions regarding the child's feelings about the way he/she talks. The questions are balanced for positive or negative attitudes, with six questions framed positively (e.g. Do

you talk well with everybody?) and six questions framed by a negative attitude of experience (e.g. Do words sometimes get stuck in your mouth?). The questions are delivered orally, and the child responds by answering either "yes" or "no". When administering the Kiddy-CAT in signed languages, it is imperative that the speech-language pathologist have sufficient background knowledge in that specific form of signed language, so as to accurately deliver the assessment questions and record responses.

Another diagnostic tool used to assess the associated affect consistent with stuttering is the Overall Assessment of the Speaker's Assessment of Stuttering (OASES; Yaruss & Quesal, 2010). The OASES is used for individuals over the age of seven, and provides deep insight into the impact of stuttering. According to Yaruss and Quesal (2010), the OASES is built on a solid theoretical foundation to assess the impact of stuttering in multiple life situations.

As discussed in the previous paragraph, there are several diagnostic tools used in the assessment of stuttering which specifically assess the negative affect associated with stuttering. For standard stuttering diagnostic protocol, standardized tests are not necessary for analyzing the individual's output. Instead, simply analyzing the individual's output in a variety of contexts and settings, bolstered by indirect self-reports of attitude towards overall communication skills, can provide sufficient diagnostic information. Because a standardized monolingual measurement is unnecessary, there is reason to believe that such methods can be extended to the assessment of stuttering across all languages, including signed languages.

As discussed earlier on page 48, Einarsdottir and Ingham (2009) report that experienced Speech-Language Pathologists are highly accurate in recognizing stuttering in foreign languages. Byrd, Watson, Bedore, and Mullis (2014, in review) completed a

preliminary investigation of the accuracy of identification of stuttering in speech samples of bilingual Spanish-English (SE) speaking children and the speech characteristics that influence bilingual SE SLP judgments of whether or not a bilingual SE child is producing stuttered speech. Fourteen bilingual SE SLPs listened to narrative re-tells in English and in Spanish that were produced by two bilingual SE children matched for age and gender, one with a confirmed stuttering disorder, and the other a confirmed typically fluent child. Results indicate that 12 out of the 14 bilingual SLP participants falsely identified the bilingual child who was confirmed as a typically fluent speaker as a child who stutters, thus warranting a false positive. Ten of the 14 SLPs correctly identified the bilingual child with a confirmed stuttering disorder a child who stutters, and only one participant accurately identified both children. These findings suggest that SLPs have a markedly increased tendency to identify bilingual children who do not stutter as children who stutter, which warrants the need for future data differentiating the disfluent speech of bilingual speakers who do not stutter. As a result, Byrd et al (2014, in review) suggest that future research attempt to identify what constitutes a "stuttering-like disfluency" in bilingual SE children, as well as standard percentages for stuttering-like, nonstuttering-like, total disfluencies, and stuttering-like over nonstuttering-like for this population.

There is reason to believe that the same basis in documenting stuttering in signed languages would be true. Speech-Language Pathologists involved in the assessment and treatment of stuttering in signed languages should be familiar with and have a background in signed languages, as there are several language-specific, cultural differences which could be of influence. An unfamiliar SLP might make a misdiagnosis of stuttering on the basis of type, timing, and tension of the movement, which differentiates a stuttering-like disfluency from a non-stuttering-like disfluency. For example, to show that an event continued to happen for an extended period of time in

ASL, the signer would use reduplication, and repeat the sign several times. An unfamiliar SLP may misdiagnose this as a whole-word-repetition and a fluency disorder, rather than a perfect construction and language difference. Similarly, facial expressions, a key characteristic of signed language enhancing semantic and prosodic information, may be incorrectly labeled as characteristics of stuttering, specifically secondary behaviors. Another aspect to consider is parent report. This is a reliable and distinguishing factor across languages for persons who stutter, so one would assume the same for sign.

Section 10: Treatment for Stuttering in Speech and Sign

Because stuttering in signed and spoken language are activated by the same brain regions and both exhibit parallel physiognomies that can be assessed the same way, there is reason to believe that stuttering in signed language would be treated clinically using the same techniques as that of spoken language. That is, the same methods of diagnosis and treatment can be utilized. That being said, the expectations within the Deaf community specific to communication accuracy and fluency may be different from that of the hearing community. For example, in regards to frequency of stuttering-like disfluency, stuttering in speech is said to occur if there is a disfluency rate that exceeds 5% of spoken words (Roseberry-McKibben & Hedge, 2011). Currently, there are no data that say otherwise in terms of the frequency of disfluencies in signed languages. From a different perspective, there are various elements that are known to exacerbate the frequency of severity of stuttering in speech. Stuttering in the speech of adults and school-age children, specifically, is more likely to occur on consonants rather than vowels, on the first sound or syllable of a word, on the first word in a phrase or sentence, on the first word in a grammatical clause, and on longer, more complex, and less frequently used content words (Roseberry-McKibben & Hedge, 2011). Similarly, there are no data which suggest that these characteristics are consistent with stuttering in signed languages. These are just two of the many reasons why we need more research in this area of study, and will be discussed in greater detail later in this report.

According to Conture and Yaruss (2009), clinical evidence indicates that individuals who stutter can benefit from speech therapy at any time in their life span. Depending on the age of the client, different fluency shaping and modification techniques can be used in therapy. The following sections provide information as to how stuttering

in speech is treated at different ages, and how such treatment methods can be adapted for stuttering in signed language.

PRESCHOOL AGE

The Lidcombe Program is a method of behavioral treatment for preschool children who stutter (Byrd, 2013). Through this program, children attend speech therapy weekly, at which time parents and caregivers learn to implement strategies in everyday environment. Through the Lidcombe Program, parents give verbal contingencies during conversations with their child directed at stutter-free speech, unambiguous stuttering, correct self-evaluation of stutter free speech, and spontaneous self-correction of stuttering. Verbal contingencies include acknowledgement and/or praise for periods of stutter-free speech, acknowledgement of stuttering and/or a request that the child corrects stuttering, praise for correct self-evaluation or stutter-free speech, and praise for spontaneous self-correction of stuttering (Harris, Onslow, Packman, Harrison, and Manzies (2002). If executed appropriately, decreased disfluency may be noted within 12 weeks of treatment (Byrd, 2013).

The Lidcombe Program could also be adapted to treat preschool children who stutter in signed languages. Provided that the child has a parent or caregiver who can communicate in signed language, he or she could provide the child with manual contingencies, rather than verbal contingencies. With the only alteration being execution modality, the Lidcombe Program can be implemented in signed languages in a parallel manner to that of oral stuttering.

SCHOOL-AGE

The goals of fluency treatment for school age children include those related to education, identification, modification, desensitization, and development of a positive

communication image (Byrd, 2013). It is imperative that children who stutter be educated about both speech production and stuttering, as these clients often don't know why they're in therapy.

The Cognitive, Affective, Linguistic, Motor, and Social (CALMS) model of stuttering is related to the complex interaction of stuttering. The cognitive approach aims to increase child understanding of stuttering, educate him/her about the anatomy and physiology of speech production and mechanism, identify stuttering behaviors, inform peers and family members about stuttering and its treatment, and develop consistent "language of fluency" terminology, so as to ensure that everyone involved in the child's recovery understands and utilizes the same terminology. The affective component attempts to decrease the child's negative emotions, fear, anxiety, tension, and sensitivity to stuttering, increase his/her ability to cope with negative responses (such as teasing), improve all areas of self-esteem, and increase the child's ability to discuss stuttering with others. The linguistic component aims to increase linguistic complexity by increasing utterance length and decreasing word avoidance. The motor aspect aims to identify speech modification/fluency shaping techniques, while increasing practice and use of these techniques and awareness of self-monitoring skills. The social component targets increasing the child's social/pragmatic skills, verbal interactions in both familiar and unfamiliar settings, as well as the number of opportunities for the child to use new skills in realistic speaking activities.

Let's look at each of the five elements encompassed in the CALMS model and see if they can be applied to signed languages. First: *Cognitive*. Do deaf children who stutter have thoughts, perceptions, awareness, and understanding of their stuttering? If we explore this question further, we realize that cognitive abilities include the comprehension and production of language. Because signed language and spoken

language are activated by analogous regions in the brain, we can comfortably assume that deaf children who stutter have cognitive abilities related to stuttering. As a result, they are likely to have *affective* feelings, emotions, and attitudes towards their stuttering. Although there is no research which looks at the affective components associated with stuttering in sign, there is reason to believe that similar feelings and attitudes would be present due to the demand for fluency in both cultures and modalities. As discussed earlier, signed languages are recognized languages with *linguistic* elements and, therefore, signed language users must have language skills, language formulation demands, and discourse. Signed languages are manual languages, which require sensori-*motor* control of speech (or output) movements to produce language. The production of language is used for, amongst other reasons, *social* reasons, just like spoken language.

The educational component of stuttering therapy often includes identifying truths about stuttering, as well as a review of the anatomy and physiology of the speech mechanism. For children who stutter in sign, the anatomical review would have to be significantly modified, as a review of the oral speech mechanism would be irrelevant. Instead, I suggest these children be education on the neurological process of language, specifically where and how expressive and receptive language skills are activated in the brain. I would then extend their knowledge to include that of efferent nerve fibers, explaining that efferent fibers travel from the brain to their muscles, which allow them to formulate signs and facial expressions. I would also explain how the cerebellum plays an important role in motor control, and is responsible for the coordination of motor movements necessary to produce signs.

Identification is important in the treatment of stuttering because, in order to modify their stuttering moments, individuals must first be able to quickly, correctly, and objectively identify when they stutter and what they do when they stutter. Physically

feeling the behavior is crucial to stuttering therapy, because once they see or hear it, it has already happened (Byrd, 2013).

Identification may pose a greater difficulty for children who stutter in sign, as they can only identify their disfluencies through two senses (touch, sight), whereas oral stutterers can identify their disfluencies through auditory means, as well. Although they will be unable to hear the disfluencies, children who stutter in sign may be at more of an advantage in regard to visual identification. Because signing takes place in front of the signer's bodies, they may be able to physically see the repetitions and prolongations as they occur, and utilize fluency modification strategies more easily and effectively.

Once they have learned to identify their stuttering moments, children can learn modification techniques. Historically, a dichotomy of approaches has existed in treating stuttering, specifically those of fluency shaping and stuttering modification (Blomgren, Roy, Callister, & Merill, 2005). Fluency shaping approaches focus on speaking more fluently, while stuttering medication focuses on a decrease in stuttering severity (Guitar, 1998). The goal of fluency shaping is to apply techniques that facilitate a new speech production pattern to shape overall fluency. Such techniques include easy onset, continuous phonation, and prolonged speech. Fluency shaping allows individuals to modify their entire speech production by focusing only on complete fluency, with the ultimate goal of automatically incorporating these techniques into all speaking situations.

Although there is no research focusing on the use of fluency shaping techniques with children who stutter in signed languages, I hypothesize that such techniques would yield similar results as we see in oral stuttering. Easy onset suggests that the individual yawn to relax the speech mechanism which, inevitably, relaxes the whole body, including the muscles necessary for producing signs. In regards to continuous phonation and prolonged speech, these techniques may not be plausible for stuttering in sign; however,

fluency shaping is not considered an effective technique if used alone, and often leads to relapse of stuttering (Byrd, 2013). Therefore, the fact that each of the characteristics associated with fluency shaping cannot be appropriately extended to stuttering in sign does not mean we cannot attempt to treat stuttering in sign.

In contrast to fluency shaping, stuttering modification therapy is based on combinations of procedures directed at desensitization to stuttering, increasing acceptance of one's stuttering, and motoric techniques directed at decreasing the tension associated with stuttering moments when they occur (Blomgren et al., 2005). Modification therapy allows individuals to modify their moments of stuttering, reduce fears of stuttering, and eliminate avoidance behaviors. Three techniques often used to modify stuttering moments include cancellation ("I like Ka-Ka-Ka-Kalamazoo…Kalamazoo), pull-out ("I like Ka-Ka-Ka-Kalamazoo"), and preparatory set ("I like Kalamazoo"; Byrd, 2013). In cancellation, the individual experiences the complete stuttering moment, and then fluently produces the desired output after the fact. In pull-out, the individual is able to "pull-out" of the stuttering moment mid-stutter to fluently produce the desired output. In preparatory set, the individual is able to use techniques to produce fluent speech. Similar to therapy for oral stuttering, signed language stutterers should be able to learn to modify their manual output in a similar manner, moving from cancellation, to pull-out, to preparatory set, sequentially.

More important than using techniques, the goal of fluency therapy for school age children, specifically, is anxiolytic (i.e. anxiety reducing) in emphasis, and each child should walk away from each therapy session feeling like good communicators. The same holds true for children who stutter in signed languages; if they do not feel good about their overall communication abilities, progress is likely to be stunted. Therefore, more

than anything, a positive communication image should remain a target for children who stutter in signed languages.

ADULT

Adults who seek speech therapy for fluency disorders likely do so because it is impacting their lives in a negative way. Comprehensive treatment approaches focus on increasing fluency, improving attitude toward communication, and minimizing any negative affect impacting overall quality of life (Byrd, 2013). As a result, it is imperative that the covert symptoms or, as mentioned earlier, avoidance strategies (see page 8), be addressed in therapy. Covert symptoms can be addressed through activities such as voluntary stuttering, self-disclosure, and education. The goal of such activities is to desensitize the individual to his or her stuttering moments, and to stutter openly without fear or embarrassment. If the emotional aspect of stuttering is not addressed, however, success in therapy will be stilted and will not be maintained over time. Conture and Yaruss (2009) suggest that speakers may have greater benefits from comprehensive approaches than from those that focus only on changes in speech fluency.

Section 11: Conclusion

Stuttering is a complex disorder that appears to exist in both oral speech and signed languages. Without the awareness that stuttering occurs in signed languages, a large population would continue to go untreated, and maintain the negative consequences associated with being a person who stutters.

To increase our awareness of stuttering in signed languages, I conclude this report by providing a framework for future research studies. To begin, we need direct, unbiased data points to work with. This means that future research needs to directly study the individual instead of relying on second-hand reports of individuals who are suspected to stutter in signed language.

It is important for future studies to investigate whether individuals who are presumed to stutter in signed language present with characteristics consistent with stuttering in spoken language. The characteristics could be adopted from studies that already exist on spoken languages, but should also be open to the idea of additional characteristics of stuttering in signed languages. Participants can be recruited through several different domains, such as schools, advertisements, or referrals. The study design should consist of two parts: a questionnaire and a variety of sign tasks.

The questionnaire should seek to answer questions regarding whether or not the negative affect in deaf individuals who stutter in sign is similar to hearing individuals. This can be accomplished through administering assessment tools such as the Kiddy-CAT or OASES, in conjunction with free response answers. Not only would this indicate whether similar feelings and attitudes are associated with stuttering in speech and sign, but also open the door to the possibility of additional or different social penalties associated with stuttering in signed languages, exclusively.

The third component should include a variety of sign tasks. Participants could complete automatic speech tasks, such as counting to 20 or signing the ABC's. These tasks will inhibit the participants from engaging in any covert or avoidance behaviors. Additionally, participants should engage in conversation with a variety of different communication partners. Communication partners should include individuals with whom the participants are familiar, as well as unfamiliar, in both group and individual settings.

Studies in this area of research are sorely needed. If the outcomes are consistent with the speculations made in this report, such knowledge could result in effective clinical applications, improving the quality of life of deaf children and adults in ways they never before dreamed possible.

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