Disfluency Clusters in Adults with Stuttering:

An Exploratory Study

Priyanka

Register No. 10SLP022

A Dissertation Submitted in Part Fulfillment of the Degree of Master of Science

(Speech- Language Pathology)

University of Mysore,

Mysore

ALL INDIA INSTITUTE OF SPEECH AND HEARING

MANASAGANGOTHRI, MYSORE-570006

MAY 2012

CERTIFICATE

This is to certify that this dissertation entitled **“Disfluency Clusters in Adults with Stuttering: An Exploratory Study”** is a bonafide work in part fulfillment of the degree of Master of Science (Speech-Language Pathology) of the student (Registration No. 10SLP022). This has been carried out under the guidance of a faculty of this institute and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysore
May 2012

Prof. S. R. Savithri
Director
All India Institute of Speech and Hearing
Manasagangothri, Mysore-570006

CERTIFICATE

This is to certify that this dissertation entitled **"Disfluency Clusters in Adults with Stuttering: An Exploratory Study"** is a bonafide work in part fulfillment of the degree of Master of Science (Speech-Language Pathology) of the student (Registration No. 10SLP022). This has been carried out under my guidance and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysore
May 2012

Dr. Swapna N
(Guide)
Lecturer in Speech Pathology
Department of Speech-Language Pathology
All India Institute of Speech and Hearing
Manasagangothri, Mysore-570006

DECLARATION

This dissertation entitled **"Disfluency Clusters in Adults with Stuttering: An Exploratory Study"** is the result of my own study under the guidance of Dr. Swapna. N., Lecturer in Speech Pathology, Department of Speech-Language Pathology, All India Institute of Speech and Hearing, Mysore, and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysore Registration No. 10SLP022

May 2012

Dedicated to my Dear Parents who have never ceased to support me in any undertaking of my life

ACKNOWLEDGEMENTS

I am grateful to Almighty God, my eternal source of strength and courage to overcome all the difficulties in life and my Parents for what I am today. Dear Parents, you helped me to grow into a responsible person in this world and you taught me to selflessly contribute to the society. A million thanks would still be insufficient for how much you have done. Thank you for surrounding me with love, care and affection and for your sacrifice to help me travel through this long and challenging journey. I thank you for teaching me to live with enthusiasm, joy and hope and for having imbibed values of life in me. Thank you Amma and Appa for all that you have done to carve me into a better individual. It will be my endeavour to live upto your expectations in future. Immensely blessed to have you as my parents…!!!

To my sister and brother, with whom I share my oldest and most beautiful memories. Dearest Mini and Manu, you too have been the pillar of my growth and a backbone for all that I have achieved. Life seems so lively with you. Thank you for your endless support and love.

This study of mine couldn't have been possible without the cooperation and assistance of each and everyone in the chain.

I am grateful to Prof. S. R. Savithri, Director of All India Institute of Speech and Hearing for permitting me to take up this dissertation.

My heartfelt thanks to my Guide Swapna ma'am who has rendered invaluable help and guidance in my undertaking. Thank you ma'am for listening to my ideas, offering your useful insights and giving your heart and soul to the work. Thank you so much ma'am for your continuous efforts in motivating me to complete this work successfully. I appreciate the patience you have exercised throughout to clarify all my doubts, your incredible organizational talents and your perfection. These few lines are not enough to express my gratitude towards you. You have inspired me as a person, as a teacher and as a guide. Ma'am you made it all possible !!!!!

My deep sense of gratitude to Vasanthalakshmi ma'am and Santosh sir for their help and guidance in providing the necessary statistical inputs during the study.

I also take this opportunity to express my gratitude to all the clients who willingly participated and cooperated with me during my study.

I also extend my thanks to all my friends who contributed in my effort in one way or the other. Sahana, thanks for leaving apart your work to sort out my problems. No one can match your unconditional nature Sanu… I am lucky to have you in my life. Shishira, thanks for all the time you have spared for me to complete my work without any hurdles.

A very special thanks to Rahee. I feel really fortunate to have you as my friend. I have shared the most beautiful thoughts with you and have indeed spent the most memorable days of my life in your presence which will be forever cherished. These six years have left indelible memories in our friendship. Hats off to a great friend..!!!

I owe great many thanks to great many people who have been a significant part of my life during this long journey at AIISH. I would stop here to thank Sahana, Deepashree, Spoorthi, Baljeet, Shishira, Yashaswini, Barkha and Sapna Di. Thanks, Thanks and THANKS is all I can say…!!!!!

Jazz, Nita, Anusha, Greeshma, Rahee and Barkha…… I have certainly enjoyed your company during postings or otherwise. We have had wonderful chats at the canteen over a cup of tea. Miss the time spent with you guys..!!!!

Informally, I would like to thank my brother Chethan and my sisters Vidya, Chaitra, Sushma, Gowri, Latha for making this world a better place to live in. We make a group of best cousins. Chetu, Dear Brother, your presence will always be felt in our hearts. Miss you lots..!!!

In the end I would like to express my deep gratitude to each and everyone who helped me in some way or other in this work.

TABLE OF CONTENTS

List of Tables

List of Figures

Chapter 1

Introduction

Stuttering is a riddle wrapped in a mystery inside an enigma

- Churchill (1939)

Stuttering, a disorder of disruption in the fluency of speech is well known for its high intra and inter-individual variability and in spite of decades of research it remains a mystery with regard to its definition, characteristic features and etiology. This is in turn reflected in the difficulties in decision making during the assessment and management of the disorder. It is described as a complex, multifaceted and heterogeneous disorder. The term "stuttering", as popularly used, covers a wide spectrum of severity; it may encompass individuals with barely perceptible impediments, for whom the disorder is largely cosmetic, as well as others with extremely severe symptoms, for whom the problem can effectively prevent most oral communication.

Stuttering is a diagnostic label referring to a complex multidimensional composite of behaviours, thoughts and feelings of persons who stutter. Precisely stuttering is a fluency disorder with certain overt features (interrupted speech events) and covert or hidden features (negative emotional reactions). These interrupted speech events that occur in the ongoing speech have been referred to as dysfluencies which are also referred to as stuttering instances/moments. These dysfluencies are the cardinal feature of stuttering.

Bloodstein (1981) defined a stuttering moment as the "momentary failure of the complicated co-ordinations involved in speech". These difficulties are exacerbated by environmental pressures which serve as triggers to the event of stuttering. Such environmental pressures include emotional/psychoemotional stress and speech anxiety. There are several theories of stuttering which are based around a description of stuttering moments. Researchers have also expanded on the idea of stuttering as a "momentary breakdown" through various explanations involving motor deficits (Adams, 1974; Perkins, Rudas, Johnson, & Bell, 1976), cerebral planning deficits (Travis, 1931), and language processing deficits (Moore & Haynes, 1980).

Examining the moment of stuttering involves looking at the various dimensions of disfluency including frequency, type, duration/length, and loci of the disfluency. All these aspects of speech disfluencies within utterances produced by persons who stutter have been studied extensively since the 1930's (e.g., Johnson & Knott, 1937; Brown & Moren, 1942; Bloodstein, 1960; Soderberg, 1966; Wingate, 1967; Williams, Silverman, & Kools, 1969; Bloodstein & Grossman, 1981). The frequency of occurrence of each of the disfluency types and their total count has been the most commonly examined and reported dimension. It is reported in terms of (1) the number of disfluencies per 100 syllables or 100 words, or (2) percent syllables or words that contain disfluency. The frequency information is considered important in diagnosing the severity of a person with stuttering.

The dimension of duration or length refers to the time elapsed from the beginning to the end of the disfluent event. This measure could be applied to all disfluency types. The repetition disfluencies are determined by counting the number of iterations per disfluent event. Many studies have focussed only on the frequency of disfluent events, neglecting the information about length (Yairi & Seery, 2011). The duration information is also an important part of the diagnostic protocol used in persons with stuttering.

Primary stuttering behaviours include different types of disfluencies such as repeating sounds, syllables, words or phrases, silent blocks and prolongation of sounds. While the so called normal disfluencies such as repetition of whole words, phrases or parts of sentences, pauses (both filled and unfilled), interjections and hesitations are seen in all individuals including persons with stuttering, stuttering like dysfluencies such as prolongations, blocks and part-word repetitions, sound/syllable repetitions are seen only in persons with stuttering and are not seen in normal individuals. Many researchers including Johnson (1959), Hubbard (1998), Throneburg and Yairi (2001) and Natke, Sandrieser, Ark, Pietrowsky, and Kalveram (2004) have created a classification system for categorizing disfluencies. However, controversy still exists regarding the manner in which disfluencies are categorized. Einarsdottir and Ingham (2005) discussed the issue of using disfluency typology in stuttering research and identified one difficulty as the lack of consistency of categorization system used between studies.

Probably the most commonly used system to categorize types of disfluencies was proposed by Yairi and Ambrose (1992). The system uses two categories, reflecting either stuttering-like disfluencies (SLD) or other disfluencies (OD). This classification system works by reorganizing Johnson's 8 disfluency types into two categories: SLD (i.e., part-word repetition, single-syllable word repetition, disrhythmic phonation, tense pause) and OD (polysyllabic word repetition, phrase repetition, interjection and revision-incomplete phrase). The premise for this classification is that SLDs are disfluencies related to stuttering and ODs are normal disfluencies. Existing information illustrates that there are different viewpoints on the value of disfluency type measures in the area of stuttering. Concerns raised regarding the use of these measures, with particular reference to SLDs, suggest that caution should be taken when categorizing disfluencies.

Research has also been carried out to describe the context or location of disfluencies in an utterance. Studies on adults and children with stuttering revealed that disfluencies usually occur in the initial position of an utterance, on longer words, on words at beginning of sentence and on nouns, verbs, adjectives, adverbs (Brown, 1937; 1938). Further children who stutter are more apt to stutter on function as opposed to content words on which the adults stutter more (Bernstein Ratner, 1981; Howell, Au-Yeung, & Sackin, 1999; Graham, Conture & Camarata, 2004). This aspect pertaining to the loci of disfluencies based on the surrounding factors has continued to receive research attention.

Through the study of the frequency, structure/type, size and location of speech disfluencies within utterances produced by persons who stutter, a new line of research evolved focusing on the geographical or spatial distribution of disfluencies. It was found that while many of the disfluencies occurred as single instances in an utterance, other disfluencies appeared to occur physically close to each other or cluster together, that is, they had a tendency to occur adjacent to each other. This phenomenon of speech disfluencies occurring in close proximity to one another in connected speech was referred to as clusters or runs. Silverman (1973) defined a disfluency cluster as the occurrence of two or more disfluencies on the same word and/or adjacent words, e.g., "W∂w∂w∂wha-what big box?" where a within word cluster occurred consisting of dysrhythmic phonation and part word repetition. The clusters could be further classified as 1) SLD-type; which involves the occurrence of two or more SLDs on the same word and/or adjacent words. (e.g., a part-word repetition followed by a disrhythmic phonation, “The b-b-boy wwent”, 2) OD-type; which involves the occurrence of two or more ODs on adjacent words (e.g., an interjection followed by a phrase revision “The man um -the boy went”, or 3) mixed-type; which involves the occurrence of both OD and SLD types (e.g., an interjection followed by a part-word repetition “He um w-w-wants”) (Yairi and Ambrose, 1992). However, this feature received very limited attention. The significance of clustering is that it may contribute to the perceptual impression of ‘stuttering’ or suggest greater severity (Sargent, 2007; Sawyer & Yairi, 2010).

To date, there have been few investigations of clustering, attempting to throw light on the nature of this potentially significant phenomenon. Overall, these studies found clusters to be an integral part of disfluent speech, occurring more often than would be expected by chance, both in children and adults who stutter. Results from the studies conducted suggest that children who stutter produce longer (Hubbard & Yairi, 1988; LaSalle & Conture, 1995; Rhea, Seby, & Swapna, 2011), proportionately more (Hubbard & Yairi, 1988; Rhea, Seby, & Swapna, 2011), and qualitatively different (LaSalle & Conture, 1995) disfluency clusters than children who do not stutter. Sawyer and Yairi (2010) also found that clusters occurred at rates greater than chance for both stuttering and normally fluent children. Children who stuttered had significantly more and longer clusters than did normally fluent children, however the cluster frequency and length decreased over time for children in the persistent and recovered groups. The proportion of disfluencies in clusters was significantly lower in the recovered group than it was in the persistent group after 6 months.

Additionally, it has been shown that the frequency with which children produce disfluency clusters correlates positively with stuttering severity measures

(LaSalle & Conture, 1995; Sawyer & Yairi, 2004), suggesting that disfluency clusters would indeed be detrimental to the speech of PWS. Such findings have led some clinicians (e.g., Conture, 1997; Yairi, 1997) to suggest that certain disfluency cluster measures might aid in the differential diagnosis of developmental stuttering. Further, the composition of clusters may help differentiate stuttered from normal speech. For example, clusters in which disfluencies more typical of stuttering are adjacent to each other (the stuttering–stuttering cluster type) were found to occur infrequently in an earlier study of normally fluent children (Colburn, 1985), whereas in two more recent studies they were found exclusively in the speech of children who stutter (LaSalle & Conture, 1995; Logan & LaSalle, 1999). Sawyer and Yairi (2004, 2005) found that mixed-type (OD-SLD type) clusters were the most frequently occurring cluster for CWS.

Although a few studies have been carried out in children with stuttering, research on characterizing the disfluencies of adults with stuttering are limited. Early studies of adults who stutter examined clusters with a focus on testing conflict, anxiety and feedback theories of stuttering (Still & Sherrard, 1976), looking at the probability of a disfluency occurring after one had been produced (Taylor & Taylor, 1967), or testing mathematical models based on the sequential characteristics of moments of stuttering (Still & Sherrard, 1976; Still & Griggs, 1979). The outcomes of the studies were generally ambiguous and inconclusive. Still and Sherrard's (1976) and Still and Grigg's (1979) results, for example, provided support for two different models of stuttering. Still and Grigg's study supported a tendency for clustering in adults. A similar finding was reported by Fein (1970) whose study showed significantly more stuttering among words that followed stuttered words than would be expected by chance.

Sargent (2007) studied the characteristics of disfluency clusters in adults who stutter and found that there were significantly more mixed clusters than SLD-type or OD-type clusters, utterances containing disfluency clusters were significantly longer than fluent utterances and the speaking rate of fluent utterances was found to be significantly faster than that of disfluent utterances.

Robb, Sargent, and O'Beirne (2009) compared the adults who stutter with children who stutter and found that adults produced fewer clusters than children, and the largest number of clusters occurred in the speech of adults who reported not having had therapy for stuttering. The investigators proposed that therapy and maturity of the speech motor system influenced the smaller number of clusters in adults than in children.

The disfluency clusters have received numerous interpretations for their occurrence. An interesting interpretation of clusters was proposed by Wexler and Mysak (1982) who considered both linguistic and motor influences on disfluency clusters with reference to particular disfluency types. Wexler and Mysak (1982) suggested that certain types of disfluencies represented both motor and linguistic components. Interestingly, the disfluencies identified as linguistically-related by Wexler and Mysak (1982) relate to the disfluency types categorized as ODs by Yairi and Ambrose (1992), and those identified as motor-related correlate with the types of disfluencies categorized by SLDs. The other most notable ones are the linguistic hypothesis which suggests that disfluency clusters reflect difficulties formulating and/or expressing syntactically complex utterances (Logan & LaSalle, 1999), and the motor hypothesis which explains clusters purely as disruptions to the neurotransmissions of the motor planning process caused by exceeding the limits of the speech musculature (Hubbard & Yairi, 1988). Hence, disfluency clusters have received both motor and linguistic interpretations.

Need for the study

Despite having gained some potentially significant findings regarding disfluency clusters, there is not yet enough information in this area for any findings to be more than speculation. In addition, the phenomena of disfluency clusters have been examined in great majority in the speech of children with and without stuttering. However, there is a paucity of research evaluating the characteristics of disfluency clusters in an adult population. Little is known about disfluency clusters in the adult population especially in the people speaking Indian languages. Because stuttering is a fluency disorder observed across languages and cultures (reviews by Van Riper, 1971; Bloodstein, 1995; Cooper & Cooper, 1998; Shapiro, 1999; Van Borsel, Maes, & Foulon, 2001; among others), understanding disfluencies in speech and specifically cluster disfluencies in culturally and linguistically diverse backgrounds is essential.

Since disfluency clusters are found in the speech of adults who stutter, although reports are scanty pertaining to the same, it seems important to explore in detail, the disfluency types, the differences between them, the information on the internal composition and location of clusters. Such information could prove valuable in understanding the progression of stuttering and the supposed linguistic and or motoric influence of disfluency clusters. This could add to the data towards establishing a cause for the occurrence of disfluency clusters. In addition, the majority of studies attempting to determine motor and linguistic influences have used child participants, hence no picture of the progression of stuttering (i.e. adulthood), with regard to these influences, has been formulated.

Besides the theoretic value of information about clusters, there are also potential practical implications. To investigate further the potential of clusters as holding diagnostic predictive value, it is necessary to develop an understanding of the role of disfluency clusters in the stuttering of adults. Just as frequency, type and severity of disfluencies exert a considerable influence on listener judgements during the assessment (Young, 1994), the 'density' of distributions of disfluencies (spatial distribution) in speech could be another factor. The traditional measures do not take into account the differences that may exist between the same number of disfluencies under varying temporal conditions. For example, a count of five disfluencies within five utterances is considered to be similar as five disfluencies occurring within the boundaries of one utterance. Consequently, the discovery of different clustering patterns would help in expanding the base of current strategies that differentiates various severities of stuttering. The study of the type, frequency, loci and the size of the cluster disfluencies can serve as a valid clinical measure which will hold value in the identification of severity of stuttering. This might result in less overlap between the groups and consequently, permit them to be more readily differentiated.

An examination of clusters may yield additional clinical information as a means of monitoring stuttering in adults. For e.g., the frequency and components of clusters may change over with intervention as well. Since there is a paucity of research evaluating the characteristics of disfluency clusters in an adult population, such exploration would lead to a more complete understanding of the nature of stuttering and the clinical utility of disfluency cluster measures in adults. Keeping this in view, the study was planned.

Aim of the study

The aim of the study was to investigate the disfluency clusters, if any, in the speech of Kannada speaking adults with stuttering. The specific objectives of the study were as follows:

1) To examine the characteristics of disfluency clusters, if any, in terms of their structure, frequency, size or length and loci in the speech of the adults with stuttering who had not undergone any intervention program to improve fluency.
2) To examine the characteristics of disfluency clusters, if any, in terms of their structure, frequency, size or length and loci in the speech of the adults with stuttering who had undergone an intervention program.
3) To assess whether the frequency of disfluency clusters would vary with the severity of stuttering.

Chapter 2

Review of Literature

Stuttering is an area that has received more attention than any other speech and language disorder. For most speech-language clinicians and researchers, it is an abstract disorder within an abstract discipline. Although many decades have gone past, yet many basic issues related to stuttering demands clarity. The area of stuttering continues to remain a mystery with regard to its definition, characteristic features and etiology. This is inturn reflected in the difficulties in decision making during the assessment and management of the disorder.

It is a well known fact that stuttering combines two distinct but intertwined elements: the observable or overt features of the disrupted speech output, and the reactions and experiences of the individual, relating to those disruptions which are covert. The overt features include aberrant sound prolongations and syllabic or part word repetitions, blocks and other abnormal dysfluencies that are interspersed with otherwise perceptually normal speech patterns (Bloodstein, 1995). Guitar (2006) described stuttering as unusually frequent disruptions in the flow of speech. According to World Health Organization (1992), stuttering refers to “disorders in rhythm of speech in which the individual knows precisely what he wishes to say but at the same time is unable to say it because of an involuntary repetition, prolongation or cessation of a sound”. In other words, a person who stutters may communicate normally without disruption, however suddenly may begin to produce unexpected rapid oscillatory phonemic, syllabic or word repetitions which may be uncontrollable. Additional symptoms include facial grimacing, fixed articulatory postures, and obvious fear during speech attempts, or anticipation of speech failure prior to speech attempts (Sheehan, 1975). These are referred to as the secondary stuttering behaviours which are unrelated to speech production and are learnt behaviours which become linked to the primary behaviours.

However, there are also some covert or hidden features experienced by persons with stuttering which include negative emotional reactions such as depression, lack of self confidence, increased stress levels, social stigma, depression, frustration, embarrassment, shame, guilt, hostility, fear and anxiety. These covert features appear due to the presence of the disfluencies and the overall difficulty in communicating. Since these features were found in persons with stuttering, some researchers focused on these aspects in their definitions. Cooper (1993) described stuttering as consisting of a behavioral, affective and cognitive component. Van Riper (1982) defined stuttering as having three elements: 1) aberrant speech behaviors, 2) emotional upheaval, reflected in physiological and stress reactions, and 3) negative communication attitudes and lifestyle adjustments. However, the overt symptoms of stuttering are the primary or the cardinal feature of the disorder. It could be said that there is no stuttering without the overt features.

The major challenge to speech-language clinicians involved in working with the persons with stuttering is the variability of the disorder. The severity of a person who has stuttering is often not constant even for severe stutterers. They commonly report dramatically increased fluency when talking in unison with another speaker, copying another's speech, whispering, singing, and acting or when talking to pets, young children, or themselves. Other situations, such as public speaking and speaking on the telephone are often greatly feared by stutterers, and increased stuttering is reported. Moreover no two individuals with stuttering stutter the same way. Each person has their own individual pattern of stuttering. Thus, there is a high level of variability in the quality and quantity of disfluencies in PWS, both within and among individuals, depending on the speaking situations and the language related factors.

Stuttering disfluencies also vary in quality. There are normal disfluencies which involve repetition of whole words, phrases or parts of sentences, pauses (both filled and unfilled), interjections and hesitations which occur in normal individuals and persons with stuttering; there are stuttering like disfluencies too which involve prolongations, blocks and part-word repetitions (sound/syllable repetitions) found only in individuals with stuttering. Therefore variability is the hallmark of the disorder and hence many researchers have described it as a heterogeneous disorder.

Since stuttering is a complex, multifaceted and highly variable disorder, the assessment process is complicated. The overt features or the moments/event of stuttering or the disfluencies are most commonly examined and researched since these are observable behaviours. According to Wingate (1984), one advantage of examining stuttering event is that they are readily identifiable and therefore measurable. Johnson (1959) asserted that stuttering should be viewed as individual moments of disfluency and that these moments should be the focus of investigation. In addition, as stuttering behaviour is a symptom of the problem, analysis of disfluencies may be able to provide information regarding the etiology of the disorder. Although disfluencies are more measurable than psychological functions, evaluating moments of stuttering is by no means a simple process. Indeed, considerable controversy exists among researchers pertaining to the manner in which stuttering is evaluated and measured. Particular controversy exists regarding the manner in which disfluencies are categorized.

In an attempt to measure the overt behaviours or the stuttering event, researchers have studied the various dimensions of disfluencies. These include the structure/type, location, frequency, length/duration of speech disfluencies within utterances produced by persons who stutter. These dimensions have been studied extensively since the 1930s (e.g., Johnson & Knott, 1937; Brown & Moren, 1942; Bloodstein, 1960; Soderberg, 1966; Wingate, 1967; Williams, Silverman, & Kools, 1969; Bloodstein & Grossman, 1981).

Structure/type of disfluencies

With regard to the structure/type of speech disfluencies, Johnson created an eight-part classification system for categorizing the types of disfluencies: they were 1) interjections, 2) repetition of sounds or syllables, 3) repetition of words, 4) repetition of phrases, 5) revisions 6) incomplete phrases, 7) broken words, and 8) prolonged sounds (Johnson, 1959). Johnson's findings suggest, in other words, that within his classification there are certain descriptions that are distinctly typical of disfluencies likely to be considered stuttering. This view is strengthened by other research findings showing that listeners are likely to classify sound or syllable repetitions and prolonged sounds as stuttering and revisions as normal disfluency (Boehmler, 1958; Williams & Kent, 1958; Schiavetti, 1975). A measure that attempts to separate "stutter-type" disfluencies from others is the index of disfluency used by Sander (1961), which has found some application in research. It is the count of disfluent words for which a disfluency is defined as a sound, syllable, or word repetition; a sound prolongation; a broken word; or an interjection within a word.

Johnson's eight disfluency categories have been subject to several adaptations including Throneburg and Yairi (2001) who used seven disfluency types and Hubbard (1998) used eight and Natke, Sandrieser, Ark, Pietrowsky, and Kalveram (2004) who used five categories. Particular controversy exists regarding the manner in which disfluencies are categorized. Einarsdottir and Ingham (2005) discussed the issue of using disfluency typology in stuttering research and identified one difficulty as the lack of consistency of categorization system used between studies. Perhaps not surprisingly, there has been much debate about what is the right set of symptoms to characterize stuttering, but few investigations have supplied empirical evidence as to whether one scheme is preferred over another.

Campbell and Hill (1987) distinguished between more typical and less typical disfluency. They described their classification system as a continuum of disfluent speech behaviours. On one end of the continuum are the typical disfluencies of hesitations, interjections, revisions, and phrase repetitions; on the opposite end are the atypical disfluencies of sound repetitions, prolongations, blocks and other signs of increased tension. In the middle are the 'crossover behaviours' that could be either typical or atypical, depending on such features as numbers of repetitions per instance, or tension level. These disfluencies include part-word and one-syllable word repetitions. This classification is also problematic because of the terminology 'normal or typical' used as the reference within a framework of a continuum. It implies that stuttering is merely a change in degree of what normal speakers do, not something unique to the disorder (Yairi & Seery, 2011).

Conture (1990a) based on his clinical experience, distinguished between within-word disfluency and between-word disfluency. He proposed that stuttering that occur within words is a sign that stuttering is likely to persist and, as such, is more characteristic of stuttering than stuttering that occurs across words (what he called "between-word disfluencies"). Sound/syllable repetitions, sound prolongations, broken words, and monosyllabic whole-word repetitions were placed into the within-word category. The first three are equivalent to Johnson's characteristics 6, 7, and 8 and monosyllabic whole-word repetitions are a subset of his characteristic 4. The between-word category has multisyllabic whole-word repetitions (part of Johnson's characteristic 4), phrase repetitions (characteristic 5), interjections (characteristic 3), and revisions (characteristic 2). Conture's scheme has been used in studies to diagnose cases, though there has been no validation of it in terms of whether it improves diagnosis relative to other schemes or whether it distinguishes persistent and recovered cases. Within-word disfluencies have been used (either alone or in conjunction with ancillary measures) to specify whether children should be considered as stuttering by Zebrowski, Conture, and Cudahy (1985), Conture and Kelly (1991), Zebrowski (1991), Curlee (1993), Wolk, Edwards, and Conture (1993), and Zebrowski (1994).

Conture's proposal was not evidence-based and the emphasis was on monitoring individual cases, not for establishing general developmental trends shown by speakers who go on to persist or recover from stuttering. Cordes and Ingham (1995b) argued against the characterization Conture offered because both within and between-word disfluencies occur in fluent and stuttered speech.

Yairi believed that it was confusing if disfluency types considered as "stuttering" are also tabulated in the speech of people who do not stutter. In attempts to rectify this situation, Yairi and Ambrose (1992) introduced the stuttering like disfluencies (SLD) measure, which they believed had particular saliency for measuring childhood disfluency. Yairi and Ambrose proposed the category of SLD, to improve diagnosis and in their examination of persistence and recovery of stuttering.

This is probably the most commonly used system to categorize types of disfluencies. The system uses two categories, reflecting either SLD or other disfluencies (OD). This classification system works by reorganizing Johnson's eight disfluency types into two categories: SLD (i.e., part-word repetition, single-syllable word repetition, disrhythmic phonation, tense pause) and OD (polysyllabic word repetition, phrase repetition, interjection and revision-incomplete phrase). The premise for this classification is that SLDs are disfluencies related to stuttering and ODs are normal disfluencies. A fact to note is the similarity between Conture's and Yairi's and Ambrose's schemes for those symptoms considered most typical of stuttering.

Yairi and Ambrose's system has also received criticism. Einarsdottir and Ingham (2005) argued that even within these two categories there has been variation in what is included within SLD and OD, and also state that the reliability of measuring disfluency types is poor. However, Hubbard (1998) examined the difference between using disfluency type measures and listener judgments in the differentiation of stuttering and found that neither method was significantly more reliable than another. Wingate (2001) presented a more specific criticism of SLDs when he questioned the inclusion of whole-word repetitions as a SLD, claiming that whole-word repetitions are widely regarded as aspects of normal speech. With this in mind, Graham, Conture, and Camarata (2004) analyzed the speech samples of CWS with and without whole-word repetitions using the SLD categorization system. Graham et al., (2004) found that exclusion of whole-word repetitions within SLDs did not alter the results. However, one is still left wondering how best to categorize whole-word repetitions.

Existing information illustrates that there are different viewpoints on the value of disfluency type measures in the area of stuttering. Concerns raised regarding the use of these measures, with particular reference to SLDs, do not justify the exclusion of this area of research but do suggest that caution should be taken when categorizing disfluencies.

Frequency of disfluencies

The frequency of occurrence of each of the disfluency type and their total count has been the most commonly examined and reported dimension. This has been suggested as a potential predictive tool for the persistence or recovery of childhood stuttering. Yairi (1997) stated that disfluency counts have been the classic metric of the disorder for both clinical and basic research. Clinically, the number of disfluencies has been regarded as the most important index of stuttering severity (Van Riper, 1971). Analyses of disfluencies have been weighted heavily in instruments of evaluation and diagnosis of early childhood stuttering, especially in differentiating between normal disfluency and incipient stuttering (Adams, 1977; Curlee, 1980; Pindzola & White, 1986; Campbell & Hill, 1987; Gorden & Luper, 1992; Ambrose & Yairi, 1999). Disfluency counts have also been used in formal and informal instruments designed to predict stuttering chronicity (Riley, 1981; Cooper & Cooper, 1985; Conture, 1990a; Curlee, 1993). This measure is reported in terms of (1) the number of disfluencies per 100 syllables or 100 words, or (2) percent syllables or words that contain disfluency. Roughly if a person experiences disfluencies on the average about on 10 percent of words in oral reading, he/she can be diagnosed as stuttering (Bloodstein, 1995). However the variability of this measure, both from person to person and under different conditions, is quite high.

The frequency of disfluencies in individuals with and without stuttering has been studied by various researchers. Throneburg and Yairi (2001) attempted to identify trends in the frequency of disfluencies in preschool children who recovered from stuttering and those who persisted. Results indicated that the overall frequency of disfluencies remained constant over time for the persistent group but dropped significantly for the recovered group. This finding is in agreement with Ryan (2001) who also found the frequency of disfluencies in preschool children to decrease in the recovered group and increase or remain stable in the persistent group. It has been suggested that filled pauses are by far the most frequent speech disfluencies found followed by repairs and unfilled pauses (Alvstad, Hild, & Tiselius, 2011).

Judging the severity of stuttering

Previous research has also examined a listener's ability to identify moments of stuttering (Hegde & Hartman, 1979b) and to rate levels of stuttering severity (Leach, Wolfolk, Fucci, & Gonzales, 1995). Findings indicated that listeners were reliable in their identification of mild to moderate disfluencies but reliability decreased when rating more severe-type disfluencies (Hegde & Hartman, 1979b). Prosek, Walden, Montgomery, and Schwartz (1979) presented speech-language pathologists with pairs of sentences recorded by 13 male adults with stuttering and required them to identify the most severe stutterer from each pair. Results indicated that reading rate and number of intrasentence pauses were the most important factors in determining the severity of a stutter. On the other hand, frequency of disfluencies or type of disfluencies appeared less related to overall stuttering severity. O'Brian, Packman, Onslow, and O'Brian (2004) compared two forms of stuttering measurement, (1) percentage of syllables stuttered and (2) a 9-point severity scale. They found that the two forms of measurement were largely interchangeable. Exceptions included when the speech sample contained either a small number of significant fixed postures or a large number of repeated movements. In these cases, O'Brian et al., (2004) recommended that both a percentage score and severity rating be used. Results from the above studies suggest that frequency and type of disfluency alone are not sufficient in establishing a reliable measure of severity.

Duration/length of disfluencies

Stuttering duration is another aspect of the stuttering event which has been shown to have relevance to assessment and monitoring of the disorder (Riley, 1980; Zebrowski, 1994; Throneburg & Yairi, 2001). The dimension of duration or length refers to the time elapsed from the beginning to the end of the disfluent event. Measures of duration have included duration of instances of repetitions and duration of sound prolongations (Zebrowski, 1994). The repetition disfluencies are determined by counting the number of iterations per disfluent event. These were also termed as repetition units by Ambrose and Yairi (1995). Many studies have focussed only on the frequency of disfluent events, neglecting the information about length (Yairi & Seery, 2011). Most of the available literature is on children, for e.g., Zebrowski (1994) found that the 80% to 87% of the repetitions of the preschool children had only one repetition unit with a mean of 1.16 and the mean for the stuttering children was between 1.53 and 1.70 (Ambrose & Yairi, 1995). However, research has also indicated no difference in the duration of stuttering between preschool children who stutter and preschool children who do not stutter (Zebrowski, 1991; Kelly & Conture, 1992). Several other studies found that most disfluent events in the speech of adults who stutter are quite short with a mean length for individual participants ranging from 0.5 to 3.7 s, with a group median of 0.9 s (Bloodstein, 1995). Johnson and Colley

(1945) reported that the mean of 10 shortest blocks was 0.41 s, whereas the mean of the 10 longest was 4.1 s.

Location of disfluencies

Examining the moment of stuttering involves more than simply looking at frequency and duration of the disfluency. Research has also been carried out to describe the context or locus of disfluencies. Webster's Ninth New Collegiate Dictionary (1988) defines locus as "place, locality, the set of all points whose location is determined by stated conditions". Applied to stuttering, therefore, loci refer to points at which fluency disruptions cluster, for whatever reason. Although stuttering can occur at any place or time during speech production, the locus of overt stuttering events in connected speech has been a topic of strong interest over the years, and certain linguistic trends have been found that can exist independently of the anticipated stuttering on certain sounds.

In both children and adults who stutter, stuttering has been found to occur more frequently in the first few words of a sentence (Brown, 1945; Wingate, 1982). Studies on adults and children with stuttering reported that disfluencies usually occur in the initial position of an utterance, on longer words, on words at beginning of sentence and on nouns, verbs, adjectives, adverbs (Brown, 1937; 1938). Brown (1945) also reported six variables believed to hold predictive value in the likelihood of a stutter occurring. These were (1) words beginning with a consonant other than /w, hw, h, t, th/, (2) words from the grammatical classes of nouns, verbs, adjectives, and adverbs, (3) long words (five or more letters), (4) words occurring early in a sentence, (5) the first sound of a word, and (6) stressed syllables. This notion of being able to predict the likelihood of a stutter based on the surrounding factors has continued to receive research attention.

The question of precisely where stuttering occurs has at least two distinguishable aspects that are readily investigated-its locus within the word and the locus of the stuttered word in the larger context of speech. The first question has been of lesser concern to research workers because it is so easily answered. Over 90 percent of stutterings have been found to take place on the initial sound of the word (Johnson & Brown, 1935; Hahn, 1942b). Of the remaining blocks, almost all occur on the first sound of the syllable. The reason for these findings has yet to be adequately explained, though the combination of increased frequency at the beginning of an utterance with increased frequency on the initial phoneme has for years led researchers to believe that stuttering is associated with an inherent difficulty in initiating speech. This theory has influenced therapeutic orientation and, hence, it is a theory that cannot be dismissed lightly. In addition, there is tendency for stuttering to be associated with accented syllables within polysyllabic words (Brown, 1938b; Hejna, 1972). It was the second problem that of identifying the distinctive characteristics of stuttered words that presented the more serious challenge.

The loci studies have yielded some fairly consistent patterns regarding points of fluency breakdown as a function of grammatical parts of speech. The distribution of stuttering across “content” words such as nouns, adjectives, verbs, and adverbs; and function words such as pronouns, prepositions, or conjunctions has been the subject of much debate. Though children have been observed stuttering more on function words, the trend seems to shift in adults, who seem to stutter more on content words (Howell et al., 1999). The results of a study done in the same regard showed that children who stutter are more apt to stutter on function as opposed to content words (Bernstein Ratner, 1981; Howell et al., 1999; Graham, Conture, & Camarata, 2004). It was thought that this occured because content words carry higher levels of “propositionally” or weight with regard to their meaning in their utterance. However, this concept has also been recently revisited. In a study that examined stuttering frequency on 63 content and, 63 function words matched for initial sound and number of syllables, Dayalu, Kalinowski, Stuart, Hobert, & Rastatter (2002) concluded that the best predictor of stuttering on any given word was its inverse frequency of use in English language. That is, words that were more commonly used were found to be stuttered less than those used less frequently. As such, stuttering frequency was not thought to be directly related to content or function categories per se. The authors explained this phenomenon by a generalized adaptation effect (i.e., stuttering occurred less frequently upon repeated productions) to the small list of 100 to 200 function words that are repeatedly used in English language. This view may also find some support in the finding that stuttering occurs more on words that are less familiar to those producing them (Hubbard & Prins, 1994). Therefore, it appears that, generally speaking, the more times a word is used, the less chance there is of stuttering on it.

Another dimension of the locus or "geographical"/“spatial” distribution of disfluencies within a given speech sample is their physical closeness—that is, their tendency to occur adjacent to each other to form **clusters.** Although there has been much interest in various aspects of the location of disfluencies surrounding the stuttering event, there has been significantly less interest with regard to their proximity to one another in connected speech. Many of the disfluencies occur as single instances in an utterance, however there are other disfluencies that appear to cluster together either on the same word or adjacent word. This phenomenon of speech disfluencies occurring in close proximity to one another in connected speech was referred to as clusters or runs (Silverman, 1973). Silverman (1973) defined a disfluency cluster as the occurrence of two or more disfluencies on the same word and/or adjacent words. Colburn (1985) also recognized the significance of clusters in terms of the time period in which disfluencies occur and described them as ‘temporal influences’.

This idea of the spatial distribution of disfluencies evolved gradually over the years through the investigations carried out to measure the various dimensions that define the overt features of stuttering. Although various studies have been published regarding frequency, types, consistency and variation of these disfluencies and the linguistic factors that influence their appearance (Bloodstein, 1981), the studies pertaining to the spatial distribution of disfluencies are scanty. In spite of the concentrated research efforts in the area of assessment of stuttering, the aspect of clustering of disfluencies within a single word or adjacent words has received very limited attention.

Accounting for the occurrence of disfluency clusters

Disfluency clusters have received a range of interpretations. Perhaps the most basic explanation for disfluency clusters is that they result from mere happenstance. In this view, the various speech disfluencies that constitute a disfluency cluster would essentially be seen as unrelated to one another. This possibility seems unlikely, however, given that children’s speech disfluencies appear to cluster together at levels significantly greater than expected by chance (Silverman, 1973; Colburn, 1985; Hubbard & Yairi, 1988; LaSalle & Conture, 1995). Another possible cause of cluster disfluency may be that any one speech disfluency might serve as a stimulus or cue that elicits increased anxiety, physical tension, and, consequently, additional speech disfluencies could result (Still & Griggs, 1979). Still and Griggs suggested that the anxiety and physical tension created when a stutter occurs serves to increase the likelihood of another stutter occurring. Furthermore they claimed that when a person is anxious about their speech they are likely to focus undue attention to their voice and this monitoring also leads to an increased chance of stuttering. As Hubbard and Yairi (1988) have pointed out, however, such an explanation seems limited in that it is unlikely to adequately account for disfluency clusters produced by persons who do not stutter. Another possibility holds that dysfluency clusters may be an outcome of either a lack of quick correcting capacity after disputed speech movements resulted in the first dysfluency in the chain.

Currently, several theories or models of stuttering implicate motoric factors underlying the disorder. For example, dynamic patterns concepts, embracing a nonlinear theory of motor control (Kelso, 1995), have been applied to stuttering (Smith & Kleinow, 2000; van Lieshout, Hulstijn, & Peters, 2004). Other theories have offered interaction of motoric and linguistic processes underlying speech production. Stuttering has been seen as the product of interference between language formulation and the motor processes of speech (Peters & Starkweather, 1990). Peters, Hulstijn, and van Lieshout (2000) suggested that people who stutter have inefficient motor control systems in which performance is influenced by linguistic variables. Howell (2004) suggested that stuttering results from linguistic plans arriving too late for the motor system to execute. If the plan for the next utterance is not ready, it is hypothesized that the speaker may repeat a word or an entire phrase while waiting for the plan for the remaining message to arrive. Manning and Shirkey (1981) categorized disfluent events into those produced by motoric and linguistic influences.

The motoric hypothesis

Considering these theories as a basis, Hubbard and Yairi (1988) provided a motor interpretation of clusters on a model of disfluency presented by Zimmermann (1980). This model describes a stutter as occurring due to an overload on the speech musculature. This overload causes the brain to "get stuck" in this repetitive action, and unless the system is quickly restored, subsequent stuttering will develop (Zimmermann, 1980). It was noted by Hubbard and Yairi (1988) that this interpretation could readily explain the stuttering behaviours of dysrhythmic phonations and part-word repetitions but was more difficult to relate to revisions and interjections. As noted by earlier studies, revisions and interjections have been associated with disfluency behaviours of fluent individuals (Wexler & Mysak, 1982; Colburn, 1985), whereas behaviours associated with stuttering include partword repetitions and dysrhythmic phonations (Yairi & Ambrose, 1992). Therefore, if these certain stuttering behaviours are characteristic of stuttering, and stuttering is a motor disorder, it is likely that normal disfluencies do not reflect a motor breakdown. Rather, normal disfluencies are likely to result from influences related to the organization of speech and language.

The linguistic hypothesis

Logan and LaSalle (1999) agreed that the occurrence of disfluency clusters is not due to chance alone, however they suggested that disfluency clusters were most likely attributed to linguistic factors. In a study which looked at the characteristics of utterances containing disfluency clusters in children with stuttering and children with no stuttering, Logan and LaSalle (1999) observed that disfluency clusters occurred more often in syntactically complex utterances. In addition, it was also found that clusters often included instances of linguistic revision, which could be a reflection of syntactic monitoring/formulation. A linguistic influence on clusters is further supported by the finding that disfluency clusters often occur at the beginning of utterances or clauses.

Wexler and Mysak (1982) carried out an analysis among a group of children with no stuttering to identify correlations between various types of disfluencies which were observed to occur in clusters. Findings indicated strong correlations between phrase revisions and interjections, revision-incomplete phrase and word repetitions, and between phrase repetitions and disrhythmic phonations. Lowest correlations were noted between interjections and phrase repetitions, tense pause and word repetitions, and tense pause and interjections. The authors interpreted the high correlations found between phrase revisions and interjections; and phrase revisions and word repetitions as supporting a linguistic hypothesis, due to these types of disfluencies being "intuitively" linguistic related.

Interaction between motoric and linguistic processes

Both the motor and linguistic interpretations of disfluency clusters are attempts to identify the underlying cause of the stuttering event. An alternative interpretation of disfluency clusters was proposed by Wexler and Mysak (1982). They proposed an interaction of motoric and linguistic processes underlying speech production.

Stuttering has been seen as the product of interference between language formulation and the motor processes of speech (Peter & Starkweather, 1990). Peters, Hulstijn, and van Leishout (2000) suggested that people who stutter have inefficient motor control systems in which performance is influenced by linguistic variables.

Howell (2004) suggested results from linguistic plans arriving too late for the motor system to execute. If the plan for the next utterance is not ready, it is hypothesized that the speaker may repeat a word or an entire phrase while waiting for the plan for the remaining message to arrive. Manning and Shirkey (1981) categorized disfluent events into those produced by motoric and linguistic influences.

Wexler and Mysak (1982) proposed motoric and linguistic categories of disfluency. The findings by Wexler and Mysak (1982) introduce an alternative method for analyzing and interpreting disfluency clusters, which can be combined with recent findings regarding disfluency clusters as categorized by the SLD-OD system of Yairi and Ambrose (1992). Sawyer and Yairi (2005) used the SLD-OD system to analyze the disfluency clusters of persistent and recovering children with stuttering and children with no stuttering. Essentially three types of clusters can occur using this system. The first cluster is SLD-SLD, which would involve two motor-based disfluencies. The second type of cluster is OD-OD, which would involve two linguistic-based disfluencies. The third cluster is mixed and would involve both SLD and OD type disfluencies. Results indicated that near the onset of stuttering, children with stuttering had similar frequencies of SLD and mixed clusters but significantly less OD clusters in their speech. A speech sample collected six months later showed that recovering children with stuttering displayed a significant drop in the number of SLD and mixed clusters and no change in OD. On the other hand, persisting children with stuttering had a significant decrease in SLD only, although the frequency of SLD in this group continued to be significantly more than children with no stuttering. Further investigation of the composition of mixed clusters identified that for all groups of children, 80% of mixed clusters began with an OD and were usually followed by an SLD. Considering the findings from Wexler and Mysak (1982), it could be hypothesized that OD's reflect linguistic disfluencies and SLD's reflect motor disfluencies.

In summary, disfluency clusters have received numerous interpretations. Disfluency clusters may be an outcome of either a lack of quick correcting capacity after disrupted speech movements resulted in the first disfluency in the chain and/or continuing difficulties in the interaction between central linguistic and motor processes. In addition, as suggested by the various theories, the composition of clusters may also reflect motoric and linguistic influences, two of the most notable being the linguistic hypothesis which suggests that disfluency clusters reflect difficulties formulating and/or expressing syntactically complex utterances (Logan & LaSalle, 1999), and the motor hypothesis which explains clusters purely as disruptions to the neurotransmissions of the motor planning process caused by exceeding the limits of the speech musculature (Hubbard & Yairi, 1988). The interpretation of clusters proposed by Wexler and Mysak (1982) who considered both linguistic and motor influences on disfluency clusters with reference to particular disfluency types is that they suggested certain types of disfluencies to represent both motor and linguistic components. Interestingly, the disfluencies identified as linguistically-related by Wexler and Mysak (1982) relate to the disfluency types categorized as ODs by Yairi and Ambrose (1992), and those identified as motor-related correlate with the types of disfluencies categorized by SLDs. Previous findings and observations are taken to suggest that the motor and linguistic influence on disfluency clusters may be analyzed using the SLD-OD classification system. In addition, the majority of studies attempting to determine motor and linguistic influences have used child participants, hence no picture of the progression of stuttering (i.e. adulthood), with regard to these influences, has been formulated.

Better understanding of the differences among various disfluency types and additional information on the internal composition of clusters could be extremely important in resolving these questions as well as other theoretical alternatives.

Research in the area of disfluency clusters

To date, there have been few investigations of clustering in persons with stuttering, attempting to throw light on the nature of this potentially significant phenomenon. Some of these studies have been conducted on typically developing children and children with stuttering, while others have been carried out on adults with stuttering. Most of these studies investigated the disfluency clusters in terms of their frequency, length and location and characteristics of the utterance that encompasses them. Some of these studies also offer a linguistic, a motoric or a combination of two theories as an explanation for the occurrence of clusters. Other studies have also focused on the influence of intervention strategies on these clusters. A few of these studies have been described below.

Two studies investigated cluster disfluencies in the speech of young nonstuttering children. One such study was by Silverman (1973) in which instances of speech disfluency produced by 10 four-year-old nonstuttering boys during spontaneous speech were analyzed to determine whether clusters occurred more often than expected by coincidence or chance. The children's speech was tape recorded in their nursery school classroom while they talked with playmates and familiar adults during relatively free play activities and in a testing room in the classroom building while they performed selected speech tasks, such as telling stories in response to Peabody story cards in the presence of experimenter. The samples collected in both the classroom and the structured interview were used to determine whether the tendency for instances of the children's disfluency to cluster would vary situationally as had their disfluency frequency. The samples were analyzed and she found that while the children produced approximately twice as many disfluencies in single instances than in runs in both situations, they all produced more disfluency in runs than could be expected by chance.

Colburn (1985) also studied clustering of disfluencies in the speech of four nonstuttering two-year old subjects and found that clusters occupied one-third of the disfluent speech. Audiotaped speech samples had been made over several months time in the childrens' homes. The utterances that fell between 2.25 and 3.0 morphemes for the children were used. Each disfluent moment was identified and classified and the disfluent utterances were categorized as containing either single disfluencies or clusters of disfluencies. The clusters of two disfluencies were examined to determine if specific disfluency types tended to cluster together more often than others. While there were more disfluent utterances that occurred as single instances rather than clusters, overall, the disfluent tokens seemed to distribute equally as both singles and as clusters. He concluded that clustering of disfluency within the speech of nonstuttering preschool children is a normal phenomenon and does not increase substantially over time.

Several studies have been published which investigated the cluster disfluencies in young children with stuttering. Hubbard and Yairi (1988) obtained speech samples from 15 children who stutter (mean age: 34.07 months [*SD* = 5.98]) recorded only 5.5 months post onset and from matched normally fluent peers. While 57% of the disfluencies produced by the first group occurred in clusters, only 33% of disfluencies produced by the latter group occurred in clusters. They reported that the proportion of disfluencies which occurred in clusters in the speech of preschool children with stuttering was six times higher than that of the nonstuttering samples. They also found that the clusters exhibited by the children with stuttering were considerably longer ranging from two to ten disfluencies per cluster than that exhibited by the non stutterers. Highest clustering proportions for the children with stuttering were phrase repetition, multiple-syllable word repetition and interjection. For controls, the highest proportions were tense pause, phrase repetition and dysrhythmic phonation. The investigators suggested that certain types of clusters, such as those comprising part-word repetition and disrhythmic phonation (sound prolongations and blocks), might be indicative of a motoric component. They anchored this notion in Zimmermann's (1980b) brainstem reflexes model of stuttering, which postulated that stuttering occurs when speech movement exceeds space or time thresholds, triggering afferent feedback to the brainstem, which responds by throwing the speech system into oscillation or tonic behavior—thus, stuttering. If the system is not stabilized quickly, it might be speculated that the stimulation from oscillatory and tonic activity causes additional reflexive responses and hypertonic disfluency, hence the phenomenon of clusters—one disfluent event begets the next. A tight, fixed speech posture in association with disrhythmic phonation or fast tense sound or syllable repetition suggests that motorically, excessive force has been applied. Hence, these disfluency types fit nicely into this model of unchecked reflex-induced tonic activities. This, however, does not explain the presence of clusters containing revisions and interjections. The authors speculated that these types of disfluency seemed to reflect formulating and planning processes.

The characteristics of disfluency clusters in children have been employed in the assessment of theories of stuttering. LaSalle and Conture (1995) used the covert repair hypothesis (Postma & Kolk, 1993) to explain the production of clusters in young children. They analyzed the speech of 30 children who stuttered (mean age: 51.2 months [SD= 10.4]) and 30 normal fluent peers. The children who stutter were at an average of 16.5 months past the onset of stuttering, and divided into 3 subgroups: ten had mild stuttering, 19 had moderate stuttering, and one had severe stuttering. Clusters were classified into 4 classes based on the covert repair hypothesis: (a) stuttering-stuttering, which contained only disfluency types more typical to the speech of people who stutter; (b) repair-repair which were dysfluency types regarded as more typical to the speech of normally fluent speakers; (c) stuttering-repair; and (d) repair-stuttering. Repairs were classified as either overt (e.g., revisions) or covert (e.g., interjections, phrase repetitions, multiple-syllable repetitions, and "slow" whole word repetitions). Stuttering included part-word repetitions, broken words, and audible and inaudible prolongations. The stuttering children produced significantly more clusters of the stuttering-stuttering and stuttering-repair clusters, whereas normally fluent children produced significantly more repair-repair clusters but did not produce any stuttering-stuttering clusters. Disfluencies tended to occur in clusters more often than chance for the two groups, leading to the conclusion that disfluencies influenced each other in nonrandom way. LaSalle and Conture concluded that phonological encoding was disrupted after one disfluency was produced, leading to the production of a second disfluency of cluster.

Logan and LaSalle (1999) proposed linguistic influences on clusters because they tended to occur in more syntactically complex speech. Utterances that contained disfluency clusters were compared with utterances without clusters in the speech of 14 children who stuttered and 14 control peers (mean age: 52 months [*SD* = 9.0]). For both groups of children, utterances with clusters contained significantly more syllables and clausal constituents than did utterances without clusters. Furthermore, there were no significant group differences in the number of syllables and clausal constituents in utterances with clusters. Most of the clusters (85%) coincided with the onset of an utterance or clause, a position commonly associated with linguistic and/or speech motor planning. It is not clear, however, if the linguistic factors (utterance length and position) directly influence the formation of clusters or if there were more clusters because typically more stuttering occurs at these loci.

In the Indian context a study of disfluent clusters undertaken by Rhea, Seby and Swapna (2011) revealed that the percentage of cluster disfluencies was significantly greater in the children with stuttering than in the typically developing children. Further, the cluster size was higher in children with stuttering. As reported by Rhea et al., (2011) in their study, the most commonly occurring disfluency pairs were interjection with single syllable repetition and tense pause with single syllable repetition. Amongst the eight disfluencies considered, word repetitions and revision of incomplete phrases tended to occur more in clusters than as single disfluencies both in children with stuttering and nonstuttering children.

Additionally, it has been shown that the frequency with which children produce disfluency clusters correlates positively with stuttering severity measures (LaSalle & Conture, 1995; Sawyer & Yairi, 2004), suggesting that disfluency clusters would indeed be detrimental to the speech of PWS. Such findings have led some clinicians (e.g., Conture, 1997; Yairi, 1997) to suggest that certain disfluency cluster measures might aid in the differential diagnosis of developmental stuttering. Further, the composition of clusters may help differentiate stuttered from normal speech. For example, clusters in which disfluencies more typical of stuttering are adjacent to each other (the stuttering–stuttering cluster type) were found to occur infrequently in an earlier study of normally fluent children (Colburn, 1985), whereas in two more recent studies they were found exclusively in the speech of children who stutter (LaSalle & Conture, 1995; Logan & LaSalle, 1999). Sawyer and Yairi (2004, 2005) found that mixed-type (OD-SLD type) clusters were the most frequently occurring cluster for CWS.

However, Taylor and Taylor (1967) found that the school age children did not have the tendency for clustering. This could be because of the different definitions and analysis methods applied in the study (Yairy & Seery, 2011).

Although a few studies have been carried out in children with stuttering, research on characterizing the disfluencies of adults with stuttering are limited. Early studies of adults who stutter examined clusters with a focus on testing conflict, anxiety and feedback theories of stuttering (Still & Sherrard, 1976), looking at the probability of a disfluency occurring after one had been produced (Taylor & Taylor, 1967), or testing mathematical models based on the sequential characteristics of moments of stuttering (Still & Sherrard, 1976; Still & Griggs, 1979). The outcomes of the studies were generally ambiguous and inconclusive. Still and Sherrard's (1976) and Still and Griggs's (1979) results, for example, provided support for two different models of stuttering. Still and Griggs's study supported a tendency for clustering in adults. A similar finding was reported by Fein (1970) where Phonetically Balanced Word Lists (w-22) were presented to 15 severe stutterers. The percentage of nonfluencies among the total list was compared with the percentage of nonfluencies among words that followed stuttered words. There was significantly more stuttering among words that followed stuttered words than would be expected by chance.

Sargent (2007) studied the characteristics of disfluency clusters in adults who stutter (AWS). The participants were ten AWS ranging in age from 18 to 60 (mean age = 35), with a stuttering severity of 9 to 30% (mean = 19%). Each participant provided a conversational speech sample of at least 300 words. Analysis focused on disfluency type, utterance length, speaking rate, and perceptual measures. He found that there were significantly more mixed clusters than SLD-type or OD-type clusters, utterances containing disfluency clusters were significantly longer than fluent utterances and the speaking rate of fluent utterances was found to be significantly faster than that of disfluent utterances. Collectively the results supported a linguistic interpretation of disfluency clusters.

Disfluency clusters and overall severity of stuttering

Logan and LaSalle (1999) commented that it is unclear as to whether the presence of disfluency clusters has more of a negative impact on the speech of PWS than single disfluencies. Previous studies examining the duration of utterances that contain single disfluencies and clustered disfluencies have found that clustered utterances are more than three times as long as single utterances in terms of the time spent speaking (Logan & LaSalle, 1996). This would suggest that listeners would be more likely to react adversely to utterances containing disfluency clusters, which may in turn provide more information regarding listener perceptions.

Disfluency clusters have been shown to be positively correlated to stuttering severity (LaSalle & Conture, 1995; Sawyer & Yairi, 2004), suggesting that disfluency clusters would indeed be detrimental to the speech of PWS. It could be expected that if disfluency clusters and stuttering severity are correlated, then listeners may perceive disfluency clusters as being more reflective of the severity of a person's stutter. Furthermore, it could be anticipated that the types of disfluency clusters that PWS exhibit most frequently will be the most closely correlated with that person's severity of stutter.

Effect of intervention on disfluencies

Today, treatment in the line of stuttering disfluencies suggests that disfluency counts are the single most valid measure of stuttering. Nowadays, trends are changing with respect to the adoption of more meaningful therapy goals for stuttering intervention. Apart from providing intervention after the disorder has stabilized, there is an increasing emphasis on early intervention. Other than the traditional techniques used to treat stuttering viz. modified air flow rate, prolongation etc., an awareness of the significance of metalinguistic skills to intervention, adopting a wholistic view of the person with stuttering during the intervention, the value of commercially produced therapy programs, an increased awareness of the limitation of short-term intensive treatment programs, the recognition of the life-long chronic stutterer, and the development of support systems for the adult stutterer are being emphasized upon. However, even though there have emerged many other parallel options for treatment of disfluencies as discussed, the traditional way of intervention employing the standard techniques have been the most resorted to even to date.

Several studies have been carried out to investigate the effect of the various intervention programs on children, adolescents and adults with stuttering. The frequency and other dimensions of disfluencies have been an important parameter in investigating the presence/absence of progress seen in the individual. Some studies have also investigated the effect of intervention on cluster disfluencies in different age groups. Robb, Sargent, and O'Beirne (2009) compared the adults who stutter with children who stutter. The spontaneous speech of ten AWS was sampled and organized according to utterance length in syllables. The overall number and type of disfluency clusters occurring in each sample were determined. The authors found that adults produced fewer clusters than children. Findings also indicated that utterances containing disfluency clusters were significantly longer than fluent utterances, and the occurrence of disfluency clusters was correlated with overall percentage of disfluency. The largest number of clusters occurred in the speech of adults who reported not having had therapy for stuttering. The investigators proposed that therapy and maturity of the speech motor system influenced the smaller number of clusters in adults than in children. Sargent (2007) did a cursory analysis in his study on AWS and found that the group that had received prior treatment for stuttering, had a lower overall disfluency level (17.2%) compared to the non-treatment group (21.5%).

Sawyer and Yairi (2010) studied disfluency clusters in preschool children to determine whether they occurred at rates above chance, whether they changed over time, and whether they could differentiate children who would later persist in, or recover from, stuttering. Thirty-two children recruited near stuttering onset were grouped on the basis of their eventual course of stuttering and matched to 16 normally fluent children. Clusters were classified as SLD, OD or mixed disfluencies (SLD and OD combined). Cluster frequency and length were calculated for all children and again after 6 months for those who stuttered. These authors also found that clusters occurred at rates greater than chance for both stuttering and normally fluent children. Children who stuttered had significantly more and longer clusters than did normally fluent children, however the cluster frequency and length decreased over time for children in the persistent and recovered groups. The proportion of disfluencies in clusters was significantly lower in the recovered group than it was in the persistent group after 6 months.

In sum, the phenomenon of disfluency clusters has been examined in persons with stuttering and some explanations also have been offered for the occurrence of the same. However, a great majority of these studies have focused on the speech of children with and without stuttering. There is a paucity of research evaluating the characteristics of disfluency clusters in an adult population. Although there are some potentially significant findings regarding disfluency clusters in adults, there is not yet enough information in this area to draw significant conclusions yet. Further there are no studies carried out to study the effect of intervention on clusters. In the Indian scenario, there is paucity of information with regard to clusters. Since disfluency clusters are found in the speech of adults who stutter, it seems important to explore in detail, the disfluency types, the differences between them, the information on the internal composition and location of clusters. Such information could prove valuable in understanding the progression of stuttering and the supposed linguistic and or motoric influence of disfluency clusters. This could add to the data towards establishing a cause for the occurrence of disfluency clusters. Further, the study of the type, frequency, loci and the size of the cluster disfluencies can serve as a valid clinical measure which will hold value in the identification of severity of stuttering. This might result in less overlap between the groups and consequently, permit them to be more readily differentiated.

Keeping this in view, the study was planned with the aim of investigating the cluster disfluencies in the speech of adults with stuttering. The method adopted in carrying out the study has been described in detail in the following chapter.

Chapter 3

Method

The main aim of the study was to investigate the cluster disfluencies, if any, in the speech of two groups of adults with stuttering; one group who had not undergone any intervention for improving fluency and the other group who had undergone intervention. In addition the variation in the frequency of clusters with respect to severity was also examined.

Participants: Thirty persons with stuttering in the age range of 18 to 30 years with Kannada as their native language participated in the study. There was no attempt made to match the participants on gender, however all those who participated in the study belonged to the male gender. They were divided into two groups: one group comprised of 15 adults who had not undergone any intervention for improving fluency (who had just enrolled for therapeutic intervention, Group I) and the other group comprised of 15 adults who had undergone intervention (Group II). Each of these groups in turn comprised of individuals with different severities of stuttering (mild, moderate and severe), five in each subgroup. Therefore a total of 30 adults with stuttering (AWS) participated in the study. The participants of Group I were entirely different from those of Group II i.e., the participants of Group I were not studied longitudinally following intervention, hence the participants of both the groups were different and they formed two different study groups. The participants for this study were originally evaluated at the diagnostic clinic of the All India Institute of Speech and Hearing, Mysore. The participants of both the groups were diagnosed as having mild, moderate and severe stuttering by qualified speech-language pathologists. This was estimated by marking their speech sample obtained through a conversation for disfluencies and measuring the percentage of disfluencies from the total words in the sample. The severity was calculated using SSI-3 (Stuttering Severity Instrument Version 3, Riley, 1994) based on frequency (included job task and reading task), duration of disfluencies (duration of three longest blocks) and physical concomitants exhibited by these adults. Based on the results from the SSI, all the adults considered in the groups exhibited 'mild, moderate or severe' stuttering.

The participants of Group I consisted of AWS who had just enrolled for their intervention to improve fluency at the fluency clinic of All India Institute of Speech and Hearing, Mysore. The participants of Group II consisted of adults who had undergone intervention at the fluency clinic for an average of $1^{1/2}$- 2 months for a minimum duration of 40 min per day to improve fluency and were discharged following the attainment of normal fluency. The techniques used during the intervention to improve the fluency were the modified air flow technique and prolongation. They had also been given guidance to practice speaking using the same techniques at home. They all had been discharged from the fluency clinic. They were contacted as a part of this research and were requested to come back to the clinic for a follow up. The data collected from these individuals for the present study was after a time gap of 8-10 months on an average (mild group=8 months, moderate group=8.8 months and severe group=10.2 months) after the intervention process.

All the participants were Kannada speakers with Kannada as their native language. They were very proficient in speaking and understanding Kannada and had exposure to English too. The ISLPR scale developed by Ingram (1985) was used to check the language proficiency in the second language English. ISLPR describes language performance at eight points along the continuum from zero to native like proficiency in each of the four macro skills (speaking, listening, reading and writing). The scale is divided into primary (speaking and listening) and secondary skills (reading and writing). It has 8 ratings which includes 0, 0+, 1, 1, 2, 3, 4, 5 as rated from a continuum zero proficiency to native like proficiency. The participants obtained a rating of '2' and were equally proficient in listening, speaking, reading and writing in English language.

They were also matched for their socioeconomic status using the NIMH socioeconomic status scale developed by Venkatesan (2009). The scale has sections such as occupation and education of the parents, annual family income, property, and percapita income to assess the socioeconomic status of the participants. Interpretation on this scale showed a middle socioeconomic status for all the participants

Only those adults with no history of sensory, neurological, communicative, academic, cognitive, intellectual or emotional and orofacial abnormalities were included in the study. They were screened for voice, articulation, fluency and language. Oral mechanism examination and hearing screening were carried out to rule out any abnormality. It was ensured that participants had a normal rate of speech. Ethical procedures were used to select the participants, that is, the participants were explained the purpose and the procedures of the study and an informed verbal and /or written consent were obtained.

Procedure: The selected participants were seated comfortably and were tested in a room with minimum external noise and distractions individually. A small general conversation was carried out initially to make the client comfortable and familiar with the examiner, the settings and the task. Instructions specific to the task were given in Kannada. A Kannada narration sample was obtained from each participant by asking them to speak about their college. As the participants might not have been well versed in the topic, there was chance of a bias which could have crept in the test, in the sense that paucity of information may have had an influence on their speech and stuttering. To preserve spontaneity and yet give sufficient structure, the experimenter briefed the participants about what is expected out of them to speak. Thus, the speakers were mentally prepared on the topics. Just after the briefing, a representative sample was obtained. The speech sample obtained from each participant was audio and video recorded using Sony Cyber-Shot Digital Camera, W390. Participants were seated at a level directly in front of a camera and were asked to face upwards while speaking to allow better view of facial movements. The first 350 words from each adult sample were considered out of which the middle 300 words were selected for the analysis. Use of a 300-word sample is generally deemed sufficient for the differentiation between stuttering and non-stuttering populations (Hubbard & Yairi, 1988; LaSalle & Conture, 1995; Logan & LaSalle, 1999; Throneburg & Yairi, 2001). The testing was carried out in one session which lasted approximately for an hour. The participants were given reinforcement after the completion of the recording.

Data transcription: The researcher listened to the speech sample recordings and orthographically transcribed each participant's utterances verbatim. An utterance was defined as a string of words or clauses that a) communicate an idea, b) are set apart by pauses and c) are bound by a single intonational contour (Meyers & Freeman, 1985). Unintelligible utterances, single-word utterances, and one-syllable utterances were deleted from the samples. The initial 25 and the final 25 words were not considered to minimize the potential influence of the participants' initial adjustment to the audio recording environment and to the experimenter that may have had an effect upon the naturalness of their speech and language.

Analysis: After the transcription process, each moment of disfluency was identified. Individual disfluencies were coded as either stuttering-like disfluencies (SLD) or other disfluencies (OD). A SLD was defined as any of the following disfluencies: disrhythmic phonations, part-word repetitions, tense pauses and single word repetitions (Ambrose & Yairi, 1999; Throneburg & Yairi, 2001; Sawyer & Yairi, 2004). An OD was defined as an interjection, revision-incomplete phrase, multisyllabic word repetition or phrase repetition (Ambrose & Yairi, 1999; Throneburg & Yairi, 2001; Sawyer & Yairi, 2004). The overall percentage of the adult's frequency of disfluency that occurred as discreet or single instances and in clusters were determined for each participant. A single instance was defined as that time where disfluency will occur just once within an utterance (e.g., "my-my name is Arun"), where the word repetition 'my' represented a single occurrence. The operational definition of these disfluencies has been provided in the appendix. A cluster was defined as the occurrence of two or more different instances of disfluencies on the same word and/or consecutive words, e.g., "W∂w∂w∂wha-what big box?" where a within word cluster occurred consisting of dysrhythmic phonation and part word repetition. This analysis was carried out for both the groups.

The clusters were further classified as 1) SLD-type; which involved the occurrence of two or more SLDs (e.g., a part-word repetition followed by a disrhythmic phonation, "The b-b-boy wwent", 2) OD-type; which involved the occurrence of two or more ODs (e.g., an interjection followed by a phrase revision "The man um -the boy went", or 3) mixed-type; which involved the occurrence of both OD and SLD types (e.g., an interjection followed by a part-word repetition "He um w-w-wants").

Using the three categories of cluster types, each participant's spontaneous speech sample were analyzed for:

a. Percentage of SLD type clusters: Defined as the proportional occurrence of disfluency clusters containing only SLD type disfluencies within each 300-word sample.

b. Percentage of OD type: Defined as the proportional occurrence of disfluency clusters containing only OD type disfluencies within each 300-word sample.

c. Percentage of mixed clusters: Defined as the proportional occurrence of disfluency clusters containing both OD and SLD type disfluencies within each 300-word sample.

d. Percentage of total disfluency clusters: Defined as the proportional occurrence of all OD, SLD and mixed disfluency clusters within each 300-word sample.

Size of the cluster: The size of the cluster was determined by the number of instances of disfluencies that occurred together on the same word and/or consecutive words.

Loci of the cluster: The locus of the cluster was determined by noting the position of the first disfluency of a cluster in the utterance.

Statistical analysis: The analyzed data was tabulated for each participant, averaged across participants in each group and subjected to statistical analysis. The inter-judge reliability measure was carried out on 50% of the sample in both the groups. Mean and standard deviation were calculated. Various statistical procedures were applied to assess if any significant difference existed within the speech of Group I and II with respect to cluster disfluencies and other aspects of the study using SPSS software.

Chapter 4

Results and Discussion

In an attempt to study the disfluency clusters in adults with stuttering, the data obtained from each participant was transcribed and analyzed. The total number and percentage of single and cluster disfluencies were computed for each participant which was averaged across all the participants of mild, moderate and severe subgroup of Group I and II separately. The cluster disfluencies were further categorized into SLD type and OD type according to the classification given by Yairi and Ambrose (1992). However, during the process, it was found that there were other disfluencies which did not fall into the classification, such as phoneme repetitions (M..m..m..my name is Arun), blocks (complete voice and articulatory arrests during speech), unfinished sentence/false start (I will go to….Did you have lunch?) and word revision (compete…complete). Hence, to account for these disfluencies which were occurring substantially, in addition to the classification followed in this study given by Yairi and Ambrose (1992), phoneme repetitions and blocks were categorized into SLD type whereas unfinished sentence and word revision were grouped into OD category. This data was also averaged across the participants of the different subgroups in each group. Further the information regarding the size and the loci was also analyzed for the three subgroups in each group. These values were subjected to statistical analysis using the SPSS software, version 18. Within group comparisons were made to answer the research questions posed for the present study. Non-parametric statistics were used for all the comparisons. The following statistical procedures were used:

- Descriptive statistics to compute the mean and standard deviation for all the severity subgroups in both the groups.

- Cronbach's alpha to assess inter judge reliability.
- Wilcoxon Signed Ranks test to check for the significant difference, if any, across each dimension for each severity subgroup and the overall values for both the groups.
- Kruskal-Wallis test to check for overall performance within the severity subgroups for each dimension for both the groups.
- Mann-Whitney test to compare across severities within the Group I and II and to compare the overall performance of Group I with Group II.
- Pearson's correlation to assess the correlation between total disfluencies and cluster disfluencies.

The results obtained have been presented and discussed under different sections:

I. Inter judge reliability: The inter judge reliability was computed using cronbach's alpha test on 50% of the sample in both the groups. The cronbach's alpha value was found to be 0.96 indicating excellent reliability.

II. Frequency, type, size and loci of clusters in Group I (who had not undergone intervention): The first objective of the study was to address differences in frequency, type, size and loci of clusters in the speech of participants across all severities (mild, moderate and severe subgroups) who had not undergone any intervention program (Group I).

II a. Frequency of occurrence of single and cluster disfluencies in Group I:

The frequency of single and cluster disfluencies were calculated by using the following formula:

$$\frac{\text{Number of single/cluster disfluencies in the 300 word sample}}{300} * 100$$

This was calculated for different severity subgroups and the group as a whole. Descriptive statistics was used to calculate the mean and standard deviation (SD) which has been depicted in Table 1. Group data based on frequency of disfluencies per 300 words was calculated and the group means were then derived. The mean of single disfluencies were higher than the mean of cluster disfluencies for all the different severity subgroups and the group as a whole. The proportional occurrence of single and cluster disfluencies were 63% and 37% respectively in this group. It was seen that more than 1/3rd of disfluencies accounted to single disfluencies (63%) relative to the clusters (37%). Further, the mean of cluster disfluencies for the severe group was greater compared to the mild and moderate severity subgroup. In the mild and the moderate severity subgroup the single disfluencies occurred to a much greater extent than the cluster disfluencies as seen from the mean values depicted in Table 1. However in the severe group the mean values of the single and cluster disfluencies are almost the same. The mean values for single and cluster disfluencies in mild, moderate and severe subgroups in the Group I has been graphically represented in Figure 1.

Table 1: *Overall mean, standard deviation (SD), chi-square and |z| values for single and cluster disfluencies for various severity subgroups in Group I.*

Subgroups	**Single disfluencies**		**Cluster disfluencies**		**|z| values**
	Mean	**SD**	**Mean**	**SD**	
Mild	6.46	1.24	2.32	1.86	**2.02***
Moderate	9.39	2.07	2.79	1.23	**2.03***
Severe	9.13	2.80	9.26	2.37	0.67
Total	8.33	2.40	4.79	3.71	**2.75***
Chi-square values	4.49		**9.47***		

***p<0.05**

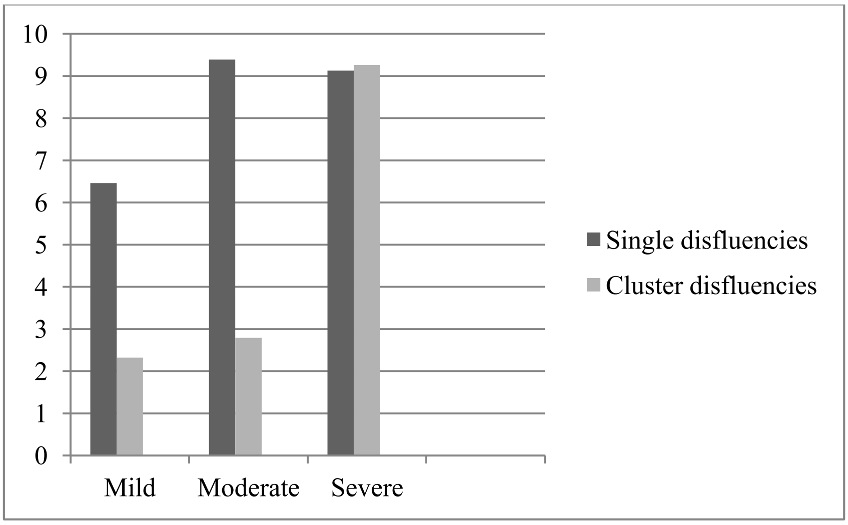

Figure 1. *Mean values for single and cluster disfluencies in mild, moderate and severe subgroups in Group I.*

The mean of single and cluster disfluency values within each severity subgroup were subjected to Wilcoxon signed ranks test to check for any significant difference between the two. The results revealed a significant difference in single and cluster disfluencies for mild and moderate subgroups (*p*<0.05). However, there was no significant difference for the same parameter in the severe subgroup (*p*>0.05). On the whole, there was a significant difference between single and cluster disfluencies between the group (*p*<0.05). The |z| values have been depicted in Table 1.

The overall and specific mean values of single and cluster disfluencies for the three severity subgroups were subjected to Kruskal Wallis test to check for any significant difference. The results revealed that the single disfluencies did not differ significantly (*p*>0.05) across all severities, however a significant difference was noted in the occurrence of clusters (*p*<0.05) across the severity subgroups of mild, moderate and severe. The chi-square values have been depicted in the Table 1.

Also, comparison using Mann-Whitney test was carried out across pairs of various severity subgroups within Group I to check for statistical significance for each dimension. The |z| values have been depicted in Table 2.

Table 2: *Results of the mann-whitney test for the different severity subgroups for the frequency of disfluencies in Group I.*

Frequency of disfluencies	**Mild vs. Moderate subgroup**	**Moderate vs. Severe subgroup**	**Mild vs. Severe subgroup**
	|z| values	**|z| values**	**|z| values**
Single disfluencies	1.89	0.42	1.67
Cluster disfluencies	0.41	**2.61***	**2.61***

***p<0.05**

The results revealed that there was no significant difference between frequencies of single and cluster disfluencies in the mild vs. moderate subgroup (p>0.05) whereas values differed significantly only with respect to the cluster disfluencies across moderate vs. severe and mild vs. severe severity subgroups ($p<0.05$).

The outcome substantiates previous reports regarding the presence of such clustering in speech of adults with stuttering (Fein, 1970; Still & Griggs, 1979; Still & Sherrard, 1976). The results of this study are also in consonance with the study done on children who stuttered by Sawyer and Yairi (2010) in which clusters occurred at rates significantly greater than chance. This study also supports the findings of the other previous studies (Hubbard & Yairi, 1988; LaSalle & Conture, 1995). Thus it can be concluded that clustering is a significant factor in disfluent speech, for which there must be an account.

The overall mean values for single disfluencies (63%) overshot that of cluster disfluencies (37%) in the present study. This result is in consonance with Rhea et al.,'s, (2011) research which indicated the percentage of single instances of disfluencies (55%) to be greater than overall percentage of disfluency clusters (45%). The reduced occurrence of disfluency clusters in this study than that of Rhea et al.,'s from 45% and 37% can be explained by the establishment or stabilization of language aspects in the population considered in this study whereas in children, language is in a phase of development.

II b. Type of disfluency clusters in Group I:

The data pertaining to the three classes of disfluency clusters-SLD-SLD, SLD-OD and OD-OD-were quantified for the three severity subgroups. On the whole, when the overall mean percentage values of the different cluster types were compared, the most frequently occurring type of cluster was found to be SLD-SLD type being marginally more than the SLD-OD type clusters with the least occurring type being the OD-OD type (SLD-SLD type>SLD-OD type>OD-OD type). The OD-OD clusters were found to be statistically insignificant in their occurrence. The mean and standard deviation (SD) values for the different severity subgroups and the group as a whole have been depicted in Table 3.

When the mean percentage values of the two types of clusters were compared with each subgroup, it was found that in the mild group, the mean percentage of SLD-OD type of clusters was higher whereas for the moderate and severe subgroups, the percentage of SLD-SLD type of clusters was higher. The mean percentages of different types of cluster disfluencies for mild, moderate and severe subgroups in Group I has been represented in Figure 2.

Table 3: *Overall mean, standard deviation (SD), chi-square and |z| values for SLD-SLD and SLD-OD type cluster disfluencies for various severity subgroups in Group I.*

Subgroups	**SLD-SLD type**		**SLD-OD type**		**|z| values**
	Mean	**SD**	**Mean**	**SD**	
Mild	0.73	0.36	1.39	1.53	0.96
Moderate	1.79	1.01	0.99	0.66	1.35
Severe	5.93	3.60	3.33	3.99	0.94
Total	2.82	3.07	1.90	2.54	1.11
Chi-square values	**9.24***		1.64		

$*p<0.05$

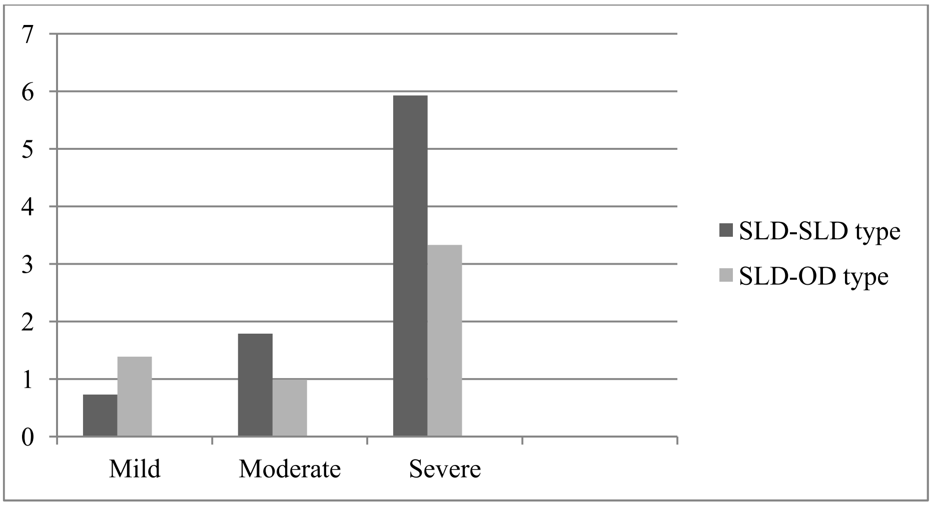

Figure 2. *Mean percentages of different types of cluster disfluencies for mild, moderate and severe subgroups in Group I.*

The occurrence of OD-OD clusters were insignificant relative to the other types. Table 4 shows the occurrence of this type of cluster for each participant in the Group I. As seen in the table, the OD-OD cluster type occurred only in the mild group and not in the other severity subgroups.

Table 4: *Occurrence of OD-OD cluster for each participant in Group I.*

Subgroup	**P 1**	**P 2**	**P 3**	**P 4**	**P 5**
Mild	1	-	1	-	1
Moderate	-	-	-	-	-
Severe	-	-	-	-	-

*P-Participant

The mean values obtained for the SLD-SLD cluster and OD-OD cluster type with each severity subgroup were subjected to Wilcoxon signed ranks test to check for any significant difference between the two. The results revealed that was no significant difference seen (p>0.05) between the type of clusters in mild, moderate and severe subgroups per se. Thus the overall score also did not depict any significant difference for single and cluster disfluencies for all the severity groups ($p>0.05$). The |z| values have been depicted in the Table 3.

The mean scores were subjected to Kruskal Wallis test to check for significant difference between the different cluster types in different subgroups. The results revealed a significant difference between SLD-SLD clusters ($p<0.05$) across all severities and no significant difference between SLD-OD clusters ($p>0.05$) across the severities of mild, moderate and severe. The chi-square values have been depicted in Table 3.

Mann-Whitney test was carried out across pairs of various severity subgroups within Group I to check whether any significant difference existed between the SLD-SLD cluster type and SLD-OD cluster type. The |z| values have been depicted in Table 5. The results revealed that there was no significant difference with respect to SLD-SLD and SLD-OD clusters between mild vs. moderate subgroup ($p>0.05$) within Group I. However, there was a significant difference considering SLD-SLD clusters between moderate vs. severe and mild vs. severe subgroups ($p<0.05$) and no significant difference between SLD-OD clusters for both these groups ($p>0.05$).

Table 5: *Results of the mann-whitney test for various severity subgroups for the type of disfluencies in Group I.*

Type of disfluencies	**Mild vs. Moderate subgroup**	**Moderate vs. Severe subgroup**	**Mild vs. Severe subgroup**
	|z| values	**|z| values**	**|z| values**
SLD-SLD Type	1.73	**1.98***	**2.65***
SLD-OD Type	0.10	1.47	0.63

***p<0.05**

The SLD-SLD type of clusters occurred greatest in the speech sample of the Group I. The findings of LaSalle and Conture (1995) and Logan and LaSalle (1999) also indicate towards the same result in which stuttering children produced significantly more clusters of the stuttering-stuttering and stuttering-repair clusters i.e., they found that children with stuttering produced qualitatively different disfluency clusters.

Hubbard and Yairi's (1988) also found that certain types of clusters, such as those comprising part-word repetition and disrhythmic phonation (sound prolongations and blocks) occurring in the speech of children with stuttering which might be indicative of a motoric component. They anchored this notion in Zimmermann's (1980b) brainstem reflexes model of stuttering, which postulated that stuttering occurs when speech movement exceeds space or time thresholds, triggering afferent feedback to the brainstem, which responds by throwing the speech system into oscillation or tonic behavior—thus, stuttering. If the system is not stabilized quickly, it might be speculated that the stimulation from oscillatory and tonic activity causes additional reflexive responses and hypertonic disfluency, hence the phenomenon of clusters—one disfluent event begets the next.

The SLD-OD (mixed clusters) occurred next to the SLD-SLD type i.e., mixed clusters were the second largest cluster for the adults who stuttered in the present study and the OD-OD clusters did not reach the significant percentages of occurrence. This result is in consonance with Sawyer and Yairi's, (2010) results where the OD clusters did not occur at rates greater than chance for either group of children. The current finding that ODs do not generally cluster together adds to the literature regarding the marginal merit of ODs in stuttering assessment (Yairi, Ambrose, &

Niermann, 1993; Yairi & Ambrose, 1999). According to Hubbard and Yairi (1988) these types of disfluency may reflect formulating and planning processes.

The occurrence of OD-OD clusters in mild group goes to say that when the stuttering is less severe, the manifestation of OD-OD clusters are more and SLD component is by far less than the OD component in speech of adults with stuttering. However, when the severity advances, the SLDs increase in number and contribute to more of SLD-SLD or SLD-OD type of clusters.

However, the results of the present study are in contrast with the results reported by Rhea et al., (2011) where the authors found that the most commonly occurring pairs were interjection with single syllable repetition (SLD-OD clusters) which accounted to 19% and tense pauses with single syllable repetition (SLD-SLD clusters) accounting to 16% in children with stuttering. Sawyer and Yairi's (2010) study also resulted in the same finding. This result could be attributed to the reason that the present study included adults with stuttering with developmental origin. Hence, the OD type disfluencies were gradually blown into SLD type over a long period of continuous stuttering. Hence, this necessitates the need for early intervention for stuttering in childhood.

Sargent's (2007) study on adults with stuttering also found that there were significantly more mixed clusters than SLD-type or OD-type clusters which do not support the results of the present study. This finding could have resulted due to the language differences between both the studies and the age range considered for the subjects. According to Van Riper, (1971); Bloodstein, (1995); Cooper & Cooper, (1998); Shapiro, (1999); Van Borsel, Maes, & Foulon, (2001), stuttering may vary across culturally and linguistically diverse backgrounds. Also the study by Sargent

(2007) strictly adhered to the classification given by Yairi and Ambrose (1992) which was not so in the present study which could have in turn lead to the difference in findings.

The occurrence of SLD-SLD clusters were the greatest in the present study. Based on the system proposed by Sawyer and Yairi (2005), we can infer that the presence of greater number of SLD-SLD clusters in the present study might be indicative of a motoric component involving two motor-based disfluencies. This model describes a stutter as occurring due to an overload on the speech musculature. This overload causes the brain to “get stuck” in this repetitive action, and unless the system is quickly restored, subsequent stuttering will develop (Zimmermann, 1980). It was noted by Hubbard and Yairi (1988) that this interpretation could readily explain the stuttering behaviours of dysrhythmic phonations and part-word repetitions but was more difficult to relate to revisions and interjections. As noted by earlier studies, revisions and interjections have been associated with disfluency behaviours of fluent individuals (Wexler & Mysak, 1982; Colburn, 1985), whereas behaviours associated with stuttering include partword repetitions and dysrhythmic phonations (Yairi & Ambrose, 1992). Therefore, if these certain stuttering behaviours are characteristic of stuttering, and stuttering is a motor disorder, it is likely that normal disfluencies do not reflect a motor breakdown. Therefore, the greater occurrence of SLD-SLD type clusters in the present study lends support to the fact that stuttering is a motor disorder.

II c. Size of disfluency clusters in Group I:

The size of the cluster was determined by the number of instances of disfluencies that occurred together on the same word and/or consecutive words. The mean and standard deviation (SD) for 2, 3 and 4 size clusters were computed for the different severity subgroups and the values are depicted in Table 6. On comparison of the overall mean scores, it was seen that in all the three groups, the clusters consisting of two disfluencies occurred more frequently than the other cluster sizes i.e., an inverse relationship was observed between the size of clusters and their frequency of occurrence. The 2, 3 and 4 size clusters were found to the maximum extent in the severe subgroup. Within each severity subgroup too, it was found that the two size cluster occurred to a greater extent than the other two cluster sizes. This has been graphically represented in Figure 3. The clusters exhibited by all the various subgroups in Group I ranged from 2 to 12 disfluencies per cluster.

Table 6: *Overall mean, standard deviation (SD), chi-square and |z| values for 2, 3 and 4 size clusters for all severity subgroups in Group I.*

Subgroups	**2-Size clusters**		**3-Size clusters**		**4-Size clusters**		**|z| values (Size 2 and size 3 clusters)**
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	
Mild	4.60	2.88	1.80	1.64	0.60	0.89	1.83
Moderate	6.80	3.03	1.40	0.89	0.20	0.44	**2.04***
Severe	13.00	5.78	6.60	1.81	2.80	1.48	**2.02***
Total	8.13	5.30	3.26	2.81	1.20	1.52	**3.30***
Chi-square values	**8.31***		**9.56***		**8.85***		

$*p<0.05$

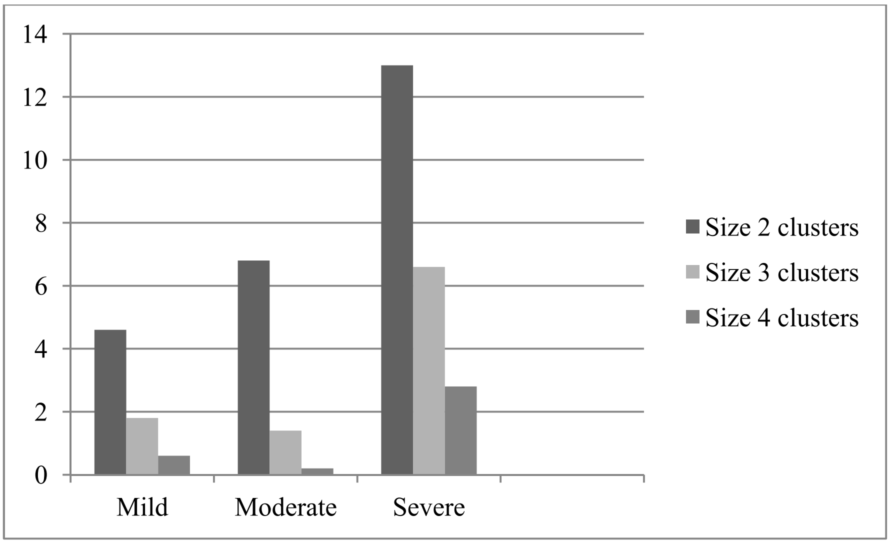

Figure 3. *Mean values for mild, moderate and severe subgroups for 2, 3 and 4 size clusters in Group I.*

Although less in number, the occurrence of size 4+ clusters was seen. Table 7 depicts the same considering each participant in Group I. As can be seen from the table, the size 4+ clusters occurred frequently in the severe subgroup.

Table 7: *Depiction of occurrence of size 4+ clusters for each participant.*

Subgroup	**Participant***	**Size 5**	**Size 6**	**Size 7**	**Size 8**	**Size 9**	**Size 10**	**Size 11**	**Size 12**
Mild	P 1	-	-	-	-	-	-	-	-
	P 2	-	-	-	-	-	-	-	-
	P 3	-	-	-	-	-	-	-	-
	P 4	-	-	1	-	-	-	-	-
	P 5	-	-	-	-	-	-	-	-
Moderate	P 1	-	-	-	-	-	-	-	-
	P 2	-	-	-	-	-	-	-	-
	P 3	-	-	-	-	-	-	-	-
	P 4	-	-	-	-	-	-	-	-
	P 5	-	-	-	-	-	-	-	-
Severe	P 1	2	-	1	-	-	-	-	-
	P 2	4	7	2	1	-	-	1	1
	P 3	1	1	-	-	-	-	-	-
	P 4	2	1	-	-	-	-	-	-
	P 5	1	-	2	-	-	-	-	-

*P-Participant

The mean values of the 2 and 3 size clusters for each severity subgroup were subjected to Wilcoxon signed ranks test to check for any significant difference between the two. It was found that there was no significant difference in these clusters in mild subgroup ($p>0.05$) whereas the moderate and severe subgroups exhibited a significant difference ($p<0.05$). There existed a significant difference between 2 size and 3 size clusters for the group as a whole ($p<0.05$). 4 size clusters were not subjected to the analysis due to their rare occurrence. The |z| values have been depicted in Table 6.

The overall mean values were further subjected to Kruskal Wallis test to check for any significant difference between 2, 3 and 4 cluster sizes. The results of this test (chi-square values) have also been depicted in Table 6. The results revealed a significant difference between 2, 3 and 4 size clusters ($p<0.05$) across all severity subgroups in Group I.

Mann-Whitney test was used to compare the 2, 3 and 4 size clusters across various severity subgroups. The results of the Mann-Whitney test i.e., the |z| values have been depicted in Table 8. There was no significant difference between 2, 3 and 4 size clusters for mild vs. moderate subgroup ($p>0.05$). However, there was a significant difference in 2, 3 and 4 size clusters for moderate vs severe subgroup and in 3 and 4 size clusters for mild vs severe subgroup ($p<0.05$).

Table 8: *Pair-wise comparison of various severity subgroups for size of disfluencies in Group I along with |z| values.*

Size of disfluencies	**Mild vs. Moderate subgroup**	**Moderate vs. Severe subgroup**	**Mild vs. Severe subgroup**
	|z| values	**|z| values**	**|z| values**
2-Size clusters	1.16	1.99	**2.62***
3-Size clusters	0.21	**2.65***	**2.62***
4-Size clusters	0.77	**2.60***	2.24

$*p<0.05$

Thus, the study of the third feature which was cluster size indicated unequivocally that the subjects exceeded two-disfluency clusters infrequently. This result was also reported by Hubbard and Yairi (1988) in children with stuttering. There was an inverse relationship observed with respect to the size of disfluency clusters i.e., as the size of clusters increased, the frequency of occurrence decreased.

Sargent's (2007) study on adults with stuttering showed that the total number of clusters across all participants with two elements, three elements and four (or more) elements was 108, 25 and 11 respectively. This indicates a consonance with the present study since there were significantly more two-element clusters than three-element clusters or four-element clusters. However, there was no significant difference between the number of three element clusters and four-element clusters.

The present results are also in consonance with the study carried out by Rhea et al., (2011) which indicated that the clusters consisting of two disfluencies were more frequently occurring than the other cluster sizes. They also reported that the occurrence of 2 size clusters was significantly different from three and four size clusters. The result of 2 size clusters being significantly different from 3 size clusters has been seen in the present study also in the moderate and severe groups to be specific.

Hubbard and Yairi (1988) reported of 2-10 disfluencies per cluster in the speech of pre-school children with stuttering. Rhea et al., (2011) also found the clusters size to range from 2 to 7 disfluencies per cluster in the children with stuttering. The cluster size in the present study was wider and it ranged from 2-12 disfluencies per cluster. This could be attributed to the difference in the age group of participants considered for this study. The adult participants considered in the study had been experiencing stuttering right from their childhood and it is possible that the disfluencies could have gradually increased in intensity over a period of time due to several factors and manifested in a full fledged manner resulting in a wider cluster size. Further, the present study considered mild, moderate and severe subgroups. The severe subgroup having exhibited highest number of disfluencies in a sequence hence justifies the result.

II d. Loci of disfluency clusters in Group I:

The information pertaining to loci were arrived at by noting the position of the first disfluency of a cluster in the utterance in terms of initial, medial or final positions. The mean and standard deviation value was arrived at by using the descriptive statistics which have been depicted in Table 8. On comparison of the total mean scores, it was seen that the clusters occurred most frequently in the medial position in sentences. Medial clusters occurred more than the initial clusters which were in turn greater than final clusters (Medial>Initial>Final) with a proportional occurrence of 79%, 15% and 6% respectively. The pattern was similar in all the three severity subgroups too. This has been graphically represented in Figure 4.

Table 9: *Overall mean, standard deviation (SD), chi-square and |z| values for disfluency clusters for all severity subgroups with respect to loci in Group I.*

Subgroups	**Initial clusters**		**Medial clusters**		**Final clusters**		**|z| values**		
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Initial-Medial**	**Medial-Final**	**Initial-Final**
Mild	1.40	1.34	5.40	3.97	0.40	0.54	**2.03***	**2.03***	1.63
Moderate	0.40	0.89	7.40	3.20	0.60	0.89	**2.02***	**2.02***	0.44
Severe	4.80	3.34	21.40	4.09	1.60	1.51	**2.03***	**2.02***	1.82
Total	2.20	2.78	11.40	8.15	0.86	1.12	**3.40***	**3.41***	**2.03***
Chi-square values	**7.74***		**9.74***		2.78				

***p<0.05**

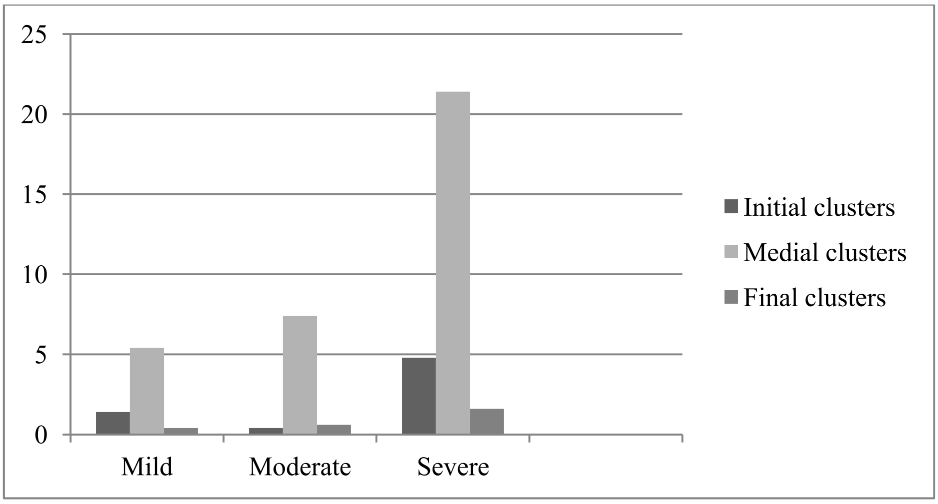

Figure 4. *Overall mean values for disfluency clusters for mild, moderate and severe subgroups with respect to initial, medial and final position of clusters.*

The three positional clusters were checked as to whether they were significantly different or not in various severity subgroups by subjecting the mean values to Wilcoxon signed ranks test. Results revealed a significant difference between the initial-medial and medial-final clusters in all the severity subgroups ($p<0.05$). However, there was no significant difference for initial-final clusters for all the subgroups ($p>0.05$). Interestingly, the overall values for the entire group revealed that there was a significant difference between all initial-medial, medial-final and initial-final clusters in all the severity subgroups ($p<0.05$). The $|z|$ values have been depicted in Table 9.

The overall mean values were subjected to Kruskal Wallis test to check for any significant difference between these clusters occurring in initial, medial and final position in sentences. The chi-square values have been depicted in Table 9. The results revealed a significant difference in the initial and medial clusters ($p<0.05$) and no statistically significant difference in the final clusters ($p>0.05$) across all severity subgroups in the Group I.

Mann-Whitney test was carried out across pairs of various subgroups within Group I and the $|z|$ values have been depicted in Table 10. The results of the comparison revealed that there was no significant difference between initial, medial and final position of clusters for the mild vs. moderate pair ($p>0.05$) within the Group I. There was a significant difference in the initial and medial clusters ($p<0.05$) and no significant difference in the final position of clusters ($p>0.05$) for the moderate vs. severe pair within Group I. There was a significant difference in medial clusters ($p<0.05$) and no significant difference in the initial and final clusters ($p>0.05$) for the mild vs. severe pair within this group.

Table 10: *Pair-wise comparison of severity pairs for loci of disfluencies in Group I along with |z| values.*

Loci of disfluencies	**Mild vs. Moderate subgroup**	**Moderate vs. Severe subgroup**	**Mild vs. Severe subgroup**
	|z| values	**|z| values**	**|z| values**
Initial clusters	1.31	**2.51***	1.83
Medial clusters	0.84	**2.61***	**2.62***
Final clusters	0.23	1.20	1.56

$*p<0.05$

This aspect of position of occurrence of cluster is not in consonance with Rhea et al.,'s (2011) study on children with stuttering which implicated that the most common loci for cluster disfluencies was the initial position of sentences (83%) and cluster disfluencies having occurred lesser in medial position of sentences (17.4%) compared to initial position. Logan and LaSalle's (1999) study was also seen to contrast with this which also found that 85% of all disfluency clusters coincided with the initiation of either an utterance or a clause within an utterance. However, it is in consonance with the result indicating least occurrence of final position of clusters.

One reason to explain the present findings could be the difference of population chosen. In the present study adults with stuttering were included where the developmental motor patterns and patterns of language are stabilized whereas in children the process of linguistic and/or motor planning is ongoing and not yet complete (Hubbard & Yairi, 1988; LaSalle & Conture, 1995).

The finding obtained in the present study that the clusters occur to a greater extent in the medial position may have its origin in the language itself and could be related to the grammatical uniqueness of the language. Kannada which is an Indian Dravidian language carries some salient features for example it is an exceptional language having subject, object, verb (SOV) constituent order (Sridhar, 1990). The object and verb are the content words in a sentence. The content words generally consist of nouns, main verbs, adverbs and adjectives that are an open class of words. Therefore the content words occur more frequently in the later part of the sentences. Also, it is a common finding for disfluencies to generally occur on content words than the function words in adults with stuttering (Brown, 1945). It could be argued that the syntactical differences suggest that there would be more planning involved for words in later sentence positions in Kannada compared to English. Hence, it is logical to ponder over this unique finding in a way it has been explained above.

Also, this language has a set of 'post positions' added to the end of noun phrase usually after a case marker to indicate time, location, instrumentality etc. (Schiffman, 1979). Murthy (1984) states that all cases are expressed through post positions and we have reasons to believe that the post positions which are mostly bound forms now, were free forms earlier. But certain post positions function independently of noun phrases as adverbs. Sridhar (1990) remarked that the burden of the syntax is carried by participles, both relative and verbal, gerunds, infinitives, compound and conjunct verbs, and postpositions in this language. The result obtained in this study could be correlated to this explanation.

III. Frequency, type, size and loci of clusters in Group II (who had undergone intervention program): The second objective of the study was to address differences, if any in frequency, type, size and loci of clusters in the speech of AWS across all severities in the group who had undergone an intervention program.

III a. Frequency of occurrence of single and cluster disfluencies in Group II:

Descriptive statistics was used to calculate the mean and standard deviation (SD) for the different severity subgroups which has been depicted in Table 11. Group data based on frequency of disfluencies per 300 words was calculated and the group means were then derived. The overall mean of single disfluencies were higher than the mean of cluster disfluencies for the group as a whole and for all the different severity subgroups. The approximate proportional occurrence of single and cluster disfluencies was found to be 76% and 24% respectively in this group. It was seen that almost $1/4^{th}$ disfluencies in this group amounted to cluster disfluencies (24%). Further, the mean of cluster disfluencies for the severe group was greater compared to the mild and moderate severity subgroup. The mean values for single and cluster disfluencies in mild, moderate and severe subgroups in the Group II have been graphically represented in Figure 5.

Table 11: *Overall mean, standard deviation (SD), chi-square and |z| values for single and cluster disfluencies for various severity subgroups in Group II.*

Subgroups	**Single disfluencies**		**Cluster disfluencies**		**|z| values**
	Mean	**SD**	**Mean**	**SD**	
Mild	3.66	1.77	0.99	0.52	**2.02***
Moderate	4.79	2.86	1.06	0.27	**2.02***
Severe	9.26	6.34	3.66	2.01	**2.02***
Total	5.90	4.58	1.90	1.70	**3.41***
Chi-square values	3.55		3.70		

$*p<0.05$

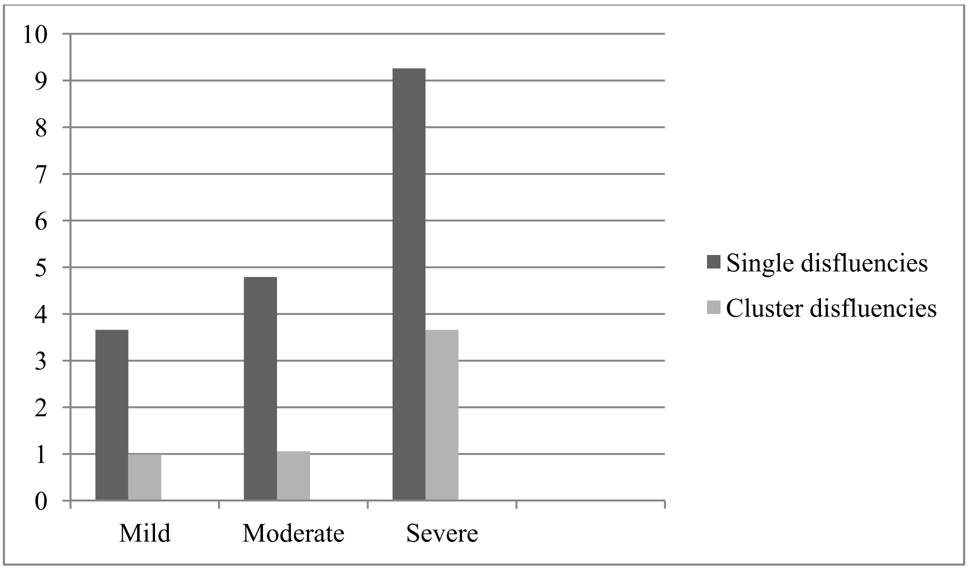

Figure 5. *Mean values for single and cluster disfluencies in mild, moderate and severe subgroups in Group II.*

The mean of single and cluster disfluency values within each severity subgroup were subjected to Wilcoxon signed ranks test to check for any significant difference between the two. The results revealed that there was a significant difference in single and cluster disfluencies for all the severity subgroups (p<0.05). There was also a significant difference seen between single and cluster disfluencies for the overall values of the group as a whole (p<0.05). The |z| values have been depicted in the Table 11.

The total mean of single and cluster disfluencies for the three severity subgroups were subjected to Kruskal Wallis test to check for any significant difference between the two. The chi-square values have been depicted above in the Table 11. The results revealed that the single and cluster disfluencies did not differ significantly (p>0.05) across all severities mild, moderate and severe subgroups. Since the overall findings indicated that there was no significant difference between the values, comparison of values across severity subgroups was not carried out.

Results suggest that the disfluency clusters were lesser in the Group II compared to the Group I. This overall reduction could be possibly attributed to the intervention received i.e., the cluster disfluencies showed a decrease with intervention where a reduction from 37% to 24% was seen. This finding thus suggests that the length of disfluencies reduce with intervention that is clusters are transforming to single disfluencies after the intervention program. Hence, this conveys that intervention is useful in bringing down the overall percentage of disfluency clusters as such.

Yet another interesting and specific finding noticed was the drastic drop of percentage of disfluency clusters in the severe subgroup alone which is not noted in either of the other subgroups. The pattern of the results almost matches with that of the Group I for the mild and moderate subgroups. The severe subgroup, however bears an exceptional finding that there is a raise in disfluency clusters in Group I relative to single disfluencies whereas an abrupt fall of disfluency clusters compared to the single disfluencies in Group II, which again indicates the positive effect of intervention on cluster disfluencies.

III b. Type of disfluency clusters in Group II:

The data pertaining to the three classes of disfluency clusters-SLD-SLD, SLD-OD and OD-OD-were quantified for the three severity subgroups. On the whole, when the total mean values were compared, the most frequently occurring type of cluster was found to be SLD-SLD type being marginally more than the SLD-OD type clusters with least occurring type being the OD-OD type (SLD-SLD type>SLD-OD type>OD-OD type). The OD-OD clusters were found to be statistically insignificant in their occurrence. The mean and standard deviation (SD) for the different severity sub-groups and the group as a whole has been depicted in Table 12. The mean percentages of different types of cluster disfluencies for mild, moderate and severe subgroups in Group II have been represented in Figure 2.

Table 12: *Overall mean percentages, standard deviation (SD), chi-square and |z| values for type of clusters for various severity subgroups in Group II.*

Subgroups	**SLD-SLD type**		**SLD-OD type**		**|z| values**
	Mean	**SD**	**Mean**	**SD**	
Mild	0.13	0.18	0.53	0.50	1.51
Moderate	0.19	0.29	0.26	0.27	0.58
Severe	2.66	1.77	1.06	0.54	1.75
Total	0.99	1.55	0.61	0.54	0.46
Chi-square values	5.46		5.23		

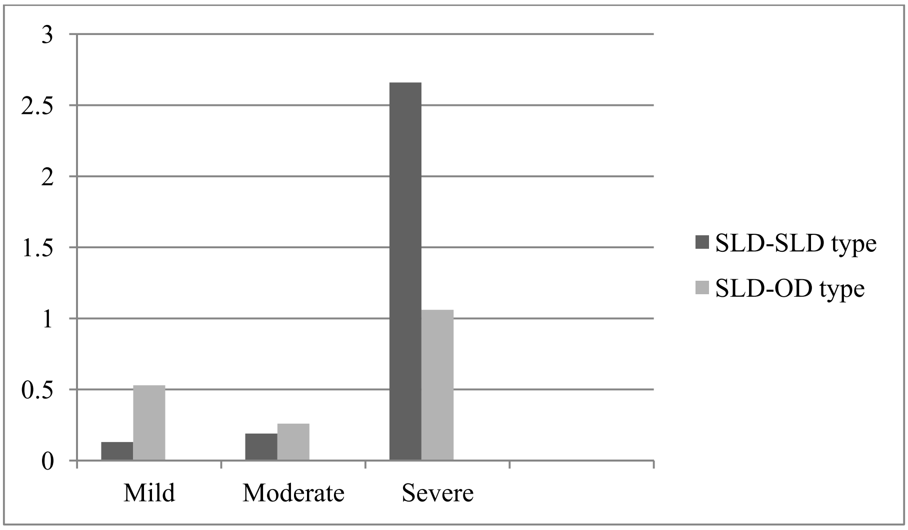

Figure 6. *Comparison of mean percentages of type of cluster disfluencies for mild, moderate and severe subgroups in Group II.*

When the total mean values were compared, the occurrence of SLD-SLD type of clusters was greater. However, when the mean values of the SLD-SLD and SLD-

OD cluster types of different severity subgroups were compared, it was seen that the mean percentage of SLD-OD type of clusters was higher in the mild and moderate groups, whereas for the severe group, the percentage of SLD-SLD type of clusters was higher. The occurrence of OD-OD clusters was insignificant relative to the other types. The following table shows the occurrence of this type of cluster for each participant in the Group II. As seen in the table, the OD-OD cluster type occurred in the mild and moderate subgroups and not in the severe subgroup.

Table 13: *Occurrence of OD-OD cluster for each participant in Group II.*

Subgroup	P 1	P 2	P 3	P 4	P 5
Mild	1	-	-	2	2
Moderate	-	2	1	2	4
Severe	-	-	-	-	-

*P-Participant

The mean values obtained for the SLD-SLD cluster and OD-OD cluster type with each severity subgroup were subjected to Wilcoxon signed ranks test to check for any significant difference between the two. The results revealed that was no significant difference seen ($p>0.05$) between the type of clusters in mild, moderate and severe subgroups per se. There was no significant difference between the type of clusters for the overall values for the group as a whole as well ($p>0.05$). The |z| values have been depicted in the Table 12.

The mean scores were subjected to Kruskal Wallis test to check for significant difference between the different cluster types in different sub-groups. The results revealed no significant difference between SLD-SLD clusters and SLD-OD clusters ($p<0.05$) across the severities of mild, moderate and severe. The OD-OD clusters did not have a statistically significant occurrence. The chi-square values also have been depicted in Table 12.

The results suggest a consistent pattern of findings in mild and severe severity subgroups where precisely SLD-SLD type was lesser than SLD-OD type in mild subgroup in both the groups. However, the SLD-SLD type was greater than SLD-OD type in severe subgroup for both the groups. There was a decrease in the overall cluster disfluencies in both SLD-SLD and SLD-OD types in Group II compared to Group I which indicates an intervention effect. While considering the pattern of shift of values in the moderate subgroup of Group II, the SLD-SLD type of clusters have deteriorated compared to the SLD-OD type which is contrary to Group I. This finding is adequate to speculate that intervention has had a positive impact on the occurrence of SLDs during instances of disfluency clusters.

III c. Size of disfluency clusters in Group II:

The mean and standard deviation (SD) for 2, 3 and 4 size clusters were computed for the different severity subgroups and the values are depicted in Table 14. The overall mean scores on comparison revealed that the clusters consisting of two disfluencies occurred more frequently than the other cluster sizes i.e., an inverse relationship was observed between the size of clusters and their frequency of occurrence. When the size of disfluency clusters were compared across the different severity subgroups, the 2, 3 and 4 size clusters were found to the maximum extent in the severe subgroup. This has been graphically represented in Figure 7. The clusters exhibited by all the various subgroups in Group II ranged from 2 to 7 disfluencies per cluster.

Table 14: *Overall mean, standard deviation (SD), chi-square and |z| values for all severity subgroups for 2, 3 and 4 size clusters.*

Subgroups	**2 Size clusters**		**3 Size clusters**		**4 Size clusters**		**|z| values (Size 2 and size 3 clusters)**
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	
Mild	2.40	1.67	0.80	1.30	0.00	0.00	1.22
Moderate	1.60	1.34	1.00	0.70	0.40	0.54	0.82
Severe	8.00	4.52	2.40	1.51	0.60	0.54	**2.03***
Total	4.00	3.98	1.40	1.35	0.33	0.48	**2.48***
Chi-square values	5.42		3.58		3.92		

$^*p<0.05$

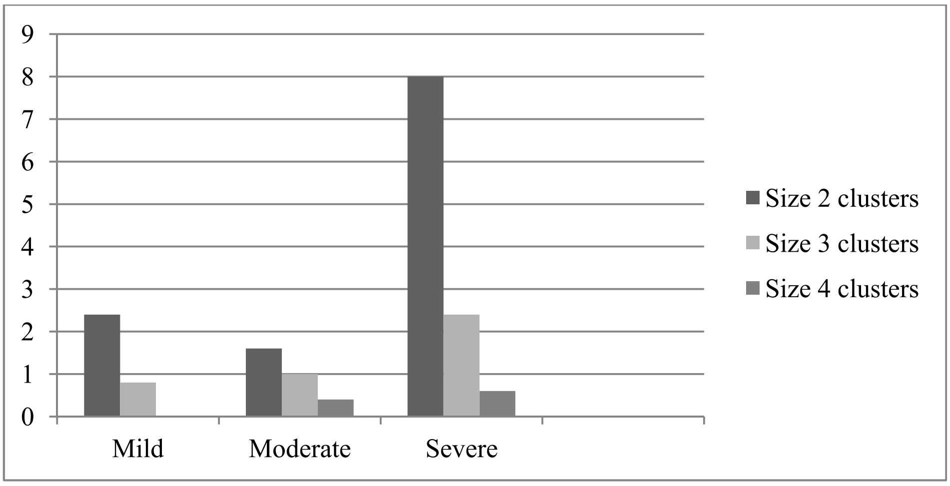

Figure 7. *Mean values for mild, moderate and severe subgroups for 2, 3 and 4 size clusters in Group II.*

Although less significant, the occurrence of size 4+ clusters were seen. Table 15 depicts the same considering each participant in Group II. As can be seen from the

Table 15, the size 4+ clusters occurred very rarely i.e., just once each in mild, moderate and severe subgroups.

Table 15: *Depiction of occurrence of size 4+ clusters for each participant in Group II.*

Subgroup	Participant*	Size 5	Size 6	Size 7
Mild	P 1	-	-	-
	P 2	-	-	-
	P 3	-	-	-
	P 4	-	-	-
	P 5	-	-	1
Moderate	P 1	1	-	-
	P 2	-	-	-
	P 3	-	-	-
	P 4	-	-	-
	P 5	-	-	-
Severe	P 1	-	-	-
	P 2	-	-	-
	P 3	-	-	-
	P 4	-	1	-
	P 5	-	-	-

*P-Participant

The mean values of the 2 and 3 size clusters for each severity subgroup were subjected to Wilcoxon Signed Ranks test to check for any significant difference between the two. It was found that there was no significant difference in these clusters for mild and moderate subgroup ($p>0.05$) whereas only the severe subgroup exhibited a significant difference in this dimension ($p<0.05$). Further, there was a significant difference between 2 and 3 size clusters in the group as a whole ($p<0.05$). 4 size clusters were not subjected to the analysis due to their rare occurrence. The |z| values have been depicted in Table 14.

The overall mean values were further subjected to Kruskal Wallis test to check for any significant difference between 2, 3 and 4 cluster sizes. The result of this test has also been depicted in Table 14. The results revealed no significant difference between 2, 3 and 4 size clusters (p>0.05) across all severity subgroups in Group II.

As observed from the results, the pattern of variations of 2, 3 and 4 size clusters in Group II have been very consistent with that of Group I. Hence, the only change that is seen is in terms of overall as well as specific reduction in various sized clusters for various severities of mild, moderate and severe subgroups. This substantial improvement could be possibly attributed to the intervention process.

III d. Loci of disfluency clusters in Group II:

The mean and standard deviation (SD) value was arrived at using the descriptive statistics which have been depicted in Table 16. On comparison of total mean scores, it was seen that the clusters occurred most frequently in the medial position in sentences. The pattern was similar in all the three severity subgroups too. Overall, a proportional occurrence of 15%, 85% and 0% was seen for initial, medial and final clusters respectively. This has been graphically represented in Figure 8

Table 16: *Overall mean, standard deviation (SD), chi-square and |z| values for disfluency clusters for all severity subgroups with respect to loci in Group II.*

Groups	Initial clusters		Medial clusters		Final clusters		|z| values		
	Mean	SD	Mean	SD	Mean	SD	Initial-Medial	Medial-Final	Initial-Final
Mild	0.80	0.44	2.20	1.92	0.00	0.00	1.29	1.83	**2.00***
Moderate	0.60	0.54	2.60	0.54	0.00	0.00	**2.06***	**2.07***	1.73
Severe	1.20	0.83	10.00	6.12	0.00	0.00	1.76	1.83	1.86
Total	0.86	0.63	4.93	5.06	0.00	0.00	**2.99***	**3.19***	**3.12***
Chi-square values	2.04		3.92		0.00				

***p<0.05**

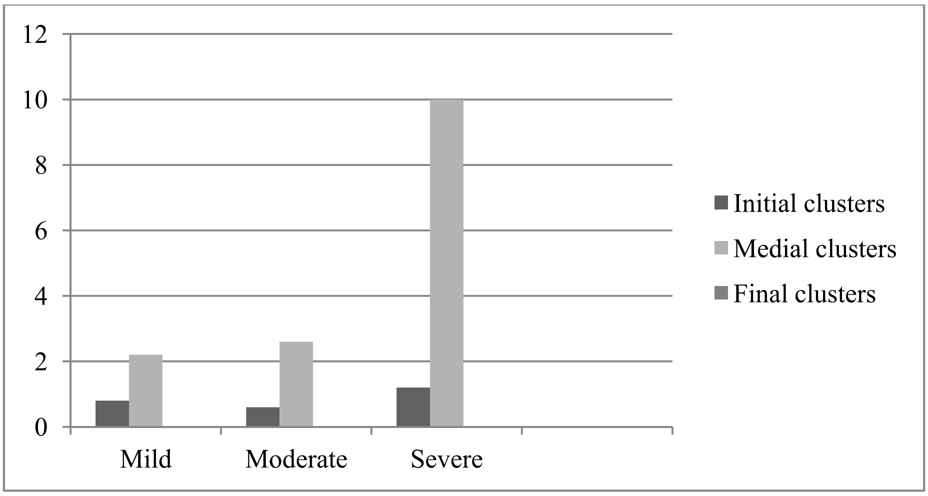

Figure 8. *Overall mean values disfluency clusters for mild, moderate and severe subgroups with respect to initial, medial and final position of clusters in Group II.*

The clusters occurring in the three different positions were checked as to whether they were significantly different or not in various severity subgroups using Wilcoxon Signed Ranks test. Results revealed a significant difference between the initial-medial and medial-final clusters only for the moderate subgroup ($p<0.05$). The mild subgroup differed significantly in terms of the initial-final clusters alone ($p<0.05$). However, there was no significant difference for initial-final clusters for moderate and severe subgroups and for initial-medial and medial-final clusters in mild and severe subgroups ($p>0.05$). Overall, there was a significant difference between all the three pairs of initial-medial, medial-final and initial-final clusters for all the severity groups ($p<0.05$). The $|z|$ values have been depicted in the Table 16.

The overall mean values were subjected to Kruskal Wallis test to check for any significant difference between these clusters occurring in the initial, medial and final position in sentences. The results revealed no significant difference in initial, medial and final clusters ($p<0.05$) across all severities in Group II.

These results indicated that even after undergoing the intervention process, the pattern of occurrence of positional clusters are preserved in Group II, though the participants were not longitudinally considered for this study. Hence, we can conclude by saying that the pattern of occurrence of position of clusters are universal i.e., medial clusters>initial clusters>final clusters. However, this pattern was spared for the moderate subgroup where the medial clusters occurred at its peak followed by the final clusters which are marginally more than the initial clusters. Nevertheless, the difference is very minimal and can be almost negated. Overall, initial clusters occurred with the same proportion of 15% in both the groups with a relative increase in the proportion of medial clusters from 79% in Group I to 85% in Group II and final clusters having dropped completely from 6% to 0%. The appropriate explanation of such an occurrence can be the equal composition of content words in sentences at the initial and final positions with the content's peak in the medial position of sentences.

Here too, an overall reduction in all the categories of positional clusters is seen relative to Group I which picturizes the role of intervention in bringing them down.

Comparison between Group I and Group II:

A comparison of both the groups on the cluster characteristics was done. In both the groups the single disfluencies occurred to a greater extent than clusters, however these values were lesser in Group II that had undergone intervention. With respect to the type of disfluency clusters, the trend of the SLD-SLD clusters occurring more than SLD-OD clusters was persistent in both the groups. Considering the size of clusters, size 2 clusters were seen to occur maximally followed by size 3 and by size 4 clusters thereafter. This pattern was observed in both the groups. For the loci/position of clusters in sentences, majority of the clusters occurred in the medial position of utterances in both the groups followed by initial clusters and then final clusters. Also, it was found that there were no clusters in the final position in Group II.

Mann-Whitney test was done to compare overall results of both the groups across all the parameters. The mean values along with the |z| values have been depicted in Table 17. Results revealed a statistically significant difference in most of the parameters i.e., *frequency* of single disfluencies and clusters ($p<0.05$), *type* of disfluency clusters i.e., SLD-SLD and SLD-OD clusters. For the third dimension which included *size* of clusters there was a significant difference between size 2 clusters ($p<0.05$) whereas no significant difference between size 3 and 4 clusters ($p>0.05$). Under the last dimension of *loci* of clusters, there was a significant difference between medial and final clusters ($p<0.05$). However, overall there was no significant difference between initial position of clusters ($p>0.05$).

Table 17: *Overall mean, standard deviation (SD) and |z| values for all cluster characteristics in Group I and Group II.*

Parameters		**Group I**		**Group II**		**|z| values**
		Mean	**SD**	**Mean**	**SD**	
Frequency	Single disfluencies	8.33	2.40	5.90	4.58	**2.51***
	Cluster disfluencies	4.79	3.71	1.90	1.70	**2.24***
Type	SLD-SLD clusters	2.82	3.07	0.99	1.55	**2.70***
	SLD-OD clusters	1.90	2.54	0.61	0.54	**2.07***
Size	2-size clusters	8.13	5.30	4.00	3.98	**2.35***
	3-size clusters	3.26	2.81	1.40	1.35	1.91
	4-size clusters	1.20	1.52	0.33	0.48	1.62
Loci	Initial position	2.20	2.78	0.86	0.63	1.27
	Medial position	11.40	8.15	4.93	5.06	**2.41***
	Final position	0.86	1.12	0.00	0.00	**3.20***

***p<0.05**

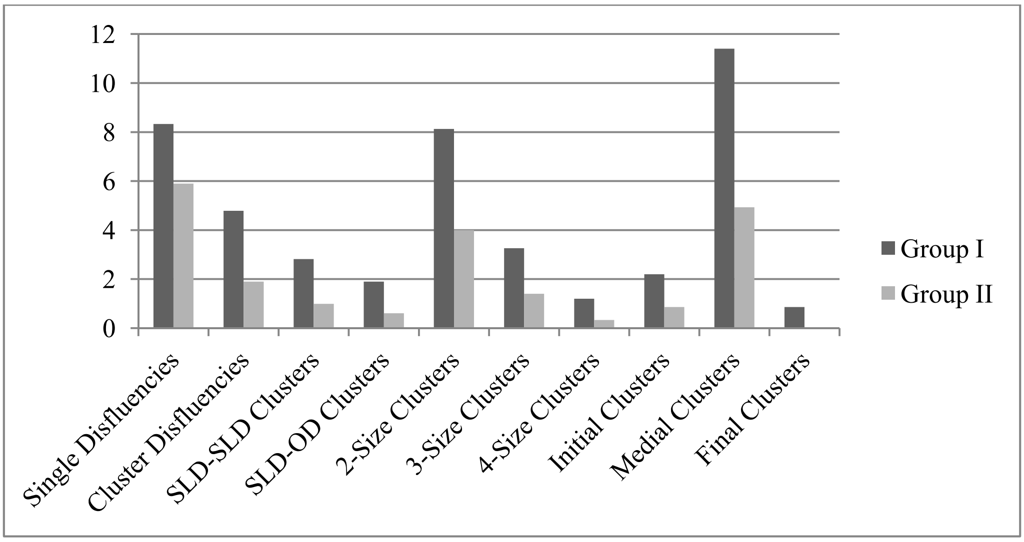

Figure 9. *Representation of comparison of all parameters across both the groups.*

Since we can see that the values of most of the parameters in Group II differed significantly from that of Group I, a comment can be made on the role of intervention, i.e., the intervention had a predominant role in bringing down the disfluency clusters in all the severity subgroups in majority of the domains. Although these two groups comprised of different participants, a preliminary conclusion can be drawn that the clusters had reduced following intervention.

Robb et al.,'s study (2009) also reported a therapy effect on stuttering. The results are in consonance with the present study in that the largest number of clusters occurred in the speech of adults who had not attended intervention. Also, the investigators attributed the finding of smaller number of clusters in adults than in children to therapy and maturity of the speech motor system. Sargent (2007) also suggested in his study on AWS that the group which had received prior treatment for stuttering had a lower overall disfluency level (17.2%) compared to the non-treatment group (21.5%) which is again supporting the results of the present study.

IV. Variation of frequency of disfluency clusters with the severity of stuttering within each group: The third objective was to assess whether the frequency of disfluency clusters would vary with the severity of stuttering. Mean values depicted in Table 19 clearly suggested that there was a linear increase in the occurrence of disfluency clusters as the severity increased from mild to moderate to severe stuttering in both the groups. This implicates the reduction of the occurrence of disfluency clusters with decrease in severity and vice versa as observed for the single/discreet occurrence of disfluencies.

Table 18: *Overall mean and standard deviation (SD) values for disfluency clusters across all severity subgroups in both the groups.*

Severity subgroups	Group I		Group II	
	Mean	SD	Mean	SD
Mild	2.32	1.86	0.99	0.52
Moderate	2.79	1.23	1.06	0.27
Severe	9.26	2.37	3.66	2.01
Total	4.79	3.71	1.90	1.70

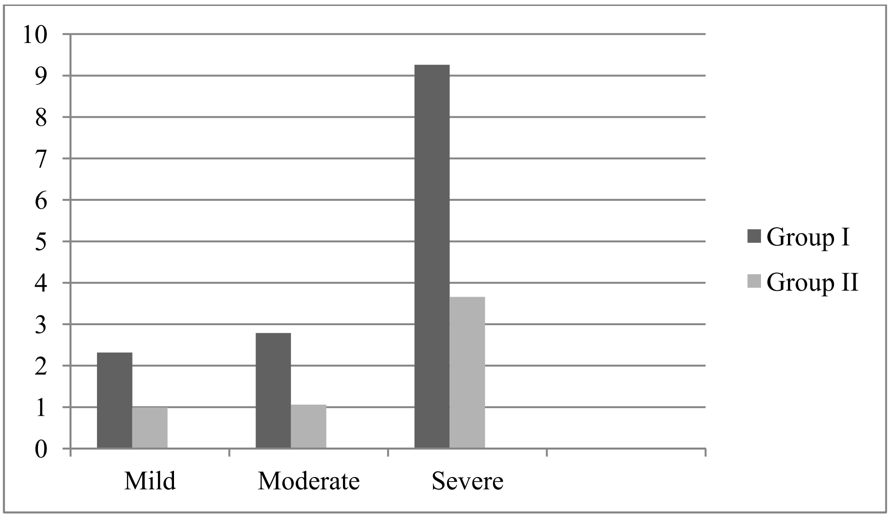

Figure 10. *Comparison of various severity subgroups for disfluency clusters in both the groups.*

The correlation of the total disfluencies with the cluster disfluency percentages were carried out for both the groups using the Pearson's correlation coefficient measure. The results indicated that there was a highly significant correlation of the total disfluencies with the cluster disfluencies as the severity increased from mild to moderate to severe in both the groups ($p<0.01$). Hence, there was a perfect positive correlation and the cluster disfluencies increased linearly as the total disfluencies increased from mild to moderate to severe severities in both the groups. Table 19 depicts the correlation values for the variables. The linearity of the variables have been represented in Figure 11 and 12 for Group I and Group II respectively.

Table 19: *Pearson's correlation values for measures of total disfluencies and cluster disfluencies in both the groups.*

Correlation values	**Correlation of total disfluencies with cluster disfluencies**	
	Group I	**Group II**
Pearson's correlation values	**1.00***	**0.99***

***p<0.01**

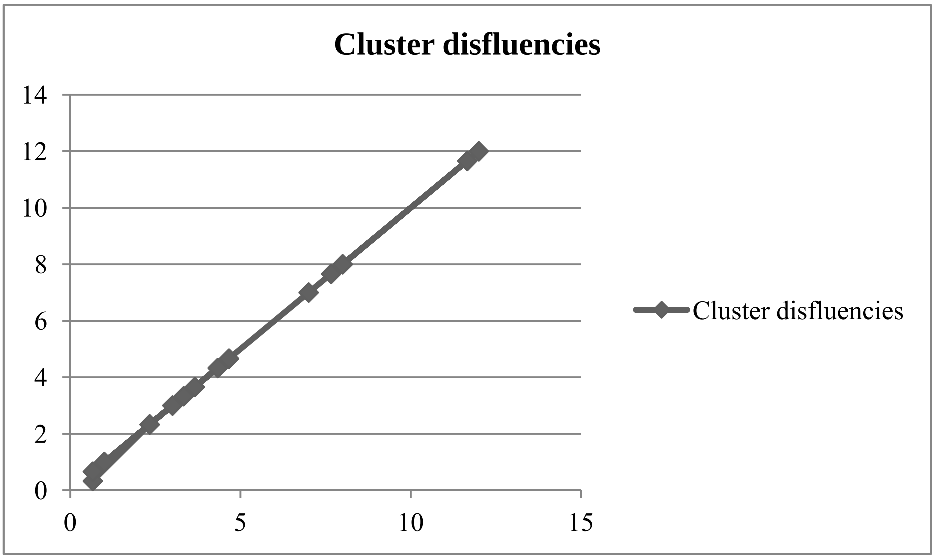

Figure 11. *Representation of scatter plot for the correlation between total disfluencies and cluster disfluencies in Group I.*

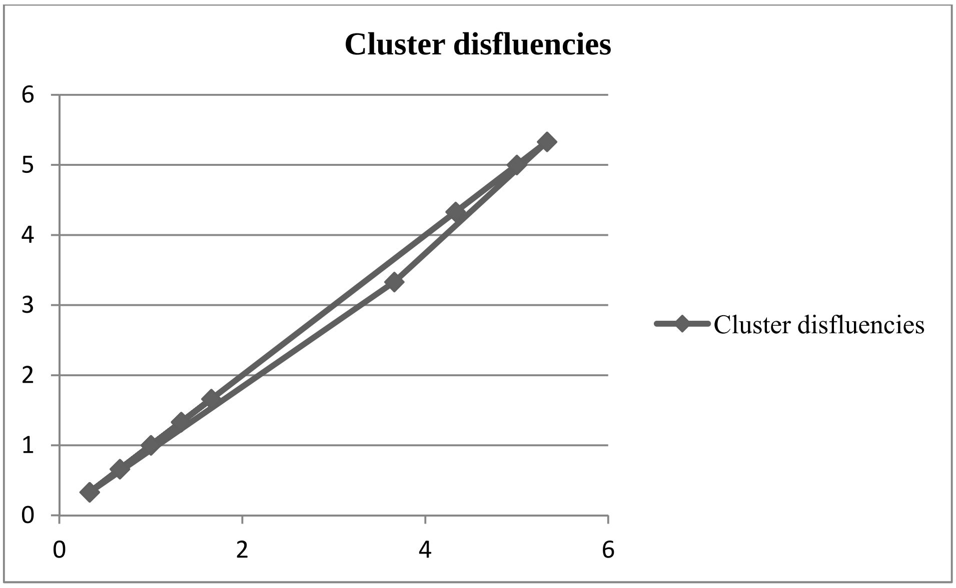

Figure 12. *Representation of scatter plot for the correlation between total disfluencies and cluster disfluencies in Group II.*

Studies suggest that disfluency clusters have been shown to be positively correlated to stuttering severity (LaSalle & Conture, 1995; Sawyer & Yairi, 2004). Sargent's (2007) study in adults with stuttering also revealed a significant positive relationship between each participant's stuttering severity and corresponding number of disfluency clusters suggesting that as stuttering severity increased the number of disfluency clusters also increased. The results obtained in the present study are in agreement with these studies, suggesting that disfluency clusters would indeed be detrimental to the speech of PWS. It could be expected that if disfluency clusters and stuttering severity are correlated, then listeners may perceive disfluency clusters as being more reflective of the severity of a person's stutter. Furthermore, it could be anticipated that the types of disfluency clusters that PWS exhibit most frequently will be the most closely correlated with that persons' severity of stutter.

In sum, the overall pattern of results obtained for both the groups, one not having attended intervention program and the other having undergone intervention is consistent considering all the domains of study with a linear drop of occurrence of disfluency clusters seen in Group II relative to Group I. With regard to the frequency of disfluencies, single disfluencies occurred more (63% and 76%) than the cluster types (37% and 24%) consistently in Group I and Group II respectively. With respect to the type of disfluencies, results for both the groups revealed the composition of SLD-SLD clusters being more than SLD-OD which was in turn greater than OD-OD type. The pattern of results was preserved for the parameter pertinent to size of clusters also for both the groups where the occurrence of 2-size clusters were consistently greater than 3 and 4 size clusters and inverse relationship of the clusters decreasing from 2 to 3 to 4 size clusters was seen for both the groups. With regard to the loci, consistent hierarchical occurrence of medial clusters (15% and 15%)>initial clusters (79% and 85%)>final clusters (6% and 0%) was observed in Group I and Group II respectively.

Hence, one can hypothesize looking at the findings of the present study that disfluency clusters have their own unique way and pattern of occurrence and manifestation with respect to frequency, type, size and loci characteristics especially in the population chosen for this study i.e., adults with stuttering. Also, one can clearly conclude by saying that intervention has an immense positive impact on the reduction of disfluency clusters with respect to each and every feature discussed in this study.

Chapter 5

Summary and Conclusions

Stuttering is a complex multidimensional composite of behaviours, thoughts and feelings of persons who stutter. Precisely stuttering is a fluency disorder with certain overt features (interrupted speech events) and covert or hidden features (negative emotional reactions). The interrupted speech events that occur in the ongoing speech have been referred to as dysfluencies which are also referred to as stuttering instances/moments. These dysfluencies are the cardinal feature of stuttering.

Through the study of the frequency, structure/type, size and location of speech disfluencies within utterances produced by persons who stutter, a new line of research evolved focusing on the geographical or spatial distribution of disfluencies. It was found that while many of the disfluencies occurred as single instances in an utterance, other disfluencies appeared to occur physically close to each other or cluster together, that is, they had a tendency to occur adjacent to each other. This phenomenon of speech disfluencies occurring in close proximity to one another in connected speech was referred to as clusters or runs. To date, there have been few investigations of clustering, attempting to throw light on the nature of this potentially significant phenomenon. Overall, these studies found clusters to be an integral part of disfluent speech, occurring more often than would be expected by chance, both in children and adults who stutter.

An examination of clusters may yield additional clinical information as a means of monitoring stuttering in adults. For e.g., the frequency and components of clusters may change over with intervention as well. Since there is a paucity of research evaluating the characteristics of disfluency clusters in an adult population, such exploration would lead to a more complete understanding of the nature of stuttering and the clinical utility of disfluency cluster measures in adults. Keeping this in view, the study was planned. Thus, the present study was carried out to analyze the specific characteristics of disfluency clusters in two groups of adults with stuttering, Group I who had undergone intervention and the other group (Group II), who had just enrolled for the same. Further, an attempt was also made to investigate whether the frequency of disfluency clusters varies with the severity of stuttering.

Thirty adults with stuttering participated in this study, 15 in each of these groups. All the individuals were matched on socioeconomic status using the NIMH scale and their second language proficiency, English using the ISLPR. The narration speech sample of these individuals on a particular topic were recorded through an audio-video recorder and later subjected to IPA transcription during which all the disfluencies were marked. A 300 word sample was considered for each of the participant and analyzed. The sample was later scrutinized for stuttering like and other type of disfluencies. The classification system put forth by Yairi and Ambrose (1992) was followed. However, during identification of disfluencies, some disfluencies apart from the ones included in the classification were seen, namely phoneme repetition, blocks, unfinished sentence and word revision, which were also noted down and included during the categorization of disfluencies into SLD type and OD type. The percentage of overall occurrence of each of the single and cluster disfluency types in the entire sample was noted down.

Further analysis was carried out with regard to the type, frequency, size and loci of these clusters. The analyzed data was tabulated for each participant, averaged across participants in each group and subjected to statistical analysis. Interjudge reliability measure was carried out on 50% of the sample and the cronbach's alpha value was found to be 0.96 indicating excellent reliability. Mean and standard deviation were calculated. Various statistical procedures were applied to assess if any significant difference existed within the speech of Group I and II with respect to cluster disfluencies and other aspects of the study using SPSS software. Descriptive and non-parametric statistics including Mann-Whitney test, Wilcoxon Signed Ranks test and Kruskal Wallis test were used for the comparison between and within each parameter as well as groups and subgroups. Correlation analysis was carried out using Pearson's correlation coefficient.

The important findings drawn from the study were as follows. Overall, in both the groups the single disfluencies occurred to a greater extent than clusters, however these values were lesser in Group II who had undergone intervention. With respect to the type of disfluency clusters, the trend of the SLD-SLD clusters occurring more than SLD-OD clusters was persistent in both the groups. Considering the size of clusters, size 2 clusters were seen to occur maximally followed by size 3 and by size 4 clusters thereafter. This pattern was observed in both the groups. For the loci/position of clusters in sentences, majority of the clusters occurred in the medial position of utterances in both the groups followed by initial clusters and then final clusters. Also, it was found that there were no clusters in the final position in Group II.

When the pattern of change of disfluencies across change in severities were measured, mean values clearly suggested that there was a linear increase in the occurrence of disfluency clusters as the severity increased from mild to moderate to severe stuttering in both the groups. The Pearson's correlation measure indicated highly significant correlation of the total disfluencies with the cluster disfluencies as the severity increased in both the groups. This implicates the reduction of the occurrence of disfluency clusters with decrease in severity and vice versa as observed for the single/discreet occurrence of disfluencies. The overall reduction the values of disfluency clusters were attributed to the effect of intervention program.

Hence it can be concluded that disfluency clusters have their own unique way and pattern of occurrence and manifestation with respect to frequency, type, size and loci characteristics especially in the population chosen for this study i.e., adults with stuttering. Also, one can clearly conclude by saying that intervention has an immense positive impact on the reduction of disfluency clusters with respect to each and every feature discussed here.

This study has many important implications. The study of the frequency, type, size and loci of the cluster disfluencies can serve as a valid clinical measure which will hold value in the identification of severity of stuttering. This might result in less overlap between the groups and consequently, permit them to be more readily differentiated. An examination of clusters may yield additional clinical information as a means of monitoring stuttering in adults. For e.g., the frequency and components of clusters may change over with intervention as well. Such information could prove valuable in understanding the progression of stuttering and the supposed linguistic and or motoric influence of disfluency clusters. This could add to the data towards establishing a cause for the occurrence of disfluency clusters. Finally, these results may contribute towards the existing theories of disfluency clusters.

A few limitations of this study are that this study was not longitudinally carried out which could have given a better and a stronger picture of the pattern of changes with respect to disfluency clusters and its correspondence to intervention process. Yet another drawback is that the strength of participants in each subgroup were 5; both for the group that had attended and not attended intervention which if taken care of would have permitted for better generalization to the stuttering population.

In the future, studies in the line of disfluency clusters can focus on the length and complexity of cluster inclusive utterances in adults with stuttering. Also, further detailed analysis pertaining to the specific aspects of disfluency clusters like the pattern of disfluency clusters in 2 size clusters, precise composition of mixed 2+ size clusters, that is the type of disfluency which occupies the 1st, 2nd, 3rd position and so on, word position of disfluency clusters, location of initial, medial and final clusters for each of SLD type, OD type and mixed type clusters, frequency of each of the disfluencies as single instances or as clusters can be aimed to study. Few other considerations can be the study of disfluency clusters in various languages (monolinguals, other bilinguals and in multilinguals). The phonetic influences on the occurrence of disfluency clusters can be yet another aspect to be considered for study. Various other samples such as reading and conversation can be elicited and studied to check for variations in disfluency clusters during these differing situations. Since the feature of position of clusters within a sentence has been studied, further research can focus on how disfluency clusters vary in their manifestation on function and content words considering both children and adults with stuttering. Effects of specific intervention programs can be studied regarding disfluency clusters. Finally, all the above aspects could be compared across the population of children and adults with stuttering.

References

Adams, M. R. (1974). A physiologic and aerodynamic interpretation of fluent and stuttered speech. *Journal of Fluency Disorders, 1,* 35-47.

Adams, M. R. (1977). A clinical strategy for differentiating the normally disfluent child and the incipient stutterer. *Journal of Fluency Disorders, 2,* 141-148.

Alvstad, C., Hild, A., & Tiselius, E. (2011). *Methods and strategies of process research.* John Benjamins B.V Publishers.

Ambrose, N. G., & Yairi, E. (1995). The role of repetition units in the differential diagnosis of early childhood incipient Stuttering. *American Journal of Speech-Language Pathology, 4*, 82-88.

Ambrose, N. G., & Yairi, E. (1999). Normative data for early childhood stuttering. *Journal of Speech, Language, and Hearing Research, 42*, 895–909.

Bernstein Ratner, N. (1981). Are there constraints on childhood disfluency? *Journal of Fluency Disorders, 6*, 345-350.

Bloodstein, O. (1960). The development of stuttering: II. Developmental phases. *Journal of Speech and Hearing Disorders, 25*, 366-376.

Bloodstein, O. (1981). *A handbook on stuttering*. Chicago: The National Easter Seal Society.

Bloodstein, O. (1995). *A handbook on stuttering.* San Diego: Singular Publishing Group, Inc.

Bloodstein, O., & Grossman, M. (1981). Early stuttering: Some aspects of their form and distribution. *Journal of Speech and Hearing Research, 24,* 298-302.

Boehmler, R. M. (1958). Listener responses to non-fluencies. *Journal of Speech and Hearing Research, 1,* 132-141.

Brown, S. F. (1937). The influence of grammatical function on the incidence of stuttering. *Journal of Speech Disorders, 2*, 207–215.

Brown, S. F. (1938). Stuttering with relation to word accent and word position. *Journal of Abnormal and Social Psychology*, *33*, 112–120.

Brown, S. F. (1938b). A further study of stuttering in relation to various speech sounds. *Quarterly Journal of Speech, 24*, 390-397.

Brown, S. F. (1945). The loci of stutterings in the speech sequence. *Journal of Speech Disorders, 10*, 181-192.

Brown, S. F., & Moren, A. (1942). The frequency of stuttering in relation to word length during oral reading. *Journal of Speech Disorders, 7,* 153-159.

Campbell, J., & Hill, D. (1987). *Systematic disfluency analysis.* Chicago: Northwestern University.

Colburn, N. (1985). Clustering of disfluency in nonstuttering children’s early utterances. *Journal of Fluency Disorders, 10,* 51-58.

Conture, E. G. (1990a). *Stuttering* (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Conture, E. G. (1997). Evaluating childhood stuttering. In R. F. Curlee & G. M Siegel (Eds.), *The nature and treatment of stuttering: New directions* (2nd ed., pp. 239-256). Needham Heights, MA: Allyn & Bacon.

Conture, E. G., & Kelly, E. M. (1991). Young stutterers' nonspeech behaviors during stuttering. *Journal of Speech and Hearing Research*, 34, 1041-1056.

Cooper, E. B. (1993). Chronic perseverative stuttering syndrome: A harmful or helpful construct? *American Journal of Speech-Language Pathology, 2*, 11–15.

Cooper, E., & Cooper, C. (1985). Clinician attitudes toward stuttering: A decade of change (1973-1983). *Journal of Fluency Disorders, 10 (1),* 19-33.

Cooper, E., & Cooper, C. (1998). Multicultural considerations in assessment and treatment of stuttering. In D. E. Battle (Eds.). *Communication disorders in multicultural populations* (2nd Ed. pp. 247-274). Boston: Butterworth-Heinemann.

Cordes, A. K., & Ingham, R. J. (1995a). Judgments of stuttered and non-stuttered intervals by recognized authorities in stuttering research. *Journal of Speech and Hearing Research, 38*, 33-41.

Cordes, A. K., & Ingham, R. J. (1995b). Stuttering includes both with-in word and between-word disfluencies. *Journal of Speech and Hearing Research, 38*, 282-285.

Curlee, R. F. (1980). A case selection strategy for young disfluent children. *Seminars in Speech, Language and Hearing, 1,* 277-287.

Curlee, R. F. (1993). Identification and management of beginning stuttering. In R. F. Curlee (Eds.), *Stuttering and related disorders of fluency* (pp. 1-22). New York: Thieme Medical Publishers.

Dayalu, V. N., Kalinowski, J., Stuart, A., Hobert, D., & Rastatter, M. P. (2002). Stuttering frequency on content and function words in adults who stutter: A concept revisited. *Journal of Speech, Language, and Hearing Research, 45*, 871 – 878.

Einarsdottir, J., & Ingham, R. J. (2005). Have disfluency-type measures contributed to the understanding and treatment of developmental stuttering? *American Journal of Speech-Language Pathology, 14*, 260-274.

Fein, L. (1970). Stuttering as a cue related to the precipitation of moments of stuttering. *Asha, 12*, 456. Abstract.

Gordon, P. A., & Luper, H. L. (1992). The early identification of beginning stuttering II: Problems. *American Journal of Speech-Language Pathology, 1,* 21-27.

Graham, C. G., Conture, E. G., & Camarata, S. M. (2004). *Childhood stuttering on content and function words:* Paper presented at the American Speech-Language-Hearing Association Convention, Philadelphia, PA.

Guitar, B. (2006). *Stuttering: An integrated approach to its nature and treatment*, 3rd ed. Philadelphia, PA: Lippincott Williams & Wilkins.

Hahn, E. F. (1942b). A study of the relationship between stuttering occurrence and grammatical factors in oral reading. *Journal of Speech Disorders, 7*, 329-335.

Hegde, M. N., & Hartman, D. E. (1979b). Factors affecting judgments of fluency: II. Word repetitions. *Journal of Fluency Disorders, 4*, 13-22.

Hejna, R. F. (1972). The relationship between accent or stress and stuttering during spontaneous speech. *Asha, 14*, 479 (abstr.)

Howell, P. (2004). Assessment of some contemporary theories of stuttering that apply to spontaneous speech. *Contemporary Issues in Communication Science and Disorders, 31,* 123-140.

Howell, P., Au-Yeung, J., & Sackin, S. (1999). Exchange of stuttering from function words to content words with age. *Journal of Speech, Language and Hearing Research, 42*, 345-354.

Hubbard, C. P. (1998). Reliability of judgments of stuttering and disfluency in young children's speech. *Journal of Communication Disorders, 31*, 245-260.

Hubbard, C. P., & Prins, D. (1994). Word familiarity, syllabic stress pattern, and stuttering. *Journal of Speech and Hearing Research, 37*, 564–571.

Hubbard, C. P., & Yairi, E. (1988). Clustering of disfluencies in the speech of stuttering and nonstuttering preschool children. *Journal of Speech and Hearing Research,* 31, 228-233.

Ingram, E. D. (1985). How native like? Measuring language proficiency in bilinguals. *Journal of Applied Linguistics*, *XI* (2), 47-64.

Johnson, W. (1959). *The onset of stuttering: research findings and implications*. Minneapolis: University of Minnesota Press.

Johnson, W., & Brown, S. F. (1935). Stuttering in relation to various speech sounds. *Quarterly Journal of Speech, 21,* 481-496.

Johnson, W., & Colley, W. H. (1945). The relationship between frequency and duration of moments of stuttering. *Journal of Speech Disorders, 10*, 35-38.

Johnson, W., & Knott, J. R. (1937). Studies in the psychology of stuttering: I. the distribution of moments of stuttering in successive readings of the same material. *Journal of Speech Disorders,* 2, 17-19.

Kelly, E. M., & Conture, E. G. (1992). Speaking rates, response time latencies, and interrupting behaviours of young stutters, nonstutterers, and their mothers. *Journal of Speech and Hearing Research, 35*, 1256-1267.

Kelso, J. A. S. (1995). *Dynamic patterns: The self-organization of brain and behaviour.* Cambridge, MA: MIT.

LaSalle, L. R., & Conture, E. G. (1995). Disfluency clusters in children who stutter: Relation of stuttering to self repairs. *Journal of Speech and Hearing Research, 38,* 965-977.

Leach, E. A., Wolfolk, W. B., Fucci, D., & Gonzales, M. D. (1995). Simulations of stuttered speech: Numbers and types of dysfluencies. *Perceptual and Motor Skills, 81*, 367-370.

Logan, K. J., & LaSalle, L. R. (1996). *Disfluency clusters and syntactic structure in children's conversational speech.* Paper presented at the annual convention of the American Speech-Language-Hearing Association, Seattle, WA.

Logan, K. J., & LaSalle, L. R. (1999). Grammatical characteristics of children's conversational utterances that contain disfluency clusters. *Journal of Speech, Language, and Hearing Research,* 42, 80-91.

Manning, W. H., & Shirkey, E. A. (1981). Fluency and the aging process. In D. S. Beasley & G. A. Davis (Eds.), *Aging: Communication processes and disorders* (pp. 175-189). New York, NY: Grune & Stratton.

Meyers, S. C., & Freeman, R. J. (1985). Mother and child speech rates as a variable in stuttering and disfluency. *Journal of Speech and Hearing Research, 28*, 436-444.

Moore, W. H., Jr., & Haynes, W. O. (1980). Alpha hemispheric asymmetry and stuttering: Some support for a segmentation dysfunction hypothesis. *Journal of Speech and Hearing Research, 23,* 229-247.

Murthy, M. C. (1984). Further light on palatalization and velarization in a Kannada dialect. *International Journal of Dravidian Linguistics, 13,* 2, 331-353.

Natke, U., Sandrieser, P., Ark, M. V., Pietrowsky, R., & Kalveram, K. T. (2004). Linguistic stress, within-word position, and grammatical class in relation to early childhood stuttering. *Journal of Fluency Disorders, 29*, 109-122.

O'Brian, S., Packman, A., Onslow, M., & O'Brian, N. (2004). Measurement of stuttering in adults: Comparison of stuttering-rate and severity-scaling methods. *Journal of Speech, Language, and Hearing Research, 47*, 1092-4388.

Perkins, W., Rudas, J., Johnson, L., & Bell, J. (1976). Stuttering: discoordination of phonation and articulation and respiration. *Journal of Speech and Hearing Research, 19,* 509-522.

Peters, H. F. M., Hulstijn, W., & van Leishout, P. H. H. M. (2000). Recent developments in speech motor research into stuttering. *Folia Phoniatrica et Logopaedica, 52*, 103-119.

Peters, H. F. M., & Starkweather, C. W. (1990). The interaction between speech motor coordination and language processes in the development of stuttering: Hypothesis and suggestions for research. *Journal of Fluency Disorders, 15*, 115-125.

Pindzola, R. H., & White, D. T. (1986). A protocol for differentiating the incipient stutterer. *Language, Speech, and Hearing Services in Schools, 17(1)*, 2–15.

Postma, A., & Kolk, H. (1993). The covert repair hypothesis: Pre-articulatory repair processes in normal and stuttered disfluencies. *Journal of Speech and Hearing Research, 36*, 472-487.

Prosek, R. A., Walden, B. E., Montgomery, A. A., & Schwartz, D. M. (1979). Some correlates of stuttering severity judgments. *Journal of Fluency Disorders, 4*, 215-222.

Rhea, M. K., Seby, M., & Swapna, N. (2011). Cluster disfluencies: A comparison between children with stuttering and without stuttering. *Journal of Indian Speech and Hearing Association*, 25, 1-8.

Riley, G. D. (1980). *Stuttering severity instrument*. Tigard, Oregon: CC Publications.

Riley, G. D (1981). *Stuttering Prediction Instrument for Young Children (Rev. Ed.).* Austin, TX: Pro-Ed.

Riley, G. D. (1994). *Stuttering Severity Instrument for children and adults* (third ed.). Austin, TX: Pro-Ed.

Robb, M. P., Sargent, A., & O'Beirne, G.A. (2009). Characteristics of disfluency clusters in adults who stutter. *Logopedics Phoniatrics Vocology, 34*, 36-42.

Ryan, B. P. (2001). A longitudinal study of articulation, language, rate, and fluency of preschool children who stutter. *Journal of Fluency Disorders, 26*, 107-127.

Sander, E. K. (1961). Reliability of the Iowa Speech Disfluency Test [Monograph]. *Journal of Speech and Hearing Disorders, 7*, 21–30.

Sargent, A. (2007). *Characteristics of disfluency clusters in adults who stutter.* Doctoral thesis submitted to the University of Canterbury.

Sawyer, J., & Yairi, E. (2004). *Disfluency clusters in preschoolers persisting in, or recovering from, stuttering.* Paper presented at the American Speech-Language- Hearing Association Convention, Philadelphia, PA.

Sawyer, J., & Yairi, E. (2005). *The dynamics of disfluency clusters in preschool children who stutter.* Paper presented at the ASHA Convention, San Diego.

Sawyer, J., & Yairi, E. (2010). Characteristics of disfluency clusters over time in preschool children who stutter. *Journal of Speech, Language, and Hearing Research, 53*, 1191-1205.

Schiavetti, N. (1975). Judgements of stuttering severity as a function of type and locus of disfluency. *Folia Phoniatrica, 27*, 26-37.

Schiffman, H. (1979). *A Grammar of Spoken Tamil.* Madras: Christian Literature Society. Revised, 1995.

Shapiro, D. (1999). *Stuttering intervention: A collaborative journey to fluency freedom.* Austin, TX: Pro-Ed.

Sheehan, J. G. (1975). Conflict theory and avoidance-reduction therapy. In J. Eisenson (Eds.), *Stuttering: A second symposium*. New York: Harper and Row.

Silverman, E. M. (1973). Clustering: A characteristic of preschoolers' speech disfluency. *Journal of Speech and Hearing Research,* 16, 578-583.

Smith, A., & Kleinow, J. (2000). Kinematic correlates of speaking rate changes in stuttering and normally fluent adults. *Journal of Speech, Language, and Hearing Research, 43*, 521-536.

Soderberg, G. A. (1966). The relations of stuttering to word length and word fluency. *Journal of Speech and Hearing Research, 9,* 584-589.

Sridhar, S. N. (1990). *Kannada: Descriptive Grammar*. Publisher: Routledge.

Still, A. W., & Griggs, S. (1979). Changes in the probability of stuttering following a stutter: a test of some recent models. *Journal of Speech and Hearing Research, 22*, 565-571.

Still, A. W., & Sherrard, C. (1976). Formalizing theories of stuttering. *British Journal of Mathematical and Statistical Psychology, 29*, 129-138.

Taylor, I., & Taylor, M. (1967). Test of predictions from the conflict hypothesis of stuttering. *Journal of Abnormal Psychology, 72*, 431-433.

Throneburg, R. N., & Yairi, E. (2001). Durational, proportionate, and absolute frequency characteristics of disfluencies: A longitudinal study regarding persistence and recovery. *Journal of Speech, Language and Hearing Research, 44*, 38-52.

Travis, L. E. (1931). *Speech Pathology*. New York: D. Appleton-Century.

Van Borsel, J., Maes, E. E., & Foulon, S. (2001). Stuttering and bilingualism: A review. *Journal of Fluency Disorders, 26,* 179-205.

van Lieshout, P. H. H. M., Hulstjin, W., & Peters, H. F. M. (2004). Searching for the weak link in the speech production chain of people who stutter: A motor skill approach. In B. Maassen, R. Kent, H. Peters, P. van Lieshout, & W. Hulstijn (Eds.), *Speech motor control in normal and disordered speech* (pp. 313-355). New York, NY: Oxford University Press.

Van Riper, C. (1971). *The nature of stuttering.* N.J: Prentice Hall

Van Riper, C. (1982). *The nature of stuttering*, 2nd Edn., Prentice-Hall, Englewood Cliffs, NJ.

Venkatesan, S. (2009). Readapted from 1997 Version. *NIMH Socio Economic Status Scale*. Secunderabad: National Institute for the Mentally Handicapped.

Webster's Ninth New Collegiate Dictionary (1988). Merriam-Webster Inc., Publishers, Springfield, Massachusetts, USA.

Wexler, K. B., & Mysak, E. D. (1982). Disfluency characteristics of 2-, 4-, and 6-year old males. *Journal of Fluency Disorders, 7*, 37-46.

Williams, D. E., & Kent, L. R. (1958). Listener evaluations of speech interruptions. *Journal of Speech and Hearing Research, 1*, 124-131.

Williams, D. E., Silverman, F. H., & Kools, J. A. (1969). Disfluency behaviour of elementary-school stutterers and nonstutterers: Loci of instances of disfluency. *Journal of Speech and Hearing Research, 12,* 308-318.

Wingate, M. E. (1967). Stuttering and word length. *Journal of Speech and Hearing Research, 10,* 844-848.

Wingate, M. E. (1982). Early position and stuttering occurrence. *Journal of Fluency Disorders, 7*, 243-248.

Wingate, M. E. (1984). Stutter events and linguistic stress. *Journal of Fluency Disorders*, 9, 295-300.

Wingate, M. E. (2001). SLD is not stuttering. *Journal of Speech, Language and Hearing Research, 44*, 381-383.

Wolk, L., Edwards, M. L., & Conture, E. G. (1993). Coexistence of stuttering and disordered phonology in young children. *Journal of Speech and Hearing Research*, 36, 906-917.

World Health Organization **(**1992**).** *The ICD–10 classification of mental and behavioural disorders. Clinical descriptions and diagnostic guidelines*. Geneva: WHO.

Yairi, E. (1997). Disfluency characteristics of childhood stuttering. In R. F. Curlee & G. M. Seigel (Eds.), *The nature and treatment of stuttering: New directions* (2nd ed., pp. 49-78). Needham Heights, MA: Allyn & Bacon.

Yairi, E., & Ambrose, N. G. (1992). A longitudinal study of stuttering in children: a preliminary report. *Journal of Speech and Hearing Research, 35*, 755-760.

Yairi, E., & Ambrose, N. G. (1999). Early childhood stuttering I: Persistency & recovery rates. *Journal of Speech, Language and Hearing Research, 42,* 1097-1112.

Yairi, E., Ambrose, N. G., & Niermann, R. (1993). The early months of stuttering: A developmental study. *Journal of Speech and Hearing Research, 36,* 521- 528.

Yairi, E., & Seery, C. H. (2011). *Stuttering: Foundations and Clinical Applications*. Upper Saddle River, NJ: Pearson.

Young, M. (1994). Identification of stuttering and stutterers. In R. F. Curlee & W. Perkins (Eds.). *Nature and treatment of stuttering: New directions* (pp. 13-30). San Diego: College Hill.

Zebrowski, P. M. (1991). Duration of the speech disfluencies of beginning stutterers. *Journal of Speech and Hearing Research, 34*, 483-491.

Zebrowski, P. M. (1994). Duration of sound prolongation and sound/syllable repetition in children who stutter: preliminary observations. *Journal of Speech and Hearing Research, 37*, 254-263.

Zebrowski, P. M., Conture, E. G., & Cudahy, E. A. (1985). Acoustic analysis of young stutterers' fluency: preliminary observations. *Journal of Fluency Disorders, 10*, 173-92.

Zimmermann, C. (1980b). Stuttering: A disorder of movement. *Journal of Speech and Hearing Research, 23*, 122-136.

APPENDIX

The disfluencies considered as stuttering like disfluencies and other disfluencies in the present study:

Stuttering-like Disfluencies (SLDs):

- Part-word repetition: Repetition of part of words. E.g., mar mar market
- Single syllable repetition: Repetition of single syllable in words. E.g., wa wa water
- Dysrhythmic phonation: It includes prolongation and broken words.
- Tense pause: Long pauses between words during which audible tense vocalizations are present.
- Phoneme repetition: Repetition of phonemes. E.g., M..m..m..my name is Arun.
- Block: Complete voicing and articulatory arrests during speech.

Other Disfluencies (ODs):

- Polysyllabic word repetition: Repetition of whole words. E.g., I want an apple apple.
- Phrase repetition: Repetition of two or more words or phrases. E.g., I am I am going to school.
- Interjection: Insertion of sounds, syllables, words or phrases within an utterance. These insertions are not associated with the fluent or meaningful text and are not part of the intended message. E.g., insertion of words such as ‘this’, ‘well’ etc.
- Revision of incomplete phrase: Modification in the content or grammatical form of an utterance. It also includes changes in the pronunciation of a word. E.g., I want....I will go to the market.

- Word revision: Revision of a word. E.g., compete…complete.
- Unfinished sentence/false start: A sentence which is left abandoned. E.g., I will go to….Did you have lunch?