RELATION BETWEEN COMPLEX PHONOLOGICAL UTTERENCES AND OCCURENCES OF STUTTERING

Register No. L0380008

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A dissertation submitted in part fulfillment for the degree of

*Master of Science (*Speech-Language Pathology),

University of Mysore, Mysore.

ALL INDIA INSTITUTE OF SPEECH AND HEARING.

Naimisham campus, Mansagangothri, Mysore- 570006.

Dedicated to
my Dad, Mom,
my Grandparents,
& to my Guide

CERTIFICATE

This is to certify that this Master's dissertation entitled *"RELATION BETWEEN COMPLEX PHONOLOGICAL UTTERENCES AND OCCURENCES OF STUTTERING"* is the bonafide work done in part fulfillment of the degree of Master of Science (Speech-Language Pathology) of the student with register number: L03 80008.

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May, 2005.

CERTIFICATE

This is to certify that this Master's dissertation entitled *"RELATION BETWEEN COMPLEX PHONOLOGICAL UTTERENCES AND OCCURENCES OF STUTTERING"* has been prepared under my supervision and guidance. It also certified that this has not been submitted in any other university for the award of any diploma or degree.

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DECLARATION

This is to certify that this Master's Dissertation entitled "*RELATION BETWEEN COMPLEX PHONOLOGICAL UTTERENCES AND OCCURENCES OF STUTTERING*" is the result of my own study has not been submitted earlier at any other University for the award of any other diploma or degree.

Mysore.

May, 2005. Reg. No. L0380008.

DECLARATION

This is to certify that this Master's Dissertation entitled "*RELATION BETWEEN COMPLEX PHONOLOGICAL UTTERENCES AND OCCURENCES OF STUTTERING*" is the result of my own study under the guidance of Prof. M. Jayaram, Director, All India Institute of Speech and Hearing, Mysore has not been submitted earlier at any other University for the award of any other diploma or degree.

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CHAPTER 1

INTRODUCTION

Our understanding of stuttering is aptly explained by Emrick and Hatten (1974) in the following words- “Stuttering is a baffling disorder for both client and clinician. It is amazing that such an ancient, universal, and obvious human problem should defy precise description; despite countless scientific investigations, the basic nature and cause of stuttering remains a mystery”. This clearly explains why the area of stuttering has received more attention than any other speech disorder. Even then, we can’t help, but agree with Van Riper (1971) who says- “As far as stuttering research is concerned, our journey is both over and just beginning”.

Since the time of Aristotle (384 BC), various ‘theories’ have been put forward to explain the onset, development and maintenance of stuttering (Cerebral dominance theory by Travis, 1931; Conflict theory by Sheehan, 1975; Diagnosogenic theory of stuttering by Johnson, 1957; Covert Repair Hypothesis by Postma, and Kolk, 1997; Explan model by Howell, 2004, among others). However, none of these theories have been able to explain the core of stuttering behavior, that is, repetitions, prolongations, and pauses. We have not even been able to agree on what constitutes stuttering. More recently, stuttering has been explained from the perspective of phonological deviations. .

Interest in the relationship between phonology and stuttering is not recent. In fact, the first report on this relation was published in the 1920’s (McDowell, 1928). However, interest was revived in this area in the 1990’s. Prevalence estimates of phonological disorders in children not identified as having stuttering range from 12%-13 % (Shriberg, Tomblin, and McSweeny, 1999). In contrast, it is commonly reported that 30%-50% of

children who stutter have a co-occurring phonological disorder (Bernstein Ratner, 1995; Conture, 2001; Conture, Louko, and Edwards, 1993; Louko, 1995; Melnick and Conture, 2000; Wolk, 1998; Wolk, Blomgren, and Smith, 2000). Despite frequent reference to the coexistence of articulation difficulties and stuttering in children, there have been only a few empirical investigations of the nature of these articulation difficulties and their relation to stuttering in children.

Stuttering is no longer considered a unitary disorder. Therefore, there exists a need to identify components that affect a child's/adult's threshold for fluency. This has led investigators to search for other dimensions of stuttering, which, in turn, has led to research on speech sound production in stutterers from a phonological perspective (Louko, Edwards and Conture 1990).

Phonological disorder is a failure to use speech sounds which are appropriate for the individual's age and dialect. Children with developmental phonological disorders have a language difficulty affecting their ability to learn, and organize speech sounds into a system of 'sound patterns' or 'sound contrasts'. The problem is at a linguistic level, and there is no impairment to child's larynx, lips, tongue, palate or jaw.

Recent literature suggests that amongst the different levels of speech motor programming (Levelt, 1989; Sternberg, 1978), phonological encoding (i.e. mapping of lemma to lexeme) may be crucially involved in stuttering (Wijnen, and Boers, 1994). These phonological encoding errors are detected by an internal monitor and then subjected to covert/overt self repair (Postma and Kolk, 1993). This very process of "self- repair" may be manifested as a clinical stuttering event. Accordingly, researchers have been keen to

determine if presence of phonological errors influences a child's stuttering behaviour (Louko, et al, 1990, Ryan, 1992, Wolk et al, 1993, Yaruss and Conture, 1996)

Phonological disorders are typically described by the persistence of an immature phonological process or production of an atypical process (Stoel-Gammon and Dunn, 1985). Many investigators have reported that children who stutter are far more likely to have a phonological disorder than their peers who do not stutter (Bloodstein, 1995; Louko, Conture and Edward 1999, Yaruss, and Conture, 1996 Andrews and Harris, 1964, Darley 1955). However, until recently, research examining the coexistence of stuttering and phonological disorders was largely epidemiological in nature. That is, studies mainly explored the prevalence of phonological disorders among young children who stutter. A more deeper study of phonological disorders in its relation to stuttering has not been taken up seriously.

Few studies have examined the phonological aspects of words and utterances that contain disfluencies. Yaruss and Conture (1996) evaluated aspects of Covert Repair Hypothesis (CRH) with regard to speech characteristics of children with coexisting stuttering and phonological disorders. Logon and Conture (1997) investigated temporal, grammatical, and phonological characteristics of children who stutter. In their examination of phonological factors, however, they found no significant difference between syllable structure of length–matched utterances with respect to stuttering frequency or duration.

However, when the investigator focused specifically on syllables that begin with consonant clusters, they found that stuttering occurred significantly more often when clusters were produced with phonological errors (25.3%) than when they were produced correctly. Consonant clusters are precise sequences of phonemes that involve increased

phonological complexity (Levelt, 1989). In addition, consonant clusters are late developing phonological forms. The normal phonological process of consonant cluster reduction often persists past the age of 3-4 years, when single consonant in a CV syllable can already be produced with reasonable accuracy (Stoel – Gammon and Dunn, 1985).

Consonant clusters involve more complex motoric programming, and exquisite timing control. Thus, one may predict a greater percentage of disfluencies at moments of increased articulatory complexity. Howell, Au-Yeung, and Sackin (2000) investigated the influence of phonological difficulty of a word on the frequency of stuttering in young children (3-11 years). The phonological aspects that they studied were late emerging consonants and consonant clusters. The results revealed that frequency of stuttering occurred with a higher frequency on words containing late emerging consonants and consonant clusters. In other words, when phonological realization/production is made more complex, then there are chances that the coexisting phonological abnormality and stuttering may come to the surface. Then a proper study of the relationship between phonological difficulty and stuttering can be made. Understanding occurrence of stuttering and phonological errors may shed light on aspects of motor planning and execution in both of these speech disorders.

Statement of the problem

Therefore, the purpose of the present study was to investigate the possible interaction between stuttering and phonology in children who stutter, when they are made to produce speech which is phonologically more complex. A related aim of the study was

to investigate if phonological complexity of words had any effect on the frequency of disfluencies in their utterances. Articulatory rate was also investigated.

Aim of the study

The aims of this study were to

a) investigate and compare the frequency of occurrence of stuttering on phonologically complex sequences and other phonological sequences,
b) investigate and compare the frequency of phonological processes
   - between stutterers and normal children, and
   - between complex and simple phonological sequences in each group
c) compare the frequency of occurrence of stuttering in stuttering children with disordered phonology (DP) and in stuttering children with normal phonology (NP), and
d) to study the relationship between articulatory rate, on the one hand, and occurrence of phonological processes and stuttering , on the other hand.

Need for the study

Studies on the relationship of phonology to stuttering have reported equivocal results. This may be because the studies did not make the speaking sufficiently complex phonologically. As the content and vocabulary of the samples was determined solely by the child and/or his caregivers, it was possible for a child to avoid phonologically complex words. The majority of the words produced by children in these studies were phonologically simple. Therefore, there is a need to replicate these studies using

procedures that would prompt the children to produce a greater number of phonologically complex words consonant (words with consonant clusters, multisyllabic words, etc). This may shed light on the probable relationship between stuttering and phonology.

CHAPTER 2
REVIEW OF LITERATURE

Three lines of evidence suggest that phonological factors are related to speech fluency:

a) First, there is the long standing observation that persons who stutter commonly report difficulty producing words that contain specific sounds within specific phonetic contexts (Bloodstein, 1995; Van Riper, 1971)

b) Numerous studies have reported that the prevalence of phonological disorders among children who stutter is significantly greater than it is among children who do not stutter (Louko 1995; Wolk; Edward and Conture, 1990).

c) Increase in the number of syllables per utterance has been shown to be associated with increase in stuttering (Gaines, Runyan and Meyers, 1991; Logon and Conture, 1995; Soderberg, 1966; Tornick and Bloodstein, 1976; Weiss and Zebrowski 1992; Wingate, 1967) leading some to speculate that the relationship between the number of syllables produced and stuttering may in part reflect the effect of increased phonological processing demands.

Peters and Starkweather (1990) proposed, "Language and speech motor processes may interfere with one another during the act of talking" such that "simultaneous performance of language formulation and motor programming may result in a deterioration of performance in one or both areas".

Stuttering can be conceived as a disorder of speech motor control. This conception is more a perspective than one single viewpoint. It encompasses a family of theories or models and it leads to its own unique types of investigation. It has often been

cited in literature that stuttering events frequently occur at the beginning of a word or utterance and moreover, there is a greater tendency of stuttering to occur on longer rather than shorter words (Soderberg, 1966) and sentences (Tornick, and Bloodstein, 1976; Jayaram, 1984). This in conjunction with the assumption that utterances are supposed to be programmed before their initiation suggests that a programming process may be underlying the etiology of stuttering (Hulstijn, 1987).

A few studies have demonstrated a longer speech reaction time (SRT) associated with longer utterances, this effect being greater for stutterers than for non-stutterers (Peters, Hulstijn and Starkweather, 1989). On comparable lines, Postma, Kolk and Povel (1990) showed that stutterers were slower than non-stutterers in silent (sub-vocal) speech and still slower in lipped and overt speech conditions implying an increased speech planning difficulty in the former of the two groups apart from an extra amount of difficulty when motor execution is involved. These authors have put forth a hypothesis, which views stuttering as a "**phonological encoding disorder**".

Inherent to the understanding of the above is the comprehensive knowledge of the stages involved in the speech production process.

Lexical concept to the articulation of the corresponding word

Lexical access in speech production proceeds at a rate of an average of two or three words per second. At this rate, words are selected from a production lexicon, which contains thousands, probably tens of thousands of words. These words are not only selected, but also phonologically encoded. This happens at a rate of about 15

speech sounds per second. Architecture for the organization of these processes of lexical access is the so called 'formulator' receiving as input the (lexical) concept to be expressed (usually as a part of a plan for a larger utterance).

This formulator receives input from the preceding stage the 'conceptualizer' (The conceptualizer is a nonlinguistic stage in which the basic of topics to be expressed in an utterance are selected and represented in a preverbal prepositional code) based on which the 'formulator' provides the utterance with its linguistic form. The 'formulator' has two major active subcomponents that are currently of interest to us:

a) Grammatical encoding that is selecting appropriate words (lemmas) and ordering them syntactically and,
b) Phonological encoding that is elaborating the sound structure of words. The end product of the 'formulator' is a phonetic or articulatory program specifying how the utterance should be pronounced (phonemes, syllables, stress etc).

There is also a third stage, "articulator stage" where the phonetic program is translated by the motor system into audible speech movements.

Phonological Encoding and Stuttering

There is consensus among researchers that phonological encoding may be crucially involved in stuttering. A number of studies have demonstrated that stutterer's speech planning activities prior to any speech motor movement tend to deviate from normals (Peters, Hulstijn and Starkweather, 1989).

Stutterers are slower than non-stutterers even in silent reading which implies that the problem is not restricted to motor execution, but, in all probability, involves phonological encoding difficulty.

There are two views on the lexical access. The first one is the more traditional modular view, which says that there is no feedback from phonological encoding before lexical selection and accordingly no feedback from phonological encoding to lexical selection. On this view, lexical selection and phonological encoding proceeds through strictly successive stages.

The second view is the connectionist picture, which assumes a temporal overlap of lexical selection and phonological encoding, and a continuing interaction between the two processes. The temporal relation between lexical selection and phonological encoding is one of cascading.

In the classical theories, there is an early stage of semantic activation, which ends up in lexical selection. It is followed by a stage of phonological encoding where only the selected item becomes phonologically encoded.

According to Kolk (1991), stuttering is the result of a phonological encoding problem. In phonological encoding, segments (phonemes) are selected for syllable frames. Segments are considered to be modes in an activation-spreading network. Several segments may compete for a particular syllable slot. The segment that is most activated is selected. Kolk proposed that, in stutterer's activation, spreading is lower than in non-stutterers. As a consequence, several elements that compete for the same

slot are at the same level for activation for a longer period of time. This, in combination with the speaker's wishes to produce speech at a 'normal' speaking rate, increases the chance of wrong selection of segments.

Kolk (1991), and Postma, Kolk, Povel (1990, 1991) hypothesized a "speech monitoring" system that detects and corrects the resulting error before it is uttered. This is referred to as the "**Covert-Repair Hypothesis (CRH)"**. According to this hypothesis, speech disfluencies, including stuttering behaviours occur "when a speaker disrupts ongoing speech production in an attempt to covertly repair errors within their phonetic plan before such errors are overtly produced".

Yaruss and Conture (1996) suggested that children who stutter might have "a slow- to-activate phonological encoding mechanism" which makes it difficult for them to select, resulting in stuttering behaviour. They also suggested that children with numerous phonological errors might be more disfluent than those errors might create "more opportunities for error detection and self repairs."

Based on CRH, Melnick and Conture (2000) stated that "if the frequency of stuttering is greater for longer and more complex utterances, then the reason for this may be a greater number of phonological errors, errors that are detected, repaired, and hence stuttered on".

Levelt (1983, 1989) postulates three ways of monitoring:

1. First, there is monitoring of preverbal message during the conceptualization stage.

2. Speakers may use an inner monitoring loop, that is, inspection of the articulatory plan itself.
3. Speakers can also use an external auditory loop.

Levelt assumed that both the internal and the external loop feed through the speech comprehension system. The monitor thus receives parsed speech messages, which in turn are scrutinized for their correctness. Crosson (1985) states that the temporoparietal area plays a major role in prearticulatory monitoring of speech production. Thus, according to this explanation, repetitions, prolongations and blocking of speech sounds are a by-product of covertly repairing errors in the speech plan.

Wijnen and Boers (1994) attempted to test the hypothesis that stuttering involves a perturbation of the process of phonological encoding. They compared stutterers and non-stutterers responses in an experimental paradigm- phonological priming- that has been advocated to probe this level of processing. The results suggested that phonological encoding processes in stutterers differ from those in fluent speakers.

Hubbard and Prins (1994) studied the effect of word frequency and syllabic stress patterns on stuttering frequency using specially designed sentences read orally by stutterers and non-stutterers. Their results revealed significant differences in stuttering frequency between sentences with low and high frequency words, but not between sentences with regular and irregular stress patterns. They proposed that word access and phonological encoding difficulties could be a core factor that underlies the occurrence of stuttering events.

Throneburg, Yairi and Paden (1994) investigated the relationship between the phonologic difficulty of words and the point at which stuttering like disfluencies occurred in the speech of preschool children identified as having a stuttering problem. The results were contradictory to those of Hubbard and Prins (1994) and did not show a systematic predictable relation between phonologic difficulty and the occurrence of stuttering like disfluencies at the early stage of stuttering. Such a relation may be formed as the problem progresses and become chronic. Hence, the assertion that speech difficulty of children who stutter may result from problems with central premotor planning of the speech act (Postma, and Kolk, 1990) is not supported by this study.

However, an application of the CRH to the speech errors of children shows that many children, particularly those children exhibiting phonological disorders, frequently produce both systematic and non-systematic speech errors. However, it is not clear whether children's systematic speech errors, which are often described in terms of phonological processes (e.g., Edwards, 1992; Edwards and Shriberg, 1983) are similar to the nonsystematic or "slip of the tongue" speech errors (e.g., LaSalle and Conture, 1995; Stemberger, 1989) on which the CRH was originally modeled.

Phonological Processes

Phonological processes are modifications of speech sound production away from standard adult production in isolation. In general, phonological processes simplify sound production.

Edward and Shriberg (1983) define phonological processes as "systematic sound changes that affect a class of sound or a sound sequence". According to Hodson and Pader (1983), phonological processes are regularly occurring deviations from standard adult speech pattern, which may occur across a class of sounds, a syllable shape or syllable sequence. Still others have defined a phonological process as a mental operation that applies in speech to substitute for a class of sounds or sound sequences presenting a common difficulty to the speech capacity of the individual (Stampe, 1979).

There are two kinds of phonological processes: Natural processes and idiosyncratic processes. **Natural processes** are those that are common in the speech development of children across languages. **Idiosyncratic processes** are those that never occur or occur rarely in normal child phonology.

Phonological processes are classified from a different perspective, as syllable structure processes, substitution processes, and assimilatory processes.

Syllable structure processes describe sound changes that affect the syllable structure of the child's production of an adult target word. These processes are most frequently seen in younger children with mean length of utterances between 1 and 4 morphemes (Prates and Swift, 1982).

Substitution process involves sound changes whereby one sound class replaces another class of sounds. The name of these processes typically reflects the replacing sound class. Thus in stopping we find sounds are replaced with stops and in fronting we find that the replacing sounds are made more anterior than adult target.

Assimilation is the process in which a sound becomes similar to (or is influenced by) another sound in the word (Ingram, 1989). Assimilation can be total or partial. Total assimilation means that after the sound changes the sound that changes and the sound that influenced the change are the same. A partial assimilation occurs, when the sound change results in the two sounds being more similar but not the same. Assimilation can be voicing, place, manner or a combination of these features, but usually affects the place of articulation.

Many of the processes in speech of children with phonological disorders do not qualify as "natural". Stoel-Gannon and Dunn (1985) refer to these unusual processes as idiosyncratic processes. Idiosyncratic processes are those which are unique to an individual child or uncommon in normal development. For example, while stopping of fricatives is a common process, stops rarely become fricatives.

Leonard (1985) describes some of the characteristics of unusual sound changes as given below:

a) Cases where a presumably later developing sound replaces a presumably earlier developing sound.

b) Cases where the child's production constitutes an addition to the adult surface form.

c) Cases where the child shows systematic use of a sound not present in the ambient language or use of a supra segmental feature in a manner not seen in that language.

d) Cases where the child shows systematic use of a sound not seen in any natural language.

Till date, there have been only few studies done on phonological processes in young stutterers. In these studies, they have analyzed and categorized speech sound errors according to the frequency and type of phonological processes exhibited.

Louko, Edwards and Conture's (1990) study attempted (a) comparison of the phonological processes exhibited by children who stutter and their normally fluent peers, and (b) related these phonological processes to typical measure of stuttering and other speaking variables. Subjects for this study were 30 stutterers and 30 normals in the age group of 4 years 6 months. Results indicated that children who stutter are more likely to exhibit speech sound errors than their normally fluent peers. Stutterers as a group exhibited 18 different phonological processes which included atypical phonological processes as glottal replacement while their normally fluent peers exhibited 11 phonological processes. Occurrence of cluster reduction was significantly more in young stutterers than in normal fluent children. There were also atypical phonological processes seen in stutterers.

Wolk et al (1993) conducted a study to assess differences in stuttering, phonological and diadochokinetic behaviors in young children who exhibit both stuttering and disordered phonology and children who exhibit only one of the disorders.

Subjects were 21 male children (aged 4-6 years) representing the following 3 groups with 7 children in each.

Group 1: Stuttering and normal phonological abilities (S+NP).

Group 2: Stuttering and disordered phonology (S+DP).

Group 3: Normal fluency and DP.

Results revealed that there was a significant difference in sound prolongation between young stutterers with and without phonological disorders. Specifically, S+DP children evidenced more sound prolongation while S+NP children evidenced more sound/syllable repetition. There was no statistically significant difference in diadochokinetic rates between the 3 groups of children.

Sneha (1994) investigated phonological processes in 12 Kannada speaking stuttering children, in the age range of 3-7 years. Speech samples were recorded using pictures of Kannada articulation test. The results indicated that young stutterers were found to exhibit more varieties and more number of processes than their fluent peers. Further, 10 phonological processes- stopping, frication, multiple processes, lateralization, depalatalization, substitution of glide, epenthesis, interchange of place of articulation, dimunitization, and change in place of articulation – were identified as specific to stutterers. Among these stopping, frication and lateralization were deviant phonological processes.

Paden and Yairi (1996) made a comparative study of the phonological skills in 12 children whose stuttering persisted and 12 children who recovered early from their

stuttering (age range from 27-65 months). 50 words were elicited during conversation and were analyzed for the phonological processes. The comparison between the persisted and recovered groups revealed that, in all measures, the persistent group was poorer phonologically. Clear group difference noted between the persistent and recovered groups suggested that at an early stage of stuttering, the level of phonological skills might contribute to the differentiation between persistency and recovery. These studies suggest that there may be an interaction between stuttering and phonology in some children.

Stuttering and the Phonological Complexity of Words and Syllables

Yaruss and Conture (1996) subdivided children with stuttering into two groups, i.e. children who stutter and have a phonological disorder (S + DP) and children who stutter but have normal phonological (S + NP). They examined the speech behaviors of 20 children in a 30-minutes spontaneous conversation with the mother. Their results revealed no statistically significant differences between groups with respect to either the frequency, duration, or type of disfluencies.

Logon and Conture (1997) examined the relationship between speech disfluencies and syllable structure complexity in stutterers in the age range of 3.0-5.6 years. A conversational speech sample of at least 100 utterances was elicited from each child in a 30-minutes interaction between mother and the child. Results revealed no significant correlation between syllabic complexity measures (numbers of filled onsets, filled codas, consonants, and consonants clusters) and measures of stuttering frequency (number of syllables stuttered) and duration (length of disfluencies in sec). But, they reported that stuttered utterances contained more syllables and were more grammatically complex than

perceptually fluent utterances. Similar findings were also reported by Melnick and Conture (2000).

Ryan (1992) also investigated the phonological skills of 20 children (mean age: 4.4 years) who stuttered. Twenty children were administered the Arizona Articulation Proficiency Scale (Barker, 1973). Findings were not statistically significant indicating that children who stuttered more did not necessarily produce more speech sound errors. Anderson and Conture (2000) reported similar findings. Thus, in terms of phonological patterns and behaviors, children who stutter did not appear to differ from their peers with normal fluency.

Conclusion from these studies:

- → Young stutterers exhibit more varieties of phonological processes than normal children.

- → Percentage of occurrence of phonological processes and the frequency of their occurrence was more in stutterers as compared to their age, and gender matched normals.

A few authors have studied the frequency of simultaneous disfluencies and phonological errors (Wolk, Blomgren, and Smith, 2000). Speech sample gathered during 30-minutes interaction between mother and the child was analyzed for disfluencies, phonological errors, stuttering, and phonological error co-occurrence. The results revealed that the frequency of disfluencies on word-initial consonant clusters

with phonological errors was significantly higher than on word-initial consonant clusters without phonological errors.

Peters, Von Liestout, and Hulstijn (2004) investigated the influence of gestural overlap between two adjacent consonants within syllables and across syllable boundaries in bi-syllabic words on speech reaction time and word duration in persons with stuttering and persons without stuttering. They studied two types of clusters: homorganic (same place of articulation) and heterorganic (different places of articulation). Heterorganic clusters elicited more incorrect speech productions and longer reaction times than the homorganic clusters, but there was no difference between the homorganic and the heterorganic clusters in the word duration data. Therefore, the production of two consonants with the same place of articulation across a syllable boundary puts higher demands on motor planning and/or initiation than producing the same cluster at the end of a syllable, in particular for persons with stuttering.

From the above review, it is apparent that there exists a relation between phonology and stuttering. Although the interaction has been examined in a variety of ways, studies failed to demonstrate that

- Greater amounts of stuttering were associated with a greater number of phonological errors (Louko et al., 1990; Ryan, 1992, 2001; Wolk et., 2000; Yaruss and Conture, 1996).

- Stuttering severity differed in children with phonological disorders compared to those with normal phonological development (Wolk et al., 1993; Yaruss and Conture, 1996).

- Phonological behavior differed in children who stuttered compared to those who were fluent (Wolk et al., 1993).

- Efforts to produce phonologically complex words were associated with greater amount of stuttering (Howell and Au-Yeung, 1995; Logon and Conture, 1997; Throneburg et al., 1994).

- Phonological processes in children's conversational speech occurred more often during stuttered than nonstuttered utterances (Melnick and Conture, 2000).

Nippold (1990) highlighted several methodological problems that tend to limit the overall conclusions that can be drawn from the above mentioned studies in young stutterers. These are:

a) the use of parental interview or informal observation in place of direct testing of children (as in Andrews and Harris, 1964; Darley, 1955; Seider, Gladstein and Kidd, 1982),
b) the use of spontaneous speech could not ensure that the children would attempt to produce phonologically complex words (for example, Throneburg et al., 1994),
c) the absence of data establishing test-retest and inter-scorer reliability of articulation assessment (Blood and Seider, 1981; McDowell, 1928; Williams and Silverman, 1968), and
d) the difficulty in distinguishing true articulation errors from manifestations of stuttering (Schindler, 1955).

The review above shows that past research has failed to show a relationship between phonology or phonological development, or phonological processes and

stuttering. For every study that has shown a relationship, there is another study which has shown contradictory findings. Failure to show a more consistent relationship between phonology and stuttering may have something to do with the way speech material was collected from these children and the nature of speech material. As the child and the mother were in control of the conversational situation, they determined the content and vocabulary of what was said. It was quiet possible for these children to avoid phonologically complex words. Therefore, if the child is made to produce a greater number of phonologically complex sequences, then it may lead to unearthing of a more consistent relationship between stuttering and phonology.

CHAPTER 3

METHOD

Objectives of the study

- The purpose of the study was to investigate the relationship between stuttering and phonology in children, who stutter. This was done by analyzing the speech of stutterers with disordered phonology and comparing that with stutterers with normal phonology. Disordered phonology was determined on the basis of occurrence of atypical phonological processes.

Subjects

- Subjects were ten child stutterers in the age range of 3 to 6 years (mean age = 4.2 years) and ten age and gender matched normal children. The normal children were in the age group of 3 to 6 years (mean age = 4.29 years).
- All subjects were native speakers of Kannada and were attending school (lower kindergarten, upper kindergarten or 1st standard). The language age of all children, obtained on the Receptive Expressive Emergent Language Scale-extended version, was appropriate to their chronological age.

Children in both the experimental and the control group had

- Kannada as their native language,
- no known or reported difficulties in behavioural and/ or intellectual functioning,
- no known reported neurological illnesses or trauma,
- normal hearing (as reported),
- no evidence of oral muscular weakness,
- normal oral speech mechanism, and

- had no prior history of therapy for misarticulation or language problem.

Only those who were diagnosed as child stutterers at the Department of Speech Pathology at the institute were taken into the experimental group. All stutterers were graded by the speech pathologist who diagnosed them to have mild to moderate severity of stuttering. History of therapy for stuttering was no criteria for selection of child stutterers into the study.

Material

Samples of spontaneous speech were collected from all children in a story telling session. The children were presented a series of pictures, each series accounting for a story. Three such series of pictures were presented. The investigator had analyzed the story and had identified a total of 28 target words which could be elicited from children. Accordingly, he talked to the children, asked questions, and encouraged them to repeat after him sometimes, to elicit the target words. Most of the times the children had come out with the intended word by themselves. Extreme care was taken to make sure that the children do not become conscious of this act.

The target word pertained to the following categories:

- words with late emerging consonants (LEC) such as /h, v, r, k, g, st, t/ (as reported by Tasneem Banu, 1977) in the word-initial position,
- words with complex syllable shapes (CC) such as the presence of clusters and blends /st, skr, kr, bl, dr, ks/ (as reported by Tasneem Banu, 1977) in any position of the word, and
- polysyllabic words (PS), that is, words containing 4 or more syllables.

Procedure

Subjects were seated comfortably and tested in a quiet room individually. Initially, rapport was built up with each of the subject's before eliciting speech sample. Each child was presented with picture cards and was encouraged to narrate the story. An attempt was made to obtain the spontaneous production of all the target words, but it was sometimes necessary to elicit delayed imitations, in which a verbal model was provided. This procedure was repeated for all the target words if they had not been uttered by the children by themselves. This way speech sample was collected approximately for a duration of 30 minutes in a play situation. The speech of all the children were audio- recorded onto a digital recorder (Sony MZ-R30) with the microphone placed at approximately 10 cms away from child.

Judgement of stuttering and phonological processes

The experimenter along with a speech language pathologist (a postgraduate native speaker of Kannada), transcribed the recorded speech sample and analyzed it for instances of stuttering and phonological processes. The recorded speech sample was listened to as many times as required until the speech pathologist and the experimenter agreed hundred percent upon the instances of stuttering and phonological processes. Stuttering was defined as any audible or silent repetitions of a sound or syllable, or any audible or silent prolongations of a sound, or any repetition of a monosyllabic word repetition (whole word repetition).

The substitutions, omissions, and additions were examined for phonological processes. Grunwell's (1985) definition of phonological processes was adopted for the examination of the phonological processes present in the speech sample of the subjects.

The phonological processes considered were:

- Syllable structure processes
- Substitution processes
- Assimilatory processes

Test- retest reliability

The test- retest reliability was established by asking the initial two judges to judge a portion of the speech again (about 20%) of 3 children each in the experimental and control group. This was done 20 days after the first set of judgement. A Product Moment correlation of 0.97 for phonological process and 0.98 for stuttering utterances was obtained between the two sets of judgements. The validity of the judgement by the experimenter and the speech pathologist was tested by asking a second speech-language pathologist to transcribe and judge a portion of speech (about 15%) of speech of 4 children. A Product Moment correlation of 0.95 was obtained between the two sets of judgements for phonological processes and 0.96 for stuttering instances.

Analysis and comparisons

The entire 30-minute's audio-recorded speech sample of each child was used for analysis. The sample was divided into the following two sets for analysis:

a) Set A had words with late emerging consonants in the word-initial position, words with consonant clusters, and polysyllabic words (words having four or more syllables).
b) Set B had all the remaining words in the corpus.

The following computations were made for each of the two sets:

- Total number of syllables was calculated by manually counting the number of syllables excluding the pauses greater than 250msecs.
- Percentage of disfluencies was calculated by dividing the number of stuttered syllables by the total number of syllables in each category and multiplying it by 100.
- Percentage of occurrence of a phonological process was computed by the following formula (Newman and Creaghead, 1988):

$$\frac{\text{Number of times a process occurred}}{\text{Total number of words spoken}} \quad \text{X } 100$$

Percentage of occurrence of 5% or more was considered high, following Newman and Creaghead, 1988. Frequency of occurrence of phonological process was defined as the number of subjects showing each of the processes and the frequency of occurrence of a phonological process was considered high if it occurred in 50% or more of the subjects (following Newman and Creaghead, 1988). In addition phonological processes which were common to both stutterers and normals and which were specific to stutterers were identified.

Based on the type of phonological processes that were noted (e.g., age-appropriate or atypical processes), each child was then placed in one of the following two phonological categories:

a) Normal Phonology (NP) in which the child exhibited only normal phonological processes.
b) Disordered Phonology (DP) in which the child exhibited at least one "age inappropriate or atypical" phonological process at least 5 times. Atypical phonological processes are processes not typical of normal development. For example, Backing of Dentals, Fricatives replacing stops, Glottal replacement, Metathesis etc (Edwards and Shriberg, 1983; Steol-Gammon and Dunn, 1985).

Articulatory speaking rate

Articulatory speaking rate was defined as the child's speaking rate (in syllables/sec) arrived at after excluding all instances of pauses greater than 250msec (Kelly and Conture, 1992; Walker, Archibald, Cherniak, and Fish, 1992; Yaruss and Conture, 1995). Articulatory rate was calculated by digitizing the recorded material at a sampling frequency of 8 kHz using a 12-bit analog to digital converter of the Cool Edit program. Initially, the end points of the words in the transcription were located, and then all the pauses between words (>250msec) were eliminated. Later, the number of syllables was manually counted and divided by the total time taken.

CHAPTER 4
RESULTS

The aims of this study were to:

- investigate and compare the frequency of occurrence of stuttering on phonologically complex sequences and other phonological sequences,
- investigate and compare the frequency of phonological processes
  - between stutterers and normal children, and
  - between complex and simple phonological sequences in each group,
- compare the frequency of occurrence of stuttering in stuttering children with disordered phonology (DP) and in stuttering children with normal phonology (NP), and
- to study the relationship between articulatory rate, on the one hand, and occurrence of phonological processes and stuttering, on the other hand.

The data obtained from the normally fluent children and children with stuttering were analyzed for the following:

Phonological processes analysis

- Between-group comparison of the phonological processes shown (that is, children with stuttering and normally fluent children), and across conditions (that is, phonologically complex words and phonologically simple words).
- Comparison of the phonological processes exhibited within each group (that is, stuttering and normally fluent children), but across different phonologically complex words of LEC, CC, and PS.

Speech disfluency analysis

- Between-group comparison of the disfluencies shown (that is, children with stuttering and normally fluent children), and across conditions (that is, phonologically complex words and phonologically simple words).
- Comparison of the disfluencies exhibited within each group (that is, stuttering and normally fluent children), but across different phonologically complex words of LEC, CC, and PS.

Articulatory rate analysis

- Comparison of the articulatory rate (syllables/sec) between groups (normally fluent children and children with stuttering).
- Comparison of the articulatory rate (syllables/sec) by stuttering children with disordered phonology (S + DP) and child stutterers with normal phonology (S + NP).

Owing to the relatively small number of children taken into the study and due to the difficulty in determining whether the sample is normally distributed, nonparametric Mann Whitney U test was performed to compare the two subject groups. In addition, the Wilcoxcon Signed Rank Test was performed (for within group comparison)

Descriptive analysis revealed that stuttering children, as a group, exhibited 32 different phonological processes while their normally fluent children exhibited only 16 processes.

Phonological processes exhibited by both the groups

The results indicated that around sixteen phonological processes were exhibited by both young stutterers and normally fluent children (shown in Figure 4.1). They were: Affrication (AFF), Centralization (C), Cluster reduction (CR), Devoicing of stop (DOS), Final consonant deletion (FCD), Fronting (FR), Gliding of liquids (GL), Interchange of vowels (IOV), Lateralization (L), Palatalization (PAL), Retroflex fronting (RF), Stopping (STP), Substitution of trill (SOT), Velar fronting (VF), Vowel changes (VC), Post vocalic devoicing (PVD). A visual inspection of Figure 4.1 shows that the frequency of these phonological processes is very high in children with stuttering.

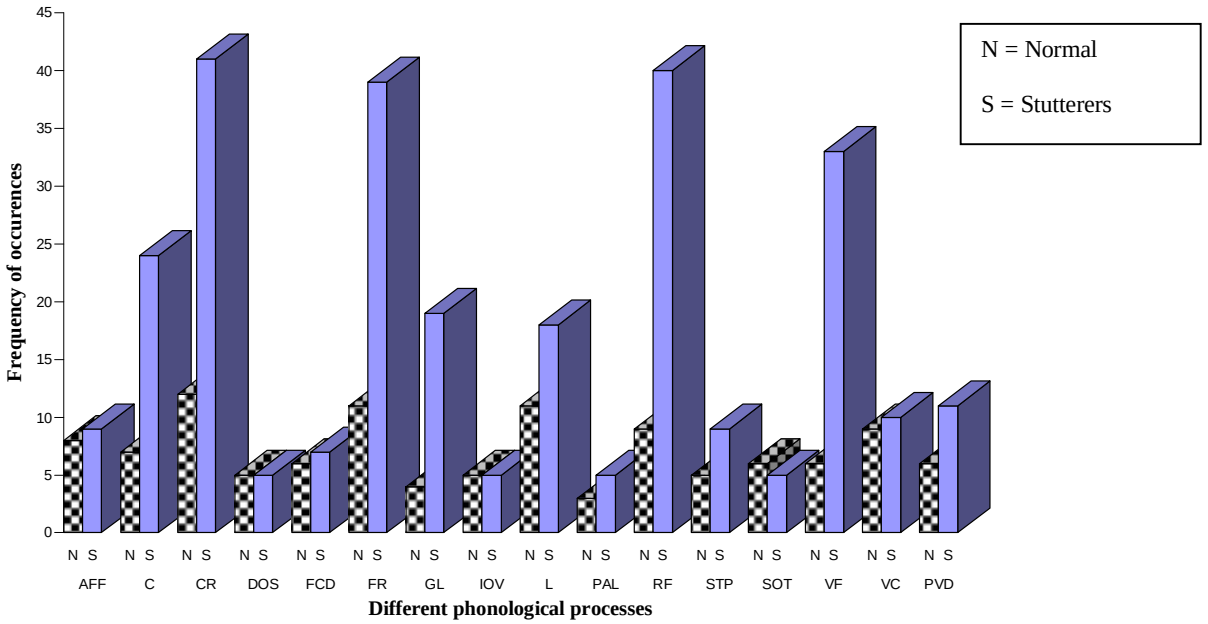

Figure 4.1: Frequency of occurrence of phonological processes exhibited by both children with stuttering and normally fluent children

Phonological processes specific to children with stuttering

The results indicated that the following sixteen phonological processes were exhibited by only children with stuttering (shown in Figure 4.2). They were: Backing of Dentals (BD), Coalescence (COAL), Deaffrication (DEAFF), Denasalization (DENAS), Epenthesis (EPEN), Fricative replacing stops (FRS), Glottal replacement (GR), Glide replacing stops (GRS), Initial consonant deletion (ICD), Metathesis (METATH), Medial consonant deletion (MCD), Neutralization (NEUT), Omission of trill (OOT), Palatal Assimilation (PASS), Stridency deletion (STR), Prevocalic voicing (PVV).

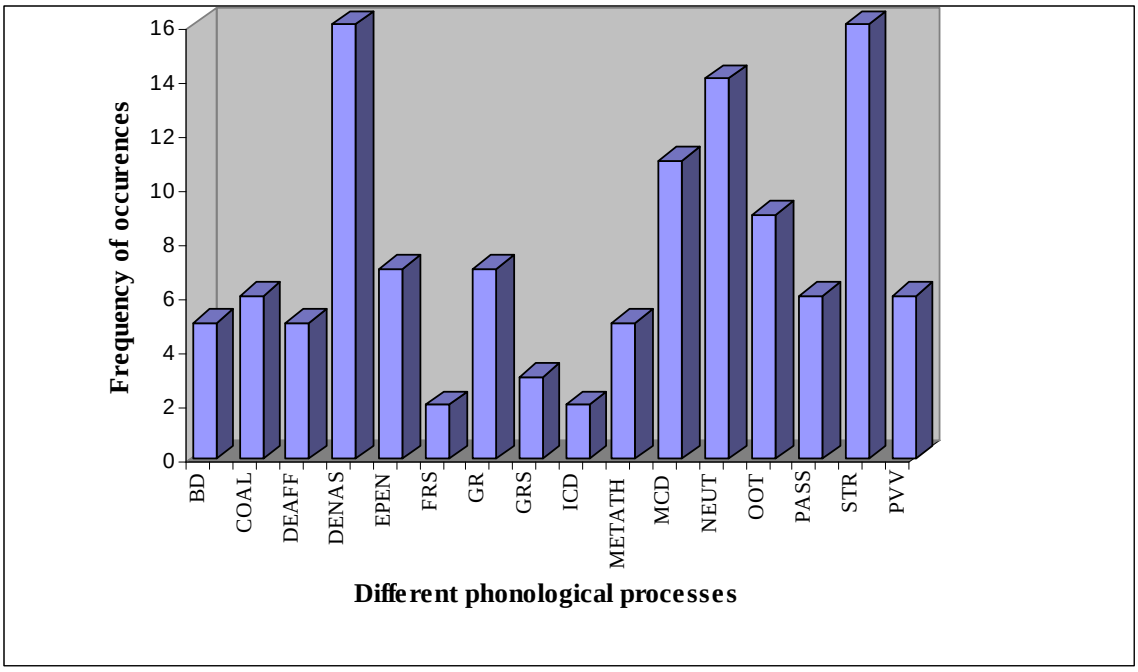

Figure 4.2: Frequency of occurrence of phonological processes seen only in the speech of stuttering children.

Comparison of the frequency of phonological processes in child stutterers and normal children

The mean percentage of phonological processes on phonologically complex words and phonologically simple words in the speech of stuttering and normal children is shown in Table 4.1. The number of words with late emerging consonants, consonant clusters and polysyllabic words was the basis for determining phonologically complex words. Words without these characteristics were grouped under phonologically simple words.

Table 4.1: The Mean percentage of occurrence of phonological processes in the speech of the subject groups

Phonological category	Stutterers		Normal	
	Mean	Standard deviation	Mean	Standard deviation
Complex words	18.14	5.50	8.04	2.07
Simple words	4.14	1.80	0.86	0.29

Mann-Whitney U test was performed to compare the mean percentage scores between the two groups. The results of the Mann-Whitney U test are shown in Table 4.2. The results show that child stutterers, as a group, exhibited significantly more number of phonological processes ($p<0.01$) than their normal counterparts on both phonologically complex and phonologically simple words.

Table 4.2: Results of Mann Whitney U test for the significance of difference of mean percentage of phonological processes between the two groups

Significance	Complex words Stutterers Vs Normal	Simple words Stutterers Vs Normal
Z	-3.477	-3.780
p	0.001	0.000

Comparison of phonological processes within groups

The results in Table 4.1 indicated that child stutterers, as a group, exhibited significantly higher frequency of phonological processes, both in phonologically complex and phonologically simple words than normal children. Next, a comparison was made between the conditions of phonologically complex and phonologically simple words, in each group, for the occurrence of phonological processes. The Wilcoxcon Signed Rank test was applied and the results are shown in Table 4.3. The results revealed that both stuttering and normal children exhibited significantly more number of phonological processes on phonologically complex words ($p<0.001$) when compared to the number of phonological processes exhibited on phonologically simple words.

Table 4.3: Results of Wilcoxon Signed Rank Test for the difference in mean percentage of phonological processes between phonologically complex and simple words in each group

Significance	Complex words Vs simple words in stuttering children	Complex words Vs simple words in normal children
Z	-2.803	-2.803
p	0.005	0.005

Comparison of phonological processes in each group between different groups of phonologically complex words in each subject group

The mean percentage of phonological processes exhibited by children, in each group, between words with late emerging consonants (LEC), consonant clusters (CC) and polysyllabic (PS) words were compared. Mean percentages are shown in Table 4.4. Friedman (nonparametric) test was performed to compare the mean percentage scores between categories.

Table– 4.4: Mean percentage of phonological processes on LEC, CC, PS words in children with stuttering and normal children

Phonological category	Stutterers		Normal	
	Mean	Standard deviation	Mean	Standard deviation
LEC	22.76	7.11	8.77	3.58
CC	29.38	16.93	9.04	3.07
PS	11.84	4.89	6.65	3.69

[LEC: late emerging consonants, CC: consonant clusters, PS: polysyllabic words]

The mean and standard deviations for both the groups are as shown in the Table-4.4. Next, pairwise differences, between LEC, CC, PS, were subjected to statistical test through Wilcoxon Signed Rank test. Results given in Table-4.5 revealed a highly significant difference between PS and LEC, and between PS and CC in stuttering children. None of the differences was significant in respect of normal children. A visual inspection of mean scores, for both the groups, revealed that more phonological processes were exhibited on CC followed by LEC and PS.

Table 4.5: Results of Wilcoxon Signed Rank test for the significance of difference of mean percentage of phonological processes between LEC, CC, and PS in each of the subject groups

Significance	CC- LEC		PS- LEC		PS- CC	
	stutterers	normal	stutterers	normal	stutterers	normal
Z	-1.07	-0.05	-2.70	-0.96	-2.70	-1.58
p	0.28	0.95	0.007	0.33	0.007	0.11

Comparison of speech disfluencies exhibited by stutterers across conditions

The mean percentage of speech disfluencies exhibited by children with stuttering on phonologically complex words and simple words is shown in Table 4.6.

Table 4.6: Mean, and standard deviations, percentage of disfluencies on phonologically complex words and simple words in the speech of children with stuttering

Phonological category	Stutterers	
	Mean	Standard deviation
Complex words	17.13	4.32
Simple words	7.18	1.77

The results of Wilcoxcon Signed Rank Test, given in Table 4.7, revealed that children with stuttering exhibited significantly more number of disfluencies on phonologically complex words ($p<0.01$) in comparison to mean percentage of disfluencies on simple words.

Table 4.7: Results of Wilcoxon Signed Rank Test for percentage disfluencies between phonologically complex and simple words in stuttering children

Significance	Complex words-simple words
Z	-2.803
p	0.005

Comparison of speech disfluencies on words with LEC, CC, and PS words

The mean percentage of speech disfluencies exhibited by children with stuttering on words with LEC, CC, and PS is shown in Table 4.8. Friedman (nonparametric) test was performed to compare the significance of difference between the three categories. Results of Friedman test revealed a highly significant difference between the three categories ($p<0.001$). Further, pairwise difference was tested with Wilcoxon Signed Rank test and the test results are shown in Table 4.9. Results revealed that the difference between all possible pairs were significantly different ($p<0.05$). There was more stuttering on words with CC followed by LEC and PS words.

Table 4.8: Mean percentage of disfluencies on LEC, CC, and PS words in the speech of children with stuttering

Phonological category	Stutterers	
	Mean	Standard deviation
LEC	19.70	4.29
CC	26.97	7.00
PS	9.10	2.87

Table 4.9: Results of Wilcoxon Signed Rank test for significance of mean percentage of disfluencies between LEC, CC, and PS

Significance	CC- LEC	PS- LEC	PS- CC
Z	-2.09	-2.80	-2.80
p	0.037	0.005	0.005

Comparison of speech disfluencies exhibited by stuttering children with disordered phonology (S + DP) and stuttering children with normal phonology (S + NP)

In the present study, six out of ten stuttering children exhibited disordered phonology (DP) characterized by at least one atypical phonological process or one age-inappropriate process, namely, Backing of Dentals, Fricatives replacing stops, Glottal replacement, Metathesis, Coalescence, Epenthesis etc. (Edwards and Shriberg, 1983; Steol-Gammon and Dunn, 1985). Conversely, no atypical processes were exhibited by normally fluent children.

The mean percentage of speech disfluencies exhibited by child stutterers with disordered phonology (S+ DP) and stuttering with normal phonology (S + NP) on phonologically complex words and simple words is shown in Table 4.10 and the results of the Mann Whitney U test for the significance of difference between the two subgroups are shown in Table 4.11. The results revealed that the mean percentage of speech disfluencies exhibited by S + DP was not significantly different from S + NP ($p>0.05$) with respect to both stuttering on phonologically complex and phonologically simple words.

Table 4.10: Mean percentage disfluencies exhibited by the two subgroups of stutterers (stutterers with DP, and stutterers with NP).

Phonological category	S + DP		S + NP	
	Mean	Standard deviation	Mean	Standard deviation
Complex words	16.31	3.07	18.34	6.07
Simple words	7.62	1.73	6.52	1.86

Table 4.11: Results of Mann Whitney U test for the significance of difference in mean percentage of disfluencies between S + DP and S + NP groups

Significance	Complex words S + DP	Simple words S + NP
Z	-0.42	-1.06
p	0.67	0.28

Comparison of articulatory rate (in syllables/sec) between groups

The mean articulatory rate of both normal and children with stuttering is shown in Table 4.12. The results of Mann Whitney U Test for the significance of difference between the two groups are shown in Table 4.13. The results revealed that stutterers as a group exhibited significantly faster articulatory rate ($p<0.01$) than normal children.

Table 4.12: Mean articulatory rate of speech (in syllables/sec) for normal and child stutterers

Variable	Stutterers		Normal	
	Mean	Standard deviation	Mean	Standard deviation
Articulatory rate	3.18	0.48	2.55	.24

Table 4.13: Results of Mann Whitney U test for articulatory rate for the significance of difference between the two groups

Significance	Stutterers Vs Normal
Z	-3.06
p	0.002

Comparison of articulatory rate (syllables/sec) between S + DP and S + NP

Next, the mean articulatory rates were compared between the two subgroups of stutterers (S+ DP and S + NP) and are as shown in the Table 4.14. The result of Mann Whitney U test for the significance of difference between the two subgroups (Table 4.15) showed that there was no significant difference between the two subgroups ($p>0.05$).

Table 4.14: Mean articulatory rate (syllable/second) for S+ DP and S + NP

Variable	S + DP		S + NP	
	Mean	Standard deviation	Mean	Standard deviation
Articulatory rate	3.33	.591	2.94	.12

Table 4.15: Results of Mann Whitney U test for significance of difference of mean articulatory rate between S + DP and S + NP groups

Significance	S + NP Vs S + DP
Z	-0.85
p	0.39

CHAPTER 6
DISCUSSION

The main objectives of the present study were to analyze the relationship between phonological processes and stuttering in stutterers with and without disordered phonology. Spontaneous speech samples were collected using picture-story sequences and interview. The children were encouraged to come out with pre-identified target words either spontaneously by asking questions or by repeat after-me procedure. The target words corresponded to words with late emerging consonants (LEC) or consonant clusters (CC) or polysyllabic words (PS).

According to the current theories, that is, Covert Repair Hypothesis, the speech disfluencies of persons who stutter reflect repairs at the level of phonetic planning. Therefore, it was hypothesized that the phonological complexity that increases the opportunity for the occurrence of such errors should likely increase the occurrence of stuttering. Results of the present study support previous research which indicated that children who stutter are more likely to exhibit speech sound errors when compared to normally fluent children.

Several interesting findings emerged from the study. First, when the speech task is made complex, child stutterers exhibited more number of phonological processes as shown in Figure 5.1. Increased frequency and type of phonological processes was also accompanied by increased frequency of occurrences of stuttering (Figure 5.2). This is a strong indicator that stuttering is, in some way, related to stuttering.

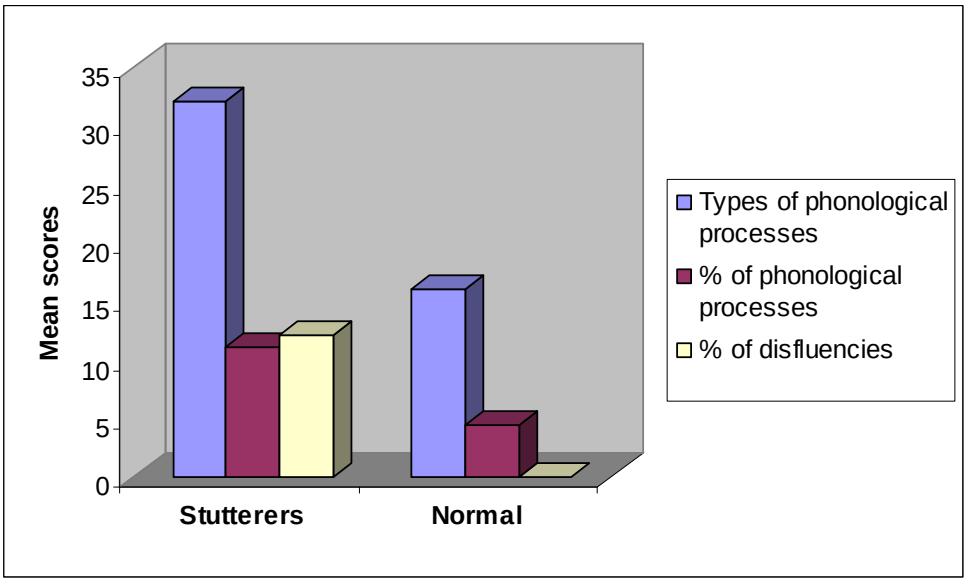

Figure 5.1: Mean of phonological processes, types of phonological processes and disfluencies, in the speech of child stutterers and normal children

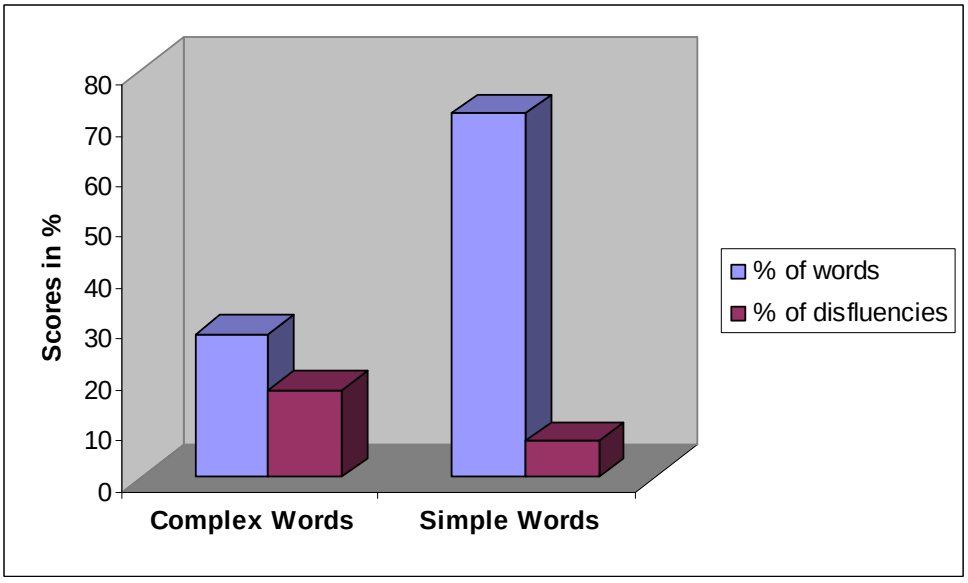

Figure 5.2: Occurrence of stuttering as phonologically complex and phonologically simple words

The present finding that stutterers' speech was associated with greater number and types of phonological processes are in agreement with that of Louko, Edwards, and Conture (1990), Wolk, Edwards, and Conture (1993), and Sneha (1996). However, the present study aimed at eliciting phonologically complex speech from the subjects which is an important methodological difference from the above mentioned studies. But, as the evidence has now come from both simple and complex speech of child stutterers, the hypothesis must be accepted that child stutterers have some kind of phonological planning or executing difficulties. This lends support to Peters, Hulstijin and Starkweather (1989) who reported that initiation time of vocal responses, a measure of the time needed for speech planning, revealed larger difference between stuttering speakers and normal speakers when utterances to be produced was longer.

Young stutterers in the present study exhibited more age-inappropriate or atypical phonological processes (e.g. Backing of Dentals, Glottal replacement, Metathesis, and Coalescence), which were not present in normally fluent children. These atypical processes differ from the more common phonological processes. Persistence of these processes after age 3.0 to 3.5 years is likely to reflect a phonological disorder (Bernthal and Bankson, 1993).

The frequency of disfluencies as well as phonological processes on phonologically complex sequences (words with consonant clusters and word-initial late emerging consonants) is significantly higher than on other simple words. This reflects a greater likelihood of disfluencies and speech errors at specific moments of increased phonological complexity. These findings are in consonance with previous research, for

example, Wolk, Blomgrem, Smith, 2000, who found that the frequency of disfluencies on word-initial consonant clusters with phonological errors was significantly higher than on word-initial consonant clusters without phonological errors. The present finding also contradicts the findings of an earlier study by Throneburg, Yairi, and Paden (1994) who concluded that "phonological difficulty does not have much of an influence on disfluency for these young children at the early stage of stuttering".

The fact that stutterers exhibit significantly more disfluencies on consonant clusters and exhibit more cluster reduction processes when compared to normally fluent children seem to suggest that there may be a subtle disruption in temporal programming (in particular phonological encoding) which results in difficulty in producing sequences of consonant clusters (Wolk, 1990) which, in turn, may lead to increased disfluencies. The difficulty these children might have with controlling and stabilizing the temporal-spatial parameters for correct speech sound production might cause them to simplify, truncate, or reduce consonant clusters as well as produce reiterations and cessations (i.e., sound/syllable repetitions and sound prolongations). It is also possible that young stutterers reduce clusters in order to simplify the beginning of words, and the difficulty stutterers often have in producing word initial consonants fluently may be related to this. The greater frequency of stuttering on longer words (Brown, 1945) may be a reflection of their programming difficulty.

The findings of the present study strongly indicate that stuttering and phonology are related. However, this relation implies neither that one disorder 'causes' the other, nor that two problems result from the same cause. However, the two disorders could be different manifestations of the same etiology. In fact, it could be that both stuttering

(Schwartz and Conture, 1988; Van Riper, 1982) and disordered phonology (Stoel-Gannon and Dunn, 1985) have multiple causes, and the possibility exists that, in some cases, one causal factor underlies both problems. For example, some children inherit a speech production system that is slow to develop in terms of its ability to quickly, precisely, and smoothly effect the temporal spatial demands for speech production. Difficulty in meeting the temporal-spatial demands could manifest itself as disfluencies, or speech sound production errors, or both.

The other possibility could be that the two disorders could have the same etiologies and manifestations, and could interact throughout their development in such a way as to exacerbate one another. For example, if a child struggles to articulate correctly a specific speech sound, he or she may also be disfluent on that particular sound, or when a child is disfluent, he/ she may find it more difficult to articulate correctly the problematic speech sounds or speech sound sequences.

Stutterers with disordered and normal phonology

The frequency of stuttering in the S + DP group was not significantly different from that of the S + NP group (Figure 5.3). So also the articulatory rate. In fact, the S + NP exhibited more stuttering, albeit statistically not significant, than the S + DP group, a finding not consistent with the phonological complexity hypothesis. This finding is consistent with that of Yaruss, and Conture (1996), Louko, Edwards, and Conture (1990), and Wolk et al. (1993). However, the criterion for inclusion in the S + DP group in this study was too lax, the result being not much of a difference between the groups. Not withstanding this, these results warrant continued research on the potential differences in

the types of disfluencies produced and subgrouping the children with stuttering into S + NP and S + DP.

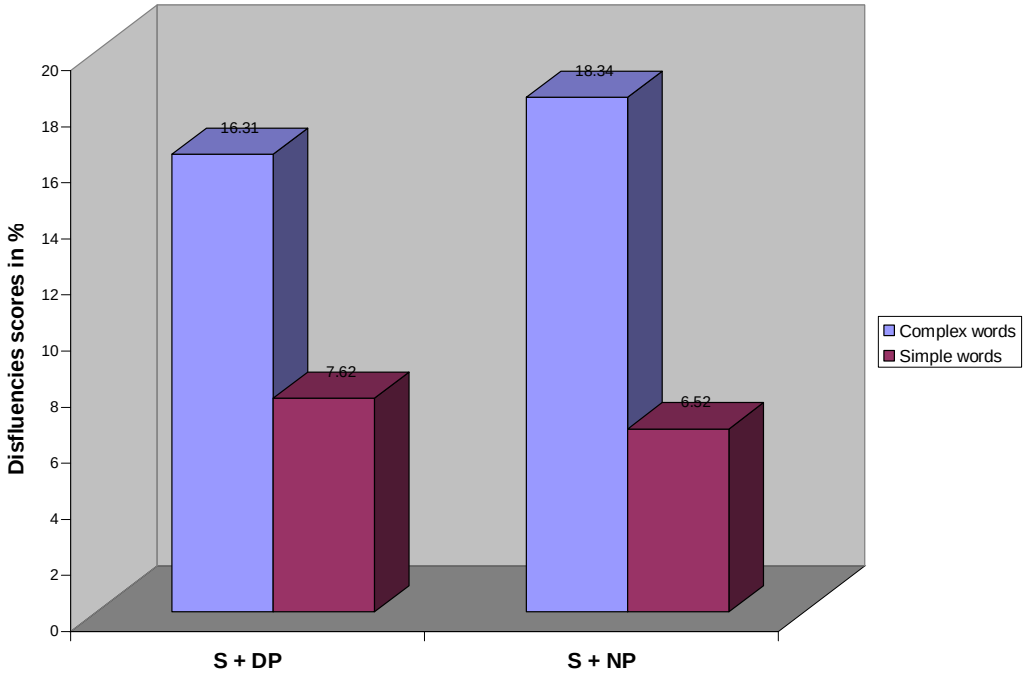

Figure 5.3: Comparison of the frequency of disfluencies exhibited by S+ DP and S+ NP groups of stutterers

The Covert Repair Hypothesis (Kolk, Conture, Postma, and Louko, 1991) postulates that the frequent production of systematic (phonological processes) errors and speech disfluencies by children with stuttering may be due to the children's inability to either detect or successfully repair phonological encoding errors in their speech (i.e., their internal monitors are in some way deficient). Therefore, one can expect higher stuttering in children with greater problems in phonological encoding. But, this postulation was not supported by this study, subject to the above said limitation.

Children with stuttering exhibited significantly faster articulatory rate of speech when compared to normally fluent children in this study. According to Covert Repair Hypothesis, individuals who stutter exhibit delayed phonological encoding and attempt to

initiate speech too rapidly or use too-fast articulatory speaking rates. The present findings support this prediction. As reported by previous research, both speech errors and disfluencies increase with speaking rate (Dell, 1986; Postma & Kolk, 1990). Speeding up speech tempo causes more planning lapses, that is, internal speech errors, and thus increases overt error rate (Dell, 1986; Mackay, 1982). More internal errors also provide greater occasion for covert repair, and would thus elevate disfluency numbers (Kolk, 1991; Postma, & Kolk, 1990). However, the result of the present study seem to suggest that this increased articulatory rate and associated stuttering may not be due to phonological encoding or anything related to that.

Kolk (1991) has characterized stuttering speaker's phonological encoding defect primarily as a temporal one. People who stutter would have a crucial problem in generating the phonetic plan without normal time constraints, that is, at output rates corresponding to the speech tempo of an average speaker. According to Kolk (1991) the built up of activation of phonemic control elements is too slow in people who stutter. Consequently, if selection of an element for insertion in the phonetic plan takes place at ordinary time intervals, the risk of choosing an incorrect element is high because of an elevated degree of response competition of alternative elements.

In general, the findings from the present study suggest that, from a clinical perspective, it is important to focus on designing suitable therapy techniques that best facilitate fluency and phonological accuracy. For example, the issue of whether to provide phonological therapy to an individual with a coexisting fluency disorder has risen by many researchers. Conture, Louko, and Edwards (1993) suggested a "blended" treatment program that combined fluency therapy into activities designed to address

phonological remediation. In an evaluation of therapy options for concomitant fluency and language/ phonological impairment, Ratner (1995) stated, “to the extent that all fluency- shaping goals need to be practiced in some communication activity, it is efficient to practice them while working on other areas of communication development. The practice holds true only to the extent that either the articulation/ language skill to be worked upon does not inherently stress the fluency system”. However, this conclusion may be warranted because the present study did not focus on therapeutic management of either stuttering or phonological errors.

CHAPTER 6

SUMMARY AND CONCLUSIONS

The co-occurring phonological disorder in children with stuttering is commonly reported to be that of 30%-50% (Bernstein Ratner, 1995; Conture, 2001; Conture, Louko, and Edwards, 1993; Louko, 1995; Melnick and Conture, 2000; Wolk, 1998; Wolk, Blomgren, and Smith, 2000) Despite frequent reference to the coexistence of phonological difficulties and stuttering in children, there have been few empirical investigations of the nature of these articulation difficulties and their relations to stuttering in children.

The purpose of the present study was to investigate the possible interaction between stuttering and phonology in children who stutter, and to determine if the phonological complexity of words had any effect on the frequency of disfluencies in their utterances when compared with their normally fluent children. Articulatory rate was also investigated.

The speech samples of these children were obtained using three stories which were depicted in pictures. These stories contained a total of twenty-eight target words which included words with late emerging consonants, consonants clusters, and polysyllabic words. The speech sample thus obtained was analyzed for phonological processes: frequency, types, and percentage of occurrence, frequency of disfluencies and articulatory rate.

Based on the type of phonological processes exhibited, each child was placed in one of the following two phonological categories:

a) Normal Phonology (NP) in which the child exhibited only normal phonological processes.

b) Disordered Phonology (DP) in which the child exhibited at least one "age inappropriate processes or atypical" phonological process.

The articulatory rate and disfluencies exhibited by stuttering with disordered phonology (S+ DP) and stuttering with normal phonology were also compared.

The results revealed that

- children with stuttering exhibit far more number of phonological processes compared to normal children,
- there were some phonological processes specific to the speech of children with stuttering,
- stutterers as a group exhibited more number of phonological processes on phonologically complex words than on phonologically simple words,
- stuttering children with disordered phonology did not exhibit more disfluencies than stuttering children with normal phonology, and
- stuttering children had significantly higher speech articulatory rate than normal children.

In general, the results suggest that stuttering and phonology are related in the following ways:

- stuttering children exhibit greater, and unique, number of phonological processes,
- the higher the number of phonological processes, the higher is the frequency of disfluencies, and

- stuttering children seem to have greater difficulty in executing complex words, the result being higher phonological processes and higher stuttering on them.

The results seem to suggest the possibility of stuttering children having some difficulty in the phonological planning leading to speech problems. However, the etiology was not investigated, and that it is only a possibility.

Future research

The present study focused on just the frequency of occurrence of stuttering. There is a need for studies which investigate the type of disfluencies (repetitions, prolongations, pauses, whole word repetitions) and their probable relationships to phonological errors and processes. Further understanding the degree to which phonological errors and disfluency influence each other may help determine:

a) if targeting phonological errors does, in fact, further stress the speech motor system,
b) whether training certain phonological targets may facilitate fluency, and
c) which order to address these two disorders in therapy.

Which specific reference to consonant clusters, children exhibiting co-occurring disfluency and phonological errors may benefit from therapeutic intervention that includes a graded hierarchy of syllabic complexity. That is, progressing from CV to CVC to CCVC to CCCVC may be useful in managing increased phonological complexity. Another possibility is splitting the cluster (e.g., from CCV to CVCV) as an interim therapy strategy to encourage smoother temporal transitions using reduced speech rate, prolonged speech, and easy onset, and then gradually returning to the correct phonological form (i.e., the consonant cluster).

Limitations

Perhaps, the characterization of S + DP group in this study was too lax. Occurrences of just one atypical process was sufficient for inclusions under the S + DP group and therefore, the S + DP group in this study was not really different from the S + NP group. Studies are warranted where more rigorous criteria are employed to define S + DP group. Perhaps, in such group of S + DP, there are more demands on phonological planning, and more probability of speech errors and stuttering.

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