INTERACTION OF SIMULTANEOUS LANGUAGE PROCESSING AND SPEECH MOTOR ACT IN ADULT STUTTERERS

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DEDICATED TO

My Dearest Papa

who are proud even of my small achievements

and

My adorable Mummy

love and my strength

for moulding me into

what I am to-day

CERTIFICATE

*This is to certify that this dissertation entitled "INTERACTION OF SIMULTANEOUS LANGUAGE PROCESSING AND SPEECH MOTOR ACT IN ADULT STUTTERERS" the bonafide work in part fulfillment for the degree of "MASTER OF SCIENCE (SPEECH **AND** HEARING)", of the student with Register No. M 9314.*

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DECLARATION

This dissertation entitled ***"INTERACTION OF SIMULTANEOUS LANGUAGE PROCESSING AND SPEECH MOTOR ACT IN ADULT STUTTERERS"*** *is the result of my own study under the guidance of* ***Dr. SAVITHRI S.R.,*** *Lecturer, Department of Speech Sciences, All India Institute of Speech and Hearing, Mysore, and has not been submitted earlier at any university for any other diploma or degree.*

MYSORE ***(REG NO. M 9314)***

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TABLE OF CONTENTS

LIST OF TABLES

INTRODUCTION

CHAPTER I

INTRODUCTION

Stuttering has been called a riddle. It is a complicated, multidimensional jigsaw puzzle with many pieces still missing. It is also a personal, social and scientific problem with many unknowns (Van Riper, 1982).

Wingate (1964) proposed a three part standard definition of stuttering. The first part denotes the core features of stuttering which have universal applicability, the second and third parts identify the accessory and the associated features respectively. According to Wingate (1964) the term stuttering means :

1. a. Disruption in the fluency of verbal expression, which is

   b. characterized by involuntary, audible or silent repetition or prolongation in the utterance of short speech elements, namely sounds, syllables and words of one syllable. These disruptions

   c. usually occur frequently or marked in character and

   d. are not readily controllable.

2. Sometimes the disruptions are (e) accompanied by accessory activities involving the speech apparatus, related or unrelated body structures or stereotyped speech utterance. These activities give the appearance of being speech related struggle.

3. Also, these are not infrequently (f) indication or reports of the presence of an emotional state ranging from a general condition of excitement or tension to more specific emotions of a negative nature such as fear, embarrassment, imitation or the like.

4. The immediate source of stuttering is same in co-ordination expressed in the peripheral speech mechanism. The ultimate cause is presently unknown and may be complex or compound. Extensive research has been conducted to investigate the etiology of stuttering. However, the etiology of stuttering is equivocal and several views prevail in this regard. While some consider is as organic,the other opine that it is learnt. Orton (1927), Travis (1931) and Bryngelson (1935) developed cerebral dominance theory according to which stuttering is attributed to inability to achieve the laterality which disturbs the synchronization of timing patterns from both hemispheres to their muscle groups. West (1943) views stuttering as a mild or latent form of **epileptiform** disorders called Pyknolepsy which could be precipitated by various kinds of stress or a mild form of sub-clinical cerebral palsy. Szondi (1932) and Seeman (1934, 1959) have called stuttering a neurogenic disorder.

The middle of 20th century saw the advent of many psychogenic views on stuttering. [Fenichel (1945), Johnson (1955), Shames and Sherick (1963)]. While Brutten and Shoemaker (1967) considered stuttering as a disorder of conditioned

disintegration, Bloodstein (1969) proposed anticipatory struggle hypothesis. However, the postulations of psychogenic theories of stuttering were not free of lacunae and hence lost attention.

In (1951) Lee and Black came out with interesting findings on subjecting the stutterers and non-stutterers to different delay (in-duration) in auditory feedback conditions. This was the evidence for the possibility of delayed auditory feedback mechanism in stutterers which leads to disfluencies.

Wingate (1969, 1970, 1976, 1984) has called stuttering as a prosodic disorder. This was based on the findings of significant relationship between stuttering and linguistic stress. Freeman and Ushijima (1978) reported some distinct patterns of laryngeal abnormalities in stutterers.

Review by Adams (1984), Peters (1987) unequivocally demonstrated slower speech reaction times in stutterers. The co-ordination between laryngeal and respiratory systems also seems to be diminished in stutterers. The perceptually fluent speech patterns of stutterers contain unusual patterns of air pressure build up [Peters and Boves (1987, 1988)]. EMG and EGG studies have shown abnormal laryngeal behaviour even in the perceptually fluent speech of stutterers (Freeman and Ushijima, 1978, Shapiro 1980; Van Lieshout, Peters, Hulstijin and Starkweather, 1988).

Peters and Starkweather (1990) have formulated hypotheses and suggested lines of research to explore the relationship

between motoric and linguistic function in stutterers. Previous research on speech physiology in stuttering has shown that both the fluent and the dysfluent speech of stutterers contain irregularities not found in the speech of nonstutterers. These irregularities occur within the individual motor subsystems involved in speech-respiration, phonation, and articulation - as well as in the co-ordination between these subsystems. The main findings can be summarized as follows :

1. As reviewed by Adams (1984) and Peters (1987), stutterers unequivocally demonstrate slower speech reaction times. These slower speech reaction times seem to result from a slower initiation of the speech movements themselves (Peters, Hulstijn, and Starkweather, 1989). Also the difference between stutterers and nonstutterers seen to be larger in longer and motorically more complex speech utterances (Peters et al; 1989).

2. Stutterers show a diminished capacity to co-ordinate respiratory movements with laryngeal adjustments during the onset of phonation. Recently, Peters and Bovis (1987, 1988) could demonstrate that in perceptually fluent speech, stutterers use unusual patterns of air pressure build up significantly more often than non-stutterers.

3. From experiments on laryngeal behaviour that use electromyographic (EMG), Electroglottographic (EGG) and fibroscopic technique, it can be concluded that there is abnormal laryngeal behaviour during perceptually fluent as

well as during dysfluent speech. This is evidenced by in appropriate abductory and/or abductory behaviour of the vocal folds during stuttering and high levels of muscle activity influent as well as dysfluent speech utterances (Freeman and Ushijima, 1978 ; Shapiro, 1980 ; Van Lie shout, Peters, Hulstijn and Starkweather, 1988).

4. From research on articulatory behavior, it can be concluded that in stutterer's perceptually fluent speech, the timing of articulatory movements shows a number of differences compared with that of non stutterers. Stutterers show a longer delay in the onset of movements (Caruso, Gracco and Abbs, 1987; Peters et al, 1989), longer transition times (Caruso et al, 1987 ; Zimmermann 1980 a, b) and longer steady state postures (Zimmermann, 1980 a, b).

5. The timing of articulatory and phonatory movements as measured in the various intervals in speech physiologic processes just before the onset of speech seems to be more variable in stutterers (Janssen, Wieneke, and Vaane, 1983; Watson and Alfonso, 1987).

The findings with regard to language and stuttering can be summarized as follows:

1. On the average, stuttering children are slightly but significantlys lower in the development of language skills than closely matched non-stuttering children (Kline and Starkweather, 1979, Wall, 1977) and score lower than nonstutterers on tests of language performance (Andrews et

al, 1983) although the possibility of this difference being a by-product of the fluency disorder cannot yet be completely ruled out. For example, it could be that children who have had some experience as stutterers choose briefer sentences with consequently simple constructions, which would lower their performance on language tests.

2. Children whose language development is delayed often begin to stutter as language emerges, often during treatment (Merits, Peterson and Reed, 1981). But it is difficult to reconcile this with the fact that some children clearly develop stuttering even though, perhaps even because, their language development is advanced (Starkweather, Gottwald,and Halfond, 1989).

3. Stuttering occurs more often at points in the utterance that can be described in Linguistic terms, specifically on words that are close to the beginning of the sentence (Wingate, 1976), on longer as compared to shorter utterances (Jayaram, 1984), and at major clause boundaries (Wall, Starkweather, and Cairns, 1981). One can describe these locations in Linguistic terms, but there are probably also alterations in the accuracy or the velocity of movement at the same locations, and this implies that these may well be larger amounts of motoric effort used to achieve the more demanding acoustic product.

4. Normal non-fluencies in young children occur more often on syntactically complex than on syntactically simple sentences

when and only when syntactic formulation precedes their production (Gordon, Luper, and Peterson, 1986), suggesting that the effort required to formulate sentences reduces fluency in normal young speakers.

Three hypotheses (Peters and Starkweather 1990) have been suggested that seem to account for these findings. These are:

1. "There are subgroups of stutterers such that one develops primarily out of motoric deficit while another develops it primarily out of a linguistic deficit".

2. Language and speech motor processes may interfere with one another during the act of talking, atleast in children, who are beginning to stutter. This interference hypothesis is based on research on non-stutterers which suggests that the simultaneous performance of language formulation and motor programming may result in deterioration of performance in one or both areas (Kinsbourne and Hicks, 1978). Such a hypothesis is suggestive for a number of reasons one of which is the explanation it offers for the location of stuttering between sentences.

3. "Competence and performance have different effects on fluency".

Peters and Starkweather (1990) opine that refined technical procedure in the assessment of stuttering have increased the understanding of the various factors that play a role in the

development of the stuttering. At the moment, therefore, one is much more familiar with the motoric and linguistic parameters he has to investigate in the assessment of stuttering behaviour. However, the number of tests presently available is very limited. Indeed it seems realistic to say that the assessment of stuttering is scarcely out of the egg.

New standardized methods should be developed in which a number of speech physiologic processes can be measured, especially during the early development of speech. It will be necessary to develop formal criteria, or norms for each measurement in such a test. The assessment of language functions seems to be more important than is widely recognized. A systematic assessment of phonologic, syntactic, semantic and pragmatic functions in language testing is often left undone because the importance of it is underestimated.

There are indications that linguistic or motoric defects may play an etiologic role. In the area of language it seems evident that attempts to improve the language skills of children need to be implemented in a way that minimizes pressure to perform and the motoric sequellae to the emotional changes that this pressure can induce. Even without pressure to perform, increased language performance is almost inevitably accompanied by increased motoric performance. Until we know more, it seems wisest in most cases simply not to attempt language remediation in children who show signs of stuttering. If, as in some cases, it seems worth the risk, then a particularly gentle form of language therapy needs to be implemented along with the kind of environmental changes

that have been found effective in reducing dysfluency in young children.

"The more interesting question is in the motor area. It is time we began to consider the usefulness of trying to develop the speech co-ordination of children who stutter not through endlessly asking them to say the word over again fluently, but instead through a systematic attempt to increase the ease with which speech movements can be made without increasing muscle mass or chronic tension" (Peters and Starkweather 1990).

The present study was planned to test the hypothesis that language and speech motor processes may show interference. This interference hypothesis requires two comparisons.

(a) Comparison of the interference effect of a language task on a simultaneous speech motor task with interference effect of a non-language cognitive task on simultaneous nonspeech motor performance and

(b) Comparison of the interference effect of a non speech motor task on simultaneous language performance.

Specifically interference of language task and speech motor task will be investigated in stuttering adults in the age group of 13 years and above and their scores would be compared with that of normal adults.

REVIEW OF LITERATURE

CHAPTER II

REVIEW OF LITERATURE

The challenge faced in attempting to integrate the numerous theoretical positions relating to stuttering with the practically countless number of experimental findings in this area is powerful indeed. In recent years, as the promises of behavioral and other explanations of stuttering have become less attractive, a number of new approaches to treating stuttering have reawakened interest, in Motor and Linguistic phenomenon. Stuttering has been viewed as a motor defect (Mackay, 1970, Van Riper, 1971; Adams, 1974, 1975b; Schwartz 1976, and Zimmerman, 1980).

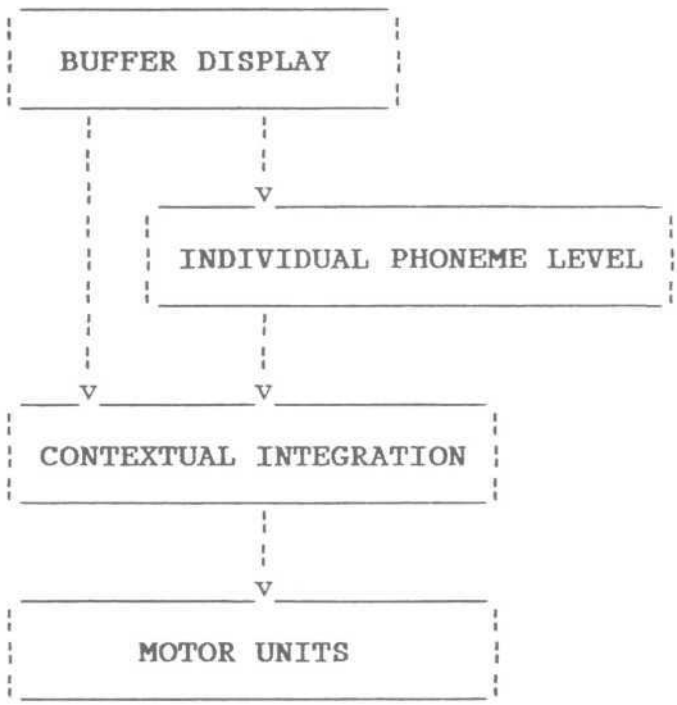
The primary purpose of this review is to summarize the available research on Linguistic and Motor aspects of stuttering and to assess the theoretical positions which have been helped to explore the relationship between motoric and linguistic function in stuttering. It is organized under the following subheadings.

I. Stuttering as a Motor defect.
II. Stuttering as a Linguistic disorder.
III. Stuttering as an Interaction of motor language processing.

I. STUTTERING AS A MOTOR DEFECT:

A. STUTTERING AS A DEFECT IN PHONETIC AND SYLLABIC CONTEXTUAL PROGRAMMING (MACKAY, 1970):

Mackay (1970) proposed a normal speech production model at the phonetic level which can account for pathological stuttering. According to him the model contains the following levels :



The model is composed of a "buffer system" which displays phonetic units in abstract form but in correct serial order. The buffer feeds into an "individual phoneme level" partially activating or "priming" a set of singly represented phonemic units which are unordered. The buffer also generates a set of programs for modifying the phonemes according to 'contextual constraints' These levels then feed into a motor unit level where

the contextual variants are coded. This model also has a scanner which passes over the partially primed units giving an additional boost of excitation. This brings the primed units to the threshold and a series of motor commands are sent to the appropriate speech musculature.

The authors account for the repetition in stuttering. For eg. In a word 'khak' where initial phoneme /k/ is stressed and following /k/ is unstressed, when the first unit is activated by the scanner, the other units are simultaneously inhibited. This is followed by the excitation of the second unit and the cycle continues for a period until damping occurs.

When two excitation peaks of either the first and second phoneme /k/ reaches the threshold, that phoneme is repeated and thus stuttering occurs. Mackay (1970a) and Mackay and Soderberg (1970c) suggest that the contextual programming model can also account for pathological stuttering in three ways :

MODEL - I Postulates that the preactivated level for stressed and unstressed units are normal but the motor unit threshold may be lowered in stutterers, thus resulting in stuttering.

MODEL - II Hypothesizes greater levels of hyperexcitability than normals thus leading to stuttering.

MODEL - III Postulates greater prepriming for stressed units, but normal threshold and normal excitation.

B. STUTTERING AS A DEFECT IN COARTICULATORY TIMING (VAN RIPER, 1971)

Van Riper (1971) defined stuttering behaviour as a "word improperly patterned in time and the speakers reaction there to". Like Wingate, Van Riper opines that stuttering reflects a breakdown primarily at the level of the syllable. The hypothesizes that the stability of motor patterns which maintain the integrity of syllables is somehow lacking in stutterers, which could be due to overreliance on auditory feedback for speech control rather than on the tactile Kinesthetic proprioceptive feed back. In addition, stutterers are unable to time or integrate long motor sequences. Van Riper also takes into account the physiological difficulties such as defective breathing, voicing and articulation which could lead to the speech deficiencies.

The combined result of these short comings is the core of stuttering behaviours syllabic repetition, sound prolongations, silent articulatory postures and phonatory arrests. Though Van. Riper's model considers syllable as an important locus of stuttering, he also reports of increase in stuttering for other Linguistic factors such as word length, word position, information load and initial sound.

Evaluated in the light of research on the motor abilities of stutterers, van Riper model fares well. A defect in timing may explain some of the problems stutterers may have in maintaining rhythmic repetitions of various speech and non-speech tasks.

While it is consistent with almost all of research on respiratory, phonatory and articulatory abilities of stutterers its major flaw is its lack of specificity.

C. STUTTERING AS A DEFECT IN AIRFLOW AND VOCALIZATION (Adams, 1974)

Adams (1974, 1975b) described stuttering as a defect in airflow and vocalization. Adams has viewed irregularities in respiration and phonation as primary coping strategies while articulatory irregularities are seen as secondary coping strategies. According to him stuttering is seen as a breakdown in timing, smooth initiation and maintenance of exhalation and voicing. When such breakdowns occur the speaker either repeats the same articulatory gesture or prolongs the articulatory posture being attempted. In order for voicing to occur, subglottal air pressure must exceed supraglottal air pressure and be able to overcome the resistance imposed by the glottis itself.

Adams states that insufficient subglottal air pressure in stutterers is caused by any, or all, of the following respiratory irregularities :

1. Fixations, or passive and active forces of inhalation and exhalation occurring simultaneously ;
2. Mistiming, or exhalations interrupted by short inspiratory gasps;
3. Shallow breathing, or insufficient inhalations and/or exhalations;

4. Asynchronous respiratory movements, or antagonistic movements between the thorax and abdomen; and

5. Respiratory tremors or diaphragmatic flutter.

Excessive supraglottal air presure in stutterers is usually caused by the secondary coping strategies in the upper articulators. When this happens, compensatory activity in the expiratory musculature is called for. Without this, constrictions or blockages of the airflow by the tongue or lips raise the supraglottal air pressure above the level of subglottal air pressure and cause cessation of phonation. Excessive glottal resistance is attributed either to excessive stiffness within the vocal folds or to completely abducted folds prior to phonation.

Adam's model accounts for the fact that supraglottal air pressure is excessive during the stuttering (Hutchinson, 1975; Hutchinson and Navarre, 1977) and the fluent speech of stutterers (Agnello and Wingate, 1971).

It seems reasonable to speculate that the delayed voice onset and difficulty in shifting from voiceless to voiced sounds in stutterers is due to excessive glotal stiffness. Thus the model is consistent with the data on phonatory abilities of stutterees.

Adam's model, in general, is not inconsistent with articulatory data. However, there is no definitive evidence yet

to conclude that articulatory disturbances are secondary to respiratory and phonatory breakdown.

D. STUTTERING AS A LEARNED EXCITORY RESPONSE TO A LARYNGEAL ABDUCTOR REFLEX (Schwartz 1976)

Schwartz (1976) stated that the core of the stuttering block is the "tendency, under conditions of psychological stress for the loss of supramedullar, inhibition controls upon the PCA in the presence of subglottal air pressure associated with speech" (Schwarts, 1975b). Central to the model is an "airway dilation reflex" (ADR) which flares the nostrils, moves the body of the tongue forward, dilates the pharynx, and abducts the glottis.

The ADR is normally active when there is blockage of the airway or a need for greater than normal air volume, as for yawning, sighing or coughing. According to Schwartz, ADR is mediated by the medulla. During normal speech, subglotal pressure is elevated, but the ADR is not elicited because of inhibition of medullary centers by higher centers.

During periods of psychological stress, however, this inhibition breaksdown and the ADR is elicited. This causes the PCA to contract thus rendering phonation impossible. The speaker who finds himself unable to phonate may also attempt to "do battle supraglottally" by tensing the lips, tongue or jaw. Overt stuttering thus consists of learned excitatory behaviour.

Schwartz model of stuttering has been criticized on its scientific accuracy, logic and explanatory power (Freeman,

Ushjima and Hirose, 1975 ; Zimmerman and Allen, 1975). It does not account for the linguistic findings of stuttering. It does not predict any general motor co-ordination deficit in stutterers.

E. STUTTERING AS TENSION AND FRAGMENTATION (Bloodstein,1958)

Bloodstein has explained stuttering in terms of an anticipatory struggle reaction(Bloodstein, 1958). However, in recent years he has increasingly considered the two additional notions of tension and fragmentation (Bloodstein, 1969, 1974, 1975a, 1975b).

Tension typically produces prolongations of continuant sounds or hard attacks of stop consonants. In the latter case, the stop phase of the consonant is prolonged, presumably with a high degree of intra-oral air pressure, followed by a greater than normal explosion of air and onset of voicing. This combination of factors results in a notably hard glottal attack. Tension can also result in complete stoppage of the airstream from an excessively tense and prolonged stop phase of a consonant or from an attempt to vocalize with a tightly closed glottis. Such stoppages are probably typical only of severe stutterers (Van Riper, 1971).

The result of fragmentation depends on the speakers conception of the locus of difficulty in speech. Early or mild stutterers probably are only vaguely aware of where their difficulties lie; therefore, they tend to fragment natural syntactic units such as phrases, clauses, or sentences. The

result is repetition of the first word of the syntactic unit. Rarely do these repetitions occur in the middle or at the end of a syntactic unit.

The shift of focus from syntactic units to words which takes place somewhere around the early elementary years may explain why most of the studies conducted with adults speaking spontaneously have yielded different results than the vast majority with sampled oral reading (Hannah and Gardner, 1968 ; Lanyon 1969).

The tension aspect of the model appears consistent with much of the research using electromyography. The data consistently indicate higher levels of muscle activity during stuttering than during fluency.

The major weakness of the tension and fragmentation model is that it does not satisfactory explain why speech becomes fragmented. The only support given for this hypothesis that "getting started" in speech involves a more complex motor plan than continuing or finishing an utterance,is the observation that people seem to have the greatest difficulty in getting started in several fine motor skills. While bloodstein is probably correct in this supposition, an explanation of why getting started is difficult is not provided.

II. STUTTERING AS A LINGUISTIC DISORDER

A. STUTTERING AS A DEFECT IN PROSODIC TRANSITION TO STRESSED SYLLABLES (Wingate, 1980)

Wingate (1969 b) described stuttering as a "phonetic transition defect", or a problem not of producing one sound but of generating the appropriate transitions from one sound to the next. He also describes stuttering as a "Prosodic defect" manifested as "an intermittent disorder of actualizing stress increase" (Wingate, 1976), Combining terms in his early and later formulations, Wingates view of stuttering might be termed a defect in prosodic transition to stressed syllables.

"Prosodic" refers to the various suprasegmental features such as juncture, intonation patterns, and stress (or accent) changes which cut across the typical phonetic segments. "Transition" defect still implies that stuttering is a problem of movement between sounds rather than stuttering "on" a sound. "To" means that the problem in stuttering occurs in transitions toward not away from the next sound. "Stressed syllable" refers to the fact that stuttering is most inevitably associated with syllable production, notably in production of the vowel in each syllable. Vowels carry considerably more acoustic energy than consonants and the primary source of that acoustic energy is phonation. Further more, the effort required for vowel production is magnified in stressed syllables, and these syllables are most likely to be stuttered.

Stuttering results from both linguistic and motoric difficulties both of which interact to produce the stutterers intermittent inability to "actualize" the vowels of stressed syllables. Observable stuttering symptoms are audible or silent prolongation of segments of one syllable or less in length.

Wingates prosodic transition model of stuttering is not inconsistent with most of the data on voice onset and voicing irregularities of stutterers.

In order to explain the fact that stuttering mostly occurs on the initial syllable of words, Mingate (1976) cited evidence that about 80% of most frequently used English words have primary stress on the first syllable. The predominance of stuttering on consonants versus vowels is also viewed as an artifact of the frequency of sound in the language. Wingate(1976) states that the factors of initial word position and consonant vowel effects are artifacts of:

i) the frequency of occurrence of stressed syllables in the initial word position, and

ii) the frequency with which English word begin with consonants.

Wingates model of stuttering is consistent with most of the data on voice onset and voicing irregularities of stutterers, and also with the articulatory data on stutterers. Fine motor abilities, temporal speech characteristics and respiratory abilities, are not considered within the model.

Wingates observations are particularly interesting when the loci of stuttered events and so called "slips of the tongue", or segmental speech errors. are compared. Both stuttering and segmental errors tend to occur at the same locations among and within syllables in connected speech (Mackay, 1970, 1987). Because segmental errors are believed to reveal the normal processes associated with speech encoding, it is reasonable to speculate that stutter events, as well as segmental errors may reflect a breakdown of these processes.

Recently, three theories have been proposed citing inadequate formulation of linguistic structure as a potential source factor of stutter events. Wingate (1988) states that stuttering represents " a lack of proper synchrony of linguistic elements" in terms of "utterance planning". He suggests that mistiming occurs not only within "the word, its retrieval, and its assembly", but also across words that are pivotal elements" for utterance assembly. He suggests that "stuttering is a defect in the language production system, a defect that extends beyond the level of motor execution".

B. STUTTERING AS A DISORDER IN LANGUAGE SYSTEMS AND PROCESSING (Hamre, 1976)

According to Hamre (1976) stuttering is a problem of speech programming and production. This also indicates that stuttering is a problem at two levels; a Linguistic level termed " Languages system and a Psychophysiological level termed "Language processing".

Because of the phonological problem involving segments and prosody, stutterers show impairment in using both context, sensitive rules and context free rules. Here, "context-sensitive" is intended to indicate that the rules contain interdependencies among the variables, as in the case of later occuring sounds influencing the production of earlier sounds. "Context-free" rules contain no inter-dependencies among the variables, and here stutterer may stutter on words beginning with any particular sound but, by itself.

He also states that, if stuttering increases in severity, it begins to influence, or be influenced by, variables at other levels. For eg, an usually severe instance of stuttering may affect the speakers ability to generate appropriate syntax and/or his ability to perceive sensory stimuli. It also predicts that the most significant linguistic problems in stuttering will be found in the area of phonology rather than morphology or syntax.

The following Linguistic variables have been studied by various investigators and are said to be related to the moments of stuttering.

1. Grammatical function.
2. Propositionality or Information load.
3. Phonemic characteristics.
4. Sentence length.
5. Word Length.
6. Word Position in a sentence.
7. Word Frequency.

1) Grammatical Function and Stuttering:

Brown (1937) was the first person to study stuttering from a grammatical stand point. The result of several investigation suggest that instance of disfluency may not be distributed at random in the speech of non-stutterers Mackay and Osgood (1959) reported that the instance of disfluency tend to be associated with lexical than functional words. Stuttering is more on content words compared to function words. (Nicol & Miller, 1959).

2) Propositionality, Information Load and Stuttering:

It refers to the meaningfulness of the material as related to stuttering. Brown (1937) showed that in oral reading adult stutterers tended to have most of their difficulty on the part of speech which are more important for conveying informatiorn or meaning i.e., nouns, adjectives, verbs and adverbs. This was also agreed upon by Hahn (1942); Eisenson & Horowitz (1945), Bluemel (1957) and Bloodstein (1958).

3) Phonemic Characteristics and Stuttering:

Whether stuttering will occur or not seem to depend on the characteristics of the first sound of the word or the first sound of the syllable (Van Riper, 1971). In 1946, Sheehan recorded twenty five consecutive stutterings from each of twenty adult stutterers. Ninety-six percent of the stutterings occured on initial sound (Sheehan, 1974).

Wingate (1976, 1977) reported that the consonant vowel effect is an artifact of the frequency of occurrence of consonants and vowels as word initiating sounds. In a study (Wingate 1973) in which four lists of the one thousand most frequently spoken words of English were analyzed he found that 81% of all words began with consonants.

4) Sentence Length and Stuttering:

Bloodstein (1975) made use of 20 pairs of sentences, one set with short sentences and the other set had long sentences. Significantly more stuttering was found on the same words when they served as the initial segments of long sentences than when they stood alone as short sentences. The results seem to give evidence of the role of motor planning, or anticipated motor complexity in stuttering.

5) Word length and Stuttering:

Most of the research indicates that the longer words are stuttered more frequently than the short ones whether measured by number of syllables or number of letters (Brown, 1938, 1945; Brown & Moven,1942, Milisen, 1938; Hejna, 1955; Soderberg, 1966, 1975; Taylor 1966; Wingate, 1967; Lanyun 1964; Silverman, 1972 and Danzper & Halpner, 1973).

6) Word Position in a Sentences and Stuttering:

Taylor (1966 b) showed that word position was a more important determiner of the loci of stuttering than either the

length of the word or the phonetic characteristics of the syllables.

It was also found that more stuttering occured in initial word clauses than on subsequent words even though initial words were more typically the function words and pronouns while final words were more often the lexical class (Soderberg, 1967).

7) Word Frequence and Stuttering:

Danzger and Halpern (1973) observed stuttering to be affected by frequency usage of words. Studies that followed revealed a high coincidence of stuttering events with words that are less familiar (Soderberg, 1966; Schlesinger, Milkman & Levy, 1966; Rouson, 1976).

Numerous other studies also explain stuttering as a language disorder. Ratner & Sih (1957) studied the effects of utterance length and task complexity in normal and stuttering children. Both groups showed fluency breakdown as they imitated sentences with gradual increase in syntactic complexity and length.

Ratner & Sih proposed that non-fluencies occur when children are pressed to produce utterance beyond their linguistic capacity. Stocks & Usprich (1983) studied learning aspects of stuttering and reported that stuttering children stuttered more frequently and had increase in disfluences as the level of language demand increased.

Kathryn (1989) evaluated respictive and expressive language age equivalency scores for sixteen stutterers (5-9 years) to determine if differences exist between these skills of young stutters. The findings that young stutterers were not delayed in their receptive language skills, but were delayed in their expressive language skills, was interpreted as support for the hypothesis that language deficits observed in stuttering children result from their attempts to specify verbal responses as a means of coping with their stuttering.

The most recent explanation based upon the language aspects for the etiology of stuttering has been the demand and capacity model by Adams (1991). According to Adams, fluency breaks down when environment and self imposed demands exceed the speakers cognitive, linguistic, motoric and or emotional capacities for responding. The idea for organizing the data into two major categories-demands for fluency and capacities for fluency developed as the solution to a puzzling combination of facts about the role of language in the development ot stuttering.

According to Adams (1991) this demand for language performance strains the child's learning capacity, but more importantly they also strain the child's motor capacity in two different ways. First, language and motor performance occur at the same time during speech production so central nervous system processing for learning may detract from motor performance (Kinsbourne, 1971). Second, the longer words and sentences that are inherent in more complex learning, require a more complex motor plan (Peters, Hulstijn & Starkweather, 1989) and are also

executed more quickly than the words and sentences of simpler learning (Amster, 1984). So asking for more complex learning ability, as in language therapy, or at the high end of learning ability, as with the superior child, is motorically, as well as linguistically demanding. In both cases the discrepancy between the demand and the capacity for performance is similar and may cause disfluency in speech.

Conveying evidence support that stuttering is associated with deficits in the planning and execution of speech. And the evidence also suggests that the onset, development and occurrence of stuttering may be related to demands that learning places on speech motor planning and execution.

III. STUTTERING AS A DISORDER CAUSED DUE TO INTERACTION OF MOTORIC AND LANGUAGE PROCESSING:

In the last few years, approaches to stuttering whether for theory construction or therapy have tended to focus either on motoric or linguistic factors. It is quite clear at a descriptive level that stutterers young and old, produce speech in a way that is motorically aberrant, but this fact does not lead very obviously in any therapeutic direction.

Peters and Starkweather (1990) have explored the relationship between motoric and linguistic function in stutterers in order to derive suggestions for therapy and to develop new research hypotheses.

III. Competence and performance have different effects on fluency. Higher levels of languages competence (knowledge) could hinder fluency by creating a large lexicon and a greater availability of syntactic forms from which to choose words and formulate sentences. Higher levels of performance skill, however such as word finding and sentence construction can only improve fluency by increasing the rate at which language performance is executed. In this way, the child with advanced linguistic knowledge may run an increased risk of stuttering because he or she lacks the motor skill to execute fluently the sentence, but knows how to construct. While the child whose language is delayed, although not hindered by a large vocabulary or syntactic variation, might find words even from a small lexicon or to construct even simple sentences and perform motor activity, at the same time.

An effort was made by Deepa (1994) and Nandakumar (1994) to test the hypothesis that language and speech motor process may interfere with one another during the act of speaking. Roth the studies showed similar results. Deepa (1994) took fifteen stutterers and fifteen normals in the age range of 6-9 years while Nandakumar (1994) conducted the study with an equal number of subjects in the age range of 9-12 years.

The tasks selected for their studies were

a) Task I : interference between language and speech motor task (subject had to perform pointing to the picture, the name of which was heard through headphones and to simultaneously say papapa....);

b) Task II : interference between language and non-speech motor task (subjects had to perform pointing to the picture, the name of which was heard through headphones and to simultaneously tap their foot) and

c) Task III : interference between cognitive and non-speech Motor task (subjects had to complete a puzzle and simultaneously tap their foot).

First, in both the studies the difference in the performance of stuttering vs normal was significant only for Task I. Stuttering children showed an interference between language and speech motor act. No significant differences were obtained between the scores of stuttering and normal children on Task II and Task III i.e., no interference was found between non-speech motor and language and non-speech motor and cognitive tasks.

The results of this study support the hypothesis of Starkweather that, "Language and speech motor processes may interfere with one another during the act of talking at least in children who are beginning to stutter (Peters & Starkweather, 1990)".

Second, males performed better than females. The reason attributed was that it might be because the number of males were more than that of females in the studies and thus better average scores for the males. Third, on comparison of the two studies, it was found that the performance of stutterers improved on Task I as the age progresse. Lesser amount of interference between the language and the speech motor act was seen with the increase in age. This was attributed to physiological maturation. Generally the performance of stuttering children was better on Task II i.e., least interference was observed between language task and non-speech motor task, followed by Task III and Task I.

Also, in both the studies the scores on speech motor task and language task indicated that while the children obtained very low scores on speech motor tasks, it was not so on language task. This finding indicates that the possibility of occurrence of the sub-groups of stutterers with motoric deficit may be more than the other sub-groups.

The present study was planned to test the interference of language and speech motor tasks in stuttering and normal adults in the age group of 13 years and above.

CHAPTER III

METHODOLOGY

SUBJECTS:

Thirty four adult stutterers and thirty four normal adults served as subjects. The adult stutterers had normal intelligence as assessed by a psychologist and were diagnosed to have stuttering and had normal language level as assessed by a speech language pathologist. They did not have any history of misarticulation or any other speech and hearing problems.

The normal adults were matched for age and sex for stuttering adults. Table I depicts the subject details.

AGE RANGE IN YEARS	STUTTERING ADULTS MALES	NORMAL ADULTS MALES
13 - 15	7	7
15 – 25	23	23
26 – 35	3	3
35 – 45	1	1

Table I : Details of subjects

MATERIAL:

Three tasks; interference between language and speech motor task, interference between language and non-speech motor task,

interference between cognitive and non-speech motor task were selected. For task I and task II, sixteen picturable meaningful Kannada words were selected [the material was taken from the study of Deepa (1994) and Nandakumar (1994)].

These sixteen words were categorized under :

a) four nouns

b) four adjectives

c) four transitive verbs

d) four intransitive verbs.

The materials for task I and task II are presented in Table II.

SL.NO	NOUNS	ADJECTIVES	TRANSITIVE VERBS	INTRANSITIVE VERBS
1	mi:se (Maustache)	bili (White)	bari (Writing)	da:ns (dancing)
2	ca:ku (knife)	haladi (yellow)	ujju (brushing)	o:du (running)
3	pa:tre (vessel)	kempu (red)	o:du (reading)	nagu (coughing)
4	Ka:lu (leg)	braun (brown)	ogi (washing)	*alu (crying)

* Keywords

Table II : Material for Task I and II

The four Kannada words (Keywords) as uttered by adult normal female were audio recorded on a cassette with an interstimulus

FIG NO: 1 Puzzle for Task. III

interval of five seconds which formed the material. Four sets of pictures were made, each set consisting of one noun, one adjective, one intransitive verb and one transitive verb.

For task III, puzzle was used which the adult had to arrange, depending on the model given (Fig.l). It was expected that if the interference between language and speech motor task is present in adult stutterers, they would perform poorly on task I but not on task II and III.

METHOD:

The subjects were tested individually. They were seated comfortably in a quiet place and the audio material was presented through the headphones. The subjects were instructed to listen to the words through the headphones and were to point out to the appropriate picture representing the word in the set of four pictures placed in front of them. While doing this they were instructed to simultaneously, and continuously say "papa papa . . . . . " for task I. In task II the same method was followed but here the subjects had to simultaneously and continuously tap his right foot.

In task III the subject was provided with a puzzle and he was instructed to complete the puzzle by referring to the model. While doing so he was to simultaneously and continuously tap his right foot.

SCORING:

These responses were recorded on a response sheet

(Appendix - I) by the experimenter and a scoring system was adopted. A score of 1' was given if the subject was able to perform the test and a score of 'o' was given when the subject was unable to perform the task (unable to point to appropriate picture or unable to tap foot correctly or unable to repeat "papa. ___papa . . . . ." continuously or interrupting the task by either stopping, repeating initial syllables or prolonging it).

The total score on each task was computed for each subject and paired 't' test was administered to find out the significance of the difference between tasks and between normals and stutterers.

RESULTS & DISCUSSION

CHAPTER IV

RESULTS AND DISCUSSION

1. Performance of the subjects on all the three tasks:

In general the difference in the performance of stutterers and normals was significant for Task I and Task III (Table III). On Task I, while stuttering subjects scored 94.8%, normal subjects scored 99.6%. Totally twenty four adult stutterers scored 100%, six had 87.5% and four scored 75%. On Task III, there was a significant difference with stutterers obtaining 58.8% and normals scoring 91.1%. Among the stutterers six scored 100%, twenty eight subjects scored 50% In Normals scores were reversed with twenty eight subjects scoring 100% and six 50%.

On Task II, twentyone stuttering subjects had 100%, ten 87.5%, two 75% and one subject scored 50%. Among the normals twenty two obtained 100% scores and twelve 87.5%. But the differences were not statistically significant.

It was very interesting to note that the Adult stutterers showed interference in both, cognitive and non-speech motor tasks which contradicts the hypothesis.

TASK	SUBJECTS	NO.	%AGE	t value	P	S / NS At(0.05 level)
I	NORMALS	34	99.6	3.016	0.0049	S
	STUTTERERS	34	94.8			
II	NORMALS	34	95.5	1.0627	0.2956	NS
	STUTTERERS	34	93.3			
, III	NORMALS	34	91.1	6.699	0.0	S
	STUTTERERS	34	58.8			

Table III : Performance of the subjects on all the three tasks

Key : S -> Significant

NS -> Non-Significant.

TASK	PERFORMANCE IN %AGE	INTER-TASK COMPARISON	t value	P	S / NS at 0.05
I	94.8	I vs II	0.6433	0.5245	Ns
II	93.3	II vs III	43.6942	0.0	S
III	58.8	I vs III	41.9943	0.0	S

Table IV : Inter task comparison of stuttering adults

III. Performance on various tests of the tasks :

Performance of stuttering subjects was poorer than that of normals on all the tasks except for the language tasks, where there was not much difference between the two groups.

While normals obtained 100% score in language task and cognition, stuttering adults did not obtain 100% score in any of three tasks. While both the normals and stutterers performed better in language and cognition task,their performance was poor in the motor task indicating an interference between language and motor tasks and cognitive and motor task. Also, the difference between normals and stuttering adults was more in the motor task especially in non-speech motor task.

SUBJECTS	LANGUAGE	SPEECH MOTOR	NON-SPEECH MOTOR	COGNITIVE TASK
NORMALS	100 %	99.21 %	89.41 %	100 %
STUTTERERS	97.79 %	91.91 %	74.7 %	94.11 %

Table V : Performance on various tests of the tasks

IV. Intertest comparison of stuttering adults on each task:

The results of paired t' test indicate significant difference (at 0.01 level) between the two tests of task III, i.e., conginitive test and non-speech Motor test. No significant difference was obtained between the tests of language and speech motor (Task I) or language and non-speech motor test (Task II).

TASKS	SUBJECTS	t value	P value	S / NS (0.01 level)
I	LANGUAGE SPEECH MOTOR	2.264	0.0303	NS
II	LANGUAGE MOTOR	2.1669	0.0376	NS
III	COGNITION NON SPEECH	10.35616	0.0	S

Table VI : Intertest comparison of stutteruson on each task

V. Individual variations among the Adult stutterers:

Analysis of individual variations among the adult stutterers reveal that performance was best for the language test of Task I and cognitive test of Task III. This was, followed by the Language test of Task II and the speech motor task of Task I and non-speech motor test of Task II. Results indicated poor performance on the non-speech motor test of Task III. In task I

three subjects exhibited poor performance on Language task, nine subjects exhibited poor performance on speech-motor task. This indicates that the subgroup of stuttering with motoric deficit occur more than Stuttering with language deficit. Table VII given below shows the scores in percent.

	TASK I NO. OF SUBJECTS		TASK II NO. OFSUBJECTS		TASK III NO.OF SUBJECTS	
SCORES	LANGUAGE	SPEECH MOTOR	LANGUAGE	NON SPEECH MOTOR	COGNITIVE TEST	NON SPEECH MOTOR
100%	31	25	32	23	32	6
75%	3	7	19			
50%		2	1			
0%				1	2	28

Table VII : Individual variations among the stutterers

DISCUSSION

The results reveal several points of interest. First of all stutterers performance was poor on Task III.There was no significant difference between the scores of stutterering and normal adults on Task II. While the percent scores of stutterers on Task III was 58.8%, score for normals was 91.1%. For task I, score for stutterers was 94.8% and that of normals it was 99.6%.These suggest that stutterers have difficulty performing speech motor and language tasks and non-speech motor and cognitive tasks. The results of this study support the hypothesis of Peters and Starkweather, 1990, that "Language and speech motor processes may interfere with one another".

On comparison with the studies of Deepa (1994) and Nandakumar (1994) conducted on stuttering children it was found that adult stutterers and stuttering children do not show similar performance. The results of the study by Deepa (1994) and Nandakumar (1994) indicated that stutterers performed poorly on Task I and there were no significant difference between the scores of stutterers and normal children on Task II and Task III. The comparison of the results obtained in these previous studies with the present study has been compiled in table VIII. A comparison reveals that while the child stutterers perform poorly on Task I adult stutterers do better. The performance in stutterers improve as age advances which could be attributed to physiological maturation.

STUDIES	TASK I NORMALS STUTTERERS	TASK II NORMALS!STUTTERERS	TASK III NORMALS STUTTERERS
DEEPA (1994)	96 % ! 53 % S	NO SIGNIFICANT DIFFERENCE	NO SIGNIFICANT DIFFERENCE
NANDA KUMAR (1994)	96.8% ! 55.8% S	NO SIGNIFICANT DIFFERENCE	NO SIGNIFICANT DIFFERENCE
PRESENT STUDY	99.6% i 94.8% SIGNIFICANT DIFFERENCE	NO SIGNIFICANT DIFFERENCE	91.1% ! 58.8% S

Table VIII : Comparison of the three studies

Secondly, intertest comparison of stuttering adults indicate significant difference only for Task III. i.e, Stutterers show an interference between the cognition and the non-speech motor task. No significant difference was obtained for the subjects of task I and II. On comparison with the result of the studies by Deepa (1994) and Nandakumar (1994) which reveal an interference between the language and speech motor act it can be concluded that as the age progresses the interference between the language and speech motor act reduces but the interference between congition and motor task becomes apparent.

Third, the scores on motor (speech and Non-speech) tasks, language tasks and cognitive task indicate that while the stuttering subjects obtained low scores on motor tasks, it was not so for the language task or for the cognitive task. This

finding supports the possibility of occurrence of the sub-groups of stutterers with motoric deficit may be more than the other sub-groups. It would be possible to use these tasks as a test to find out the interference between speech motor and language tasks in stutterers. Further, the test could be administered to other stuttering individuals both males and females to find out the interference along with purely language tasks and purely speech motor tasks. If found poor on language task, language could be improved and if found poor on speech motor task speech-motor task could be worked on. Also, if poor scores are obtained for the interection of cognitive test and motor test then the simultaneous execution of the two could be worked upon. The study reveals an interference of language on simultaneous speech-motor task and interference of non-language cognitive task on simultaneous non-speech task. However, the interference of language on simultaneous speech motor task in adult stutterers is very low compared to stuttering children and the interference of non-language cognitive task on simultaneous non-speech task is significantly higher in adult stutterers when compared to stuttering children. Also, it supports the hypothesis that there are subgroups (Linguistic and Motoric) of stutterers.

SUMMARY AND CONCLUSION

CHAPTER V

SUMMARY AND CONCLUSION

This study was aimed at verifying the hypothesis that "Language and speech motor processes may interfere with one another during the act of talking in stutterers". Thirty four adult stutterers and thirty four adult normals in and above 13 years of age were investigated on three tasks specifically designed to test the following :

1. Language and speech motor processes interference.
2. Language and non-speech motor processes interference.
3. Non-speech motor and cognitive processes interference.

For task I, the stimulus words were presented through headphones, the subjects were required to point to the appropriate picture from a set of four presented before them. While listening for the stimulus word and pointing to the appropriate picture, the subjects had to continuously say papa' (speech motor task). For Task II, the pointing response remained the same but instead of saying papa', the subjects had to continuously tap their right foot (non-speech motor task). For Task III, the subjects had to complete a puzzle, while continuously tapping their right foot (non-speech motor task). It was expected that if the Hypothesis is true the adult stutterers would perform poorly on Task-I but not on Task II and III.

The subjects were given a score of '1' if they could point to the right picture and 'o' indicated failure. Also, the subjects scored 1' if they said papa'/tapped continuously and 'o' if there was any repetition, prolongation, pause etc. While saying 'papa', Task II was scored similarly. For Task III, completion of puzzle earned the subjects a score of 1' and failure 'o' . For foot-tapping (Continuity earned a score of 1) and any stoppage earned a score of o'.

The results were analysed using paired 't' test. The percentage of scores obtained by subjects on each task was calculated and was analyzed.

The results indicated that while there was significant interference of language and speech motor task and of cognition and non-speech motor task in adult stutterers it was not so in normals. The result that there was interference between cognitive and non-speech motor task was striking and was uncalled for. On comparing the present study with that of Deepa (1994) and Nandakumar (1994) it was observed that the score in Task-I improved in stutterers as age progresses while scores of Task III showed a decline.

Also, the scores on non-speech motor and speech motor tasks and language task indicate that while stuttering adults obtained very less scores on motor tasks, it was not so on language task. This was observed among most of the stuttering individuals in the present study. This finding indicates that the possibility of

occurrence of the sub-groups of stuttering with motoric deficit was higher than stuttering with language deficits.

The test could be administered to stuttering adults to find out the interference along with purely language tasks and purely speech motor tasks. If found poor on language task language could be worked on and if found poor on speech motor task, it could be improved.

As the time and sources for the study were limited, female stutterers were not available in the investigation. It would be interesting to learn more about how the various sub-groups (males and females) of stutterers would perform on this test. It is recommended that this test could be used clinically for sub-grouping stuttering and further to use it for therapy.

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APPENDIX

APPENDIX

SCORE SHEET

NAME : LANGUAGE :

AGE : HANDEDNESS :

SEX : OCCUPATION :

SL.NO.	LANGUAGE TASK	SPEECH-MOTOR TASK	SCORES
1. 2. 3. 4.			
SL.NO.	LANGUAGE TASK	NON SPEECH-MOTOR TASK	
1. 2. 3. 4.	COGNITIVE TASK	NON SPEECH-MOTOR TASK	