PHONOLOGICAL PROCESSES IN DEVELOPMENTAL APRAXIA OF SPEECH : A CASE STUDY

REGISTER NO. M 9908

A dissertation submitted in part fulfillment of the Second year M.Sc. (Speech and Hearing), University of Mysore, Mysore.

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MAY, 2001

Dedicated

to

Papa & Mummy

For being such

wonderful parents

my cute sisters

Jasmine & Sonia

&

my loving husband

Sugata

Certificate

This is to certify that this dissertation entitled *"Phonological Processes in Developmental Apraxia of Speech : A case study"* is the bonafide work in part fulfillment for the degree of Master of Science (Speech & Hearing) of the student (Register No. M 9908).

Mysore,
May, 2001

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Certificate

This is to certify that this dissertation entitled *"Phonological Processes in Developmental Apraxia of Speech : A case study"* has been prepared under my supervision and guidance. It is also certified that this has not been submitted earlier in any University for the award of any other Diploma or Degree.

Mysore,

May, 2001 Guide

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Declaration

This dissertation entitled *"Phonological Processes in Developmental Apraxia of Speech ,' A case study"* is the result of my own study under the guidance of Dr.R. Manjula, Lecturer, Department of Speech Pathology, All India Institute of Speech & Hearing, Mysore, and has not been submitted earlier in any University for the award of any other Diploma or Degree.

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INTRODUCTION

Developmental apraxia of speech (DAS) is a controversial diagnostic label in the literature on communication disorders, despite the fact that the first case was described over a century ago by Hadden, (1891).

Morley (1965) defined DAS as "A defect of articulation which occurrs when movements of the muscles used for speech appear normal for involuntary and spontaneous movements, or even for voluntary imitation of movements, but are inadequate for the complex and rapid movements used for articulation and reproduction of sequences of sounds used in speech".

Edwards (1984) has argued that two possible levels of breakdown in speech production may account for the speech errors in DAS 1) a phonetic breakdown at the level of the vocal tract and 2) a phonological breakdown at the level of linguistic planning.

A breakdown at the level of the vocal tract could result in inconsistent respiration, voicing, prosody, resonance and articulation (Snowling and Stackhouse, 1992). The second, the phonological level of breakdown is being examined in recent studies using phonological analysis. *)*

(Phonological characteristics reported in younger children with DAS were, high vowel to consonant ratios, simplification error , reduplications and final consonant inclusions. Older children used metathesis, omissions and

simplification of blends (Aram and Glasson, 1979). Adams (1992) and Pollock and Hall (1991) also reported of frequent metathetic errors in DAS.

Crary (1984b) studied 13 phonological processes and all the subjects with DAS exhibited tne processes of final consonant deletion(FCD), initial consonant deletion (ICD), cluster reduction (CR) and stopping. CR was the most frequently occurring process. Prevocalic voicing (PVV), stopping , deletion of initial consonant demonstrated the highest correlation with chronological age and/or receptive language age of DAS children. On the contrary deletion of final consonant demonstrated the highest correlation with the expressive language of DAS children. In another study by Parsons (1984) CR and FCD were the most frequently used processes by both DAS and phonologically impaired children and these groups differed significantly only on epinthesis and backing. Bowman, Parsons, and Morris (1984) found that the most frequently used process was CR followed by liquid simplification, stopping, glottal replacement, FCD , fronting, devoicing, epinthesis, PW, nasal assimilation, denasalization and nasalization. In 1989, Betsworth and Hall, studied five subjects with DAS and found all five to use CR and gliding as well as idiosyncratic processes.

Based on the review of literature, it can be inferred that DAS children as a group exhibit natural as well as idiosyncratic processes. Klein (1996) has also commented that DAS and phonological disorder could be the same disorder because he found that children with DAS who were resistant to traditional therapy, improved on using phonologically based intervention.

Moreover, in most of the western studies a group of processes were selected, to study their presence in the DAS and other phonologically disordered or normal children. Based on the studies in normal and disordered children, the processes can be categorised as natural or normal processes and unusual or idiosyncratic processes.

'But, in Indian languages, especially Kannada, there is dearth of studies on phonological processes and its developmental trend. This is true not only for the normally developing children but more so for the disordered group. Study of phonological processes in DAS is rendered difficult as even to date the concept of DAS remains obscure and highly debatable. There is high variability in the speech symptoms seen and the characteristics do not exhibit homogeneity i.e., every case of DAS may not have all the clinical symptoms reported for DAS in the literature. Hence this creates further methodological restrains and reduces the scope for inferences and generalisation. One should also understand that there are difficulties associated in selection of groups of DAS children exhibiting similar features. This factor may be attributed as the reason for selection of small groups of DAS in most of the studies.

In view of this, a single subject control design was chosen for the present study with the aim of:

Studying the phonological processes in the speech of a selected monolingual Kannada speaking child with DAS and compare them with those of an age and gender matched normal child.

Two subjects were taken up for the study. One child who served as the experimental subject, diagnosed as DAS was 6 years 3 months old. The other child was an age, gender, socioeconomic status and language matched (Kannada-monolingual) child who served as the control subject. The sample of the apraxic child was collected using a portable cassette recorder (SONY Model- no.TCM S63). The recording was done for one hour sessions for 20 hours, using speech stimulation techniques. A ninety minute duration sample of apraxic child's utterances was extracted and recorded in a different cassette. For the normal child, a 90 minute matched speech sample was collected in a similar manner. Utterances of both children were transcribed. The transcribed data was cross-checked by another Speech and Language Pathologist (SLP). Both the samples were subjected to phonological process analysis.

Limitations:

The results of the study cannot be generalised as it is a single case study.

Since only the elicited conversational speech sample was taken, it is possible that all the sounds in the language were not equally represented.

REVIEW OF LITERATURE

Developmental apraxia of speech is one of the most controversial nosological issues in the field of clinical speech and language pathology. Part of the confusion and controversy surrounding this disorder is the result of dozens of names and labels applied to children who show unusual speech production patterns expected to be motoric in origin (Crary, 1993)

Some of the names include articulatory apraxia (Morley, Court and Miller, 1954), developmental apraxia of speech (Rosenbek and Wertz, 1972), developmental verbal dyspraxia or apraxia (Edwards, 1973), developmental articulatory dyspraxia, phonological programming deficit syndrome (Rapin and Allen, 1981.

In 1957, Morley, defined developmental articulatory apraxia or dyspraxia as a defect of articulation which occurs when movements for speech, that is tongue, lips or palate appear normal for involuntary and spontaneous movement such as smiling or licking the lips, or even for voluntary imitation of movements carried out on request, but are inadequate for the complex and rapid movements used for articulation.

Developmental apraxia of speech can be understood by defining each of the words that make up the diagnostic category. The first word "developmental" refers to the point in time of the onset of the articulation disorder and is meant to be contrasted with the label "acquired apraxia". Rosenbek and Wertz (1972)

stated, that the term DAS is used if the lesion occurs before the onset of speech development. In acquired apraxia of speech the lesion occurs after the onset of speech development.

The second word "apraxia" is composed of the prefix "a" and "praxis", Stedman (1966) defined "praxis" as the performance of action or movement patterns i.e., normal volitional oral movements (VOM). Rosenbek and Wertz (1972) stated "the term apraxia, by emphasizing the articulatory or motor programming deficit in those children, differentiates them from children with central language impairment. The third word "speech" identifies the type of apraxia that the individual manifests. An apraxia of speech (AOS) describes a deficit in the ability to perform the skilled movements of speech with normal vegetative function of the speech musculature. A child can have an AOS, oral apraxia and limb apraxia etc. These disorders can manifest in isolation or concurrently.

Eisenson (1972) described articulatory apraxia as being "restricted to the child's ability to organize and produce the appropriate movements for the production of certain phonemes or sequences of phonemes. On the other hand, he described an oral apraxia as "an inability or a severe impairment in the individual's ability to perform voluntary movements, involving muscles of the larynx, pharynx, tongue, lips, palate and cheeks although automatic movements of the same musculature appear to be unimpaired". Guyette and Diedrich (1981) on the other hand, state that a child with DAS has normal vegetative function

while impaired in his ability to produce skilled movements for speech due to neurological impairment that occurrred prior to the onset of speech.

Hall, Jordan and Robin (1993) discussed the two views encompassing the term DAS. The single-entity view, which is often found in majority of the literature, and views language and articulation problems as a single entity. In line with this view Aram and Glasson (1979) reported that the DAS is not confined to the articulatory or motor aspects of speech. Later, however Aram (1980, 1982), adopted the term "developmental verbal apraxia" because it denotes that the expressive disorder is not confined to speech, but includes all other aspects of verbal expression..)

A second view of the relationship between DAS and language is held by a group of investigators who separate the apraxic features from other behaviours that may accompany the disorder - Morley, et al, 1954; Air and Wood (1985).

DAS involves a variety of symptom cluster. But individuals with DAS may not exhibit all the symptoms at a time. Characteristics of DAS can be categorised as speech and nonspeech . Elaborate description of these characteristics are provided by various investigators (Yoss and Darley, 1974a; Morley, 1957, 1959, 1965 ; Ferry, Hall and Hicks, 1975; Hall , Hardy and LaVelle, 1990; Hall et al, 1993) of which some however are still controversial in nature. Errors reported have not been seen to occur consistently, thus leading to a debate regarding the characteristic features of DAS. Some investigators view the disorder from the motor linguistic point of view, and some from the

phonologic linguistic point of view. Klein (1996) even suggested DAS to be a phonological disorder because some children diagnosed as DAS showed improvements with phonologically oriented therapy, after being resistant to traditional therapy. Edwards (1984) has argued that two possible levels of breakdown in speech production may account for the speech errors in DAS. First is the phonetic breakdown at the level of the vocal tract and second, is the phonological breakdown at the level of linguistic planning. Inconsistent respiration, voicing, prosody, resonance and articulation could occur due to breakdown at the level of vocal tract, (Snowling and Stackhouse, 1992). At the second level i.e., the linguistic planning, a phonological breakdown may occur.

In f 1979, Aram and Glasson differentiated the phonological characteristics of young and older children with DAS. The younger children used high vowel to consonant ratios, simplification errors, reduplications and only final consonant inclusion, but these were often used with some degree of regularity. The older children's attempts to produce multisyllabic words contained frequent metathetic errors, syllable omissions, and simplification of blends. Methathetic errors were also reported by Adams (1990) and Pollock and Hall (1991).

I A series of descriptive studies were undertaken for the purpose of identifying phonological processes prominent in the speech of children with AOS (Crary 1984b). Thirteen processes were selected, they were: deletion of final consonant (DFC), deletion of initial consonant (DIC), glottal replacement (GR), weak syllable deletion (WSD), cluster reduction (CR), prevocalic voicing (PVV),

stopping (ST), fronting (FR), backing (BK), gliding (GL), vocalization (VOC), labialization (LAB), vowel neutralization (VN). These phonological processes were evaluated for their ability to account for the total number of errors in children's speech. Results indicated that this set accounted for an average of 84% of all errors, and were significantly correlated with the severity of the phonological problems. Thus as the severity of the problem increased, the accountability of the set of phonological processes also increased.*)*

*/*To provide an objective index to the phonological process analysis, a ratio of the number of occurrence of each process to number of potential occurrence was computed^ This ratio, or percentage of error, (was termed the "relative strength" of the phonological process (number of occurrence divided by the number of potential occurrences = relative strength of process). Children with AOS between the ages of four and seven years were selected.

Results of the three descriptive studies suggested that the same types of errors were seen in apraxic and normal groups with a higher prevalence among the apraxic speakers. The average strength of the identified phonological processes was much less among the speech language normal children. In these respects, two important findings emerged from these data:

1) Children with AOS produced a greater variety of errors than children with normal speech language performance, and

2) The apraxic group demonstrated more severe errors (a higher relative strength value) in all error categories.*)*

These results suggests that children with AOS differed in both type and severity of phonological errors from younger children with normal speech language abilities. The results from the apraxic group also supported prior reports in that the dominant errors were those of omission. Phonological processes resulting in syllable structure simplification were among the most prevalent and inclusive as the strongest errors. Manner of articulation errors involving fricative, affricate, and liquid sound classes were prominent in this group. Errors of place of articulation were among the least frequent and weakest.

Cluster Errors:

'Cluster reduction was perhaps the single most dominant phonological process observed in the descriptive studies) All the children with an AOS who were evaluated demonstrated difficulty with production of clusters at a very high error rate (average of 80%). Given the dominance of omission errors, it was anticipated that clusters would be reduced primarily by omission of one or both of the sounds involved. Cluster errors were analysed. Four types of cluster errors were identified, accounting for 97% of all cluster errors:

Type I errors (CVC) were those in which one segment of the cluster is omitted but the other, original member remained. This changed the syllable shape of the word from CCVC to CVC (eg /stap/ - /tap/). These were the most frequent errors, occurring 41% of the time.

Type II errors (CCsVC) were those in which one member of the cluster is substituted, but two segments were produced (eg /tren/ - /twen/). These changes accounted for 23% of cluster errors.

Type III errors (CnVC) involve production of a single consonant that was not part of the original cluster (eg /trʌk/ - / dʌ/). These errors accoutned for 29% of cluster errors. The least frequent cluster error, was Type 12- .

Type IV (CnVnVC) accounted for only 4% of the errors. These productions resulted in a cluster containing two segments that were not in the original target (eg /krim/ - /twim/). The remaining 3% of cluster errors identified were isolated instances in which the entire cluster was omitted or replaced by a laryngeal /h/ (cc-[h]). Obviously, the dominant type of cluster error involved omission of one segment of the target cluster. This error pattern accounted for 70% of all cluster errors (Type I and TypeIII combined)

C=Consonant, V = vowels, S= substitution, A = a new consonant, that was not in the target.

Potential Relationship Between Speech and Langauge abilities :

Crary , Landess and Towne (1984) investigated potential relationships among twelve phonological processes, chronological age (CA), receptive language age (RLA) (as measured by a standard test) and mean length of utterance (MLU) in morphemes calculated from a conversational sample in ten children with AOS. They concluded that low and non significant correlations

between MLU and chronological age or RLA supported the concept of an expressive language component in DAS. Three phonological processes, PVV, ST, and DIC, did correlate significantly with chronological age and/or RLA (both of which were highly correlated with each other). These processes were more prominent among the younger children in the group. More importantly, however, was the observation that no phonological process correlated significantly with expressive language ability as measured by MLU. Crary, Landess and Towne (1984) attributed this observation to the possibility that both phonologic and syntactic deficits existed in this group of children and that the two deficit areas were not related. A retrospective analysis of that study raises two relevant points. First, among all the phonological processe^DFC demonstrated the highest correlation with MLU. The second point is that CR errors were not included in the correlation analysis. This was an oversight especially in view of the prominence of cluster seen in this group of children and the significant relationships found between this phonological process, and both CA and MLU by Crary, Welmers and Blache (1981) in speech language normal preschool children. For these reasons, the potential relationships were reevaluated with regression statistics to determine whether severity ratings (relative strength) of the phonological processes, DFC and/or CR significantly predicted expressive language ability as measured by MLU. The results suggest that DFC, but not CR, is related to expressive language ability as measured by MLU in the group of apraxic children studied.

These results seem to indicate a reversal of opinion from that published by Crary , Landess and Towne(1984). This is a false impression. The original data also suggested that DFC had the strongest relationship with MLU of all phonological processes identified. The interpretation of this relationship is that high DFC values relate to lower MLU values, implying a direct relationship between phonological performance and expresive language ability.

Crary, Landess and Towne (1984) suggest that this point is potentially important for understanding DAS, the differential diagnosis of developmental motor speech disorders, and designing treatment in cases of DAS.

Performance Load Influences on Phonological Performance

This is one of the traditional attributes tagged to developmental motor speech disorders i.e., more errors are seen as the complexity of the speech task increases. Complexity of articulatory adjustment might be one performance load factor (Rosenbek and Wertz, 1972). Yoss and Darley (1974a) reported that more errors were observed when the number of syllables attempted increased. Chappell (1973) suggested that imitation and length factors may have diagnostic significance for DAS. Aram and Glasson (1979) also implicated performance load factors, especially length of attempted utterance, as determinants of speech performance in children with an AOS. Bowman, Parsons and Morris (1984) evaluated change in 25 phonological processes across six performance load combination as in seven children with an AOS. They found no significant differences among performance load conditions for the average error frequency

(relative strength) of the combined phonological processes. They did, however, report that two processes, DFC and stopping occurred more frequently in polysyllabic than in monosyllabic words. They concluded that on an average, phonological errors produced by children studied were very consistent across performance load conditions. However, two phonological processes were negatively influenced by conditions that presumably increased the performance load of the speaking task.

Imitation and Length of Utterance

Separate studies were carried out by Ludwig and Crary (1981) and Ludwig (1983) to extensively evaluate the influences of performance load factors on speech patterns in children demonstrating an AOS. In the initial study, Ludwig and Crary (1981) imitation and utterance length were evaluated in group of eight children. This group produced the same 100 words under three conditions; single word repetition, phrase repetition and in elicited conversation. Errors were subjected to a phonological process analysis, and after identification phonological processes were categorized into two classes, syntagmatic and paradigmatic. Syntagmatic errors were those involving sound sequences. This did not necessarily mean that all syntagmatic errors were omissions. Certain types of substitution and addition errors also could be classified as syntagmatic. Paradagmatic are more classically identified as substitution errors that are not influenced by the sequence in which the target sound appears. Three types of analyses were completed;

1) The total number of errors within the respective speech sampling conditions,

2) The proportion of errors that were sound sequence (syntagmatic) or sound substitution (paradagmatic), and

3) The proportion of error types across performance load conditions (word repetition, phrase repetition, and conversation).

The largest number of total errors was obtained in phrase repetition followed by conversation and single word repetition. Statistical comparisons of these results indicated that the only significant difference was between the two repetition conditions. Significantly more errors were obtained between the phrase repetition conditions. No significant differences were obtained between the conversation and single word repetition conditions. Although more paradigmatic than syntagmatic phonological processes were identified, the proportion of syntagmatic errors was much higher. This finding implies that errors of sound-sequence including omission, were the dominant error type for these subjects. Finally there seemed to be a difference in the proportion of syntagmatic, but not paradigmatic errors across performance load conditions. Because the only significant difference were obtained between the two repetition conditions the focus of change in the distribution of error types was between the word and phrase repetition conditions. Chisquare analysis indicated that the phrase repetition condition resulted in a higher proportion of syntagmatic, but not paradigmatic, errors than the word repetition condition. In short, syntagmatic

errors increased in the phrase repetition condition (higher performance load) whereas paradigmatic errors did not. Thus, not only did syntagmatic errors dominate the error profile, but only these errors were influenced by performance load factors. Adams, (1990), Pollock and Hall (1991) reported that increasing load is a differentiating feature between developmental verbal dyspraxia (DVD) and functional articulation disorders (FAD).

Conversational Speech as a **Performance Load Factor**

The result that the conversation condition did not produce the greatest number of errors was not predicted by Ludwig and Crary (1981). It was presumed to be the highest performance load condition because each speaker was responsible for formulating his / her own responses Vs. repeating the word or phrase provided by the examiner. Also, prior reports had suggested that speech performance was most likely to be poorest in conversation. The answer to this apparent contradiction may have been found by reviewing the conversational samples. There seemed to be a tendency for the subjects to use short phrases (one, two or three words) when attempting certain target production. Thus conversational responses were similar in length and lexical composition to the word and phrase repetition tasks. This observation raised questions regarding the ability of these children to "trade off' certain grammatical properties when faced with increased complexity in other properties i.e., use a shorter utterance length when the phonological target was more complex (Crary and Hunt, 1983).

Ludwig (1983) pursued the issue of performance load factors as they pertained to repetition and utterance length. In this follow up study, she included procedures to control for and evaluate the influence of language variables on phonological performance.

First, is an attempt to control for the influence of the language abilities of the children in the study, Ludwig (1983) evaluated three groups of children:

1) a group of children characterized by DAS

2) a group of children matched to the apraxic group on RLA

3) a group of children matched to the apraxic group on expressive language age (ELA)

Because the apraxic group demonstrated a receptive language split favouring receptive abilities, the receptive language matched group was younger. Children in the apraxic and the receptive language matched groups averaged five years two months. The same 100 words used in Ludwig and Crary (1981) study were employed in the word and phrase repetition condition in this study. However, rather than try to elicit the same words in conversation, Ludwig (1983) contrived a problem solving activity designed to facilitate increased length of utterance from her subjects. She subsequently coded and grouped each resulting utterance based on the number of morphemes produced, one to two morphemes, three to four, five to six, or seven and longer. Phonological process analysis were completed on all samples using the closed set of processes

used in Ludwig and Crary (1981) study. As in that study, these were subdivided into syntagmatic and paradigmatic processes. The average relative strength value for each phonological process in each performance load condition was used to identify differences among the three groups. The total number of errors also was compared among the groups for the two repetition conditions only. Finally, additional analysis were completed on the conversation samples to evaluate syllable shape control in this performance load condition. For each utterance length in conversation the proportion of attempted syllable shapes and produced syllable shapes were computed. From, this rather complex study, Ludwig (1983) was able to evaluate the effects of increased utterance length both between and repetition tasks and within elicited conversation.

Results from comparison of the two repetition conditions indicated that the apraxic group was different from both groups of speech language normal children who did not differ from each other on any measure. The children with AOS, not surprisingly made more errors than the other groups on both the single word and phrase repetition tasks. Also the apraxic groups made significantly more errors on the phrase repetition task than on the single word task. The two normal speaking groups did not demonstrate differences between performance load levels. Comparison of phonological process across performance load levels indicated that only two syntagmatic processes increased between single word and phrase task. These were DFC and PW. Both of these changes reflect simplification of syllable structure. DFC by reducing the number of sequential

elements within the syllable and PW by reducing the complexity of the CV relationship.

Results from comparison of utterance lengths in conversation condition revealed a slightly different pattern of performance. Among the 13 phonological processes evaluated across the four utterance lengths, only DFC revealed any influence of increased performance load. The relative strength of values for DFC increased systematically with increased in utterance length. But the difference in relative strength values of DFC across utterance lengths did not reach statistical significance. In this regard, none of the 13 phonological processes studied demonstrated a statistically significant influence of increased utterance length in conversation. This was a surprising result given the apparent relationship between DFC and performance load in the Ludwig and Crary (1981) study and in the comparison of the repetition tasks in this study. Both of these results indicated decrease in syllabic complexity as utterance length increased. To address this potential relationship between syllable structure control and utterance length, Ludwig (1983) further analysed the attempted and produced syllable shapes across the respective utterance lengths. Only CV and CVC syllable shapes were included as those were the most prominent form the analysed samples and they related directly to syllable structure changes resulting from DFC.

Attempted syllable shapes were determined from the adult form of the target word. Produced syllable shapes were identified from the child's

production of speech target. The following conclusions were drawn. First there seems to be little difference among the three groups with respect to the proportion of monosyllables attempted across the four utterance lengths. The only potential difference was seen as a slight increase in CVC syllable shapes in the seven plus morphemes utterances produced by the apraxic group. More important, however, was the obvious effect of DFC on the proportion of monosyllables produced. Little difference was noted between attempts and produced closed syllables (those ending in a consonant) in either of the two control groups. But, in the apraxic group, there was a pronounced difference at each level of utterance length. Furthermore, there seemed to be an increase in the difference between the proportion of attempted and produced *CVC* syllables in the apraxic group as utterance length increased. However, this was not a consistent, linear trend across utterance lengths. It seemed that there was sufficient fluctuation in the proportion of CVC syllables produced across the four utterances lengths to preclude any meaningful conclusion that increased utterance length in elicited conversation negatively influenced control of monosyllabic forms.

Subgroups of Phonological Performance

Attempts have also been made to evaluate subgroups of DAS based on phonological performance. Crary, Towne, Comeau and Korte (1982) and Crary (1984b) described cluster analysis results on phonological processes of 24 children with an AOS. Simply stated, cluster analyses subdivides a group into

subgroups based on similarities and differences among multiple variables. In these two studies, phonological processes were used as the distinguishing variables. Interestingly, two analysis used different cluster analysis procedures but obtained very similar results. Three subgroups were identified: (a) dominated by syllable structure errors (primary omission), (b) sound - class substitution errors, (c) specific sound errors. The second analysis (Crary, 1984b) contained more rigorous analysis procedure. In this analysis, the three groups seemed to be distinguished, not only by type of dominant phonological error, but also by the more general factor of severity. Group one, characterised primarily by omission errors, was not the youngest group, but it did contain the most severely impaired cases. Group two was the youngest group, but its members were not as severely impaired as those in group one. Group three members demonstrated difficulties primarily with /r/ and /l/ sounds as singletons and in clusters.

Crary (1993) observed that the result of these studies were not applicable to the motolinguistic model. Neither study attempted to classify the subjects based on motor performance indices either before or after the cluster analysis of phonological errors in children with different motor performance profiles. The results of these cluster analysis studies do, however, suggest a potential avenue of phonological alteration that occurs with overall phonological improvement. As a child's phonological ability improves, a corresponding shift in the type of dominant error would be expected. Crary (1984b) has demonstrated this pattern in a limited case example. Weckler and Crary (1982) also have reported this

pattern of "phonological reorganization" in apraxic children receiving speech language therapy.

Parsons (1984) compared a group of DAS children with matched non-DAS phonologically disordered children. The errors in single word utterances were analysed for the presence of 29 processes, 24 of which were found to actually occur. CR and FCD were the most frequently used processes by both groups. Although the children with DAS demonstrated processes similar to those exhibited by other phonologically impaired children, there were statistically significant differences between the two groups for only the processes of backing and epinthesis.

Bowman, Parsons, and Morris (1984) also reported phonological processes used by children with DAS. They postulated that the inconsistent errors reported in literature may actually have been rule based, and that consistency itself might have been found if the co-occurring phonologic contexts, situations contexts, nature of the tasks, and language effects also had been examined. The DAS subjects participating in their study performed speech tasks ranging in difficulty from a spontaneous contextual speech sample to imitation of examiner modeled single words. No task involved multiple trials. All protocols underwent analysis for 24 phonological processes. The mean rankings of the processes, revealed that CR was the most frequently used process, followed by liquid simplification, ST, GR, devoicing, epinthesis, PW, nasal assimilation, denasalisation and nasalization. The investigators reached three conclusions:

a)inconsistency may be an artifact of the manner in which the errors are investigated,, b) inconsistency in use of phonological processes does not seem to be a characteristic of DAS, and c) children with DAS use consistent types and frequencies of phonological processes between linguistic tasks and performance loads.

In an attempt to determine the usefulness of the phonological approach to understanding the speech disorder of the children presenting DAS, Jackson and Hall (1987) addressed longitudinal change in use of phonological rules, using the Compton-Hutton phonological assessment (Compton and Hutton, 1978). Changes over time were found to occur in same subject's use of common and unique rules. Common rule use predominated and increased with age in the word initial position, while unique rule use decreased. It was noted that more rules, both common and unique were written for errors in the sound classes of fricatives, affricates, liquids, and vocalics. However, the authors found individual variability in these trends.

Williams , Ingham & Rosenthal (1980) found that children suspected of DAS differed from equated group with developmental phonological disability on few of the variables being tested. Only two of the 11 speech variables differentiated the two groups of misarticulating children. However, if the omission errors were removed from the phonologic samples, differences between the two groups were not obvious at all. It clearly appeared that school age

children with suspected DAS could not be consistently differentiated from equated children with developmental phonological disability.

In another study, Betsworth and Hall (1989) studied the application of phonological processes as defined by Stoel-Gammon and Dunn (1985) and Hodson and Paden (1983) by five subjects with DAS. They found that the process usage was highly individualistic. The subjects employed a total of 29 different processes and all five of the subjects used CR and gliding, as well as idiosyncratic processes, which did not fall into described categories. This study used two trials of the same stimulus words gathered on two different days. The errors made on the same stimulus word were highly inconsistent leading to variability in the processes that described the error.

Variability was found in the results of Jackson and Hall (1987) and Betsworth and Hall (1989) studies when phonological rules were applied to longitudinal data sets, as well as when applied to data gathered on two days close in time. This lead to the question of usefulness of phonological analyses and the application of the theories underling a phonological process approach to DAS, because different views of a child's phonology could be gained if the testing was conducted on different days. Hall et al, (1993) feel the motor control hypothesis better explains the inconsistencies and variabilities found in the speech of children with DAS.

From the review of literature, we can say that phonological characteristics in children with DAS is not well documented. Studies done are few and have

been done in a very heterogenous population. This may be because DAS exhibit a wide variety of symptoms i.e., a symptom cluster, and each case of DAS might not exhibit all the features, which makes it difficult to find a homogeneous group of DAS children. Moreover, phonological process analysis has not been well studied in normal and DAS population in Kannada as well as other Indian languages and most of these studies are from western literature. With these observations in mind the present study was addressed with the aim :

To study the phonological processes in the speech of a selected child with DAS and comparing with those of an age and gender matched normal child.

METHODOLOGY

Phonological processes have not been widely studied in children with DAS, especially in Kannada and other Indian languages. There is a scanty literature available on phonological development in normal children. This is also true with respect to the disordered population including DAS. Many studies on developmental phonology, usually adopt the procedure where in a list of phonological processes are made and the presence or absence of these are checked for a given group of DAS children. This is probably because of the difficulty in selection of homogeneous group of DAS subjects who usually exhibit a heterogeneous symptom cluster, and also in establishing homogeneous group of experimental controls. This augments the skepticism that is associated with the interpretation of results or the conclusion itself, and thus increases the controversy. These issues led to the selection of a single case study design to analyse descriptively the phonological processes of a child with DAS in an Indian language, namely Kannada.

AIM

The study aimed at analyzing the phonological process in the speech of a selected child with Developmental apraxia of speech and comparing with those of an age and gender matched normal child.

DESIGN

A single subject control design was used. A descriptive analysis of the phonological processes of the utterances of the DAS child was carried out and compared with that of the age and gender matched normal child's utterances.

SUBJECT

Two subjects were taken up for the study.

Subject 1 : was a male child with DAS of age 6 years 3 moths, who served as an experimental subject.

Subject 2 : was a normal male child of age 6 years 3 months, who served as control subject.

Criteria for subject selection

Subject: **1**

A child with a confirmed diagnosis of DAS as made by an experienced speech language pathologist was selected for thestudy. The diagnosis was confirmed on the basis of:

- Clinical observation made during the diagnostic session as well as remedial therapy sessions for a period of one month.
- Screening test for developmental apraxia of speech by Blakely (1980).

The other criteria for inclusion of the experimental subject were: (1) The expressive vocabulary of the child should be atleast 50 words with/without remedial therapy program. (2) The DAS child should be a monolingual with mother tongue being Kannada. (3) Hearing should be within normal limits and the child should not exhibit any other sensory or associated problems.

Subject :2

A normal child was selected who matched with the age and gender of the experimental child was selected as a control subject. The other criteria for inclusion of the control subject were: 1) The control subject should be a monolingual, with mother tongue being Kannada. 2) The control subject should have hearing within normal limits and should not exhibit any other sensory or associated problems.

METHOD

A. Experimental environment and data collection

- A familiar environment in the child's home was chosen for recording the speech sample of the experimental and control subject.
- During recording, only the mother, the child and the experimenter were present in the room for both the subjects.

- Recording was done using a portable cassette recorder (SONY Model no. TCM S63). Recording of the speech sample for the subjects was done independently.

Subject 1

Specific set of toys was chosen based on the child's interest and was used during the data collection. Duration of each recording session was one hour. The utterances of the child were recorded across 20 such sessions, as his verbal output was inconsistent across time. This was carried out in order to obtain a representative comprehensive sample of his verbal repertoire for which more number of sessions was needed. These guidelines were followed during the recording of speech sample overtime:

- To elicit the utterances, various speech stimulation and play therapy techniques like prompting, modelling, expansion etc., were used. These techniques were used with the purpose of eliciting atleast word level utterances or short phrases, wherever possible. The words used to elicit the speech sample are enlisted in Appendix B.

  At a later date, only the subject's utterances excluding the mother and the investigator's sample was extracted from the corpus of data and recorded on a different audio cassette. During this transfer, transcription of the utterances was also carried out simultaneously using the symbol system in Kannada

proposed by Schiffman (1979) as indicated in Appendix A. The total duration of the extracted utterance was 90 minutes.

Criteria used for extraction were as follows :

- Utterances were atleast limited to word level or short phrases.
- Utterances were not masked or in unison with the clinician or the mother's utterances.
- Utterances were clearly audible without any background noise.

Subject 2

- The same set of toys and other material were used to elicit the same target utterances in the control subject as in the DAS subject.
- The duration of the extracted utterances was also 90 minutes on the final audio cassette.
- The same criteria was used for extraction of the words and the transcription was also done simultaneously using the symbol system for Kannada proposed by Schiffman (1979).

B. Transcription

The transcription of all the utterances for both the subjects was checked using the system proposed by Schiffman (1979) for Kannada. During this transcription standard IPA (1996) was also used wherever required. For eg.,

when *aidu* was said as *x-du,* because /x/ vowel does not exist in Kannada. A qualified speech language pathologist before the final analysis also rechecked this transcription.

C. **Selection of the Phonological Processes**

A comprehensive key of all the phonological processes documented in the literature was prepared based on the processes reported by Wiener; (1979), Shriberg and Kwiat kowski (1980), Hodson (1980), Ingram (1981), Nettlebladt (1983), Grunwell (1985), Stoel-Gammon and Dunn (1985), Dodd and Iacano (1989), Dean et al (1990), Pollock and Kieser (1990), Lowe (1994), Bauman-Waengler (1991, 2000) and Klein (1996). This was done because phonological processes are not well established in Kannada as well as other Indian languages in the normal population. Hence in this context a key assimilated from the literature, was assumed to ensure that the investigator would not miss out any of the processes, and would reduce the biases and selectivity of the investigator. The key (Appendix B) consists of the description of the processes with few examples.

D. Analysis

1 The transcribed utterances were than compared to the adult target utterances for both the subjects. Form the transcribed data, the phonological process were identified using the key based on the type of sound changes . The following Table 1 was used for the same.

Table 1. Score sheet for identification of phonological processes (sample).

ITEM NO.	TARGET	FORM	SOUND CHANGE	PHONOLOGICAL PROCESSES
1.	*baai*	*ba*	*aai* substituted by *a*	Monophthongization
2.	*kivi*	*ti*	Omission of *vi* *k* substituted by t	Syllable deletion (final position) and fronting.

In both subjects, the target words were repeated many times in the data. Each occurrrence was transcribed and process analysed, in order to

- Rank order the processes based on the frequency of occurrrence in the sample.
- Classify the processes on normal or natural, unusual or idiosyncratic processes and other processes.

In case of the DAS child, the word level utterances were difficult to approximate so speech stimulation techniques were used in order to elicit the word in terms of the basic unit i.e., syllable by syllable. Hence while analysing the target word each syllable was analysed for the phonological processes.

In the elicited speech sample of the subjects, certain borrowed words from English are also used, like *bassu, kaaru* etc as listed in Appendix B. These are considered for analysis because most of the time in the mature language in Kannada, frequent use of the borrowed English words is there in the day to day

conversation. Such words however, when used are uttered with an enunciated vowel in the final position. Since these words were subjected to influence of Kannada language, they were still considered for analysis. The vocabulary of the control subject was also matched in terms of the borrowed words.

After identifying the processes, the processes occurrring under each sound class were enlisted and the processes were added under each sound category. This gave the frequency of occurrrence of a particular process based on which the processes were rank ordered and presented in a hierarchy.

The Results are discussed under the following headings:

- Phonological processes in normal child
- Phonological processes in DAS child

RESULTS AND DISCUSSION

The present study was taken up with the aim of comparing the phonological processes in a selected child with DAS with the processes exhibited by an age and gender matched normal child. Since the applicability of the phonological processes reported in the western literature to Indian languages is limited and as there are no studies on phonological processes in Kannada, it is even more difficult to comment about the phonological processes in the disordered group including DAS. In addition to this it is difficult to get a homogeneous group of DAS children, because of the wide variety of symptoms reported in the literature. Keeping these limitations in view, a descriptive single case study design is chosen in the study.

The literature on phonological processes is mostly from the western studies, and is inadequate in the Indian languages including Kannada. Given this fact, it was assumed that the best approach to analyse the phonological processes would be to prepare a list of the processes from the literature and compare the data with these, keeping in mind the structure and variation of the Kannada language. Also, keeping in mind the inclusive and exclusive features of some processes, it was assumed that such a procedure would ensure that the investigator would not miss out any of the processes. It was also presumed to reduce the biases and selectivity of the investigator.

In the study, two children, one with confirmed diagnosis of DAS who was 6 years 3 months of age and another an age, gender and socioeconomic status matched normal child were included. A 90 minute speech sample of both DAS and normal child, which was elicited using various speech stimulation techniques like prompting, modelling etc was chosen for analysis. These samples were transcribed and analysed for phonological processes. Based on the sound changes occurring, the phonological processes were identified, and an inventory of the phonological processes for the two children was thus prepared.

Each word utterance of the two subjects was analysed sound by sound (syllable by syllable). This was undertaken because during the data collection of the apraxic child, it was observed that the expressed words were effortful and characterized by typical apraxic difficulties. To elicit speech, various speech stimulation techniques such as prompting and modelling for the whole target word (which was greater than two syllables) were used and inspite of this, sometimes the expression of the child was elicited syllable by syllable. The different phonological processes, in the word utterance were then analysed. For eg: *aatu* for *aidu,* the sound changes occurring are *aa* for *ax* and *t* for *d.* The process here was identified as monophthongization and devoicing respectively.

The expressive vocabulary of the subjects was categorized into various sound classes like bilabials, nasals, fricatives, dentals etc. and the processes were enlisted under each sound class. The example noted above was enlisted in the category of dentals and vowel errors. The number of times each process occurred

under a particular sound class in the 90 minute sample of each subject was added to give the frequency of occurrence of each process. Based on the frequency of occurrence a list of the processes in a hierarchy is made. The outcome is presented and discussed in the following sequence:

- Phonological processes in the normal child
- Phonological processes in the DAS child.

Phonological Processes in the normal child

From the analysis of the speech of the normal child for phonological processes it is found that very few processes are identified and the hierarchy of these processes in terms of frequency of occurrence are:

Table 2: Phonological processes in the normal child.

1. Fronting
2. Backing
3. Assimilation
4. Metathesis and Cluster Reduction
5. Stopping, vowel assimilation, gliding, denasalisation and aspiration.

Although these processes are noted across the transcribed speech sample they are not consistent across all the sound classes. This might be because of the influence of the maturatiory development of the processes, thus accounting for the

features of inconsistency and fading off. In the absence of any known studies on the developmental trend in phonological processes in Kannada, it is rendered difficult to compare the data for approximation with adult form or the maturation of the process. From the analysis, it is observed that, fronting occurred often for the retroflex sounds and the retroflex nasal, which is present in the Kannada language (Appendix A). It may be postulated that the child is still at the stabilization phase as the retroflex sounds are acquired at a later age in Kannada.

The rest of the processes are found to occur inconsisten ly throughout the sample. The phonological development is said to continue till the age of 4 years (Yavas, 1998) and after this age very few processes might persist depending on the language structure. In Kannada language, phonological process development in children has not been established, so it is difficult to comment regarding the process being delayed or deviant. Backing and assimilation are noted with reference to retroflex sounds and metathesis is seen in *r* and / phonemes. Cluster reductions are very few and even when present, they are often combinations of *s*, *sh* phonemes. This suggests a pattern, in that most of the processes observed are those with reference to the late acquired sounds. As their occurrence is inconsistent, the influence of maturing cannot be precluded.

Phonological processes reported are categorised by some investigators as natural or normal processes and unusual or idiosyncratic processes. Those processes that reportedly occur developmentally in normal children across languages are called natural or normal processes. Processes that never occur or

occur only rarely in normal child phonology are called unusual or idiosyncratic processes (Stoel-Gammon and Dunn, 1985). In this child, all the processes found are reported in literature as normal processes except for denasalization, which is reported as an unusual process and aspiration, which has not been reported as a process in the literature. In addition to this the only vowel process observed was vowel assimilation which was not very frequently occurring.

Aspiration is one of the attributes in the sound system of Kannada language and can be expected to be acquired as a natural process. But this is a limited statement because of the lack of literature on phonological processes in Kannada. Comparison across other Indian languages is also not possible since even in those languages, phonological processes are not well established. The reduced frequency of this and other phonological processes in the control subject could be suggestive of late acquisition of these processes rather than "fading off' or diminishing of these processes.

Phonological processes in the DAS child

(As is seen in the normal child, natural or normal processes as well as unusual or idiosyncratic processes and processes not reported in the literature were found This is in agreement with the reports of Betsworth and Hall (1989).

The phonological processes observed in the DAS child were also arranged in the hierarchy and were classified as

a) natural or normal processes

b) unusual or idiosyncratic processes

c) processes not reported in literature.

Processes that are observed in the subject are also those reported as natural or normal phonological processes in the normally developing children in western literature. These are listed in the hierarchy of their occurrences.

Table 3: Natural or normal processes in the DAS child.

Processes in the DAS child	**Reported as natural process in western literature (English) observed in DAS**
• Syllable Deletion	Aram and Glasson (1979)
• Stopping	Crary (1984b), Crary et al. (1984), Bowman et al. (1984).
• Devoicing	Bowman etal. (1984).
• Fronting	Crary (1984b), Bowman et al. (1984).
• Vowelization	Aram and Glasson (1979), Crary (1984b).
• Lateralization	Not reported.
• Cluster Reduction	Betsworth and Hall (1989), Bowman et al. (1984), Aram and Glasson, (1979), Crary (1984b) Parsons (1984)
• Reduplication	Aram and Glasson (1979)
• Voicing	Bowman et al. (1984), Crary (1984b), Crary et al. (1984), Ludwig (1983).
• Gliding	Crary (1984b), Betsworth and Hall (1989)
• Palatalization	Not reported

The most prevalent process observed in the DAS child is syllable deletion; in the final position i.e., final syllable deletion (FSD). This may be because of the language structure of Kannada where the words and sentences end with a CV. It is interesting to note that the most frequently occurring process reported in the

DAS population (Crary, 1984b; Bowman et al. 1984; and Parsons, 1984) is that of final consonant deletion (FCD). Final consonant ending is the feature of English words and sentences and occurrence of FCD as a highly prevalent process in DAS is reported by these investigators. In the DAS child of the study, FSD is noted to be the most prevalent process. Since the words and sentences in Kannada end in a CV, the syllable rather than consonant is deleted in the final position. In other words, the DAS child exhibited the same features as reported by the investigators listed above, but the process accorded is FSD and not FCD.

Stopping as a process occurred next in the hierarchy followed by devoicing, which has been documented in western literature also, as shown in the table. Voicing and devoicing errors in DAS are also reported by Yoss and Darley (1974a), Aram and Glasson (1979), Hall et al. (1993).

The next process in the hierarchy is fronting. The DAS child was undergoing remedial speech training during which he was being trained for bilabial and dental approximation. The influence of therapy on the elicited speech sample collected from the subject cannot be ruled out. Although it is difficult to conclude, it may well be postulated that therapeutic focus influenced the occurrence of fronting as one of the prevalent process.

Vowelization has also been noted to occur in children with DAS as represented in the table. This may truly be his attempts to express but due to limited articulatory movements resulted in vowelization. Vowel errors have been reported in DAS children by Morley (1959), Rosenbek and Wertz (1972),

Lohr (1978), Davis Marquardt and Sussman (1985), Pollock and Hall (1991), Crary (1993), Hall et al. (1993).

Lateralization is also observed as a process in the subject studied. This has not been reported in literature as a common process in the DAS population. Subjectively it was observed that the child exhibited lateralization during his attempts to approximate velar and retroflex target dental sounds. This implies that lateralization was used to substitute any target sound produced by tongue tip or posterior tongue.

Cluster reduction has been reported as one of the most frequently occurring process in many studies (Table 3). All the clusters produced were reduced, but the frequency in this case might be less because the child's vocabulary contained few words with clusters. This can be a limitation because all the sound classes have not been represented in the child's elicited sample.

Reduplication has been noted to occur in children with DAS. The occurrence of this process is explained as the child's attempt to repeat the same syllable during his effort to approximate the targets due to restricted articulatory transitions.

Voicing as a process is less frequent as compared to devoicing. Devoicing requires the synchrony between the vocal cords and articulators, where as voicing only involves the vocal cord. The occurrence of devoicing as a more prevalent process than voicing in the DAS child suggests that the child might have difficulties in synchronizing the action of two distantly placed structures.

Gliding and palatalization are the last processes in the hierarchy of the natural processes. The child seems to exhibit difficult in the production of glides and palatal sounds.

Table 4 : Unusual or Idiosyncratic processes in the DAS child.

- Initial consonani deletion

  Denasalization

  Nasalization

  Vocalic support for final consonants

  Initial consonant adjunction

- H-zation of consonants

  Dentalisation

The most frequently occurring unusual process is the initial consonant deletion, this is also reported as a frequently occurring process by Crary et al. (1984) and Crary (1984b).

Denasalization and nasalization are next in hierarchy. Bowman et al. (1984) have also reported the occurrence of these processes in the group of DAS children that they studied. Incoordination of the "nasopharyngeal sphincter" has been suggested as the cause by Morley (1957, 1965, 1972), Dabul (1979), Yoss and Darley (1974a), Aram and Glasson (1979), Hall et al. (1990), Hall et al. (1993).

The process called vocalic support for final consonants is also observed frequently in this subject. Since words in Kannada terminate in enunciated vowels, it is unusual to find vocalic support for final consonant. It seems like the subject emerged with extended vowelization before the final CV utterances. Poor or slow transition of the articulators can also be a cause for such an observation, eg., medial consonant deletion, occurred as an unusual process, but less frequently in the sample. This may be because the child used very few three syllabic words as he still persisted to have difficulty in producing longer words or utterances due to difficulty in sequencing. Difficulty in sequencing of phonemes and syllables has been well reported as a characteristic of DAS (Murdoch, Porter, Younger and Ozanne, 1984; Hall et al., 1993; Morley, 1957, 1965, 1972; McGinnis, 1965; Rapin and Allen, 1981; Crary 1984b; Chappell, 1973; Hardcastle, MorganBarry and Clark, 1987).

Initial consonant adjunction is also seen as an infrequent but normal process. It is observed that the initial consonant adjuncted are often bilabial, glides and occasionally velars. The focus of the remedial sessions was on bilabials and dentals and this could have partially influenced the process occurrrence. This also implicates that certain motor movements, which are overlearned are inserted before the target sounds which are different from their sounds resulting in addition of a consonant in the beginning of a word.

H-zation of consonants and dentalization occurrred very rarely. Dentalization can be attributed to the effect of remedial sessions. H-zation could

be an effect of the child's strenuous attempts to initiate speech which is rendered difficult due to non participation or incoordination of the articulators resulting in production *of h* instead of other consonants.

Along with these, certain other processes not reported as processes in the western literature are found to be present in the child. These other processes are listed according to hierarchy.

Table 5: Other processes in the DAS child

- Aspiration
- Addition of/
- Final consonant addition
- Medial consonant addition
- Fricative addition

Aspiration was very frequently occurrring, and was.also noted in the normal subject. As explained for the normal child, may be the process is one which, occurrs commonly in Kannada language, but this needs to be established on the normal subjects in future research. Eg., *tha* for *ta*. Once again, it can only be presumed but difficult to ascertain that inconsistent patterns of aspiration occurrred due to incoordination of the articulators.

Addition of /: It was observed that while trying to speak the child would add the / after a vowel or after the first syllable in the word. It may only be

reasoned that he exhibited the same as he was learning dental sounds in the remedial sessions.

Addition processes observed were addition of consonant in the medial and final position. In the sound class errors, addition errors have been noted as unusual patterns by Rosenbek and Wertz (1972). Yoss and Darley (1974a) and Hall *et al*, (1993).

Fricative addition, was seen very rarely, but it is interesting to note that this was produced inspite of the child not being able to produce the fricative sound either after the model or in meaningful contexts. The fricative used most often was the sibilant's.' Eg: *akas* for *akka*.

To summarize it can be stated that DAS show unusual processes. But to comment whether the process rules follow a common or unique rule would be difficult due to lack of adequate and standardized literature in the Kannada language.

Vowel Processes

Certain vowel processes have also been identified in the apraxic subject. In the vowel processes also, it is found that certain processes which are not reported in the literature as normal or natural and unusual or idiosyncratic processes are occurrring. These processes are enlisted below as "other vowel processes". The vowel processes will be discussed under:

Comparison with reported process in the western literature

Other processes.

Comparison with reported processes in the western literature

Table 6: Normal vowel proceesses in DAS child

- Vowel lowering
- Monophthongization
- Diphthongization
- Vowel raising
- Vowel assimilation

Vowel lowering is found to be the most frequently occurring process in the sample. This implies less movement or minimal participation of the tongue for the required sound articulation. Monophthongization might be due to lack of coordination required to produce a diphthong, and thus the child seem to have reduced it to a monophthong. On the contrary diphthongization of certain vowels is also present, thus pointing to the inconsistency reported in children with DAS. Vowel raising was also rarely seen along with vowel assimilation.

Other vowel Processes: Some vowel processes are also noted in the DAS child which do not fit the description of any of the defined vowel processes reported in the literature. Those processes are reported in the Table 7, according to their frequency of occurrence in the sample in a hierarchy.

Table 7 : Other vowel processes in the DAS child.

- Initial vowel addition (IVA)
- Initial vowel prolongation (IVP)
- Final vowel deletion (FVD)
- Initial vowel deletion (IVD)

These processes are different from vowelization as they do not include substitution of a syllable by a vowel, but are specific to additions, deletion or prolongations of the vowels in initial or final position. Within these, FVA is the most frequently occurring process. These can only be explained as an effort on the part of the child to imitate the utterance, which only leads to vowel production and not consonants due to restricted articulatory gestures. The reason for the vowels in the initial position being prolonged could be poor transition of articulatory gesture and the reason for arrest at the final consonant level could result in final vowel deletions. But, at this point it is difficult to categorize these

vowel processes as normally occurring or idiosyncratic, in the absence of any comparative literature from western as well as Indian studies.

As a concluding remark it can be said that the normal child and DAS child exhibit processes that are markedly different. The normal child is showing a very few processes which are however not very prominent. The only unusual process exhibited in normal is denasalization and the rest of the processes are normal processes.

Vowel assimilation is the only vowel process being exhibited in normals and aspiration is noted in the other processes in the study but is not yet documented as a process in literature. Aspiration is also seen in the DAS child, hence this process might be a normally occurring process in the Kannada language. Similarly, other processes found which are not reported in literature like addition of /, final consonant addition, medial consonant addition and fricative addition, might be normally occurring, or unusual for which further study on the phonological processes in Kannada needs to be addressed. The same is true with the vowel processes namely IVA, IVP, FVD, IVD which have been reported as other vowel processes and might be language specific processes.

On the other hand, certain phonological processes, which have been reported as natural or normal process, in the vowel processes too have also been found to occur. It may be speculated that these processes are ones which are common across languages and hence can be called as innate universal processes. This is akin to the observation made by Ingram (1979, 1986) (Nettlebladt (1983)

regarding the theory of natural phonology, which states that the phonological processes are in some sense innate and therefore universal, because of the phonetic basis of speech. The same observation can be extended to the evaluation of unusual processes too. Thus processes like initial consonant deletion, denasalization, nasalization, vocalic support for final consonants, medial consonant deletion, initial consonant adjunction, H-zation of consonants, dentalisation may be unique or idiosyncratic in DAS in all languages. In other words they don't occur or occur rarely in children with normal phonological development across all languages. The only unusual process found to be common in both DAS and control subject is denasalisation, which in the true sense might not be an unusual process in Kannada.

In order to generalize these observations, phonological processes needs to be studied in normals as well as disordered population in Kannada with larger representative sample for the respective groups.

SUMMARY AND CONCLUSION

Developmental apraxia of speech is one of the most controversial nosological issues in the field of clinical speech language pathology. A child with developmental apraxia of speech is understood to have normal vegetative function while impaired in his ability to produce skilled movements for speech due to a neurological impairment that occurred prior to the onset of speech (Guyette and Diedrich, 1981).

An attempt to explain the errors in DAS from the phonological view point, has been made by a few investigators (Ludwig, 1983; Crary, 1984b; Bowman et al., 1984; Betsworth and Hall, 1989). These studies reveal that the children with DAS exhibit some normal or natural processes as well as some unusual or idiosyncratic processes. Most of these studies, have selected a group of processes which are reported in the literature and checked for presence of these processes in the DAS children.

To comment on natural and idiosyncratic processes, the phonological system of normal children needs to be established in that language. Such reports are lacking in most of the Indian languages including Kannada.

Moreover, it is difficult to get a group of DAS children with homogenous features as DAS includes a symptom cluster. All children may not exhibit all the features reported in this cluster. As it is difficult to get a matched DAS group,

study of phonological processes in these children is rendered all the more difficult.

The present study was undertaken with the following aim:

To study the phonological processes in the speech of a selected child with DAS and compare with those of an age, and gender matched normal child.

The method used to study this was:

One experimental subject (DAS child) and one control subject (normal child) were matched for age (6 years, 3 months), sex, gender and socioeconomic status. Portable cassette recorder (SONY, Model no. TCM S63) was used to record the samples of both the subjects. Since the DAS child was less verbal across time, the recording were made in repeated one hour sessions. Twenty sessions were taken up to collect a corpus of data. A 90 minutes sample was later extracted on to a audio cassette from the corpus. During extraction, the sample of the child's utterances was also transcribed using the symbol system for Kannada proposed by Schiffman (1979). The sample of normal child was also recorded for 90 minutes and the utterances were elicited to match the utterances of DAS child. Transcription was done for normal child also. Transcription of both the subjects was rechecked by a qualified Speech Language Pathologist. These utterances were analysed to look for the sound changes occurring and to identify the phonological processes. These processes were classified under each sound class and a particular process was added across the sound classes to give the

frequency of occurrence of a process. Based on this, a hierarchy of the processes was prepared for both the subjects.

The results showed that the phonological processes exhibited by the DAS child and normal child were different. The normal child exhibited a few processes, which were reported as normal processes in English as per the western literature. The only unusual process noted was denasalization and only one vowel process was exhibited, which was vowel assimilation. Aspiration was one of the processes, which was noticed and has not been reported in literature as a process. This was also exhibited by the DAS child. Based on these observations, we can infer that may be aspiration is a language specific normal process. To establish this phonological processes have to be studied in the normal and the disordered population in Kannada.

The DAS child also exhibited normal or natural processes as reported in western literature like syllable deletion, stopping, devoicing, fronting, vowelisation, lateralisation, cluster reduction, reduplication, voicing, gliding and palatalization. So, may be, these processes are normal processes across all languages which may be called as innate universal processes. This has also been commented on by Ingram (1979, 1986), and Nettlebladt (1983) regarding the theory of natural phonology, which states that the phonological processes are in some sense innate and therefore universal, because of the phonetic basis of speech. Similarly the processes noted as unusual in literature and found in the DAS child could be unusual processes across all languages. In addition to these,

the DAS child also exhibited certain processes, which have not been reported in literature. They are aspiration, addition of /, final consonant addition, medial constant addition, fricative addition. Certain vowel processes were also found which are not reported in literature, which are IVA, IVP, FVD and IVD. It is difficult to comment about these rules as either natural or idiosyncratic due to a lack of comparative literature in Kannada as well as any other Indian language. Normal or natural vowel processes were also found in the DAS child (Vowel lowering, monophthongization, diphthongization, vowel raising, vowel assimilation and centralisation). These again could be the universal processes that are common across all languages. In order to generalise these results further research in this field with a more representative sample is indicated.

Recommendations for future research

- A larger group of monolingual (Kannada) DAS children can be studied which can help in generalising these results.
- A study to establish the normal phonological developmental pattern in Kannada speaking children *needs* to be undertaken.
- More comparison studies can be undertaken using group design strategy to study the phonological processes in DAS and normal children to establish the natural and idiosyncratic process *e.s* .in Kannada speaking population.

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APPENDIX A

The phonological system of Kannada (Schiffman, 1979)

Vowel sounds

		Front	Central	Back
High	short	*i*		*u*
	long	*ii*		*uu*
Mid	short	*e*		***o***
	long	*ee*(ae)*		*oo*(d)*
Low	short		***a***	
	long		***aa***	

Dipthongs *ai* and *au* also occur. They may be considered to consist of *a+i* and *a+u* respectively. In addition, **ae* and * ∂ may occurr in foreign loanwords. But often, the Kannada letters *ee* and *aa* may be used instead of *ae* and **d* respectively, (Schiffrnan, 1979).

Vowel sounds:

The Kannada vowel system consists of five long and five short vowel phonemes, which are distinguished according to length (Sridhar, 1990).

Short vowels	**Long vowels**
i	*ii*
e	*ee*
o	*oo*
u	*uu*
a	*aa*

Ramanujam (1967) and Bright (1970) point that there is the deletion or extreme reduction of short vowels in spoken Kannada when they follow the first syllable of a word. Schiffman (1979) observes that long vowels (particularly when final) are shortened so that they are shorter than full long vowels, but generally a bit longer than short vowels.

Consonant sounds

	Stops and Nasals				
	Unaspirated	Aspirated	Unaspirated	Aspirated	Nasal
Velar	*k*	*kh*	*g*	*gh*	
Palatal	***c***	*ch*	*j*	*jh*	*n*
Retroflex	*T(ṭ)*	*Th(ṭh)*	*D(ḍ)*	*Dh(ḍh)*	*N(ṇ)*
Dental	*t*	*th*	*d*	*dh*	*n*
Lateral	*P*	*ph*	*b*	*bh*	*m*

	Glides	Sibilants		Fricatives	Lateral	Continuants
	Voiced	Voiceless	Voiced	Voiceless	Voiced	Voiced
Pharyngeal				***h***		
Retroflex		*S(ṣ)*			*L(ḷ)*	
Apicopalatal	***y***	*sh(ś)*				
Alveolar		***s***	***z****		***L***	
Labiodental	v		***f****			

(Note : The Kannada letters used for z and/are the same as those for *j/s* and *ph* respectively).

The literary version of Kannada varies in terms of phonology, lexicon, morphology, syntax or semantics. Some of the phonological variations include a) spoken Kannada tends to eliminate or use less frequently the aspirated consonants found in words borrowed from Sanskrit or other Indo-Aryan languages (Upadhyaya, 1976), b) Spoken Kannada deletes many short vowels found in literary Kannada words eg., *bandaru* (come) - *bandru.*

APPENDIX B

Target words used in the elidtation of the sample

Kannada words		Borrowed words
ba	*haudu*	*bassu*
beeku	*haaki*	*bɔl*
beDa	*huuvu*	*bukku*
appa	*akka*	*biskiT*
amma	*tegi*	*kap*
muugu	*kudko*	*bau bau*
ondu	*koDi*	*bai*
eraDu	*illi*	*rozez*
muuru	*ille*	*poket*
naalakku	*yella*	*ful*
aidu	*illa*	*ɔf*
aaru	*alli*	*pozez*
yeeLu	*tale*	*hasha*
enTu	*biDi*	*busha*
ombattu	*aache*	*ɔl*
hattu	*iDi*	*fɔ l*
paTaki	*ta*	*Daun*

baai	*idu*	*Tavar*
meele	*haalu*	*kaaru*
bantu	*haaku*	*fɔxn*
Topi	*haLadi*	*voc*
bittu	*kaNNu*	*plen*
avi	*kivi*	*sviiT*
catri	*kai*	*laaiT*
nandu		*halo*
naai		*kii*
niili		*cɔkleT*

Transcribed based on the phonological system proposed by Schiffinan (1979) and PA (1996).

APPENDIX C

Phonological processes selected

- Weak syllable deletion (WSD) - Omission (or loss) of unstressed syllable(s) in a word or more than one syllable.

  a) Pretonic WSD - eg., banana - ['nanə]

  b) Post-tonic WSD - eg., elephant - ['ɛfənt]

- Final consonant deletion (FCD) - Omission of final consonants,

  eg., bus - [bʌ]

- Initial consonant deletion (ICD) - Omission of initial consonant,

  eg., soup - [up]

- Medial consonant deletion (MCD) - Deletion of intervocalic consonants

  eg., bottle - [bio]

- Glide omission and substitution - Omission of/j/,/w/

- Stridency deletion - A strident sound [f,v,s,z, ʃ, ʒ, tʃ, dʒ] is either deleted or replaced with a non strident sound eg., soap - [op] or [top]

- Medial consonant substitution - Replacement of intervocalic consonants with one or more phonemes eg., button - [bʌ ja]

- Gliding - Replacement of a liquid by a glide eg., /l/ - [j] or [w] /r/ - [w] or [j]

- Glottal replacement / Realization - Use of the glottal stop [ʔ] as a replacement of target consonants eg., telephone - [tɛʔəʔon]
- Stops replacing glides - Substitution of stop consonant for a glide

  eg., yellow- [dɛlo]
- Fricatives replacing stops - Substitution of fricative consonant for a stop consonant eg., bat - [bæs]
- Cluster reduction (CR) - Deletion of one or more members of a consonant cluster eg., star - [tɑ]
- Consonant cluster substitution - Replacement of one member of a cluster

  eg., street - [stwit]
- Coalescence - Replacement of two sounds by a new one that combines features of both original sounds eg., thread - [fɛd]
- Epinthesis - Vowel is inserted to break the cluster eg., si - [s ə l]
- Initial consonant adjunction - Inclusion of an initial consonant,

  eg., apple - [ˈwabʊ]
- Vocalic support for final consonants and vowel insertion before a final consonant eg., bed - [ˈbɛdə], race – [ˈweiəs]

- Voicing - Loss of voiced/voiceless contrast, can be in initial or final position, eg., bat could be bat, bad, pat, pad.
- Devoicing - Replacement of a voicelss for a voiced sound, eg., beet - [pit]
- Postvocalic devoicing - Replacing of a voiced postvocalic obstruent with a voiced phoneme eg., page - [peIt∫]
- Prevocalic voicing - Replacing a voiceless prevocalic consonant with a voiced sound eg., two - [du]
- Prevocalic devoicing - Replacing a voiced prevocalic obstruent, with a voiceless phoneme eg., bee - [pi]
- Postvocalic voicing - Replacing a voiceless postvocalic consonant with a voiced sound eg., leaf- [liv]
- Devoicing of stops - Replacement of a voiced stop with a voiceless phoneme (usually a stop) in a word-initial position eg., daddy - [tɤdi]
- Reduplication - Duplicating the prominent (i.e., usually stressed) syllable of the target word eg., bottle - [bɒbɒ] – vowel reduplication

  bottle - [bɒdɒ] - consonant reduplication.

Associated patterns —

Doubling : Creation of two syllable form where the target is monosyllabic

eg., cat [ˈkaka]

Diminutives : Addition of [i]or even [ci] as a final syllable, usually again for target monosyllables eg., dog [ˈdɒgi]

- Assimilation (consonant harmony)- Manifest harmonization in the consonants in a word usually with regard to place of articulation eg., dark - [gɑ k]

  Labial assimilation - When there is a labial culprit in the word other sounds go to the labial position eg., cup - [pʌ p]

  Alveolar assimilation - When there is a alveolar culprit in the word, other sounds go to alveolar position, eg., cat – [tæt]

  Velar assimilation - When there is a velar culprit in the word, other sounds go to velar position eg., dog - [gɔg]

  Nasal assimilation - When there is a nasal culprit in the word, other sounds become nasal eg., lunch - [nʌnʃ]

  Manner assimilation - When there is a culprit having a particular manner in a word (i.e., stop, fricative, affricate, lateral etc.,) other sounds in the word take on the same manner eg., shoot- [ʃʉs]

- Perseveration - Repetition of syllable.

- Dissimilation - Child avoids the production of two like consonants in the same word eg., cake - [kep]

- Vowelization / Vocalization - Syllabic consonants including nasals and liquids are realized as full vowels, without the consonants in the word final position eg., button - [ˈbʌtə]

- Fronting - Change in place of articulation of the target consonant to a more anterior placement.

    a) Fronting of velar stops / k g ŋ / to alveolar placements, that is, [t d n]

    b) Fronting of palatoalveolar affricates and fricatives.

    eg., /tʃ dʒ ʃ ʒ / to alveolar placements, that is [ts, dz, s z]

- Backing - Non-back targets are realized to posterior place of articulation

    eg., tub - [k ʌ g]

- Backing of fricatives - Replacement of fricatives that are made in a more posterior position eg., suit - [ʃ ut]

- Backing of stops - Replacement of front consonants by phonemes made posterior to target phonemes (typically velars) eg., toe - [ko]

- Stopping - Target fricatives and affricates are replaced by homoorganic stops.

    eg., /f/ - [p], / θ / - [p/t] , /s/ - [t], / ʃ / - [t], /tʃ / - [t], /v/ - [b],

    /ð / - [b/d], /z/ - [d], / ʒ / - [d], /dʒ / - [d], /l/r/ - [d]

. Nasalization - Nasal emission during the production of typically nonnasal sounds.

- Denasalization - Target nasals are realized as homoorganic plosives,

  eg., broom - [bub]

- Lateralization - Emission of a sound to the side(s) rather than centrally effects primarily sibilants.

- Lateral realization of sibilants - eg., /s/ - [t]

- Alveolarization - Change of nonalveolar sounds, mostly interdental and labio-dental sounds into alveolar ones eg., thumb - [s ʌ m]

- Derhotacization - The loss of r-coloring in rhotics [r] and central vowels with r-coloring. [ɝ] and [ɚ] eg., ladder - [Lædə]

- Fricative enhancement - Strengthening of the fricative quality in voiceless stop liquid clusters, usually accompanied by some coalescence eg., tree - [tr]

- Palatalization - Realisation of phoneme to the palatal place of articulation.

  eg., /t/ - [ʧ]

- Palatalization of stridents : eg., /s/ - [ʂ] or [ʃ] and clusters /gr/ - [dʒ]

- Depalatalization : when the palatal component is deleted from a palatal phoneme target eg., shoe - [su]

- Pharyngealization/velarization : Production of consonants with an inappropriate constriction in the velopharyngeal area.

- Dentalization : of/ t,d,n,l/

- Apicalization of labial consonants : eg., pie – [tɑI] or [sɔ]

- Labalization of lingual consonants : to a labial place of articulation,

  eg., thumb - [fʌm]

- Labialization of fricatives : eg., /s/ - [f] or [w]

- Affrication : Realization of target fricatives as affricates eg., /s/ - [ts]

- Afftication of plosives : eg., /t/ - [ts]

- Deaffrication : Target afffricates being realized as fricatives eg., /tʃ / - [ʃ]

- Weakening : (or spirantization) of plosives eg., /p/ - [f]

- Tetism : /f/ is realised as [t] or [d]

- H - zation : Use of [h] for other consonants eg., /t; s; r;ɧ /

- Migration : Refers to the movement of a sound to another position in the word

  eg., blue - /bala/

- Metathesis : Position of two sounds in reversed, although both sounds are produced correctly eg., ask - /æk s /

- Lisping : Substitution 'th' for other sounds.

- Early sounds replaced by late sounds - In terms of acquisition.

  eg., /p/ - [k], pencil ['kɛ n z ə˞]

• Use of sounds absent from model language-eg., clock -[ɬ l p]

• Use of sounds absent from natural languages - soft -[n̪ˢ d̪ ɒ]

• Deletion of unstressed functor words - A limited form of deletion of unstressed syllables whereby only the functor words (preposition, articles, infinitives etc.) are involved eg., I wanna go to the store -1 wan go store.

• Deletion of unstressed bound morphemes - Omission of bound morphemes eg., ing, es (plural), ed (past).

• Stopping of fricatives (except in verbs)

• Glottal replacement in the copula and auxiliary "is"

eg., The boy is eating - ʔbɔɪ ɪ itiŋ ʔ

Vowel processes

• Vowel backing - A front vowel is replaced by a back vowel of a similar tongue height eg., *HI* - [ʊ]

• Vowel fronting - A back vowel is replaced by a front vowel of a similar tongue height eg., /u/ - *[i]*

• Centralization - A front/back vowel is replaced by a central vowel.

eg., / ɛ / - [ʌ]

• Decentralization - A central vowel is replaced by a front/back vowel.

eg., /ʌ/- [ʊ]

- Vowel raising - A front vowel is replaced by a front vowel with a higher tongue position, or a back vowel is replaced by a back vowel with a higher tongue position. eg., /æ/ - [ɛ]

- Vowel lowering - A front vowel is replaced by a front vowel with a lower tongue position or a back vowel is replaced by a back vowel with a lower tongue position eg., /u/ - [ʊ]

- Dipthongization - A monophthong is realized as a diphthong eg., /ɛ/ - [ɛ^{ɪ}]

- Monophthongization (or diphtong reduction)- A diphthong is realized as a monophthong eg., /a^{ɪ} / - [a]

- Complete vowel harmony - A vowel change with in a word that results in both vowels being produced the same eg., /tɛ di/ - [tɛ dɛ]

- Tenseness harmony - A lax vowel becomes tense when there is another tense vowel in the same word eg., /mɛ n i/ - [meni]

- Height vowel harmony - A vowel is replaced with a vowel that is closer in tongue height to another vowel in the same word eg., /bæskIt/ - [bɛskIt]