LANGUAGE IN INDIA

Strength for Today and Bright Hope for Tomorrow

Volume 12 : 11 November 2012

ISSN 1930-2940

Clustering of Disfluencies in 2.1 to 3 Year Old Kannada Speaking Children

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Disfluency – Definition and a Brief Review

Interruptions or breaks in the normal flow of speech are termed as disfluencies, i.e., disfluency is anything that impedes the forward movement of speech. The preschool child is developing vocabulary, grammatical structures and the ability to talk about abstract ideas and events. Because these skills are not yet fully developed, there is a lack of automaticity. Hence, the child might struggle to find the word he wants to say to communicate his idea. Hence, it appears that for most youngsters, disfluency is part of the developmental process.

In the period between two to three years, children start acquiring early syntactic skills as they learn to join two or more words together. It has been observed that normally speaking children exhibit interruptions or breaks in fluency even in these early utterances (Yairi, 1981, 1982; Colburn and Mysak, 1982).

In the earlier studies, disfluency analyses were limited to defining and identifying only single instances of disfluencies (Johnson, Boehmler, Dahlstrom, Darley, Goodstein, Kools, Neelley, Prather, Sherman, Thurman, Trotter, Williams & Young) 1959; Haynes and Hood, 1977; Yairi, 1981, 1982). However, it can be noted that while some disfluencies appear to occur singly, there is a tendency for disfluencies to join or cluster together on same or adjacent words. Some studies have thrown light on the clustering phenomenon in preschoolers' speech (Silverman, 1973; Colburn, 1985, Logan and LaSelle, 1999; Korah, Manuel and Narayanan, 2011).

It can be presumed that disfluencies cluster together just as a matter of chance. In this view, various speech disfluencies that constitute a cluster would be seen as being unrelated to one another. This view cannot be considered because studies [Silverman (1973), Colburn (1985) Hubbard and Yairi (1988) LaSelle and Conture (1995)] have shown that speech disfluencies appear to cluster together at levels significantly greater than expected by chance.

Also, most studies focusing on disfluencies and their clusters have been predominantly carried out using English speaking children (e.g., Johnson et al., 1959; Silverman, 1973; Colburn, 1985; Ambrose and Yairi, 1999; Hubbard and Yairi, 1988; Logan and LaSalle, 1999). Since stuttering and disfluencies are observed across cultures and languages (Bloodstein, 1995; Cooper and Cooper, 1998; Shapiro, 1999, Carlo and Watson, 2003), studies involving children from culturally and linguistically diverse backgrounds becomes essential. Several studies on the disfluencies of Kannada speaking children have been carried out (Nagapoornima, 1990; Indu, 1990; Rajendraswamy, 1991; Yamini, 1990; Geetha, Karanth and Shetty, 2000; Korah, Manuel and Narayanan, 2011). However, most of these have focused on the measurement of single instances of disfluencies. Further, clustering phenomenon has been studied only in the disfluencies of 5-6 year old Kannada speaking children (Korah, Manuel and Narayanan 2011) and the authors suggest the need to probe into the cluster disfluencies of younger children. Also, none of the previous studies involving both English and Kannada speaking children have probed into the possible gender differences with respect to the clustering phenomenon.

Further, data on clustered disfluencies in typically developing children would be essential for the diagnosis of stuttering. Hence the following study investigated clustering of disfluencies in the speech of 2-3 year typically developing Kannada speaking children. Specifically, the extent of clustering, the disfluency types that cluster together more frequently, and gender differences in clustering were investigated.

Method

Subjects: Ten children (5 boys and 5 girls) in the age group of 2-3 years participated in the study. Only native speakers of Kannada and children with no history of speech, language or

hearing problems, no orofacial abnormalities and no neurological problems were considered. Screening procedures were used to rule out voice, articulation, fluency and language anomalies. Oral mechanism examination and hearing screening was done to rule out any abnormality.

Material: Material was specially developed. It included pictures (common objects, body parts, vehicles, fruits, vegetables, vehicles, action verbs) and cartoons depicting simple stories.

Procedure: Speech samples were elicited using the material developed in conversation and narration task. Simple questions were asked to involve the child in conversation and for narration task, pictures and cartoons were used. Care was taken to ensure that the sample was no less than 5-minute duration of the child's talking. Conture (1990) noted that the sample size should be sufficient to permit averaging across several 100 word samples. Hence, a 1000 word sample from each child was considered for the study. The speech samples from the children were audio recorded using a digital sound recorder.

Analyses: The recorded speech samples were transcribed verbatim and the presence of the following disfluencies were analysed using the adaptations of classification systems given by DeJoy (1975), Yairi (1981), DeJoy and Gregory (1985), Campbell and Hill (1987) and Carlo and Watson (2003). Accordingly, the disfluencies analysed included: interjections (I), sound repetition, part-word repetition (PWR), word repetition (WR), Phrase repetition (PR), Revisions, Dysrhythmic phonation (DP) , Tense Pause (TP). The description of these disfluencies has been provided in Appendix A.

The disfluencies were further classified as Stuttering-like Disfluencies (SLD) and Other Disfluencies (OD) as stated by Young (1984) and Yairi and Ambrose (1992). Accordingly, Sound Repetitions, Single-syllable word repetitions, Dysrhythmic phonations were considered **Stuttering-like disfluencies** (SLD) (found more evidently in the speech of children with stuttering). Word repetitions, phrase repetitions, interjections and revisions were classifies as **Other Disfluencies** (found more in typically developing children as part of the normal non fluency stage.)

A single instance of disfluency was defined as a disfluency within an utterance. For example, [da daddy dropped me to school] which comprises of one instance of part word repetition. Clustering was defined as ".... the occurrence of two or more instances of disfluency on the same word and/ or consecutive words" (Silverman, 1973). For example, [my dad mummy dr drops me to um school]. This comprises of Revision, Part word repetition and Interjection.

While calculating % disfluency for clusters each cluster was considered as one unit and added to the single instances to compute total % disfluency (e.g., in an utterance, my my mommy sent me to school dance clclass, WR has occurred as single instance and a cluster of R and PWR is seen.

The percentage of each child's total frequency of utterances containing single instances of disfluency, and utterances containing clusters of two through four disfluencies were calculated using the following formulae.

$$\% \text{ disfluency} = \frac{\text{Total no. of disfluencies}}{\text{Total no. of syllables}} * 100$$

$$\% \text{ single disfluency} = \frac{\text{Total no. of single disfluencies}}{\text{Total no. of syllables}} * 100$$

$$\% \text{ clustered disfluency} = \frac{\text{Total no. of clustered disfluencies}}{\text{Total no. of syllables}} * 100$$

Results

Single vs. Clustered Disfluencies

Of the total number of subjects with 5 boys and 5 girls in the age group of 2-3 years, in a speech sample comprising of 1000 syllables, 2.5% occurred as single instances of disfluencies and 0.41% clustered disfluencies were observed.

The average percent of single disfluencies was six times more than the average percent of clustered disfluencies in the 10 children. Also, boys showed relatively higher percentage of disfluency compared to the girls with a ratio of 1.3 for overall disfluency and for single and clustered disfluencies. Table 1 shows the percent of single and clustered disfluencies.

	Mean % disfluencies	
Mean	Single disfluencies	Clustered disfluencies

Boys	3.34	2.88	0.46
Girls	2.52	2.16	0.36
Total	2.93	2.52	0.41

Table 1: Percent Disfluency for Single and Clustered instances

Within the disfluencies, around 14% of the disfluencies were clustered and 86% occurred as single instances as shown in **table 2**.

Subjects	% single disfluencies	% clustered disfluency
Boys	86.23	13.77
Girls	85.71	14.28
Total	86	13.99

Table 2: percentage of single vs. clustered disfluencies among total disfluencies

Analysis of Single disfluencies

Among the single disfluencies, Interjections were seen predominantly (31%), followed by part word repetitions (16%), Revisions (16%), Word Repetitions (14%), Dysrhythmic Phonations (8%), Phrase Repetition (6%), Tense Pause (6%) in the decreasing order of percent disfluency. The least frequently occurring disfluency was Sound Repetitions (3%). Thus overall, other disfluencies (interjections, part word repetitions –here predominantly multi syllabic part word repetitions, revisions and word repetitions) occurred with a greater frequency than Stuttering – Like Disfluencies (disrhythmic phonation, tense pause). Phrase repetitions were found less in speech of children between 2 to 3 years. Table 3 shows percent of each disfluencies.

Disfluency type	% disfluency (Total)	% disfluency	
		Girls	Boys
Interjection (I)	31.06	28.14	34.92
Sound repetition(SR)	3.41	2.99	3.97
Part-word repetition (PWR)	16.69	13.77	20.59
Word repetition(WR)	14.03	14.97	11.9
Phrase repetition(PR)	6.82	5.99	
Revision (R)	16.72	16.17	17.46
Dysrhythmic Phonation(DP)	8.29	11.98	4.96
Tense Pause(TP)	6.82	5	11.9

Table 3: Percentage disfluency for each disfluency type.

Also, among the other disfluencies, girls showed a higher frequency of occurrence for interjections, part word repetitions and revisions. Word repetitions were found more in boys compared to those in girls. Phrase repetitions were not seen in girls. Results of Mann Whitney test showed significant difference between genders on Dysrhythmic Phonations. Boys showed more Dysrhythmic Phonations compared to girls. Figure 1 and tables 4 and 5 show mean frequency of disfluencies in both genders, and results of Mann Whitney test, respectively.

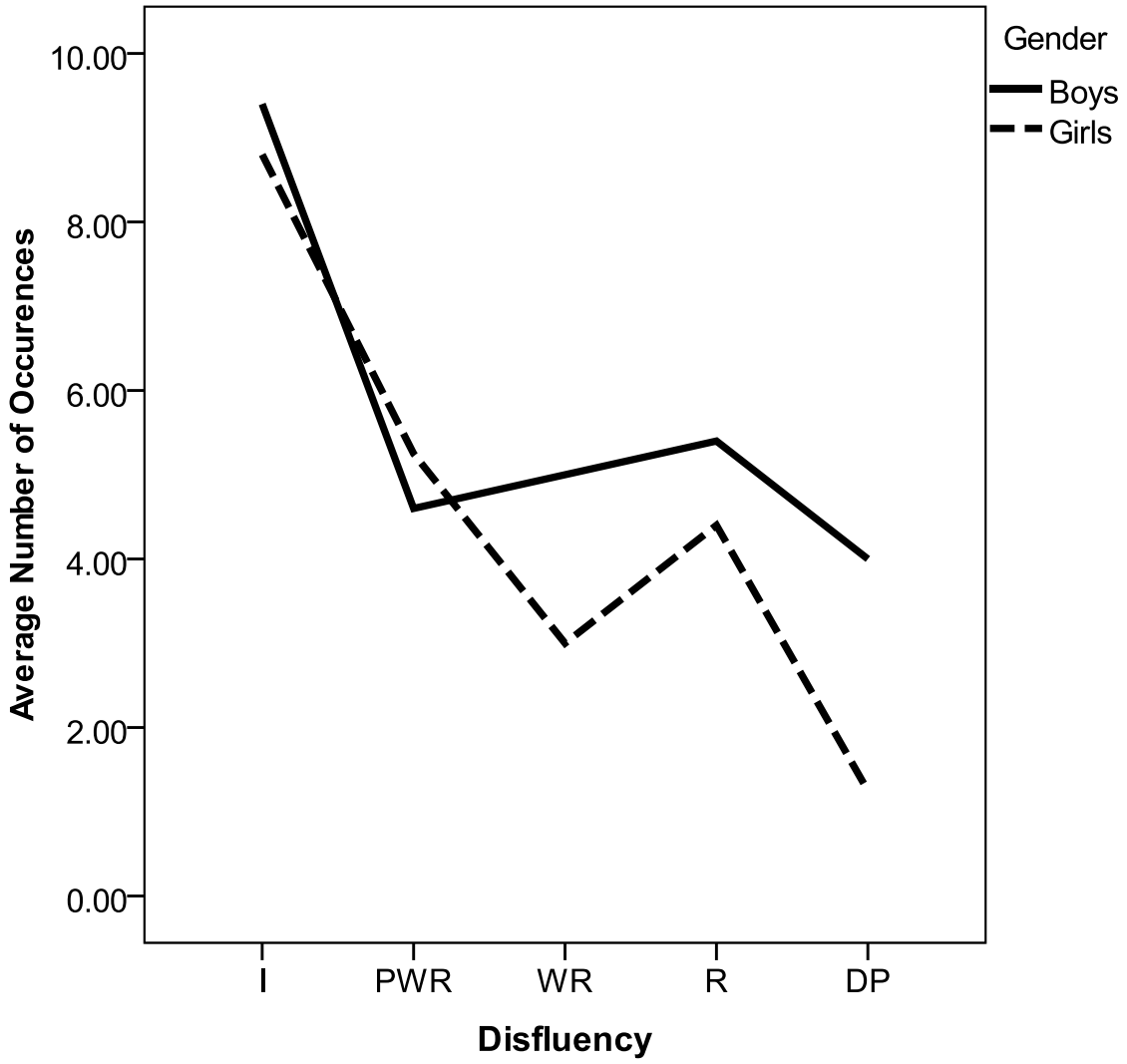

Fig. 1: Mean frequency of disfluency for boys and girls (I = interjection; PWR = part=-word repetition; WR = word repetition; R = revisions; DP = dysrhythmic phonation)

GENDER			N	Mean	Std. Deviation	Median
dimension	Boy	I	5	9.4000	8.26438	6.0000
		PWR	5	4.6000	3.36155	4.0000
		WR	5	5.0000	2.54951	4.0000
		R	5	5.4000	2.96648	5.0000
		DP	3	4.0000	2.00000	4.0000
	Girl	I	5	8.8000	4.86826	8.0000
		PWR	4	5.2500	3.50000	5.5000
		WR	4	3.0000	1.41421	2.5000
		R	5	4.4000	2.60768	4.0000
		DP	4	1.2500	.50000	1.0000
	Total	I	10	9.1000	6.40226	7.0000
		PWR	9	4.8889	3.21887	4.0000
		WR	9	4.1111	2.26078	3.0000
		R	10	4.9000	2.68535	5.0000
		DP	7	2.4286	1.90238	2.0000

Table 4:

Mean frequency and Standard Deviation Values for the disfluency seen in majority of the subjects

	I	PWR	WR	R	**DP**
Z	-.105	-.247	-1.501	-.638	-2.038
Asymp. Sig. (2-tailed)	.916	.805	.133	.523	**.042**

b. Grouping Variable: GENDER

Table 5: Mann Whitney test results

Analysis of Clustered Disfluencies

Of the total disfluencies approx., 86% disfluencies occurred as single instances while 14% appeared to be clustered. Among the clustered disfluencies, around 11.2% appeared as 2- cluster disfluencies, 2.05% appeared as 3 cluster disfluencies and 0.68 % appeared as 4 cluster disfluencies. Overall the girls showed higher percent of cluster disfluencies, specifically 2 cluster disfluencies compared to the boys. No 4 cluster disfluencies were seen in the girls. Table 6 shows distribution of clustered disfluencies.

Subjects	% cluster disfluencies	% 2 cluster disfluencies	% 3 cluster disfluencies	% 4 cluster disfluencies
Boys	13.77	10.18	2.39	1.2
Girls	14.28	12.69	1.59	
Total	13.99	11.26	2.05	0.68

Table 6: Distribution of clustered disfluencies

Interjections, Part word repetitions, Word Repetitions and Revisions tended to occur more frequently as singles than in clusters. This shows that the "Other Disfluencies" have a tendency to occur more as single instances though they can occur in combination with other types of disfluencies in clusters. Table 7 shows mean frequency of disfluency types occurring as single and clusters.

Disfluency	Mean frequency of single disfluencies			Mean frequency of clustered disfluencies		
	Total	Boys	Girls	Total	Boys	Girls
I	9.1	9.4	8.8	2.78	3.25	2.4
SR	1	1	1	1	1	
PWR	4.89	4.6	5.25	1.83	1.33	2.33
WR	4.11	5	3	2.25		2.25
PR	2	2		1	1	1
R	2	2		1	1	1
DP	2.43	2	1.25	1.67	1.67	
TP	2	1.67	3	1		1

Table 7: Mean Frequency of disfluency types occurring as singles and in clusters (I = interjection; SR = syllable repetition; PWR = part word repetition; WR = word repetition; PR = prolongation; R = revisions; DP = dysrhythmic phonation; TP = tense pause)

Discussion

The results of the study revealed several interesting points. First of all, ***all the children had less than 5% disfluency*** and hence could be considered as being only normally nonfluent as per the reports of several Western studies like Wexler and Mysak (1982), Haynes and Hood (1977), Yairi (1981), DeJoy and Gregory (1985, Pellowski and Conture (2002).

Second, the ***average percent of single disfluencies was six times more than the average percent of clustered disfluencies*** in the 10 children. Also, boys showed relatively higher percentage of disfluency compared to the girls with a ratio of 1.3 for overall disfluency and for single and clustered disfluencies. This is in congruence with Yairi (1981) who reports slightly higher disfluency values for 2-3 year old children, although this difference is not statistically significant.

Third, ***other disfluencies*** (interjections, part word repetitions –here predominantly multi syllabic part word repetitions, revisions and word repetitions) ***occurred with a greater frequency than Stuttering –Like Disfluencies*** (disrhythmic phonation, tense pause). This is in accordance with previous studies which have found occurrence of Stuttering like disfluencies to be lower than other disfluencies in typically developing preschool children (Ambrose and Yairi, 1995, 1999)

Fourth, ***phrase repetitions were found less in speech of children*** between 2 to 3 years. This is in congruence with the explanation given be DeJoy and Gregory (1985) that, 2 year olds may be relatively restricted in the structures they have available to use, i.e. as they are just beginning to use syntax in speech, they may not be formulating many combinations of words/phrases. Table 3 shows percent of each disfluencies.

Fifth, ***results of Mann Whitney test showed significant difference between genders on Dysrhythmic Phonations***. Boys showed more Dysrhythmic Phonations compared to girls. Since Dysrhythmic Phonations form an important part of Stuttering like disfluency, it can be assumed that boys produced more SLDs than the girls. This is in congruence with previous studies (Ambrose and Yairi, 1995, 1999).

Lastly, within the disfluencies, ***around 14% of the disfluencies were clustered and 86% occurred as single*** instances. Colburn (1985) however found 64% of disfluencies to be single and 36% to be clustered. Silverman (1973) also reported that her subjects (4 year old) produced 38% of their disfluencies in clusters. The ratio of single vs. clustered disfluencies obtained in the

present study is slightly higher owing to the subjects being from different cultural and linguistic background i.e., the previous studies were based on English speaking children, while the present study employed Kannada speaking children. The results of this study thus warrant the need for age and language specific analyses of clustered disfluencies. ***Among the clustered disfluencies, around 11.2% appeared as 2- cluster disfluencies, 2.05% appeared as 3 cluster disfluencies and 0.68 % appeared as 4 cluster disfluencies.*** This is in accordance with Colburn (1985) who reported high occurrence of 2 cluster disfluencies compared to the higher combinations. Overall the girls showed higher percent of cluster disfluencies, specifically 2 cluster disfluencies compared to the boys. This may be attributed to faster maturity and rate of speech and language development in girls in contrast to the boys i.e., the girls acquire syntactic skills (i.e. stringing words together) earlier than the boys (Colburn, 1985).

Conclusions and Implications

The study throws light upon the clustering phenomenon seen in the speech of very young typically developing Kannada speaking children in the age range of 2 to 3 years. Thus as children begin to use syntax they start exhibiting clustering phenomenon even in their normal disfluencies. Since it may not be worthwhile generalising findings from western studies, attempt was made to collect and analyse data from Indian population. This study thus provides a base for studying clustering phenomenon in other languages and for different age groups among the pre school population. Given that disfluencies are influenced by gender, an attempt was made to study gender differences in clustering phenomenon. Although statistically gender difference could not be computed, this study warrants the need for computing gender differences in the higher age groups. Also, employing a bigger sample would provide clear cut normative values for clustering phenomenon in the speech of preschool children and aid in better statistical computation.

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APPENDIX A

1. Interjection (I) - Insertion of sounds, syllables, words or phrases within an utterance. These insertions are not associated with the fluent or meaningful text and are not part of the intended message.

2. Sound repetition (SR) - Repetition of a phoneme that does not stand alone as an intended syllable or word.
3. Word repetition (WR) – Repetition of whole words. I went to school school
4. Part word repetition (PWR) - Repetition of part of words.eg., mom mommy
5. Phrase repetition (PR) - Repetition of two or more words, with no revision or modification of content.eg., I have I have a book
6. Revision(R) - Modification in the content or grammatical form of an utterance. Revision also includes changes in the pronunciation of a word.eg., I went home I went to school
7. Dysrhythmic Phonation (DP) – it includes prolongations and broken words.
   Broken word (BW)- Momentary cessation of phonation within words.
   Prolongations (P) - Audible prolongation of sounds within or at the end of words that are judged to be not intended.
8. Tense Pause (TP)- Long pauses between words during which audible tense vocalizations are present.

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