Stuttering.docx

by Author Author

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Background

Stuttering is a fluency disorder that is observed as disruptions in the natural flow of speech. These dysfluencies can be in terms of repetitions (sounds, syllables, and or words) prolongations (sounds, syllables and or words) and blocks. Dysfluencies are accompanied by secondary behaviors such as nose flaring, jerky articulatory movements, head and extremities movement, etc. Previous studies have reported the presence of stuttering in older children and adults more in males than females with an approximate ratio of 4:1(Craig, Hancock, Tran, Craig, & Peters, 2002).

Various aspects related to stuttering have been investigated. One of the long reviewed and researched aspect is the linguistic feature associated with stuttering (Brown, 1945). Linguistic factors include phonetic, lexical, morphological,syntactic, and pragmatic factors. Phonetic determinants influencing stuttering are inclusive of consonants, vowels, and consonant clusters. Previous studies have indicated the presence of stuttering more on consonants than vowels (Brown, 1945; Hejna, 1963; Geetha, 1979) and on consonant clusters than singleton consonants(Howell, Au-Yeung, & Sackin, 2000; Howell & Au-yeung, 2007).

Huinck, Van Lieshout, Peters, and Hulstijn (2004), conducted a study on production tasks on different types of clusters in the Dutch language. They reported that Adults who stutter (mean age 23.7 years) had longer production durations for cluster non-words. Similarly, in 2007,Howell and Au-yeungconducted a study in Englishusing conversation tasks on participants with a mean age of 8.0-26.9 years. They analyzed the phonetic complexity and factors leading to stuttering in English. They found that cluster words could lead to stuttering. However, a study conducted by Masumi, Kashani, Hassanpour, and Kamali(2015) on 16 Adults who stutter(AWS)suggested no

significant difference between clusters words and non-words without cluster for reading task. Similarly, Byrd, Coalson, Yang, and Moriarty (2017) investigated the effect of phonetic complexity in English on picture naming tasks in 15 Adults who stutter (AWS) and Adults who do not stutter (AWNS) in the age range of 18-46 years. Concerning cluster consonants, no significant difference was found between AWS and AWNS for its speed of production. Thus mixed findings have been reported regarding the phonetic effect of consonant clusters. These could be due to the methodological differences and linguistic properties of the language considered for the studies.

The dysfluencies on words with clusters could be explained by EXPLAN (Howell & Au-Yueng, 2002) theoryand the Covert Repair Hypothesis (CRH) (Postma & Kolk, 1993).EXPLAN theory (Howell & Au-Yeung, 2002)suggests the occurrence of stuttering as a result of increased time to plan and execute the segments of speech. Two components are considered; the linguistic formulator that generates plan (PLAN) and the motor process (EX) is required to execute this plan. This theory suggested that both PLAN and EX are independent and equivalent to each other. This feature leads to the rapid planning and execution of the next segment of the word. Ideally, the PLAN is delivered before the EX and any delay in this process leads to a fault that is perceived as a stutter (stalling or advancements).

Covert Repair Hypothesis (CRH) (Postma & Kolk, 1993),derives its ideology from Levelt's model of speech production which comprises of a pre- articulatory monitoring stage. CRH states that persons who stutter (PWS) demonstrate deficits in phonological encoding in terms of temporal aspects (slower). When this encoding plan is affected, it yields to covert repairs, restarts, and delay that is observed as the overt behavior of stuttering. Thus, stating that stuttering occurs due to the occurrence of self-repairs during an ongoing speech. CRH explains the

incidence of dysfluencies like prolongations, repetitions, and interruptions as a process of covert repair (Au-Yeung, Gomez, & Howell, 2003).

Literature has also focused on investigating the difference between the frequency and typology of dysfluencies between children and adults who stutter. Recent literature has also highlighted the presence of cluster dysfluencies in PWS. Cluster dysfluencies were initially identified by Silverman (1973). (Silverman, 1973)(Silverman, 1973)(Silverman, 1973)He affirmed them as the presence of two or more dysfluencies on a single word or adjacent words. The dysfluencies are classified as Stuttering like dysfluencies (SLD's) or other dysfluencies (OD's) or mixed dysfluencies (SLD-OD type).

The presence of cluster dysfluencies can reflect the components affected in stuttering. As stated by Wexler and Mysak, 1982 clusters with SLD like dysfluencies are indicative of motor factor of speech (timing- coordination aspect). Similarly, through the EXPLAN theory, stalling and advancements can be explained. Stalling dysfluencies are inclusive of OD's (phrase repetitions, interjections, whole word repetitions, silent pauses) and advancements include SLDs (part- word repetitions, prolongations, broken words).

Previous studies have been conducted to identify the types of cluster dysfluencies on Children with stuttering (CWS) and Children with no stuttering (CWNS).Researchers have found that OD type dysfluencies are more evident in CWS (Colburn, 1985;LaSalle & Conture, 1995; Hubbard, 2017). Limited studies have been conducted on adults. A study conducted by Robb, Sargent, and O'Beirne(2009) revealed that AWS demonstrated fewer cluster dysfluencies when compared to CWS. They reported thatmixed types of dysfluencies were predominant in their utterances.

In summary, higher percentages of dysfluencies have been reported on cluster consonants when compared to singleton consonants. Similarly, cluster dysfluencies have been reported more frequently in children with stuttering.

Evidencing from the CRH model, it can be comprehended that investigating the effect of a simple (non-cluster words) and complex structure (cluster words) would provide us more insight on the effect of linguistic factors on stuttering. Inferring from the current literature, it can be seen that findings on the linguistic factors vary based on the languages. However, to the best of our knowledge, limited studies have been conducted on Indian languages especially on Kannada speaking adults. Kannada is a phonologically less complex language, and it constitutes more of the geminate consonant cluster (VC1C1V) as compared to non- geminate clusters (C1C2VC3). Thus, in the current study,we aim to explore the differences between the percentage of dysfluencies between cluster words and non-cluster words through a standardized reading passage in Kannada speaking adults who stutter.We also intend to explore the frequency of cluster dysfluencies in adults who stutter.

Method

Participants

The participants (N=30) were segregated into two groups based on the severity of stuttering. Group A constituted of 15 AWS (14 males, 1 female; age range=18-30 years, mean age= 20 years and 2 months) with moderate stuttering and Group B included 15AWS (12 males, 2 females; age range= 18-30 years, mean age= 24 years and 2 months) with severe stuttering.All the participants were recruited from the Department of Clinical Services, All India Institute of Speech and Hearing, Mysore.

The participants had to meet the following inclusionary criteria for the study: (a) native speaker of Kannada Language, (b) no history of speech, language, sensory or motor impairment (exception of stuttering), (c) no history of emotional or psychological disorders (d)Did not undergo any form of fluency therapy for past 5 years and (e) graduate level of educational qualification.

All the participants were assessed for stuttering by an experienced Speech Language pathologists based on the stuttering severity Instrument (SSI-4)(Riley, 1963)The severity of stuttering was measured based on the tasks of spontaneous speech and reading.

The percentage of stuttering was calculated as:

$$Percentage of Total dysfluencies (TDP) = \frac{Total number of syllables stuttered}{Total number of syllables suterred} * 100$$

Individuals with a score of 21-27 and 28-35,with a percentile range of41-77 and 78-95 were diagnosed as moderate and severe stuttering respectively.

Stimuli

A standardized Kannada passage (Gayathri,1980) constituting of total 263 syllables was considered. For the purpose of this study, words in the passage were segmented by the first author into two categories, cluster words (CW) and Non- Cluster words (NCW). The passage included 46 cluster words(CW) (e.g /radzjada/) and 30 non-cluster words (NCW) (e.g /u:ru/) which are listed **Appendix- 1**.These words lists were then verified by the second author. Clusters words were categorized as those words that had two sequences of consonants. It was inclusive of both geminate clusters (C1C1) for example /*namma*/and non- geminate clusters (C1C2), example /*sahyadri*/. All the clusters occurred predominantly in medial position except three words/*krishna*/, / *stha:na:*/and / *pradeshavu*/. The passage constituted of word length ranging from one syllable (eg: /*i:*/) - eight syllables*(/a:ndraprade:shagalalli:/)*.The combination of clusters in the passage were, /dzy/,/dy/,/shm/,/kr/,/shn/,/hy/, /dr/,/shv/,/pr/,/sth/,/shtra/,/rn/, /dhy/,/mb/,/nd/ /mm/,/dd/,/nn/, /ll/,/thth/,/tt/, and /kk/.

Procedure

The participants were comfortably seated in a soundproof room and were asked to read the Kannada passage. This was audio-video recorded using the Sony HDR-PJ340 handy cam. The experiment lasted for aduration of 10 minutes.Informed consent was taken from all the participants.

Analysis

The audio-video samples of the participants were orthographically transcribed (Broad Band transcription- International Phonetic Association (IPA), 1999) by the first author to identify the typology of dysfluency and clusters of dysfluencies. These were then verified by the second

author. The cluster of dysfluencies was identified as the presence of more than 2 dysfluencies on a single stuttered syllable (e.g. prolongation and blocks). The following outcomes were measured from the sample:

Total percentage of dysfluencies on cluster words was calculated as

$$TotalDysfluenciesonClusterwords(TDCWP) = \frac{Numberofclusterwordsstuttered}{Totalnumberofclusterwords} * 100$$

Total percentage of dysfluencies on non-cluster words was calculated as

$$TotalDysfluenciesonNonClusterwords(TDNCWP) = \frac{Numberofnonclusterwordsstuttered}{Totalnumberofnonclusterwords} * 100$$

Total percentage of cluster dysfluencies on cluster words was calculated as

$$TotalClusterDysfluenciesonClusterwords(TCDCWP) = \frac{Numberofclusterdysfluencyforclusterwords}{Totalnumberofclusterwords} * 100$$

Total percentage of cluster dysfluencies on cluster words was calculated as

$$TotalClusterDysfluenciesonNonClusterwords(TCDCWP) = \frac{Numberofclusterdysfluencyfornonclusterwords}{Totalnumberofnonclusterwords} * 100$$

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The data was entered and statistical analysis was carried out using the SPSS software (version21).

Results

A total of 30 participants were included in the study. However, three participants(2= moderate group, 1 = severe group) were identified as outliers and were removed from the statistical analysis. The Mean, Median, and Standard Deviation (SD) for moderate and severe groups of adults with stuttering are listed in **Table 1 and Table 2.** Since the standard deviations were high, the medians were considered for comparisons.Percentages of dysfluencies on cluster words and non-cluster words between and within adults with moderate and severe stuttering are discussed as follows:

The median percentage of dysfluencies on Cluster words and Non-cluster wordsbetween degrees of severity

Median values indicated that the adults with severe stuttering (Mean= 31.99; SD= 18.83; Median= 27.17) had higher percentage of dysfluencies on cluster words when compared to the adults with moderate stuttering (Mean = 19.06; SD=9.85; Median= 21.74). However, Mann Whitney Test suggested no significant difference (/z/=1.82; p>0.05) for the dysfluencies on cluster words for both adults with moderate and severe stuttering.Thusinferring from median values, adults with severe stuttering had more dysfluencies on cluster words when compared to adults with moderate stuttering.

For non cluster words, median values indicated higher percentage of dysfluencies in adult with severe stuttering (Mean= 27.14; SD= 18.53; Median =20.00) when compared to adults with moderate stuttering (Mean= 18.21; SD=11.99; Median=16.67). However, Mann Whitney test results indicated no significant difference (/z/ =1.29; p>0.05) for dysfluencies on non- cluster words for both adults with moderate and severe stuttering. Thus, with regards to the median

values adults with severe stuttering had more dysfluencies on non-cluster words when compared to adults with moderate stuttering.

In summary, adults with severe stuttering had higher percentages of dysfluencies on both cluster words and non-cluster words when compared to adults with moderate stuttering.

The median percentage of dysfluencies between Cluster Word and Non-Cluster Word for adults with moderate and severe stuttering

Median scores indicated that the percentage of dysfluencies were higher for cluster words (Mean= 19.06, SD= 9.85, Median = 21.74) when compared to the non cluster words (Mean= 18.21; SD=11.99; Median=16.67) for adults with moderate stuttering. However, Wilcoxon's sign ranked test result indicated no significant difference (/z/=0.38; p>0.05) between cluster words and non-cluster words. Thus by means of median values, it can be concluded that the percentage of dysfluencies is more in cluster words when compared to non-cluster words for adults with moderate stuttering.

Similarly, median scores indicated that the percentage of dysfluencies were higher for cluster words (Mean= 31.99, SD= 18.83, Median = 27.17) when compared to the non cluster words (Mean= 27.14; SD= 18.53; Median =20.00) for adults with severe stuttering. However, Wilcoxon's sign ranked test indicated no significant difference (/z/=1.79; p>0.05) between cluster words and non-cluster words.Thus by virtue of median values, it can be concluded that the percentage of dysfluencies is more in cluster words when compared to non-cluster words for adults with severe stuttering.

Thus, in summary, cluster words had higher percentages of dysfluencies when compared to non-cluster words in both adults with moderate and severe stuttering.

The median percentage of cluster dysfluencies on Cluster Words and Non-Cluster wordsbetween degrees of severity

Median values indicated that both adults with moderate stuttering (Mean= 1.67; SD= 1.81; Median= 2.17) and severe stuttering (Mean= 3.26; SD= 4.49; Median= 2.17) had similar occurrences of cluster dysfluencies on cluster words. Mann Whitney Test results suggested no significant difference (/z/=0.57; p>0.05) for the cluster dysfluencies on cluster words for both adults with moderate and severe stuttering. Thus, both adults with moderate and severe stuttering had similar frequencies of cluster dysfluencies on cluster words.

Similarly, for non cluster words, median values indicated that both adults with severe stuttering (Mean=1.67; SD=2.53; Median =0.00) and moderate stuttering (Mean=0.51; SD=1.25; Median =0.00) had similar occurrences of cluster dysfluencies.Mann Whitney test results indicated no significant difference (/z/ = 1.30; p>0.05) for dysfluencies on non- cluster words for both adults with moderate and severe stuttering.Thus, both adults with moderate and severe stuttering had similar frequencies of cluster dysfluencies on non-cluster words.

In summary, both adults with moderate and severe stuttering had similar occurrences of cluster dysfluencies for both cluster and non-cluster words.

The median percentage of cluster dysfluencies between Cluster Word and Non-Cluster Word in adults with moderate and severe stuttering

Median scores indicated that the percentage of cluster dysfluencies were higher for cluster words (Mean= 1.67, SD= 1.81, Median = 2.17) when compared to the non cluster words (Mean=0.51, SD=1.25, Median= 0.00) for adults with moderate stuttering. Wilcoxon's sign ranked test result indicated no significant difference (/z/=1.70; p>0.05) for the frequency of cluster dysfluencies

between cluster words and non-cluster words.Thus by means of median values, it can be concluded that the percentage of cluster dysfluencies is more on cluster words when compared to non-cluster words for adults with moderate stuttering.

Similarly, in adults with severe stuttering, median scores indicated that the percentage of cluster dysfluencies was higher for cluster words (Mean= 3.26, SD= 4.49, Median = 2.17) when compared to the non-cluster words (Mean=1.67, SD=2.53, Median= 0.00). Wilcoxon's sign ranked test indicated a significant difference (/z/=2.11; $p < 0.05$) for the frequency of cluster dysfluency between cluster words and non-cluster words for adults with severe stuttering. Thus, it can be concluded that the percentage of cluster dysfluencies is more in cluster words when compared to non-cluster words for adults with severe stuttering.

In summary, a significant difference was obtained for adults with severe stuttering. Cluster dysfluencies had higher percentages of occurrence on cluster words when compared to on cluster words.

Qualitative analysis was done to assess the type of cluster dysfluencies between individuals with moderate and severe stuttering. The results revealed that both the groups had Stuttering like dysfluencies (SLD)(prolongations, repetitions, and blocks).However, occurrences of SLD's were more in adults with severe stuttering when compared to adults with moderate stuttering.

Discussion

In the current study, we examined the effect of syllable structure on speech dysfluencies of Kannada speaking adults who stutter. To study this, a standardized Kannada passage constituting the cluster and non-cluster words was used.To our knowledge, this is the first study to investigate the occurrence of cluster dysfluencies in Kannada speaking adults who stutter.

The results from the current study suggested that though not significant,a higher percentage of dysfluencies were present on cluster words when compared to non-cluster words in both adults with moderate and severe stuttering.Individuals with severe stuttering had higher percentages of dysfluencies on both cluster words and non-cluster words when compared to adults with moderate stuttering. These findings are in agreement with the findings of Huinck et al(2004). In the current study, significant differences were not obtained and can be attributed to the fact that the Kannada language has lesser frequencies of clusters and contributed to 7.5% of stutter data(Venkatagiri, Nataraja, & Deepthi, 2017). Also, it has been evidenced that individuals who stutter tend to be more dysfluent on less frequent words(Anderson, 2008).

Smith et al (2010)reported that with an increase in phonological complexity, there is an increase in dysfluencies in AWS. Hence, the occurrence of a higher percentage of dysfluencies can be attributed to the fact that cluster words have increased phonetic complexity.Research has indicated that individuals with stuttering have deficits in phonological encoding. It can be inferred that with an increase in phonological complexity there is an increase in cognitive load that leads to the delay in the phonological encoding process. Thus, increased encoding durations lead to an error in the motor program, which is reflected as a stutter. The evidence can also be drawn from the CRH model which states that stuttering occurs as a result of self-repairs due to the delay in the phonological encoding plan.

Another finding in the current study was the presence of cluster dysfluencies in individuals with moderate and severe stuttering. The results indicated that both groups had similar occurrences of cluster dysfluencies. Both the groups had SLD. This is in partial agreement with the study conducted by Robb et al (2009).The authors found both OD's and SLDs in adults who stutter. The variation in our study could be because of the methodological differences.

Similarly, by virtue of median scores, it was evident that cluster words had higher percentages of cluster dysfluencies when compared to non-cluster words. This finding can be attributed to the fact that cluster words have increased phonological complexity.The presence of SLD type of cluster dysfluency reflects the increased durations and tensions within the utterance, thereby categorically differentiating it from the typical dysfluencies(Perkins, Kent, & Curlee, 1991).

Conclusions

The current study highlightedthat, adults who stutter demonstrated higher percentages of dysfluencies on cluster words when compared to non-cluster words. These results yielded due to the phonetic complexity and lesser word frequency of the word type. Thus accounting as an important component to the linguistic factor related to stuttering. Also, cluster dysfluencies of SLD type were evident in both the groups of stuttering.Thus, suggesting that cluster dysfluencies are characteristic of individuals who stutter irrespective of the severity.The limitation of the current study was that the syllable length of the words was not considered. The current study only focused on the occurrences of dysfluency on the reading task. In specific, differences between cluster types (geminates and non-geminates) were not studied in detail.

Implications of the study

The current study provided insight into the influence of a complex syllable structure on the speech dysfluencies on adults who stutter. Even though the occurrence of clusters is lesser in frequency in the Kannada language, it can contribute to the linguistic factor influencing stuttering. The results of the current study also support the explanation of the EXPLAN theory and the Covert Repair Hypothesis. Thus the findings of the current study supplements to linguistic factors related to stuttering. However, recent authors state stuttering to be a complex

paradoxical condition. Thus, no single factor is associated to influence stuttering but a multifactorial model with the interaction of linguistic, cognitive, and motoric components is considered.

Table1: Mean, Median, and SD values for cluster words and non-cluster words between adults with moderate and severe stuttering.

Parameters	Adults with moderate stuttering				Adults with severe stuttering			
	N	Mean	SD	Median	N	Mean	SD	Median
PTDCW	13	19.06	9.85	21.74	14	31.99	18.83	27.17
PTDNCW	13	18.21	11.99	16.67	14	27.14	18.53	20.00

Note PTDCW:Percentage of Total Dysfluencies for Cluster words;PTDNCW:Percentage of Total Dysfluencies for Non -Cluster words

Table2: Mean, Median and SD values for cluster dysfluencies on cluster words and non cluster words between adults with moderate and severe stuttering.

Parameters	Adults with moderate stuttering				Adults with severe stuttering			
	N	Mean	SD	Median	N	Mean	SD	Median
PTCDCW	13	1.67	1.81	2.17	14	3.26	4.49	2.17
NCWCDP	13	0.51	1.25	0.00	14	1.67	2.53	0.00

Note PTDCW: Percentage of Total Cluster Dysfluencies for Cluster words;PTDNCW:Percentage of Total Cluster Dysfluencies for Non -Cluster words

1 Appendix

List of cluster words	List of non cluster words
1. namma, 2. radzyada 3. ondu 4. dodda 5. u:rannu 6. namma 7. raradzyada 8. bombai 9. yennuvaru 10. Indiyada 11. dodda 12. nagaragallali 13. ondu 14. u:rannu 15. u:rugalinda 16. idallade 17. namma 18. radzyadalliruva 19. nandi: 20. ivugalannu 21. nadinalli 22. re:shmeyannu 23. krishna 24. sahyadri 25. parvathagalalli 26. mahabaleshwarada 27. haththira 28. hutthuthade 29. prade:shavannu 30. sthana 31. maharashtra 32. karnataka 33. maththu 34. a:ndhrapradeshagalli 35. ko:lliyannu 36. se:ruthade 37. Idakke 38. tungabhadra 39. ghataprabha 40. malaprabha 41. a:vugallali 42. a:nekattanu: 43. katti	1. bengaluru 2. u:ru: 3. i: 4. i:du: 5. i: 6. nodalu 7. dzanaru: 8. be:re 9. be:re 10. baruvaru 11. be:lu:ru 12. jo:g 13. nodalu: 14. janaru 15. baruvaru 16. i: 17. beleyuvaru 18. nadiyu 19. i: 20. ramaniyavada 21. i:du 22. haridu 23. bangala 24. u:panadigalu 25. halavu 26. ko:yina 27. bhi:ma 28. kelavu 29. ko:yina 30. nadige

44. vidyuthannu 45. uthhpadane 46. ma:duththa:re	

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