Research Article

Effect of Syllable Complexity on Speech Disfluencies of Kannada Speaking Adults Who Stutter

JAIISH(2020)
Vol 39 pp. 23 -30

Sangeetha Mahesh & Reny Raju

Affiliations

All India Institute of Speech and Hearing,, University of Mysore, Manasangangothri, Mysore, 570006, Karnataka, India

Corresponding Author

Sangeetha Mahesh
All India Institute of Speech and Hearing,, University of Mysore
Mysore
570006
Karnataka
India.
smahesh64@gmail.com

Key Words

Stuttering
Cluster Words
Cluster Disfluencies
Phonetic Complexity
EXPLAN theory
Covert Repair Hypothesis

Abstract

Stuttering is a speech disorder that is described by involuntary disruptions in natural flowing speech. Literature focuses on the variation in the typology and frequencies of disfluencies in both children and adults who stutter. Speech disfluencies across languages have been explored in the western context and distinct findings have been reported on the occurrences of stuttering on phonetically complex structures along with the presence of cluster disfluencies. The current study aims to investigate the effect of syllable complexity (words with and without consonant clusters) on the speech disfluencies of Kannada speaking adults who stutter. Thirty Kannada speaking adults with stuttering in the age range of 18 to 30 years were considered. A standardized Kannada reading passage constituting of words with and without consonant clusters was used. Results indicated that WCC had higher percentages of disfluencies as compared to WWCC in adults with moderate as well as severe stuttering. However, these findings were not statistically significant. Also, cluster disfluencies on words with consonant clusters were observed to be greater in adults with severe stuttering when compared to adults with moderate stuttering. Concerning the typology of cluster disfluencies, a combination of Stuttering like Disfluencies (SLD-SLD type) was observed that indicated involvement of the motoric component of stuttering. Results have been discussed with regard to the Covert Repair Hypothesis and EXPLAN theory.

INTRODUCTION

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

Previous research has focused on investigating the difference between the frequency and typology of disfluencies between children and adults who stutter. Recent literature has also highlighted the presence of cluster disfluencies in persons who stutter (PWS). Cluster disfluencies were initially studied by Silverman (1973) and have been recently explored in adults who stutter (AWS) (Penttilä, Korpijaakko-Huuhka, & Kent, 2019; Robb, Sargent, & O'Beirne, 2009). Cluster disfluencies, as stated by Silverman (1973), refer to the presence of two or more disfluencies on a single word or adjacent words. Another variation in cluster disfluencies is the presence of complex disfluencies. Referring to several disfluencies that might appear adjacent to the clustered disfluencies. The presence of more than two disfluencies indicate severe speech planning difficulties when compared to a singleton or cluster of two disfluencies (Bóna, 2019). Cluster disfluencies are broadly classified as Stuttering like disfluencies (SLDs), Other disfluencies (ODs), and Mixed disfluencies (combination of SLDs and ODs). The presence of cluster dysfluencies can reflect the impairment of either linguistic or motor components related to stuttering. As stated by Wexler and Mysak (1982), while clusters with SLDs are indicative of deficits in motor aspect (timing-coordination) of speech, ODs reflect on issues in the linguistic component (planning) related to speech.

Studies have been conducted to identify the types of cluster disfluencies in children with stuttering (CWS) and children with no stuttering (CWNS). Researchers have found that ODs are more evident in CWS. They have also reported an increase in cluster disfluencies with an increase in the severity of stuttering (Colburn, 1985; LaSalle & Conture, 1995; Hubbard & Yairi, 1988). However, studies exploring cluster disfluencies in AWS are limited. A study by Robb, Sargent, and O'Beirne (2009) revealed that AWS demonstrated fewer cluster disfluencies when compared to CWS that mixed types of dysfluencies were predominant in their utterances.

The presence of cluster disfluencies could be attributed to the anxiety of the speaker about the occurrence of the single disfluency (Still & Griggs, 1979). It could also indicate the difficulty encountered during the articulation of phonetically complex utterances (LaSalle & Conture, 1995b) thereby. The association of phonetic determinants to stuttering has been widely explored using the Index of Phonetic Complexity (IPC) (Jakielski, 1998). Studies using IPC have been conducted by Dworzynski and Howell (2004) on German- English bilingual individuals with stuttering. The findings revealed that the word shape had an influence on stuttering. Previous studies have indicated the presence of higher percentages of stuttering on consonants than vowels (Brown, 1945; Mahesh & Geetha, 2015) and on consonant clusters than singleton consonants (Howell & Au-yeung, 2007; Howell, Au-Yeung, & Sackin, 2000; LaSalle & Wolk, 2011).

Throneburg, Yairi, and Paden (1994) studed the effect of phonological difficulty on disfluencies in children with stuttering and found that consonant clusters did not contribute to the occurrence of disfluencies. In contrast, Howell et al. (2009), conducted a study in English using conversation tasks on participants in the age range of 6 to 18 plus years. They analyzed the IPC and identified the factors that could lead to stuttering in English. Though at the lower end of the hierarchy, they found that contiguous consonant clusters might have an effect on stuttering. Similarly, Huinck, Van Lieshout, Peters, and Hulstijn (2004), investigated production of different types of clusters in Dutch language and reported that AWS (mean age 23.7 years) had longer production durations for cluster non-words. Further, a study conducted by Masumi, Kashani, Hassanpour, and Kamali (2015) on 16 AWS reported a significant difference in the frequency of disfluencies between clusters words and words without cluster for a non-word reading task. Similarly, Byrd, Coalson, Yang, and Moriarty (2017) investigated the effect of phonetic complexity in English on picture naming tasks in 15 AWS and adults who do not stutter (AWNS) in the age range of 18 to 46 years. No significant difference was found for the speed of production of these consonant clusters between AWS and AWNS. Thus, mixed findings have been reported regarding the phonetic effect of consonant clusters on stuttering. These could be due to the methodological differences (such as the tasks) and linguistic properties of the language (phonetic complexity) considered for the studies.

The occurrence of cluster disfluencies on phonetically complex utterances (cluster words) could be explained by two main theories of stuttering, the EXPLAN theory (Howell & Au-Yeung, 2002) and the Covert Repair Hypothesis (CRH) (Postma & Kolk, 1993). EXPLAN theory (Howell & Au-Yeung, 2002) posits stuttering to be 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), required for executing this plan. Ideally, the PLAN is delivered before the EX and any delay in this process leads to a fault that is perceived as a stutter. According to this model, phonetic properties are considered as a part of the speech plan. The EXPLAN model predicts that stuttering occurs due to increased phonetic complexity that leads to delay in planning and thereby, execution. Thus, consonant clusters, being phonologically complex, requires complex motor programming and timing control. Greater time can be expected to plan and execute consonant clusters due to its articulatory complexity. This delay in PLAN and EX can be perceived as disfluencies.

According to the EXPLAN theory, disfluencies can be stalling (ODs) or advancements (SLDs). While, the occurrence of stalling disfluencies reflect the linguistic segment (PLAN), advancing disfluencies reflect the motoric segment (EX). Thus, advancing disfluencies occur in SLD-SLD clusters and stalling occurs in OD-OD combinations (Robb et al., 2009). 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 PWS monitor their speech and during this process, they detect the errors in their phonetic plan even before the error is produced. On detection, they tend to repair the error that is exhibited as disfluencies. Thus, PWS demonstrate slower phonological encoding for words in terms of temporal aspects. When this encoding plan is affected, it yields to covert repairs, restarts, and delay that is observed as the overt behavior of stuttering. Occurrence of stuttering is, therefore, considered as self repairs during an ongoing speech. CRH also explains the instances of disfluencies such as prolongations, repetitions, and interruptions as a process of covert repair (Au-Yeung, Gomez, & Howell, 2003). Hence, following CRH, one may predict higher occurrences of disfluencies on complex target words (such as consonant clusters) (Wolk, Blomgren, & Smith, 2000). Due to the presence of a complex target, the clustering of disfluencies can also be related to self-repair made by an individual who stutters. In summary, higher percentages of disfluencies have been reported on consonant clusters when compared to singleton consonants. Similarly, cluster disfluencies have been reported more frequently in children when compared to AWS.

inferring from the CRH model, it can be speculated that investigating the effects of simple (non-cluster words) and complex structure (cluster words) on the disfluencies of stuttering would provide us more insight on the effect of phonetic complexity on stuttering. Inferring from the current literature, it can be seen that findings on the linguistic factors vary based on the languages in terms of the phonetic, phonological structure, syllable length, frequency of the words, overall complexity etc. However, to the best of the researchers' knowledge, limited studies have been conducted in Indian languages especially in Kannada. Hence, it is vital to explore the effect of these consonant clusters on the frequency of disfluencies in AWS.

Thus, in the current study, we aim to explore the effect of syllable complexity on the frequency and typology of the speech disfluencies of Kannada speaking AWS.

The objectives of the study are (i) to compare the percentage of disfluencies in words with and without consonant clusters in Kannada speaking adults with moderate and severe stuttering, and (ii) to study the frequency of cluster disfluencies in Kannada speaking adults with moderate and severe stuttering.

METHODS

Participants

A total of thirty Kannada- English sequential bilingual individuals. All participants had Kannada as their native language and had educational proficiency in English. sequential bilingual with stuttering were considered for the study. They were segregated into two groups based on the severity of stuttering. Group A constituted 15 AWS (14 males, 1 female; age range= 18-30 years, mean age= 20;2 years) with moderate stuttering and Group B included 15 AWS (12 males, 2 females; age range= 18-30 years, mean age= 24;2 years) with severe stuttering. All the participants were recruited from the Department of Clinical Services, All India Institute of Speech and Hearing, Mysore. An informed consent was obtained from each participant for the audio video recording. The study followed the guidelines of the Ethical Committee of the Institute.

The participants had to meet the following inclusion 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) no history of fluency therapy for past five years and (e) graduate level of educational qualification.

All the participants were assessed for stuttering by two experienced Speech-Language Pathologists (with experience of more than 4 years) based on the Stuttering Severity Instrument Fourth edition (SSI-4) (Riley & Baker, 2009). The severity of stuttering was measured on the basis of spontaneous speech and reading tasks. Cronbach's reliability test indicated an excellent inter-rater reliability ($\alpha = 0.90$) for the severity of stuttering.

Stimuli

A standardized Kannada passage (Shashidhar & Nataraja, 1984) consisting a total of 263 syllables was considered. For the purpose of this study, words in the passage were segmented by the second author into two categories, words with consonant clusters (WCC) and words without consonant clusters (WWCC). The passage included 46 words with clusters (e.g /ra:dzjada/) and 30 words without clusters (e.g /u:ru/). These words lists were then verified by the first author.

Cronbach's reliability test was performed to measure inter-rater reliability for the categorization of words as either WCC or WWCC. The value obtained was $\alpha = 0.85$, indicative of a good reliability. WCC refers to those words with two or three consecutive consonants. All the consonant clusters occurred predominantly in medial position except in three words - /kri$\int$na/, /st^{h}a:na/ and /prade:$\int$avu/. The length of the words in the passage ranged from one syllable (eg: /i:/) to eight syllables (/a:nd raprad e:$\int$agalalli/). The consonant clusters included in the passage were /dzj, / dj/, /shm, /kr/, /$\int$n/, /hy/, /d r/, /$\int$v/, /pr/, /sth/, /$\int$tra/, /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 a Sony HDR-PJ340 handy cam. The task lasted for a duration of ten minutes.

Analysis

The audio-video samples of the participants were orthographically transcribed by the second author. The dependent variables considered for this study were the typology of dysfluencies and occurrence of cluster disfluencies. The typology of disfluency included blocks, prolongations, part word repetitions, syllable repetitions, tense pauses and dysrhythmic phonation. The cluster disfluencies were classified as combinations of SLDs (SLD-SLD), ODs (OD-OD) or mixed as SLD-OD. These were then verified by the first author. The cluster disfluencies were identified as the presence of more than two disfluencies on a single stuttered syllable (e.g. prolongation and blocks). The inter rater reliability on Cronbach's test revealed good reliability ($\alpha = 0.81$) for the presence of cluster dysfluencies. The following outcomes were measured from the sample:

Total percentage of disfluencies on WCC was calculated as

$Percentage\ of\ Total\ Disfluencies\ on\ WCC\ (TDWCCP)$

$$= \frac{No.\ of\ disfluencies\ on\ WCC}{Total\ no.\ of\ WCC} * 100$$

Total percentage of disfluencies on WWCC was calculated as

$Percentage\ of\ Total\ Disfluencies\ on\ WWCC\ (TD\ WWCC)$

$$=\frac{No.\ of\ disfluencies\ on\ WWCC}{Total\ no.\ of\ WWCC} * 100$$

Total percentage of cluster disfluencies on WCC was calculated as

$Percentage\ of\ Total\ Cluster\ Disfluencies\ on\ WCC\ (TCDWCCP)$

$$=\frac{No.\ of\ disfluencies\ WCC}{Total\ no.\ of\ WWCC} * 100$$

Total percentage of cluster disfluencies on WWCC was calculated as

$Percentage\ of\ Total\ Cluster\ Disfluencies\ on\ WWCC\ (TCDWWCCP)$

$$=\frac{No.\ of\ cluster\ disfluency\ on\ WWCC}{Total\ no.\ of\ WWCC} * 100$$

The data was subjected to statistical analysis using SPSS software (version21). Shapiro Wilk test was administered to assess the normality of the data. Outliers (three participants) were identified and eliminated from the statistical analysis. The data did not follow normality, hence, non- parametric tests including Mann Whitney U test and Wilcoxon Signed rank test were used.

RESULTS

A total of 30 participants were included in the study. However, three participants (2 from Group A and 1 from Group B) were identified as outliers and their data were not included in the statistical analysis. The Mean, Median, Standard Deviation (SD) and Inter Quartile Range (IQR) related to the frequency of disfluencies and cluster disfluencies on WCC and WWCC are represented in Table 1 and Table 2. Since non-parametric statistics were used, median values were considered for comparisons.

Frequency of total disfluencies in Kannada speaking adults with moderate and severe stuttering

Comparison of median percentage of disfluencies between the two groups of participants indicated that adults with severe stuttering (Mean= 31.99; SD= 18.83; Median= 27.17, IQR= 29.89) had higher percentage of disfluencies on WCC when compared to adults with moderate stuttering (Mean = 19.06; SD= 9.85; Median= 21.74, IQR= 18.48). However, Mann Whitney U Test suggested no significant difference (/z/= 1.82; p= 0.06) for the disfluencies on WCC between adults with moderate and severe stuttering. For WWCC, median values indicated higher percentage of disfluencies in adults with severe stuttering (Mean= 27.14; SD= 18.53; Median= 20.00, IQR= 35.00) when compared to adults with moderate stuttering (Mean= 18.21; SD= 11.99; Median= 16.67, IQR= 16.67). However, results of Mann Whitney U test indicated no significant difference (/z/= 1.29; p= 0.19) for disfluencies on WWCC between adults with moderate and severe stuttering. In summary, adults with severe stuttering had higher percentages of disfluencies on both WCC and WWCC when compared to adults with moderate stuttering.

Median percentage of dysfluencies were also compared between words with and without consonant clusters in the two groups of participants. The percentage of disfluencies were higher for WCC (Mean= 19.06, SD= 9.85, Median= 21.74, IQR= 18.48) when compared to the WWCC (Mean= 18.21; SD= 11.99; Median= 16.67, IQR= 16.67) for adults with moderate stuttering. However, results of Wilcoxon's signed rank test indicated no significant difference (/z/= 0.38; p= 0.70) between WCC and WWCC. Similarly, median percentage of disfluencies were higher for WCC (Mean= 31.99, SD= 18.83, Median= 27.17, IQR= 29.89) when compared to WWCC (Mean= 27.14; SD= 18.53; Median= 20.00, IQR= 35.00) for adults with severe stuttering.

While, the proportion of disfluencies on WCC among the total disfluencies for adults with moderate stuttering was 0.62:1, for adults with severe stuttering, it was 0.64:1. WCC exhibited higher percentage of dysfluencies (62%) compared to WWCC (38%) in the group of participants with moderate stuttering. Almost similar percentages were obtained for adults with severe stuttering (WCC=64% and WWCC=36%) (Figure 1). Thus, in summary, WCC had higher percentages of disfluencies when compared to WWCC in adults with both moderate and severe stuttering.

Frequency of cluster disfluencies in Kannada speaking adults with moderate andsevere stuttering

Comparison of median percentage of cluster disfluencies on WCC and WWCC between the two groups of participants indicated that both adults with moderate stuttering (Mean= 1.67; SD= 0.81; Median= 2.17, IQR= 3.26) and severe stuttering (Mean= 3.26; SD= 4.49; Median= 2.17; IQR= 7.06) had similar occurrences of cluster disfluencies on WCC. This was statistically verified using Mann Whitney U Test and the results revealed no significant difference (/z/= 0.57; p= 0.57) for the cluster disfluencies on WCC between adults with moderate and severe stuttering. Similarly, for WWCC, median values indicated that both adults with severe stuttering (Mean= 1.67; SD= 2.53; Median= 0.00, IQR= 4.16) and moderate stuttering (Mean= 0.51; SD= 1.25; Median= 0.00, IQR= 0.00) had similar occurrences of cluster disfluencies. Mann Whitney test results indicated no significant difference (/z/= 1.30; p= 0.19) for disfluencies on WWCC between the two groups of participants. It was also observed that more than 50% of the participants did not have disfluencies on WWCC. In summary, adults with both moderate and severe stuttering had similar occurrences of cluster disfluencies for words with as well as without consonant clusters.

Table 1: Percentage of disfluencies for WCC and WWCC across adults with moderate and severe stuttering

	Adults with moderate stuttering					Adults with severe stuttering				
Word type	N	Mean	SD	Median	IQR	N	Mean	SD	Median	IQR
WCC	13	19.06	9.85	21.74	18.48	14	31.99	18.83	27.17	29.89
WWCC	13	18.21	11.99	16.67	16.67	14	27.14	18.53	20.00	35.00

Note: N: Total number of individuals.

Table 2: Percentage of Cluster Disfluencies on WCC and WWCC across adults with moderate and severe stuttering.

	Adults with moderate stuttering					Adults with severe stuttering				
Word type	N	Mean	SD	Median	IQR	N	Mean	SD	Median	IQR
WCC	13	1.67	.81	2.17	3.26	14	3.26	4.49	2.17	7.06
WWCC	13	0.51	.25	0.00	0.00	14	1.67	2.53	0.00	4.16

Note: N: Total number of individuals.

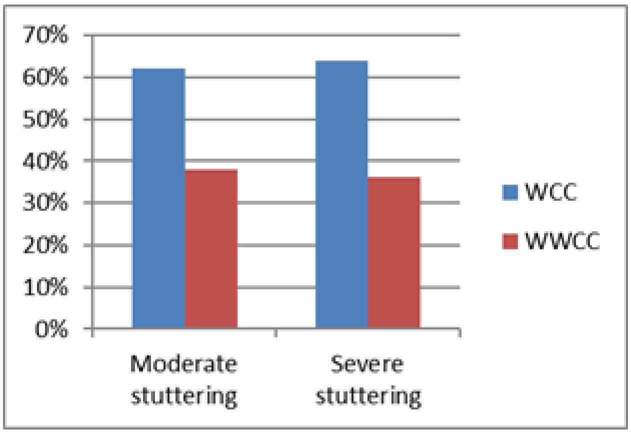

Figure 1: Percentages of dysfluencies on words with and without consonant cluster for moderate and severe stuttering groups.

Median percentage of cluster dysfluencies were also compared between words with and without consonant clusters in the two groups of participants. The percentage of cluster disfluencies were higher for WCC (Mean= 1.67, SD= 1.81, Median= 2.17, IQR=0.00) when compared to WWCC (Mean=0.51, SD=1.25, Median= 0.00, IQR=0.00) for adults with moderate stuttering. Results of Wilcoxon's signed rank test indicated no significant difference (/z/= 1.70; p= 0.09) for the frequency of cluster disfluencies between WCC and WWCC. Similarly, in adults with severe stuttering, median scores indicated that the percentage of cluster disfluencies was higher for WCC (Mean= 3.26, SD= 4.49, Median = 2.17, IQR=7.06) when compared to WWCC (Mean= 1.67, SD= 2.53, Median= 0.00, IQR=4.16). Wilcoxon's signed rank test indicated a significant difference (/z/= 2.11; p= 0.03) in the frequency of cluster disfluency between WCC and WWCC for adults with severe stuttering.

While the proportion of cluster disfluencies on WCC among the total cluster disfluencies for adults with moderate stuttering was 1:1.2, it was 1:1.3 for adults with severe stuttering. Percentage of disfluencies for WCC and WWCC was 83% and 17% respectively for adults with moderate stuttering. A similar trend was seen in adults with severe stuttering (WCC= 75% and WWCC= 25%) (Figure 2). Thus, in summary, WCC had higher percentages of cluster disfluencies when compared to WWCC in adults with both moderate and severe stuttering.

Qualitative analysis was done to assess the type of cluster disfluencies between individuals with moderate and severe stuttering. The results revealed that both the groups had SLD-SLD type combinations of clustered disfluencies (prolongations, repetitions, and blocks). However, occurrences of SLD-SLD type were more in adults with severe stuttering when compared to adults with moderate stuttering. Overall, the SLD-SLD combinations included blocks and syllable repetition (n=18), prolongations and blocks (n=7), part word repetition and syllable repetition (n=7), part-word repetition and blocks (n=4), syllable repetition and monosyllable word repetition (n=2), prolongation and monosyllable word repetition (n=1), and lastly syllable repetition and prolongation (n=1). The SLD-SLD type of disfluencies were restricted to two disfluency combinations and no complex disfluencies were observed in the participants of the study.

Figure 2: Percentages of cluster dysfluencies on words with and without consonant cluster for moderate and severe stuttering groups.

DISCUSSION

In the current study, we examined the effect of syllable complexity on the frequencies and typology of speech disfluencies of Kannada speaking adults who stutter. To study this, a standardized Kannada passage constituting WCC and WWCC was used. To the best of the researchers' knowledge, this is the first study to investigate the occurrence of cluster disfluencies in Kannada speaking adults who stutter.

The results from the current study suggested that higher percentages of disfluencies were present on WCC when compared to WWCC in adults with both moderate and severe stuttering. However, these findings were not significant. Individuals with severe stuttering had higher percentages of disfluencies on both WCC and WWCC 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 for WCC and can be attributed to the fact that the Kannada language has lesser frequencies of clusters that contributes to 7.5% of stutter data (Venkatagiri, Nataraja, & Deepthi, 2017). No significant difference on WWCC could be attributed to its simple phonetic structure that requires lesser time for linguistic formulation and execution when compared to WCC (based on CRH).

On the basis of the CRH and EXPLAN theory, it can be inferred that individuals with stuttering have deficits in phonological encoding for a phonetically complex structure such as a consonant cluster. The findings from Smith et al. (2010) study also highlights the fact that with an increase in phonological complexity, there is an increase in disfluencies in AWS. Increase in phonological complexity also increases the cognitive load thereby delaying the phonological encoding process and leading to an error in the motor program, which is reflected as a moment of stuttering. WCC have increased phonetic complexity, thereby leading to the occurrence of higher percentages of disfluencies when compared to WWCC as was observed in the current study. The proportion of disfluencies was also observed to be greater on WCC when compared to total disfluencies in adults with both moderate and severe stuttering, further indicating that the occurrence of disfluencies is influenced by the phonetic complexity of the consonant clusters. In consensus with the present study, Howell, Au-Yeung, and Sackin (2000) suggested that the content words with late emerging consonants and consonant clusters in the intitial position of a word had a higher probablity of stuttering for AWS. Smit (1993) provides information with regard to the type of consonant cluster and complexity. According to the IPC scheme a complex cluster such as /str/ is easy as it is homorganic (coronal consonants) compared to /pl/ and /kw/ that are heterorganic consonant strings. However, in the current study, the type of consonant clusters were not analyzed in detail.

The percentage of occurrence of cluster dysfluencies was more on WCC compared to WWCC in adults with both moderate and severe stuttering. These differences were found to be significant in only individuals with severe stuttering. These findings can be attributed to the increase in the total SLDs on WCC. The findings of the increase in cluster disfluencies with the increase in severity of stuttering is in consensus with the previous literature (Colburn, 1985; LaSalle & Conture, 1995; Hubbard,1988).

Listeners perceive more disfluencies in PWS during the instances of cluster disfluencies. Thus, the presence of cluster disfluencies could be attributed to the anxiety of the speaker about the occurrence of the single disfluency (Still & Griggs, 1979).

Qualitatively, both the groups had SLD- SLD type of cluster disfluencies. According to the EXPLAN theory, the occurrence of stalling disfluencies reflects the linguistic segment (PLAN) and advancing disfluencies reflect the motoric segment (EX). Advancing disfluencies occur in SLD-SLD clusters and stalling occurs in OD-OD combinations.

Thus, the presence of SLD- SLD cluster disfluencies can indicate the involvement of the motoric component related to stuttering. However, these findings are not in agreement with the study conducted by Robb et al.(2009). The authors found both ODs and SLDs (mixed type) in adults who stutter. The variation in our study could be because of the methodological differences in the speech task chosen and the language studied. While Robb et al. (2009) used spontaneous speech task in English language, the current study used reading task in Kannada language. The presence of SLD-SLD type of cluster disfluency reflects the increased durations and tensions within the utterance, thereby categorically differentiating it from the typical disfluencies (Perkins, Kent, & Curlee, 1991).

CONCLUSIONS

The current study highlighted that AWS demonstrated higher percentages of disfluencies on WCC when compared to WWCC. This indicated the effect of syllable complexity on the frequency of stuttering. Another finding in the current study was the presence of cluster disfluencies in individuals with both moderate and severe stuttering with higher percentages of occurrence on WCC compared to WWCC. However, these differences were found to be significant in only individuals with severe stuttering. Also, cluster disfluencies of SLD–SLD type were evident in both the groups of participants that indicated the involvement of the motor component (execution) associated with stuttering. The findings of the current study, therefore, indicates that cluster disfluencies are characteristic of PWS irrespective of the severity. However, syllable length of the words analyzed in the study not being taken into consideration could be a limitation of the study.

The current study provided insight into the influence of syllable complexity on the frequency and typology of the speech disfluencies of AWS. Even though the occurrence of consonant clusters is lesser in frequency in the Kannada language, it can influence the frequencies of disfluencies related to stuttering. The results of the current study also support the explanation of the EXPLAN theory and the CRH. The findings of the current study based on Kannada language provides cross linguistic evidence and adds support to the literature emphasizing the influence of linguistic factors on the disfluencies of stuttering.

ACKNOWLEDGEMENTS

We are grateful to Dr. M. Pushpavathi, Director of AIISH for allowing us to conduct this study. We thank all the participants who provided their valuable time for this study.

REFERENCES

Au-Yeung, J., Gomez, I. V., & Howell, P. (2003). Exchange of disfluency with age from function words to content words in Spanish speakers who stutter. J*ournal of Speech, Language, and Hearing Research, 46*(3), 754–765. https://doi.org/10.1044/10924388(2003/060)

Bóna, J. (2019). Clustering of disfluencies in typical, fast and cluttered speech. *Clinical Linguistics and Phonetics, 33*(5), 393–405. https://doi.org/10.1080/02699206.2018.1513075

Brown, S. F. (1945). The Loci of Stutterings In The Speech Sequence. *Journal of Speech Disorders, 10*(3), 181-192. doi:10.1044/jshd.1003.181

Byrd, C. T., Coalson, G. A., Yang, J., & Moriarty, K. (2017). The effect of phonetic complexityon the speed of single-word productions in adults who do and do not stutter. *Journal of Communication Disorders, 69*(December 2016), 94–105.https://doi.org/10.1016/j.jcomdis.2017.06.009

Colburn, N. (1985). Clustering of disfluency in nonstuttering childrens' early utterances. *Journal of Fluency Disorders, 10*(1), 51–58. https://doi.org/10.1016/0094-730X(85)90005-1

Craig, A., Hancock, K., Tran, Y., Craig, M., & Peters, K. (2002). Epidemiology of Stuttering in. *Journal of Speech, Language, and Hearing Research, 45*, 1097–1105.

Dworzynski, K., & Howell, P. (2004). Predicting stuttering from phonetic complexity in German. *Journal of Fluency Disorders, 29*(2), 149–173. https://doi.org/10.1016/j.jfludis.2004.03.001

Howell, P., & Au-yeung, J. (2007). Phonetic complexity and stuttering in Spanish. *Europe PMC Funders Group, 21*(2), 111-127. https://doi.org/10.1080/02699200600709511.

Howell, P., & Au-Yeung, J. (2002). The EXPLAN theory of fluency control and the diagnosis of stuttering. *Pathology and Therapy of Speech Disorders.* https://doi.org/10.1075/cilt.227.08how

Howell, P., & Au-Yeung, J. (2007). Phonetic complexity and stuttering in Spanish. *Clinical Linguistics & amp Phonetics, 21*(2), 111—127. https://doi.org/10.1080/02699200600709511

Howell, P., Au-Yeung, J., & Sackin, S. (2000). Internal structure of content words leading to lifespan differences in phonological difficulty in stuttering. *Journal of Fluency Disorders, 25*(1), 1–20. https://doi.org/10.1016/S0094-730X(99)00025-X

Howell, P., Au, Yeung, J., Yaruss, S. J., & Eldridge, K. (2009). Phonetic difficulty and stuttering in English. *Clinical Linguistics & Phonetics, 20*(9), 703-716. doi:10.1080/02699200500390990

Hubbard, C. P., & Yairi, E. (1988). Clustering of disfluencies in the speech of stuttering and nonstuttering preschool children. *Journal of Speech and Hearing Research, 31*(2), 228–233. https://doi.org/10.1044/jshr.3102.228

Huinck, W. J., Van Lieshout, P. H. H. M., Peters, H. F. M., & Hulstijn, W. (2004). Gestural overlap in consonant clusters: Effects on the fluent speech of stuttering and non-stuttering subjects. *Journal of Fluency Disorders, 29*(1), 3–25. https://doi.org/10.1016/j.jfludis.2003.09.001

Handbook of the International Phonetic Association: A guide to the use of the International Phonetic Alphabet. (1999). Cambridge, U.K.: Cambridge University Press.

Jakielski, K.J. (1998). Motor organization in the acquisition of consonant clusters (Unpublished thesis). University of Austin, Texas.

LaSalle, L. R., & Conture, E. G. (1995a). Disfluency clusters of children who stutter: Relation of stutterings to self-repairs. *Journal of Speech and Hearing Research, 38*(5), 965–977. https://doi.org/10.1044/jshr.3805.965

LaSalle, L. R., & Conture, E. G. (1995b). Disfluency clusters of children who stutter: Relation of stutterings to self-repairs. *Journal of Speech and Hearing Research, 38*(5), 965–977. https://doi.org/10.1044/jshr.3805.965

LaSalle, Lisa R., & Wolk, L. (2011). Stuttering, cluttering, and phonological complexity: Case studies. *Journal of Fluency Disorders, 36*(4), 285–289. https://doi.org/10.1016/j.jfludis.2011.04.003

Mahesh, S., & Geetha, Y. V. (2015). Phonetic environment of disfluencies in children with stuttering. *International Journal on Disability and Human Development, 14*(1), 67–73. https://doi.org/10.1515/ijdhd-2013-0042

Masumi, E., Kashani, Z. A., Hassanpour, N., & Kamali, M. (2015). The Effect of Syllable Structure on the Frequency of Disfluencies in Adults With Stuttering. *Middle East Journal of Rehabilitation and Health, 2*(2). doi:10.17795/mejrh-26436

Penttilä, N., Korpijaakko-Huuhka, A. M., & Kent, R. D. (2019). Disfluency clusters in speakers with and without neurogenic stuttering following traumatic brain injury. *Journal of Fluency Disorders, 59*(December 2018), 33–51. https://doi.org/10.1016/j.jfludis.2019.01.001

Perkins, W. H., Kent, R. D., & Curlee, R. F. (1991). A Theory of Neuropsycholinguistic Function in Stuttering. *Journal of Speech, Language, and Hearing Research, 34*(4), 734–752. https://doi.org/10.1044/jshr.3404.734

Postma, A., & Kolk, H. (1993). The covert repair hypothesis: Prearticulatory repair processes in normal and stuttered disfluencies. *Journal of Speech and Hearing Research, 36*(3), 472–487. https://doi.org/10.1044/jshr.3603.472

Riley, G. D., & Bakker, K. (2009). Stuttering Severity Instrument: SSI-4. Austin, Texas: Pro-Ed.

Robb, M. P., Sargent, A., & O'Beirne, G. A. (2009). Characteristics of disfluency clusters in adults who stutter. *Logopedics Phoniatrics Vocology, 34*(1), 36–42. https://doi.org/10.1080/14015430902748519

Shashidhar, K. N., & Nataraja, N. P. (1984). Analysis of Speech of Stutterers (Unpublished dissertation). All India Institute of Speech and Hearing.

Silverman, E. M. (1973). Clustering: a characteristic of preschoolers' speech disfluency. *Journal of Speech and Hearing Research, 16*(4), 578–583. https://doi.org/10.1044/jshr.1604.578

Smit, A. B. (1993). Phonologic Error Distributions in the Iowa-Nebraska Articulation Norms Project. *Journal of Speech, Language, and Hearing Research, 36*(5), 931–947. https://doi.org/10.1044/jshr.3605.931

Smith, A., Sadagopan, N., Walsh, B., & Weber-Fox, C. (2010). Increasing phonological complexity reveals heightened instability in inter-articulatory coordination in adults who stutter. *Journal of Fluency Disorders, 35*(1), 1–18. https://doi.org/10.1016/j.jfludis.2009.12.001

Still, A. W., & Griggs, S. (1979). Changes in the probability of stuttering following a stutter: A test of some recent models. *Journal of Speech and Hearing Research, 22*(3), 565–571. https://doi.org/10.1044/jshr.2203.565

Throneburg, R. N., Yairi, E., & Paden, E. P. (1994). Relation between phonologic difficulty and the occurrence of disfluencies in the early stage of stuttering. *Journal of Speech and Hearing Research, 37*(3), 504–509. https://doi.org/10.1044/jshr.3703.504

Venkatagiri, H. S., Nataraja, N. P., & Deepthi, M. (2017). Stuttering in relation to the morphophonemics of Kannada. *Clinical Linguistics and Phonetics, 31*(4), 313–329. https://doi.org/10.1080/02699206.2016.1259353

Wexler, K. B., & Mysak, E. D. (1982). Disfluency characteristics of 2-, 4-, and 6- yr-old males. *Journal of Fluency Disorders, 7*, 37–46. Retrieved from https://doi.org/10.1016/0094730X(82)900365

Wolk, L., Blomgren, M., & Smith, A. B. (2000). The frequency of simultaneous disfluency and phonological errors in children: A preliminary investigation. *Journal of Fluency Disorders, 25*(4), 269–281. https://doi.org/10.1016/S0094-730X(00)00076-0