Research Article

Phonological Processing in Children Who Stutter: Evidence Through Non-Word Repetition Task

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What is already known in this subject?
Children with stuttering exhibit problems in phonological encoding and studies carried out in the past have reported sufficient evidence in this direction. Several experimental tasks like lexical decision task, non-word repetition task effectively teases out the phonological processing and findings pertaining to the performance can highlight the phonological processing in this direction.

What this study adds to existing literature?
The current study tapped both the speed of processing as well as accuracy based performance index to document the phonological processing. Non words of different syllable length was used and the performance was documented separately for the non-words of each syllable length.

What are the potential or actual clinical implications of the current study?
The retrieval of phonemes from the phonological output lexicon was tested through the non-word repetition task. The performance of CWS was compared with CWNS and the findings from the study indicated a clear distinction in terms of performance for the two groups. CWS exhibited greater difficulty in repetition of the non-words of greater syllable length and this was reflected in terms of the reaction time and accuracy based measures and this shows the need of training phonological encoding skills in CWS.

Abstract
Phonological processing has been explored by many researchers till date. The non-word repetition task is used to tap phonological processing. Non-Words are formed by transposing the sound segments of a given word in the language and is language specific. This necessitated the current study. A total of 60 participants were recruited for the study, the participants were divided into two groups. Group 1 consisted of 30 children who stutter while the second group (group 2) comprised of 30 children who do not stutter. The non-word repetition task was carried out on the participants. The non-words ranged from 1-3 syllables. The participants were required to repeat the non-word as they hear. The reaction time and accuracy of responses was computed to mark the performance. It was revealed that children who stutter required a greater reaction time than children who do not stutter regardless of the syllable length and the difference was significant statistically. While there was no difference between children who stutter and children who do not stutter on accuracy measurement statistically for 1 syllable and 2 syllables non word, but the results was statistically significant for 3 syllables non word.

Keywords: Reaction time, Accuracy, Syllable length, Repetition.

Introduction

Stuttering is a disorder of fluency where the forward flow of speech gets interrupted due to dysfluencies like repetitions, prolongation, pauses etc. Persons Who Stutter (PWS) are also assumed to have difficulty in formulating speech motor plans due to synchrony issues in speech sub systems (Ingram1998; Kent 2000). Some of the recent empirical studies suggest that PWS may manifest linguistic deficits also. It can be seen in adults who stutter as well as children who stutter. This linguistic deficit may be more remarkable in children who stutter compared to children who do not stutter. Arguably, further investigation in this area of research should provide specifically meaningful insight into whether some parts of the linguistic processes are involved in the initiation and maintenance of stuttering.

Studies exploring the linguistic deficits in stuttering revolve around the phonological aspects. The phonological aspects in stuttering have garnered special attention over the past few years. Generally, the term phonological

loop in most of the studies. This phonological loop is assumed to be a part of the working memory. In other words, the phonological information is stored in the short-term memory. This storage is assumed to be temporary in nature (Baddeley, 1986; Gathercole, Hitch, Service, & Martin, 1997; Gathercole, Willis, Baddeley, & Emslie, 1994).

Further the phonological loop, is assumed to be made up of two components: a phonological store and articulation rehearsal mechanism. The phonological store is important is instrumental in new word learning. The new word learning is assumed to be executed with the interaction of cognitive and semantic systems (Baddeley, Gathercole, & Papagno, 1998; Gathercole et al., 1997). Considerable studies regarding the phonological domain have been carried out in communication disorders like specific language impairment and stuttering.

Studies tapping the integrity of phonological loop have used a variety of tasks ranging from novel word repetition to non-word repetition. Both these tasks are found to be effective in assessing the integrity of phonological domain as they impose the load on the system. The load on the semantic system is assumed to be minimal for non-word task compared to novel word repetition. The non-word task would require the participants to keep the phonological constituents of the non-word in their memory and repeat the target. The accuracy with which the target is produced is taken into consideration by comparing the response provided by the participant with that of the target. The task is found to be sensitive in case of children as well as adults. The task complexity can be increased by increasing the syllable length of the non-words. The non-words are usually formed by transposing the sound segments of a legal word. As the current article revolves around the phonological processing in stuttering only the data linking phonological deficits and stuttering has been reviewed.

Tasks used to assess the phonological deficits.

Literature review reveals that both behavioural as well as objective tasks have been used in the past. As stated earlier the phonological processing can be tested by employing novel word or non-word repetition task. Non-Word repetition would involve phonological analysis, phonological storage and retrieval, speech motor planning and execution. The non-word reading task considered as an alternate to study the phonological processing. In this task, the underlying process is same as that of non-word repetition but the focus would on the orthographic code unlike the former, where the focus is on phonological code. As far as the objective measure is concerned, speech kinematics is generally used but the kinematic measures provide a sensitive index of speech formulation and implementation (Goffman & Smith, 1999), thus it provides a comprehensive picture on speech planning and production processes involved in its causation and maintenance.

Kinematic studies on non-word repetition in persons who stutter

The first significant study in this direction was carried out by Namasivayam and Van Lieshout (2008). This study investigated the spatial and temporal variability of cyclic patterns of upper lip, lower lip, and jaw trajectories for the multiple repetitions of two simple bisyllablic nonwords—/bapi/ and /bipa/ across three sessions spanning several days in five persons who stutter and five typically fluent speakers. The aim of the study was to the speech motor learning and practice effects in PWS. They reported that the magnitude practice effect was low in PWS. A higher movement variability and reduced strength of inter-gestural coupling between bilabial closure and tongue body gestures was seen in PWS when compared to PWNS.

Smith et al. (2010) tested non-word repetition skills in 17 PWS and an equal number of fluent speakers' pair matched for age, education, and sex. The non-words used for the study ranged from 1-5 syllables. The behavioural (% correct) and kinematic data on speech duration and lip aperture variability for PWNS showed a higher inter-articulator coordination variability and longer speech duration compared to normally fluent adults. The group differences increased with increase in the non-word length and complexity. Furthermore, a practice effect was observed in PWS as a significant increase in the consistency of articulatory movements, and reduction in speech duration was seen across the sessions.

Behavioural evidence on phonological deficits in persons who stutter

The earliest evidence pertaining to this, was reported by Bosshardt (1993). The study was carried out on adults who stutter, and the performance of these individuals was compared with that adult who do not stutter. A serial short-term memory task was used, and the findings revealed that adults who stutter performed more poorly than fluent adults inferring that adult who stutter have slower phonological encoding and rehearsal times. Further a study carried out by Ludlow, Siren and Zikeria (1997) showed that adults who stutter may demonstrate difficulty in learning phonological novel sequences compared to adults who do not stutter.

Further Byrd et al. (2012) explored the phonological working memory of PWS. Phonological memory was tested by employing non-word repetition and a phoneme elision task. 14 AWS and 14 age and gender matched normal participants were recruited for the study. For the non-word repetition task, the participants had to repeat a set

of 12 non-words across four syllable lengths (2, 3, 4, and 7 syllables). For the phoneme elision task on the other hand, the participants repeated the same set of non-words same as the non-word repetition task but with a designated target phoneme eliminated. The syllable length of the non-word repetition was same the previous task. The performance of PWS was poorer than PWNS. The difficulty in performance increased with the increase in the syllable length (i.e., 7 syllables). It was also noted that PWS also required a significantly higher mean number of attempts especially for producing 7-syllable non-words than adults who do not stutter. For the phoneme elision task, there was no significant interaction between group and syllable length. The group difference was significant for the non-word repetition task and a defective phonological working memory deficit was reported in PWS. Hence it can be inferred that the phonological deficits are evident in persons who stutter. There is plethora of studies on phonological deficits in children who stutter. The next section of the introduction is on phonological deficits in children who stutter based on non-word repetition.

Phonological deficits in children who stutter

Children are generally presumed to use the phonological loop for storing words and they are also known to utilise their vocabulary knowledge while learning new words (Baddeley, Gathercole, & Papagno, 1998; Gathercole et al., 1997). Alike adults the non-word repetition is used to investigate the phonological deficits in children who stutter. The non-words also require the temporary storage of an unfamiliar phonological sequence, the performance relies on how good the person is able to store the given information in their short-term memory and also on how well the person is able to retrieve the same information from the memory (Gathercole et al., 1994). The non-word repetition task was originally used for children with specific language impairment and was employed in stuttering eventually. This notion gained importance as there is a connection between non-word repetition and speech motor skills. The earliest experimental evidence on phonological deficits in children who stutter was reported by Melnick, Conture, and Ohde (2003). They considered preschool CWNS and CWS as their participants The findings of the study reported a significantly negative correlation between their speed of speech reaction time and score on the Goldman-Fristoe. Such correlation was not noticed in CWS. This study provided an apparent and established link between stuttering and diminished language ability, as well as a smaller body of evidence suggesting a link between stuttering and phonological encoding deficits.

In the subsequent year, Hakim and Ratner (2004) assessed non-word repetition ability of 8 CWS and 8 CWNS on 2-5 syllable non-words. CWS exhibited more phonemic errors compared to CWNS. The phonemic errors increased with increase in the syllable length. A similar kind of study was reported by Anderson in 2006. The authors investigated non-word repetition skills in younger CWS and CWNS (3.0 and 5.2 years old). The phonemic errors were more in CWS compared to CWNS.

Bhaktiyar, Ali and Sadegh (2007) investigated the phonological deficits in CWS alike the other studies cited above. The major difference was that the authors considered the reaction time in addition to the accuracy of production, a measure used in the previous studies. A total of 24 participants (12 CWS and 12 CWNS) took part in the study. The children were native speakers of Turkish and were in the age range of 5.1 to 7.10 task. Bi syllabic and tri syllabic non words were used as stimuli. The difference between CWS and CWNS was evident for accuracy measurements but not for reaction time. They concluded by stating that the CWS might not have a gross problem in phonological retrieval of the novel phonological context and the problems can increase with increase in syllable length.

Relation between linguistic complexity and degree of stuttering

Persons who stutter regardless of their age may exhibit greater difficulty with increase in the linguistic complexity. The earlier evidences (Gaines, Runyan, & Meyers, 1991; Zackheim & Conture, 2003) in this regard suggested increase in the severity of stuttering increase in the length and complexity of utterance. It was noted that as the length and syntactic complexity of an utterance increased, the stuttering severity increased, Furthermore, adults who stutter show decreased speech motor stability (i.e., stability of the lower lip during articulation) for increase in the syntactic complexity, In fact, decreased motor speech stability is seen with increased syntactic complexity in normally fluent adults and children as well (Maner, Smith, & Grayson, 2000; Kleinow & Smith, 2000). This may because of the extra demand placed on a speaker imposed by increased syntactic complexity. The studies on non-word repetition also provides similar evidence as the performance would show a dip with increase in the linguistic load. The degree of stuttering also is also known to increase in the syllable length of the non-word.

The present study was undertaken to explore phonological processing among Arabic-speaking children who stutter, recognizing that phonological encoding, storage, and retrieval vary across languages and that most existing research has been conducted in Western contexts. Given the inherent phonological complexity of Arabic, this investigation aimed to examine how children who stutter (CWS) perform on a non-word repetition

task compared to children who do not stutter (CWNS). Specifically, the study sought to compare the two groups in terms of reaction time and accuracy, as well as to analyze how these measures vary across non-words of different syllable lengths.

Methods

The aim of the study was to investigate phonological processing in children who stutter. Phonological processing was tested through non-word repetition task. The study employed a comparative group design where the performance of children who stutter was compared with the performance of children who do not stutter.

Participants: A total of 60 participants were recruited for the study. The participants were recruited through convenient sampling. The participants were divided into two groups designated as group 1 and group 2. Group 1 participants had a history of stuttering (the participants of group 1 were pre diagnosed with stuttering) while group 2 participants were pair matched with group 1 participants based on age and gender.

The age of the participants ranged from 8-12 years. All the participants were native of Saudi Arabia and Arabic was their first language. Stuttering severity Instrument IV was administered on the participants of group 1. The details of the participants are tabulated below (see table 1)

SSI-4 is used to diagnose stuttering and to estimate the severity of stuttering. There are 5 severity ratings on SSI 4 (very mild, mild, moderate, severe, very severe stuttering). As shown in table 1, there were more participants under the moderate stuttering severity category followed by mild, severe stuttering and very mild stuttering. There were no participants under the very severe stuttering severity and there was only 1 participant under the very mild stuttering severity. Out of the 30 participants in this group, 26 were boys and 4 were girls. The participants were not divided into subgroups based on the gender. The participants in group 2 were normal children (children with no stuttering). The participants of this group were matched with the age and gender of children of group 1 participants. SSI 4 was administered on the participants of group 2 also to exclude the presence of stuttering. The participants of both the groups did not have any history of cognitive deficits, hearing problems or speech and language delay. The non-word repetition task was administered on the participants. To ensure that the participants had normal hearing, they were asked to repeat the Ling's six sounds (/a/,/i/,/u/,/s/, /sh/,/m/) at a distance of 5-6 feet. All the participants were able to repeat these sounds.

Stimulus: The non-words were formed by transposing the sound segments. True words were taken, and the sound segments of the sounds were transposed for the formation of non-words. Care was taken to follow the rules of the language while forming non-words. All these non-words were pronounceable. The non-words had a syllable length ranging from 1 syllable to 3 syllables. A total of 45 stimuli was used. The details of the stimulus is given in Appendix 1. The non-words were recorded from a male speaker in order to ensure homogeneity. In other words, live presentation of the stimulus would pave way for heterogeneity, to counteract this recorded sample was used. The recorded non-words were presented through head-phones. The stimulus was presented using E Prime software 2.1. The inter-stimulus duration was kept at 1000 milliseconds and the maximum duration was 4000 milliseconds was allotted for the participants to respond. If the participants did not respond within this stipulated duration, the response was considered as a time lapsed error

Setup: The data collection was carried out in a silent room. The data collection was carried out in a two-room setup. The investigator presented the stimulus in one room using E Prime software, while the participants (children) sat in the other room.

Instruction: The participants were asked to listen to the stimulus carefully and repeat the stimulus as they heard as quickly as possible.

Procedure: A trial block of non-words was presented to the participants before the commencement of the main task. The trial block was used to acclimatize the participants. The investigator presented the stimulus one by one. As stated in the stimulus section, the non-words ranged from 1-3 syllables and a total of 45 stimuli was used in the study. The stimuli were presented in a random order. The participants were asked to repeat the stimulus. The reaction time was computed automatically by the software. The recorded responses were analysed by the investigator to compute the accuracy of responses.

Analysis: The mean reaction time and accuracy of responses was analysed for group 1 and group 2 participants in order to address the objectives.

Results

The study investigated the non-word repetition ability in children who stutter. The performance of children who stutter (designated as group 1) was compared with children who do not stutter (designated as group 2) on non-word repetition task. Non-words ranging from 1 syllable to 3 syllables was used as stimuli. The mean reaction

time and accuracy of responses were the dependent variables. The first objective compared the mean reaction time and accuracy of responses of children who stutter and who do not stutter. Table 2 provides the mean reaction time and the median values for group 1 and group 2 participants.

As shown in table 1 and Figure 1, the mean reaction time was more for group 1 participants compared to group 2 participants. The same trend was observed for all the three syllable lengths (1 syllable-3 syllables). It was observed that the reaction time successively increased with increase in syllable length. The reaction time was least for 1 syllable non words while the reaction time was greater for 3 syllables non word. This was true for both groups (group 1 as well as group 2 participants). In addition to the mean reaction time, the median values were also extracted. The median values also showed the same trend with greater reaction time for group 1 participants compared to group 2 participants. In addition to the reaction time values, the accuracy of responses was also computed. Table 3 provides the accuracy values for group 1 and group 2 participants.

The accuracy scores were calculated by considering the accuracy of production. A response was considered as correct when the response resembled the target. The overall phonemic accuracy was taken into consideration and weightage was not given to the dysfluencies. As seen in Table 2 and Figure 2, the accuracy scores for group 1 and group 2 varied with syllable length. For 1 syllable and 2 syllables, the accuracy scores were same for both the groups (with a little exception for 1 syllable, where the accuracy score was marginally more for group2 than group 3). For 3 syllables non word, the accuracy score was better for group 2 compared to group 1.

In order to verify if there was any statistically significant difference between group 1 and group 2 on mean reaction time values and accuracy scores, the data was subjected to the test of normality. The normality check was carried out by using Shapiro-Wilk's test of normality. The p values obtained was less than 0.05 showing that the data was non-parametric in nature. Thus, the appropriate non parametric statistical measures were administered on the data.

Reaction time: Mann Whitney U test was used to compare the reaction time for group1 and group 2. The test was run thrice for each of the syllable lengths (1 syllable, 2 syllables and 3 syllables) and Z score obtained by comparing the reaction time values for group1 and group 2 was 3.46, 3.72 and 4.12. The corresponding p values showed significant difference between the two groups for all the three syllable lengths.

Accuracy: Mann Whitney U test was administered to compare the accuracy scores for group1 and group 2 in the same lines as that of reaction time comparison. The Z scores obtained for 1, 2 and 3 syllables non words were 0.92,0.12 and 2.03 and the corresponding p values showed significant difference only for 3 syllables non word.

A within-group analysis was conducted for both Group 1 (children who stutter) and Group 2 (children who do not stutter) to determine whether reaction time and accuracy differed according to syllable length. Reaction times for one-, two-, and three-syllable non-words were compared separately for each group using Friedman's test. The results revealed χ^2 values of 3.36 for Group 1 and 3.86 for Group 2, with corresponding p-values indicating significant differences, suggesting that reaction time varied with syllable length in both groups. Similarly, within-group analyses of accuracy scores across different syllable lengths (one, two, and three) yielded χ^2 values of 0.88 for Group 1 and 1.06 for Group 2, with p-values showing no significant differences. Therefore, it can be concluded that while reaction time was influenced by syllable length, accuracy scores remained consistent across syllable variations in both groups.

Additional objective: To correlate the degree of stuttering and accuracy scores

In addition to the pre-set objectives, the average SSI-4 scores was correlated with the accuracy scores on non-word repetition task for the three-syllable length. The average SSI score was computed by averaging the SSI scores for the participants under each severity levels (Table 3). This was correlated with the accuracy scores. The accuracy score was converted into percentage by considering the number of correct responses as numerator, the number of stimuli as denominator and the whole value obtained was multiplied into 100. Corelation was not established for reaction time measures as the unit of measurement was different

Table 5 shows that Sig.(2-tailed) =0.48 and 0.39. This value is higher than 0.05, indicating that there is no significant relationship between average accuracy scores and stuttering severity score. This value is "between 0 and 0.5", indicating a weak relationship or no relationship between the two variables". Thus it can concluded that there was no correlation between stuttering scores and the accuracy scores on non-word repetition.

Discussion

Stuttering is a fluency disorder and some studies suggest subtle language deficits in this population. Phonological processing in specific has received a special consideration from researchers. The phonological processing can be assessed by employing a novel word or non-word repetition task. The non-word repetition task is used in children who stutter as well as adults who stutter. Studies concerning adults who stutter (Bosshardt, 1993; Ludlow, Siren and Zikeria, 1997) have shown that adults who stutter performed more poorly on than normally

fluent adults. The poor performance in adults who stutter demonstrated that these individuals can have slower phonological encoding and rehearsal times. These studies also have highlighted the possibility that adults who stutter may exhibit difficulty in learning phonological novel compared to neuro typical individuals. As far as studies on phonological processing in children is concerned, notable studies (Melnick, Conture & Ohde, 2003; Hakim & Ratner, 2004; Bhaktiyar, Ali & Sadegh, 2007) have shown that children who stutter can have delay in phonological encoding and may also exhibit more errors on the non-word repetition task compared to their peer group. The current study aimed in exploring phonological processing in children who stutter. The study was carried out in Arabic.

The objectives of the study were two folds. The first objective was to compare the reaction time and accuracy for non-words of different syllable length in CWS and CWNS. The non-words ranged from 1-3 syllables. The mean reaction time was more for CWS compared to CWNS for all the three syllable lengths. The median values also showed the same trend as that of the mean reaction time measure. The data was non-parametric (as shown on Shapiro-Wilk's test) and Mann Whiney U test was carried out to verify if there was any significant difference between CWS and CWNS on non-words ranging from 1-3 syllables. The statistic revealed that the difference was significant statistically for all the three syllable lengths. This showed that the time taken for phonemic encoding and vocal reaction time was more for CWS than CWNS. The vocal reaction time could be delayed in this population as children who stutter may have delayed initiation time and the time required to encode the phonemic segments also would have been more in this population as a consequence of subtle language processing issues in CWS. This finding was in consonance with the previous studies carried out by researchers (Melnick, Conture & Ohde, 2003; Hakim & Ratner, 2004; Bhaktiyar, Ali & Sadegh, 2007). The accuracy of measures was also taken into consideration in addition to the reaction time. The statistic (Mann-Whitney U test) revealed that there was no significant difference in the accuracy scores of CWS and CWNS for non-words of 1 syllable and 2 syllables. However, there was significant difference between the accuracy scores of CWS and CWNS for 3 syllable non-words. This indicated that CWS can show more errors on non-word repetition with increase in the syllable length.

The second objective was to compare the reaction time and accuracy scores for non-words of different syllable length Within group analysis was carried out for group1 and group 2 separately to verify if the reaction time and accuracy varied with syllable length. For group 1 as well as group 2, the statistic (Friedman's test) revealed that there was significant difference in the reaction time of non-words of 1 syllable, 2syllables and 3 syllables. The results were suggestive that the reaction time measures on non-word repetition varied with the syllable length for both groups. The same statistic was used for comparing the accuracy scores for 1 syllable, 2 syllables and 3 syllables non-word. The statistic revealed that there was no significant difference for group 1 and group 2 on the accuracy scores. The results suggested that the accuracy scores did not vary with syllable length. In the current study, only non-words ranging from 1-3 syllables were used. The study can be extended further in this line, by using non-words with a syllable length greater than 3 syllables in future study.

In addition to the pre-set objective, an additional objective was undertaken at the time of analysis. This additional objective was to correlate the degree of stuttering and accuracy scores. Stuttering Severity Instrument (SSI-4) was administered on the participants and the average composite scores on SSI-4 was correlated with the accuracy scores on non-word repetition. For this objective, only the accuracy score was taken into consideration and the reaction time was not considered as the unit of measurement was different. The Spearman's correlation was carried out for estimating the corelation coefficient. The Spearman's rho revealed that there was no (weak) correlation between the two measures. Generally, studies in this direction (Gaines, Runyan, & Meyers, 1991; Zackheim & Conture, 2003) have shown that the accuracy scores would vary as a function of stuttering severity. However, this trend was not evident in this study, this could be attributed to the fact that there were more participants with mild and moderate stuttering compared to severe and very severe stuttering. As the severity of stuttering was lesser in majority of the participants, the accuracy scores may not have varied with stuttering severity. The study can also be extended in this line by considering a larger number of participants especially under the severe and very severe stuttering variants.

Conclusions

The study aimed to investigate phonological processing in children who stutter. The study was carried out in Arabic. Phonological processing was tested through non-word repetition task. Non-words were formed by transposing the words in Arabic. Non-Words ranged from 1-3 syllables. The stimuli were presented by employing E-Prime. The task of the participant was to repeat the non-words. The maximum duration allowed for the participant to respond was 4000 milliseconds. The first objective was to compare the reaction time and accuracy on non-word repetition for children who stutter with children who do not stutter. The statistic (Mann-Whitney

U test) revealed that there was a significant difference between the groups for reaction time measures at all three syllable lengths. The accuracy measurement revealed no significant difference between the two groups for non-word repetition of 1 syllable and 2 syllable non- words, significant difference was seen for 3 syllable non words. The second objective dealt with the comparison of reaction time and accuracy measures for non-words of different syllable length. Friedman's test revealed that there was significant difference for non-words of different syllable length however the same statistic revealed that there was no significant difference for accuracy scores obtained on repetition of non- words of different syllable length. Additional analysis was carried out to coorelate the scores on SSI-4 and accuracy scores on non-word repetition and the analysis on Spearman's corelation coefficient revealed a weak corelation between the two variables.

Competing interests
The authors declare that they have no competing interests.
Disclosure
The funders had no role in the study design, data collection, analysis, or interpretation, manuscript preparation, or decision to submit the manuscript for publication.
Availability of data and materials
All data that were generated or analysed during this study are presented in the manuscript. Please contact the corresponding author for access to data presented in this study.

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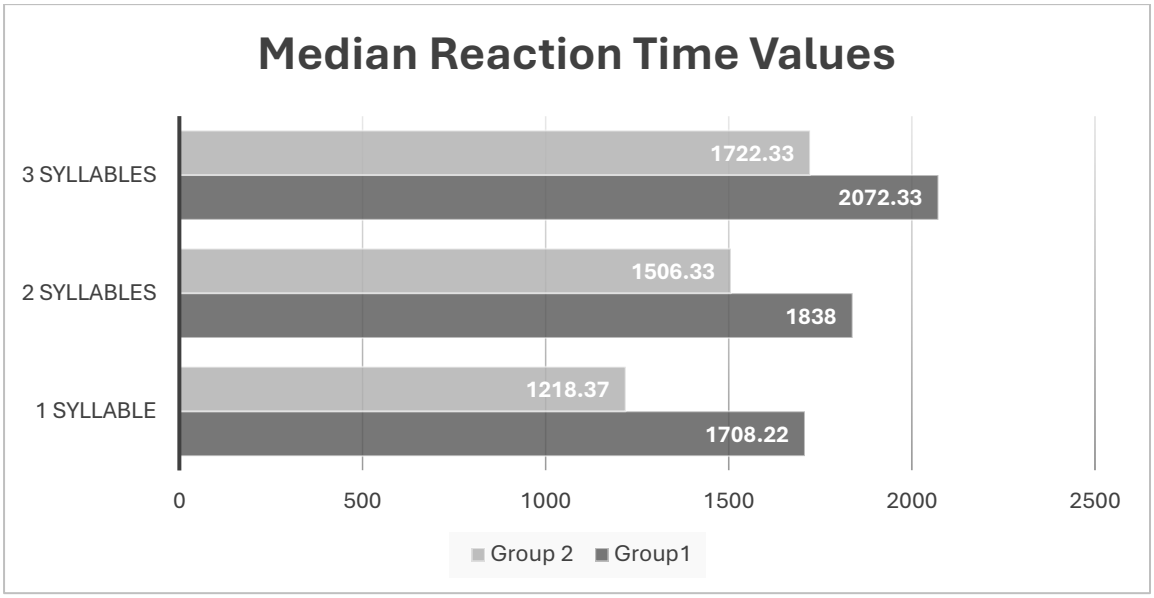


Figure 1: Median Reaction time values for group 1 and group 2 participants

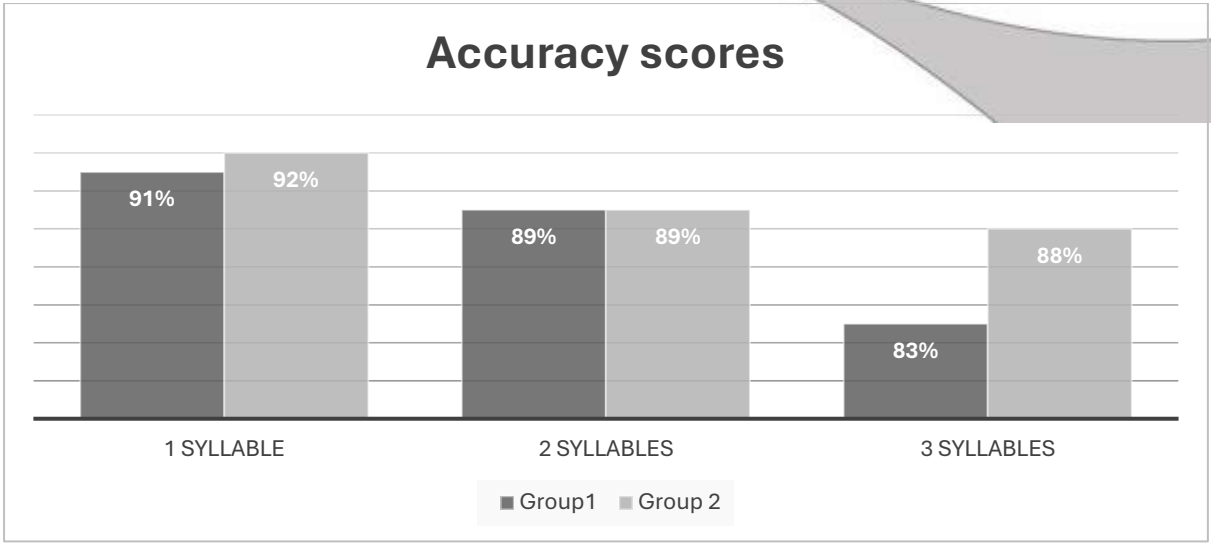


Figure 2: Accuracy Scores for Group 1 and Group 2 participants

Table 1: Details of Group 1 participants

	8-9 years	9-10 years	10-11 years	11-12 years
Very Mild Stuttering	--	--	1	--
Mild Stuttering	1	4	4	1
Moderate Stuttering	2	5	3	2
Severe Stuttering	2	3	2	--
Very Severe Stuttering	--	--	--	--

Table 2: Mean Reaction Time and Median Values for Group 1 and Group 2 participants on non-word repetition task

		1 syllable	2 syllables	3 syllables
Group 1	MRT	1658.33ms	1727.31ms	1933.32ms
	Median	1708.22ms	1838ms	2072.33ms
Group 2	MRT	1222.48ms	1302.56ms	1456.78ms
	Median	1218.37ms	1506.33ms	1722.33ms

Table 3: Accuracy Scores for Group 1 and Group 2 participants on Non word repetition task

	1 syllable	2 syllables	3 syllables
Group 1	91%	89%	83%
Group 2	92%	89%	88%

Table 4: Accuracy scores for different stuttering severity

	1 syllable	2 syllables	3 syllables	Average SSI Scores
Very Mild Stuttering	92	88	87	8
Mild Stuttering	91	87	80	13
Moderate Stuttering	89	90	84	25
Very Severe Stuttering	90	89	81	31

Table 5: Correlation values between the accuracy scores and stuttering severity scores

			Non-Word repetition	Stuttering scores
		Corelation coefficient	0.045	0. 48
	Non word repetition	Significant 2 tailed	--	0.39
		N	60	
Spearman's rho	Stuttering scores	Corelation coefficient	0. 48	0.45
		Significant 2 tailed	0.39	----------
		N	60	