

Research Paper: Comparing Speech Rate and Stuttering Frequency During Reading and Monologue Between Subjects With and Without Stuttering



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ABSTRACT

Introduction: Subjects with stuttering may show different numbers of stuttering-like disfluencies during reading and monologue tasks. The study aimed to compare the speech rate and stuttering frequency during reading and monologue tasks in subjects with stuttering and those with fluent speech.

Materials and Methods: A total of 24 subjects with stuttering and 24 subjects with fluent speech participated in this analytical-descriptive cross-sectional study. A video camera recorded the participants' reading and monologue samples. The second version of the computerized scoring of the stuttering severity (CSSS-2) software and Praat version 5.3.78 was used to measure stuttering severity and speech rate, respectively. Statistical analysis was conducted in SPSS version 23 by applying the Independent t-test and Spearman's correlation coefficient.

Results: In stuttering subjects, the mean stuttering frequency was higher during monologue than reading, but not statistically significant ($P=0.05$). In both groups, the mean speech rate was significantly higher during reading compared to monologue. Also, in both reading and monologue tasks, the mean speech rate was significantly higher in subjects with fluent speech than in those who stutter ($P<0.001$). Finally, a significant negative correlation was observed between the mean stuttering frequency and speech rate during both tasks.

Conclusion: Considering the monologue time, subjects with stuttering have higher speech rate and less stuttering in reading. Because of stuttering-induced speech disruptions, subjects with stuttering speak slower during both reading and monologue tasks compared to subjects with fluent speech.

Keywords:

Speech rate, Reading, Adult, Stuttering

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1. Introduction

Many investigations have been done to study the effect of linguistic and motor manipulations on speech fluency of subjects with stuttering [1]. Also, speech is one of the most complicated motor processes in humans, so it is almost impossible for the investigators to control all the factors influencing speech production in a study [2].

Speech rate [3] and utterance length [4] have the highest effect on stuttering severity. The speech rate is measured with the number of phonemes, syllables, or words uttered per time [5]. Utterance length is referred to as the number of phonemes, syllables, or words spoken per utterance [6]. The human being can have intelligible speech just in fixed speech rates (whether high or low) [7]. Also, breathing limitations [8] and syntactic/semantic obligations limit the utterance length [9]. So, both the speech rate and utterance length have limited ranges.

It seems that the effect of speech rate on stuttering severity is varied in different people, and it is generally accepted that changes in temporal aspects of speech may influence the number of speech disfluencies. Studies report that stuttering severity would increase [10] and decrease [11, 12] in high and low speech rate, respectively. The findings support the notion that at least some aspects of stuttering are rooted in the disorders of speech timing [13]. Generally, the results of previous studies show that when the motor and linguistic complexities of an utterance increase, the stuttering severity would increase as well. However, the effect of different speech rate tasks on stuttering severity is still unclear [10].

Investigators studied the differences and some essential relationships between spontaneous speech and reading. Studies indicate that semantic constraint effects are more influential on speech production than reading. Also, the effect of frequency of words is higher in speech production than reading without limiting the context. By limiting that, however, the effect of frequency of words is higher on reading than speech production [14].

The studies showed that expressive and receptive language skills in the preschool period could predict the future literacy skill growth of the children, i.e., the better the expressive and receptive language skills, the higher the reading scores will be [15]. Similarly, findings of a study on 30-month-old children showed that having a low speech rate in preschool ages was a predicting factor for reading disabilities [16].

However, monologue and oral reading are two different tasks requiring different linguistic formulations to be performed correctly. So, subjects with stuttering may show different stuttering severity levels during reading and monologue. Findings of previous studies comparing the stuttering frequency during reading and monologue, explain the higher number of stuttering disfluencies in conversation than in monologue [17, 18].

Based on the researcher's study [19], compared to CSSS, Praat can provide more reliable data regarding the duration of speech segments. CSSS is a software specialized for counting the syllables (fluent and stuttered), calculating the percentage of stuttered syllables, and measuring the mean duration of the three longest stuttering events. In the study, we measured the time taken for uttering intended speech materials with Praat. It can both playback the speech samples (providing an auditory cue) and show the waveform and spectrogram of the speech sample (offering a visual cue) [20].

Praat offers simultaneous attention to the auditory and visual cues, so the clinician measures the duration of the selected speech segments with high precision. Only three similar studies have compared the speech rate and stuttering severity during reading and monologue tasks [17, 18, 21]. Young's research has two limitations. First, beside stuttering frequency, Young did not include speech rate. Second, the subjects with fluent speech were not selected to participate in the study. Neither Ritto et al. (2016) nor Pinto et al. (2013) reported that Praat was used for determining the speech rate of the participants. This study aimed to compare the speech rate and stuttering severity during reading and monologue tasks in subjects with stuttering and those with fluent speech considering the limited number of previous similar studies.

2. Materials and Methods

In this study, subjects with and without stuttering were selected by non-random sampling model from governmental and private speech therapy clinics in Isfahan City, Iran. Based on the exclusion and inclusion criteria, 24 subjects with stuttering and 24 age- and sex-matched subjects with fluent speech were selected to participate in this study. Participants in both groups had at least a high school diploma. The inclusion criteria for subjects with stuttering were as follows: having at least "moderate" stuttering (being scored 25 or more based on the stuttering severity instrument [SSI-4]) and not using speech therapy interventions up to 3 months before entering the study.

The exclusion criteria for subjects with stuttering were as follows: having structural abnormalities of the articulators and being affected by neurological or psychiatric disorders. The exclusion criteria for the subjects with fluent speech were as follows: having any speech disorder, structural abnormalities in mouth and larynx, or any neurological or psychiatric disorders.

For speech sampling, based on the manual of SSI-4, the participants talked freely about topics of interest for 5 minutes. To collect reading samples, we requested the participants to read a 400-syllable text. The linguistic factors (e.g. word length and phonetic structure) that influence stuttering severity were considered when we developed the text. Before the study began, the researchers modified the text based on the comments of 5 subjects with and without stuttering regarding the degree of difficulty of the text.

They also videotaped both speech and reading samples of the participants. The researchers measured stuttering severity using the second version of the computer program, CSSS-2 [22]. The software measures the stuttering severity based on the principles offered by the SSI-4. In a study, five experienced raters reported that the values were ranged between 0.93 to 0.98 and 0.85 to 0.98 for inter- and intra-rater reliability respectively [23]. They aimed to determine the degree of inter- and intra-rater reliability of the Persian version of the SSI-4.

A total of 250 speech syllables were selected from each speech or reading sample. They measured the time for uttering 250 speech syllables by Praat 5.3.78

[24] during reading and monologue tasks. The researchers also measured speech rate based on the number of syllables uttered per minute. They analyzed data by the Independent t-test and Spearman's correlation coefficient in SPSS V. 23 [25].

3. Results

A total of 24 subjects with advanced stuttering (5 male and 19 female) aged between 18 and 42 years (Mean±SD age: 26.17±6.62) and 24 age- and sex-matched subjects with fluent speech participated in the study. In subjects with stuttering, the findings of the Independent samples t-test revealed that the mean number of stuttered syllables in monologue and reading was not statistically different (P=0.05).

The independent samples t-test showed that in both groups of participants, the mean speech rate (based on the number of syllables per minute) was significantly higher in reading than in monologue. The Independent t-test indicated that the mean speech rate was significantly higher in subjects with fluent speech comparing to those with stuttering (P<0.001) in reading and monologue tasks.

Either during monologue or reading tasks, the Spearman's correlation showed a significant negative relationship between the speech rate and stuttering frequency in subjects with stuttering. This means that an increase in speech rate would increase the stuttering frequency in both monologue and reading tasks.

Table 1. Results of stuttered syllables during reading and monologue in subjects with stuttering

Task	Mean±SD	Minimum	Maximum	P
Reading	7.48±7.18	0.06	22.09	0.05
Monologue	11.78±7.58	3.14	37.89	

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Table 2. Results of mean speech rate during reading and monologue in subjects with and without stuttering

Participants	Task	Mean±SD	Minimum	Maximum	P
With stuttering	Reading	154.64±43.00	11.97	221.55	0.006
	Monologue	114.80±52.00	24.96	202.15	
Without stuttering	Reading	305.55±49.61	174.00	399.00	0.003
	Monologue	264.60±38.81	159.00	332.40	

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Table 3. Comparing speech rate between two groups during reading and monologue tasks

Task	Participants	Mean±SD	Minimum	Maximum	P
Reading	Without stuttering	305.55±49.61	174.00	399.00	<0.001
	With stuttering	154.64±43.00	11.97	221.55	
Monologue	Without stuttering	264.60±38.81	159.00	332.40	<0.001
	With stuttering	114.80±52.00	24.96	202.15	

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Table 4. The correlation coefficient between speech rate and stuttering frequency during monologue and reading in subjects having stuttering

Task	R	P
Reading	-0.488*	0.016
Monologue	-0.538*	0.007

*Correlation is significant at P<0.05.

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4. Discussion

This study compared stuttering frequency and speech rate during reading and monologue tasks in subjects with and without stuttering. The results of the Independent samples t-test indicated that the mean number of stuttered syllables was higher in monologue than in reading in subjects having stuttering but the difference was not statistically significant (Table 1). Other studies indicate a significantly higher frequency of stuttering speech disfluencies in monologue than in reading [18, 26]. One study even suggested that subjects with stuttering had almost no stuttering speech disfluencies during reading [27].

A recent study by Ritto et al. reported the frequency of Mean±SD stuttered syllables during the monologue and reading as 16.84±7.82 and 12.91±9.63, respectively for the subjects with stuttering [21]. Another study, Pinto et al. reported that the total number of disfluencies in spontaneous speech (37.3±19.5) was significantly higher than in oral reading (13.6±14.8) [18]. The findings support this study. Differences in motor or linguistic planning required for reading and monologue may be an explanation for the difference the researchers observed between the mean numbers of disfluencies occurred in monologue and reading. They repeat the prewritten materials verbally while reading aloud [28].

But, in monologue, one has to transfer his or her ideas or thoughts by his or her selected spoken words [29]. One may have hesitations, self-corrections, and inter-

ruptions during monologue [30] because of disturbances in the process of turning concepts to spoken words (e.g. word retrieval or word-order problems). This issue may justify the higher number of disfluencies in monologue compared to reading in subjects with stuttering.

This study indicated that in those having stuttering, the mean speech rate was significantly higher in reading than in monologue (Table 2). Previous studies reported different values for the mean number of words read per minute by subjects having stuttering as 166 words per minute (w/m) [31], 183 w/m [32] 193 w/m [33], and 86.2 w/m [18]. Also, values reported for the mean number of words uttered per minute in subjects with stuttering contain 208 w/m [34], 202 w/m [27], 159 w/m [35], and 95.7 [18]. Stuttering frequency significantly affects speech rate; the higher the severity of stuttering, the lower the speech rate will be [36]. Variability on the severity of stuttering in participants of each previous study may cause the variability in the reported values for mean speech rate continuously.

The analysis of the Independent t-test in subjects with fluent speech also showed that the mean speech rate was significantly higher in reading than in monologue (Table 2). This finding was consistent with the results of previous studies reporting a descending decrease of mean speech rate for reading, monologue, and picture description in subjects with fluent speech [37, 38].

During reading, the mean speech rate was significantly higher in subjects with fluent speech comparing

to those having stuttering (Table 3). Johnson reported that the mean speech rate of subjects with stuttering is 30%-50% lower than subjects with fluent speech [27]. Bloodstein reported that even by considering the fluent speech segments, the mean speech rate is significantly lower in subjects with stuttering than in subjects with fluent speech [39].

Similarly, the mean speech rate was significantly higher in subjects with fluent speech compared to those having stuttering during monologue (Table 3). In a study by walker, a significant difference was found between the mean speech rate in subjects with stuttering (122.7 w/m) and subjects without stuttering (170 w/m) [40]. In a study on preschool children, it was found that the mean speech rate was higher in children who stutter compared to those who do not [4]. However, Kelly found no significant difference in the mean conversational speech rate between children who do and do not stutter.

According to Kelly, the difference in stuttering severity may explain the inconsistencies observed in the values reported for the mean speech rate in subjects with stuttering. In other words, variation in speech rate is observed in studies consisting of subjects with moderate to severe stuttering than subjects with mild stuttering [41]. Young concluded that the higher the stuttering severity, the lower the difference between stuttering frequency during the monologue and oral reading tasks would be [17].

In the current study, a significant negative correlation was observed between the mean stuttering frequency and speech rate during both speech sampling tasks of reading and monolog (Table 4). This finding was consistent with previous studies demonstrating that the speech rate becomes slower as the consequence of higher speech interruptions occurring with higher levels of stuttering severity [18, 36, 42]. However, this finding is inconsistent with the results of Kalinowski et al. that showed the increase in speech rate did not determine the stuttering frequency [43].

5. Conclusion

Subjects with stuttering show higher numbers of stuttered syllables in monologue compared to reading. To develop a speaking situation hierarchy for the client, we suggest that the speech pathologists place the reading tasks in lower levels of the therapeutic hierarchy compared to monologue tasks. Given the negative correlation between the speech rate and stuttering frequency, it is suggested that the clinicians apply fluent speech strategies to decrease the speech rate of clients with stuttering.

Ethical Considerations

Compliance with ethical guidelines

All procedures were in accordance with the ethical standards of the responsible committee on human experimentation and the study obtained ethical approval (Code: IR.AJUMS.REC.1394.113) from the Research Ethics Committee of Ahvaz Jundishapur University of Medical Sciences. Also, Informed consent was obtained from all participants.

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Authors contributions

Design, speech analysis, and writing: Hossein Rezaei; Draft preparation and review: Hadi Torabi; Videotaping speech samples: Neda Tahmasebi; Statistical analysis: Mohammad Hossein Haghhighizadeh; Writing and supervision: Peyman Zamani; Collecting and transcribing speech samples, and calculation of the speech rate and stuttering frequencies: Farzaneh Abdi, Mohammad Mehdi Karami, and Zohreh Mehdipour

Conflict of interest

The authors declared no conflict of interest

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