Linguistic Factors Affecting the Loci and Frequency of Stuttering Across Age Groups among Arabic-Speaking Jordanians

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ABSTRACT

Objectives: This study was designed to study the association of stuttering loci and frequency with certain linguistic factors among stuttering Jordanian children and adults.

Method: Seventy four Jordanian persons who stutter, categorized into three age groups, constituted the subjects of the present study. Speech samples were collected from each subject's oral reading and conversational speech, and analyzed according to the frequency of stuttering on each of the following linguistic factors: Word length, word grammatical class, word position, sentence position, and syntactical complexity. Paired t-tests and ANOVA were conducted to determine the significance of each linguistic factor.

Results: There were significant correlations between the stuttering loci and frequency with each of the linguistic factors studied.

Conclusion: The results are in accordance with findings in other languages. It was found that for our subjects, as it was the case for English, Norwegian, Kannada, German, and Spanish subjects, the stuttering events were strongly associated with word length, word grammatical class, word position, sentence position, and syntactical complexity.

Key words: Arabic, Jordanian, Linguistic factors, Loci of stuttering events, Stutter frequency

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Introduction

Stuttering is defined as a disturbance in the normal fluency and time pattern of speech that is distinguished by blocks, sound and syllable repetitions, and sound prolongations; and various types of normal disfluencies, such as interjections, broken words, whole-word repetitions, *etc.*; and might be accompanied by physical concomitants, such as eye-blinks, head jerks, limb movement, *etc*.[1]

Past research has shown that linguistic variables affect stuttering frequency and distribution in English-speaking persons who stutter (PWS). This relationship might explain the nonrandom distribution of stuttering events in the speech of disfluent speakers. For example, PWS were found to stutter more on longer words,[2-8] content rather than function words,[4,9-14] and syntactically complex utterances.[15-18] They also stutter on initial sounds of the words[19,20] and at the beginning of an utterance.[11,13,19,21-27] It should be noted that the word's grammatical class influence on the stuttering of young children is opposite to that reported for older children and adult PWS. Children were consistently found to experience more difficulty on function words, whether using simple analysis[28] or analyzing the phonological words.[29-31] In addition, some studies[32-37] did not find significant differences between variations in syntactic complexity and stuttering frequency. Actually, syntactic difficulty might be an age-related factor.[17,35] Logan[38] cited many studies that related increased stuttering

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occurrences with syntactic complexity in young children. Their adolescent and adult participants, however, showed no difference in disfluency rates across the four levels of syntactic complexity they studied. Also, it is worthy to note that, whereas linguistic parameters may influence stuttering, it is not at all clear that deficits in language have a role in the development of stuttering. In fact, several studies report that children at the onset of stuttering are not deviant in language skill.[39]

The association between certain linguistic factors and stuttering loci and frequency was denoted by some researchers to increased demands placed by those linguistic properties on speech motor planning and execution.[40-42] Three theories[43-45] proposed language involvement in stuttering. Perkins *et al*.,[43] Postma & Kolk,[44] and Wingate[45] claimed that the disruption in fluency is due to slow lexicalization, *i.e.* the process by which speakers retrieve and encode words to maintain ongoing speech. Recently, Prins *et al*.[46] found that slow lexical processing by the stutterers could serve to disrupt fluency. Finally, the interaction between language formulation and speech motor execution had been adopted by many researchers as an acceptable explanation for fluency breakdown.[41,47-49]

Language factors, in fact, overlap and interfere with each other during their influence on speech fluency. Designing an experiment to study a single factor without the interference of other factors presents several methodological problems. For example, in a study of the word length factor and frequency of stuttering, it is necessary to isolate factors such as word frequency, word information load, syllabic stress, and word position in an utterance. This, however, has never been completely controlled. Language factors do interfere and interact during running speech. Actually, a design aimed at isolating a given language factor results in artificial speech samples that are not representative of the stutterer's actual use during various speaking situations. A practical strategy to resolve this problem might be accomplished by securing sizable samples of the speaker's daily conversational speech and readings.

The study of language factors in stuttering is important both in terms of theory construction and clinical applications.[50] This point of view is strengthened by information about the significant role that language deficits might play in developing and maintaining components of stuttering.[51] The universality of some or all language factors in defining the loci of stuttering events among various languages might highlight linguistic processing or speech execution deficits. Language factors in stuttering were investigated in a few languages other than English, such as Norwegian,[52] German,[53,54] Spanish[55] and Kannada[56-57] and were found to influence the stuttering of their speakers. Additional accumulated information from various languages will enrich our data-based knowledge, making inferences about language processing and execution, and their connection with stuttering, more universal. Bernstein Ratner and Benitez[58] emphasized the need for cross-linguistic research in this domain. To the author's knowledge, no pertinent previous study addressed the relationships between linguistic factors and stuttering in Arabic-speaking PWS.

The purpose of the present study was to investigate the impact of certain linguistic factors, such as word length, word type and grammatical class, word and sentence positions, and syntactical complexity upon the frequency of stuttering in three age groups of Jordanian persons who stutter, using comprehensive oral readings and conversational speech samples. In addition, the distribution of stuttering moments along words and short sentences was also surveyed.

Method

Subjects

Seventy-four Jordanian PWS were chosen randomly from a population of 132 stuttering cases referred to the Speech Clinic, Royal Rehabilitation Center, during a period of 17 months. They were divided into three age groups. Group I included children from the first three grades (N=25, 20 males and 5 females, age range= 6.0–8.9 years; M=7.5 years; SD=±0.92). Group II included students in grades four to nine (N=23, 21 males and 2 females, age range=9.0–15.6 years; M=11.10 years; SD=±1.97). Group III included senior students and adults (N=26, 21 males and 5 females, age range 16.10–28.0 years; M=20.7 years; SD=±4.05).

Females were represented in the total sample according to their proportion in our clinic's stuttering caseload which is approximately one in five. Each group contained various stuttering severity levels except the profoundly severe. No sub-classification according to severity was done due to the relatively small size of each age group.

Materials

Three types of materials, oral reading, pictorial

stimuli for spontaneous speech, and structured conversational questions, were prepared to be analogous of the daily speech of a person who stutters. The oral readings (written prose) included three word lists, a sentence list, and two 100 word passages, a syntactically complex passage and a syntactically simple passage. Different written materials were prepared for each of the two older groups commensurate with their expected reading skills. The youngest children did not do the reading task. The spoken prose consisted of the subjects' responses to standard questions and conversational speech, and of naming, describing, and interpreting pictures. Care was taken to obtain a relatively comparable speech sample size from each subject. The total corpus collected from each prose type for each age group was used for analysis. A full description of the materials used to collect both prose types is presented in detail in Attieh.[59]

The validity of the materials prepared for the present study was measured by using disciplined subjectivity.[60] Each component of these materials used was assessed by a three-member jury. The jury, experts in linguistics, rated their opinions regarding two issues, the appropriateness and the representativeness, according to a four-point scale: extremely significant (3), significant (2), fairly significant (1), and insignificant (0). A mean score was then calculated for each jury's rating. Three items received the highest possible mean rating of 3 (extremely significant) and five items received mean ratings between 2 and 2.67.

Procedure

Each subject was first showed the set of pictures, one at a time, and asked to either name, describe, interpret, or answer a question, according to the card presented to him/her. The subject was then engaged in a comfortable structured conversation. Subjects of groups II and III were then asked to read the prepared word list, sentence list, and the two passages. The subjects' responses were tape-recorded in a quiet room using Grunding (STENORETTE 2060) tape recorder.

Replays of the tape-recorded utterances of each subject of the study were transliterated. The transcripts were used to register instances of stuttering during another replay of the tape-recorded utterances. Only those behaviors that are considered as core behaviors[61] of stuttering were registered. Another speech pathologist evaluated 19 (25.7%) of the tape-recorded material selected randomly and marked the instances of core stuttering. The inter-rater reliability[62] was 0.93 for the transliteration and 0.91 for the identification of stutter occurrences.

Analysis

The first analysis performed was to relate the frequency of stuttering and the word length. Various word lengths were monosyllabic, bisyllabic, trisyllabic, and four or more syllabic words. The percentage of stuttering on each word length was individually calculated for each prose sample collected from each subject, and then was averaged over the subjects of each group. The prose is the speech samples from the reading, pictures, and conversational tasks. The second analysis was done by assigning a grammatical class for each word, spoken or orally read, as either content or function word. This was followed by calculating the percentage of stuttering on each content word and function word collected from each prose provided by each subject.

The third analysis addressed word and sentence position. The corpora were analyzed to count the number and length of utterances for each subject. Two analyses were done. First, the frequencies of stuttering occurrences on initial versus other word positions was calculated in both written prose and spoken prose. Secondly, the distribution of stutters along the words of two and three word sentences was analyzed. The results then were displayed in percentages and graphs.

The last analysis addressed comparing the relative number of stuttering events on oral readings of complex and simple passages (see Material above) by the older two groups. Paired t-tests for dependent variables were conducted to determine the significance of the difference in mean frequency of stuttering for all linguistic factors under analyses (except for the factor of word and sentence position, *i.e.*, the thirds factor) for both the spoken prose and the written prose of the three age groups. A *priori* alpha level of these tests was set at 0.05. Following the paired t-test analyses, analyses of variance were done to analyze each of the dependent variables with the age group and prose type.

Results

Word length factor

As shown in Table I, there was a gradual increase in the mean percentages of stuttering along with the increase in word length for all age groups regardless of prose type.

Table I. Mean percentage of stuttering on all four word lengths, along both prose types of the three age groups.

Age Group	Stimulus	Mono-syllabic Words (Mean & SD)	Bisyllabic Words (Mean & SD)	Tri-syllabic Words (Mean & SD)	Longer Words (Mean & SD)
Group I	Spoken Prose	23.4%	32.2%	36.7%	40.4%
		(9.0)	(11.5)	(15.2)	(18.7)
Group II	Oral reading Prose	19.2%	22.6%	27.6%	29.9%
		(9.3)	(11.7)	(13.0)	(14.0)
	Spoken Prose	23.0%	25.9%	29.8%	37.3%
		(9.1)	(11.0)	(13.3)	(17.4)
Group III	Oral reading Prose	15.1%	20.8%	26.0%	30.3%
		(8.3)	(9.9)	(11.6)	(14.8)
	Spoken Prose	14.4%	22.0%	28.0%	35.7%
		(7.1)	(9.9)	(11.8)	(16.9)

Table II. Analysis of variance between the factor of word length and the factor of age

Word Length	Group	Mean	S. D.	Between- Groups F	Between- Groups P
Mono-syllabic Words	I	23.4	9.0	8.9	0.000*
	II	21.2	9.8		
	III	14.7	9.0		
Bisyllabic Words	I	32.2	11.5	7.5	0.001*
	II	24.3	11.8		
	III	21.4	10.7		
Tri-syllabic Words	I	36.7	15.2	4.7	0.011*
	II	28.7	13.0		
	III	27.0	11.6		
4 or more syllabic Words	I	40.4	18.7	1.5	0.219
	II	33.7	19.0		
	III	33.1	16.0		

Table III. Analysis of variance between the factor of word length and the factor of prose type

Word length	Prose	Mean	S. D.	Between- Groups F	Between- Groups Significance
Mono-syllabic Words	Written	17.1	10.6	2.8	0.095
	Spoken	20.2	9.3		
Bisyllabic Words	Written	21.7	12.0	5.2	0.025*
	Spoken	26.8	11.5		
Tri-syllabic Words	Written	26.8	12.1	3.7	0.058
	Spoken	31.6	13.9		
4 or more syllabic Words	Written	30.1	15.7	5.3	0.024*
	Spoken	37.9	18.5		

This increase in stuttering from one word length to the next was statistically significant, with the exception of the difference between monosyllabic and bisyllabic words of both orally read and spoken prose of group II and between trisyllabic and longer words orally read by group II and the spoken prose of group I. The six pairs of various possible comparisons between different word lengths are significant at $p \leq 0.001$ when totaling the word length for each prose of all three age groups.

When the frequency of stuttering on each word length was analyzed according to age group, it can be noted in Table I that there was a consistent increase in the mean stuttering percentage from older age to younger age for all four word- lengths. As shown in Table II, analysis of variance (ANOVA) of the mean percentage of stuttering on the first three word-lengths were significant ($p=0.000, 0.001, 0.011$ respectively) along the three age groups, while the mean percentage of stuttering on four or more syllabic- words did not vary significantly between age groups. Also, as noted in Table III, there was a consistent increase in the mean percentage of stuttering between 'written prose' and 'spoken prose' for all four word-lengths. However, only the 'between groups' differences for

Table IV. Paired T-test between the mean percentage of stuttering on content and function words, according to prose type and age group

Age Group	Stimulus	Mean % (SD) of Stutters on Content Words	Mean % (SD) of Stutters on Function Words	T	df	Significance (2-tailed)
Group 3	Written Prose	26.8% (12.2)	13.8% (7.0)	6.8	23	0.000*
	Spoken Prose	25.6% (11.8)	13.5% (6.8)	5.0	25	0.000*
Group 2	Written Prose	25.8% (13.0)	20.3% (10.4)	3.0	20	0.007*
	Spoken Prose	28.4% (12.6)	16.3% (7.3)	5.1	22	0.000*
Group 1	Spoken Prose	33.0% (11.9)	26.3% (9.4)	2.6	24	0.015*
All Groups	Both	28.0% (12.4)	18.0% (9.2)	9.6	118	0.000*

Table V. Analysis of variance for the interaction between the two prose types of the word class factor

Word- Grammatic Class	Prose Type	Mean of Stuttering	Standard Deviation	Between- Groups F	Between- Groups Significance
Content Words	Written	26.3	12.4	1.3	0.253
	Spoken	29.0	12.3		
Function Words	Written	16.8	8.3	0.9	0.329
	Spoken	18.7	9.2		

Table VI. Analysis of Variance for the interaction between various age groups of the word class factor

Word- Grammatic Class	Age Group	Mean of Stuttering	Standard Deviation	Between- Groups F	Between- Groups Significance
Content Words	1	33.0	11.9	2.7	0.069
	2	27.2	12.7		
	3	26.2	11.9		
Function Words	1	26.3	9.4	16.2	0.000*
	2	18.2	8.9		
	3	13.6	6.8		

di-syllabic and four or more syllabic-words had significant differences (p=0.025 and 0.024 respectively).

Word Grammatical Class

As shown in Table IV, there was consistently more stuttering on 'content' words than on 'functional' words. This difference was significant (p=0.001) for the whole corpus collected by the three groups (Table V) and for each age group separately, whether the speech sample collected was 'written prose' or 'spoken prose'.

The ANOVA for the interaction between age and prose type (Table V) shows that there were no significant differences in percentages of stuttering on either grammatical class of words among the three groups in respect to type of speech prose. However, only the percentage of stuttering on 'functional' words that showed statistical significance in respect to age group (Table VI). In other words, there was no statistical difference in the mean percentage of stuttering on content words between the three groups of the study. On the contrary, the mean percentage of stuttering on function words is statistically different from one age group to another, with an inverse relationship between the relative percentage of stuttering and the age of the subject. Also, as shown in Table V, there was no effect of the prose type on grammatical factor. In other words, there was no statistical difference in the mean percentage of stuttering on either content words or function words between 'written prose' and 'spoken prose' for both groups 2 and 3.

Word and Sentence Position:

The Word Position Factor

As shown in Table VII, the distribution of the occurrence of stuttering in words is invariably syllable-initial position (99.3%), and 84.1% of stutters occur in word-initial positions. Only 0.7% of stutters occur in syllable-final positions, which are mostly sound prolongations that, usually, mark a stutter on the subsequent word. The same finding is true regardless of the age group and the prose type. It is apparent that there was consistently more stutter

Table VII. The mean percentage of stuttering on each word position, according to age group and prose type

Age group	Material	Mean % of stuttering on initial sounds of first syllable	Mean % of stuttering on initial sounds of other syllable	Mean % of stuttering on syllable- final sounds
3	Written prose	87.2 %	12.8 %	0.0 %
	Spoken prose	82.5 %	16.2 %	1.3 %
2	Written prose	83.5 %	15.9 %	0.6 %
	Spoken prose	79.5 %	18.1 %	2.4 %
Both	Both	84.1 %	15.2 %	0.7 %

Table VIII. Syntactical complexity: paired t-test comparisons between the mean percentage of stuttering on both 'simple' and 'complex' passages, for both groups I & II subjects

Age group	Syntax	Paired Differences Mean	Standard Deviation	T	Significance (2-tailed)
Group 1	Simple - Complex	-5.15	4.90	- 4.70	0.000*
Group 2	Simple - Complex	-6.29	5.40	-5.71	0.000*
Both groups	Simple - Complex	-5.77	5.15	-7.4	0.000*

Table IX. Syntactical complexity: analysis of variance for the mean percentage of stuttering on each of 'simple' and 'complex' passages, for both group 2 & 3 subjects

Syntax	Age Group	Mean	S. D.	Between- Groups F	Between- Groups Significance
Simple	1	19.50	9.47	0.71	0.403
	2	16.92	10.58		
Complex	1	24.65	11.33	0.168	0.684
	2	23.21	11.87		

occurrences in word-initial positions in the 'written prose' as compared to the 'spoken prose' for both age groups; however, these differences failed to be significant (p= 0.40 & 0.42, for groups 3 and 2, respectively).

The Sentence Position Factor

Analysis of the distribution of stutters along the words of a sentence was limited in this study to two and three word utterances. The distribution of stutters along two-word sentences is shown in Fig. 1, where around two thirds of stuttering occurred on the first word of the two- word sentences. Because subjects of group I had no reading material and the material of group III contained no two-word sentences, then the only comparison to make between both prose types was for group II. It can be noted that the strength of the first word as being stuttered is relatively stronger during the use of two-word sentences in conversation than during oral reading of these sentences.

Fig. 2 shows the distribution of stutters along three- word sentences for all three groups, including 'written prose' of group II. The mean percentage of stuttering consistently decreases from the first word to the subsequent words. The mean percentage of stuttering ranged between 40% - 48% for the first word, 32% - 36% for the second word, and 19% - 28% for the third word. Analysis of the distribution of stutters on longer utterances was left for future studies.

Syntactic difficulty

As shown in Table VIII, the mean percentages of stuttering on oral readings of the syntactically 'complex' passages, for each of group I and group II subjects and for the subjects of both groups combined, were statistically higher (p=0.001) than the syntactically 'simple' passages. ANOVA (Table IX) did not show a 'between- groups' difference for either the simple or complex passages, indicating this factor is stable for the two 'reading' groups of the study.

Discussion

As it is the case with PWS from other languages and cultures, Jordanian PWS also face more difficulty on longer words, on content rather than function words, on initial positions of words and sentences, and on oral readings of syntactically complex passages. These findings are viewed as an additional support for previous findings reported for other languages.

The increased difficulty faced by persons who stutter on longer words, regardless of the spoken language, can be explained according to increased 'demands' and 'capacities'.[63]

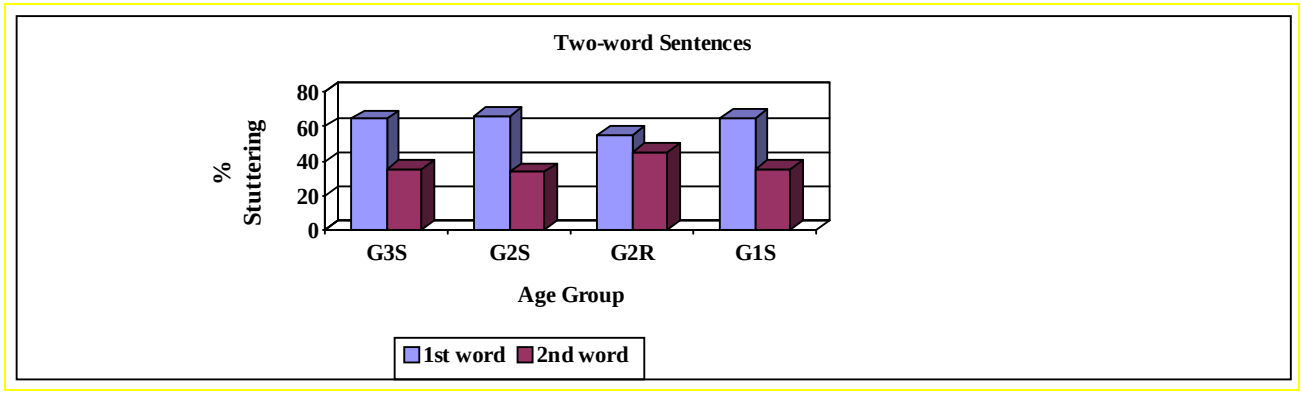

Fig. 1. The distribution of stuttering on two-word sentences, along both prose types & age groups. G refers to age group, S refers to spoken prose, and R refers to written prose

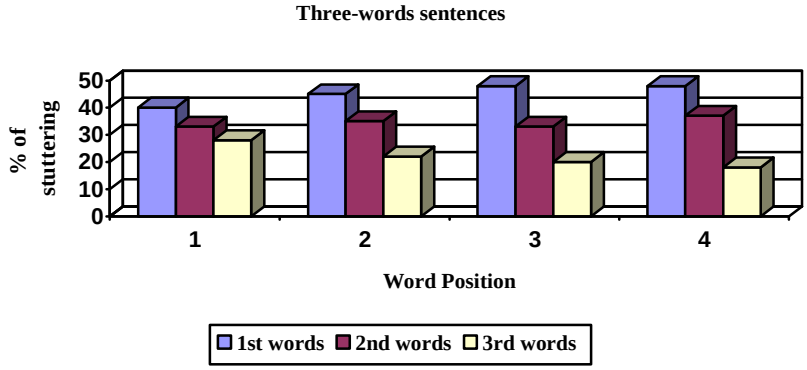

Fig. 2. Distribution of stuttering along three-word sentences, along prose type and age group. 1 represents group III spoken prose, 2 represents group II spoken prose, 3 represents group II written prose, and 4 represents group I spoken prose

Longer words require increased pressure on motor execution, rather than on word retrieval. Also note that the current data were balanced for word finding difficulties as the study compared the difficulty on a given word length in all stimulating possibilities, *i.e.* naming a picture and reading a written word versus conversational speech.

The clear word grammatical class factor, for the distinction content versus function, and syntactical complexity factor can also be explained within the same framework. Content words, such as nouns, verbs, adjectives, and adverbs that carry the meaning, require increased higher language processing in contrast to the function words, such as pronouns, articles, prepositions, *etc.* that do not carry full lexical meaning but have a grammatical or functional role.[31] The reported lack of a clear grammatical factor for young children who stutter[21] could not be tested because the youngest subject in the present study was six years old. However, as was shown in Tables 5, the mean percentage of stuttering on function words significantly decreased from the youngest age group to the older groups (26.3%, 18.3%, and 13.6%, for groups I, II, & III, respectively). This finding is in concordance with the reported literature.[30] The frequency of stuttering on content words, on the other hand, did not significantly vary across the three age groups.

When compared to the inconclusive reports of the syntactical complexity for English- speaking PWS, the results of the present study support, at least for Jordanian PWS, the tendency of increased stuttering occurrences to be associated with increased transformational demands,[15-18,64] *i.e.* synchronizing the logical content with the phonetic structure of complex sentences. The participants, regardless of age, but with few individual differences, faced more difficulty during oral reading of material that is complex in theme, structure, number of embedded clauses, and the length of the constituent sentences. This finding supports the hypothesis of syntactic complexity as a strong language factor in stuttering.

The present study also showed that the utterance length of only one to three syllables long resulted in differences in stuttering among the three age groups. Stuttering on longer utterances, four or more syllables, words did not vary among the age groups. Also, as far as the grammatical class of words, and,

to a lesser degree, the word length factor, data showed that the prose type, whether read or spoken, did not have a different effect on these linguistic factors (refer to Tables III & V). In other words, the linguistic factors affect the frequency of stuttering regardless whether the word was read aloud or spoken.

The greater difficulty encountered by the stutterers at the beginning of an utterance can be explained as either due to increased linguistic demand,[11,27,45] increased neuromotor demand,[34,57] or both.[36] Brown[19] provided a psychological explanation. He accounted for the evident influence of both sentence position and word stress, in terms of their prominence in the sequence of the utterance. Presumably the prominence triggers the stutterer's effort to avoid stuttering at these points. The mean percentage of stuttering on the first word of both two-word and three-word sentences was slightly higher for the spoken prose than for the written prose, for both groups II and III, and on all sentence lengths. However, this observation needs further research by balancing for other factors such as word length, word familiarity, information load, *etc.*

The current results should be taken cautiously due to certain limitations that need to be solved in future replications on Jordanian PWS. For example, the sample size did not allow for further comparisons according to the severity of the fluency disorder. In addition, during analysis of word and sentence position factor, no attempt was made to include syllabic stress, word information load, *etc.* in the analysis. The same applies to the position of the function words in the phonological words. Also, the results of the present study would be more meaningful when compared to the same language factors in preschool stuttering children.

Conclusion

The present study provided an additional support from another language for the association between stuttering events and certain linguistic components. All three age groups of Jordanian individuals who stutter faced more difficulty on longer words, on content words than on function words, on initial sounds of the words, and on words that are closer to the beginning of an utterance, whether the utterance was read aloud or spoken. During oral readings, the older two age groups showed increased difficulty on syntactically complex passages.

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