

Characteristic features of single-syllable word repetitions in preschool children who stutter and controls

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Abstract. The purpose of this study was to investigate differences in single-syllable word repetitions between preschool children who stutter and children who do not stutter. The participants of this study were 24 children aged 2.1 to 5.0 years who stutter and a control group matched in sex and age. Audio- and videotaped speech samples consisting of at least 1000 syllables were analysed regarding frequency, number of repetition units, and pause duration of single-syllable word repetitions. Results showed that frequency and number of iterations of single-syllable word repetitions differentiate the two groups, and that the group of children who stutter produced significantly shorter single-syllable word repetitions than the control group.

1. Introduction

Johnson et al. (1959) claimed that at the time of stuttering onset, disfluencies in the speech of children who stutter and children who do not stutter do not differ substantially. Instead, they claimed that diagnosing a child's normal disfluency as "stuttering" could cause the disorder.

Meanwhile, research on early childhood stuttering showed that disfluencies shown by children close to stuttering onset differ along several dimensions from disfluencies of children who do not stutter (Ambrose & Yairi, 1999). One differentiating aspect is the category of disfluencies shown by the children: according to the classification system of Johnson et al. (1959), Ambrose and Yairi (1999) define stuttering-like disfluencies (SLD) as part-word-repetitions, single-syllable word repetitions and disrhythmic phonation (prolongations, blocks and broken words). Interjections, revisions and multisyllable/phrase repetitions are categorized as other disfluencies (OD). The quality of SLD influence the perception and judgment of stuttering, whereas OD occur in the speech of both groups and may give the speaker time for speech planning and therefore have a functional value (Starkweather & Givens-Ackerman, 1997).

But while all other categories of SLD occur very rarely in the speech of children who do not stutter compared with children who do stutter, there is a striking overlap regarding single-syllable word repetitions. There are studies of English-speaking children which show that they differ in their number of repetition units (Ambrose & Yairi, 1999) as well as in frequency and duration (Ambrose & Yairi, 1995). Throneburg and Yairi (1994) demonstrated that children who stutter repeat single-syllable words faster than children who do not stutter by producing a shorter silent interval between the first and last spoken segment.

In contrast to these findings, Zebrowski (1991) did not find significant between-group differences, neither for the duration nor the number of repetition units.

Single-syllable word repetitions seem to belong to both categories of disfluencies: stuttering-like and other. Therefore, the purpose of this study was to investigate differences in single-syllable word repetitions in German-speaking children between a group of preschool children who stutter and a control group. A goal of this study is to gain more information about the characteristic features of single-syllable word repetitions which could lead to a valid method of diagnosing stuttering in young children.

2. Method

The participants of this study were 24 children aged from 2;1 to 5;0 years who stutter and controls matched in sex and age. Both groups consist of 10 girls and 14 boys. To be included in the group of children who stutter, subjects met the following criteria: they spoke German as the mother-tongue, were not older than 5 years and were regarded by their parents and by a clinician as having a stuttering problem.

Speech samples consisting of a total of 1000 syllables were obtained during two play situations between the investigator and child which took place one week apart. This play situation was intended to be standardized by offering the same toys and by giving the child the possibility to play with the same investigator each time. The play situation was video-taped (Panasonic, NV-SX30EG, Osaka, Japan) while the audio-signal was digitally

recorded (Microphone Systems Sennheiser MKE 2-1053, Wedemark, Germany) with an sampling frequency of 22050 kHz and a sampling depth of 16 bits.

The first 100 syllables per sample were excluded and then the speech samples were orthographically transcribed and analysed using CHILDES and CLAN (Mac Whinney, 1991). Unintelligible utterances as well as isolated affirmatives and negatives which normally are produced fluently were not included. A special coding system concerning the classification of disfluencies was added and all single-syllable word repetitions were identified by repeatedly listening to the recording using a visual representation of spoken language presented by CLAN. In cases of uncertainty the video-tapes were also used. In a second step of analysis, different aspects such as duration of the spoken segments and the silent interval within single-syllable word repetitions were determined by listening to the audio-signal. The onset and ending of a repetition unit or pause were determined by means of clear visible and audible changes in the signal. The number of repetition units were defined as a *extra production* of the single-syllable word (following Johnson et al., 1959). Total Duration (T_{total}) was defined as the duration of the first spoken segment ($T_{first\ spoken\ segment}$) plus the duration of the silent interval ($T_{silent\ interval}$) and the duration of the second spoken segment ($T_{second\ spoken\ segment}$) following the definition of Niermann Throneburg and Yairi (1994).

All durational segments were measured in milliseconds and durational ratios between the various segments were calculated for analysis. Because the single-syllable word repetitions were extracted from conversational speech, they were not identical for subjects in variables such as speech rate and vocabulary. Such influences and differences within the individuals and finally within the groups can be neutralized by calculating the ratios (Niermann Throneburg & Yairi, 1994).

In this study, ratios of *first spoken segment/ total duration*, *silent interval/ total duration* and *second spoken segment/ total duration* were first calculated for each child. Then group averages were derived from this individual data. The analysis of durational aspects was limited to single-syllable word repetitions with only one iteration because the analysis of frequency and number of repetition units revealed that children who do not stutter rarely produce single-syllable word repetitions with two or more repetition units.

For each question, group-averages were compared using the Mann-Whitney-U-Test. Since three tests were performed, the adjusted significance level was 0.017.

3. Results

1) Frequency

The mean frequency of single-syllable word repetitions units is significantly higher for all numbers of repetitions in the group of children who stutter than in the group of children who do not stutter.

Because the group of children who do not stutter did not produce single-syllable word repetitions with more than three repetition units, comparisons were limited to this number of iterations. Results are resumed in Table1 and shown in Figure 1.

Table1. Mean frequency of single-syllable word repetitions with one (I1), two (I2) and three (I3) repetition units (S.D. in brackets). Significant differences are marked with an asterisk.¹

Repetition units	Children who stutter	Control group	Z	p
	Frequency [%]	Frequency [%]		
I1	1.83 (1.01)	0.40 (0.35)	-5.434	0.000*
I2	0.47 (0.61)	0.05 (0.06)	-4.768	0.000*
I3	0.12 (0.23)	0.00 (0.02)	-2.650	0.008*

¹ This form will be continued for all results.

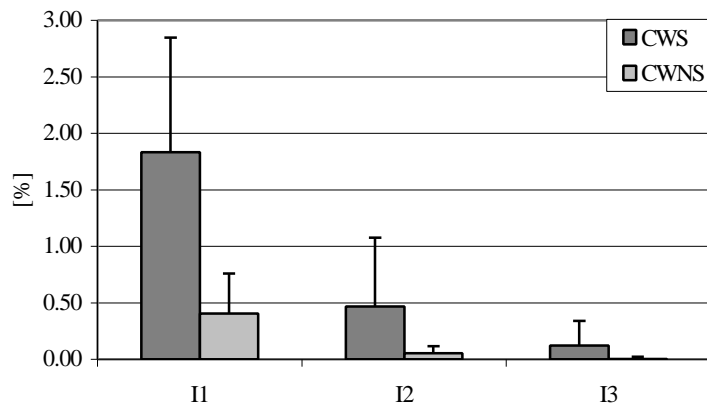


Figure 1. Mean frequency of single-syllable word repetitions with one (I1), two (I2) and three (I3) repetition units.

Although the standard deviations are higher in the group of children who stutter, all between-group comparisons reveal significant differences.

2) Number of Repetition Units

The mean number of repetition units is with 1.27 (SD=0.26) to 1.10 (SD=0.33) significantly higher in the group of children who stutter ($Z = -2.49, p = 0.010$). The group of children who do not stutter rarely produce single-syllable word repetitions with more than one repetition unit.

3) Durational Aspects

The mean absolute duration and the mean proportions of various segments are presented in Table 2.

Although the total duration in the group of children who stutter compared with children who do not stutter is not significantly shorter (CWS: 0.547 ms, CWNS: 0.951 ms), all comparisons concerning the duration of spoken segments and the silent interval show significant differences. Children who stutter repeat faster by producing a shorter silent interval while their spoken segments are longer. All results are presented in Figure 3.

Table 2. Mean absolute duration (T) in milliseconds and mean proportions of various segments and standard deviations (in brackets).

	Children who stutter	Control group	Z	p
T_{Total}	0.547ms (0.158)	0.951ms (0.109)	-1.093	0.137
$T_{1st\ spoken\ segment}/T$	44.85% (0.055)	39.37% (0.100)	-2.135	0.017*
$T_{silent\ interval}/T$	17.84% (0.086)	29.19% (0.160)	-2.313	0.011*
$T_{last\ spoken\ segment}/T$	37.31% (0.044)	31.44% (0.082)	-2.643	0.004*

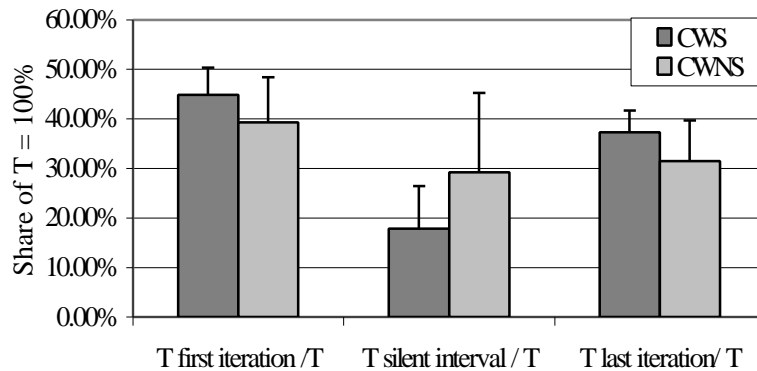


Figure3. The mean proportions of the various segments within the single-syllable word repetitions with one repetition unit

4. Discussion

The study confirmed that “frequency” and “number of repetition units” are characteristics of single-syllable word repetitions which can be used for valid differential diagnosis between children who stutter and children who do not stutter. Children who stutter produce significantly more single-syllable word repetitions than children who do not stutter. Furthermore, they show a significantly higher number of iterations. As demonstrated by Ambrose and Yairi (1999), the occurrence of more than one iteration is an indication for stuttering. The study also revealed that single-syllable word repetition with only one iteration occur frequently in both groups.

The findings of Niermann Throneburg and Yairi (1994) concerning durational aspects of single-syllable word repetitions and their differentiating character are supported by our results. The results showed that children who stutter repeat faster by producing a shorter silent interval and their spoken segments are significantly longer than the segments of children who do not stutter.

As assumed by Niermann Throneburg and Yairi (1994), the different duration of single-syllable word repetitions can be an indication for the existence of two different categories. The shorter ones belong to the category of SLD and the longer which may gain less attention by listeners, and are also less tensed are part of normal disfluencies in the speech of young children. Further studies might investigate if the durational differences can influence listeners’ judgement of stuttering. For this purpose, both categories of single-syllable word repetitions might be presented to listeners. If the shorter single-syllable word repetitions are then classified as being stuttered, this judgement will support the hypothesis that two different single-syllable word repetitions are perceptible.

To obtain more information about these two categories of single-syllable word repetitions, further studies are necessary. It is possible that they differ in other aspects such as loudness or pitch which can be used to describe the aspect of tension.

If clinicians are able to differentiate between these types of single-syllable word repetitions, the diagnosis of early childhood stuttering would become more reliable.

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