

Original articles

Comparison of reading of school-age children who stutter in two listening situations: usual and delayed

Comparação da leitura de escolares com gagueira em duas condições de escuta: habitual e atrasada

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Conflict of interest: non-existent

ABSTRACT

Purpose: to compare the immediate effects of delayed auditory feedback in the oral reading task in school-age children with persistent developmental stuttering.

Methods: this study was approved by the Institutional Ethics Committee (n° 0714/2013). Participated 16 school-children aged 8-17 years, 11 males and 5 females, divided into two experimental groups (EG1 and EG2) of 8 participants each; the EG1 composed of participants with moderate stuttering and EG2 with severe or very severe stuttering. The procedures used were audiologic evaluation, fluency assessment in spontaneous speech and evaluation of oral reading fluency in two listening situations: with Normal Auditory Feedback - NAF and Delayed - DAF. The Fono Tools software along with Andrea PureAudio USB -AS adapter and headset microphone Karsect HT- 2 were used to cause the effect of the DAF and record speech.

Results: the effect of delayed auditory feedback led to reduction of stuttering-like disfluencies in both groups, but the frequency of other disfluencies increased in moderate stuttering group and decreased in the group with severe / very severe stuttering and thus, total disfluencies showed a more significant decrease in EG2. There were statistically significant differences for the oral reading only in intergroup comparison for the stuttering-like disfluencies, at usual auditory feedback situation. **Conclusions:** the delayed auditory feedback did not cause significant effects during the oral reading in both groups, however there is a tendency of the effect be considered positive for the group with severe / very severe stuttering.

Keywords: Speech, Language and Hearing Sciences; Speech Disorders; Reading; Stuttering; Feedback

RESUMO

Objetivo: comparar os efeitos imediatos do atraso na retroalimentação auditiva na tarefa de leitura oral em escolares com gagueira do desenvolvimento persistente.

Métodos: estudo aprovado pelo Comitê de Ética da Instituição (n°0714/2013). Participaram 16 escolares, com idade de 8 a 17 anos, sendo 11 do gênero masculino e 5 do feminino, separados em dois Grupos Experimentais (GE1 e GE2) de 8 participantes cada; o GE1 composto de participantes com gagueira moderada e o GE2 com gagueira grave ou muito grave. Os procedimentos utilizados foram: avaliação audiológica, avaliação da fluência na fala espontânea e avaliação da fluência na leitura oral em duas condições de escuta: com Retroalimentação Auditiva Habitual – RAH e atrasada – RAA. O software *Fono Tools* junto com o Adaptador Andrea PureAudio USB-AS e microfone auricular Karsect HT-2 foram utilizados para provocar o efeito da RAA e gravar a fala.

Resultados: o efeito da retroalimentação auditiva atrasada ocasionou redução das disfluências típicas da gagueira em ambos os grupos, porém a frequência de outras disfluências aumentou no grupo de gagueira moderada e diminuiu no grupo com gagueira grave/muito grave e, desta forma, o total de disfluências apresentou uma diminuição mais significativa no GE2. A diferença foi estatisticamente significativa apenas na comparação intergrupos das disfluências típicas da gagueira, na situação de retroalimentação auditiva habitual. **Conclusões:** o atraso na retroalimentação auditiva não ocasionou efeitos significantes na leitura em ambos os grupos, entretanto há uma tendência do efeito ser considerado positivo para o grupo com gagueira grave/muito grave.

Descritores: Fonoaudiologia; Distúrbios da Fala; Leitura; Gagueira; Retroalimentação

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INTRODUCTION

Stuttering is a complex fluency disorder characterized by excessive interruptions during linguistic formulation¹⁻³. Muscle tension⁴ during speech production, affects smoothness⁵ and speech rate⁶. Stuttering often begins in childhood (developmental stuttering) and can persist into adulthood⁷. The presence of stuttering-like disfluencies^{1,2} is the main manifestation of the disorder. The main types of stuttering-like disfluencies comprise word repetition - more than 3, part of word repetition, sound repetition, block, prolongation, pauses and intrusions.

Reading fluency is related to decoding and understanding, in a way that the slower word processing interferes on reading automaticity, and hence on the comprehension⁸. Therefore, the fluent reader is more likely to achieve better performance in understanding a text⁹, while miscommunication might influence negative attitudes of students towards their own speech¹⁰ and as a result, reducing participation in oral reading activities, impairing the development of this skill.

An important tool used by speakers to maintain fluency during oral task is the auditory feedback of the continuous flow of speech¹¹. The advent of technology has promoted an increase in researches that can help the intervention in stuttering therapy, for example, the use the altered auditory feedback¹².

The positive effects in the speech of people who stutter in different auditory feedback conditions suggested the possibility of a significant auditory component in the complex manifestation of stuttering¹³. Fluency in people who stutter can be improved by changing the auditory feedback¹⁴.

One of the altered auditory feedback that led to an increase in fluency of people who stutter, is the Delayed Auditory Feedback (DAF)¹⁵⁻¹⁷. The speaker hears his own voice with chorus effect with this device¹⁷.

Recent investigations have shown interesting results of DAF in the speech of people who stutter. The first study used the delayed auditory feedback for people who stutter and found that the immediate effect of DAF has improved the fluency of the participants without affecting speech naturalness¹⁸. The other study compared the results in fluency of two groups of stutterers - one submitted only to speech therapy and another which received, associated with the therapy, the delay in auditory feedback - and found that the group which used the delay showed greater reduction of speech disruptions and higher gain in speech rate

and production of information, compared to the group that did not use this device¹⁹.

Although some studies have analyzed the immediate effects of DAF in promoting fluency^{3,16-20}, and others the effectiveness of the results obtained from using DAF for people who stutter, in long-term studies^{15,20-23}, few have dedicated to analyze the effect of delayed auditory feedback during oral reading task.

Considering all the above information, and the hypothesis that delayed auditory feedback can reduce the manifestations of stuttering during oral reading, this study aims to compare the immediate effects of delayed auditory feedback concerning oral reading tasks of school-children with persistent developmental stuttering.

METHODS

This research is an experimental, cross-sectional, descriptive and prospective study, involving measures of quantitative and qualitative analysis, a comparison of speech samples from the same subject in different listening conditions. It was approved by the Ethics Committee of the Faculty of Philosophy and Sciences, Universidade Estadual Paulista - CEP / FFC / UNESP under Protocol n ° 0714/2013.

Participants

A group of 16 school-children who stutter (11 males and 5 females) participated in this study. They were divided in two groups: Experimental Group 1 (EG1): school-age children between 8 and 17 years old (mean 11 years old; SD=3.20) diagnosed with moderate stuttering, and Experimental Group 2 (EG2): school-age children between 8 and 17 years old (mean 11.5 years old; SD=4.04) diagnosed with severe or very severe stuttering.

The diagnosis of persistent developmental stuttering of participants was carried out at the *Laboratório de Estudos da Fluência* [Fluency Study Laboratory] - LAEF of the *Centro de Estudos de Educação e Saúde* [Education and Health Study Center] - CEES of the Universidade Estadual Paulista - FFC - Marília.

Inclusion criteria

The inclusion criteria for both groups, were: be native speaker of Brazilian Portuguese and ages between 7 and 17 years old. Participants were recruited from the Laboratório de Estudos da Fluência - LAEF, diagnosed with persistent developmental stuttering, adopted by

the laboratory, namely: stuttering complaint; persistent developmental stuttering diagnosed by a specialist professional; onset of stuttering in childhood (developmental); presenting minimum of 3% of stuttering-like disfluencies; minimum duration of 12 months of disfluency (persistent), and stuttering, classified at least as moderate, according to the Stuttering Severity Instrument - SSI-3²⁴.

Exclusion criteria

Exclusion criteria for participants were: neurological disorders, genetic syndromes, mental retardation, conductive or sensorineural hearing loss, attention-deficit hyperactivity disorder (ADHD) or psychiatric conditions.

Procedures

Initially, those responsible for the school-children were informed about the objectives of the study, received explanation about the procedures to be performed and provided written consent for participation in the research. The following procedures were performed: 1) Basic audiological evaluation; 2) Fluency assessment; 3) Stuttering severity assessment; 4) Oral reading evaluation in two different conditions of auditory feedback: usual (unaltered) and delayed.

Audiologic assessment consisted of clinical history, otoscopic exam, pure tone audiometry, speech audiometry and acoustic immittance assessment (tympanometry and acoustic reflex).

The fluency assessment of spontaneous speech was performed to confirm the stuttering diagnosis. The stuttering severity assessment was held to compose the two groups. The Stuttering Severity Instrument (SSI-3) was used to classify stuttering as mild, moderate, severe or very severe, by evaluating the frequency and duration of stuttering-like disfluencies and presence of physical concomitants associated with disfluencies²⁴.

For the oral reading tasks, narrative texts and serials proposed by a specific reading material evaluation, according to school level, were employed²⁵. Two different sections of texts were used, one for each

auditory feedback condition to remove the effect of the adaptation.

To offer delayed auditory stimulus in listening situation with delayed auditory feedback, a software (Fono Tools) was employed. A digital camcorder Sony (Digital HDR-CX350 – 7.1 Mega Pixels) and a tripod (Atek – ômega) were used too.

After collecting the spontaneous speech samples (to diagnose stuttering) and the readings tasks of the participants, they were transcribed (of 200 fluent syllables each sample), considering the fluent and not fluent syllables according to the following description²⁶⁻²⁸.

- *Stuttering-like Disfluencies (SLD)*: words repetition – more than 3, part of word repetition, sound repetition, block, prolongation, pause, intrusion, and;
- *Other Disfluencies (OD)*: interjection, hesitation, revision, unfinished word, phrase repetition, word repetition - until 2.

Data analysis

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 21.0. The Wilcoxon Signed Posts Test was used for the intragroup analysis and the Mann-Whitney test to compare the results between the groups. Values were considered significant at p lower than 0.05 ($p < 0.05$), with a 95% confidence interval. Significant p values were highlighted with the asterisk (*) symbol.

RESULTS

The characterization of the participants in this study is shown in Table 1. It is possible to observe a larger amount of male participants (68.75%) than female. The overall age mean was 11.06 years. The percentage of stuttering-like disfluencies (SLD) and the Stuttering Severity Instrument (SSI-3) score were higher in the experimental group 2 (EG2) since this group included participants with severe or very severe stuttering, while the experimental group 1 (EG1) included people with moderate stuttering.

Table 1. Description of the study participants

Group	Age	Gender	School-level	SSI-3 Score	% SLD	Severity
EG1 -1	8	F	3rd grade	3.0	22	Moderate
EG1 -2	8	F	3rd grade	17.5	21	Moderate
EG1 -3	8	M	3rd grade	10.0	22	Moderate
EG1 -4	9	M	5th grade	5.5	21	Moderate
EG1 -5	10	M	5th grade	6.0	24	Moderate
EG1 -6	12	M	7th grade	4.5	21	Moderate
EG1 -7	13	M	9th grade	5.0	24	Moderate
EG1 -8	17	M	3rd/ High School	3.0	21	Moderate
Mean	11.00			7.00	22.00	
SD	3.20			4.85	1.31	
EG2 -1	8	F	3rd grade	19.5	29	Severe
EG2 -2	8	F	3rd grade	17.5	36	Very Severe
EG2 -3	13	F	7th grade	35.5	39	Very Severe
EG2 -4	8	M	3rd grade	15.5	30	Severe
EG2 -5	8	M	3rd grade	34.0	35	Very Severe
EG2 -6	13	M	7th grade	11.5	37	Very Severe
EG2 -7	17	M	3rd/ High School	9.0	32	Severe
EG2 -8	17	M	3rd/ High School	12.0	28	Severe
Mean	11.50			19.00	33.00	
SD	4.04			10.12	4.06	

Note: SLD= Stuttering-like Disfluencies; EG1= Experimental Group 1; EG2= Experimental Group 2; DP= Standard Deviation; M= Male; F= Female; SSI= Stuttering Severity Instrument.

In regards to the statistical values of the percentage of stuttering-like disfluencies (SLD), other disfluencies (OD) and total disfluencies (TD) during oral reading for EG1 and EG2 it is possible to affirm that in the analysis related to SLD frequency intra and intergroups, the only statistically significant difference ($p= 0.035$) was observed in the intergroup comparison, concerning the nonaltered auditory feedback (NAF) situation, in which EG2 presented a higher frequency of these disfluencies in relation to EG1. Regarding the comparison of OD

and TD frequency, inter and intragroups in EG1 and EG2, there were no statistically significant differences between the conditions of nonaltered auditory feedback (NAF) and delayed auditory feedback (DAF) (Table 2).

Table 3 shows the statistical values of syllables and words per minute (SPM and WPM) concerning oral reading for EG1 and EG2. The results indicate a reduced flow of syllables and words per minute (SPM and PPM) in EG1, and increase on these flows for EG2 in DAF condition.

Table 2. Analyses between the groups and Intragroup REGARDING THE percentual of Stuttering-like Disfluencies, Other Disfluencies and Total Disfluencies during reading in different listening conditions

Disfluencies in reading in different listening conditions												
Type	Listening Conditions	EG1					EG2					P
		Mean	Md.	Min.	Max.	SD	Mean	Md.	Min.	Max.	SD	
SLD	NAF	4.13	3.00	1.00	10.50	2.99	9.06	9.00	2.50	18.50	5.05	0.035*
	DAF	2.69	2.50	1.50	5.00	1.03	7.00	4.25	0.50	115.50	5.83	0.078
	P	0.440					0.233					
OD	NAF	6.50	5.50	2.00	17.00	5.01	6.19	6.50	0.50	13.00	4.40	>0.999
	DAF	6.45	5.25	2.00	12.00	3.59	7.94	8.75	0.50	16.50	5.35	0.599
	P	0.723					0.310					
TD	NAF	10.63	10.00	3.00	20.00	6.59	15.25	17.75	4.00	27.00	7.95	0.314
	DAF	9.44	8.00	4.50	15.00	3.91	14.94	13.50	1.00	29.50	10.21	0.292
	P	0.293					0.888					

* Statistical significance ($p \leq 0.05$) – Mann-Whitney Test – Test for the comparison between the groups - and Wilcoxon Signed Posts Test for the intragroup comparisons.

Note: EG1 = Experimental Group 1; EG2 = Experimental Group 2; SLD = Stuttering-like Disfluencies; OD = Other Disfluencies; TD = Total Disfluencies; NAF = Nonaltered Auditory Feedback; DAF = Delayed Auditory feedback; Md = Median; Min. = Minimum; Max. = Maximum; SD = Standard Deviation; P = p-value.

Table 3. Analyses between the groups and Intragroup regarding the syllables and words per minute during oral reading in different listening conditions

Speech rate in Reading												
SR	Listening Conditions	EG1					EG2					P
		Mean	Md	Min.	Max.	SD	Mean	Md	Min.	Max.	SD	
SPM	NAF	146.50	158.50	60.00	206.00	51.16	134.25	148.00	41.00	240.00	67.20	0.529
	DAF	118.63	106.50	53.00	214.00	49.25	136.75	130.50	43.00	279.00	79.16	0.793
	P	0.123					0.889					
WPM	NAF	69.63	73.50	27.00	98.00	25.14	63.25	70.50	24.00	104.00	27.07	0.600
	DAF	59.13	53.50	31.00	103.00	23.14	67.00	67.50	22.00	128.00	36.59	0.674
	P	0.889					0.889					

* Statistical significance ($p \leq 0.05$) – Mann-Whitney Test – Test for the comparison between the groups - and Wilcoxon Signed Posts Test for the intragroup comparisons.

Note: EG1 = Experimental Group 1; EG2 = Experimental Group 2; SR = Speech Rate; SPM = syllables per minute; WPM = words per minute; NAF = Nonaltered Auditory Feedback; DAF = Delayed Auditory Feedback; Md = Median; Min = Minimum; Max. = Maximum; SD = Standard Deviation; P = p-value.

DISCUSSION

Contemporary literature has shown the importance of delayed auditory feedback studies on stuttering using various devices. However, few studies have used an easily accessible technology for both, either the speech therapist as for the people who stutter. Thus, this study examined the effect of delayed auditory feedback in oral reading of school-children who stutter regarding speech disruptions frequency and speech rate, using a specific software.

A better comprehension about the effects of altered auditory feedback (AAF) in fluency of the people who stutter is fundamental, not only for indicating the use of

devices, but also for understanding the theory, research and therapy, for and about stuttering²⁸.

Data obtained from the oral reading permitted to confirm that the intragroup analysis in DAF condition did not cause significant effects in the two groups, either in disfluencies frequency as in speech rate. However, it was observed that there was a decrease of stuttering-like disfluencies (SLD) in the moderate stuttering group (34.87%) and severe / very severe stuttering (22.27%). Therefore, the results suggest that there was a tendency to decrease the main manifestation of the disorder, which are the SLD^{1,2}. These data corroborate to the results obtained from an investigation of motor skills of people who stutter under the effect of DAF¹⁸.

The response of the groups was different regarding the effects of delayed auditory feedback (DAF) in frequency of other disfluencies (OD), decreased 0.8% in the EG1 and increased 28.27% in EG2. In both groups, the total disfluencies (TD) showed a reduction in DAF condition (11.2% in EG1 and 2.04% in EG2) when compared with NAF condition. TD is the sum of SLD and OD. Therefore, the EG1, which decreased the SLD and OD, also declined the TD. However, EG2 which decreased the SLD and increased OD, showed less reduction of TD.

Regarding speech rate, there was a tendency to decrease the flow of syllables and words per minute (SPM and WPM) of EG1, while EG2 showed a tendency to increase these flows under the DAF. Therefore, the data suggest that the effect of the delay is more positive for the severe / very severe stuttering group, since one of the manifestations of stuttering consists on the reduction flow of fluent syllables and words per minute.

The analysis of the two major fluency parameters, continuity and speech rate, showed a tendency to a positive effect in the severe / very severe group because it caused reduction of SLD and TD, and increased the flow of SPM and WPM. However, despite the decline of SLD and TD in the moderate stuttering group, participants showed a tendency to decrease speech rate, considering that this is not a desirable effect. This result reinforces the previously idea observed in other studies, stating that auditory strategies should not be used in absolute way for all individuals who stutter, because not everyone is benefited, requiring, therefore, individualized tests^{15,17,19,20,23}.

The intergroup analysis showed significant differences in Nonaltered Auditory Feedback (NAF) concerning SLD. This result was expected because stuttering severity was determined by the percentage and duration of SLD and physical concomitants²⁴.

Both groups showed similarities in all variables under DAF condition, even in SLD analysis, which EG2 had presented higher amount, compared to EG1 in NAF. This result reinforces the suggestion of a positive effect of DAF during oral reading in the group of people with severe / very severe stuttering.

CONCLUSION

The results seemed to be positive for the moderate and severe / very severe stuttering groups, as it promoted fluency, by reducing the amount of stuttering-like disfluencies, despite the delay in auditory feedback had not caused a significant effect for both groups.

In regards to the analysis of the main fluency parameters, speech rate and continuity, the results suggest that the effect seemed to be considered more positive for the severe / very severe stuttering group. Participants in this group showed, under the effect of delayed auditory feedback, besides improvement in oral reading fluency, increased flow of fluent syllables and words per minute. However, the moderate stuttering group showed susceptibility to reduced flow of syllables and words per minute, under the effect of delayed auditory feedback.

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