Original Article

http://doi.org/10.1590/2317-6431-2016-1795

Audiology Communication Research
ISSN 2317-6431

Effect of delayed auditory feedback on clutter's speech and reading

Efeito da retroalimentação auditiva atrasada na fala e leitura de taquifêmicos

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ABSTRACT

Introduction: Auditory feedback changes, in general, provide the increase of the speech fluency of people who stutter, but few studies have investigated the effects on speech of people who clutter. **Purpose:** To compare the speech rate and frequency of speech disruption in spontaneous speech and reading of adults with and without cluttering, with two different auditory feedbacks. **Methods:** Participants were 16 adults, divided into two groups: Research Group (G1) composed by eight cluttering adults; Control Group (G2), composed by 8 fluent adults, paired by age and gender to participants of G1. The participants of G1 should present at least 10% of common disfluencies, and speech rate higher than the standards expected for age and gender. The procedures used were audiology assessment and fluency evaluation (spontaneous speech and reading) in two listening conditions, with Non-Altered Auditory Feedback (NAF) and after with Delayed Auditory Feedback (DAF). **Results:** DAF caused reduction of flow of syllables per minute and frequency of common disfluencies in G1 during spontaneous speech task. In reading, there was a decrease in speech disruption and flow of syllables per minute, in G2, influenced by the effect of DAF. **Conclusion:** The delayed auditory feedback effect in adults who clutter was positive in spontaneous speech due the reduction of speech rate and common disfluencies that are the main manifestations of this disorder.

Keywords: Speech, language and hearing sciences; Speech; Speech disorders; Evaluation; Feedback

RESUMO

Introdução: Alterações do *feedback* auditivo, em geral, propiciam o aumento da fluência da fala de pessoas com gagueira, porém, poucos estudos investigaram os efeitos na fala de pessoas com taquifemia. **Objetivo:** Comparar a velocidade de fala e a frequência das disfluências da fala espontânea e da leitura em adultos com e sem taquifemia, com duas formas diferentes de retroalimentação auditiva. **Métodos:** Participaram deste estudo 16 adultos, divididos em dois grupos: grupo pesquisa (G1), composto por oito adultos com taquifemia e grupo controle (G2), com oito adultos fluentes, pareados por gênero e idade. Os participantes do G1 deveriam apresentar 10%, ou mais, de disfluências comuns e velocidade de fala maior do que os padrões esperados para a idade e gênero. Os procedimentos utilizados foram: avaliação audiológica, avaliação da fluência (fala espontânea e leitura), em duas condições de escuta: inicialmente sem alteração na retroalimentação auditiva – Retroalimentação Auditiva Habitual (RAH) – e, posteriormente, com a Retroalimentação Auditiva Atrasada (RAA). **Resultados:** A RAA ocasionou redução do fluxo de sílabas por minuto e da frequência das disfluências comuns no G1, na tarefa de fala espontânea. Na leitura, houve diminuição da descontinuidade de fala e do fluxo de sílabas por minuto, no G2, sob o efeito da RAA. **Conclusão:** O efeito da Retroalimentação Auditiva Atrasada nos adultos taquifêmicos foi positivo na fala espontânea, devido à redução da velocidade de fala e das disfluências comuns, que são as principais manifestações do distúrbio.

Palavras-chave: Fonoaudiologia; Fala; Distúrbios da fala; Avaliação; Retroalimentação

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Conflict of interests: No

Authors' contribution: *DSP* literature review, data collect and analysis, writing, submission and paperwork of the article; *ACVC* researcher responsible for analysis of the audiological data, elaboration of the research, approval of the final version of the article; *RBOM* data analysis, writing, submission and paperwork of the article; *MCML* collect and analysis of data, writing, submission and paperwork of the article; *PBMDB* literature review, data analysis, correction of the article writing, submission and paperwork of the article; *CMCO* professor adviser, principal researcher, elaboration of the research, literature review, data analysis, approval of the final version of the article.

Source of funding: PROEX- UNESP – Extension Project

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Received: 10/7/2016; **Accepted:** 6/5/2017

INTRODUCTION

Cluttering is a fluency disorder[1], characterized by fast or irregular speech segments, accompanied by excessive common disfluencies, omission of syllables, syllabic stress and abnormal speech rhythms or pauses[2]. It rarely occurs as an isolated clinical condition because it is frequently associated with stuttering or other communication disorders[2].

Like stuttering, the cluttering has a multidimensional nature[3], with a neurobiological basis[4]. In the description of the cluttering neurological foundations, a study concluded that the disorder may be explained by imbalance in the anterior cingulate cortex circuit and the supplementary motor area[5].

The main characteristics of cluttering are increased speech rate and excessive disfluencies[2,6,7,8,9,10]. Fast speech was reported both by studies that assessed speech rate[8,9] and compared it with normative standard[11], as well as by reports of the own adults who clutter[1]. This last study was performed with eight cluttering adults and characterized relevant findings of the clinical history. The results showed that all participants had a fast speech complaint[1].

One of the most important goals in the cluttering treatment is to reduce the speech rate[10,12,13] and to reduce the excess of common disfluencies[12,13]. It is worth mentioning that the goal of reducing speech rate is also indicated to improve the broad spectrum of cluttering clinical manifestations[13].

A central aspect of cluttering therapy is speech monitoring[4,10,12], which provides control of speech rate. In order to obtain this domain of oral production, the speaker uses auditory feedback[14], which also assists in the maintenance of speech fluency[15].

Auditory Feedback Alteration (AFA) is the collective term for the conditions which involve the electronic alteration of the speech signal, in which the speakers perceive their speech differently from the usual one[16]. Delay and frequency alteration of auditory feedback are the most common alterations in the population of disfluent people[17-24]. According to a study, these alterations cause the "choral speech phenomenon". This phenomenon generates a second speech signal, which can be understood as an additional gestural information that promotes fluent speech[20]. The authors clarified that the additional auditory feedback provided by the choir works as an exogenous speech motor control, enabled by greater cortex activation.

As the main focus of Speech-Language Pathology intervention in cluttering is the speech rate reduction and the fluency promotion, and these are the most frequently found effects in DAF[15,17-24], it becomes relevant to investigate the effects of delayed auditory feedback on the cluttering individuals' speech. Will the greater cortex activation in people who clutter also increase the fluency?

Although the authors indicate the use of DAF in the cluttering therapy[13,25], in the compiled literature, only one research was found regarding the therapy of two cluttering adolescents with the use of DAF, induced by the device "Phonic Ear PM 505 DAF"[12]. The delay time initially used was 220 milliseconds and later reduced to 105 milliseconds, and 35 milliseconds. The results of this investigation demonstrated a decrease in fast speech, improvement in intelligibility and support in thoughts organization.

Studies have already proved effects under speech fluency through altered auditory feedback[17-24]. It was made a comparison between two groups, each one with eight stuttering adults, submitted to speech therapy: one group using the SpeechEasy® device and the other one without SpeechEasy®[5]. It was observed an improvement in the stuttering degree in both groups, and the group that used the SpeechEasy® showed a trend towards a greater reduction in disfluency index and a greater gain in articulatory rate and information production rate[17].

Another study accomplished with SpeechEasy® analyzed the immediate and long-term effect of 11 individuals with stuttering, from 11 to 51 years old[18]. The authors concluded that occurred the reduction of stuttering as an immediate effect for most participants. However, in the long term, the SpeechEasy® presented several results.

Digital Speech Aid (DSA) was the device used to cause delay and alter the auditory feedback frequency of 335 individuals with stuttering, from 6 to 62 years old[19]. The immediate fluency improvement was obtained 82.1% of the participants, in reading, 84.5%, in the dialogue, and 81.2%, in the monologue.

The impact of SpeechEasy® use on acoustic and speech motor parameters of ten adults with stuttering was compared with ten adults of the control group[20]. There was fluency improvement in adults with stuttering in spontaneous speech and significant increase in flow of syllables per minute. The authors reported that the increase of speech rate must have occurred as a consequence of the disfluencies reduction, which were not withdrawn for the calculation of the speech rate. In fluent individuals, there was an increase in the stuttered syllables percentage in spontaneous speech.

The immediate effect of altered auditory feedback (delayed and altered frequency) was used in 30 individuals with stuttering, from 18 to 68 years old, using two devices: Fluency Enhancer and SmallTalk[21]. Both devices caused a statistically significant reduction in the frequency of stuttered syllables, in the three speech samples analyzed: oral reading, monologue and dialogue.

It is believed that delayed auditory feedback may be beneficial for people who clutter, in the same way as it helps people who stutter, but the effect of delayed auditory feedback on the speech of cluttering individuals is not yet clear. Thus, it is necessary to conduct studies that demonstrate the effects of DAF on cluttering individuals, with a greater number of participants and with the use of objective assessments, which can serve as an effective measure to improve the clinical care of this population.

In this sense, the purpose of this research was to compare speech rate and frequency of speech disruption of the spontaneous speech and reading in adults with and without cluttering, with two different forms of auditory feedback: non-altered (NAF) and delayed (DAF).

METHODS

This cross-sectional, with comparison between groups, descriptive, quantitative and qualitative study was approved by the Research Ethics Committee of the *Universidade Estadual Paulista "Júlio de Mesquita Filho"* (UNESP) (nº 0671/2013). All participants were informed about the characteristics and procedures of the research and signed the Informed Consent Form.

Sample

A total of 16 adults, aged from 19 to 47 years and 11 months (mean age 33.2 ± 0.5) participated of the study and were divided into two groups:

- Research Group (G1), composed of eight adults, seven male and one female, with diagnosis of cluttering. The inclusion criteria of G1 were: being a speaker of Brazilian Portuguese; fast speech personal complaint, with communication impairment; manifesting disfluent speech, with excess of common disfluencies and presenting less than 3% of stuttering-like disfluencies in order to be dismissed the possibility of associated stuttering; no other comorbidities of oral communication, hearing loss and neurological and / or psychiatric diseases.
- Control Group (G2), composed of eight fluent adults, matched by gender and age to G1, who fit the following inclusion criteria: being a Brazilian Portuguese speaker; with no presence of fast speech complaint, cluttering or stuttering, current and past; negative familial history of cluttering and stuttering; present less than 3% of stuttering-like disfluencies in the evaluation of spontaneous speech and no have oral communication disorders, hearing loss and neurological and / or psychiatric disorders.

The G1 participants were evaluated at the Fluency Studies Laboratory (FSL), at the Education and Health Studies Center (EHSC), at the *Universidade Estadual Paulista "Júlio de Mesquita Filho"* (UNESP), and all of them presented a score above 120 in the Predictive Cluttering Inventory[25], a score that suggests diagnosis of cluttering. The G2 was composed of employees from UNESP, where the research was conducted.

Procedures

The procedures described below were applied to all participants (G1 and G2).

Audiological assessment: the data collection was done through anamnesis, meatoscopy, pure tone thresholds audiometry, speech audiometry and immittanciometry (tympanometry and acoustic reflex research). The pure tone thresholds audiometry was performed in an acoustic booth using the GSI-61 (Grason Standler®) audiometer, with TDH-50 headphones, calibrated according to ANSI-69 standards. The audibility thresholds were obtained by air conduction, in the sound frequencies from 250 Hz to 8000 Hz and were considered normal when they were in an intensity equal to or less than 25 dB, in all frequencies tested.

The speech recognition threshold (SRT) was searched through a dissyllable words list, phonetically balanced, and should be compatible with pure tone average.

For immittanciometry was used the GSI-38 immitanciometer (Grason Standler®), with a 226 Hz probe. After sealing the external acoustic meatus, tympanometry was performed. The acoustic reflex was then investigated, ipsilateral and contralateral modes, which were considered present or absent.

Fluency evaluation: a fluency evaluation protocol was applied, proposed in the Speech Fluency Profile test[11], to perform the collection and analysis of speech samples. Speech samples constituted of spontaneous speech elicited by a figure and reading of text were collected in two different listening conditions: Non-Altered Auditory Feedback (NAF) and Delayed Auditory Feedback (DAF). For the oral reading task, the narrative texts "The eating habits of Brazilians" for NAF and "Dead Sea Project" for DAF, were proposed for adults by a specific material for reading evaluation[26]. The reading texts were different, to eliminate the adaptation effect.

Recording sequence of tasks was the same for all participants. The recordings were performed with the participants sitting in a quiet environment, with the headphones set. The audio-visual record of a self-expressive speech sample composed of 200 fluent syllables was made using a video camera, tripod, headphone with microphone connected to a computer (Andrea PureAudio® USB-AS adapter and Karsect® HT- 2 auricular microphone), with a specific software (Fono Tools, 1.5h version, CTS Informatic®).

Participants' speech was recorded and processed through the software, which performed delayed auditory feedback (DAF) and returned to the participants' ears 100 milliseconds delayed (mean time of greater comfort and better results obtained in a pilot study), through the headphone, which was set with the microphone positioned at 90-degree angle and ten centimeters away from the mouth. The presentation of DAF to the participants was binaural.

The procedures involved four experimental conditions: spontaneous speech with NAF; spontaneous speech with DAF; reading with NAF and reading with DAF. A two-minute interval between each experimental condition was offered to participants and within this interval they were instructed to remain silent.

The speech samples, both spontaneous and reading, were transcribed in their entirety and considering fluent and non-fluent syllables. The transcript size for the four samples collected was 200 fluent syllables. In the readings, a section was selected for each text, standardized, for analysis in all participants, as proposed by another study[27]. Subsequently, the speech sample was analyzed and the typology of disfluencies was characterized according to the following description[11]:

- Common disfluencies: hesitations, interjections, revisions, unfinished words, segments repetition, words repetition and phrases repetition.
- Stuttering-like disfluencies: sounds repetition, syllables repetition, prolongations, blocks, pause and intrusions.

For characterizer the frequency of speech disruptions, the following measurements were used: percentage of speech discontinuity, percentage of common disfluencies and percentage of stuttering-like disfluencies. The speech rate was measured in the flow of syllables and words per minute[11].

In the G1 participants, the Predictive Cluttering Inventory was applied[25], to analyze the most indicative characteristics of the disorder and the diagnosis confirmation. Total score between 80 and 120 is indicative of stuttering/cluttering presence and, above 120, suggests a cluttering diagnosis[25].

Statistical analysis

The data were stored and tabulated and the statistical analysis was performed with Statistical Package for Social Sciences (SPSS), 21.0 version. The Mann-Whitney test was applied to compare the quantitative results between G1 and G2 individuals. In the intragroup comparison, which analyzed the same participants in each of the listening conditions, the Wilcoxon Signal Post test was used. Values were considered significant for p less than 0.05, with a 95% confidence interval. Significant values were highlighted with the asterisk symbol (*).

RESULTS

In relation to the characterization of adults with cluttering, it was possible to verify that the majority of participants belonged to the male gender (87.5%). The cluttering's group presented a total from 10% to 19.5% of common disfluencies and the values of the Predictive Cluttering Inventory varied from 124 to 141. The fluent adults were paired by gender and age to the adults who clutter (Table 1).

The G1 intragroup comparison, in relation to the spontaneous speech, showed that the delay in auditory feedback

Table 1. Description of the sample, according to the characteristics evaluated

Subjects	Age	Gender	% SD	% CD	% SLD	SPM	WPM	PCI
G1 S1	19	M	14.0	13.0	1.0	260	144	141
G1 S2	24	F	15.0	13.5	1.5	226	121	129
G1 S3	27	M	21.0	19.5	1.5	230	129	132
G1 S4	42	M	11.0	10.0	1.0	363	220	130
G1 S5	29	M	14.5	14.0	0.5	324	192	128
G1 S6	37	M	15.0	14.5	0.5	315	172	124
G1 S7	40	M	10.5	10.0	0.5	285	152	134
G1 S8	44	M	11.5	11.0	0.5	285	147	129
Average	32.8		14.1	13.2	0.87	286	160	131
SD	9.2		3.4	3.1	0.4	47	33	21
G2 S9	19	M	8.5	8.5	0	235	144	
G2 S10	23	F	9.5	9.5	0	200	113	
G2 S11	28	M	5	5.0	0	250	128	
G2 S12	42	M	8	7.0	1.0	245	118	
G2 S13	30	M	7	7.0	0	240	119	
G2 S14	36	M	7.5	7.5	0	273	144	
G2 S15	41	M	7.5	6.5	1.0	292	158	
G2 S16	45	M	3.5	3.0	0.5	226	123	
Average	33.0		7.1	6.8	0.3	139.3	123	
SD	9.5		1.9	2.0	0.5	28.1	136	

Subtitle: G1 = research group; G2 = control group; M = male; F = female; %SD = Percentage of speech disruption. % CD = Percentage of common disfluencies; %SLD = Percentage of stuttering-like disfluencies; SPM = syllables per minute; WPM = words per minute; PCI = total score of Predictive Cluttering Inventory; SD = standard deviation

caused reduction of common disfluencies and flow of syllable per minute. There were not differences for the analyzed variables, regarding the spontaneous speech of the fluent adults, compared in the conditions of NAF and DAF. The G2 results showed a tendency in the increase of speech disruption, common and stuttering-like disfluencies in spontaneous speech with DAF, in addition a decrease in the flow of syllables and words per minute (Table 2).

The intergroup comparison showed that, in the NAF condition, adults with cluttering (G1) demonstrated a higher frequency of speech disruption, common disfluencies and stuttering-like disfluencies, as well as a greater flow of words per minute. In NAF situation, there was difference between groups for common disfluencies. Adults without cluttering (G2) showed more common disfluencies when compared to adults who clutter (G1), under the effect of DAF (Table 2).

The intragroup comparison of adults who clutter (G1), in reading, it did not show differences between the NAF and DAF conditions for the different analyzed variables. Fluent adults (G2) demonstrated, in reading, reduction of speech disruption and flow of syllables per minute, as a result of delayed auditory feedback (Table 3).

The comparison between G1 and G2, in reading, showed that in the NAF condition, the fluent adults (G2) presented a higher frequency of speech disruption and greater flow of syllables per minute, whereas adults with cluttering (G1) showed higher frequency of common disfluencies. With delayed auditory feedback, adults with cluttering (G1) showed greater amount of stuttering-like disfluencies, compared to fluent adults (G2) (Table 3).

DISCUSSION

Regarding speech rate, it was observed that adults with cluttering (Table 1) showed values well above the normative data[11], confirming previous studies that described the presence of fast speech in the cluttering[6,7,8,9]. In relation to speech disruption, the cluttering group (G1) was heterogeneous: some presented values close to those considered normal[11], but the majority showed increased values. This finding is in agreement with the literature, considering that the cluttering clinical condition is heterogeneous[4] (Table 1).

The data obtained in spontaneous speech allowed to verify that, in the intragroup analysis, the DAF caused statistically significant effects only in adults with cluttering (G1) (Table 2). There was an average reduction of 20.15% in the flow of syllables per minute and 60.65% in the frequency of common disfluencies in G1, with the delay in auditory feedback in spontaneous speech (Table 2).

The data related to the comparison of non-altered and delayed auditory feedback in spontaneous speech showed positive results in the cluttering group (G1), since there was a reduction in the main manifestations of the disorder, which are increased speech rate[2,6,7,8,9] and excessive number of common disfluencies[2,7,8,9] (Table 2). It is suggested that the chorus effect provoked by the delay in auditory feedback, which facilitates

Table 2. Intragroup and intergroup comparison, regarding to occurrence of speech disruption, common disfluencies, stuttering-like disfluencies, flow of syllables and words per minute, in non-altered auditory feedback and delayed auditory feedback conditions in spontaneous speech

Spontaneous speech variables	Listening condition	G1 (n=8)				G2 (n=8)				p-value
		Mean	SD	Minimum	Maximum	Mean	SD	Minimum	Maximum	
Speech disruptions	NAF	14.6	3.35	10.50	21.00	7.06	1.94	3.50	9.50	0.001*
	DAF	9.75	8.06	4.00	28.50	10.13	4.42	4.50	17.00	0.461
p-value		0.161				0.107				
Common disfluencies	NAF	13.19	3.10	10.00	19.50	6.75	2.02	3.00	9.50	0.001*
	DAF	5.19	2.75	2.50	10.50	9.63	4.22	4.50	17.00	**0.024***
p-value		**0.011***				0.103				
Stuttering-like disfluencies	NAF	0.88	0.44	0.50	1.50	0.31	0.46	0.00	1.00	0.029*
	DAF	4.50	7.98	0.00	24.00	0.50	0.71	0.00	2.00	0.052
P-vvalue		0.068				0.581				
Syllables per minute	NAF	286.00	47.25	226.00	363.00	245.13	28.10	200.00	292.00	0.103
	DAF	228.38	58.12	117.00	292.00	215.50	33.99	153.00	255.00	0.493
p-value		**0.017***				0.063				
Words per minute	NAF	159.63	33.25	121.00	220.00	130.84	16.00	113.00	158.00	0.040*
	DAF	133.00	39.21	62.00	182.00	120.53	24.00	8.50	154.50	0.345
p-value		0.123				0.310				

*Significant values (p<0.05) – Mann-Whitney Test for intergroups comparison and Wilcoxon Signal Post Test for comparison between NAF and DAF
Subtitle: G1 = research group; G2 = control group; n = number of adults; SD = standard deviation; NAF = non-altered auditory feedback; DAF = delayed auditory feedback

Table 3. Intragroup and intergroups comparison, regarding to occurrence of speech disruption, common disfluencies, stuttering-like disfluencies, flow of syllables and words per minute, in non-altered auditory feedback and delayed auditory feedback conditions in reading

Reading Variables	Listening condition	G1 (n=8)				G2 (n=8)				p-value
		Mean	SD	Minimum	Maximum	Mean	SD	Minimum	Maximum	
Speech disruptions	NAF	1.25	0.76	0.50	2.50	4.28	5.83	0.00	23.50	0.011*
	DAF	7.88	0.47	0.50	24.00	2.25	1.41	0.50	4.00	0.063
p-value		0.553				**0.044***				
Common disfluencies	NAF	6.56	6.69	0.00	22.00	1.13	0.74	0.00	2.00	0.010*
	DAF	4.19	4.50	0.50	20.00	1.84	1.50	0.00	3.50	0.629
p-value		0.058				0.127				
Stuttering-like disfluencies	NAF	0.75	0.96	0.00	2.50	0.13	0.23	0.00	0.50	0.182
	DAF	3.69	5.00	0.00	15.50	0.31	0.37	0.00	1.00	**0.023***
p-value		0.074				0.257				
Syllables per minute	NAF	268.00	64.79	133.00	352.00	318.50	25.91	279.00	353.00	0.035*
	DAF	223.13	77.22	120.00	363.00	266.30	42.67	200.00	324.30	0.128
p-value		0.068				**0.017***				
Words per minute	NAF	128.88	32.42	64.00	171.00	143.55	11.11	125.60	158.80	0.141
	DAF	107.63	34.94	64.00	172.00	127.26	21.89	97.00	159.00	0.208
p-value		0.128				0.050				

*Significant values (p<0.05) – Mann-Whitney Test for intergroups comparison and Wilcoxon Signal Post Test for comparison between NAF and DAF
Subtitle: G1 = research group; G2 = control group; n = number of adults; SD = standard deviation; NAF = non-altered auditory feedback; DAF = delayed auditory feedback

the greater cortex activation[20], assists the speech control and monitoring of adults who clutter.

The difference observed in the comparison of flow of syllables per minute in spontaneous speech, between NAF and DAF (Table 2), is in agreement with two studies that described the relevance of the use of DAF to reduce the speech rate of individuals who clutter[12,13]. It is relevant to note that, in the spontaneous speech of the cluttering group, it was observed, in addition to the reduction of the flow of syllables per minute, the reduction of the number of common disfluencies (Table 2). Thus, the present study evidenced that the effect of DAF was positive, both to reduce the number of syllables per minute and to increase the fluency. This finding agrees with another study, which stated that the decrease in speech rate leads to an improvement in other manifestations of the cluttering clinical manifestations[13].

In this study, according to a research[12], the delay in auditory feedback resulted in a decrease in the speech rate of adults who clutter during spontaneous speech (Table 2).

In fluent adults (G2), it was observed that the delayed auditory feedback caused a tendency to increase the frequency of disfluencies in spontaneous speech (Table 2). These results reinforce reports from students who described difficulties in speaking fluently with DAF[15,28].

In the intergroup comparison of spontaneous speech, there were more differences in Non-Altered Auditory Feedback condition than in the delayed one (Tables 2). This result was already expected, once the main characteristic of cluttering is the increase in speech rate and the number of common disfluencies[2,6,7,8,9,10]. It is worth highlining that in the spontaneous speech under the DAF, the groups differed in the number of common disfluencies (Table 2). However, in this listening condition, fluent adults were more disfluent than adults who clutter. In the present study, it was clear that delayed auditory feedback decreased the number of common disfluencies in the adults who clutter and provoked an opposite effect in fluent adults, that is, an increase in the number of common disfluencies in spontaneous speech.

In relation to the reading, in the intragroup analysis, the DAF caused significant effects only for fluent adults (G2) (Table 3). There was a reduction in speech disruption and flow of syllables per minute. According to another study[22], the most cited effect of DAF on fluent people is speech rate slowing.

In intergroup comparison of the reading, it was observed more differences in the NAF condition compared to DAF (Table 3). Adults with cluttering showed greater number of common disfluencies. However, fluent adults showed greater speech disruption in relation to the adults who clutter in NAF. The flow of syllables per minute was higher in the fluents, in relation to the adults who clutter, in the NAF. Under the effect of DAF, the adults who clutter showed more stuttering-like disfluencies when compared to the fluent adults.

In summary, this research contributed to know the immediate effects of delayed auditory feedback in adults with cluttering and also to reinforce the importance of the use of DAF in individuals with this disorder.

One of the limitations of the study was the fact that the analysis was performed only to ascertain the immediate DAF effects and not in the long term. Therefore, it cannot conclude about these long-term effects in the speech of adults who clutter.

This research presented important scientific and clinical implications. In scientific terms, these new study designs are proposed with the cluttering population: researches on the effects of DAF in the long-term speech; researches that analyze the effect of delay and alteration in the frequency of auditory feedback; inclusion of subjective measures in the evaluation, as questionnaires on the effectiveness of the delay in daily life situations and, finally, evaluation of the effects of DAF on the speech intelligibility and naturalness.

Regarding the clinical implications, it is believed that the speech-language pathologist should perform a therapeutic test to analyze the immediate effects of DAF on the people who clutter before the resource use. It is also suggested a careful evaluation of the abilities for each individual, related mainly to speech and hearing, and to consider them in the decision about the indication or not of the DAF.

CONCLUSION

The immediate effect of Delayed Auditory Feedback on the speech of cluttering adults was positive, once it caused, in spontaneous speech, a significant decrease in flow of syllables per minute and in the number of common disfluencies.

In intergroup comparison of the spontaneous speech, it is possible to state that delayed auditory feedback diminished the differences between groups, due to the reduction of main manifestations of the cluttering clinical condition (fast speech and excessive common disfluencies).

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