REST AND REACTION TIME TO SPEECH: COMPARISON OF STUTTERING AND FLUENT SPEAKERS

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Abstract. *Purpose: to verify the rest and reaction time to fluent speech in fluent and stuttering adults. Method: 22 adults, divided in two groups: G1 - 11 fluent individuals; G2 - 11 stuttering individuals. The electromyography records were collected in two different situations: rest and reaction time to speech. Results: the groups were significantly different on rest, with higher scores on G2. Groups are not significantly different about latency and the muscle activity. There was a strong positive correlation between latency time and speech muscle activity only on G2. Conclusion: therapy procedures aiming adequate rest and favoring speech timing may promote fluency.*

1. Introduction

Several authors have suggested that stuttering may be the result of difficulties with speech movements timing or, more broadly, of impaired timing patterns, either motor or sensorial (De Nil and Abbs, 1991; Caruso, 2000; De Nil et al., 2001; Bosshardt et al., 2002; Andrade, 2004).

Stuttering may be due to intermittent timing irregularities on speech movements (Zimmermann, 1980). It is frequently observed that the muscle tension before speech is increased (Freeman and Ushijima, 1978). It makes the highly precise adjustments necessary to speech start very difficult, impairing the speech performance of the stuttering individual (Salmelin et al., 2000).

The aim of the present work is to verify the rest and reaction time to fluent speech in fluent and stuttering individuals. The research hypotheses were:

H1 – rest muscle tension is higher in stuttering than in fluent individuals;
H2 – latency time to speech start is higher in stuttering than in fluent individuals;
H3 – speech muscle activity of stuttering individuals is higher than that of fluent individuals;
H4 – that is a positive correlation between latency times to speech start and speech muscle activities in both groups – the larger the latency, the greater the muscle activity.

2. Method

<u>Participants</u>

This study was approved by the institution's ethic committee (CAPPesq – HCFMUSP 1021/03) and all participants signed the consent form.

The participants of this study were 22 adult individuals, divided in two groups: G1 had 11 fluent individuals, 4 female and 7 male, with mean age of 31:5 years with no history of communication disorder, hearing loss and neurological and/or cognitive disorder. G2 had 11 stuttering individuals, 4 female and 7 male, mean age of 25:1 without any other associated communication deficits, hearing loss, and neurological and/or cognitive disorder and without previous speech and language therapy.

The inclusion criteria to both groups were:

a) G1 – present up to 10 points on the Stuttering Severity Instrument (SSI-3 – Riley, 1994) that is, no stuttering severity;
b) G2 – present 11 points or more on the SSI, that is, present at least a very mild stuttering level.

Material

The electromyography records were collected using a four channel equipment, with analogical/digital converser and a signal collect and processing program (Windows platform) developed by EMG System do Brasil and installed on a Dell Dimension 2400 computer (Pentium 4 processor with 2.4 GHZ).

Before the data collection the equipment was gauged to the following specifications:

. sample frequency on each channel of 1000 Hz;
. analogical/digital converser resolution of 12 bits;
. high pass filter of 20 Hz;
. low pass filter of 500 Hz;
. total gain of 1000 (50 from the EMG channels and 20 from the active electrodes).

Data collection used active electrodes with the following configuration:

. pré-amplifier with 20 gain;
. differential amplifier with bipolar entrance;
. flexible shielded cord with 2 meters.

The electrodes used were discardable Medtrace Mini Ag/AgCl (diameter of 10mm) fixed to the cord by a pressure button.

Procedure

Just one of the electromyography equipment channels was used. The muscle activity was detected by the surface electrode placed on the medial portion of the perioral inferior region (inferior orbicular), 2mm under the free lip margin. The electrodes were fixed with approximate distance of 10mm between them. Before the electrodes were positioned the skin was cleaned with 96^{o} GL alcohol. The electrodes were fixed on the skin with adhesive tape (*transpore* 3M).

Before beginning the data collection the participants were asked to sit confortably on a chair with the head oriented according to the horizontal plan of Frakfort, parallel to the ground with the arms resting on the thighs. The reference electrode was placed on the right wrist.

The data collection procedures were:

a) rest – each participant was instructed to remain as relaxed as possible during one minute. After this time the data collection was started with the recording of 5 seconds of muscle activity of each participant to posterior analysis.

b) reaction time to speech – each participant was instructed to repeat the phrase "*Barco na água*" (boat on water) (Sassi and Andrade, 2004) as soon as they heard the sound sign – a high pitched bip – indicating the chronometer start. Only fluent productions, without disruptions, were accepted. This way, to some participants of G2 several attempts were needed to obtain a sample of fluent speech. The start of muscle activity recording coincided with the start of the chronometer. Each individual's repetitions were recorded by the equipment in 5 seconds windows.

Results' analysis

A total of 44 segments of electromyographic activity were analyzed. Results were quantified by the data acquisition program in average's square root (RMS) and expressed in microvolt (uV).

In rest situation the vales represent the average (RMS) electromyographic activity observed in five seconds. The reaction time to speech was obtained by the digital chronometer that registered the time interval between the command to initiate speech and the speech itself. The muscle activation achieved during repetition of the target phrase was also analyzed. To do it, the interval pointer of the data analysis program was used to select the segment of information representative of the start and the end of muscle contraction (on and off situation). The values obtained show the average (RMS) electromyografic activity achieved during the utterance of the target phase.

It was verified that for some participants it wasn't possible to differentiate between on and off situations and the one that would identify the electromyographic activity of rest. In these cases the first two seconds of muscle activity were selected regardless of the time used to initiate speech. The RMS obtained in this segment was registered as the speech muscle tension.

3. Results

To compare both groups the Mann-Whitney non-parametric statistical test ($p \leq 0,05$) was used, once the variables don't present a normal distribution. To study the correlation between data of latency and electromyographic (EMG) speech activity the pearson's correlation test was used and the discrepant values were discarded.

Table 1. Rest descriptive analysis (uV)

	Average	SD	Mean	Variation Coefficient	P value
G1	16.46	3.66	16.81	22.21	**0.02***
G2	26.65	10.98	28.25	41.19	

Table 2. Latency descriptive analysis (ms)

	Average	SD	Mean	Variation Coefficient	P value
G1	82.18	8.52	83.00	10.37	0.32
G2	97.7	40.7	99.00	41.69	

Table 3. Análise descritiva da EMG (uV)

	Average	SD	Mean	Variation Coefficient	P value
G1	68.45	25.10	64.24	36.67	0.32
G2	75.90	32.35	71.30	42.62	

Table 4. Latency and EMG correlation

	r	P value
GI	0.218	0.60
GII	0.716	**0.03***

4. Conclusion

H1 – CONFIRMED. The groups were significantly different on rest, with higher scores on G2. Besides in G2 there was no uniformity of data. Rest results of G2 were near twice as dispersed as on G1.

H2 – NON CONFIRMED. Groups are not significantly different about latency. However it was again detected a non-uniformity of data on G2. Results about latency on G2 were four times as dispersed as on G1.

H3 – NON CONFIRMED. Groups are not significantly different about the muscle activity neither about data dispersion.

H4 – PARTIALY CONFIRMED. There was a strong positive correlation between latency time and speech muscle activity only on G2. To this group the larger the latency the greater the electromyographic activity.

Research data agree with Bosshardt et al. (2002) findings that didn't observe differences on latency time between fluent and stuttering individuals. They also agree with data of Kleinow and Smith (2000) that found larger variability on temporal patterns of stuttering individuals. This variability evidenced by data dispersion may be indicative that the speech system of stuttering individuals needs previous trials to achieve the fluent pattern.

High muscle activity on rest, observed in the group of stuttering participants support MnClean's (1987 and 1996) findings that point out that high entry levels on mechanic-receptive pathways, in adequate moments (ex before speech) may result on the disruption of neuro-motor speech activity patterns.

The positive correlation between reaction time to speech and muscle speech activity observed on the group of stuttering participants may be the result of poor timing impact on the motor system. Several authors point out that the increasing tension also increases the chance of speech disruptions.

This way, therapy procedures aiming adequate rest and favoring speech timing may promote fluency.

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