

# EXPRESSION OF CERTAINTY AND DOUBT ON STUTTERING: STUDY OF SPEECH'S TEMPORAL FEATURES

## *Expressão de certeza e dúvida na gagueira: estudo dos aspectos temporais da fala*

Leticia Correa Celeste <sup>(1)</sup>, César Reis <sup>(2)</sup>

### ABSTRACT

**Purpose:** to examine the role of speech temporal organization on the expression as for the attitudes of certainty and doubt in the group of adults who stutter, comparing such analysis with a group of speech-fluent adults. **Method:** we analyzed 24 individuals, 12 with stuttering (SG1 and SG2) and 12 without stuttering (CG). Samples were collected with a corpus of 10 key phrases that were produced in the neutral form, expressing doubt and certainty, totaling 840 utterances. The acoustic analysis was performed using Praat and the following parameters were analyzed: time and speech rate and articulation, presence and duration of pauses and disfluencies, duration of vowels in pre-tonic and tonic syllables and occurrence of post-tonic vowel. Statistical analysis was performed by using Kruskal Wallis and chi-square tests, with a significance level of 95%. **Results:** the expression of doubt has the lowest rate of articulation in the control group, followed by neutral and certainty expressions, with statistically significant differences. Also in the control group, there was presence of pauses and disfluencies only in the expression of doubt. In the experimental group, the largest difference was found in the vowel duration of the stressed syllable. **Conclusion:** generally speaking, CG varied more its temporal organization in order to express attitudes. However, it is also possible to note a trend in the group of people who stutter. As for the speech rate, by removing the pauses and disfluencies, we see that both GE1 and GE2 differentiate certainty, faster articulating each syllable.

**KEYWORDS:** Stuttering; Attitude; Communication; Speech; Speech Acoustics

### ■ INTRODUCTION

The sound structure of human communication can be divided into segmental and non-segmental facets. Among the latter, prosody stands out for being a speaker's tool to express the so-called *mental states* or—as they will be referred henceforth—attitudes, which are the theme of the present study.

Studies on the relationship between prosody and attitudes have been encouraged<sup>1</sup> and addressed<sup>2-5</sup> in an attempt to characterize and represent the prosodic aspects in the expression of the speaker's

attitudes. These are monitored cognitively<sup>6</sup> and are conveyed, therefore, in a clear and intentional manner<sup>7</sup>. Irony, doubt, and certainty are examples of attitudes.

When studying the relationship between prosody and attitudes, several authors have found that different attitudes can be expressed from the same sentence by reorganizing the prosodic parameters of duration, intensity and melodic variability<sup>8-10</sup>.

Moraes and Stein<sup>9</sup> have studied the attitudes of consideration, disdain, disappointment, irony, justification, obviousness and uncertainty. A single sentence was produced by an individual and underwent synthesis and re-synthesis processes, in addition to a perception test. The authors concluded that some attitudes are more marked by variations in fundamental frequency (F0), while others, by variations in the duration parameters.

<sup>(1)</sup> Universidade de Brasília (UnB), Brasília, DF, Brasil.

<sup>(2)</sup> Universidade Federal de Minas Gerais, Belo Horizonte, MG, Brasil.

Source of funding: CAPES

Conflict of interest: non-existent

Cheang and Pell<sup>9</sup> have studied the tessiture, intensity variation, speech rate, harmonics-to-noise ratio and nasal resonance of the vowel /i/ in the expression of sarcasm in English. The expression of sarcasm was compared with neutral form and the attitudes of humor and sincerity. The results of their study showed statistically significant differences between the attitudes for the F0 measures; sarcasm tended to have lower values overall. Speech rate and harmonics-to-noise ratio also showed statistically significant differences, with lower values for sarcasm. The resonance of the vowel /i/ was found to have greater amplitude in nearly all the frequencies deemed critical. In contrast, intensity variation was not statistically different across the attitudes<sup>9</sup>.

The same authors showed that the rate of speech in the Cantonese language is significantly different in the expression of sarcasm, humor, and sincerity<sup>11</sup>. Silva and Reis<sup>10</sup>, in a study with actors, demonstrated that the patterns of duration differ in the expression of doubt, uncertainty and certainty.

Therefore, it is clear that the parameters related to the temporal organization of speech play a relevant role in the prosodic function of conveying attitudes. Given that the patterns of duration in the speech of individuals who stutter may be altered regardless of the presence of disfluencies<sup>12-15</sup>, the question arises as to how these individuals reorganize their speech temporally when expressing attitudes.

With this question in mind, it was hypothesized that individuals with developmental stuttering have difficulties in the expression of the attitudes of certainty and doubt for two reasons. The first is related to the very presence of speech disfluencies, as they interfere directly with the temporal organization of speech. The present study raises the following hypothesis for a second reason for such difficulty in conveying attitudes: individuals with developmental stuttering have difficulty in modulating the prosodic parameter of duration in the expression of the attitudes of certainty and doubt, even when disfluencies are excluded. The objective of the present study was to investigate the role of the temporal organization of speech in the expression of the attitudes of certainty and doubt in a group of adults with stuttering compared with a group of fluent adults.

## ■ METHODS

### *Sample*

This study included 24 male individuals aged between 20 and 40 years, born and raised in the metropolitan area of Belo Horizonte, who were assigned to one of two groups: experimental (EG, n=12) and control (CG, n=12). The EG comprised individuals diagnosed with developmental stuttering who had undergone a speech pathology evaluation to determine the degree of severity of their stuttering<sup>16</sup>, considering the following aspects: frequency and duration of disfluencies, tension, and secondary phenomena according to the Iowa scale<sup>16</sup>. The EG was further divided into EG1, comprising eight participants with moderate stuttering, and EG2, four participants with severe stuttering.

The CG was composed by 12 fluent individuals. These were matched to the EG with regard to gender, age and schooling. No participant in either group manifested phonological disorders (this was confirmed through the ABFW test for phonological disorders), any oral language complaint, or hearing deficits.

### *Procedures*

The data were collected using an HP notebook with a Plantronics unidirectional microphone connected to the audio input. The previously installed Praat software version 5.1.02 (B and W, 1992-2011) was used for the recording.

The CG recording was performed at the phonetics and phonology laboratory of the Universidade Federal de Minas Gerais (UFMG), while the EG was recorded at the FEAD integrated health clinic, in a quiet environment.

The *corpus* was prepared as follows: 10 neutral sentences were constructed to be the "key sentences". The same sentences were used in the neutral form and to express certainty and doubt. For the neutral form, the sentences were read without a context. For the expression of the attitudes, situations were created that included a short contextualization and a dialog. This dialog consisted of a question proposed by the study; the response should be given by the participants expressing the requested attitude. Figure 1 illustrates a neutral sentence with the situations created to elicit the expression of certainty and doubt. The neutral form was recorded to be used as a basis for comparison with the other forms. However, in the CG, the participants expressed doubt in two ways: either with a similar melodic contour to the declarative form, or similar to the interrogative form. For that reason, it was decided to record, with the CG, a second neutral form: the interrogative sentence.

Neutral form	Doubt	Certainty
declarative: <i>Eu entreguei o documento.</i>	João é um funcionário muito desatento. Seu chefe não está encontrando um documento e pergunta: P : João, você me entregou o documento na segunda? I: <i>Eu entreguei o documento.</i>	João é um funcionário muito eficiente, sempre cumpre o que foi pedido. Seu chefe não está encontrando um documento e pergunta: P : João, você me entregou o documento na segunda? I: <i>Eu entreguei o documento.</i>

**Figure 1 – Example of the construction of the corpus containing the key-sentence in the neutral and expressing attitudes.**

In total, 840 utterances were recorded:

- CG (12 participants X 10 key sentences): 120 declarative utterances, 120 interrogative utterances, 120 utterances expressing certainty, and 120 utterances expressing doubt (the latter were subdivided into doubt 1, with 30 utterances similar to the neutral declarative form, and doubt 2, with 90 utterances similar to the interrogative form). In total, the CG produced 480 utterances;
- EG (12 participants X 10 key sentences), 360 utterances:
  - EG1 (8 participants X 10 key sentences): 80 declarative utterances, 80 utterances expressing certainty, and 80 utterances expressing doubt. In total, 240 utterances for EG1;
  - EG2 (4 participants X 10 key sentences): 40 declarative utterances, 40 utterances expressing certainty, and 40 utterances expressing doubt. EG2 produced 120 utterances altogether.

For the recording of the neutral form, the participants were instructed, initially, to perform a silent reading of the sentences provided, and, when they felt comfortable with them, to speak each sentence aloud. For the recording of the attitudes, each participant was told what the attitude was, and that they should express it when speaking the sentence. All the situations involving doubt were recorded first; later, all the certainty situations were recorded.

The data were stored and edited for the acoustic analysis.

#### *Acoustic analysis*

The parameters related to temporal organization comprise duration, pause and rate of speech. The first is related to the duration of the vowels in the stressed and per-stressed syllables, as well as the length of pauses and disfluencies. Pause was defined as a period of silence in the speech signal, without any indication of attempts at sound production.

It was found, however, that pauses followed by occlusive consonants occurred. In order to delimit the duration of the occlusive consonants, the lengths of these segments were measured when they occurred between vowels. The mean length of time found was 0.102 s, which was used as the duration measure in the present study. Therefore, whenever a pause was followed by an occlusive consonant, the duration of 0.102 s before the vowel was taken as the duration of silence of the occlusive consonant.

The utterances containing post-stressed vowels were identified and counted, and presented as percentage values.

With respect to pauses and/or disfluencies, the number of utterances in which they appeared was counted, as well as their total duration.

The last parameter of temporal organization examined was speech rate. The analysis of this parameter is typically divided into four parts:

1. Total speaking duration (total duration spent in the production of each utterance);
2. Total articulatory duration (the length of duration taken by pauses is subtracted from the total speaking time to determine the exact time used exclusively in articulation);
3. Speaking rate (number of syllables divided by the total speaking duration), and
4. Articulatory rate (number of syllables divided by the total articulatory duration).

Over the course of the analyses, however, the following question emerged: Should the duration of disfluencies be included in the articulatory time? Answering this question either affirmatively or negatively carries implications.

To include the duration of disfluencies in the articulatory time seems coherent, since disfluencies are articulatory attempts at producing a given phoneme. As the name suggests, articulatory time comprises the total lengths of time at which speech segments were articulated. Hence, it is only natural

to include the duration of disfluencies in the total articulatory time.

On the other hand, subtracting the length of disfluencies from the duration of articulation is also an interesting proposition: the articulatory rate is aimed, in this case, at determining the mean duration of each syllable produced, and only the syllables effectively produced. This is an interesting idea because it enables the comparison of the mean duration of each syllable between the speech of individuals without stuttering and the fluent speech of individuals with stuttering.

Choosing one of these options would obviously entail losing part of the information. The methodological choice made in the present study was not to leave out one type of result, but rather, to use both.

Thus, further subdivision was proposed for the four measures described earlier, as follows:

1. Total speaking duration
2. Articulatory duration
  - 2.1. Articulatory duration with disfluencies
  - 2.2. Articulatory duration without disfluencies
3. Speech rate
4. Articulatory rate
  - 4.1. Articulatory rate with disfluencies
  - 4.2. Articulatory rate without disfluencies

The present study was approved by the Research Ethics Committee of the UFMG under protocol 122/09. All participants signed an informed consent form, which explained the study with its risks and benefits, ensured freedom of participation, refusal or withdrawal, as well as the confidentiality of the personal data, according to resolution 196/96.

#### *Statistical analysis*

Following the acoustic analysis of the data, the statistical analysis was performed using the software Excel, version 2007 and Minicab®

v. 15.1.30.0. Descriptive statistics evaluations were conducted, and the association between variables was tested. In order to compare the variables, the nonparametric test of Alaska-Wallis was used for three reasons: the normality of the data was not satisfactory; the sample data originated from three different populations, and the sample sizes were unequal.

To compare the variables “number of utterances with pauses” and “number of utterances with disfluencies”, the chi-square test was used, since an association between these variables was found for frequency of occurrence. Thus, diagrams were constructed, based on the histogram model, for the association between rows and columns<sup>17</sup>, with a confidence level of 95%.

## ■ RESULTS

The total number of utterances with pauses and disfluencies and their mean duration are shown in Table 1. To verify that the difference was statistically significant, the result of the chi-square test should be  $p < 0.05$ . The results for the intergroup comparison are depicted in Table 2. Comparisons within each group yielded the following results:

- CG: the differences were statistically significant when the neutral form and the expression of certainty were compared with the expression of doubt ( $p=0.000$ ), both for pauses and disfluencies;
- EG1: the differences were statistically significant for nearly all comparisons: declarative vs. certainty,  $p=0.4$ ; declarative vs. doubt,  $p=0.008$ , and certainty vs. doubt,  $p=0.000$ , for pauses; declarative vs. certainty,  $p=0.001$ ; declarative vs. doubt,  $p=0.1$ , and certainty vs. doubt,  $p=0.000$ , for disfluencies;
- EG2: no statistically significant differences were found.

**Table 1 – Total number of utterances, total number of utterances with pauses and total number of utterances with disfluencies, percentages of occurrence and mean in milliseconds.**

		N utter	N pauses	% pauses	Mean duration*	N disfl	% p disfl	Mean duration*
CG	Declarative	120	0	0	0	0	0	0
	Interrogative	120	0	0	0	0	0	0
	Certainty	120	0	0	0	0	0	0
	Doubt 1	30	27	90%	0.106	15	50%	0.232
	Doubt 2	90	8	8.80%	0.337	9	10%	0.157
	Declarative	80	52	65%	0.432	49	61.25	1.006
EG 1	Certainty	80	68	85%	0.315	78	97.5	1.591
	Doubt	80	36	45%	0.449	39	48.75	0.541
EG 2	Declarative	40	40	100%	0.342	40	100	6.871
	Certainty	40	37	100%	0.318	37	100	4.265
	Doubt	40	35	97.20%	0.877	36	100	5.151

**Table 2 – Value of  $p$  ( $p < 0.05$ ) by the chi-square test for comparison of the number of utterances with pauses and disfluencies between the groups.**

		CG vs. EG1	CG vs. EG2	EG1 vs. EG2
Declarative	p disfl	0.000*	0.000*	0.02
	p p	0.000*	0.000*	0.02
Certainty	p disfl	0.000*	0.000*	1
	p p	0.000*	0.000*	0.8
Doubt	p disfl	0.000*	0.07	0.02
	p p	0.6	0.000*	0.01

The means and standard deviations (SD) found for speech and articulatory rates are shown in Table 3; the statistical analysis for the comparison between groups is given in Table 4, and between modalities and attitudes in Table 5.

The means and SDs for the stressed and pre-stressed vowels are shown in Table 6. The results of the Kruskal-Wallis test within each group for the stressed vowel were the following:

CG: no statistically significant differences were found in the duration of the stressed vowel: declarative vs. certainty,  $p=0.003$ ; declarative vs. doubt 1,  $p=0.1$ ; interrogative vs. doubt 2,  $p=0.2$ , and certainty

vs. doubt 1,  $p=0.2$ ; certainty vs. doubt 2,  $p=0.5$ , and doubt 1 vs. doubt 2,  $p=0.1$ ;

EG1: the differences in duration between the neutral form and expressing attitudes were statistically significant, with declarative vs. certainty,  $p=0.000$ ; declarative vs. doubt,  $p=0.008$ , and certainty vs. doubt,  $p=0.0000$ ;

EG2: the differences in duration between the neutral form and expressing attitudes were also statistically significant, with declarative vs. certainty,  $p=0.000$ ; declarative vs. doubt,  $p=0.000$ , and certainty vs. doubt,  $p=0.002$ .

**Table 3 – Mean and standard deviation for speech and articulatory rates.**

		CG		EG1		EG2	
		Mean	sd	Mean	sd	Mean	sd
declarative	Tx E	5.88	0.98	3.94	1.16	2.09	0.78
	Tx A	5.88	0.98	4.26	0.86	2.92	0.26
	TxA-d	5.88	0.98	5.55	0.93	4.18	0.86
interrogative	Tx E	6.27	1.08	--	--	--	--
	Tx A	6.27	1.08	--	--	--	--
	TxA-d	6.27	1.08	--	--	--	--
Certainty	Tx E	6.14	1.28	3.45	0.91	2.17	0.73
	Tx A	6.14	1.28	3.78	0.46	2.32	0.41
	TxA-d	6.14	1.28	6.41	0.85	6.14	0.79
doubt 1	Tx E	3.69	0.67	4.45	1.13	1.81	0.55
	Tx A	4.01	0.63	4.75	0.58	2.01	0.08
	TxA-d	4.32	0.56	5.39	0.87	4.44	0.96
doubt 2	Tx E	5.6	0.95	--	--	--	--
	Tx A	6.03	1.04	--	--	--	--
	TxA-d	6.18	0.84	--	--	--	--

Legend:

TxE: speech rate

TxA: articulatory rate

TxA-d: articulatory rate without disfluencies

sd: standard deviation

**Table 4 – Value of  $p$  ( $p < 0.05$ ) by the Kruskal-Wallis test for comparison of speech and articulatory rates between groups.**

		Affirm	Certain	Doubt
CG vs. EG1	Tx E	0.000*	0.000*	0.008
	Tx A	0.5	0.001	0.001
	TxA-d	0.06	0.08	0.04
CG vs. EG2	Tx E	0.000*	0.000*	0.000*
	Tx A	0.000*	0.08	0.5
	TxA-d	0.03	0.1	0.4
EG1 vs. EG2	Tx E	0.000*	0.000*	0.000*
	Tx A	0.000*	0.000*	0.000*
	TxA-d	0.001	0.09	0.02

Legend:

TxE: speech rate

TxA: articulatory rate

TxA-d: articulatory rate without disfluencies

sd: standard deviation

**Table 5 – Value of  $p$  ( $p < 0.05$ ) by the Kruskal-Wallis test for comparison of speech and articulatory rates, neutral forms and attitudes.**

		<b>Tx E</b>	<b>Tx A</b>	<b>Tx A-d</b>
EG1	Decl vs. Cert	0.02*	0.09	0.000*
	Decl vs. Doubt	0.01*	0.05	0.4
	Cert vs. Doubt	0.000*	0.007*	0.000*
EG2	Decl vs. Cert	0.8	0.05	0.000*
	Decl vs. Doubt	0.03*	0.01*	0.3
	Cert vs. Doubt	0.01*	0.1	0.000*
CG	Decl vs. Cert	0.000*	0.000*	0.000*
	Decl vs. Doubt 1	0.000*	0.000*	0.000*
	Inter vs. Doubt 2	0.06	0.09	0.04
	Cert vs. Doubt 1	0.000*	0.002	0.000*
	Cert vs. Doubt 2	0.4	0.8	0.1
	Doubt 1 vs. Doubt 2	0.000*	0.001	0.000*

**Table 6 – Mean and standard deviation for the duration of stressed and pre-stressed syllable vowels.**

		<b>Stressed</b>		<b>Pre-stressed</b>	
		<b>Mean</b>	<b>sd</b>	<b>Mean</b>	<b>sd</b>
CG	Declarative	0.144	0.035	0,054	0,019
	Certainty	0.142	0.039	0.048	0.021
	Doubt 1	0.175	0.024	0.061	0.01
	Doubt 2	0.143	0.026	0.057	0.011
	Interrogative	0.129	0.035	0.069	0.026
EG1	Declarative	0.192	0.075	0.041	0.007
	Certainty	0.161	0.069	0.039	0.009
	Doubt	0.179	0.044	0.043	0.004
EG2	Declarative	0.119	0.031	0.065	0.005
	Certainty	0.158	0.039	0.062	0.012
	Doubt	0.173	0.048	0.057	0.005

The results of the Kruskal-Wallis test within each group for the stressed vowel were the following:

CG: the results were statistically very significant across comparisons, ( $p=0.000$ ), except for certainty vs. doubt ( $p=0.04$ );

EG1: no comparison showed statistically significant differences: declarative vs. certainty,  $p=0.4$ ; declarative vs. doubt,  $p=0.3$ , and certainty vs. doubt,  $p=0.06$ ;

As with EG1, no statistically significant differences were found for EG2, with declarative vs. certainty,  $p=0.08$ ; declarative vs. doubt,  $p=0.05$ , and certainty vs. doubt,  $p=0.3$ .

Regarding the occurrence of post-stressed syllable vowels, results are shown in Graph 1. The statistical analysis (chi-square,  $p < 0.05$ ) was performed only for the CG, since this was the only group that showed differences in production: when comparing declarative vs. certainty; declarative vs. doubt 1; certainty vs. doubt 1, and doubt 1 vs. doubt 2, the differences were very significant ( $p=0.000$ ). The differences were not statistically significant for declarative vs. interrogative,  $p=0.6$ ; declarative vs. doubt 2,  $p=0.3$ , and interrogative vs. doubt 2,  $p=0.6$ .

## ■ DISCUSSION

The first aspect to be addressed is the presence of pauses in the CG utterance. Given that the participants spoke short sentences, with a mean of 6.4 syllables per utterance, it was inferred that there was no physiological need for pauses. Therefore, pauses, when made by the speakers, were regarded as part of their strategy to express themselves, i.e., the pauses were produced with communicative intent. From such perspective, the first question to arise was: Was there any type of sentence or attitude in which pauses were used more consistently?

Table 1 clearly shows that the insertion of a pause in an utterance was used to reinforce the expression of doubt, particularly that which exhibits the general patterns of the assertion—doubt 1.

Viola and Madureira<sup>18</sup> have elicited a few reflections on the use of *expressive* pauses (the authors defined “expressive pause” as one which related to the expression of attitudes and emotions), showing that the variation in duration is linked to the nature of the feeling conveyed. The authors gave the example of longer duration in the attitude of contemplation, and shorter duration in a state of anxiety. In the present study, pauses were found only in the expression of doubt, with the lower mean for doubt 1 (SD, 0.05) and the greater for doubt 2 (SD, 0.019).

It is interesting to note the absence of pauses in the expression of certainty. Alves<sup>5</sup> hardly found pauses in persuasive utterances. That author explained this fact as the speaker’s need to convey assertiveness.

Another factor to be considered in the temporal organization of speech was the presence of disfluencies. The same reasoning for the use of pauses was applied to disfluencies: their presence, intentional in the case of the CG, represented a communication strategy. The following disfluency types were identified:

- Sound prolongations;
- Syllable repetitions;
- Phone repetitions;
- Hesitations.

Similarly to the use of pauses, disfluencies were inserted in order to convey doubt, more markedly in doubt 1. However, they occurred less frequently than the pauses. Compared with the pauses, disfluencies had a higher mean in doubt 1, although their number was smaller.

The fact that the occurrence of both pauses and disfluencies was limited to one attitude (doubt) corroborates the idea that their presence was intentional.

As shown in Table 1, the presence of pauses in EG1 is more marked in the attitude of certainty, while for EG2 the occurrence is practically the same for the three types of production; only one utterance of doubt had no pause. Table 1 also shows that all the differences were statistically significant, with longer pauses in the expression of certainty, followed by the declarative form, and lastly, doubt. Interestingly, the analysis of the number of utterances containing disfluencies showed similar results to those found for pauses: presence of disfluencies in all EG2 utterances and in EG1 with the same hierarchy. The following types of disfluencies were found in the EG:

- Sound prolongations;
- Syllable repetitions;
- Phone repetitions;
- Sound intrusions;
- Blocks;
- Hesitations.

The intergroup comparisons (Tables 1 and 2) reveal differentiated patterns. In the neutral form and in the expression of certainty, considering that the utterances had a relatively low number of syllables (minimum of five, maximum of eight syllables expressed, i.e., only the fluent syllables, repetitions excluded), the CG participants showed no physiological need to insert pauses, in addition to understanding that the use of expressive pauses was not necessary or coherent. The presence of long and tense pauses is a characteristic found in the speech of people who stutter, in addition to disfluencies<sup>19</sup>. Therefore, the results found for pauses and disfluencies in the declarative form were expected.

In the expression of doubt, the CG showed a peculiar result: there was a strong presence of pauses in the utterances of doubt in the CG, quite similar to EG2, without a statistically significant difference. On the other hand, the CG produced a number of utterances with disfluencies which is very close to that of EG1, also without statistically significant differences. Thus, with respect to the presence of pauses and disfluencies in the utterances, the reorganization of the temporal patterns in the CG tends to resemble the pattern found in the speech of individuals with stuttering when expressing doubt.

Two other aspects investigated in the present study were the speech rate (TxE), also known as speech rate, and the articulatory rate, which was subdivided into the articulatory rate (TxA), which takes into account the duration of the disfluencies in the articulatory duration, and the articulatory rate without disfluencies (TxA-d), which does not consider that length of duration. The analysis of these three parameters together allows us to assess



whether or not the speech rate is being influenced by aspects other than the actual syllabic duration.

As expected, in the declarative sentence type, neutral form, the speech and articulation rates were equal in the CG, while the articulatory rates without disfluencies (TxA-d) were similar for the CG and EG1, with  $p=0.5$  (Tables 3, 4 and 5). However, by comparing CG/EG1 and CG/EG2, it becomes clear that individuals who stutter speak more slowly than those who had normal speech development, even after excluding the moments of pauses and disfluencies. Moreover, the articulatory rate in EG1 is superior to that in EG2. This demonstrates that the degree of stuttering has a bearing on the rate of speech.

Studying acoustic measurements of duration in the speech of individuals with stuttering, Arcuri *et al*<sup>2</sup> found that only a few words were spoken more slowly by the group with stuttering. It is important to note that, although the authors had selected individuals with mild, moderate and severe stuttering, all participated in the same group: with stuttering. In the present study, the words were not analyzed separately, yet it is known that the duration of words reflects in the speech rate (speech rate + articulatory rate). Consequently, the results found in the present study differ from those observed by Arcuri *et al*<sup>2</sup>.

Cardoso and Reis<sup>13</sup> studied a number of variables related to the temporal organization of speech in individuals with stuttering. The authors found that the group of individuals with stuttering spoke more slowly than individuals who do not stutter. It is worth noting that the study was conducted with the fluent speech of both groups. Thus, it was possible to compare these results with those found for articulatory rates in the present study.

The result of such comparison was two-fold: the findings by Cardoso and Reis<sup>13</sup> are similar to those obtained for EG2 in the present study; they are not, however, it is not in line with the findings for EG1. This divergence probably occurred because Cardoso and Reis did not specify the degree of severity of stuttering in the studied group (comprising two participants).

The speech rate of the fluent speech produced by individuals with stuttering in declarative utterances was studied by Arcuri *et al*<sup>4</sup>. These authors allocated the individuals with stuttering into three groups: mild, moderate and severe. The groups with mild and moderate stuttering had quite similar speech rates, which were higher than those for the group with severe stuttering. Since the authors excluded disfluencies, the results for speech rates in their study are similar to those for articulatory rates in the present study. Thus, when comparing

the results for the declarative form between the present study and that by Arcuri *et al*<sup>4</sup>, the findings were similar: the greater the severity of the speech disorder, the slower the speech of the participants.

After conducting a comparative analysis of the temporal organization of speech between the groups, it becomes clear that the degree of severity of stuttering, i.e., the degree of difficulty in temporal motor control of speech manifested by these individuals, is not limited to the number of disfluencies and pauses in the speech. The more severe the stuttering, the greater the difficulty in controlling syllabic duration, even in fluent speech.

In the expression of certainty, as with the declarative form, the speech rates of EG1 and EG2 were lower than those in the CG due to the influence of pauses and disfluencies (Tables 3, 4 and 5). The articulatory rate without disfluencies showed an interesting trend: EG1 had higher rates, followed by EG2 and the CG (the latter two with nearly equivalent values). Thus, contrary to expected, the mean duration of the fluent syllables demonstrated that the individuals with moderate stuttering spoke faster than those in the CG. Therefore, the impairment seen in articulatory rates in the declarative form was not present in the expression of certainty.

Both for EG1 and EG2, the relation of articulatory rates without disfluencies between the declarative form and the expression of doubt was not statistically different, although no statistically significant difference was found when comparing declarative and doubt in the speech and articulatory rates. However, there was a statistically significant difference between certainty and declarative; the speech is faster in the expression of certainty (Tables 3 and 5). These results show that, despite the specific difficulties that individuals who stutter manifest in the temporal organization of speech, the study participants used articulatory rate variation as a strategy of communication when expressing certainty.

In the expression of doubt by the CG, if the speech rate was analyzed separately, it would seem that the doubt 1 values are lower because of the pauses and disfluencies, since both are counted in the calculation of the speech rate. However, when these two parameters are excluded (to find the articulatory rate with/ without disfluencies), doubt 1 still shows much lower values. This fact means that, to express doubt, the participants articulate more slowly—as long as the doubt is expressed with the declarative form.

Regarding the duration of the prominent stressed vowel, the results show that the patterns of duration found for the CG in this sample are very similar (Table 6), with no statistically significant differences.

This was expected, since, in Brazilian Portuguese, duration marks the stress in a word, and for that reason it is not differentiated between the forms and attitudes evaluated. However, the same was not true for the EG.

From the results for the duration of the prominent stressed vowel, it was found that EG1 and EG2 do not show the same tendency. EG1 showed longer stressed vowels in the declarative utterances, followed by those expressing doubt and, lastly, the utterances with expression of certainty. In EG2, the longer duration was in the expression of doubt, and the shorter, in the declarative form.

With respect to EG2, it was also noted that the difference between the forms studied herein showed statistically significant differences, which corroborates the idea that the participants with stuttering tried to use the change in duration parameters for the expression of attitudes.

The pre-stressed vowel showed a different behavior in the CG with respect to duration, with statistically significant differences between the neutral forms and the attitudes, as opposed to what occurred with the EG participants (Table 6). Lucente, Silveira and Barbosa<sup>20</sup> analyzed a number of acoustic differences in the declarative and interrogative sentence types. Those authors noted that the pre-stress vowel played different roles in the

forms analyzed, even for similar stressed vowel values. Similar findings have been reported in other studies<sup>21,22</sup>

The analysis of post-stress calls for a few considerations. In 100% of the utterances in the present study, the post-stressed vowel was placed on the last syllable. It is expected, therefore, that this vowel will not always be pronounced<sup>23-25</sup>. A question arises: Does the speaker use, in any way, the drop in the production of the post-stressed vowel to express an attitude? In other words, even though it is expected that the post-stressed syllable vowel will not be produced in some instances, is there a pattern in the expression of the attitudes of certainty and/or doubt?

For the CG, there were no statistically significant differences between the declarative, interrogative and doubt 2. However, when any of these forms is compared with certainty or doubt 1 (in addition to the comparison between these two), highly significant statistical differences are found in all the results. This is because post-stressed vowels are hardly ever produced in certainty, while they are very common in doubt 1. These results indicate that the (non) production of the post-stressed vowel is an important phenomenon in the expression of attitudes (Figure 2).

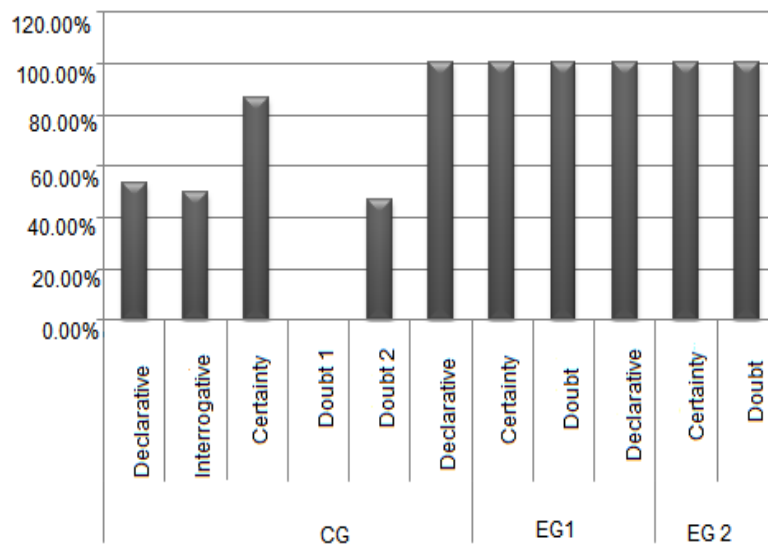


Figure 2 – Percentage of non-occurrence of post-stressed vowel.

Curiously, in EG, the post-stressed vowel was always produced, even though it was always located at the end of the utterances analyzed. One possible explanation could be the greater care taken by the speakers with stuttering at the moment of articulation.

It is worth emphasizing that, for doubt, the production of the final post-stressed vowel did not vary between the groups, unlike the declarative form and the expression of certainty. That was a striking difference, again, in the expression of doubt. Once more, the CG seems to tend towards the EG in order to convey that attitude.

## ■ CONCLUSION

Returning to the hypothesis advanced by the present study—“*individuals with developmental stuttering have difficulty modulating the prosodic parameter of duration in the expression of the attitudes certainty and doubt, regardless of disfluencies*”, it is concluded that this hypothesis was partly confirmed.

In the analysis of the group of individuals without stuttering, the pauses and disfluencies only appeared in the expression of doubt, which

indicates that the use of pauses and disfluencies by the study participants was a communicative strategy for conveying the attitude of doubt. Furthermore, the rate of speech was higher in certainty, even when the pauses and disfluencies were excluded (articulatory rate with and without disfluencies).

Overall, the CG individuals varied their temporal organization more to convey the attitudes proposed. However, a tendency can also be observed in the group of people with stuttering. Regarding the rate of speech, after removing the pauses and disfluencies, it becomes clear that both EG1 and EG2 differentiate certainty by articulating each syllable more rapidly. However, as opposed to the CG, EG1 and EG2 do not differentiate the articulatory rate in the expression of doubt (comparing doubt vs. neutral). Even when the variations occurred, the tendencies found in the CG were not followed by the EG.

## ■ ACKNOWLEDGMENTS

We are grateful to CAPES for funding part of the studies of the principal author, thereby contributing to the development of the present study.

## RESUMO

**Objetivo:** examinar o papel da organização temporal do discurso na expressão das atitudes de certeza e dúvida em grupo de adultos com gagueira, comparando-a em um grupo de adultos fluentes. **Método:** participaram desta pesquisa 24 indivíduos, sendo 12 com gagueira (GE1 e GE2) e 12 sem gagueira (GC). Foram coletadas amostras que teve como base um corpus de 10 frases chave que foram produzidas nas formas neutra, de dúvida e de certeza, totalizando 840 enunciados. A análise acústica foi realizada por meio do programa Praat e os seguintes parâmetros foram analisados: tempos e taxas de elocução e articulação, ocorrência e duração de pausas e disfluências, duração das vogais tônica e pré-tônica e ocorrência da vogal pós-tônica. A análise estatística foi realizada por meio dos testes Kruskal Wallis e qui-quadrado, com índice de significância de 95%. **Resultados:** a expressão da dúvida apresenta taxa de articulação mais baixa no grupo controle, seguida da forma neutra e de certeza, com diferenças estatisticamente significantes. Ainda no grupo controle, foi observado presença de pausas e disfluências somente na expressão de dúvida. No grupo experimental, a maior diferença encontrada foi na duração da vogal da sílaba tônica. **Conclusão:** de uma forma geral, o GC variou mais sua organização temporal a fim de expressar as atitudes. No entanto, é possível observar também uma tendência semelhante no grupo de pessoas com gagueira. Quanto à velocidade de fala, ao retirar as pausas e as disfluências, vemos que tanto GE1 quanto GE2 diferenciam a certeza, articulando cada sílaba de forma mais rápida.

**DESCRITORES:** Gagueira; Atitude; Comunicação; Fala; Acústica da Fala

## ■ REFERENCES

1. Mozziconacci SJL. Emotion and attitude conveyed in speech by means of prosody. IPO Annual Progress Report. 1997;(32):1-10.
2. Rodrigues RFL, Figueredo MF. Prosódia e pragmática: retórico de palestras motivacionais. *Diálogos pertinentes*. 2010; 6(1): 89-104.
3. Azevedo LL. Expressão da atitude através da prosódia em indivíduos com doença de Parkinson idiopática. *Rev. soc. bras. fonoaudiol.* [serial on the Internet]. 2009; 14(2): 29. Disponível em: [http://www.scielo.br/scielo.php?script=sci\\_arttext&pid=S1516-80342009000200025&lng=en](http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1516-80342009000200025&lng=en). doi: 10.1590/S1516-80342009000200025.
4. Moneta L, Cheang HS, Pell M. Understanding speaker attitudes from prosody by adults with Parkinson's disease. *J. of Neuropsychol.* 2010; 2(2): 415-30.
5. Alves LM. Estudo entonativo da persuasão na fala do vendedor [Dissertação]. Belo Horizonte: Faculdade de Letras – Universidade Federal de Minas Gerais, 2002.
6. Couper-Kuhlen E. *An Introduction to English prosody*. Baltimore: Edward Arnold, 1986.
7. Wilson D, Wharton T. Relevance and Prosody. *Journal of Pragmatics*. 2006; 38: 1559-79.
8. Moraes JA, Stein CC. . Attitudinal patterns in Brazilian Portuguese intonation: analysis and synthesis. In: 3rd International Conference on Speech Prosody, 2006, Dresden. *Proceedings of the 3rd International Conference on Speech Prosody*. 2006; 1: 83-6.
9. Cheang H, Pell MD. The sound of Sarcasm. *Speech Comm.* 2008; 50: 366-81.
10. Silva JPG Reis C. Análise dos aspectos prosódicos na expressão da certeza e da dúvida no português brasileiro na fala de atores. *Anais do III Colóquio de Prosódia da Fala*. Brasil. 2011.
11. Cheang H, Pell MD. Acoustic markers of sarcasm in Cantonese and English. *J. Acoust. Soc. Am.* 2009; 126(3): 1394-405.
12. Arcuri CF, Chiari BM, Osborn E, Schiefer AM. Medidas acusticas de duração no reconto de historias em indivíduos gagos. *ACTA ORL/Técnicas em Otorrinolaringologia*. 2006; 24(3):113-6.
13. Cardoso B, Reis C. Variables for the study of the temporal organization in speech disorders. *Proceedings of IV Speech Prosody, Brasil*. 2008: 195-8.
14. Arcuri Cf, Osborn E, Schiefer Am, Chiari Bm. Speech rate according to stuttering severity (original title: Taxa de elocução de fala segundo a gravidade da gagueira). *Pró-Fono Revista de Atualização Científica*. 2009; 21(1): 45-50.
15. Celeste LC, Reis, C. The prosody in expression of attitude in the speech with people with and without stuttering. 9th Congress for People who Stutter ISA e 2nd Latin American Congress on Stuttering AAT [oral presentation]. Argentina. 2011.
16. Yairi E, Ambrose NG. Early childhood stuttering I: persistency and Recovery rates. *Journal of Speech, Language, and Hearing Research*. 1999; 42: 1097-112.
17. Magalhães MN, Lima ACP. *Noções de probabilidade e estatística*. 6ed. São Paulo: Editora da Universidade de São Paulo. 2005.
18. Viola IC, Madureira S. The roles of pause in speech expression. *Proceedings of the IV Conference on Speech Prosody*. Brasil. 2008: 721-4.
19. Andrade CRF de. Abordagem neurolingüística e motora da gagueira. In: Ferreira LP, Béfi-Lopes D, Limongi SCO (Orgs.). *Tratado de Fonoaudiologia*, São Paulo: Roca, 2004. p.1001-16.
20. Lucente L, Silveira LS, Barbosa P A. Declarativas em PB: downstepping ou nova combinação bitonal? H+!H\* e H+L\*. IX Congresso Nacional e III Congresso Internacional de Fonética e Fonologia. Brasil. 2006.
21. Lucente L. ToBiPI: um sistema de notação entoacional para o português brasileiro. *Anais do Seta*. 2008; 8:279-86.
22. Armstrong M, Bergmann A, Tamati T. The Prosody of Negation in Brazilian Portuguese. *Proceedings of the IV Conference on Speech Prosody*. Brasil. 2008: 489-92.
23. Aragão MSS. As palavras proparoxítonas no falar de Fortaleza. *Acta Semiotica et Linguistica*. São Paulo. 2008; 08: 61-88.
24. Ramos AP, Tenani LE. Análise métrica do apagamento das vogais postônicas não finais do dialeto do noroeste paulista. *Estudos Linguísticos*. 2009; 38(1): 21-34, jan.-abr.
25. Magalhães JS. Análise translingüística – acento e redução vocálica: o caso do Western Cheremis. *Letras de Hoje*. 2010; 45(1): 43-8.

Received on: June 27, 2011

Accepted on: August 30, 2011

## Mailing Address:

Letícia Correa Celeste

Rua Flor de Índio, 100/402 Bl N – Liberdade

Belo Horizonte – MG

CEP: 31270-215

E-mail: [leticiaceleste@gmail.com](mailto:leticiaceleste@gmail.com)