STUDIES ON THE PROSODY OF THE ROMANIAN LANGUAGE: THE EMOTIONAL PROSODY AND THE PROSODY OF DOUBLE-SUBJECT SENTENCES

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Overview

- Introduction
- Bases of our approach
- Existing approaches
- The methodology
- Results
- Conclusions and further work

Introduction (I)

Definitions of prosody

- the rhythm and intonation aspects of a language (Merriam-Webster)
- a communication manner which includes the attitude, the emotions (H.N. Teodorescu)

Classification of emotions (Fakotakis)

- basic emotions
- non-basic emotions (the mixed emotions)

Introduction (II)

Basic emotions (Johnson-Laird and Oatley)

- happiness
- anger
- fear
- sadness

Emotion's recognition

(Buluti, Narayanan and Syrdal)

- 92.1% for the neutral tone
- 89.1% for sorrow
- 89.7% for sadness
- 67.3% for happiness

Bases of our approach

- The database contains short sentences or phrases fragments. The emotions are: sadness, happiness, anger and detaching state.
- The speakers are persons with age between 25-35 years, born and educated in the middle area of Moldova, with higher education, and without manifested pathologies.
- The recordings were made with a sampling frequency of 22050 Hz. Every speaker pronounced the sentence for three times, following the recording protocol.

Several speculative hypotheses

(H.N. Teodorescu)

- The same emotion is represented differently in presence of different interlocutors, depending on the relationship the speaker has with the interlocutor.
- The double-subject construction is possibly related in a specific way to the emotion and inter-relationship representation.
- Duration of phonemes, duration of pauses, pitch trajectory, including the first formants, moreover the higher formants, the subtle mixture of linear and nonlinear processes of speech generation are a set of characteristics .

Existing approaches

- The Greek emotional databases

- the goal of this research was to improve the naturalness of synthesized voice.

- The German emotional databases

- the validation commission recognized 80% of the simulated emotional states.

- The Danish emotional databases

- they were correctly recognized in a proportion of 67%.

- The Spanish emotional databases

- the goal was to describe a useful methodology in the validation of the simulated emotional states.

The methodology

- **Recording protocol**
- **The emotional speech database**
- **Processing tools used in the analysis**
  - Praat
  - Klatt analyzer
  - GoldWave
  - Wasp

Recording protocol

- The database contains short sentences or phrases fragments. The emotions are: sadness, happiness, anger and detaching state.
- The speaker signed an informed consent in accordance with to the Protection of Human Subjects Protocol to the U.S. Food and Drug Administration and with Ethical Principles of the Acoustical Society of America for Research Involving Human Subjects.
- The database contains two types of protocols, namely the recording technical protocol and the recording documentation protocol.

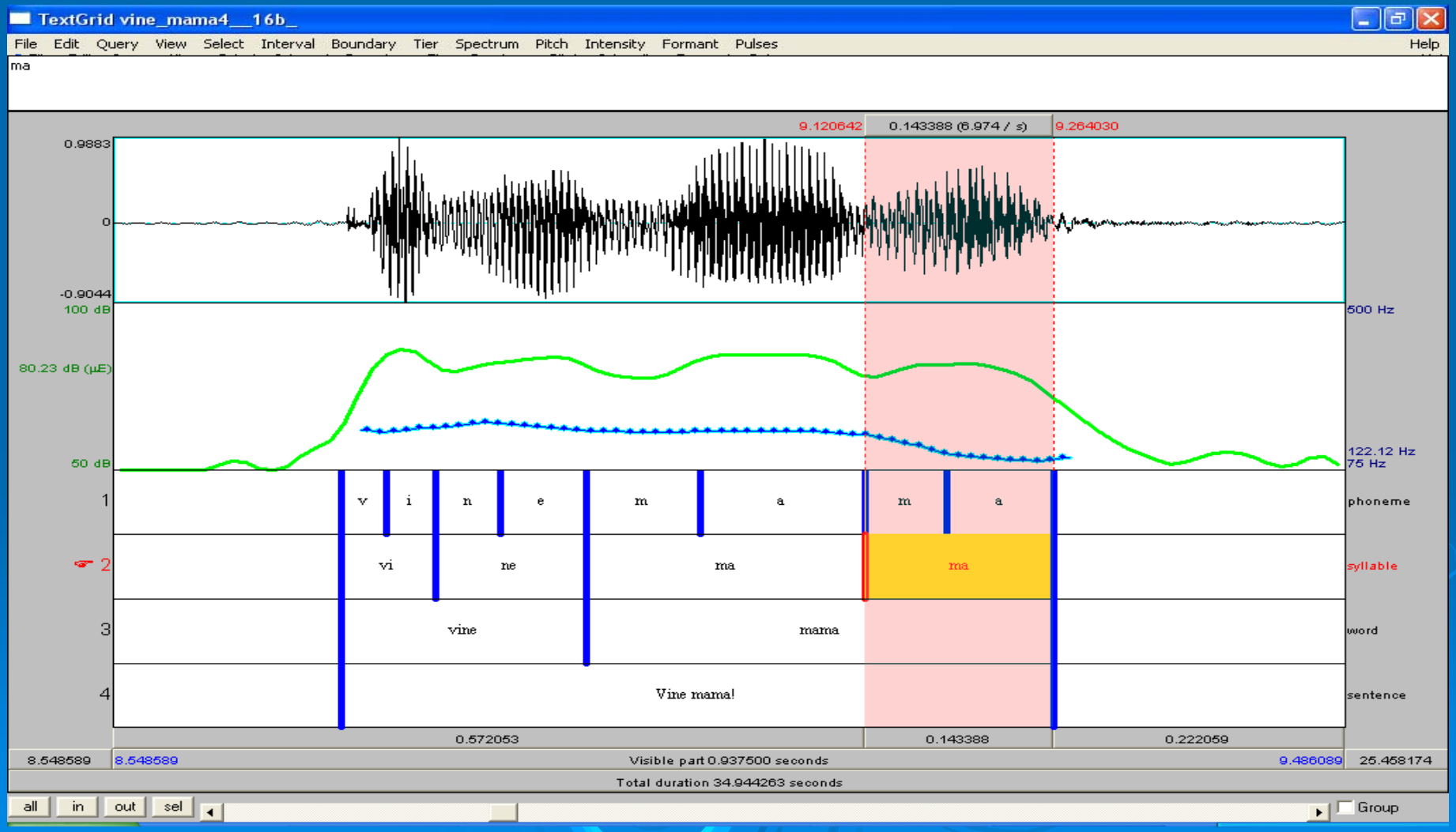
The emotional speech database

- The sentences are:
  1. *Vine mama*. (Mother is coming)
  2. *Cine a facut asta*. (Who did that?)
  3. *Ai venit iar la mine*. (You came back to me)
  4. *Aseara.* (Yesterday evening).

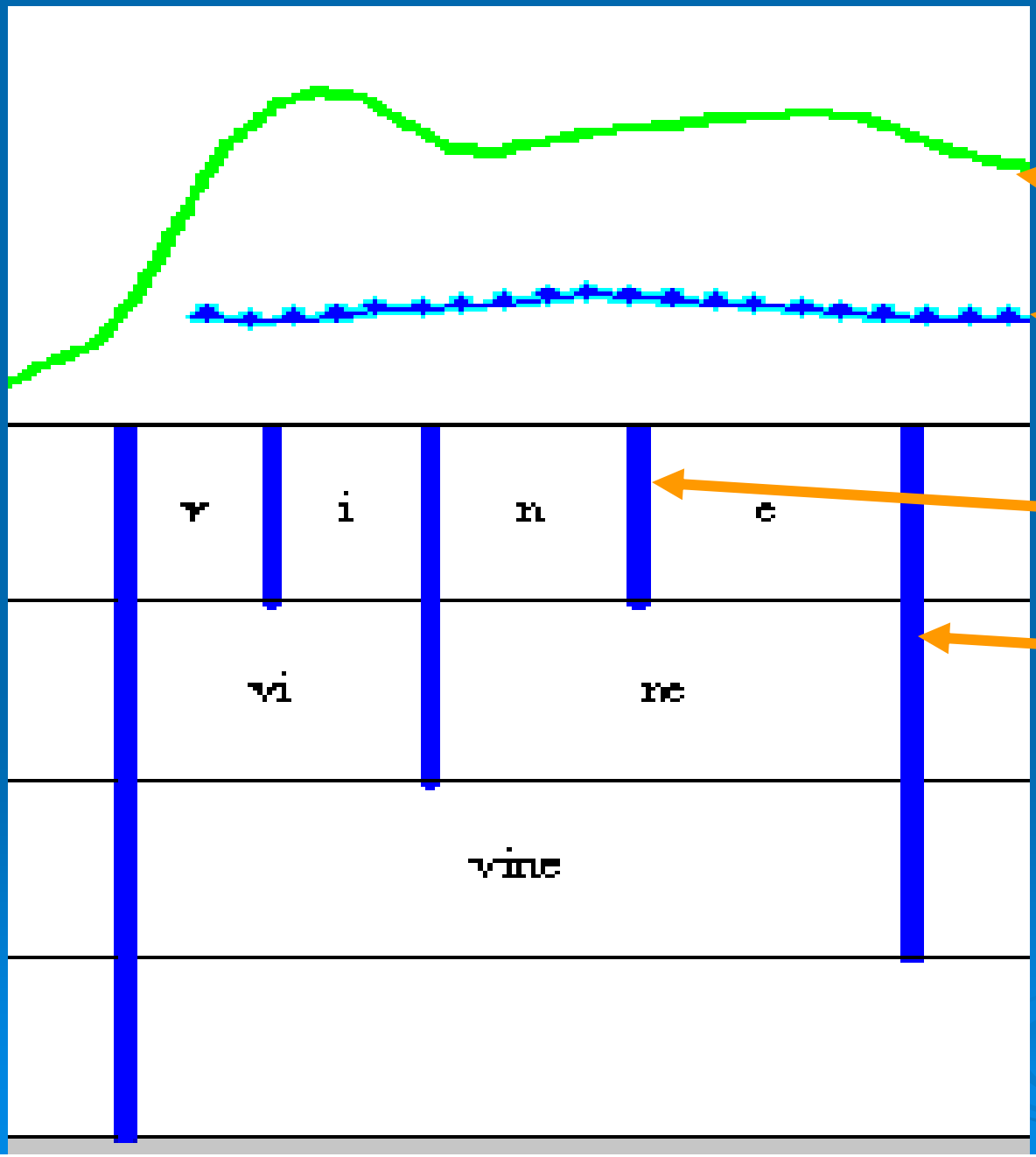
- The emotion confusion matrix has proved that all emotions are correctly identified, with a rate of more than 80% by the listeners.

- Our goal has been to discriminate between happiness and sadness emotional states.

Annotation for the sentence “Vine mama”



Details



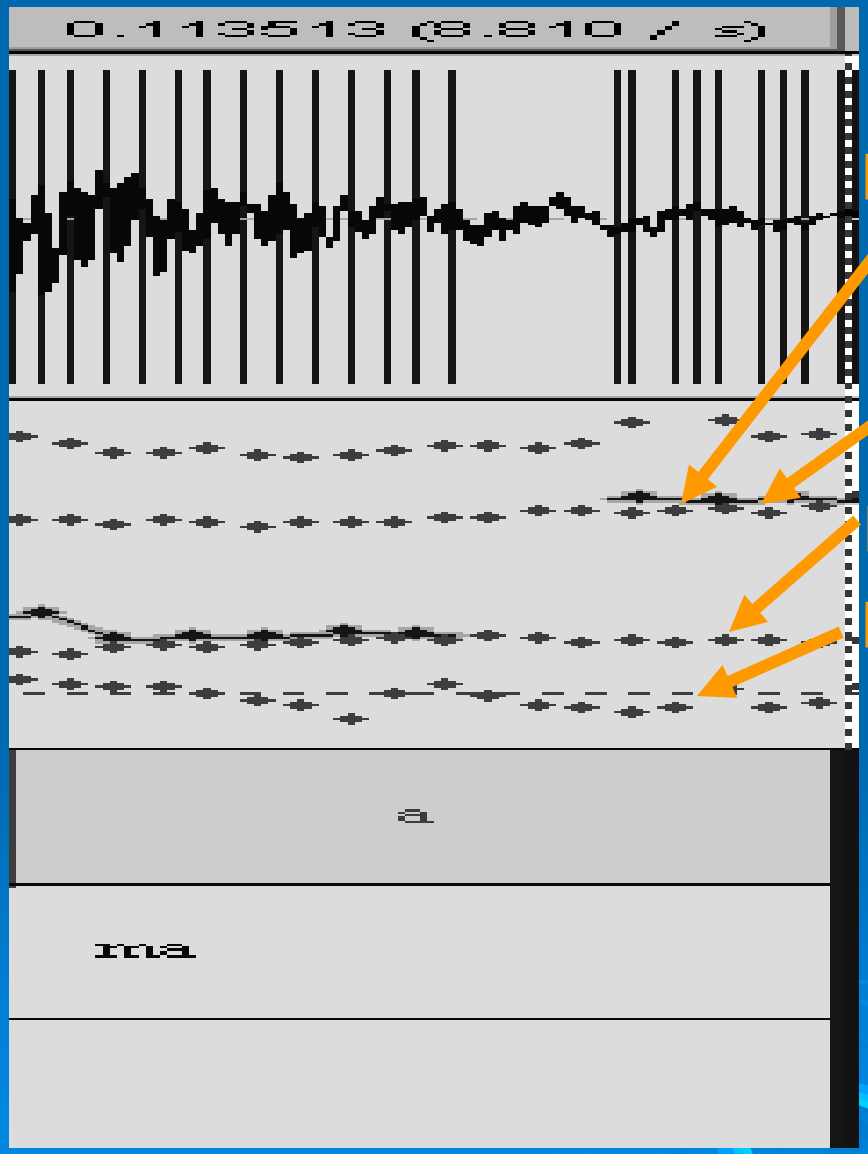
Energy

Pitch

Phoneme boundary

Word boundary

Processing tools (I)

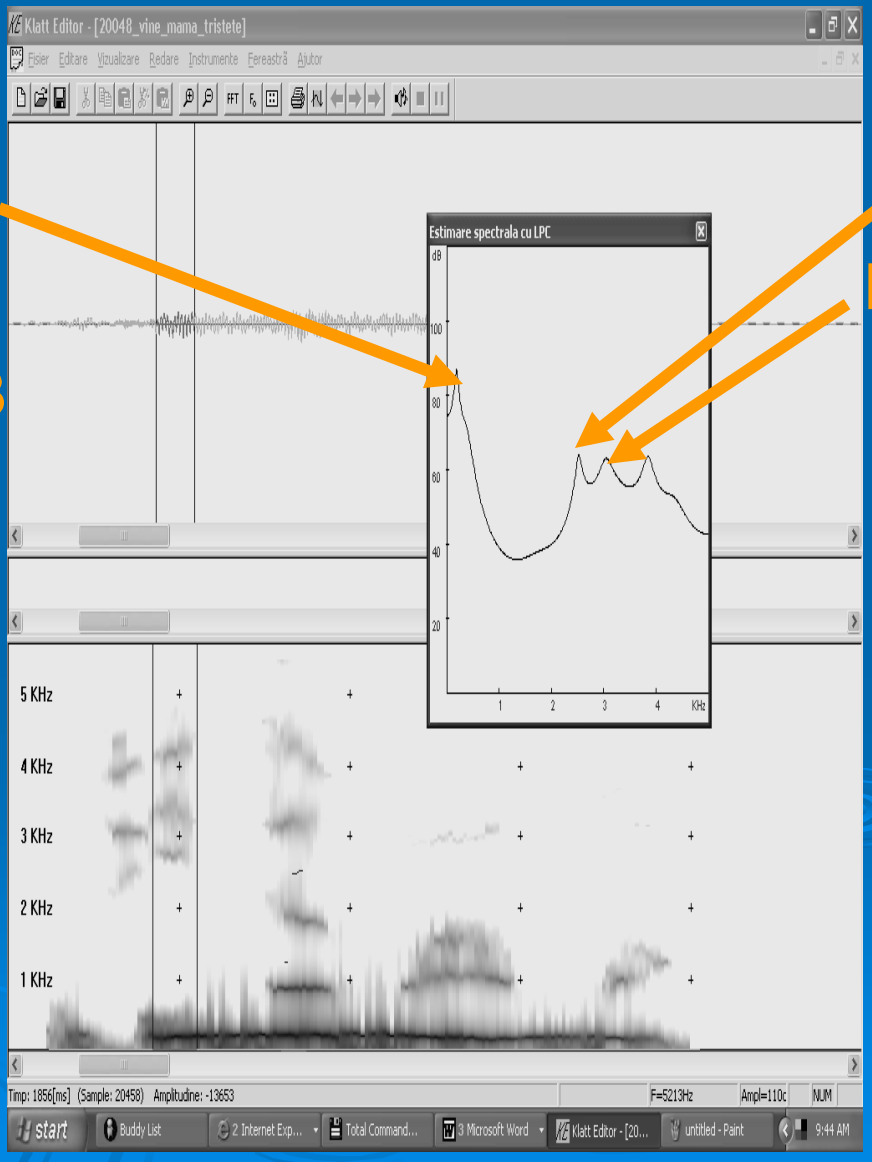


F0

F3

F2

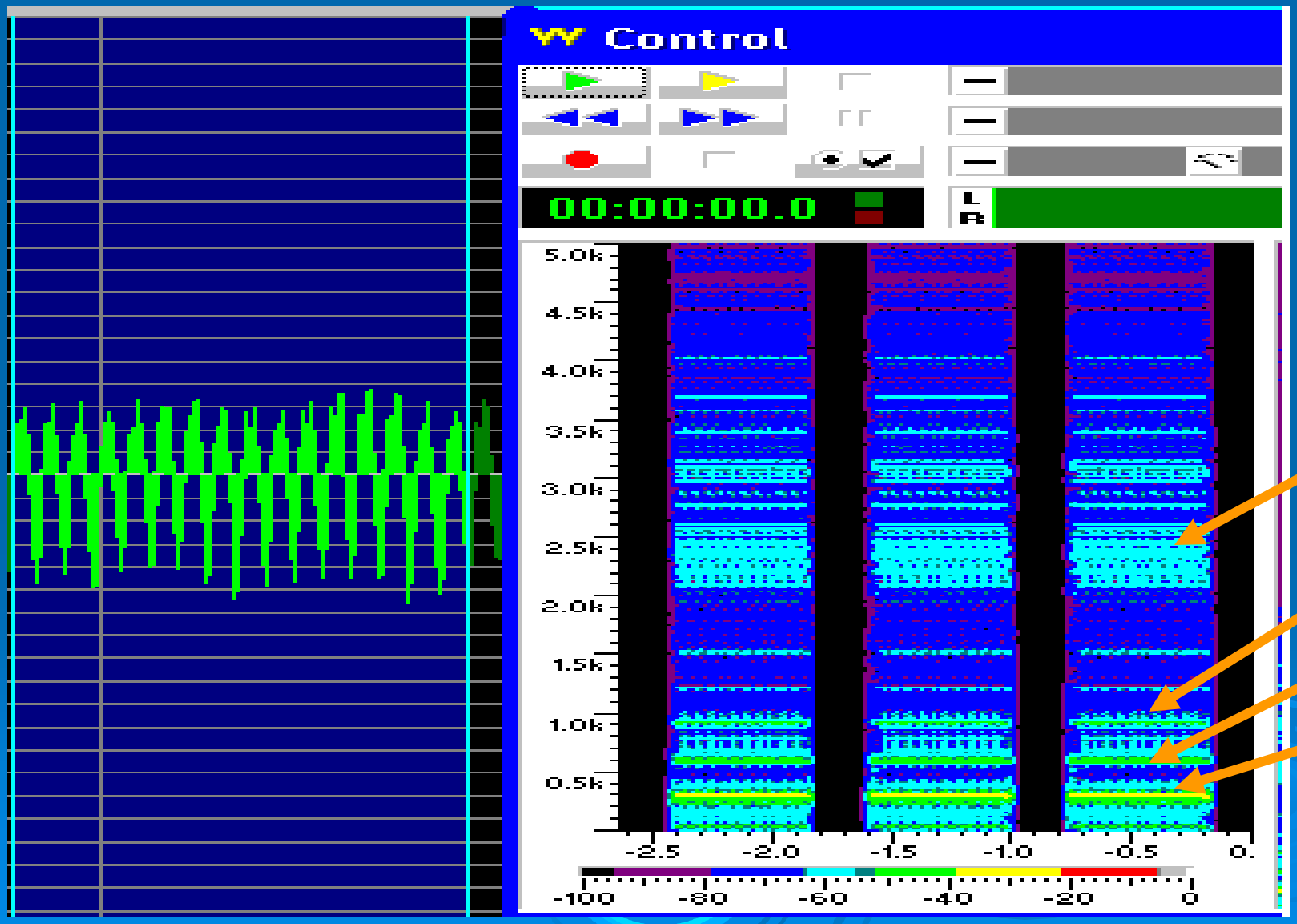
F1



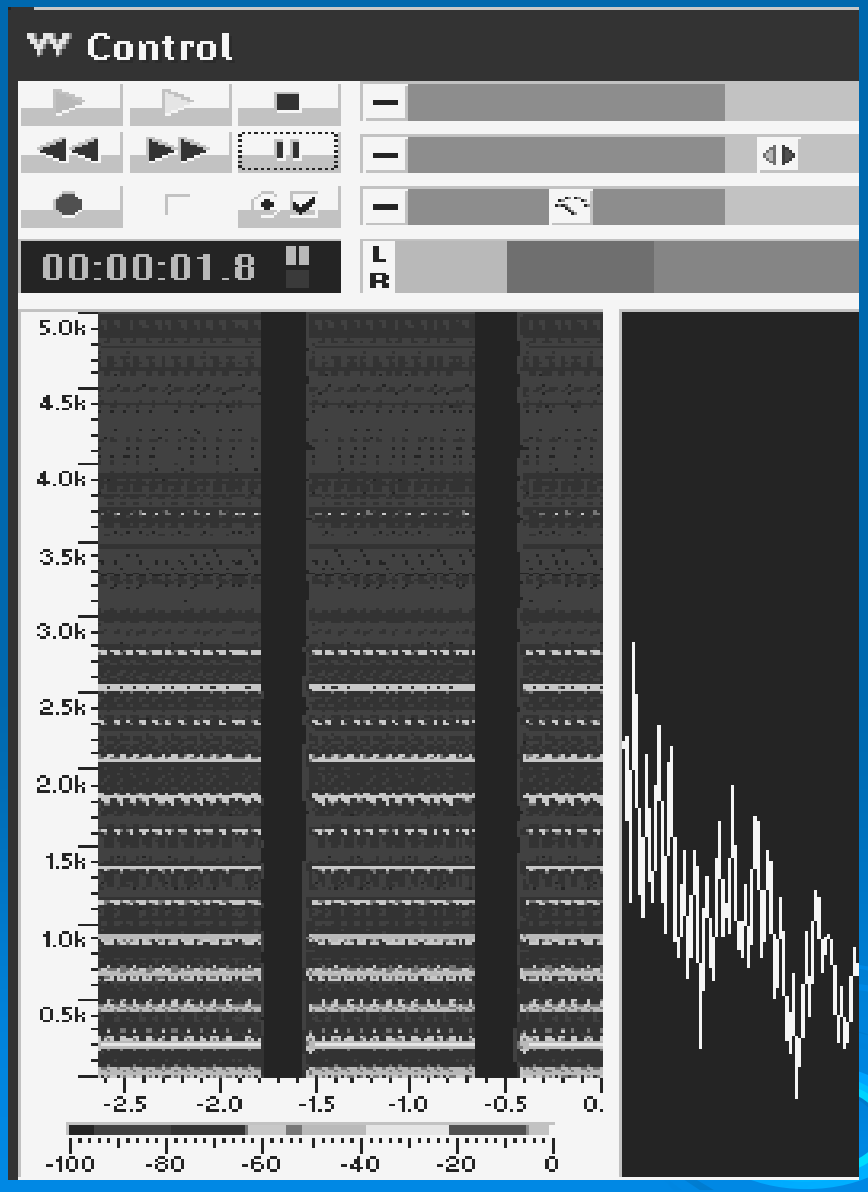
F2

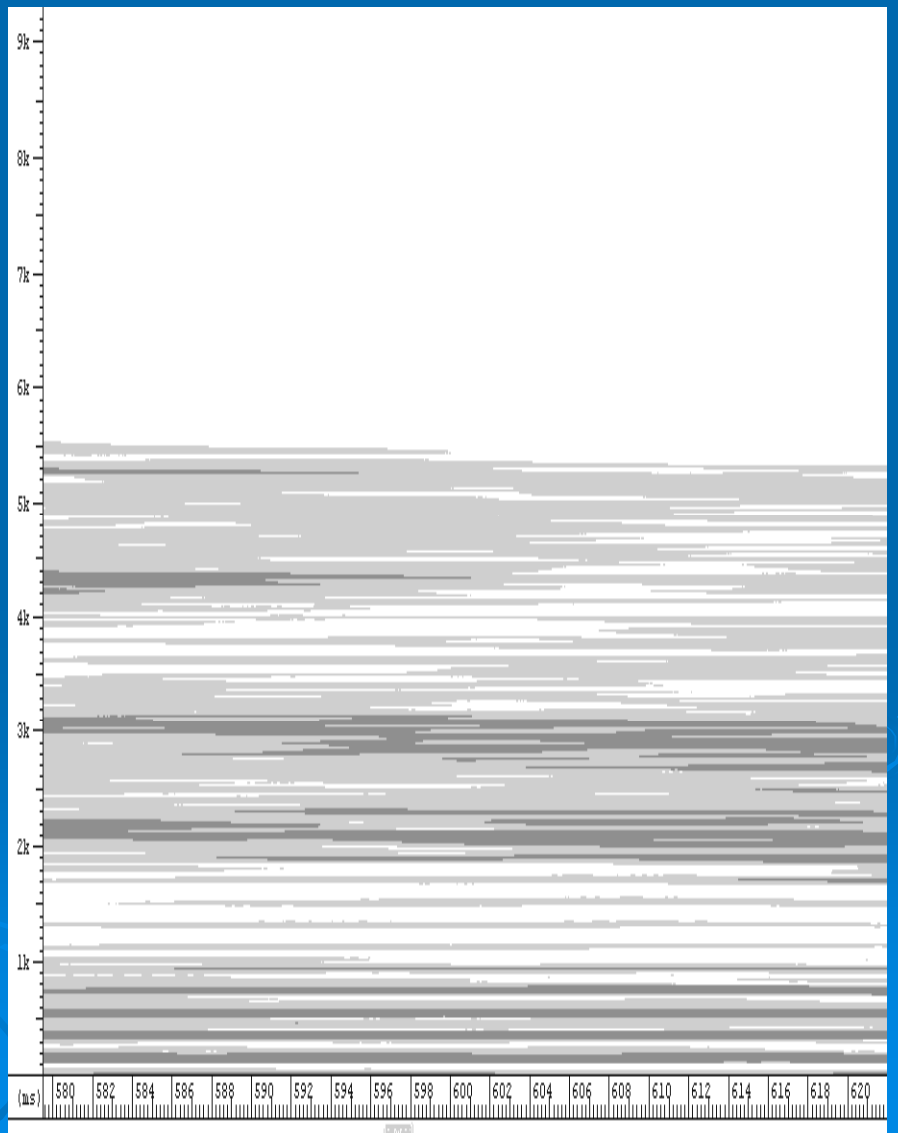
F3

Processing tools (II)



Processing tools (II)





Results (I)

- The accentuated vowels don't offer important information compared with non-accentuated vowels.
- The vowel "i" from the word "vine" has random values of the formants; it does not help in the emotion recognition.
- The obtained values for the F0 formant for all the persons decrease in sadness state compared with the happiness state.

Results (II)

- The obtained values of the formants F2, for the vowel “e” (from the word “vine”) have the tendency to decrease in sadness compared with happiness states.
- The obtained values of the formants F1 and F2, for the vowel “a” (the first “a” from the word “mama”) have the tendency to decrease in sadness compared with happiness states.
- The obtained values of the formant F2, for the vowel “a” (the last “a” from the word “mama”) decrease in sadness compared with happiness.

Results (III)- the tendency for the F0, F1, F2 formants

77777m	F0			F1			F2		
	e	a1	a2	e	a1	a2	e	a1	a2
GoldWave	-	-	-	-	-	-	-	-	-
Wasp	-	-	-	-	-	-	-	-	-
Klatt	-	-	-	-	-	-	-	-	-
Praat	-	-	undefined	-	-	+	-	-	+

The tendency for the F0, F1, F2 formants decrease in sadness state compared with the happiness state

subject	Fo			F1			F2		
	e	a1	a2	e	a1	a2	e	a1	a2
20048f	-	-	-	-	-	-	-	±	-
01312f	-	-	-	+	-	±	-	-	-
55555f	-	-	-	±	±	-	+	-	-
123456f	-	-	-	-	-	-	-	-	±
77777m	-	-	-	-	-	-	-	-	-

Double subject constructions

- Semantic arguments of a predicate:
  - Subject
  - Direct object
  - Indirect object
- Those arguments can be doubled

Double subject constructions

- Semantic arguments of a predicate:
  - Subject > personal pronoun
  - Direct object > clitic pronouns
  - Indirect object > clitic pronouns
- Those arguments can be doubled

Double subject constructions

- Semantic arguments of a predicate:
  - Subject > personal pronoun > Vine **ea** mama (Mother comes)
  - Direct object > clitic pronouns > **L**-am văzut pe Ion (I saw John)
  - Indirect object > clitic pronouns > **Îi** mulțumesc lui Ion (I thank John)
- Those arguments can be doubled

Double subject constructions

- Doubling of the subject
  - a controversial phenomenon: considered apposition
  - does not exist in other European languages. These languages use apposition to realize double subject constructions.
  - exists in some Asian languages, like Japanese and Korean (Masahiro 1996)
  - Romanian language considers both double subject and apposition structures.
- **What supplementary information brings the pronouncing in double subject phrases?**

Double subject constructions

- The main objectives of our study are:
  - comparing the prosody for simple subject and double subject sentences;
  - study the modifications induced by the doubling of the subject in the sentence prosody;
  - determine if the spoken language brings distinctions that may change the sentence behavior closer to a simple subject construction or a double subject one.

Double subject constructions

- We recorded a set of sentences bearing doubled subject for a comparative analysis:
  - Vine ea mama!
  - „A trecut el aşa un răstimp” (Sadoveanu M.)
  - O şti el careva cum să rezolve asta.
  - Mama vine şi ea mai târziu.
  - Mama ştie ea ce face.
- Last two examples are considered by some linguists (Barbu 2003) as constructions with doubled subject, while other authors (Cornilescu 1997) consider them particular structures of the Romanian language.

Double subject constructions

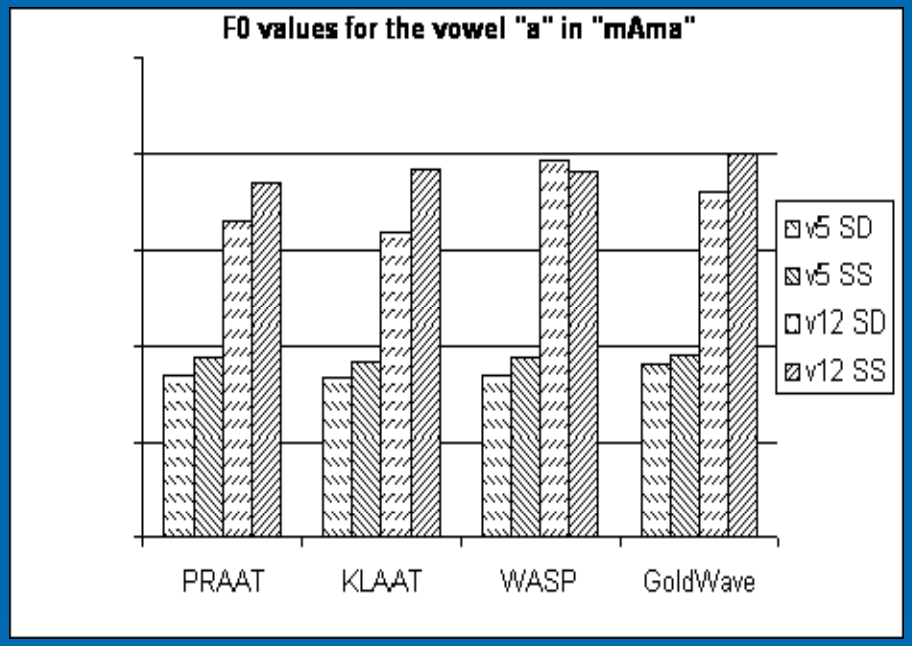
- The speakers have recorded several variants of the sentences:
  - neutral tone
  - accentuation of the doubling pronouns
  - focuses on the words next the pronouns
  - the development of the sentences.

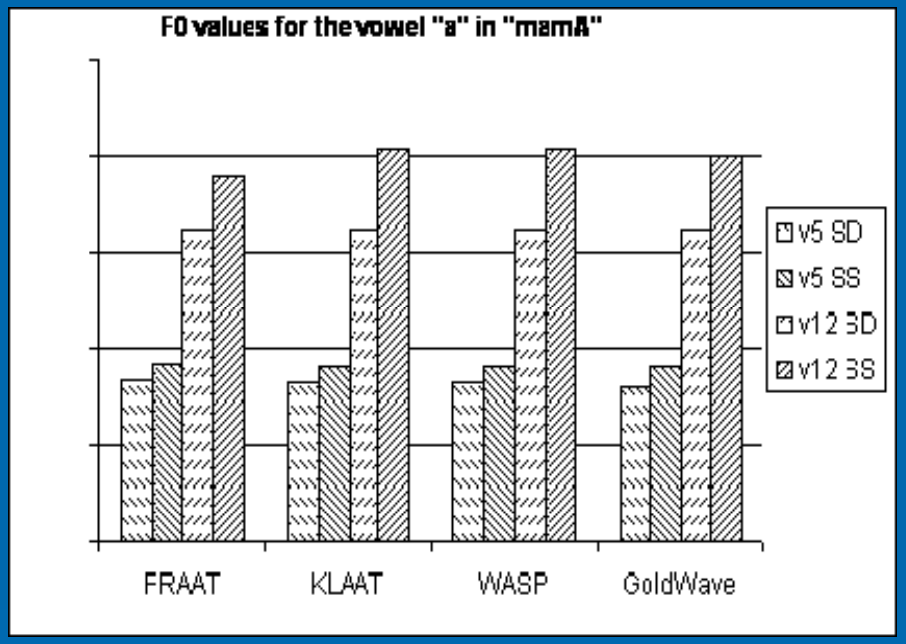
- Vine ea mama! – neutral tone
- Vine **ea** mama! – doubled subject articulation
- Vine ea **mama**! – subject articulation
- Vine ea mama **azi**! – sentence development

Double subject constructions

- The hypothesis that motivated this analysis is that the double-subject constructions are related in a specific way to the emotion and inter-relationship representation.
- We have analyzed recording from five subjects (three female and two male) from our database (http://www.etc.tuiasi.ro/sibm/romanian_spoken_language/index.htm) for the sentences:
  - "Vine mama" (simple subject)
  - "Vine ea mama" (doubled subject).

Double subject constructions





- Analysis of the F0 for two subjects for the word “mama”
  - subject 5 – male
  - subject 12 – female
- The values have been computed using the four programs (Praat, Klatt analyzer, GoldWave and Wasp)
- **All the four programs show an increasing of the F0 values for vowels in the sentences with simple subject.**

Double subject constructions

Subject	Vine ea mama				Vine mama			
	a1 in mAma		a2 in mamA		A1 in mAma		a2 in mamA	
	F0	duration	F0	duration	F0	duration	F0	duration
subject 1	200	0.086	215	0.082	211	0.103	223	0.098
subject 2	189	0.101	179	0.137	215	0.067	206	0.098
subject 12	162	0.099	162	0.135	188	0.127	196	0.136
subject 5	84	0.094	83	0.084	93	0.122	91	0.138
subject 7	76	0.080	71	0.079	77	0.089	82	0.070

The tendency to increase or to decrease the duration of the vowels seems to be preserved similar in both construction types.

Conclusions (I)

- The accented vowels do not carry significantly more emotional information than the non-accented vowels.
- The major differences in the pitch values were observed for the unaccented vowels
- Some higher formants, F1 and F2, in both accented and non-accented vowels, are essential in conveying emotional information.
- F1 and F2 formants show no regularities wrt. double subject constructions.

Conclusions (II)

- No tool provides irrefutable results.
- We have indicated a methodology to choose a stable section of the vowels for the analysis;
- We improved consistency in measurements;
- This research supports the theory of interrelationship expression through prosodic and paralinguistic information.

Further work

- More statistical data (more subjects)
- For now, statistically irrelevant
- Automatic classifier