

LANGUAGE LEARNING IN A SPECIAL EDUCATION ENVIRONMENT

Oscar Saz (CMU Post-Doc)
PSLC-CF

Overview

2

- Brief introduction: Language learning in special education
- Development of computer tutors for speech therapy in Spanish (requirements, engineering solutions and results)
- Study of lexical inaccuracies in Spanish native speakers with development disorders

Introduction

3

- B.Sc. in Telecommunications Engineering by the University of Zaragoza in 2004.
- Ph.D. by the University of Zaragoza in 2009.



Introduction

4

- Dissertation entitled: “On-Line Personalization and Adaptation to Disorders and Variations of Speech in Automatic Speech Recognition Systems”
 - ▣ Experiments on ASR in oral-driven devices for handicapped people
 - ▣ Development of speech therapy tools for Spanish

Introduction

5

□ Currently:

- 2-year scholarship funded by the Spanish Ministry of Education
- Sponsored by the Fulbright Program
- Work with Maxine Eskenazi at LTI-CMU
- Project oriented towards L2 speech training tutors which take into account the confusability of words

Language learning in special education

6

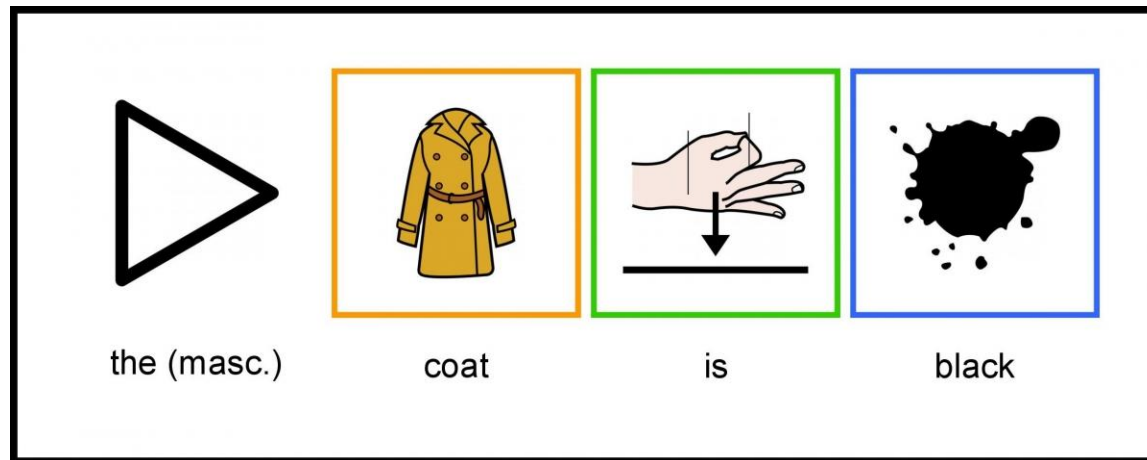
- Collaboration with the Public School for Special Education “Alborada” in Zaragoza
- Communicative disabilities create more dependency and discrimination than any other disability
- Great interest in Augmentative and Alternative Communication (AAC)

Language learning in special education

7

□ AAC

▣ catedu.es/arasaac



Language learning in special education

8

□ Challenges:

- ▣ Dealing with mid-to-severe cognitive disorders (plus development and social disorders)
- ▣ Special affections in the language
- ▣ Uniqueness of every student
- ▣ Difficulty in reaching the student with formal activities (game-like approach)

□ This leads to:

- ▣ Extensive one-on-one sessions
- ▣ Not enough time per student

Language learning in special education

9

- Computers seen as possible solution:
 - ▣ Very motivational and attractive
 - ▣ Allows for out-of-class work

- Open questions
 - ▣ Robust speech processing?
 - ▣ Allows personalization?

Development of computer tutors for speech therapy in Spanish (requirements, engineering solutions and results)

Comunica

11

- Since 2005, UZ has been working in “Comunica”: set of Windows-based tutors for Spanish speech therapy
 - ▣ PreLingua: Training in the production of voice
 - ▣ **Vocaliza: Phonological/pronunciation training**
 - ▣ Cuentame (beta): Training of language through scenarios

Vocaliza: requirements

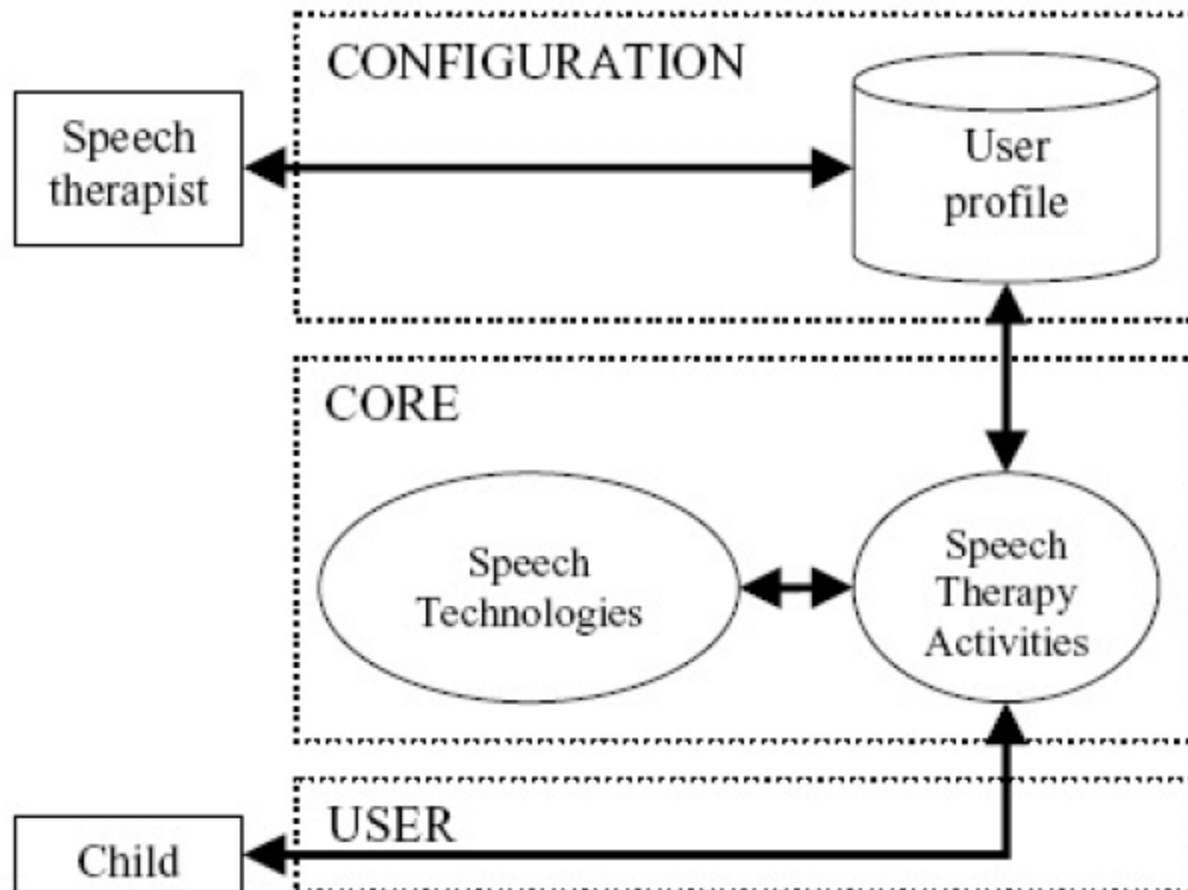
12

- Able to motivate oral productions
 - ▣ Encourage correct speech
- Suitable for use of therapists, parents and children
- Extensive use of AAC technologies
- Continuous use of multimodality

Vocaliza: development

13

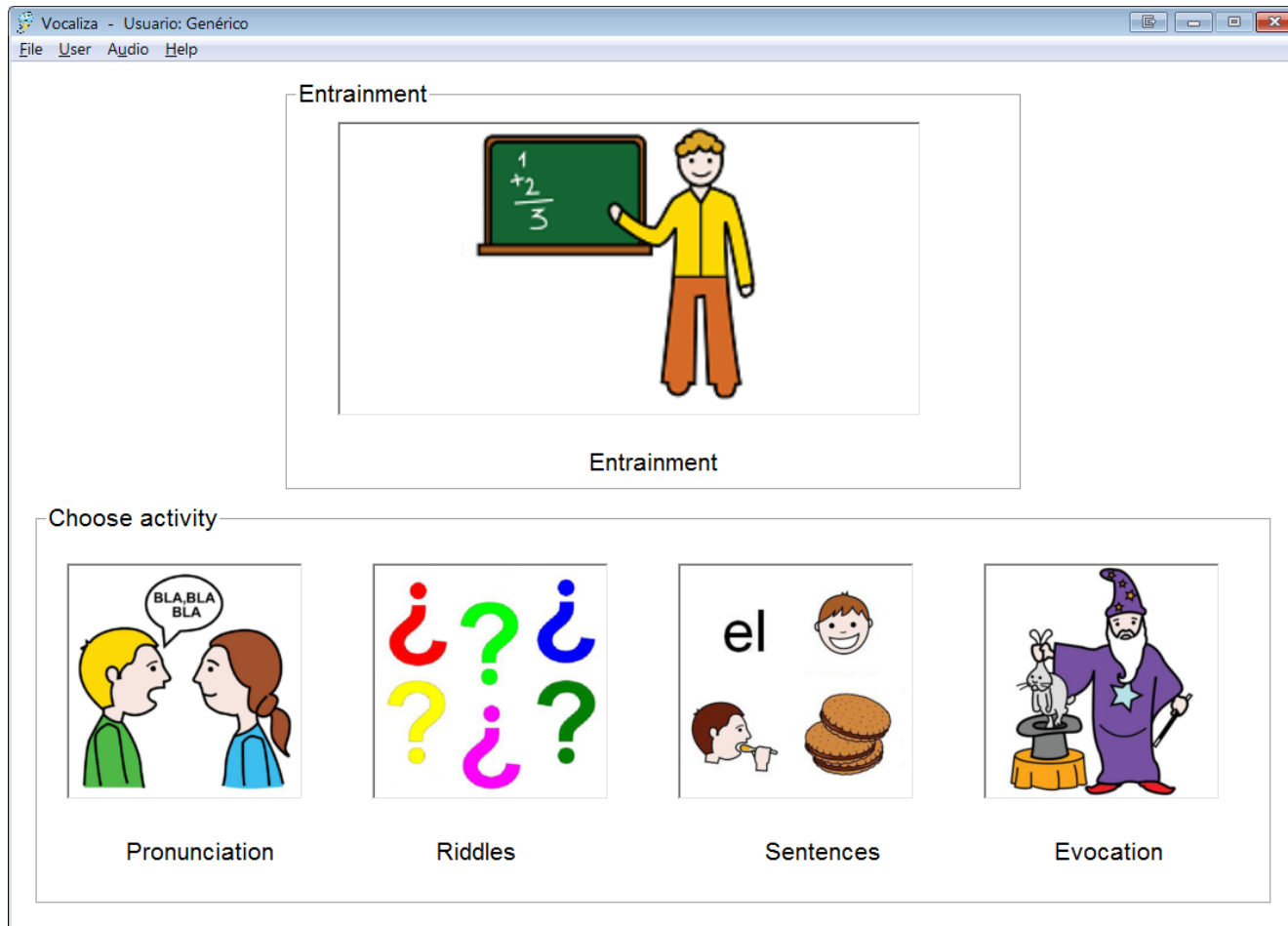
□ Application architecture



Vocaliza: development

14

□ Application front-end



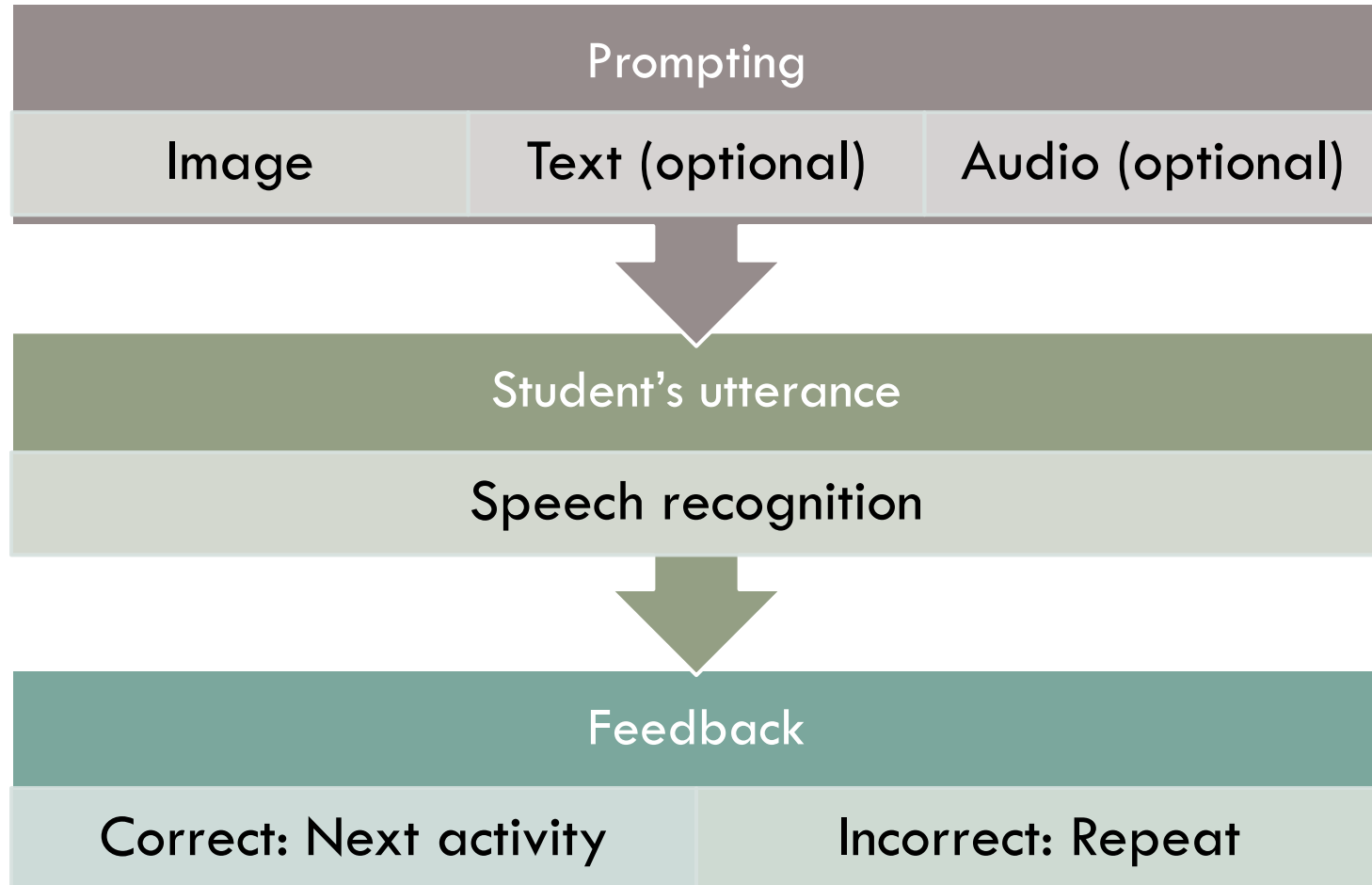
Vocaliza: development

15

- Proposed activities
 - ▣ Isolated words: Prompt and repeat
 - ▣ Riddle game: Prompt riddle, see 3 possible answers, respond
 - ▣ Sentences: Prompt and repeat
 - ▣ Evocation(extra): Blank screen, say any word, it appears on screen
- ASR is used in all activities to decode the utterance

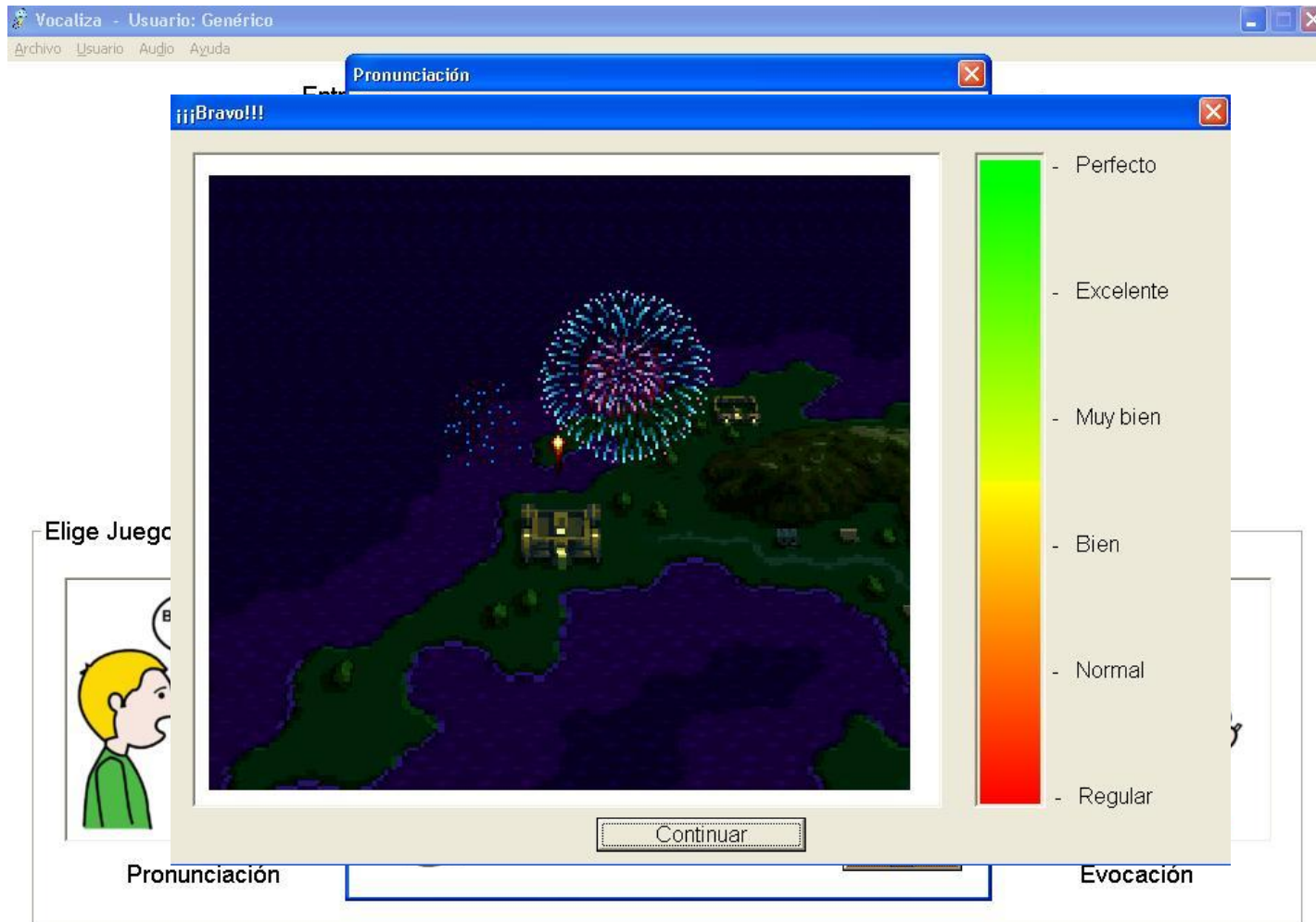
Vocaliza: development

16



Vocaliza: development

17



Vocaliza: development

18

□ Configuration

- Therapist inserts activities
- Therapists creates users, decides which activities to use for each one

The 'Word' window is used for configuring word-based activities. It features a list on the left with a header 'Palabra' and one item 'tree'. To the right, there are input fields for 'Word' and 'ID', a 'Text' field, and a 'Category' dropdown. Below these is an 'Image' field with an 'Open...' button. Further down is a text area for 'Alternative pronunciations (comma as separator)'. At the bottom, there are 'Audio options' with radio buttons for 'Synthesize speech' (selected) and 'Play recording', and a volume slider. At the very bottom are checkboxes for 'Alphabetical order' and three buttons: 'Add', 'Erase', and 'Back'.

The 'User' window is used for configuring user-specific activities. It has a top section with a 'Name' field, checkboxes for 'Display text' and 'Play audio', a 'Difficulty' dropdown (set to 'Normal'), and an 'Acoustic model' dropdown. Below this are three main sections: 'WORDS', 'SENTENCES', and 'RIDDLES'. Each section has a 'Generic' list on the left and a 'User' list on the right, with a double arrow button between them. The 'WORDS' section has a 'Palabra' header and 'tree' item. The 'SENTENCES' section has a 'Frase' header and 'the tree and the mouth' item. The 'RIDDLES' section has a 'Pregunta' header and 'Respuesta' item. Each list has an 'Alphabetical order' checkbox and a 'New' button. On the right side of the window are three buttons: 'Save', 'Save in...', and 'Exit (no save)'.

Vocaliza: results

19

- Free distribution of the tools via www.vocaliza.es
- Reaching thousands of users in Spain and Latin America
- Got a lot of feedback, new ideas and proposals
- People create their own materials with them

Vocaliza: results

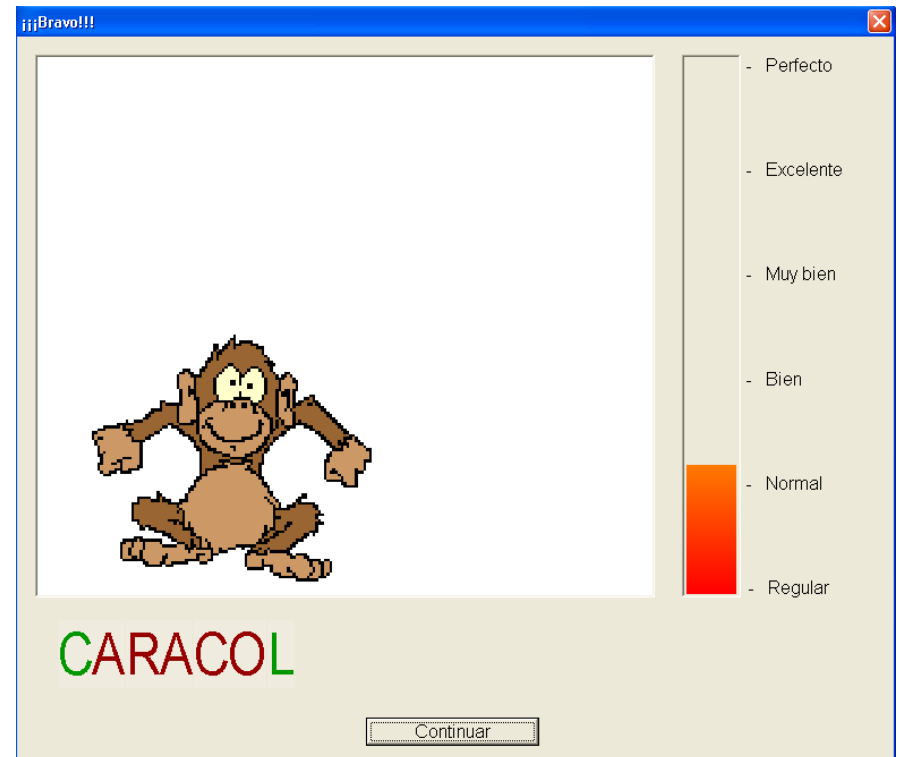
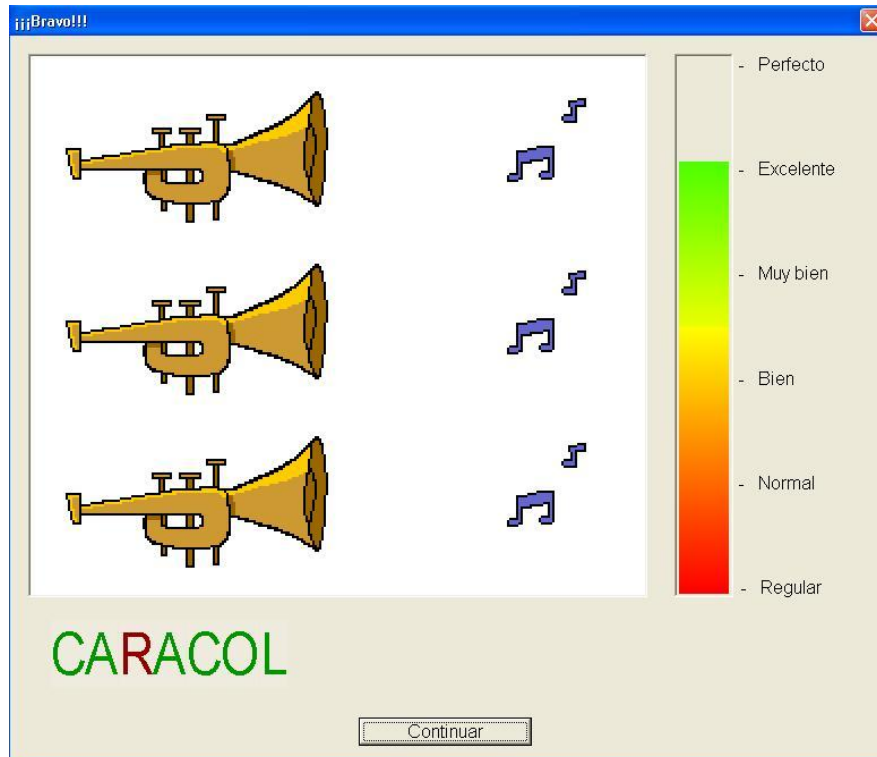
20

- ASR is a reliable feedback
 - ▣ There is a correlation between the number of lexical mispronunciations in a word and the reject ratio of the ASR to recognize that word.
 - ▣ Students do not have phonetic awareness, so ASR provides a direct feedback

Vocaliza: results

21

- Short study on L2 learning
- Vienna International School
- New version: VocalizaL2



Vocaliza: results

22

- Study data:
 - ▣ 12 students (native of English, German, Dutch, French, Icelandic, Swedish, Tamil and Urdu) + L2 English + L3 German
 - ▣ 11 years old
 - ▣ 5 weekly sessions, 45-minute session.

Vocaliza: results

23

- Comments about the tool:
 - ▣ Positive about the interface
 - ▣ High motivational value
 - ▣ Less shy than in class
 - ▣ Awareness of the phonetic feedback in the tool
 - ▣ “Cheap” synthetic voice
 - ▣ Sometimes weird feedback (lack of robustness)

Vocaliza: results

24

- Specific experiments:
 - ▣ Students raise performance in the second trial
 - ▣ Students raise performance in further sessions (new words)
 - ▣ When text prompt was removed->More difficulty for the students
- Unfortunately, no labeled data

Study of lexical inaccuracies in Spanish native speakers with development disorders

Corpus

26

- 14 young speakers with cognitive, development and/or social disabilities (e.g.: Down Syndrome)
- 11-21 years old
- Vocabulary of 57 isolated words
- 4 recordings per word (in different days)

Corpus

27

- Perceptual lexical labeling by humans
- Procedure:
 - ▣ Listen to one of the utterances
 - ▣ Ask the human to rate each phoneme in the word as:
 - 0-deleted
 - 1-mispronounced
 - 2-correct
 - ▣ Have 3 different humans rate each word
 - ▣ Final decision: Majority vote

Study

28

- Results found:
 - ▣ 17% of errors (10% subs | 7% del)
 - ▣ 50% of the words affected
 - ▣ Speakers are consistent in their (mis)pronunciations:
87% of consistency
 - ▣ With a high interlabeler agreement (80-90%)

Study

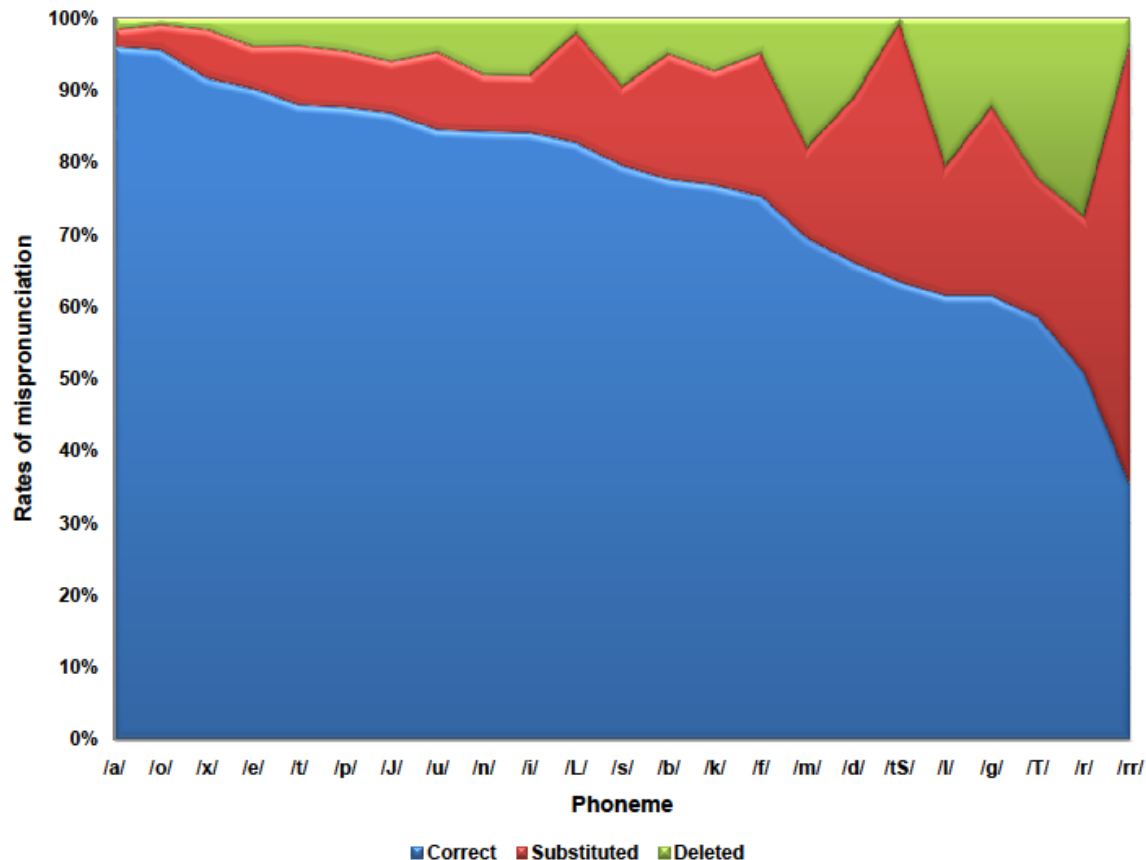
29

- What is the origin of the errors?
 - ▣ No malformations in the articulation organs
 - ▣ No hearing or perception problems
 - ▣ Lack of consciousness of their errors

Study

30

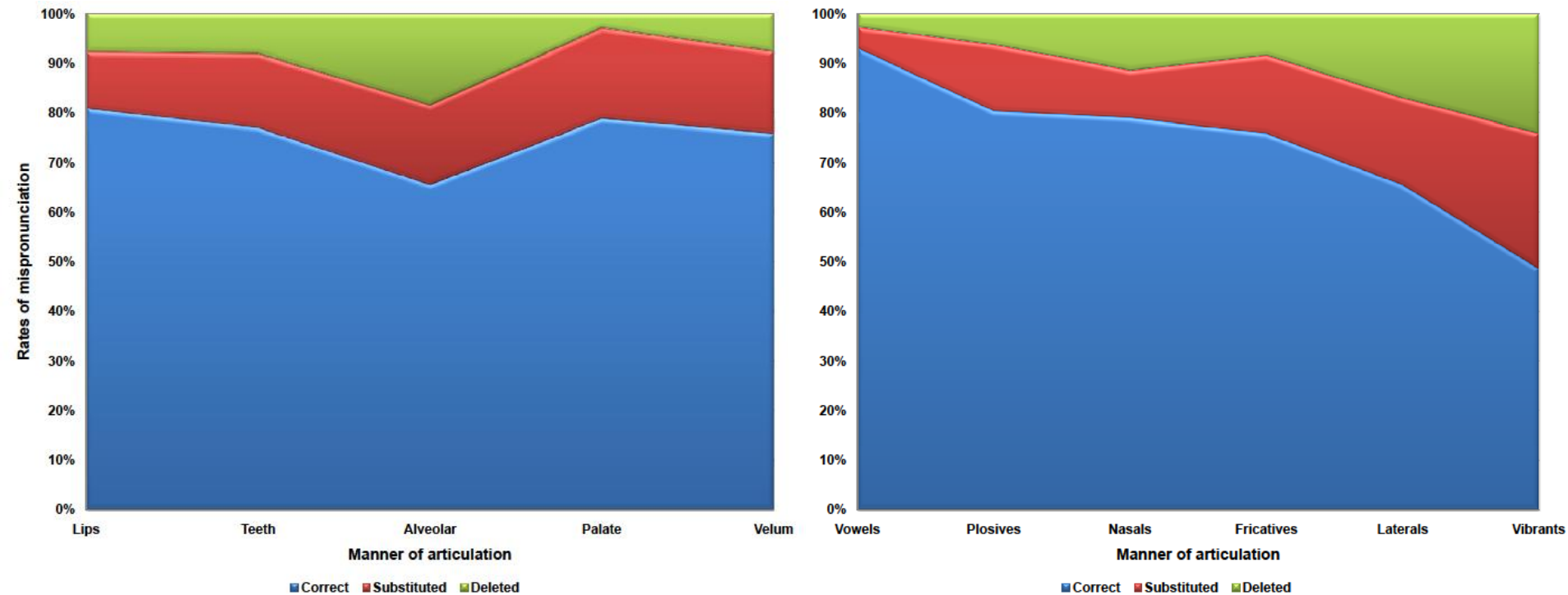
- Is there anything specific in the phonology of cognitive disabled speakers?



Study

31

□ What about manner and point of articulation?



Study

32

- So, what defines the production of errors?
- Context and position in the syllable
 - ▣ Spanish uses mostly the -CV- structure
 - -CVV-
 - -CVC-
 - -CCV-
 - -CVVV-
 - -CCVC-
 - -CCVV-

Study

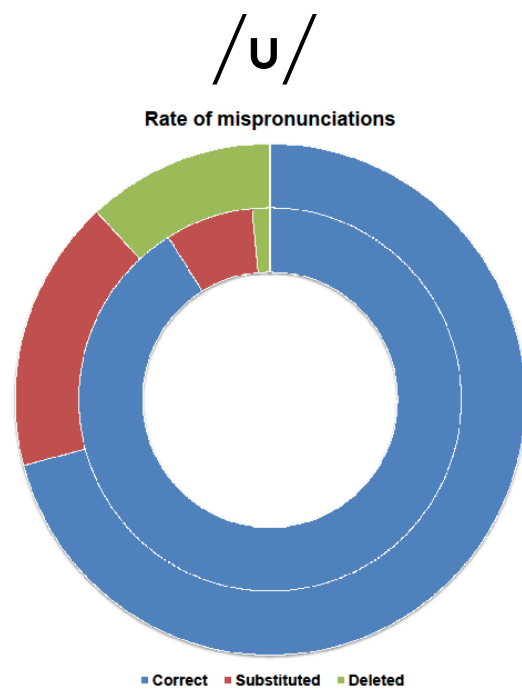
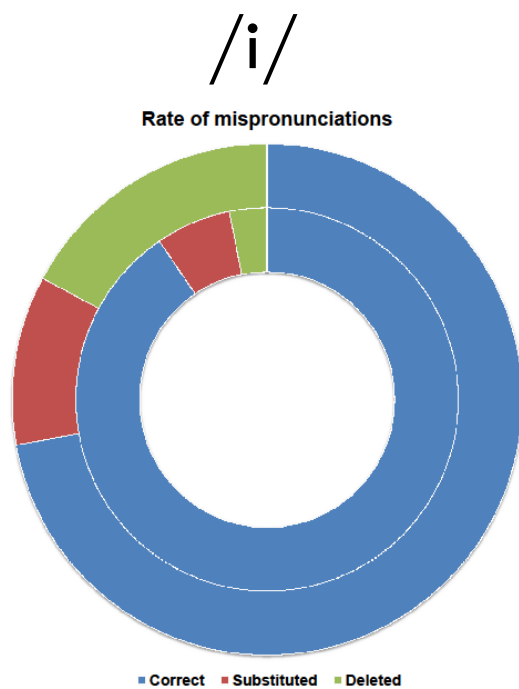
33

- 3 cases of study:
 - ▣ Vowels /i/, /u/ and their glides /i/, /w/
 - lapiz vs piano
 - ▣ Consonants in onset vs consonants in cluster
 - caramelo vs cabra
 - ▣ Consonants in onset vs consonants in coda
 - lavadora vs arbol

Study

34

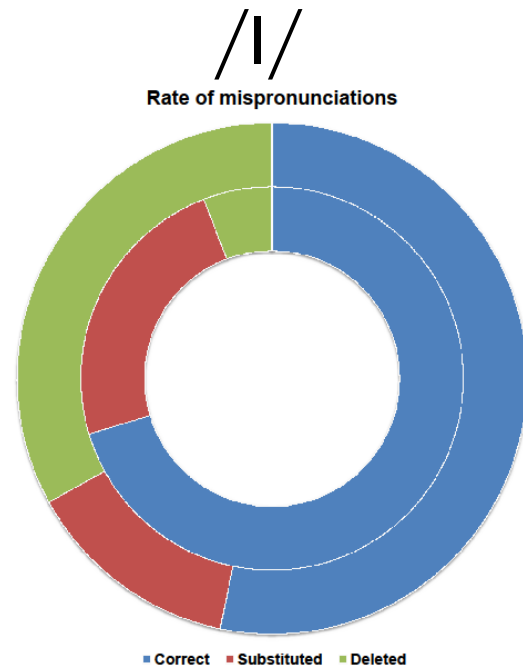
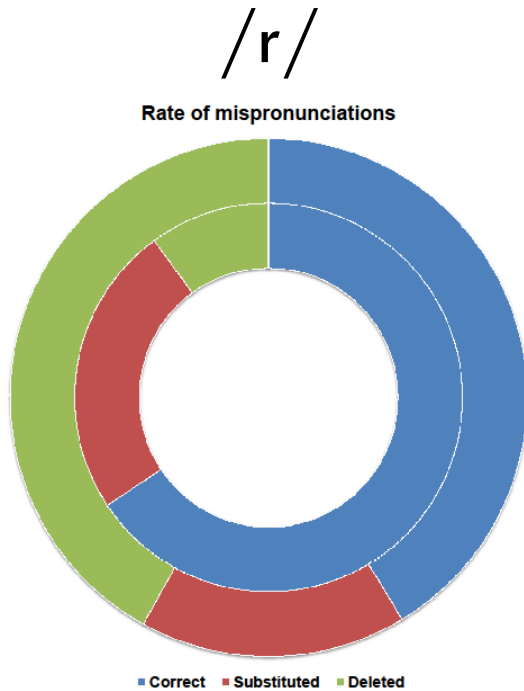
□ Glide case



Study

35

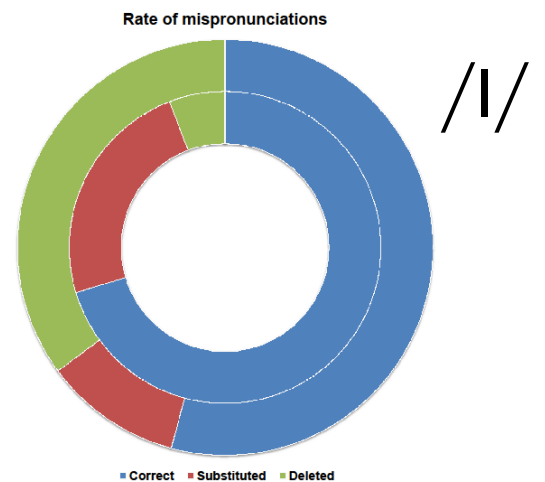
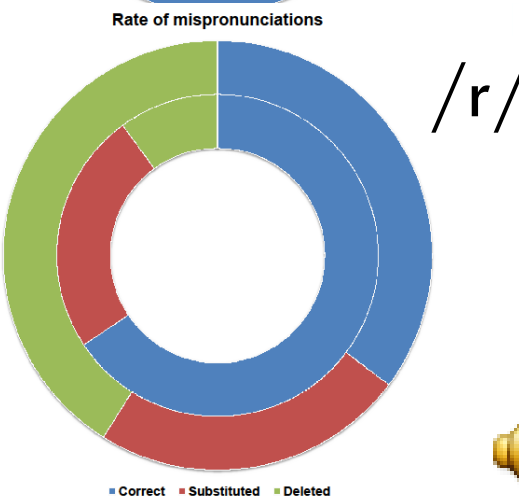
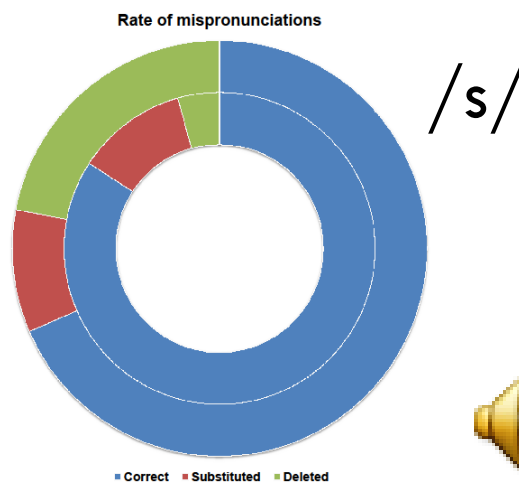
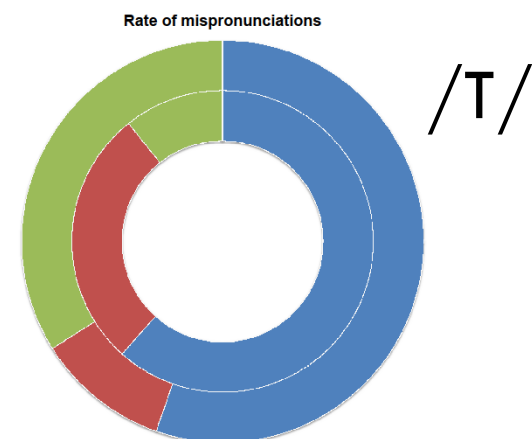
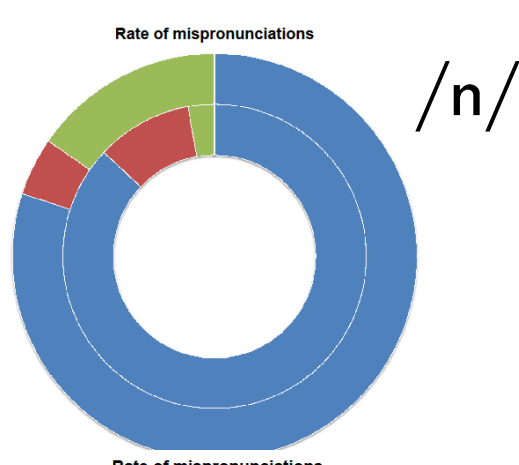
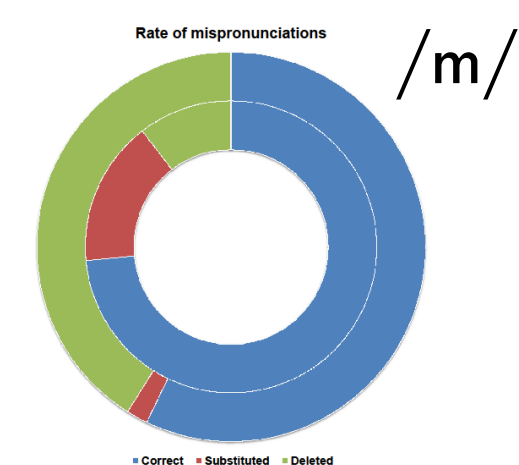
□ Onset vs cluster



Study

36

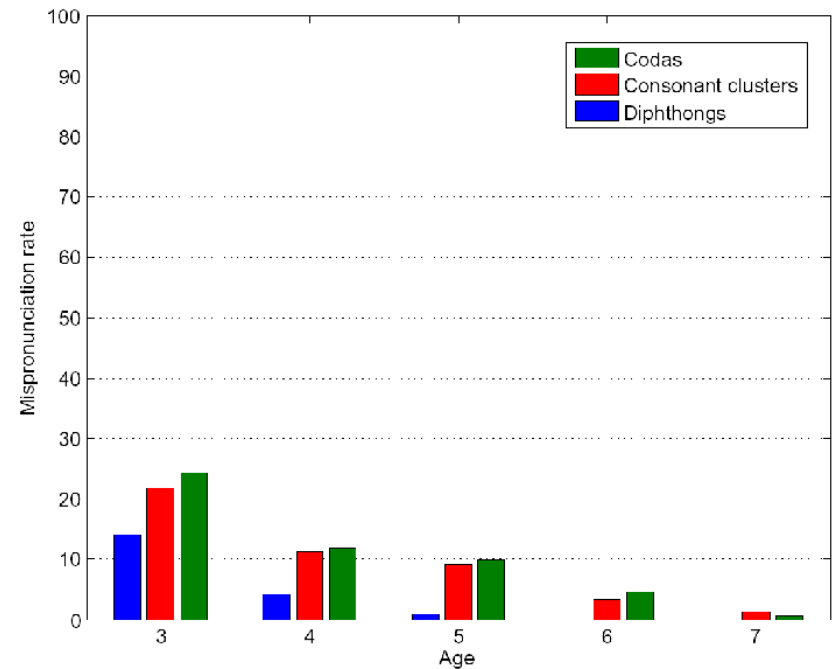
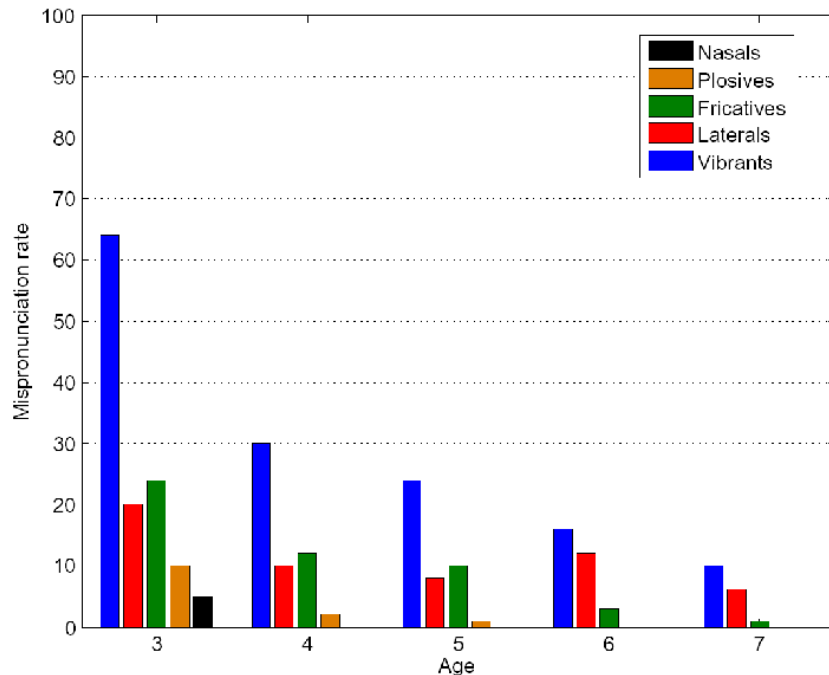
□ Onset vs coda



Study

37

- So, these results compare and relate with the findings by Bosch-Galceran in speech acquisition by 293 healthy children



Study

38

- Conclusion:
 - ▣ Students with development disabilities show a production similar to 3-4 year old children
 - ▣ In ASR, this knowledge can serve to create lexical-aware systems