LANGUAGE LEARNING IN A SPECIAL EDUCATION ENVIRONMENT

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Overview

- 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

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

- 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

- 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

- AAC
  - catedu.es/arasaac

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the (masc.)  coat  is  black
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Language learning in special education

- 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

- 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)
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

- 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

- Application architecture
Application front-end

Choose activity

- Pronunciation
- Riddles
- Sentences
- Evocation
Vocaliza: development

- 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

Prompting

Image | Text (optional) | Audio (optional)

Student’s utterance

Speech recognition

Feedback

Correct: Next activity | Incorrect: Repeat
Vocaliza: development
Vocaliza: development

- **Configuration**
  - Therapist inserts activities
  - Therapists creates users, decides which activities to use for each one
Vocaliza: results

- Free distribution of the tools via [www.vocaliza.es](http://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

- 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

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

CARACOL

Perfecto
- Excelente
- Muy bien
- Bien
- Normal
- Regular

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Vocaliza: results

- 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

- 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

- 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

- 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

- 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
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%)
What is the origin of the errors?

- No malformations in the articulation organs
- No hearing or perception problems
- Lack of consciousness of their errors
Is there anything specific in the phonology of cognitive disabled speakers?
What about manner and point of articulation?
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-
3 cases of study:

- Vowels /i/, /u/ and their glides /j/, /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

- Glide case

/i/
Rate of mispronunciations

/ʊ/
Rate of mispronunciations

Correct  Substituted  Deleted
Study

- Onset vs cluster

/r/

Rate of mispronunciations

/l/

Rate of mispronunciations

Correct  Substituted  Deleted

Correct  Substituted  Deleted
Study

- Onset vs coda

/m/

/n/

/T/

/s/

/r/

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