An intonation clinic for second language learners

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Utrecht, 13 December 2012
Lexical vs post-lexical

- **Japanese**: lexical pitch accents
  - sumimasen (= excuse me)
  - hashi / hashi (= bridge / chopsticks)
- **German**: post-lexical pitch accents
  - Entschuldigung (= excuse me, polite)
  - Entschuldigung! (= excuse me, rude)
Problem statement

• Intonation rules are language-specific
• L2 learners tend to apply their L1 intonation de/coding rules in L2
• Consequences may even be as serious as social discrimination
• Intonation rules are hard to learn and to teach
CAPT system for intonation

Read out loud:
Entschuldigung!
CAPT system for intonation

1) Automatically assess L2 learner's input

Read out loud:
Entschuldigung!

Entschuldigung!
CAPT system for intonation

1) Automatically assess L2 learner's input
2) Provide corrective acoustic feedback

Read out loud: Entschuldigung!
Functional Data Analysis

Functional PCA model
Attention-seeking task

1\textsuperscript{st} repetition

Entschuldigung!

2\textsuperscript{nd} repetition

Entschuldigung!

3\textsuperscript{rd} repetition

ENTSCULDIGUNG!
Entschuldigung!

PC scores

F0
Entschuldigung!

PC scores

F0
Modeling target phrase

Native speakers

Entschuldigung! Entschuldigung! Entschuldigung! Entschuldigung!

ASR Praat

F0

FDA

Functional PCA model
Assess L2 learner's input

L2 learner

Entschuldigung!

ASR

Praat

F0

Functional PCA model

WRONG!
Functional Data Analysis

Functional PCA model
Functional Data Synthesis

Functional PCA model

Entschuldigung!

Praat
PSOLA synth
Conclusions

1) Automatically assess L2 learner's input
   - FDA provides a model of correct intonation based on L1 speakers
   - The model is entirely data driven
   - The model is independent of the learners' L1
   - Assessment is based on statistics
   - Assessment is not based on prior knowledge on the language(s) involved
Conclusions

2) Provide corrective acoustic feedback
   - FDA can be reversed and becomes a synthesis tool
   - Feedback can be provided by modifying the learner's wrong input
   - Feedback in the learner's voice allows to focus on the relevant speech features
Credits

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Want to konw more?

lands.let.ru.nl/FDA
Appendix
Functional Data Analysis

- **Smoothing**
- **Landmark Registration**
- **Functional PCA**

![Graph](image)
Functional Data Analysis

1. Smoothing
2. Landmark Registration
3. Functional PCA
Functional Data Analysis

- Smoothing
- Landmark Registration
- Functional PCA

PC scores
Mean F0
Mean rate

PC1 score
PC2 score
norm. F0 (dB)
rel. speech rate

Graphs showing changes over time with different markers for different conditions.