

# An intonation clinic for second language learners



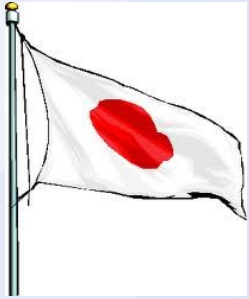
**Michele Gubian**

Centre for Language and Speech Technology  
Radboud University Nijmegen, the Netherlands

Utrecht, 13 December 2012







# Lexical vs post-lexical

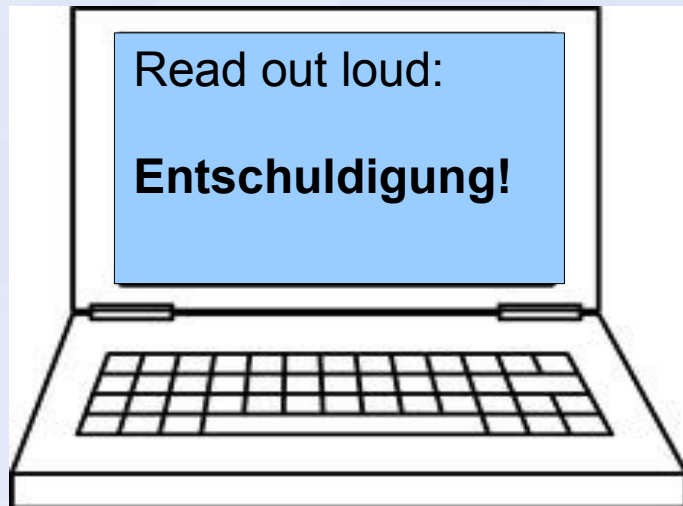


- Japanese: lexical pitch accents
  - sumimasen (pitch accent on 'ma') (= excuse me)
  - hashi / hashi (pitch accents on 'shi' and 'hi') (= bridge / chopsticks)
- German: post-lexical pitch accents
  - Entschuldigung (pitch accent on 'gung') (= excuse me, polite)
  - Entschuldigung! (pitch accent on 'gung') (= excuse me, rude)

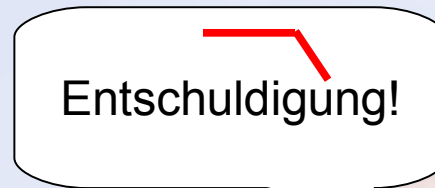
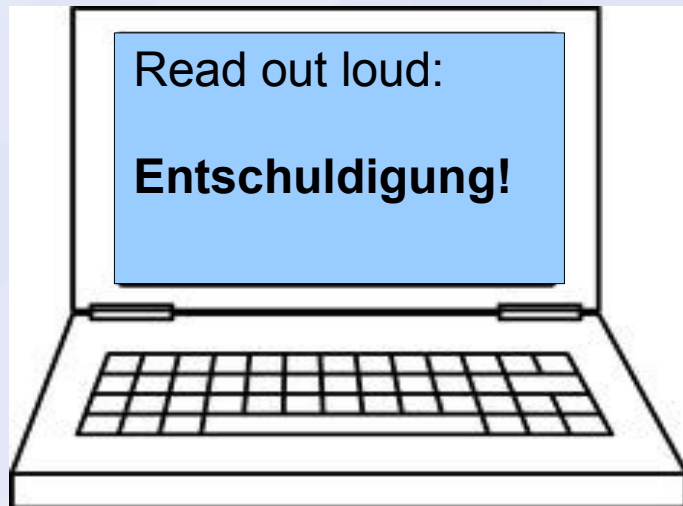
# Problem statement

- 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

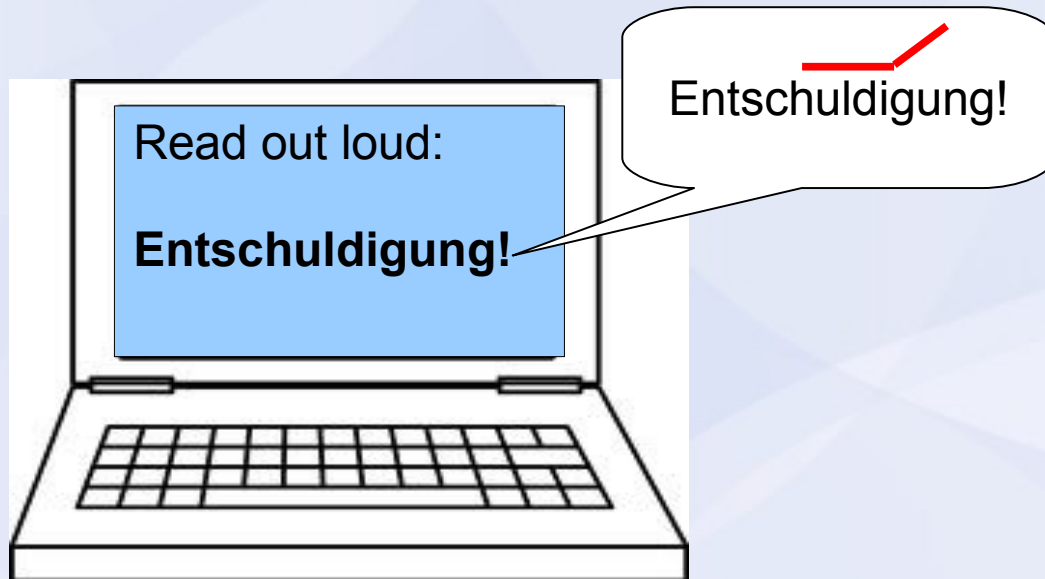


# CAPT system for intonation



- 1) **Automatically** assess L2 learner's input

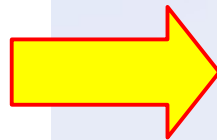
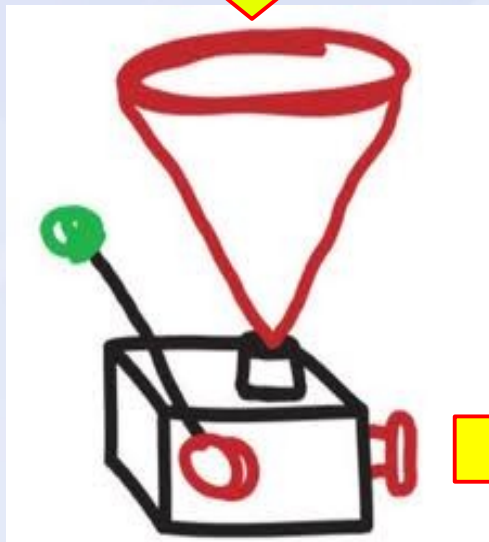
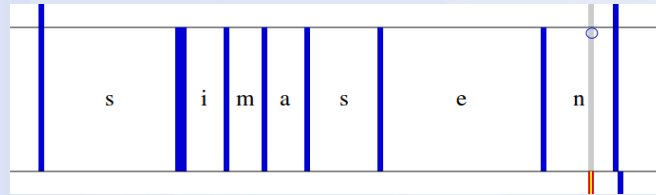
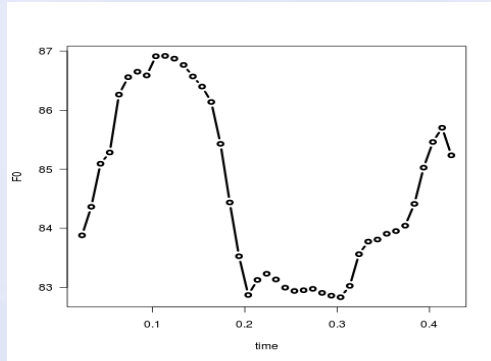
# CAPT system for intonation



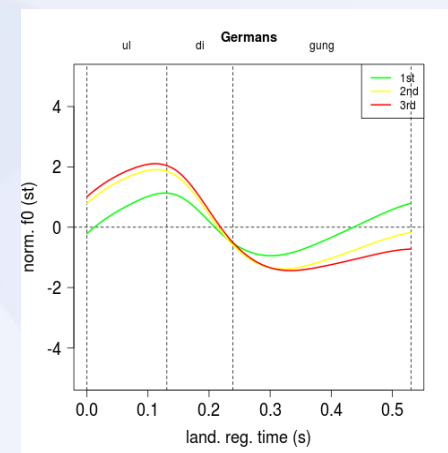
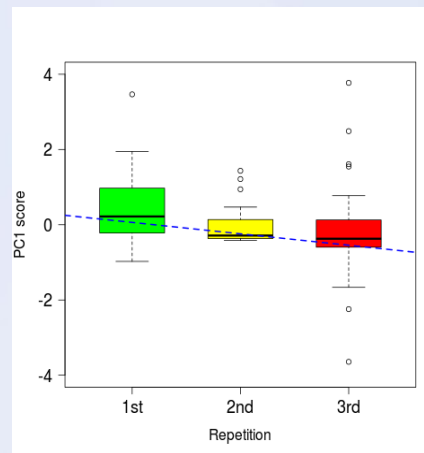
- 1) **Automatically** assess L2 learner's input
- 2) Provide corrective **acoustic** feedback



# Functional Data Analysis



## Functional PCA model



# Attention-seeking task

Entschuldigung!



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Entschuldigung!



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**ENTSCHUL  
DIGUNG!**



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**1<sup>st</sup> repetition**

**2<sup>nd</sup> repetition**

**3<sup>rd</sup> repetition**

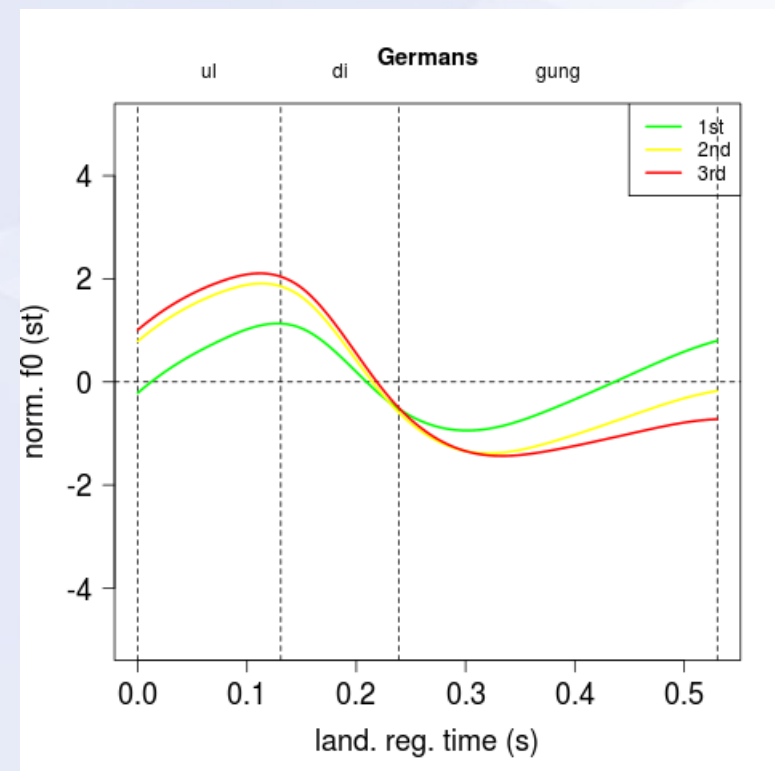
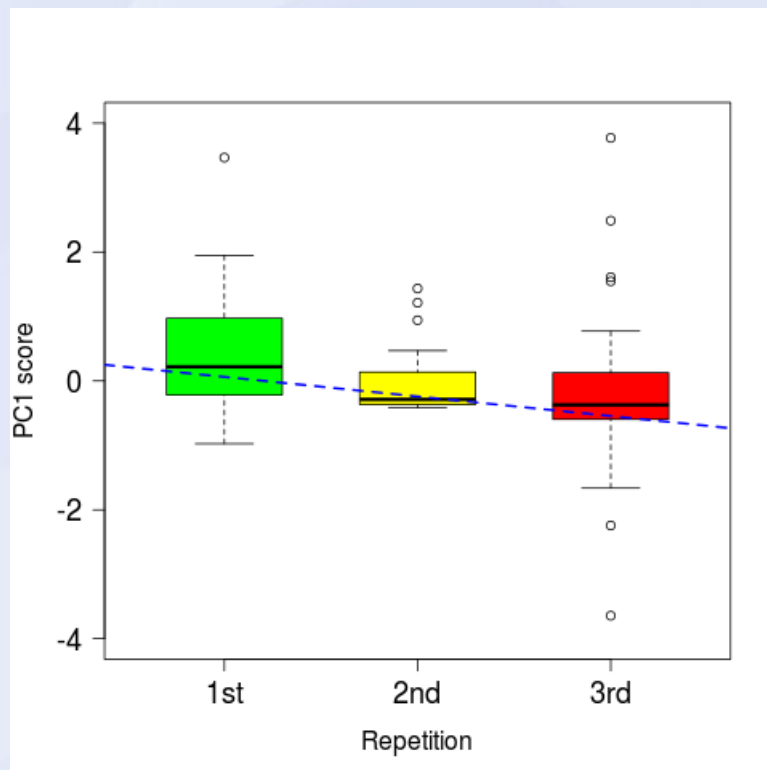


# Entschuldigung!



PC scores

F0



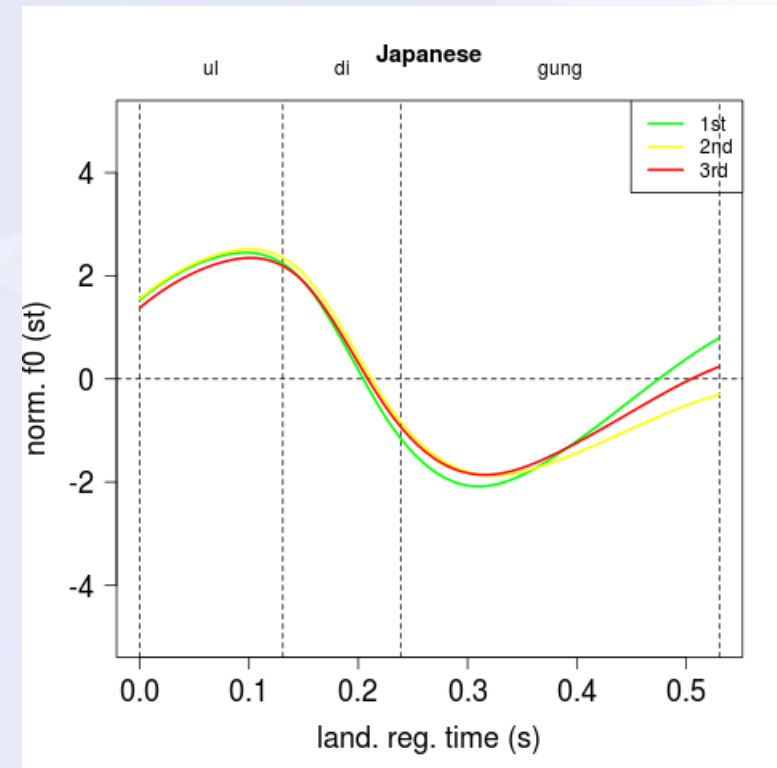
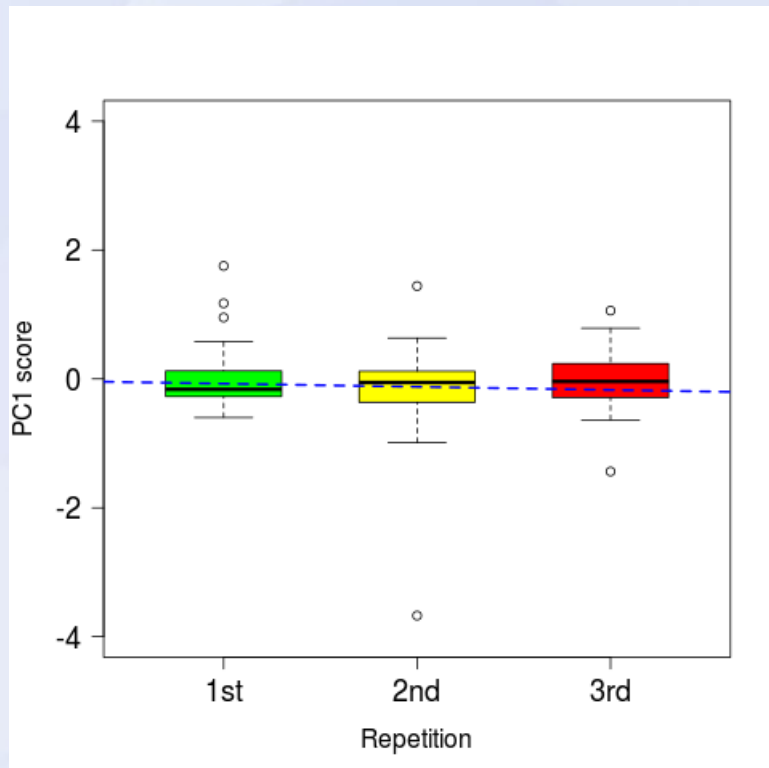


# Entschuldigung!



PC scores

F0



# Modeling target phrase

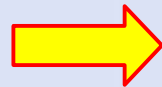
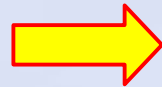
Native speakers

Entschuldigung!

Entschuldigung!

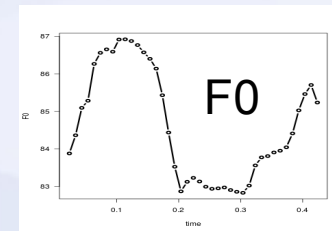
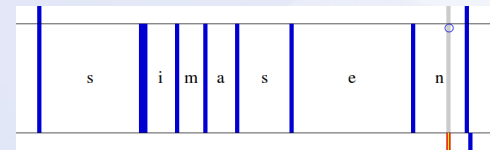
Entschuldigung!

Entschuldigung!



ASR

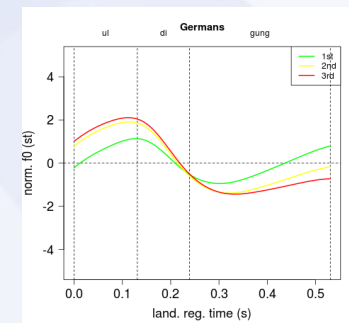
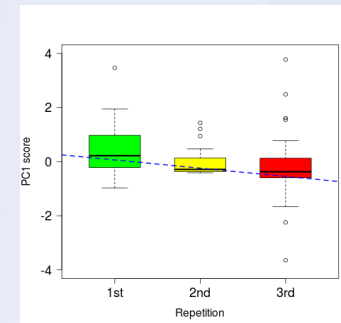
Praat



FDA



## Functional PCA model



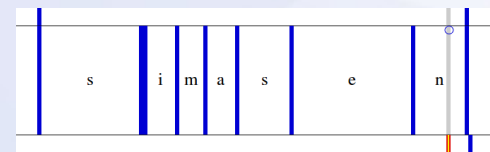
# Assess L2 learner's input

L2 learner

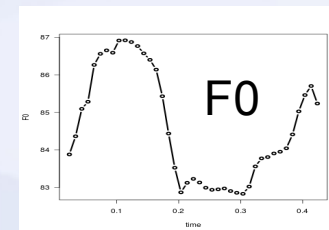
Entschuldigung!



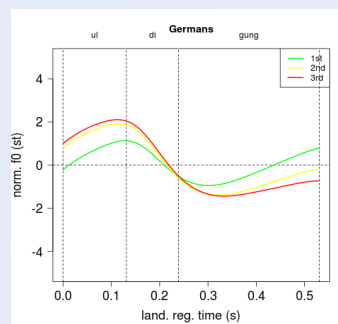
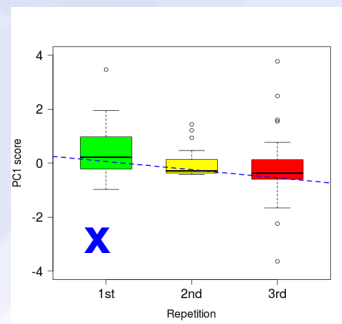
ASR



Praat

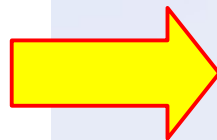
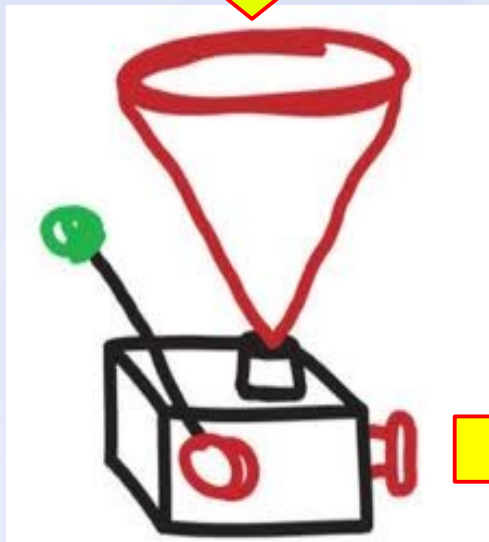
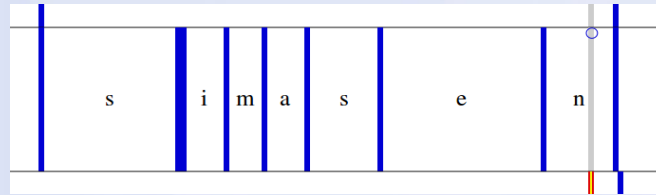
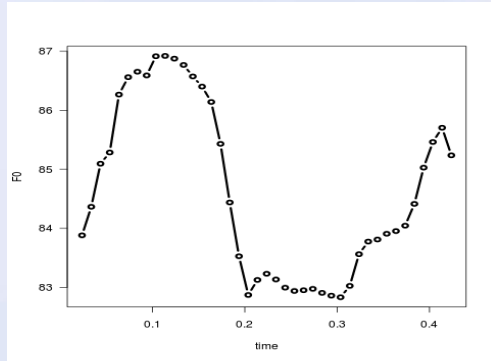


## Functional PCA model

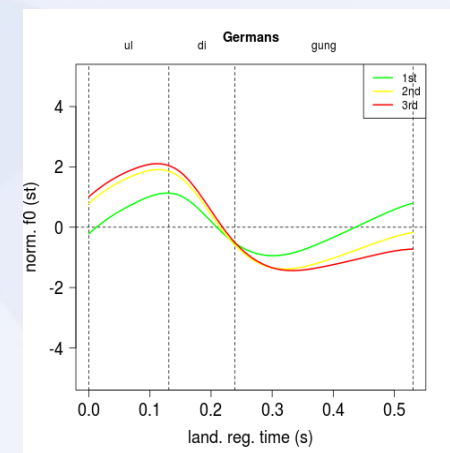
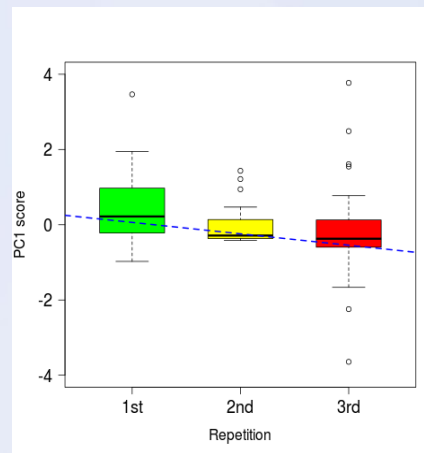


**WRONG!**

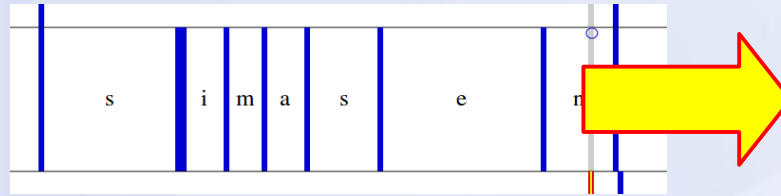
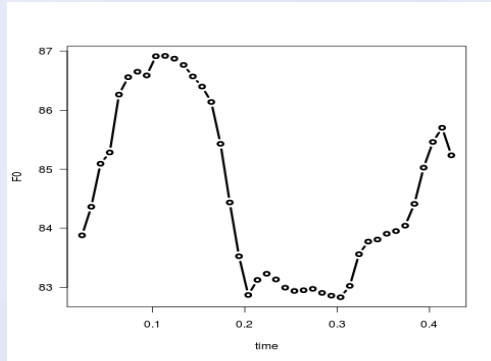
# Functional Data Analysis



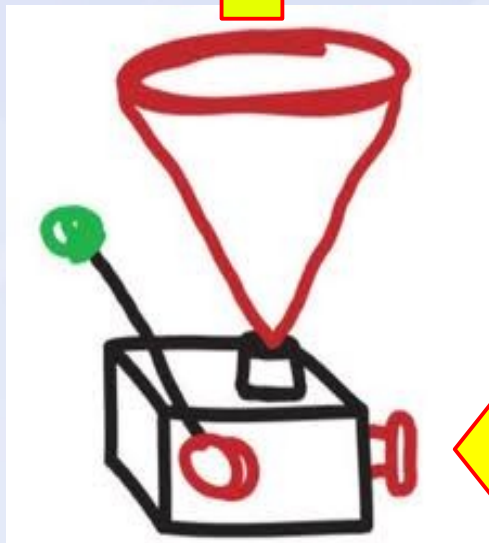
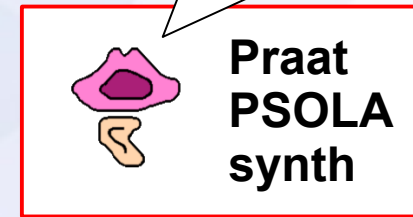
## Functional PCA model



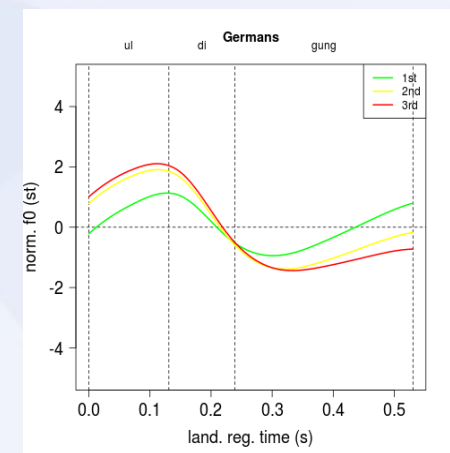
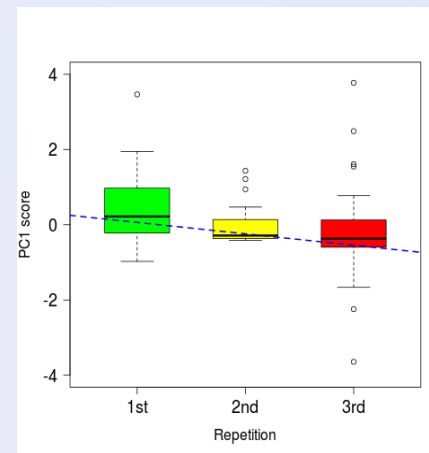
# Functional Data Synthesis



Entschuldigung!



## Functional PCA model





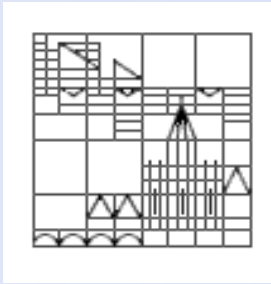
# Conclusions

- 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



**Yuki Asano, Bettina Braun**

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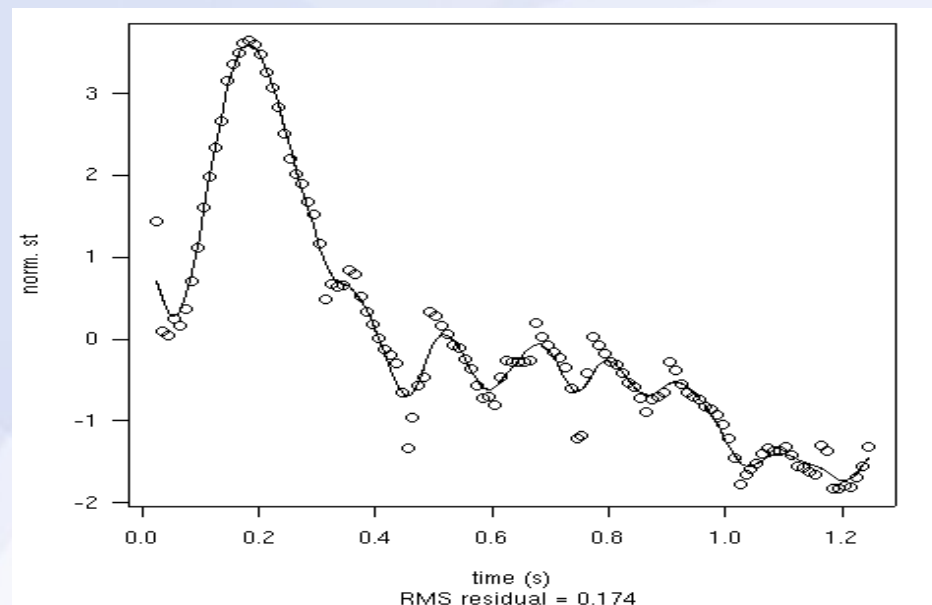
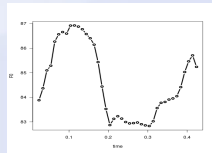
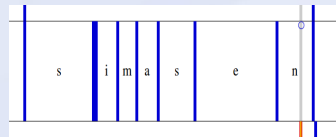
# Want to know more?



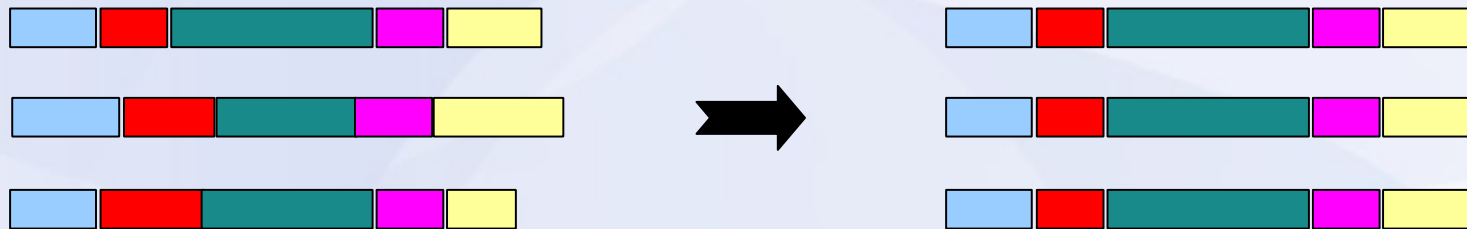
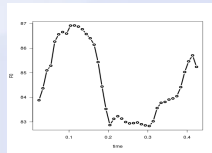
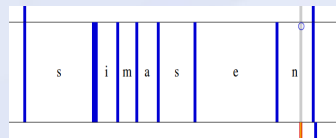
[lands.let.ru.nl/FDA](https://lands.let.ru.nl/FDA)

# Appendix

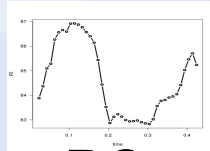
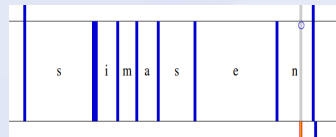
# Functional Data Analysis



# Functional Data Analysis



# Functional Data Analysis



Smoothing

Landmark  
Registration

Functional  
PCA

PC scores

Mean F0

Mean rate

