# Acoustic features of L2 Swedish and Finnish speech

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# Predicting L2 Swedish fluency & proficiency

*Prosody and fluency of Finland Swedish as a second language: investigating global parameters for automated speaking assessment* (Heini Kallio, Maria Kautonen & Mikko Kuronen, 2023)

- Global measures of prosody and fluency as predictors of *overall oral proficiency, fluency,* and *pronunciation* ratings
- Parameters related to temporal fluency, timing (based on syllable durations), and f0 change
- Comparison to L1 Finland Swedish speakers

# L2 Swedish data

N = 265

235 L2 & 30 L1 Swedish speech samples

(Semi)-spontaneous narrative speech

Human ratings: overall proficiency, fluency, and pronunciation

Discarded samples with 8 or less syllables

→186 L2 samples left

# Parameters

| Parameter | Operationalization |
|---|---|
| f0 range | Pitch range in semitones |
| f0 std | Standard deviation of pitch in semitones |
| f0 slope | Mean pitch slope in semitones |
| nPVI | Rate-normalized mean difference (ms) between consecutive syllables |
| nΔS | Rate-normalized mean standard deviation of syllable duration |
| SP-ratio | Relative proportion of silent pauses in response |
| SP-freq | Rate of silent pauses per second |
| FP-ratio | Relative proportion of filled pauses in response |
| FP-freq | Rate of filled pauses per second |
| WL-ratio | Relative proportion of wrong language in response |
| WL-freq | Rate of wrong language sections per second |
| ArtRate | Rate of syllables per second without pauses or other disfluencies |
| SpeechRate | Rate of syllables per second, pauses and disfluencies included |

MLR models for predicting Proficiency, Fluency, and Pronunciation

# Results

**Proficiency model: (33% predictive power)**

| | |
|---|---|
| f0 slope | –1.50 |
| SP-freq | –8.06*** |
| WL-ratio | –1.51 |
| SpeechRate | 7.99*** |

**Fluency model: (44% predictive power)**

| | |
|---|---|
| NΔS | 2.38* |
| SP-freq | –1.65 |
| FP-ratio | –2.32* |
| SpeechRate | 9.29*** |

**Pronunciation model: (10% predictive power)**

| | |
|---|---|
| WL-freq | –3.06** |
| Speechrate | 3.04** |

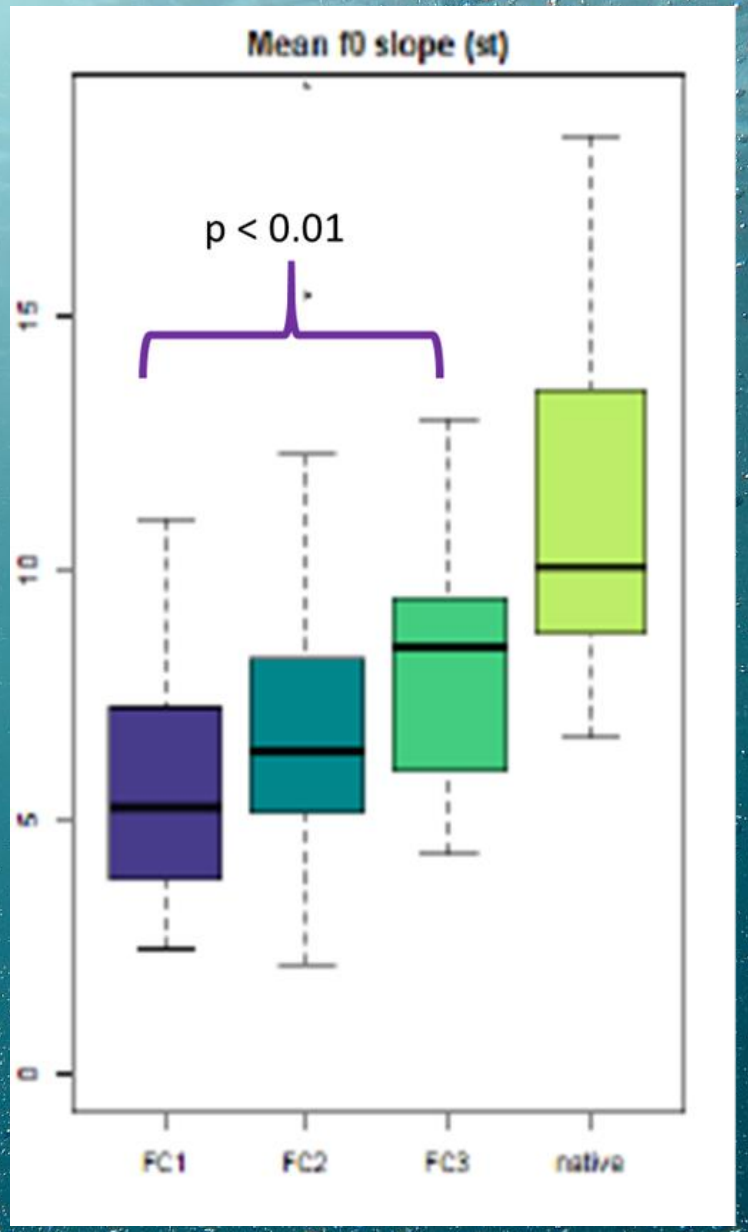
# Results

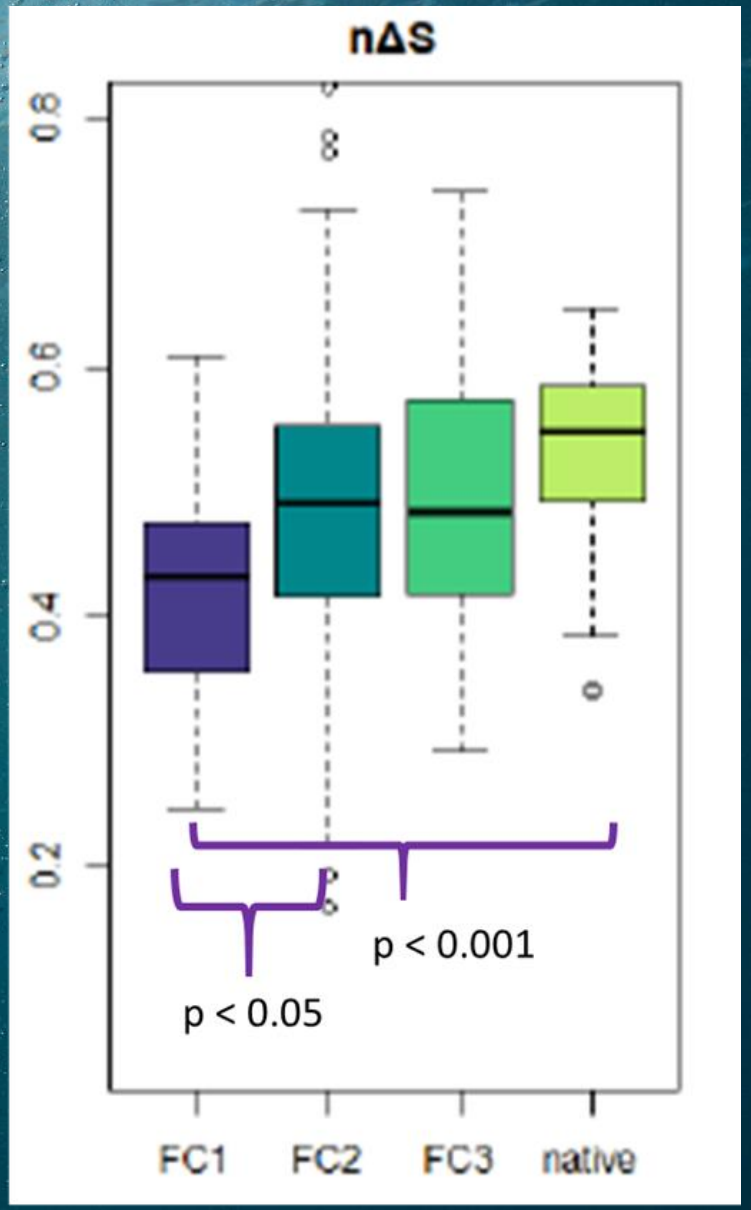
**Left:**

Mean f0 slope in relation to fluency ratings (as fluency categories)

**Right:**

Mean standard deviation of syllable duration in relation to fluency ratings (as fluency categories)



# Results

**Left:**

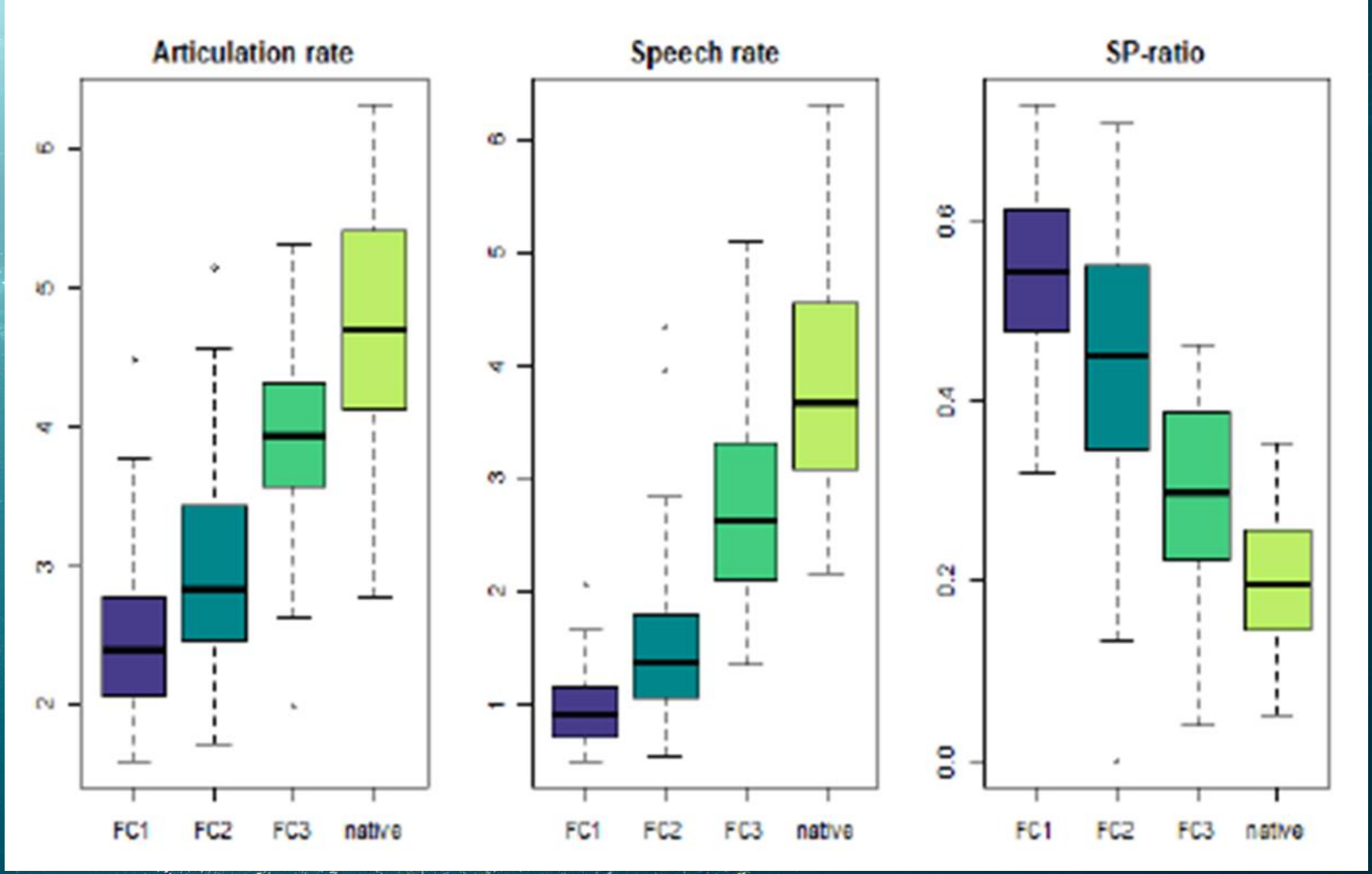
Articulation rate & fluency

**Middle:**

Speech rate & fluency

**Right:**

Ratio of silent pauses in response & fluency



# Revising fluency measures for spontaneous L2 Finnish

**Creaky voice and utterance fluency measures in predicting perceived fluency and oral proficiency of spontaneous L2 Finnish**

*Speech prosody 2022*: Heini Kallio, Rosa Suviranta, Mikko Kuronen & Anna von Zansen

**Phonetic fluency in Finnish as a second language**

*Master's thesis 2022:* Liisa Koivusalo

**The role of pause location in perceived fluency and proficiency in L2 Finnish**

*ISAPh 2022*: Heini Kallio, Mikko Kuronen & Liisa Koivusalo

**Revising parameters for predicting L2 speech fluency and proficiency**

*Accepted to ICPhS 2023*: Heini Kallio & Mikko Kuronen

# L2 Finnish data

N = 200

153 speech samples from YKI Finnish corpus:

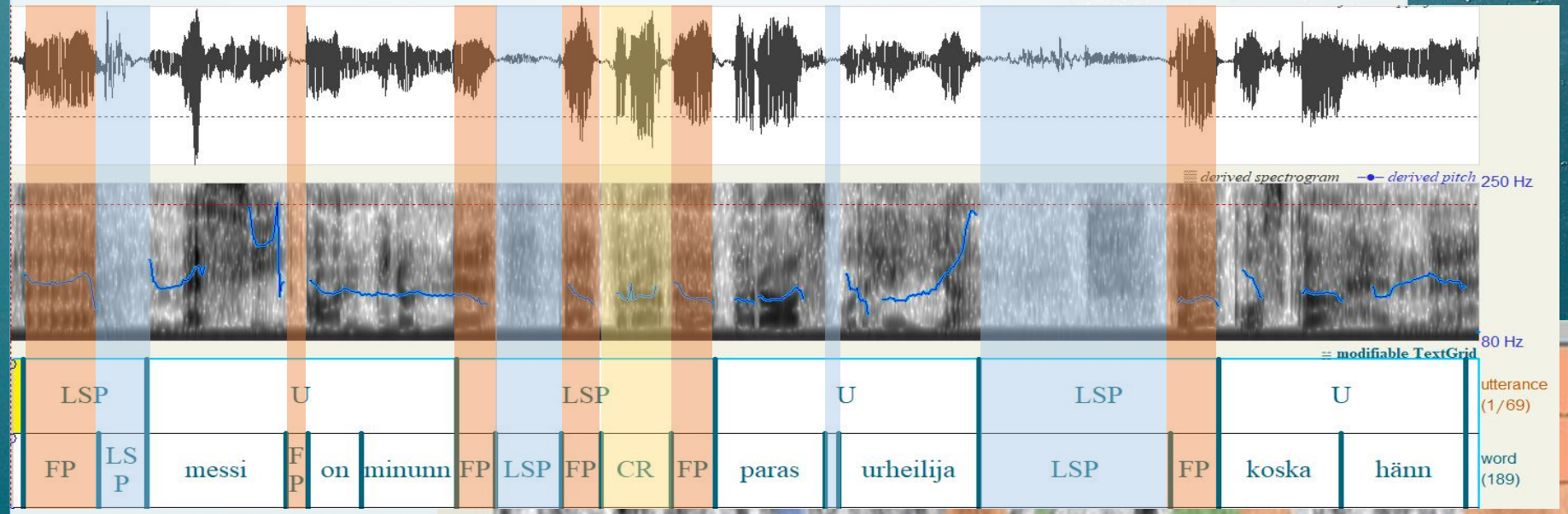
Spontaneous narrative speech (instructive response time: 1.5 min)

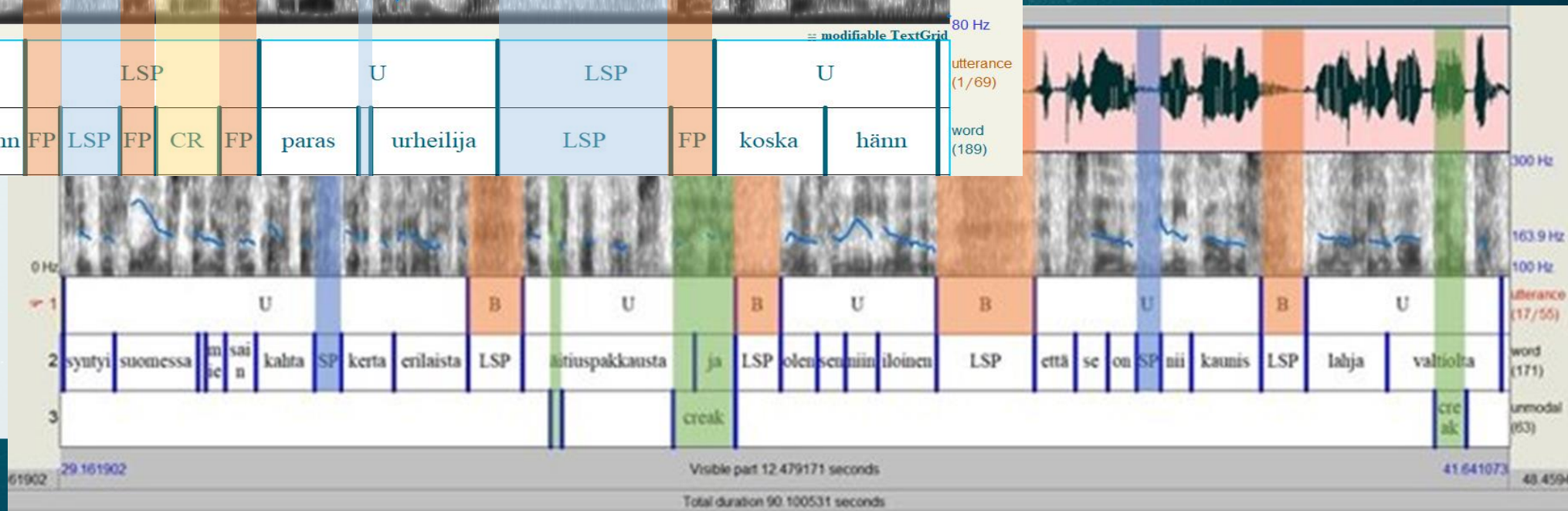
57 speech samples from L2 Finnish high school students by DigiTala:

Spontaneous narrative speech (instructive response time: 1 min)

DigiTala’s human ratings: fluency & proficiency

# Some new pause parameters, creakiness….



# New fluency parameters (some examples)

Silent pauses (SP) and filled pauses (FP)
- *between clauses (BC)*
- *within clauses (WC)*
- *between phrases (BP)*
- *and within phrases (WP)*
- Rate, ratio, and mean duration of all types

Disfluency ratio
- All pauses, hesitations, corrections, and repetitions

Mean utterance length in words

Utterance break
- Break of > 250 ms consisting of any disfluencies
- Rate and mean duration

Related to language-specific syntax,
More specific fluency parameters

More global fluency parameters to compete with speech rate

**44 fluency-related parameters altogether --> MLR models**

# Results

## Contribution of pause location parameters

Pause location parameters improved the predictive power of

- the fluency model from **59%** to **60%**
- the proficiency model from **59%** to **62%**

11 parameters contributed significantly to predicting speech *fluency*

- 2 of which were pause location parameters (filled pauses within phrases)

**However,**

14 parameters contributed significantly to predicting **proficiency**

- 7 of which were pause location parameters

# Results

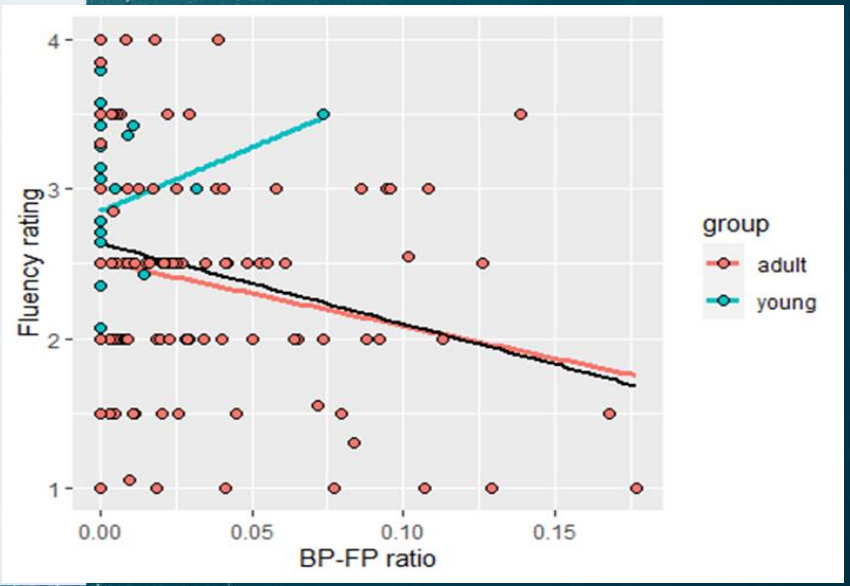
## Contribution of pause location parameters

**The relevant parameters and their significance in the regression models depend on the speech data:**

**Blue:** high school students (N = 57)
**Red:** adult learners (N = 153)

**Up:**
Filled pause rate within phrases & proficiency rating

**Down:**
Ratio of filled pauses between phrases & fluency rating

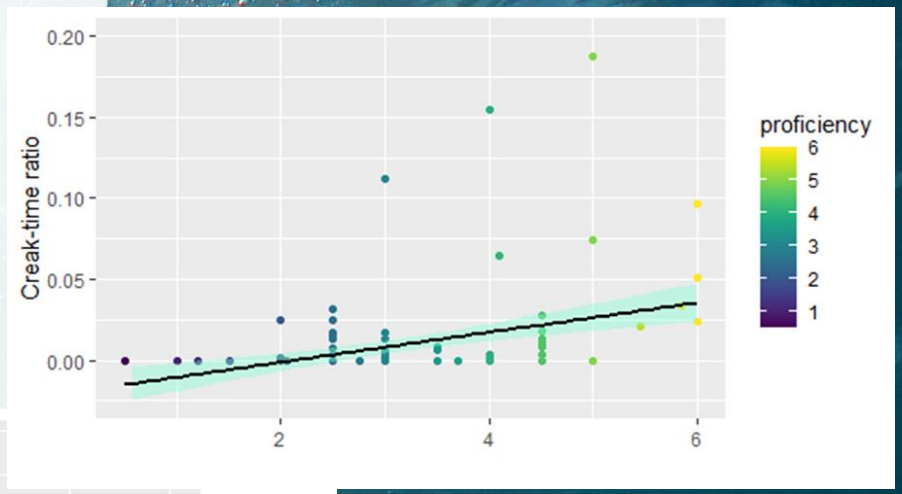



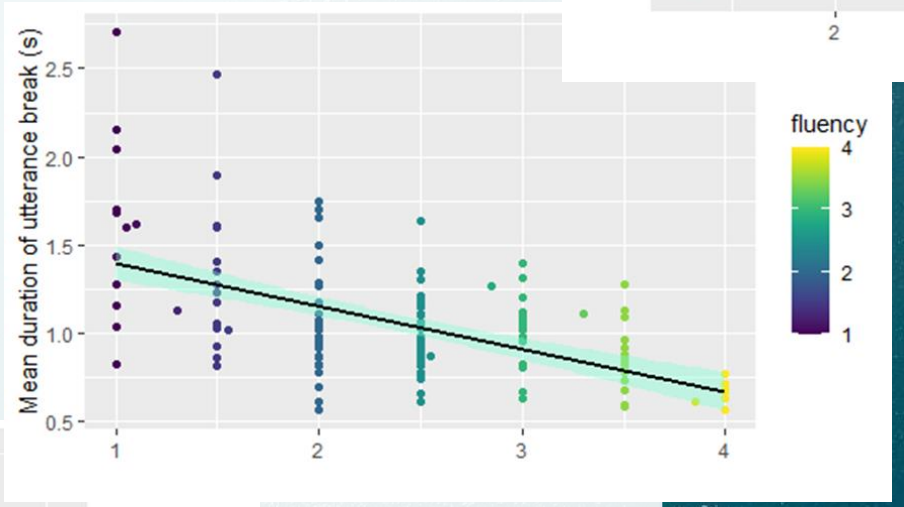
# Results:
## Contribution of global parameters

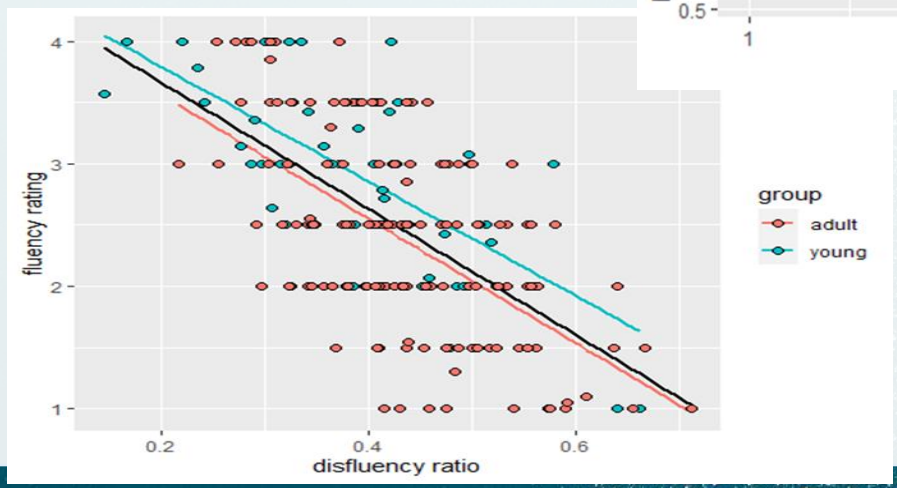
Creak

Utterance break duration

Disfluency ratio



# Discussion

**Potentials:**

- Combining automatic pause/hesitation detection with a syntactic parser to define the location of pauses & hesitations
- Recognizing & separating target language words from hesitations, repetitions etc.

**Issues:**

- Low proficiency speakers may not produce linguistic phrases
- Whatever is present in the data may become relevant

--> data-based bias

→ context-specific assessment models?

- Lack of Finnish L1 research on the phenomena

# References


•Kallio, H., Kuronen, M., & Kautonen, M. (2021). Differences in acoustically determined sentence stress between native and L2 speakers of Finland Swedish. Working papers-Lund University, Department of linguistics, General linguistics, Phonetics, 56.

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•Kallio, H. & Kuronen, M. (accepted) Revising parameters for predicting L2 speech fluency and proficiency. *20th International Congress of the Phonetic Sciences (ICPhS 2023)*

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•Koivusalo, L. (2022). Phonetic Fluency in Finnish as a Second Language: Acoustic Analysis of High School Students' Spontaneous Speech. Master's thesis, University of Helsinki