Adam Mickiewicz University, Poznań

Faculty of English

Different approaches to investigating perception in L2 & L3 phonological acquisition
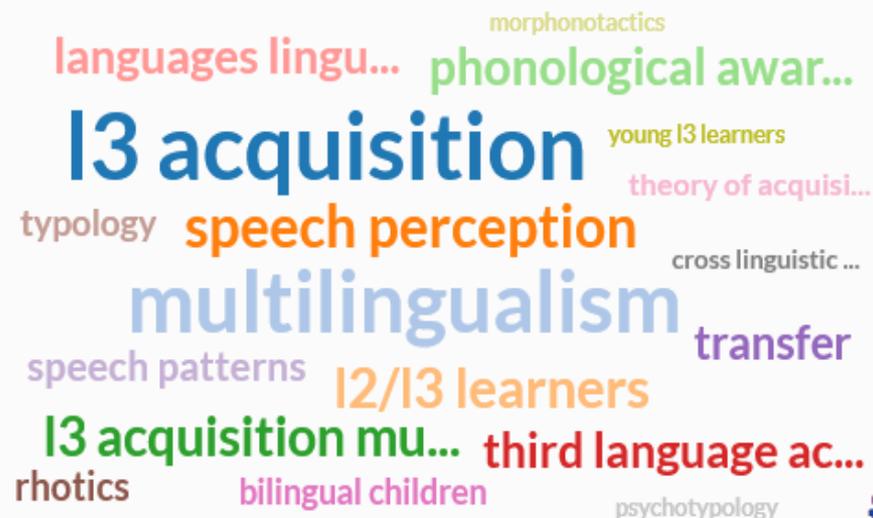
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Oslo UiO March 2023

10 YEARS *WA*
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Outline

- Overview of L2 vs. L3 phonological acquisition
  - Differences in cross-linguistic influence
  - Enhanced perceptual sensitivity

- Project findings:
  - Perception study
  - FAR
  - Processing study (ERP)

Comparing bilingual and trilingual speech

- Research comparing speech perception and production by **bilingual and trilingual/multilingual** speakers
  - e.g., Geiss et al., 2021; Domene Moreno, 2021; Amengual, Meredith, & Panelli, 2019; Gabriel, Krause, & Dittmers, 2018; Antoniou et al., 2015; Enomoto, 1994

- **Differences**:
  - broadened phonetic repertoire
  - type and direction of cross-linguistic influence
  - speakers' metalinguistic (phonological) awareness
  - perceptual sensitivity
  - facilitation in learning subsequent / new phonologies
    - e.g. Gut 2010, Wrembel 2015

Cross-linguistic Influence (CLI)

- Differences in the number of potential directions

- CLI in L3 > CLI in L2

$$L1 \Leftrightarrow L2, L1 \Leftrightarrow L3, L2 \Leftrightarrow L3 \ldots$$

- SLA: L1-based transfer (one-to-one)

- TLA: multidirectional & complex CLI

- L1-based CLI in L2/L3 (due to neuro-motor routines)

- L2-based CLI in L3 (interaction of two non-native languages 'lateral CLI' (Jarvis & Pavlenko, 2008)

Cross-linguistic Influence (CLI)

- Combined L1 & L2 CLI
  - Production: L1-L2 hybrid values in L3 VOT (Cardoso & Collins 2010, Dittmers et al., 2018, Wrembel 2015)
  - Perception: L1 German, L2 English, L3 Polish trilinguals assimilate L3 vowel sounds to both L1 and L2 categories (Wrembel, Marecka and Kopečková 2019)
- Mixed CLI - Archibald (2022) L1 Arabic, L2 French, L3 English
  - CLI from L2 French for L3 English vowels;
  - CLI from L1 Arabic for L3 English consonants
- Structure-dependent CLI - Domene Moreno (2021): German-Turkish heritage speakers learning L3 English
  - perception of vowel length and laterals; production of voiced coda consonants: Turkish-based CLI
  - production of initial consonant clusters and vowel length: German-based CLI

# Enhanced Perceptual Sensitivity

- L3 learners tend to outperform L2 learners in target language phonetic discrimination
  - e.g., Antoniou et al., 2015; Enomoto, 1994; Onishi, 2016
- Kopečková (2014) higher perceptual sensitivity for vowels
  - young multilingual vs. Polish-English bilingual learners
- Onishi (2016) 'global advantage in phonological perception':
  - L3 learners more sensitive in the discrimination of non-native speech
- BUT also contradictory or mixed results
- No significant differences between monolinguals and bilinguals in discriminating novel speech sound contrasts.
  - e.g., Patihis, Oh, & Mogilner (2015)

Facilitation in learning new phonologies

- ➢ **Trilingual advantage** found in some studies might not reflect a general advantage in phonological acquisition
- ➢ Rather: L3/Ln learners can **benefit from specific phonological properties** of their background languages

- ➢ For more -> Gut & Wrembel (forthcoming) "Comparing Bilingual and Trilingual Phonetics and Phonology" in CUP Handbook of Bilingual Phonetics and Phonology (ed. Amengual 2023)
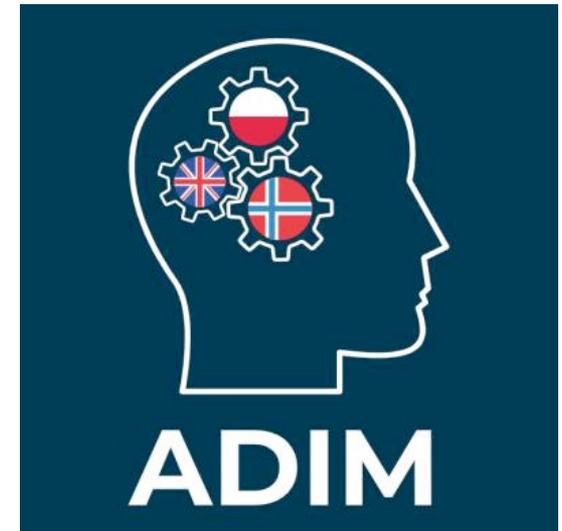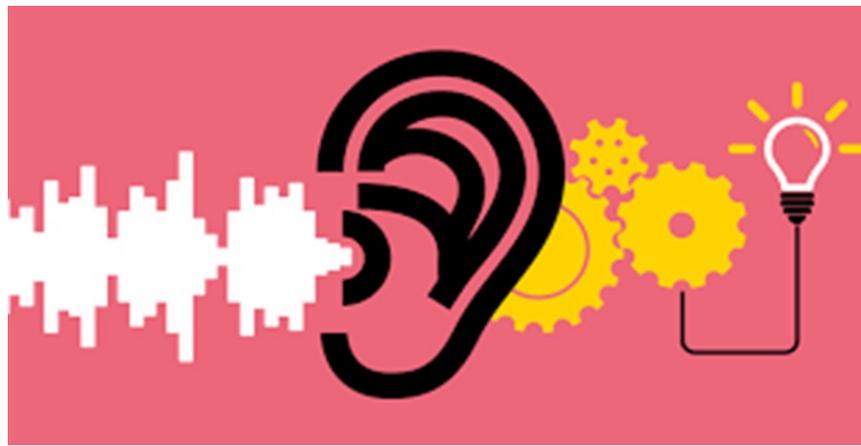
INSIGHTS FROM L3 PROJECTS

Three approaches

- to investigating perception in L2 & L3 phonological acquisition

    – Perception study (L2 & L3 vowels)

    – Ratings of perceived global accent (L3)

    – EEG study with auditory stimuli (L1, L2, L3)

Perception in L2 and L3: The relationship between English and Norwegian vowel assimilation patterns and the Euclidean distances

Anna Balas, Magdalena Wrembel, Jarosław Weckwerth, Kamil Kaźmierski, Zuzanna Cal, Karolina Rataj - **SLE 2022**

PERCEPTION STUDY

Introduction

- Part of a larger project investigating multilingual acquisition in L1 Polish – L2 English – L3 Norwegian learners

  - *Cross-linguistic influence in multilingualism across domains: Phonology and syntax* (CLIMAD)

- Longitudinal design (T1, T2, T3)

- Aim: exploration of cross-linguistic interactions in multilinguals' vowel systems

Study design: participants

- L1 Polish, L2 English (B1/B2), L3 Norwegian (A1)

- 24 participants at T1 (17 at T3), aged 20
- 1st-year students in Norwegian modern language BA programmes
  - University of Szczecin
  - Poznań College of Modern Languages (WSJO)
- Participant profiles:
  - Language History Questionnaire LHQ (Zhang et al. 2014)

Study design: time points

- Three data collection times (T1, T2, T3)
  - T1 in November 2021
  - T2 in March 2022
  - T3 in June 2022
- Three sessions
  - speech production
  - speech perception
  - grammaticality judgements
- Fieldwork mode
- L3 vs. L1, L2 language blocks (different days)

June 2021

Pilot study:
- remote recordings,
perception study,
grammaticality
judgements
- 16 participants

- recordings of
control speakers
(remote)

T1 November 2021

Study:
- on-site recordings,
perception study,
grammaticality judgements

- 24 participants with L1
Polish - L2 English - L3
Norwegian

T2 March 2022

- production, perception,
grammaticality judgements

- Control Norwegian
participants

T3 June 2022
-

- Data collection
- Drop outs
-

Aim & rationale

➢ To explore the **relationship between L2 and L3 perception** and acoustic similarity

➢ To examine **perceptual assimilation patterns** for L3 Norwegian and L2 English vowel assimilated to L1 Polish vowel categories

➢ To compare the relationship **between perceptual patterns and acoustic distance** between the vowels operationalized as Euclidean distance

➢ So far studies focused on
  ➢ L2 perceptual assimilation (Best & Tyler 2007, Tyler et al. 2014),
  ➢ relationship between vowel perception and their acoustic parameters (Strange et al. 2003, Escudero et al. 2012, Alispahic et. al. 2017)

➢ **No previous such studies on L3 nor comparing L2 and L3**

Polish, English and Norwegian vowels

Hypotheses

- H1: The smaller the Euclidean distance between two vowels, the higher the likelihood of assimilating a given L2 English/L3 Norwegian vowel to an L1 Polish vowel category.

- H2: The Euclidean distance predicts assimilation better in L3 than L2.

- H3: If we take into account the Euclidean distance, L2 vowels should be perceived as worse exemplars of L1 categories than L3 vowels.

- *Euclidean distance is typically calculated using the mean F1 and F2 values in Hertz for each category or pairs of vowels
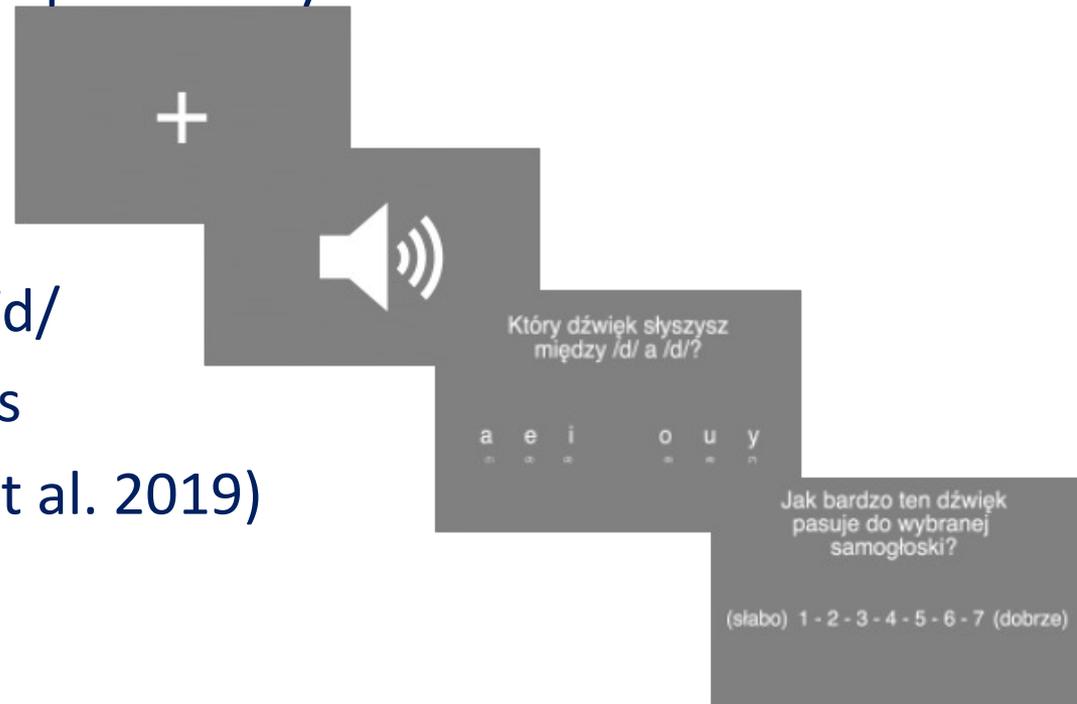
Methodology

- Participants N=24 L1 Polish
  - Mean age: 19.86
  - 17 females, 7 males
- L2 English
  - Advanced, mean of language learning: 12.23 yrs
- L3 Norwegian
  - Beginner: 2 months of intensive instruction
  - Instructed setting

Methodology

- **Perceptual assimilation task**
  - 10 English and 16 Norwegian monophthongs to six Polish vowel categories (orthographic labels)

- Two language blocks, on separate days

- **Goodness of fit ratings**
  - Likert scale from 1 to 7
  - 1 (weak fit) -- 7 (good fit)

- Stimuli: embedded in /dVd/

- Randomised, 3 repetitions

- Run in PsychoPy (Peirce et al. 2019)

Który dźwięk słyszysz między /d/ a /d/?

a e i o u y

Jak bardzo ten dźwięk pasuje do wybranej samogłoski?

(słabo) 1 - 2 - 3 - 4 - 5 - 6 - 7 (dobrze)

Results

NORWEGIAN stimuli	Polish vowel labels					
	<i>	<y>	<e>	<a>	<o>	<u>
TID /iː/	100% 5.77					
FIN /i/	33.33% 5	37.5% 5.41	26.39% 5.21			1.38% 3
STED /e/		88.89% 5.14		6.94% 5.6	1.39% 2	
LYS /yː/	70.83% 4.59	23.61% 5	1.39% 1			4.17% 4.33
SYND /y/	16.66% 5.25	62.5% 4.64	8.33% 5.17		2.78% 5	8.33% 2.33
LØP /øː/		9.72% 3.57	19.44% 5.14	5.56% 3.75	58.33% 4.45	6.94% 3.2
SØNN /ø/		11.11% 3.25	36.11% 4.35	8.33% 5	33.33% 4.29	6.94% 3.2
ROM /u/					72.22% 5.08	27.78% 4.9
GUD /ʉː/	2.78% 7	18.06% 4.23	1.39% 1		1.39% 1	75% 4.72
SLUTT /ʉ/	1.39% 3	23.61% 4.11			9.72% 5	63.89% 4.65
ENGLISH stimuli						
FLEECE	100% 5.8					
KIT	37.5% 5.03	34.72% 5.84	27.78% 6.15			
DRESS		98.61% 6.03		1.39% 5		
GOOSE						100% 5.15
FOOT	1.39% 7	4.17% 4.67			43.06% 4.61	51.39% 3.86

Results: Euclidian distance & assimilations

English vowels

Effect of Euclidean Distance over time
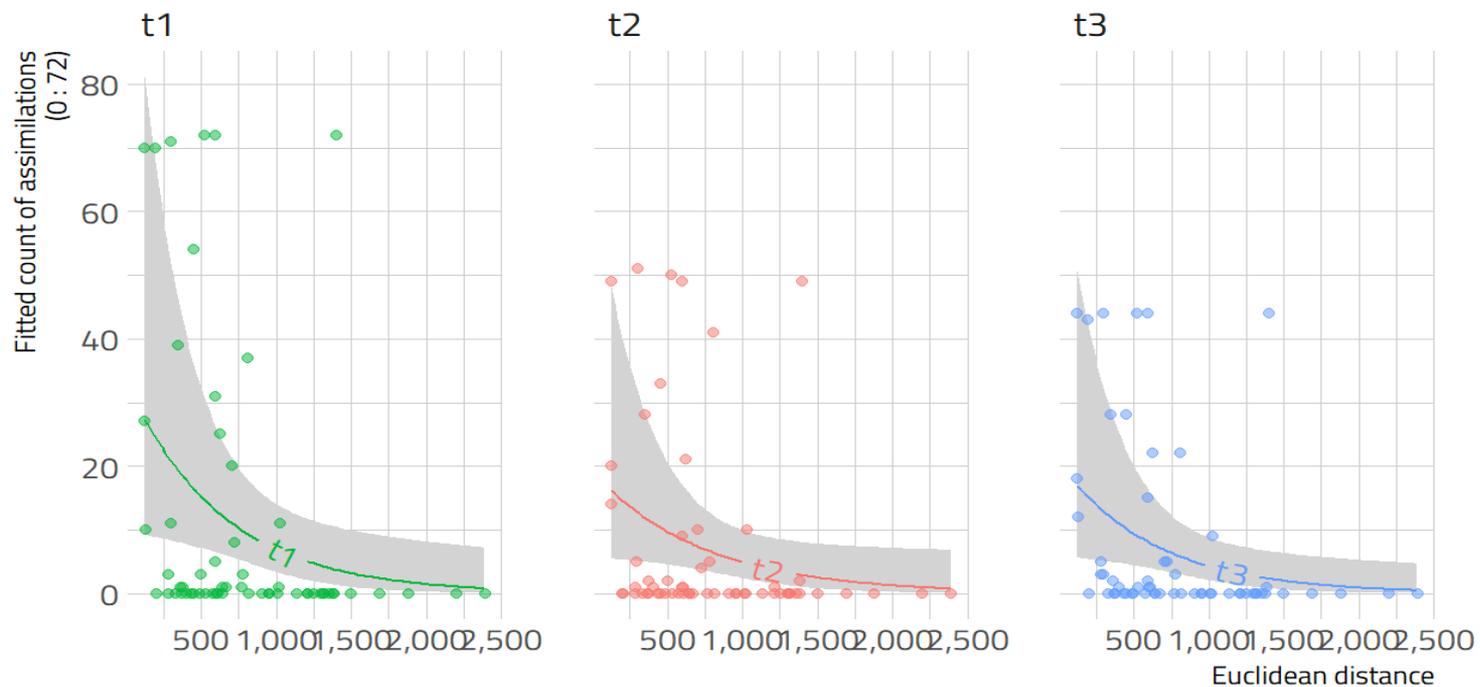
Discussion

- A negative binomial model to capture whether F1-F2 Euclidean distance is related to how often a given L2 Eng / L3 Nor vowel is assimilated to a given L1 Polish vowel
  - ED is negative and significant (z = -6.751, Pr(>|z|) = 1.46e-11***) for L2 & L3
  - T1 – the strongest effect in both L2 and L3

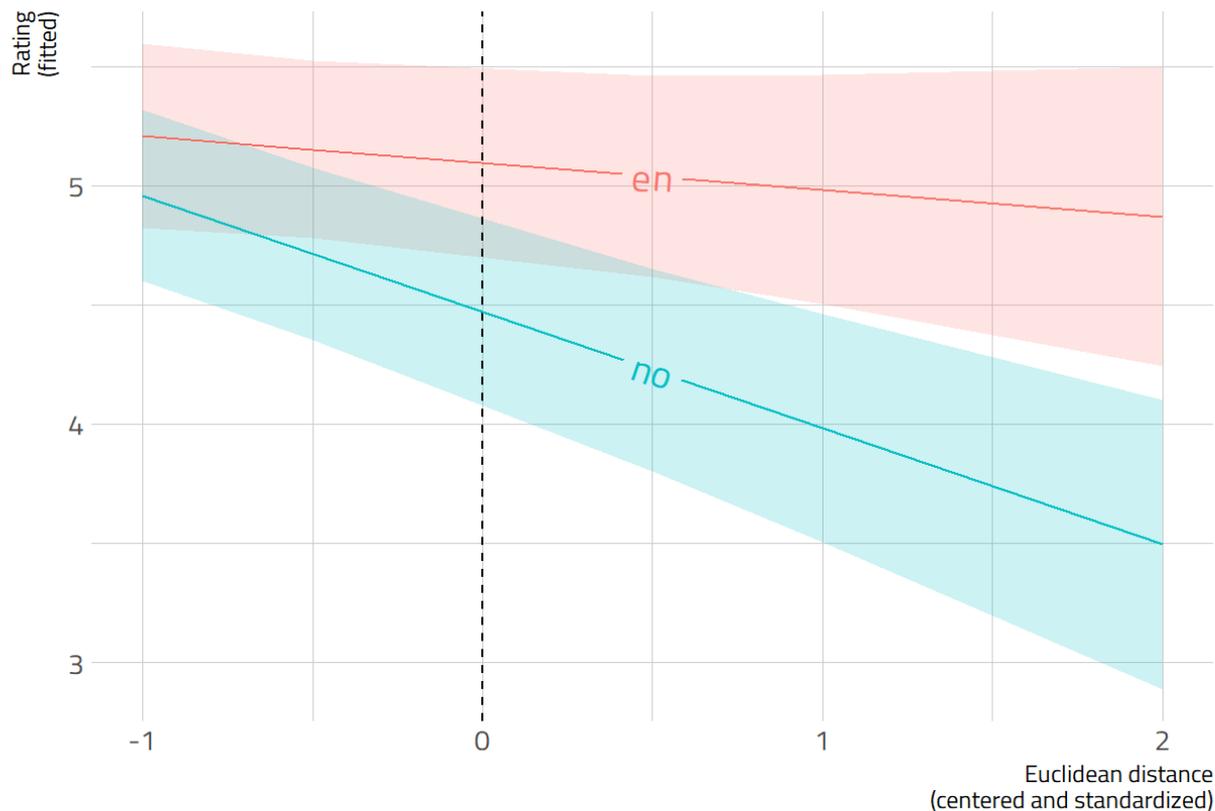- H1: The larger the Euclidean distance, the fewer assimilations predicted ✓

Discussion

- Stronger effect of the ED L3 than L2
  - coefficient in Nor ed_z = -1.7 > Eng ed_z= - 0.61,
  - assimilations in the better-known L2 have stabilized

- H2: The Euclidean distance predicts assimilation better in L3 than L2 ✓

Results: L2 or L3 vowels as better exemplars of L1?

Discussion

- Mixed effects linear model of Liker rating as a function of ED, language and their interaction; by-participant random intercept.

- Larger Euclidean distance -> lower goodness of fit ratings in both languages.

- Significant effect of language: L2 English vowels are rated higher than L3 Norwegian vowels.

- H3: If we take into account the Euclidean distance, L2 vowels should be perceived as worse exemplars of L1 categories than L3 vowels.   NO!

Interim summary

- The smaller the Euclidean distance between two vowels, the higher the likelihood of assimilating a given non-native vowel to a native category.

- There is a stronger effect of ED in L3 than in L2.

- The perceptuo-acoustic similarity patterns restructured over time; the strongest effect of ED at T1.

- L2 English vowels seem more similar to L1 Polish vowels than L3 Norwegian vowels.

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INVESTIGATING PREDICTORS OF FOREIGN ACCENTEDNESS IN L3 ACQUISITION

Magdalena Wrembel, Kamil Kaźmierski, Nicole Rodriguez, Katarzyna Dziubalska-Kołaczyk, Zuzanna Cal and **Jarosław Weckwerth**

FAR STUDY

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Study design: participants

- **Speakers (N=24)**
  - L1 Polish, L2 English, L3 Norwegian
  - aged 21
  - 8 weeks of intense initial exposure to the L3 in a formal setting
- **Raters (N=30)**
  - 18 Norwegian native speakers
  - 12 highly proficient L2 speakers of Norwegian
  - some phonetic training
  - moderate to considerable previous experience with foreign-accented speech in Norwegian.

Study design: speech samples

- Excerpts from *The North Wind and the Sun*

- Read in L3 Norwegian

- 48 words long

- 30 samples
  - 24 L3 learners
  - 6 Norwegian controls
  - presented to the raters in a randomized order

Online rating survey in Qualtrics

Rate the following speech sample according to the questions below, feel free to use the whole scale:

Q1: How much of a foreign accent does this speaker have?
1 = No foreign accent | 9 = Strong foreign accent

Q2: How comprehensible is this speech sample to you?
1 = Very comprehensible | 9 = Not comprehensible at all

▶ ●———— 0:00 / 0:10 ◀》 ————●

	1	2	3	4	5	6	7	8	9
How much of a foreign accent does this speaker have?	○	○	○	○	○	○	○	○	○
How comprehensible is this speech sample to you?	○	○	○	○	○	○	○	○	○

Measures

- **L3 Proficiency**: Norwegian placement test

- **Amount/frequency of L3 use**: a composite score based on self-declared answers in LHQ

- **Oral reading fluency**: number of words per minute (wpm)

- **Fine-grained phonetic performance**: VOT durations in /p, t, k/ in word list reading in L3

- **Profile**: Language History Questionnaire (Li et al. 2006)

- **Rating parameters** (on a 9-point scale):
  - degree of foreign accentedness
  - comprehensibility

Research questions

- **RQ1:** Do the rating parameters (accentedness and comprehensibility) correlate?

- **RQ2:** Does perceived global accent correlate with the learners' proficiency level, oral fluency and fine-grained phonetic performance in the L3?

- **RQ3:** Does perceived comprehensibility correlate with the learners' proficiency level, oral fluency and fine-grained phonetic performance in L3 Norwegian?

Results

Parameters	Experimental group M (SD)	Control group M (SD)
Accentedness (1–9)	6.72 (1.8)	1.5 (1.5)
Comprehensibility (1–9)	6.03 (2.3)	7.8 (2.7)
Oral fluency (wpm)	0.05 (0.01)	–
VOT /p/ (ms)	44 (14)	–
VOT /t/ (ms)	62 (15)	–
VOT /k/ (ms)	74 (18)	–
Norwegian use (hrs/week)	4.2 (4.6)	–

Results: Accentedness vs. comprehensibility

- Significant correlation between Accentedness and Comprehensibility
- The stronger the accent, the lower the comprehensibility
- **RQ1 – YES**


$r = -77, p < 0.05$
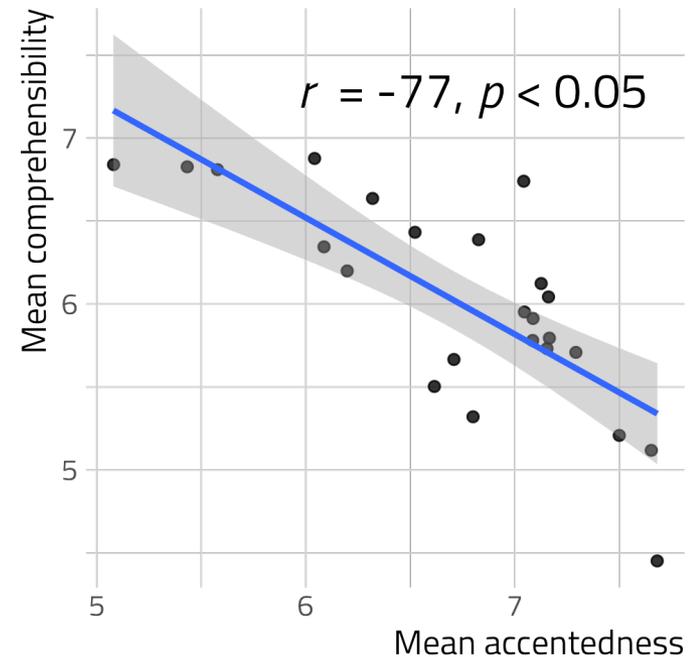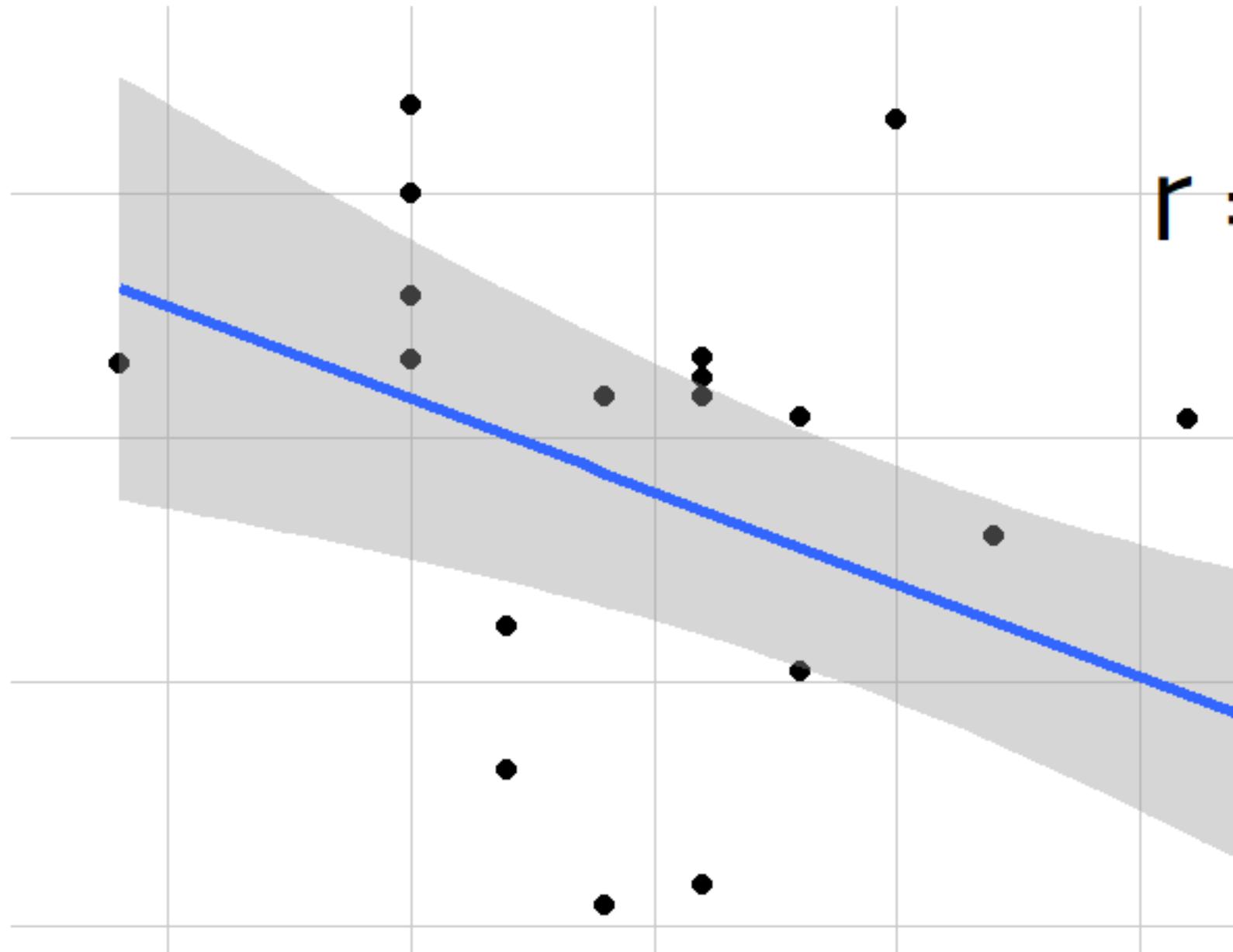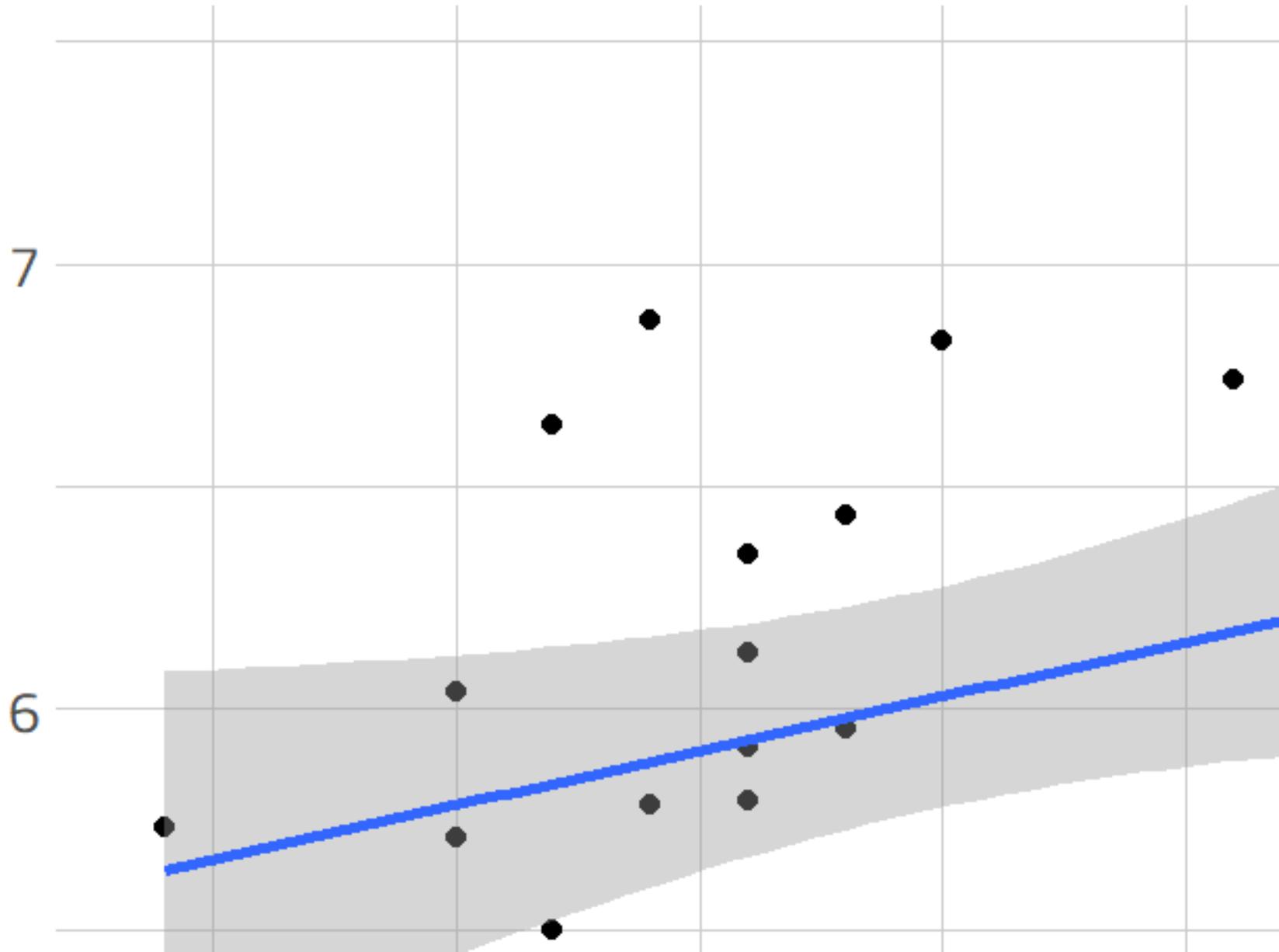
Results: rater variables

- **Native vs. non-native speaker status** significant for Accentedness but not Comprehensibility

- Mixed-effects ordinal logistic regression model: Accentedness as a function of Nativeness of Rater, with Norwegian Proficiency as control, and by-speaker and by-rater random intercepts

- **Interrater reliability**: Cronbach's alpha for Accentedness α = 0.89; for Comprehensibility α = 0.87
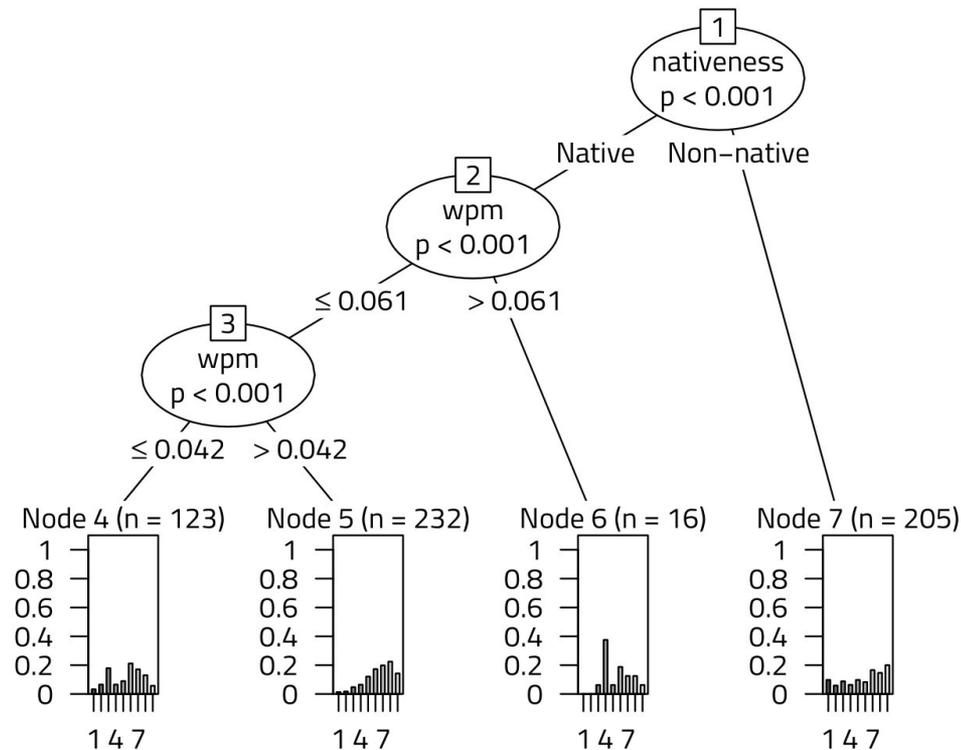
- A random forest analysis
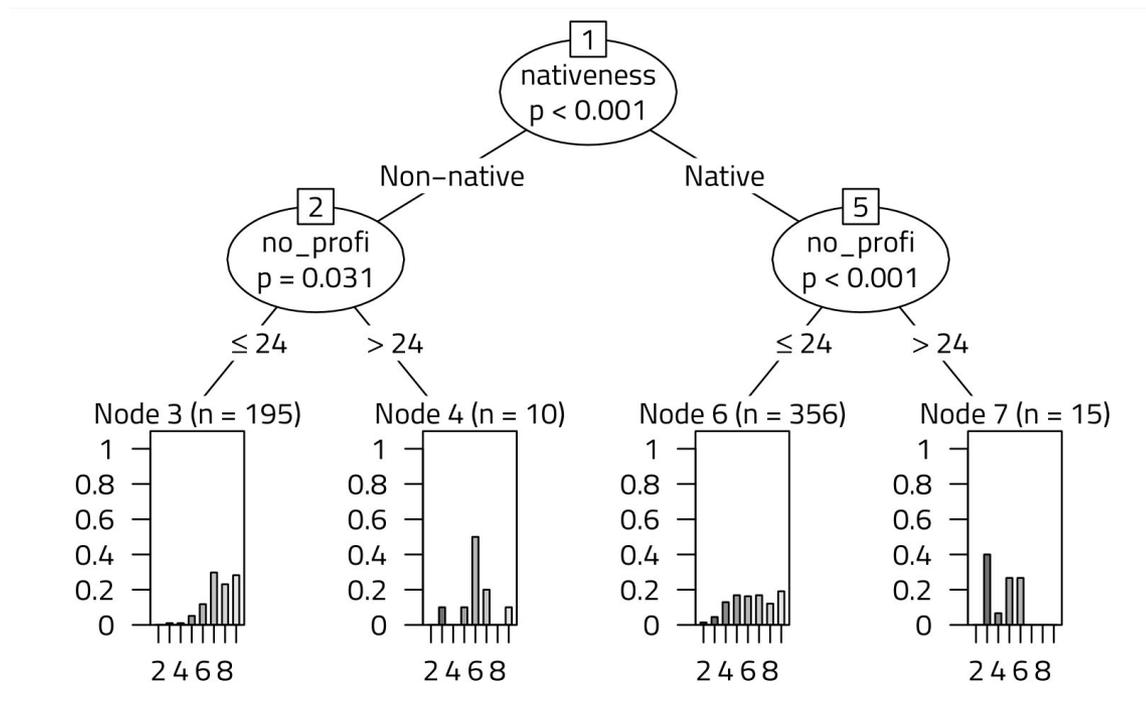
Results: predictors for Comprehensibility

- Conditional importance of predictors for Comprehensibility

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Cross-linguistic influence in vowel processing in multilinguals

Hanna Kędzierska, Karolina Rataj, Anna Balas, Zuzanna Cal and Magdalena Wrembel

ERP STUDY

10 YEARS WA
Faculty of English at AMU

EEG study

- **Aim:** to examine non-native phonological contrasts perception and processing in L2 and L3

- **RQ:** Will phonological contrasts be equally easy to detect and process in L2 and L3/Ln?

- **Predictions:** We predict the MMN to be stronger in native when compared with non-native speech (Jakobyet al., 2011; Liang & Chen, 2022; Näätänenet al., 1997; Song & Iverson, 2018).

  – BUT the scale of the MMN effect in L2 vs. L3/Ln impossible to predict

  -> NO previous studies which would focus on such a comparison.

EEG study

Procedure

600 /ɨ/ 60 /ɛ/
600 /ɪ/ 60 /ʊ/
600 /i/ 60 /ɣ/

gating task: to assess the participants' speech-specific capabilities, which have been demonstrated to affect non-native phoneme discrimination (Díaz et al., 2016)

BAG?   BEG?

consent, surveys — the ERP preparation — ERP stimuli presentation during cartoon watching — gating task, proficiency tests

EEG study

- Oddball paradigm (standard & deviant stimuli)
- Three language blocks
  - Polish /ɨ/-/ɛ/ contrast mainly manifested in height
  - English /ɪ/-/ʊ/ contrast mainly manifested in backness
  - Norwegian /i/-/ʏ/ contrast mainly manifested in roundness
- Vowels synthesized with the aid of PRAAT (Boersma, 2001)

- Mismatch negativity (MMN) component
  - index of listeners' sensitivity to phoneme constrasts at a pre-attentional level (Näätänen et al., 1997)
  - P300 – memory processing

EEG study

■ **Gating task:**

❑ After the alineation point identification, the words were divided into other gates (i.e., fragments) by adding or subtracting 10 ms from the alineation point, e.g.:

Word	AP	Duration	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10
beg	0,108	0,4463	0,088	0,098	0,108	0,118	0,128	0,138	0,148	0,158	0,168	whole

❑ The two members of the minimal pairs (e.g., BAG and BEG) were displayed on the computer screen.

BAG?   BEG?

EEG study

- 2 groups
  - Formal learners in Poland (N=24)
  - Naturalistic learners in Norwey (N=17)

EEG study: Analysis in progress

- Mean amplitudes of ERP epochs time-locked to the onset of investigated phonemes

- Analysis in 3 main time windows:
  - MMN, 3Pb, LDN

- Factors: language (L1 vs. L2 vs. L3) x deviancy (standard vs. deviant) x brain region (frontal vs. parietal)
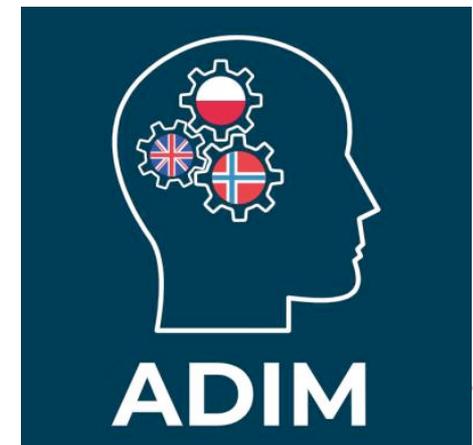
- Promising results ☺

Acknowledgements

Thanks to the project team ☺

Thank you!