NARODOWE CENTRUM NAUKI

THE PERCEPTION OF NORWEGIAN RETROFLEXES BY L1 POLISH L3 NORWEGIAN SPEAKERS:

PRELIMINARY RESULTS FROM DISSIMILARITY RATING AND DISCRIMINATION TASKS

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OUTLINE

1. Theoretical background
2. Objectives of the study
3. Rated dissimilarity task
4. Discrimination task

THEORETICAL BACKGROUND: RETROFLEXION

Retroflexion is traditionally described as an articulation involving the bending backwards of the tongue tip (e.g., Ladefoged and Maddieson 1996, Trask 1996).

Fig. 1 *Tracing of a sagittal x-ray of a retroflex stop in Tamil (Ladefoged & Maddieson,1996). The tongue tip is bent backwards and has contact on the post-alveolar area.*

THEORETICAL BACKGROUND: RETROFLEXION REDEFINED

- Keating (1991: 35): retroflex fricatives do not have to be pronounced with the curling of the tongue tip characteristic of retroflex stops.
- Hamann (2002: 117): a retroflex fricative with a curling backwards of the tongue tip as in Tamil stop has not been attested in any language.
- Hamann (2003: 32): criteria for retroflexes:
  - Apicality
  - Posteriority
  - Sublingual cavity
  - Retraction
  - N.B. bending backwards of the tongue is not universally valid.

POLISH SIBILANTS CLASSIFIED AS RETROFLEXES

- Analysis of x-ray tracings available in literature (Hamann 2002, 2004),
- Experimental EMA studies (Lorenc 2018),
- Phonological evidence (Hall 1997a, 1997b),
- Acoustic features (Żygis and Hamann 2003, Żygis 2005, Żygis et al. 2012),
- Sound change in Slavic languages (Padgett and Żygis 2007, Żygis and Padgett 2010).

THEORETICAL BACKGROUND CONTINUED

- Cross-linguistically, retroflexes are considered to be marked (Greenberg 1966)
- Retroflexes occur relatively infrequently and only in large inventories (Maddieson 1984); they are acquired late.
- The degree of perceived cross-linguistic similarity between the learner's L1 and L2 is claimed to mediate discrimination of L2 sounds (Flege and Bohn 2021, Cebrian 2022).
- Perceived cross-linguistic similarity has not been investigated from multilingual perspective.

RETROFLEXES IN NORWEGIAN, ENGLISH AND POLISH: NO FULL AGREEMENT

- Norwegian
  - a series of coronal consonants distinguished by retroflexion: alveolar /t, d, s, l, n/ and retroflex /ʈ, ɖ, ʃ, ɭ, ɳ/ (cf. Kristoffersen 2000: 23 controversy about /ʂ/ʃ/)
- Polish
  - sibilants have a controversial retroflex status;
  - some cues to retroflexion are argued to be manifested in /ʂ/, /ʐ/, /t͡ʂ/ and /d͡ʐ/;
  - cues to allophonic retroflexion – in /ʈ/ and /ɖ/ (Żygis 2005; Żygis, Pape & Jesus 2012);
- American English only has /ɽ/;

RETROFLEXES IN NORWEGIAN, ENGLISH AND POLISH

	Norwegian	Polish	English
nasal	/ɳ/		
plosive (voiceless)	/ʈ/		
plosive (voiced)	/ɖ/		
fricative (voiceless)	/ʂ-ʃ/	/ʂ/	
fricative (voiced)		/ʐ/	
affricate (voiceless)		/t͡ʂ/	
affricate (voiced)		/d͡ʐ/	
approximant	/ɭ/		/ɻ/

THE PERCEPTION OF RETROFLEXION: MOTIVATION FOR THE STUDY

- Polish /ʂ/ vs. Norwegian /ʂ/ – potentially closer counterparts;
- Remaining Norwegian retroflex sounds – /ʈ, ɖ, ɭ, ɳ/ – no close retroflex counterparts in Polish;
- We hypothesize gradiance in perceptual salience.

STUDY OBJECTIVES

- We aim to investigate the perception of Polish and Norwegian retroflexes by L1 Polish L3 Norwegian learners; specifically:
  - Discrimination of Norwegian retroflexes/non-retroflexes;
  - Assessment of cross-linguistics (dis)similarity of retroflexes and similar non-retroflex sounds;
  - How the perceived similarity is mediated by the presence or absence of retroflexion.
- Additionally, we want to account for the role of proficiency (initial vs. advanced) in perceptual performance.

RESEARCH QUESTIONS

1. What are the discrimination rates for different pairs of Norwegian retroflexes: /ʂ-s/, /ʈ-t/, /ɖ-d/, /ɳ-n/ and /ɭ-l/? Are there significant differences in the discrimination of the five experimental retroflex – non-retroflex pairs, and if so, do relative difficulties differ with experience?
2. What is the degree of perceived similarity between Norwegian retroflexes and similar retroflex/non-retroflex sounds in Polish and English?

STUDY DESIGN

- Participants: 33 L1 Polish, L2 English, L3 Norwegian learners + 35 controls (L1 Polish, L2 English)
- Two tasks:
  - Oddity categorial discrimination
  - Rated (dis-)similarity task (RDT)
- Procedure: PsychoPy

RATED (DIS-)SIMILARITY TASK: PROCEDURE

In the task, the participants were to grade the perceived similarity between Norwegian and Polish or between Norwegian and English sounds on a 7-point scale. The instructions were given in Polish. There was a training session to acquaint the participants with the rules.

very dissimilar **1 - 2 - 3 - 4 - 5 - 6 - 7** very similar

Focus on the consonant in the middle.

example NO token 1A 

example NO token 2A 

example NO token 3A 

example NO token 3A 

example PL token 1B 

example EN token 2B 

example PL token 3B 

example EN token 4B 

RATED (DIS-)SIMILARITY TASK: STIMULI

The subjects hear the pair of words, always the embedded phoneme in Norwegian W1, juxtaposed with each of the four phonemes embedded in W2 (two in Polish, two in English):

W1	W2			
Norwegian	Polish		English	
/ʈ/: /'gɑʈɑ/	/t/: /'gata/	/tʂ/: /'gatʂa/	/t/: /'gʌtə/	/tʃ/: /'gʌtʃə/
/t/: /'gata/	/t/: /'gata/	/tʂ/: /'gatʂa/	/t/: /'gʌtə/	/tʃ/: /'gʌtʃə/
/ɖ/: /'gɑɖɑ/	/d/: /'gada/	/d͡ʐ/: /'gad͡ʐa/	/d/: /'gʌdə/	/dʒ/: /'gʌdʒə/
/d/: /'gɑdɑ/	/d/: /'gada/	/d͡ʐ/: /'gad͡ʐa/	/d/: /'gʌdə/	/dʒ/: /'gʌdʒə/
/ʂ-ʃ/: /'gɑʂɑ/	/s/: /'gasa/	/ʂ/: /'gaʂa/	/s/: /'gʌsə/	/ʃ/ /'gʌʃə/
/s/: /'gɑsɑ/	/s/: /'gasa/	/ʂ/: /'gaʂa/	/s/: /'gʌsə/	/ʃ/ /'gʌʃə/
/ɭ/: /'gaɭa/	/l/: /'gala/	/r/: /'gara/	/l/: /'gʌlə/	/r/: /'gʌrə/
/l/: /'gala/	/l/: /'gala/	/r/: /'gara/	/l/: /'gʌlə/	/r/: /'gʌrə/
/ɳ/: /'gaɳa/	/n/: /'gana/	/ɲ/: /'gaɲa/	/n/: /'gʌnə/	/ŋ/: /'gʌŋə/
/n/: /'gana/	/n/: /'gana/	/ɲ/: /'gaɲa/	/n/: /'gʌnə/	/ŋ/: /'gʌŋə/

RATED (DIS-)SIMILARITY TASK: STIMULI GROUPING

Conditions compared with regard to retroflexion of NO vs. PL/EN sounds:

- white: non-matching with regard to retroflexion and the same place and manner of articulation (non-match, same P&MoA)
- grey: non-matching with regard to retroflexion with different place and/or manner of articulation (non-match, diff P&MoA)
- light green: matching with regard to retroflexion and the same place and manner of articulation (match, same_P&MoA)
- dark green: matching with regard to retroflexion and with different place and/or manner of articulation (match, diff P&MoA)

W1	W2			
Norwegian	Polish		English	
/ʈ/: /'gɑʈɑ/	/t/: /'gata/	/tʂ/: /'gatʂa/	/t/: /'gʌtə/	/tʃ/: /'gʌtʃə/
/t/: /'gata/	/t/: /'gata/	/tʂ/: /'gatʂa/	/t/: /'gʌtə/	/tʃ/: /'gʌtʃə/
/ɖ/: /'gɑɖɑ/	/d/: /'gada/	/d͡ʐ/: /'gad͡ʐa/	/d/: /'gʌdə/	/dʒ/: /'gʌdʒə/
/d/: /'gɑdɑ/	/d/: /'gada/	/d͡ʐ/: /'gad͡ʐa/	/d/: /'gʌdə/	/dʒ/: /'gʌdʒə/
/ʂ-ʃ/: /'gɑʂɑ/	/s/: /'gasa/	/ʂ/: /'gaʂa/	/s/: /'gʌsə/	/ʃ/ /'gʌʃə/
/s/: /'gɑsɑ/	/s/: /'gasa/	/ʂ/: /'gaʂa/	/s/: /'gʌsə/	/ʃ/ /'gʌʃə/
/ɭ/: /'gaɭa/	/l/: /'gala/	/r/: /'gara/	/l/: /'gʌlə/	/r/: /'gʌrə/
/l/: /'gala/	/l/: /'gala/	/r/: /'gara/	/l/: /'gʌlə/	/r/: /'gʌrə/
/ɳ/: /'gaɳa/	/n/: /'gana/	/ɲ/: /'gaɲa/	/n/: /'gʌnə/	/ŋ/: /'gʌŋə/
/n/: /'gana/	/n/: /'gana/	/ɲ/: /'gaɲa/	/n/: /'gʌnə/	/ŋ/: /'gʌŋə/

RATED (DIS-)SIMILARITY TASK: HYPOTHESIS

We hypothesized a hierarchy which demonstrates the gradation of phonological proximity based on retroflexion and place and/or manner of articulation (P&MoA):

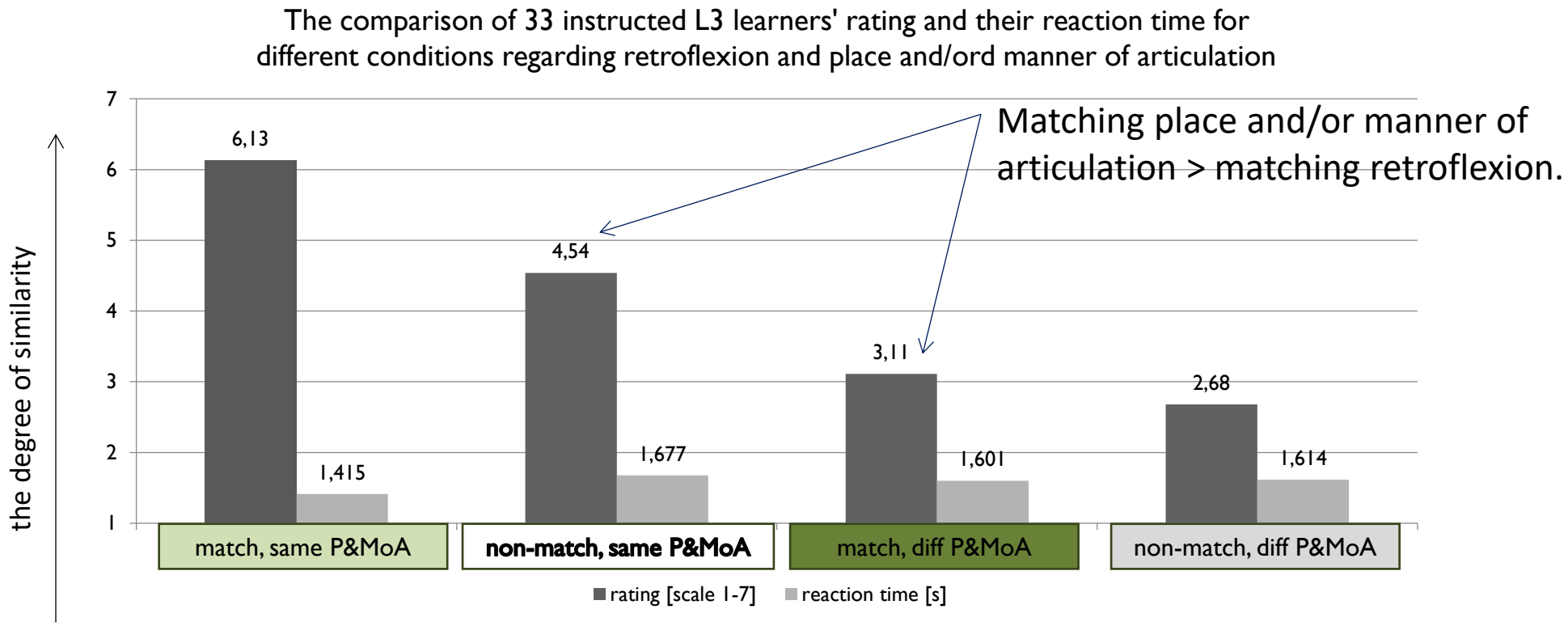
gradually from the most similar (1) to the least similar (4) ↓

	condition	retroflexion	place and/or manner of articulation
1	match, same P&MoA	+	+
2/3?	non-match, same P&MoA	–	+
	match, diff P&MoA	+	–
4	non-match, diff P&MoA	–	–

What will take precedence?
- matching retroflexion
- matching place and/or manner of articulation?

RATED (DIS-)SIMILARITY TASK: RESULTS ACCORDING TO MATCHING RETROFLEXION AND P&M OF ARTICULATION

NO vs. PL
+
NO vs. EN



- The proposed hierarchy of phonological proximity ✔

RATED (DIS-)SIMILARITY: HYPOTHESIS ON THE ROLE OF LANGUAGE

Do (dis-)similarity ratings in each condition differ according to the language (L1/L2)?

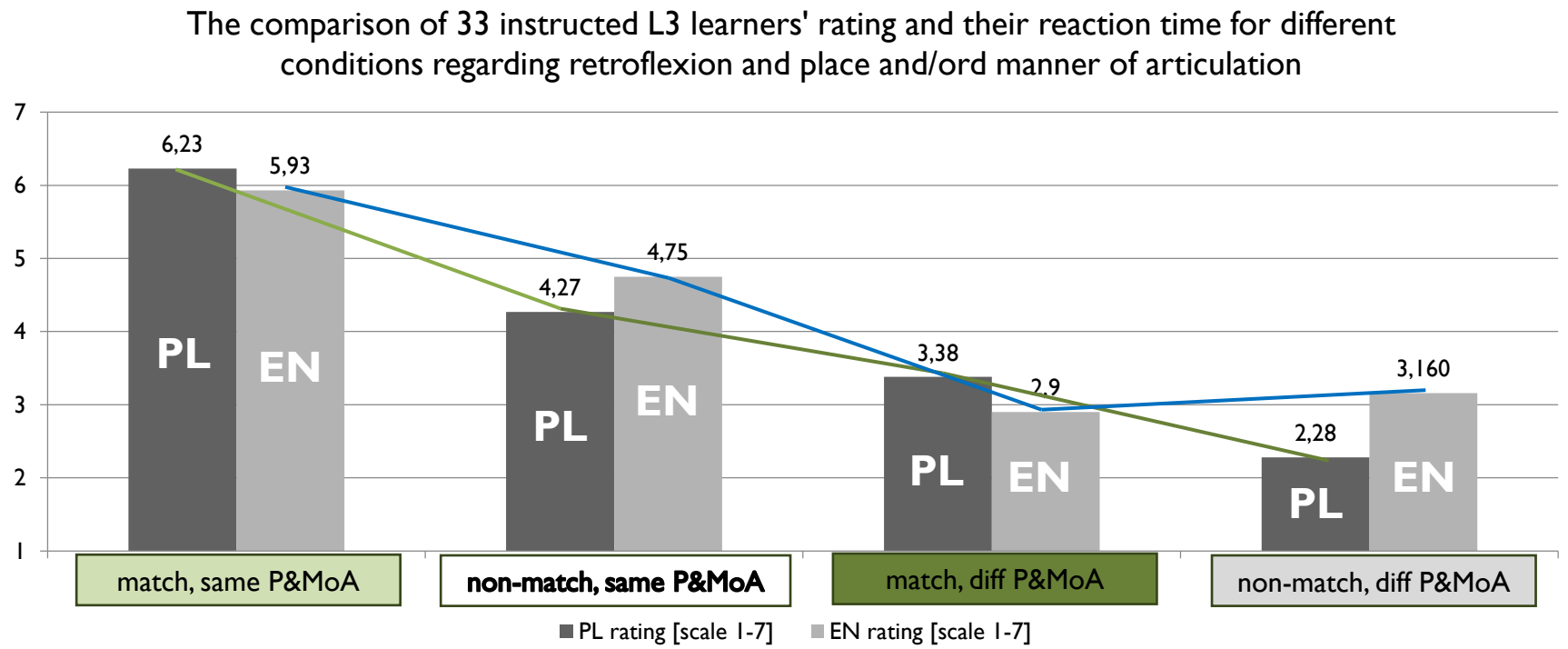
We hypothesize that the dissimilarity ratings for both L1 Polish and L2 English will be arranged according to the proposed hierarchy of phonological proximity.

gradually from the most similar (1) to the least similar (4)

	condition	retroflexion	place and/or manner of articulation
1	match, same P&MoA	+	+
2/3?	non-match, same P&MoA	–	+
	match, diff P&MoA	+	–
4	non-match, diff P&MoA	–	–

- Will matching place and/or manner of articulation take precedence over matching retroflexion for both L1 Polish and L2 English?
- Are there differences between L1 and L2?

RATED (DIS-)SIMILARITY TASK RESULTS: SPLIT BY LANGUAGE



trend line across conditions for L1 Polish

trend line across conditions for L2 English

Reaction times [s]:

condition	PL	EN
match, same P&MoA	1.397	1.524
non-match, same P&MoA	1.758	1.612
match, diff P&MoA	1.686	1.533
non-match,_diff P&MoA	1.476	1.780

- For L2 English, matching retroflexion yielded lower similarity ratings than non-matching retroflexion in the case of different P&MoA.
- Comparing matching retroflexion (match, same P&MoA and match, diff P&MoA) with non-matching retroflexion (non-match, same P&MoA and non-match, diff P&MoA), we found that matching retroflexion elicited higher perceived similarity values for L1 than for L2, whereas non-matching retroflexion elicited higher perceived similarity values for L2 than for L1 .

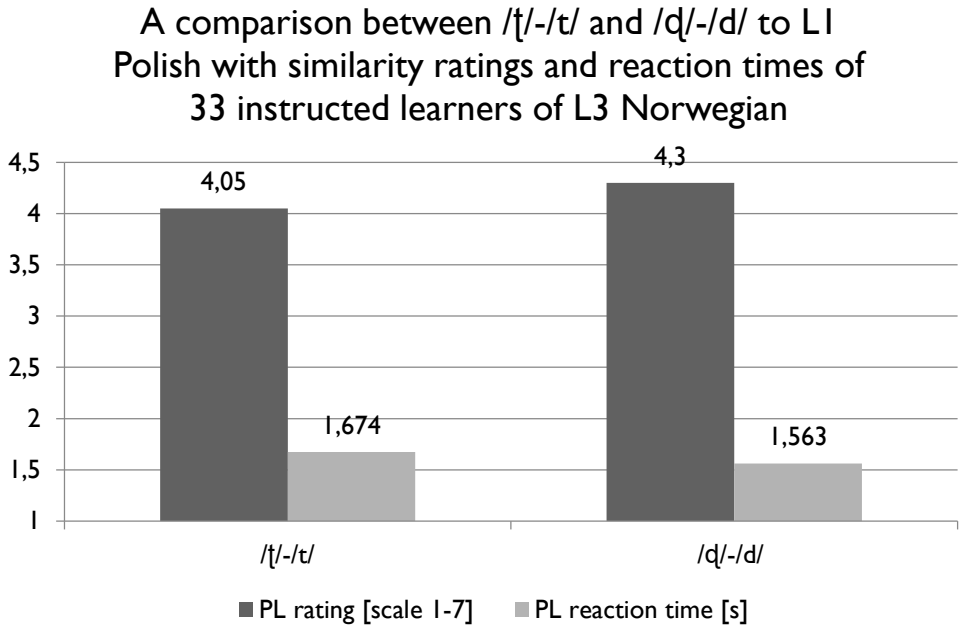
RATED (DIS-)SIMILARITY TASK: FOCUS ON NORWEGIAN STOP RETROFLEXES

A cross-linguistic comparison between /ʈ/-/t/ and /ɖ/-/d/, taking all four conditions together.

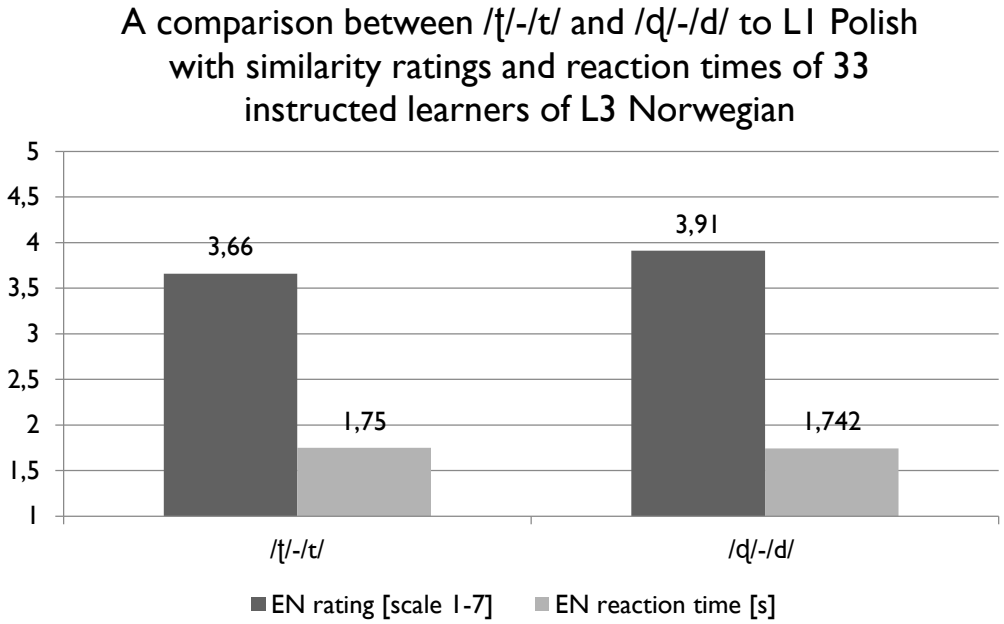
We hypothesize that there should be no statistically significant differences between the similarity ratings for NO /ʈ/-/t/ and /ɖ/-/d/ both when compared to L1 Polish and when compared to L2 English.

We assume, though, that there will be differences between similarity ratings for NO /ʈ/-/t/ and /ɖ/-/d/ compared to L1 and L2 sounds .

RATED (DIS-)SIMILARITY TASK: RESULTS FOR NORWEGIAN STOP RETROFLEXES



L1 Polish



L2 English

- The perceived similarity between /ɖ/-/d/ and the counterparts was slightly higher than between /ʈ/-/t/ and the counterparts, in the case of comparisons with both Polish and English sounds.
- Ratings for /ɖ/-/d/ are higher than ratings for /ʈ/-/t/ when compared to counterparts in both languages (0.25 point); yet overall similarity ratings were higher for L1 Polish than for L2 English (approx. 0.4 point).

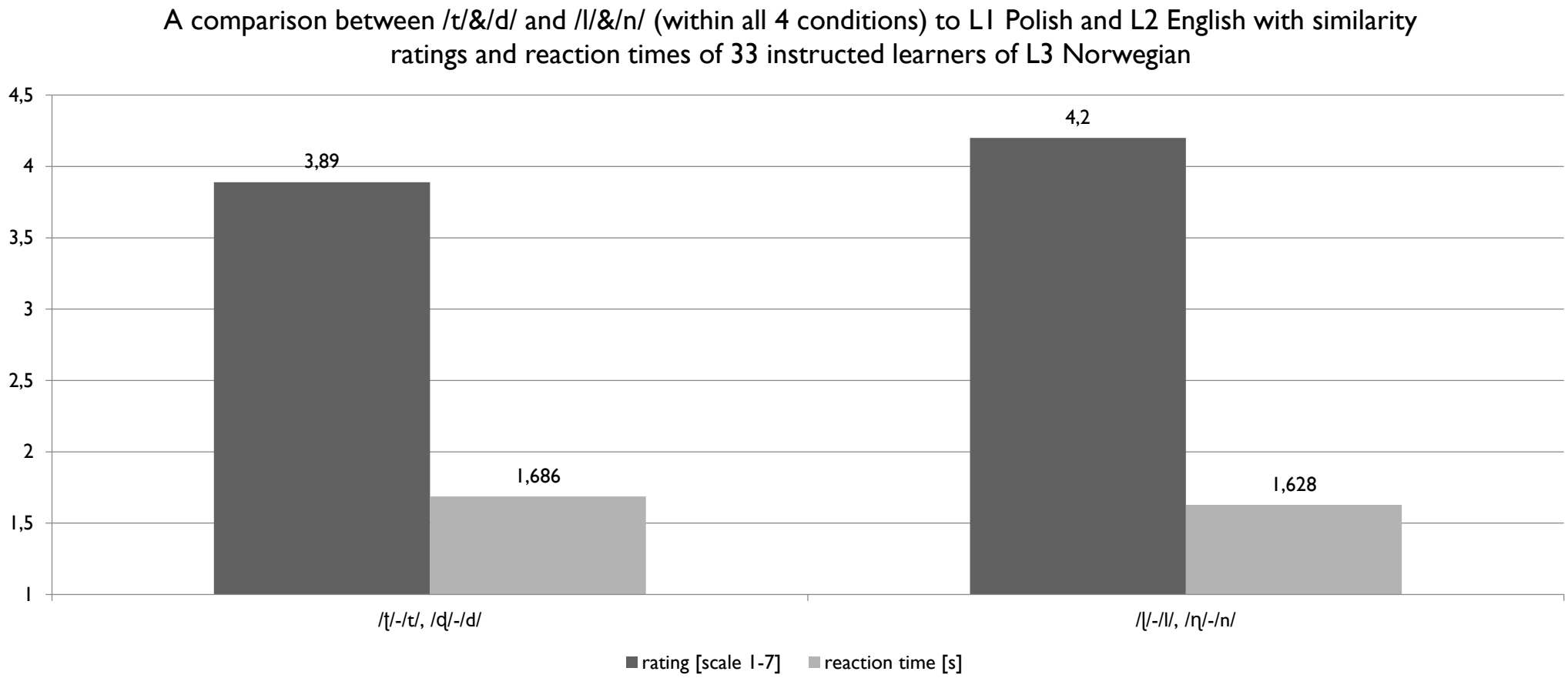
RATED (DIS-)SIMILARITY TASK: STOPS VS. SONORANTS

Are there differences in (dis-)similarity ratings for stops (/ʈ/-/t/, /ɖ/-/d/) and sonorants (/ɭ/-/l/, /ɳ/-/n/)?

We hypothesize that sonorants (/ɭ/-/l/, /ɳ/-/n/) will exhibit different patterns than stops (/ʈ/-/t/, /ɖ/-/d/) across conditions due to their different phonological nature?

We compared a balanced pair across conditions for /ʈ/-/t/, /ɖ/-/d/ vs. /ɭ/-/l/, /ɳ/-/n/ in L1 Polish and L2 English.

RATED (DIS-)SIMILARITY TASK: STOPS VS. SONORANTS



DISCRIMINATION TASK IN L3 NORWEGIAN

Categorial Discrimination task (e.g., A1 A2 B1): Which of the words is different?

A1 *garla /gɑɭɑ/ A2 *garla /gɑɭɑ/ B1 *gala /gɑlɑ/

Oddity paradigm

All twelve possible combinations were presented randomly over trials within a test

A1A2B1, A1B1A2, B1A1A2, A1B1B2, B1A1B2, B1B2A1

A2A1B1, A2B1A1, B1A2A1, A1B2B1, B2A1B1, B2B1A1

where:

- A1 and A2 – a retroflex embedded in a token read by two different speakers
- B1 and B2 – a non-retroflex embedded in a token read by two different speakers
- each trial consisted of **three tokens read by three different speakers**

DISCRIMINATION TASK: STIMULI

- Stimuli:

- retroflexes embedded in non-existing words in [C]/a/[Cr]/a/ pattern and their non-retroflex counterparts [C]/a/[Cn-r]/a/,
  - investigated retroflexes: /ʈ, ɖ, ɭ, ɳ, ʂ/, e.g.,
    - **varta* /vaʈa/ vs. **vata* /vata/
    - **farda* /faɖa/ vs. **fada* /fada/
    - **karla* /kaɭa/ vs. **kala* /kala/
    - **garna* /gaɳa/ vs. **gana* /kana/
    - **farsa* /faʂa/ vs. **fasa* /fasa/

/a/ – the vowel /a/

[C] – one of the consonants /g/ /v/ /k/ or /f/

[Cr] – one of the consonants which is a retroflex: /ʈ, ɖ, ɭ, ɳ, ʂ/

[Cn-r] – one of the consonants which is a non-retroflex: /t, d, l, n, s/

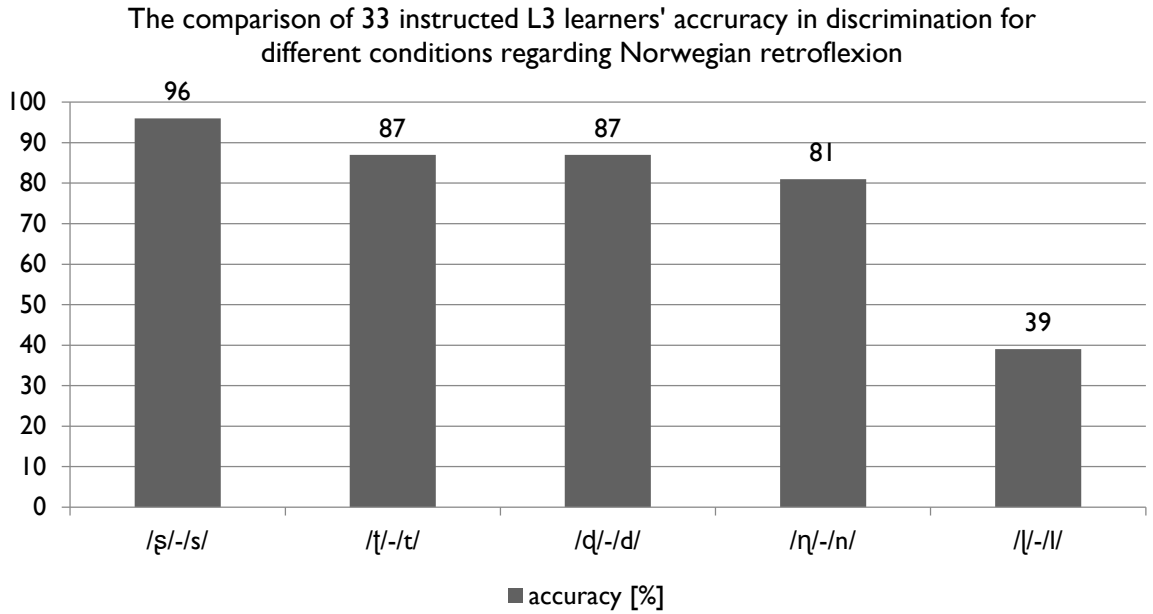
DISCRIMINATION TASK: HYPOTHESIS

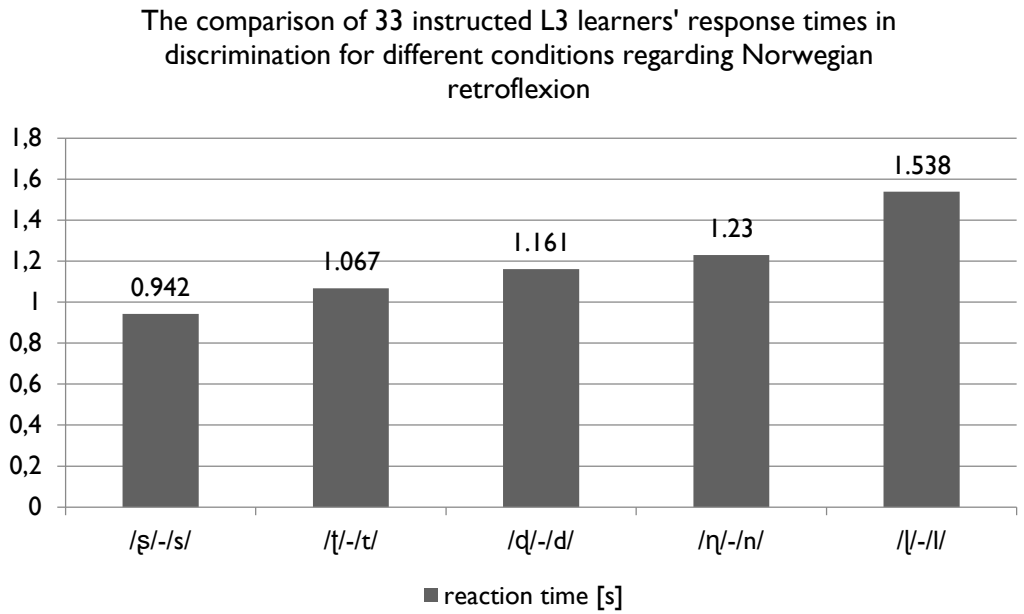
We hypothesize that discrimination in pairs involving the retroflex /ʂ-ʃ/ as opposed to the non-retroflex /s/ may be enhanced compared to other retroflex-non-retroflex pairs, as learners are familiar with this phonemic distinction from their L1 or L2.

Disrimination accuracy for stop retroflexes is hypothesized to be intermediate, because of similarity to allophonic realizations.

The lowest accuracy rates are hypothesized for /ɭ, ɳ/ retroflexes than for other retroflex-non-retroflex pairs, as learners are not familiar with the former either from their L1 or L2.

DISCRIMINATION TASK: RESULTS





- ceiling discrimination of /ʂ/-/s/ (96%);
- highly accurate scores for /ʈ/-/t/ and /ɖ/-/d/ pairs (both 87%);
- 81% for /ɳ/-/n/;
- below chance level discrimination rates for /ɭ/-/l/ (39%);

The results can generally be accounted for by the familiarity with L1 and L2 retroflexion patterns. Discrepancy between accuracy rates for /ɳ/-/n/ and /ɭ/-/l/.

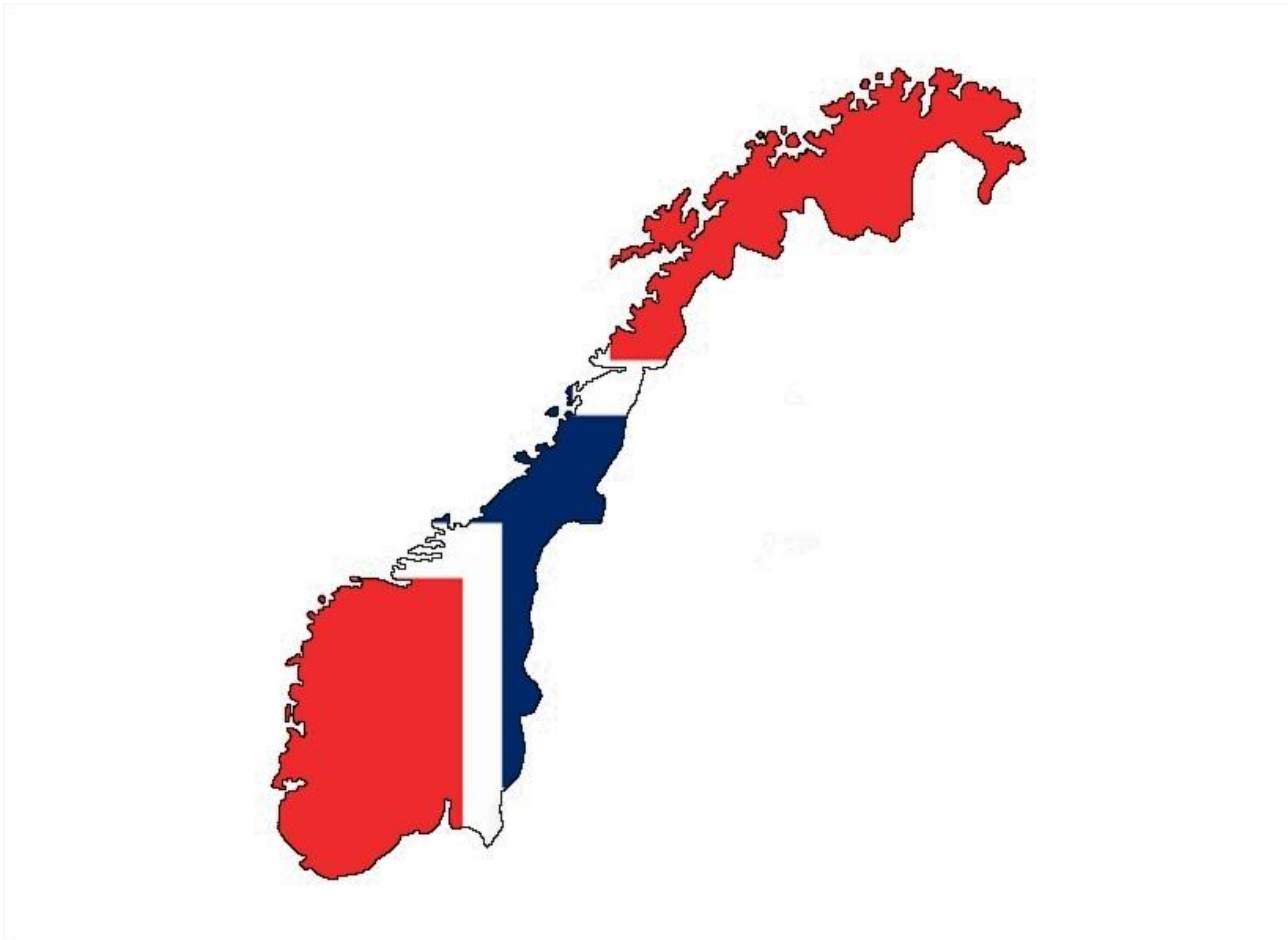
FUTURE PLANS

- We hope to shed novel light on the non-native speech perception from the multilingual acquisition perspective.

- Statistical analysis.

- We gathered control data from 35 L1 Polish L2 English participants. Our plan is to compare the results and test the influence of proficiency (advanced classroom setting learners vs. learners with no knowledge of Norwegian) in the perception of Norwegian retroflexion.

- We are gathering baseline data for retroflex discrimination by native Norwegian listeners.



THANK YOU!!

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