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# Exploring spectral overlap in L1 Polish, L2 English and L3 Norwegian vowels

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# Introduction

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- Part of a larger project investigating multilingual acquisition in L1 Polish – L2 English – L3 Norwegian learners
- Project: Cross-linguistic influence in multilingualism across domains: Phonology and syntax (CLIMAD)
- Longitudinal design (T1, T2, T3)
- Aim of this pilot study: preliminary exploration of cross-linguistic interactions in multilinguals' vowel systems



# Overview: L3 vowel acquisition



- Missaglia 2010
  - Italian-German child bilinguals, L3 English
  - Bilingual advantage for learning vowels in L3
- Sypiańska 2013, 2016
  - L1 Polish, L2 Danish and L3 English
  - Focus: Polish /ɛ/, Danish /e, ɛ, æ/ and English /e/
  - L3 influenced L1 and L2 vowel formants,
  - Multilinguals' vowel space subject to reshaping in all three languages -> less peripheral, different from monolingual baseline data



# Overview: L3 vowel acquisition



- Kopečková et al. 2016
  - L1 German, L1/L3 Polish (Heritage speakers), L2 English
  - Great individual variability in vowel production in all three languages
  - Language status is a factor shaping multilingual phonological subsystems



# Study design: participants

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- 15 participants (all aged 21)
  - 9 female participants reported on here
- 3rd-year students in a Norwegian modern language BA programme
- L1 Polish, L2 English, L3 Norwegian (B1)
- Participant profiles:
  - Leap-Q Language Experience and Proficiency Questionnaire (Marian et al. 2007)



# Study design: tasks



- Several tasks
- Here, reading of sentences and isolated words to elicit all the vowel phonemes in the 3 languages
- Real and nonce words in (dVd, dVt) in a carrier sentence and in isolation, e.g.
  - There's the same vowel in “god” and “dod”
- Three language blocks (L1, L2, L3)



# Study design: procedures

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- Remotely controlled recording procedure due to Covid-19 restrictions
  - Participants read slides presented remotely
  - Used their smartphones to record themselves locally



# Processing and measurement



- Forced alignment (WebMAUS, Kisler et al. 2017)
- Target vowel boundaries manually corrected by three phoneticians
- Averages of the first three formants measured in the central portion (30–70%) of each vowel
- Normalized according to Fabricius and Watt (2009)
- Durations measured



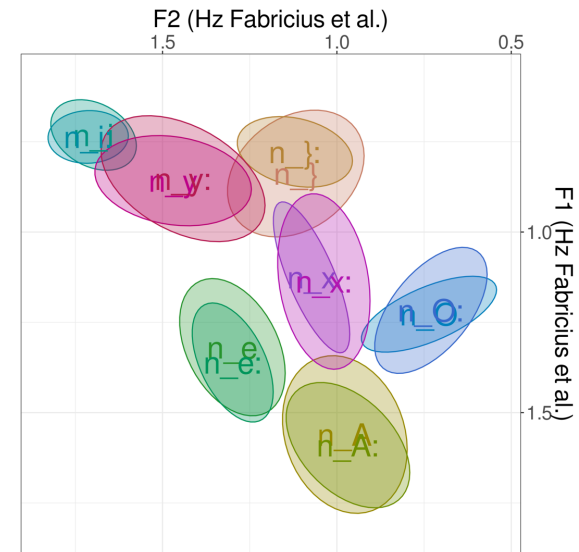
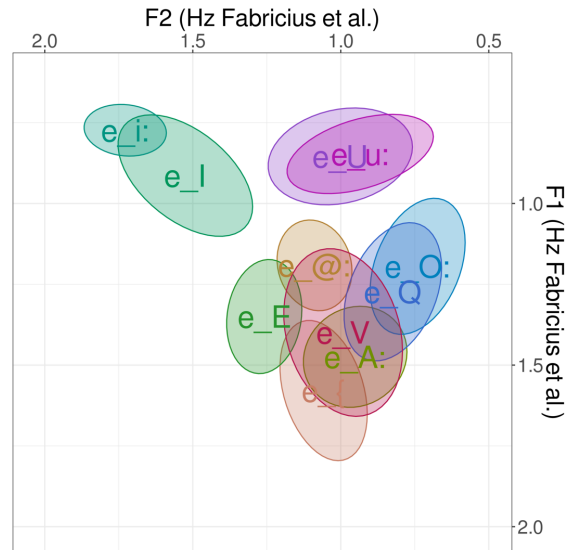
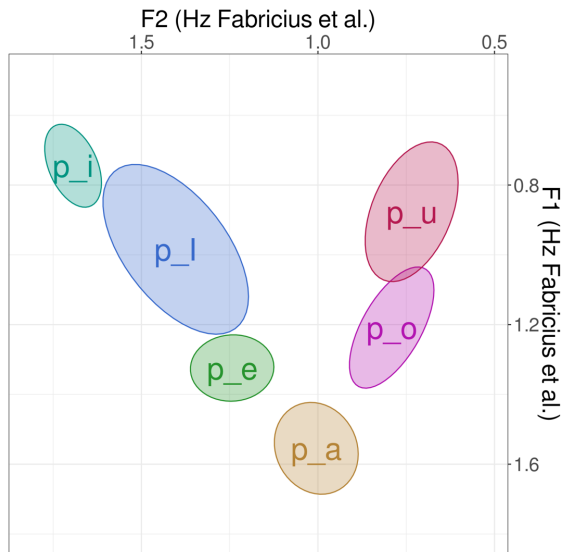
# Research questions



- RQ1: Do multilingual learners keep their vocalic systems apart?
  - > language-specific phonological categories
- RQ2: What are the interactions between the three vocalic subsystems in multilingual learners?
  - > L1->L2, L1->L3, L2->L3
- RQ3: What drives the overlap between pairs of cross-linguistically adjacent vowels?
  - > language status, frequency of use, chronology of acquisition or dominance?



# Results

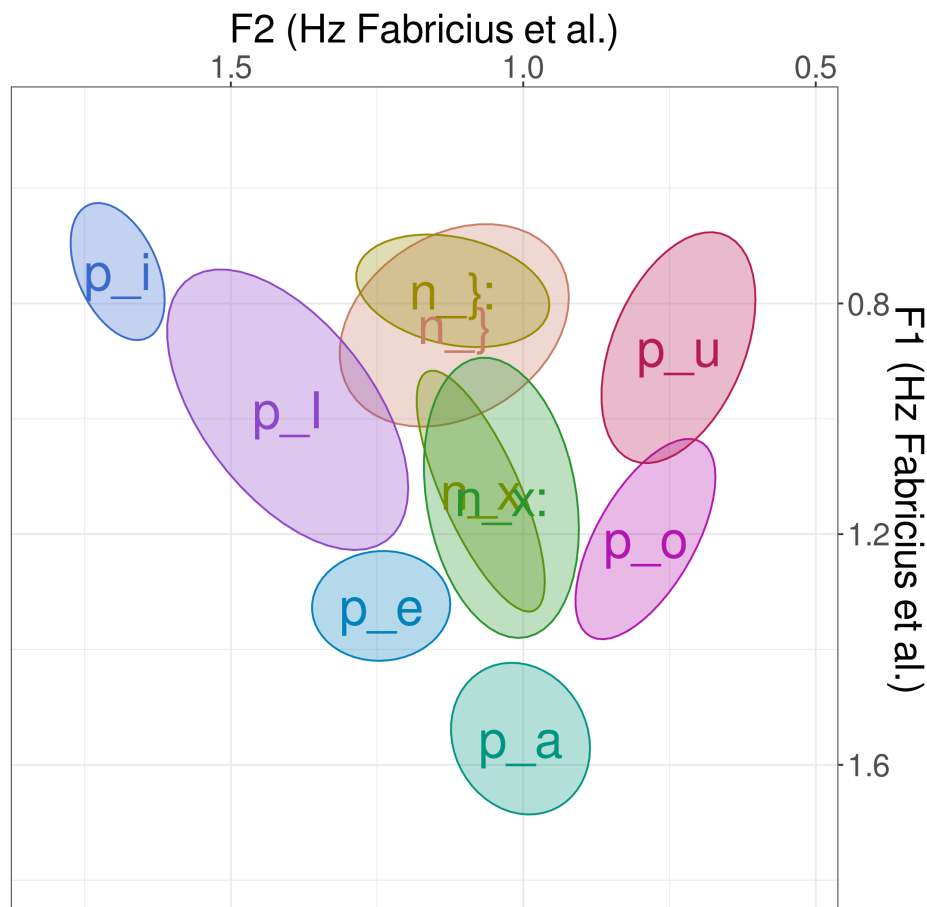






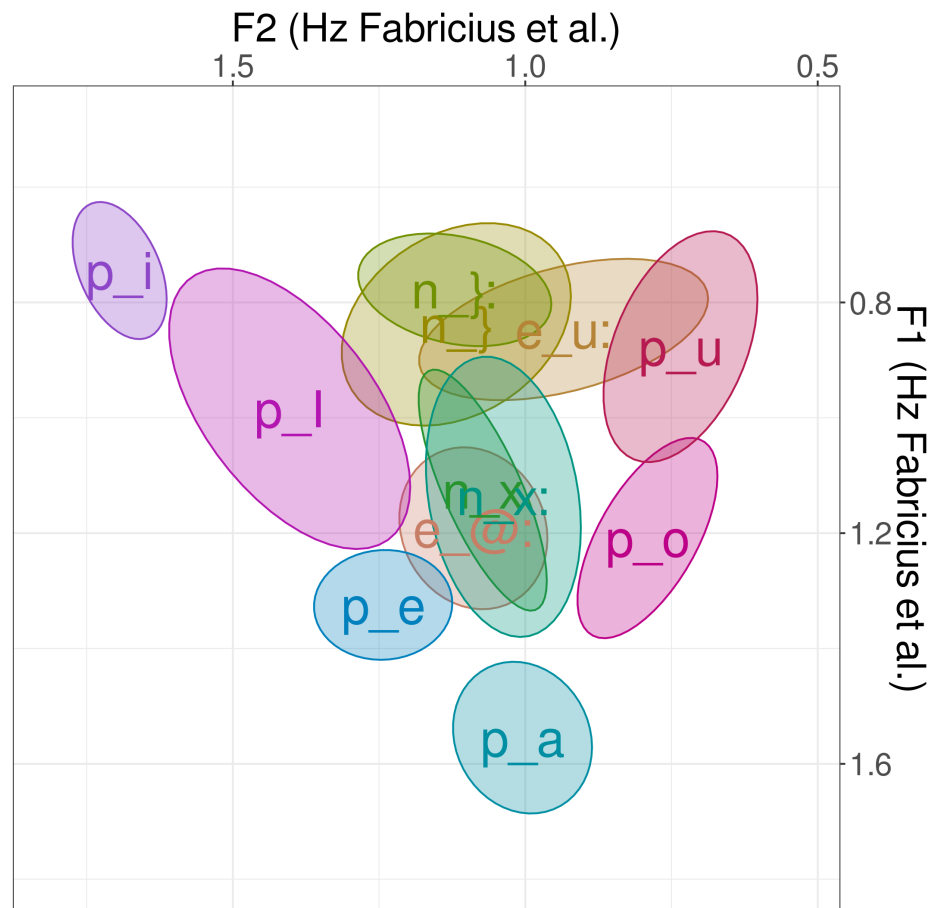


# no /ɤ(:)/ /ø(:)/ separate from pl





# But add English GOOSE/NURSE...







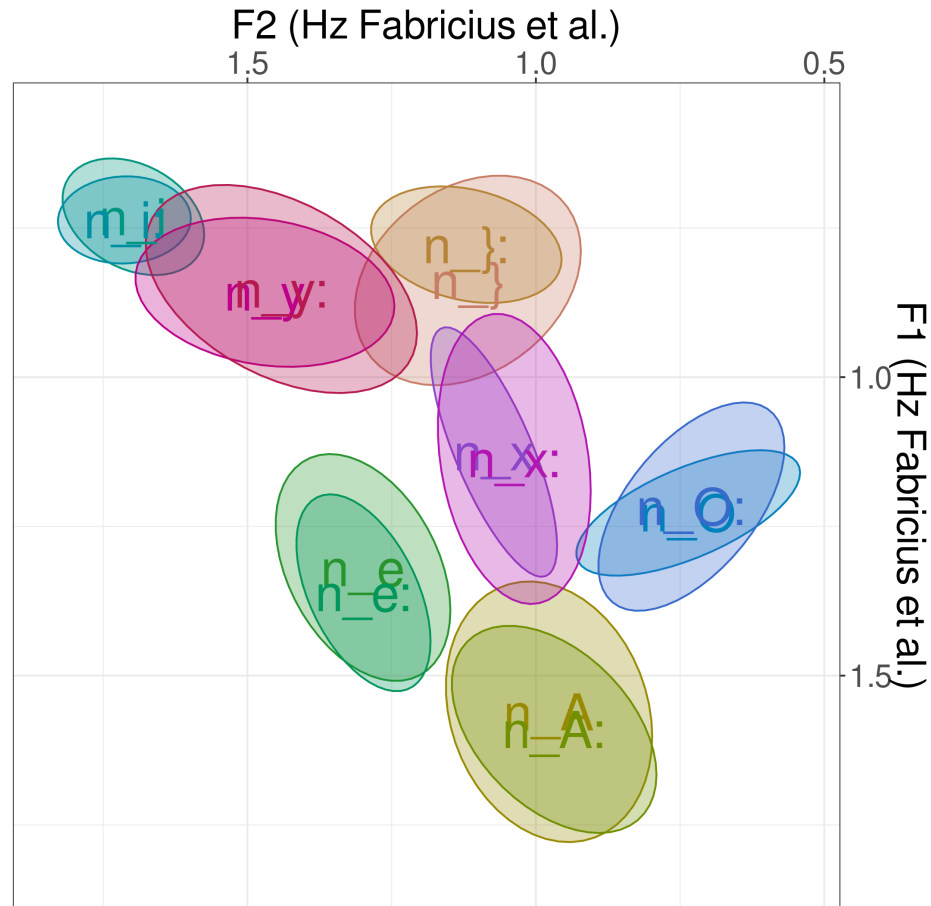
# Pillai scores

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- GUD vs. pl /i/: 0.69
- GUD vs. pl /u/: 0.75
- LØP vs. pl /ε/: 0.45
- LØP vs. pl /ɔ/: 0.58
- GUD vs. GOOSE: 0.21
- GOOSE vs. pl /u/: 0.33



# Norwegian categories





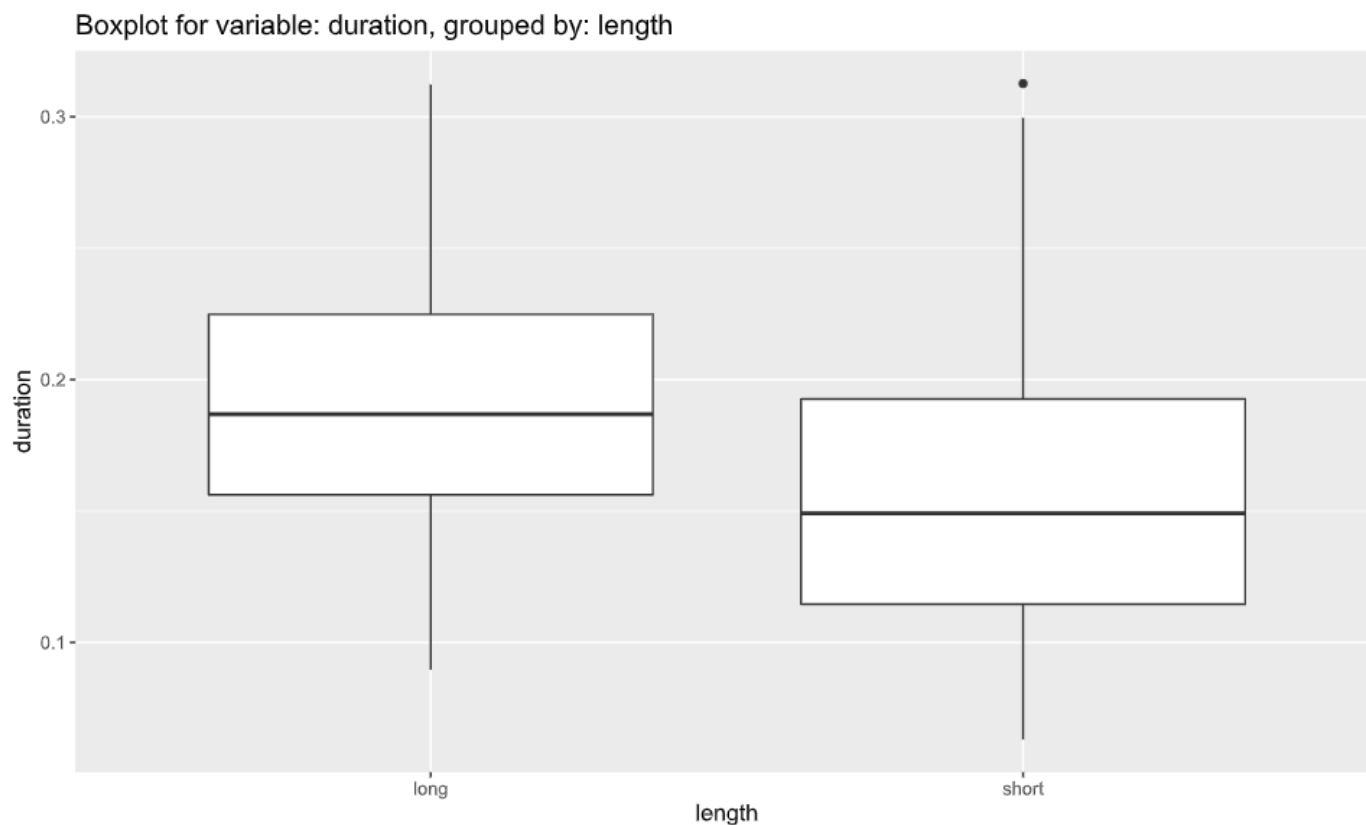
# Pillai scores (long vs. short)



- TID vs. MITT: 0.002
- STED vs. BEST: 0.015
- DAG vs. TAKK: 0.005
- RÅD vs. FÅTT: 0.003
- BOK vs. BORT: 0.05
- GUD vs. SLUTT: 0.082
- LYS vs. SYND: 0.005
- LØP vs. SØNN: 0.015

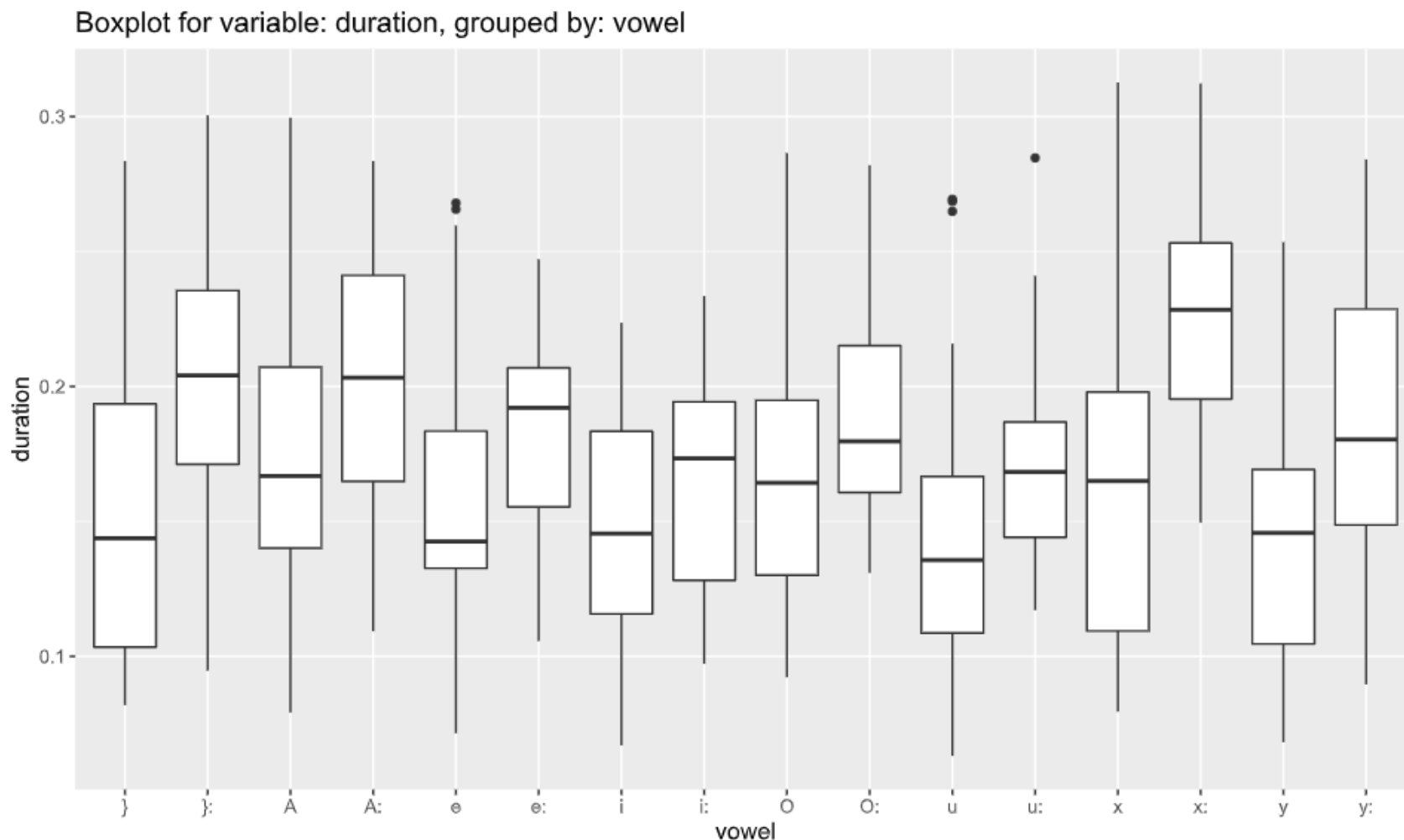


# Duration averages for Norwegian





# Duration averages for Norwegian







# Mixed model for duration

- Best model includes only phonological length and F2 as fixed effects, speaker and vowel as random effects

Random effects:

Groups	Name	Variance	Std.Dev.
vowel	(Intercept)	0.0001191	0.01091
speaker	(Intercept)	0.0015714	0.03964
Residual		0.0011850	0.03442

Number of obs: 351, groups: vowel, 16; speaker, 11

Fixed effects:

	Estimate	Std. Error	df	t value	Pr(> t )	
(Intercept)	1.931e-01	1.586e-02	3.001e+01	12.179	3.84e-13	***
embedding.Embedded	-2.421e-03	1.839e-03	3.241e+02	-1.317	0.188883	
f1	2.984e-06	9.048e-06	2.781e+02	0.330	0.741854	
f2	-1.166e-05	5.212e-06	4.479e+01	-2.238	0.030250	*
length.long	1.626e-02	3.294e-03	1.388e+01	4.936	0.000224	***

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Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1



# Summary



- Additional L2 and L3 spectral categories seem most robust in areas unoccupied by L1 vowels
  - Cf. our related perception study
- It seems that there is at least some differentiation between L2 and L3 in these more advanced students
- However, less differentiation is seen in our T1 data from the main project
  - In particular, there is a “foreign [u]” effect conflating Norwegian GUD/SLUTT and English GOOSE



# Summary



- Orthography is a major complicator
  - Norwegian BOK/ROM is highly diffuse, with [ɔ], [o], [u] and [ʊ]-like qualities
- Dialectal differences also complicate the picture
  - Ironically, more for English than for Norwegian
- For more the subtle spectral categorization in Norwegian, duration seems to trump spectral effects
  - Again, this is more visible in or T1 data



# Conclusion



- RQ1: Do multilingual learners keep their vocalic systems apart?
  - > language-specific phonological categories in L3
  - > English L2 less stable, subject to variability
- RQ2: What are the interactions between the three vocalic subsystems in multilingual learners?
  - > prevailingly L1>L3, but some L2>L3
- RQ3: What drives the overlap between pairs of cross-linguistically adjacent vowels?
  - > main predictor – intensity of L3 use





# Future directions

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- T1 data from the main project seem to show similar patterns
  - From less advanced students
- In particular
  - Norwegian front rounded vowels are already present
  - Duration is used to distinguish spectrally similar pairs
- T2 data already collected but not yet analyzed



# Future directions

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- We will be trying to investigate the effect of overt instruction
  - The main project participants are 1st-year students with no history of stays in Norway
- The patterns identified will be subject to in-depth analysis in another project



# Acknowledgement

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# References



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