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HANYANG INTERNATIONAL SYMPOSIUM
ON PHONETICS AND COGNITIVE SCIENCE OF LANGUAGE 2023

Covariation between fine phonetic detail and outcomes of sound change in the microtypology of Jutland Danish dialects

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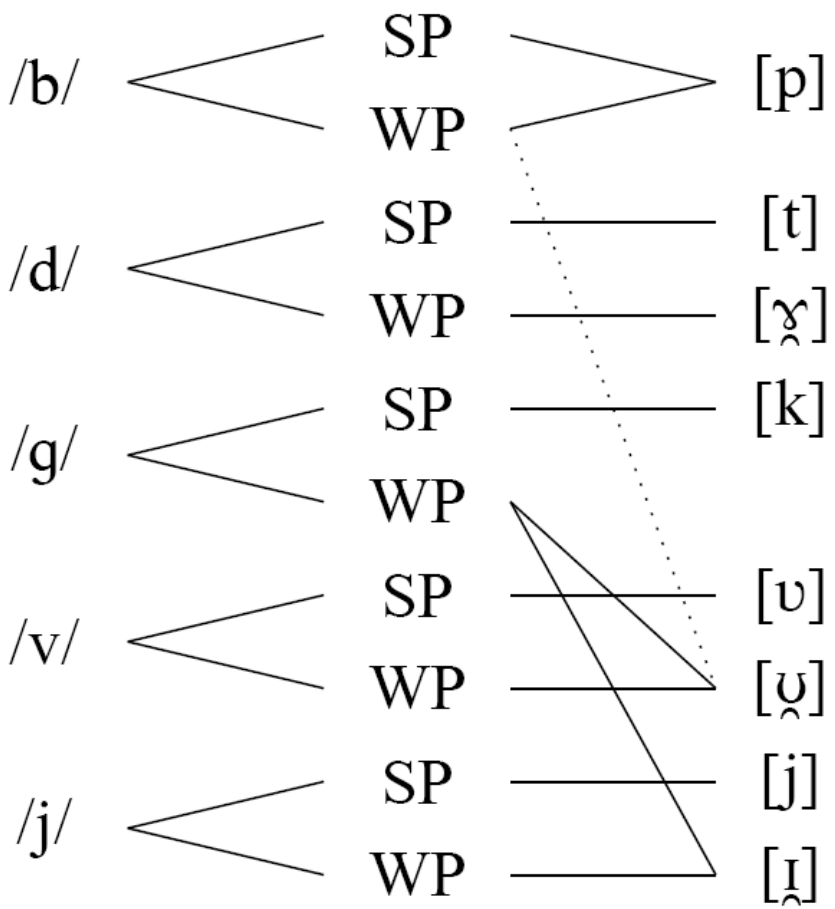
Phonological variation in Danish final stop lenition mirrors variation in the fine phonetic detail of initial stop realization

Stop gradation

- Danish has an important phonological distinction between **strong** and **weak** prosodic positions
  - **Strong position** is syllable-initial before full vowels
  - **Weak position** is syllable-final or syllable-initial before [ə ɐ (i)]
- In **Modern Standard Danish**, strong allophones are all voiceless
  - Contrast between unaspirated [p t k] and aspirated [pʰ tʰ kʰ]
- Weak and strong 'allophones' are sometimes radically different



Rischel (1970), Basbøll (2005), Horslund et al. (2022), Puggaard-Rode et al. (2022), Puggaard-Rode (2023)

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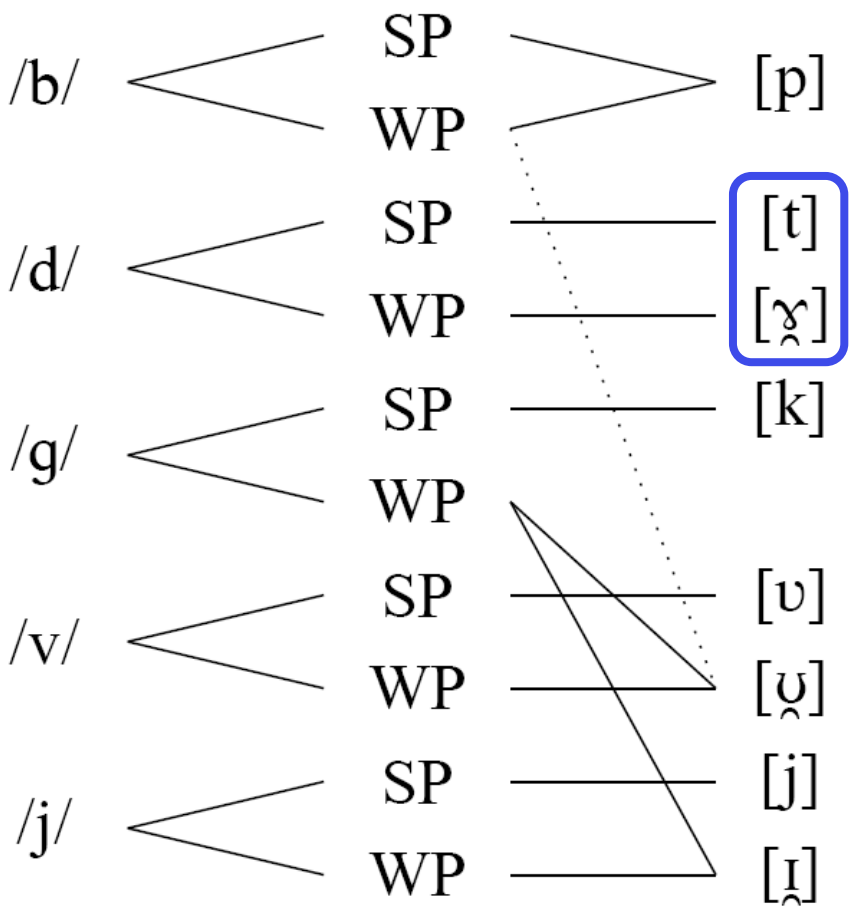

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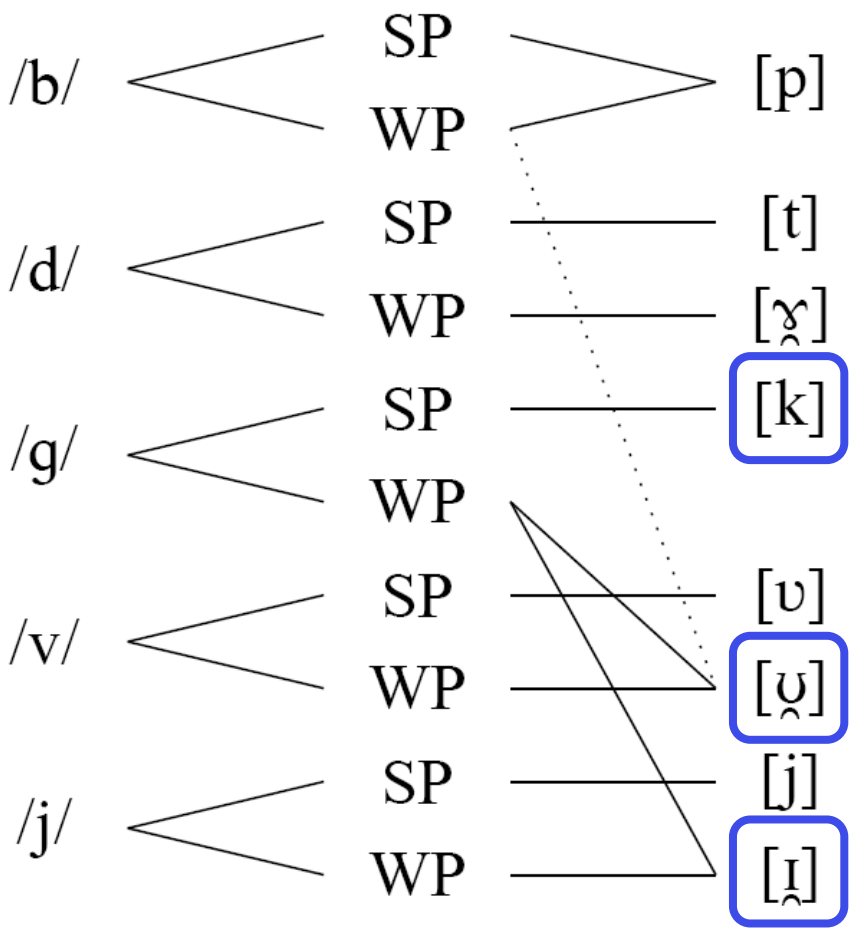

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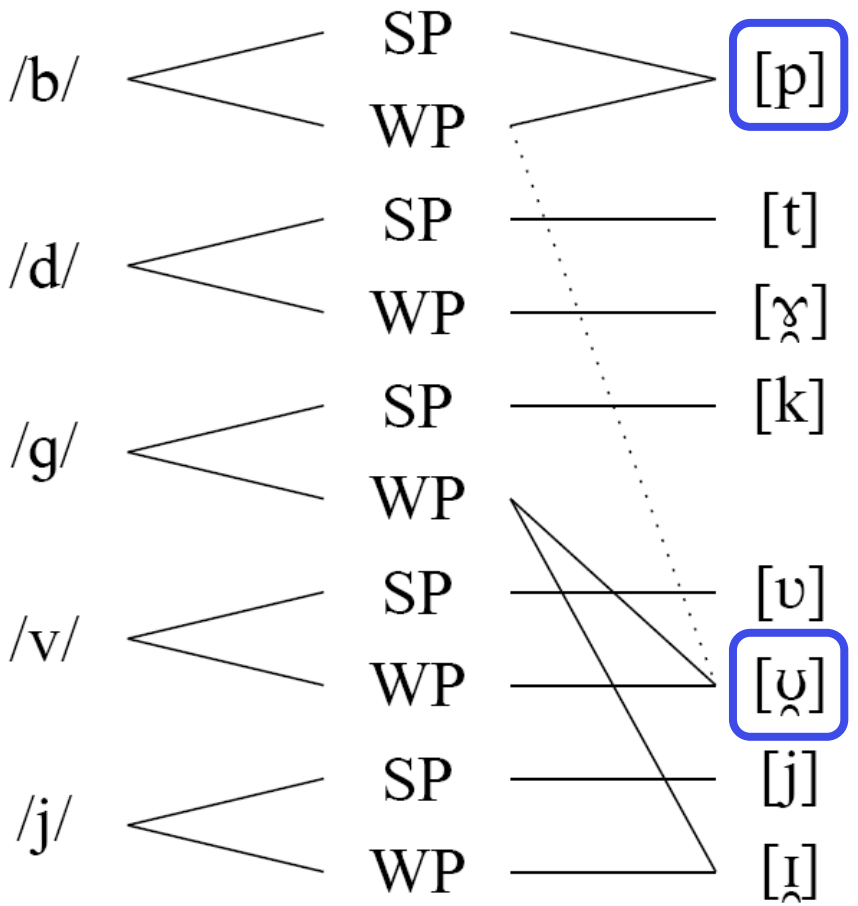

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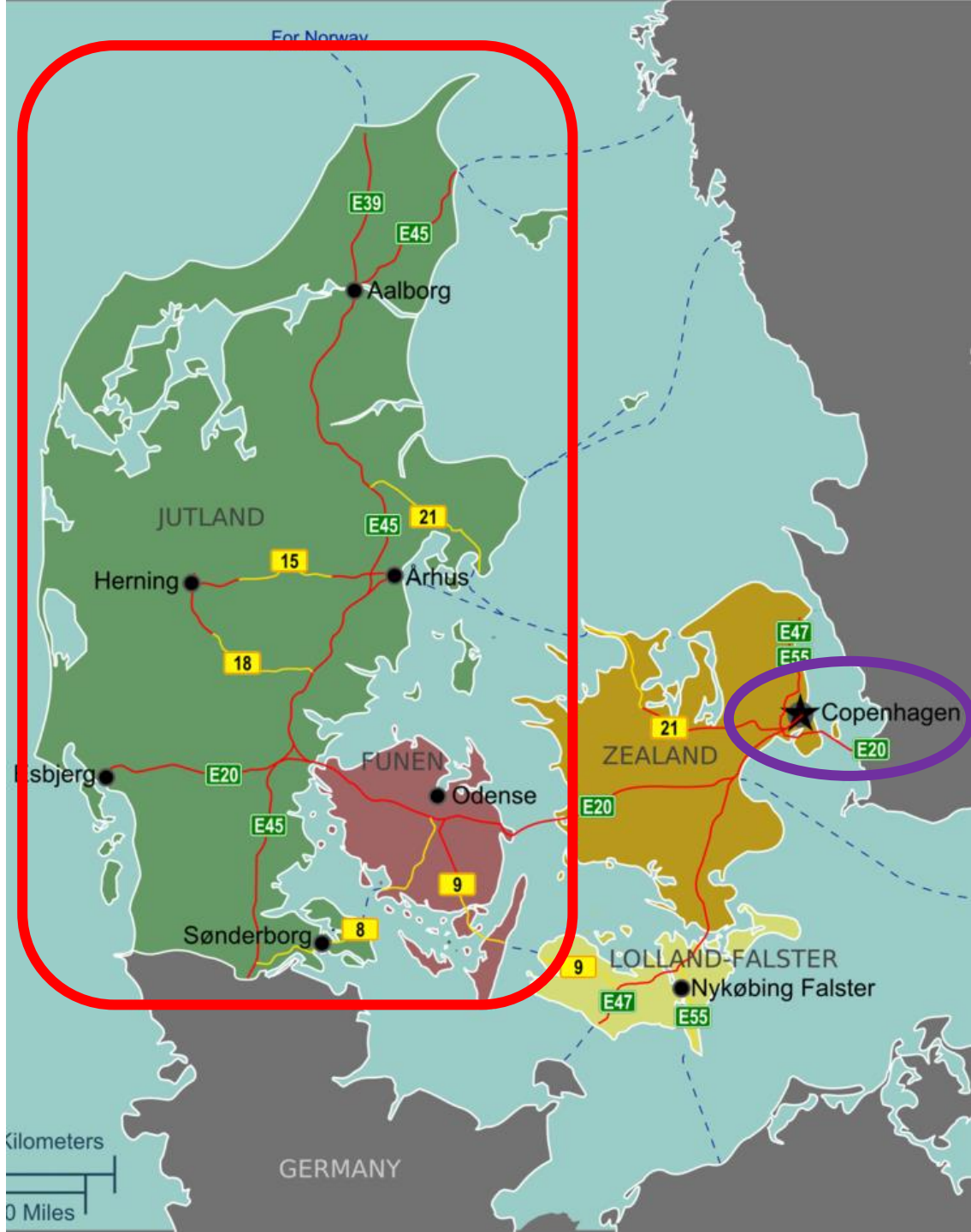
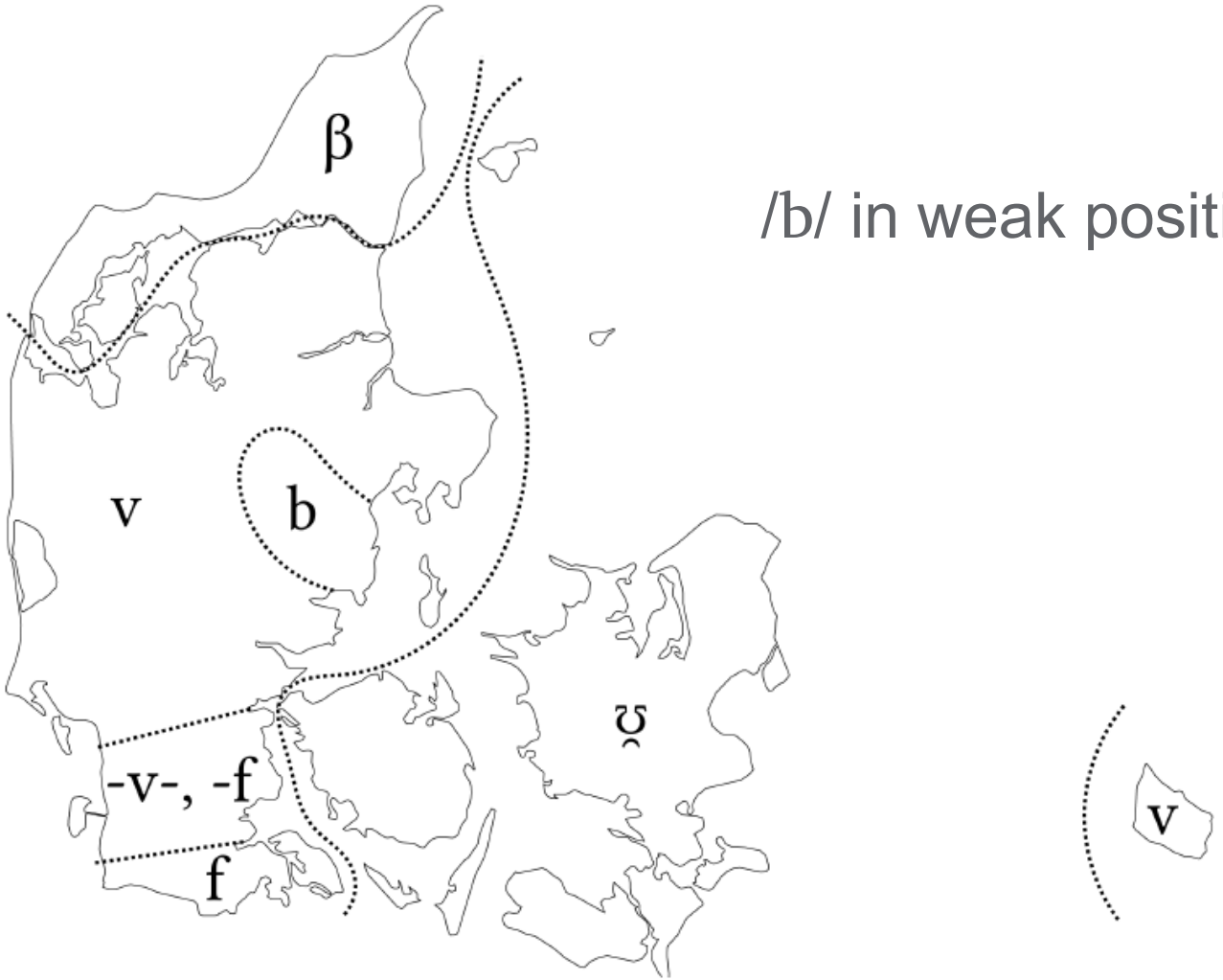

E39
E45
Aalborg
JUTLAND
E45
21
15
Herning
Århus
18
E47
E55
Copenhagen
21
E20
ZEALAND
FUNEN
Esbjerg
E20
Odense
E20
E45
9
8
Sønderborg
9
LOLLAND-FALSTER
Nykøbing Falster
E47
E55
GERMANY
Kilometers
0 Miles

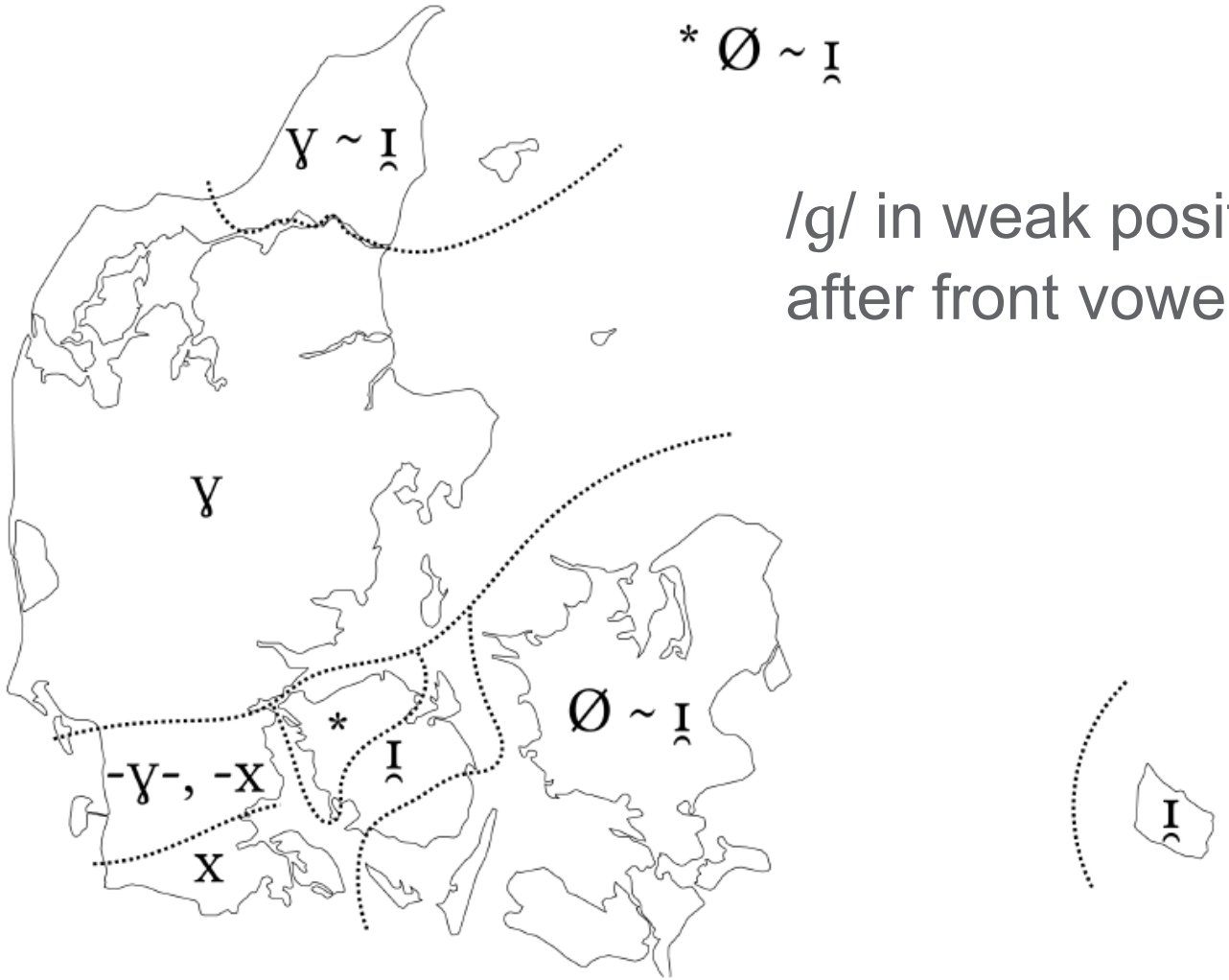
Geographical distribution of stop gradation



/b/ in weak position

Bennike & Kristensen (1898–1912)

Geographical distribution of stop gradation



/g/ in weak position after front vowels

Bennike & Kristensen (1898–1912)

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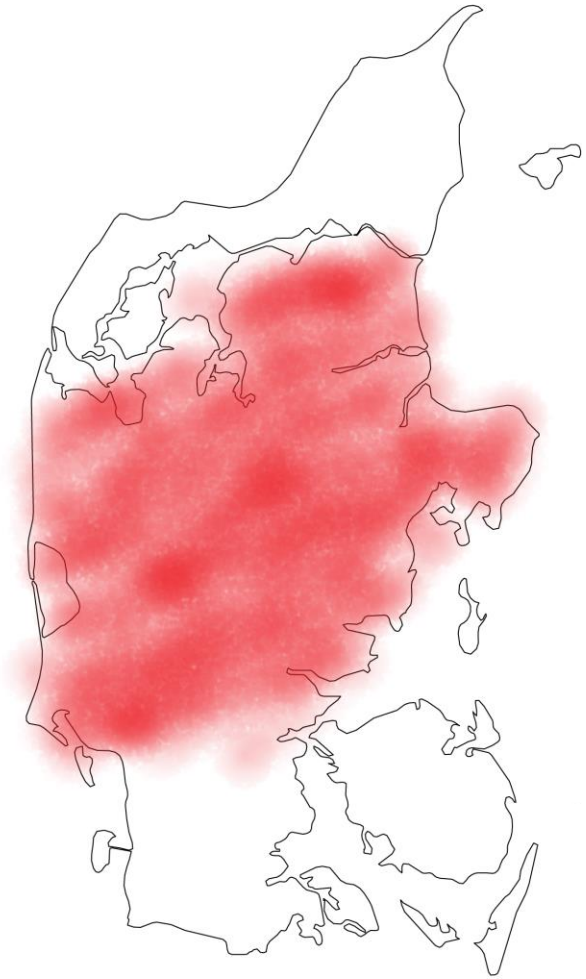
Geographical distribution of stop gradation



Voiced fricatives

Bennike & Kristensen (1898–1912)

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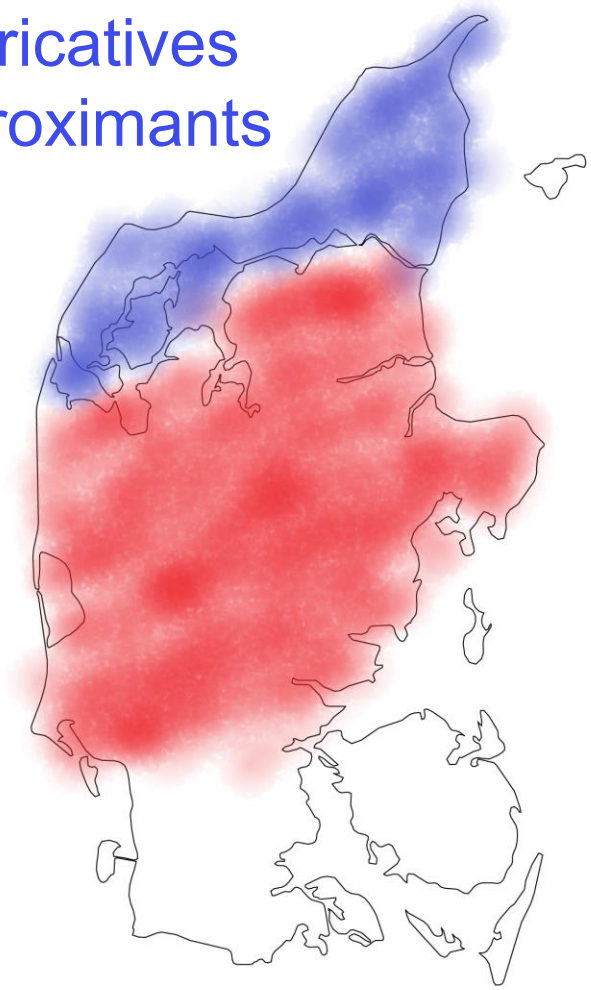
Geographical distribution of stop gradation

Voiced fricatives
OR approximants



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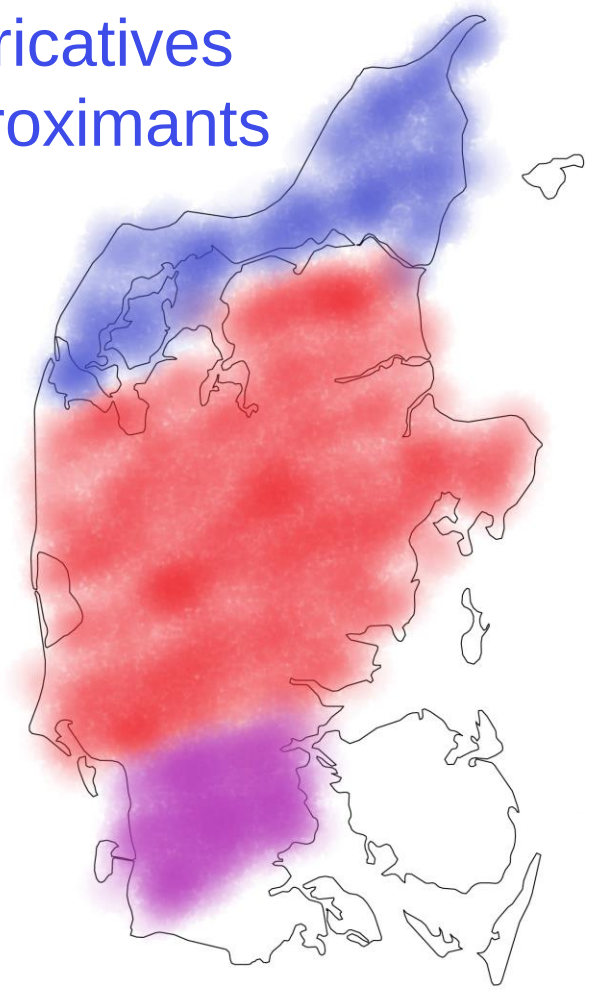

Voiced
fricatives

Voiced medially,
voiceless finally

Bennike & Kristensen (1898–1912)

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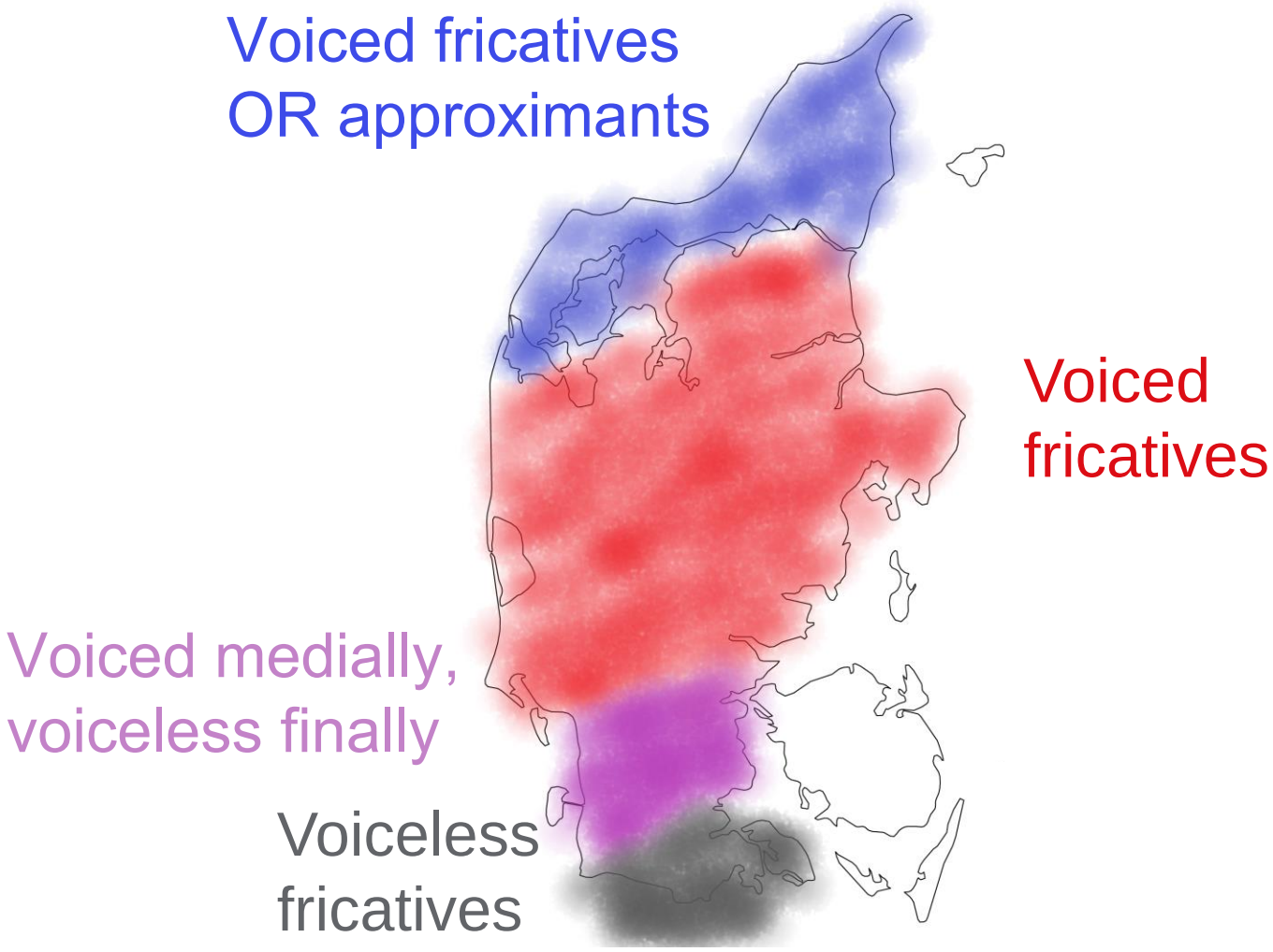
Geographical distribution of stop gradation



Bennike & Kristensen (1898–1912)

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RQ:
Is this geographical variation limited to weak position, or are there correlates in strong position?

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RQ

- **Two possible reasons why realization in weak and strong position would be correlated**

- They are allophones of the same phoneme, and share **abstract but fine-grained** underlying representations

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RQ

- **Two possible reasons why realization in weak and strong position would be correlated**

- ~~They are allophones of the same phoneme, and share **abstract but fine-grained** underlying representations~~
- They were historically both realized as stops, and variation in fine-grained stop phonetics influenced their diachronic path

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Hypothesis:
Moving north–south in Jutland, there is a decrease in stop ‘sonority’ in strong position.

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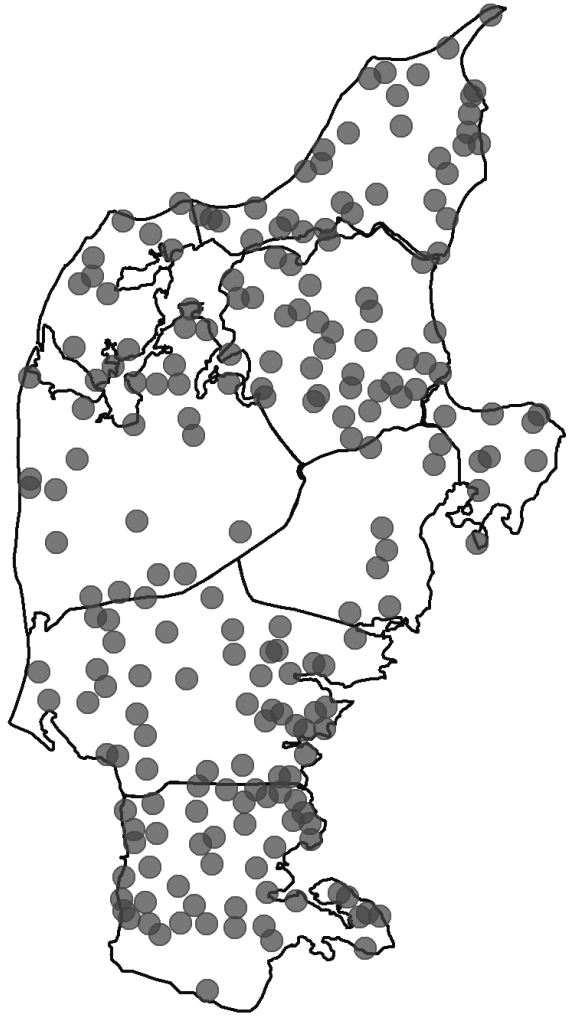
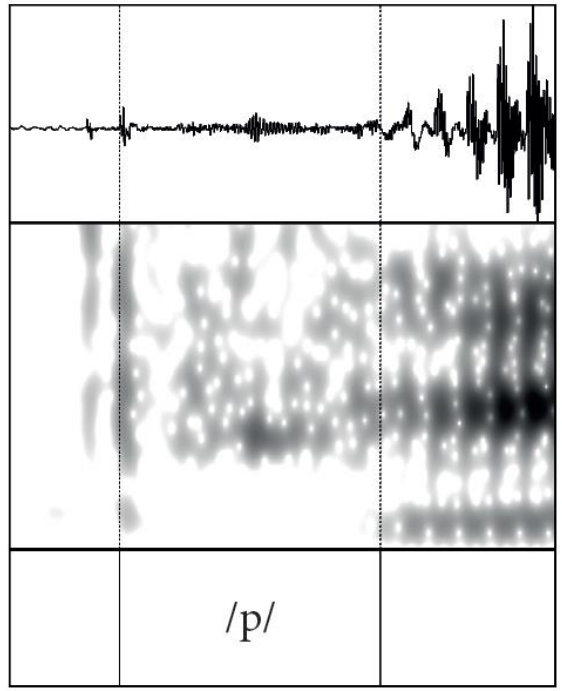
Recordings

- Due to a significant political campaign for language standardization, Denmark is now one of the most linguistically homogeneous countries in Europe
  (Kristiansen 1998, 2003; Pedersen 2003; Maegaard & Monka 2019)
- Data come from a legacy corpus of sociolinguistic interviews recorded between 1971–1976
  (RDL 1971–1976; Andersen 1981; Goldshtein & Puggaard 2019)
  - Mostly NORM speaker population
  - Specifically chosen for dialect “purity”
    (Goldshtein & Ahlgren 2021)
  - 525 interviews
  - Total duration ~370 hours

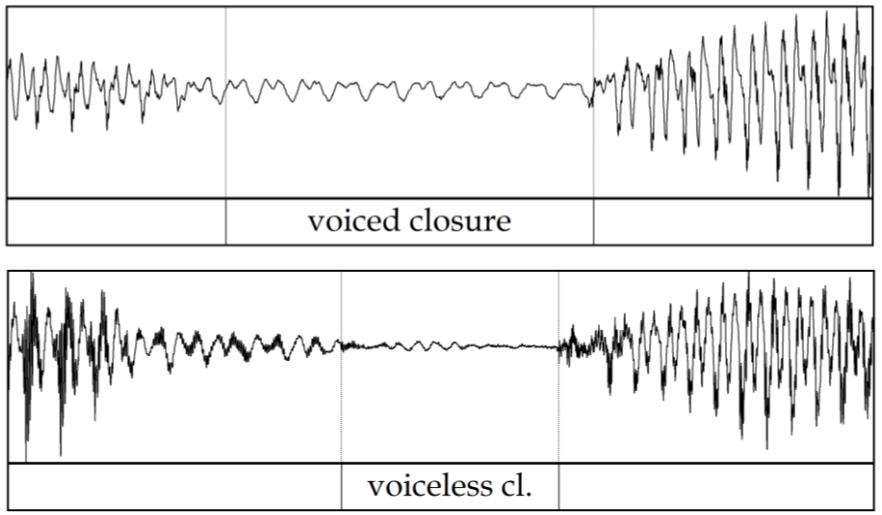


Acoustic analysis

- **Voice onset time**
  (Puggaard 2021)
  - /p/ – 1,386 tokens
  - /t/ – 5,169 tokens
  - /k/ – 4,095 tokens



- **Closure voicing**
  - Presence / absence
    - Presence: **fully voiced** / **pre-voiced**
  - /b/ – 2,212 tokens
  - /d/ – 2,369 tokens
  - /g/ – 2,273 tokens



Using Praat (Boersma & Weenink 2021)

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Statistical analysis

- **Spatial generalized additive mixed models**
  (Wieling et al. 2011, 2014)
- **Dependent variables**
  - Voice onset time (scaled *t* distribution)
  - Presence of voicing (binomial)
- **Independent variables** (orthogonal contrasts)
  - Place of articulation, stress, speaker gender, preceding boundary, (following vowel) roundness, backness, height, palatalization
- By-speaker **random slopes** for all of the above
- **Two-dimensional smooth** modelling geographical coordinates

Using R (R Core Team 2021) with packages `mgcv` (Wood 2017, 2022) and `mgcViz` (Fasiolo et al. 2018, 2021)

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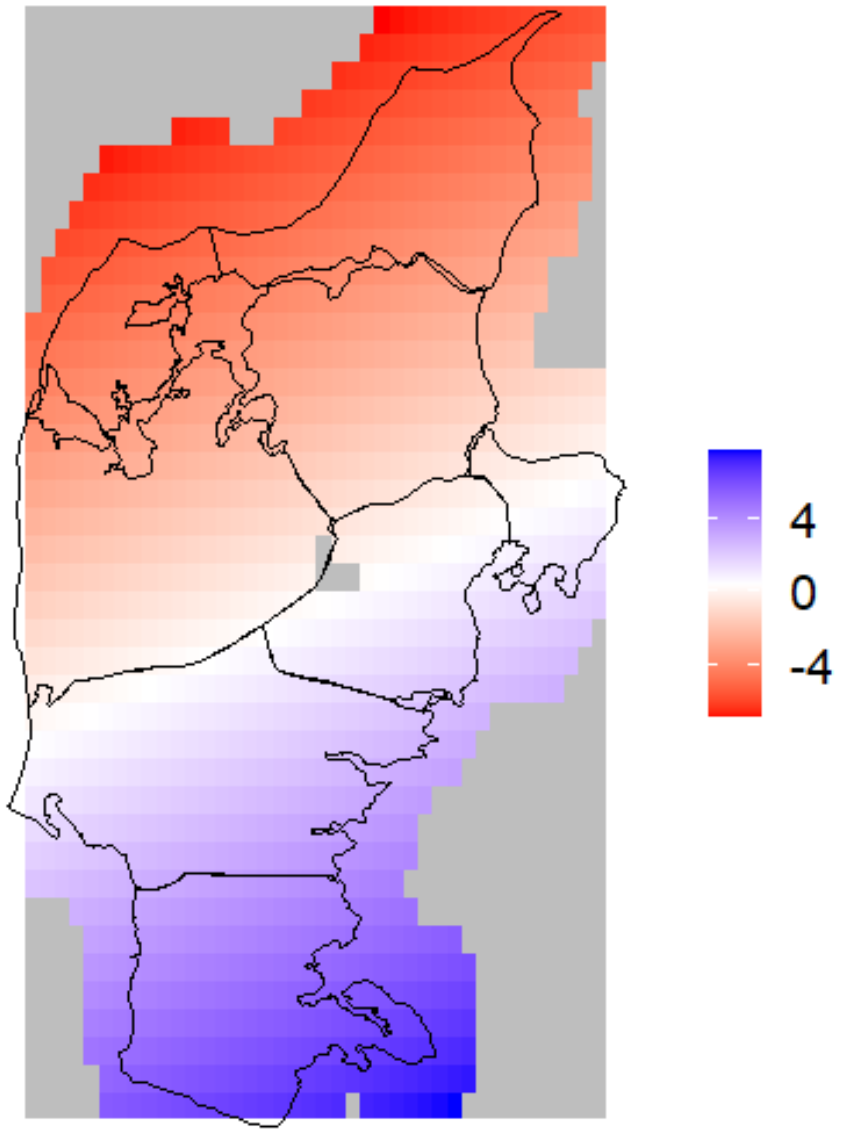
Fitted VOT



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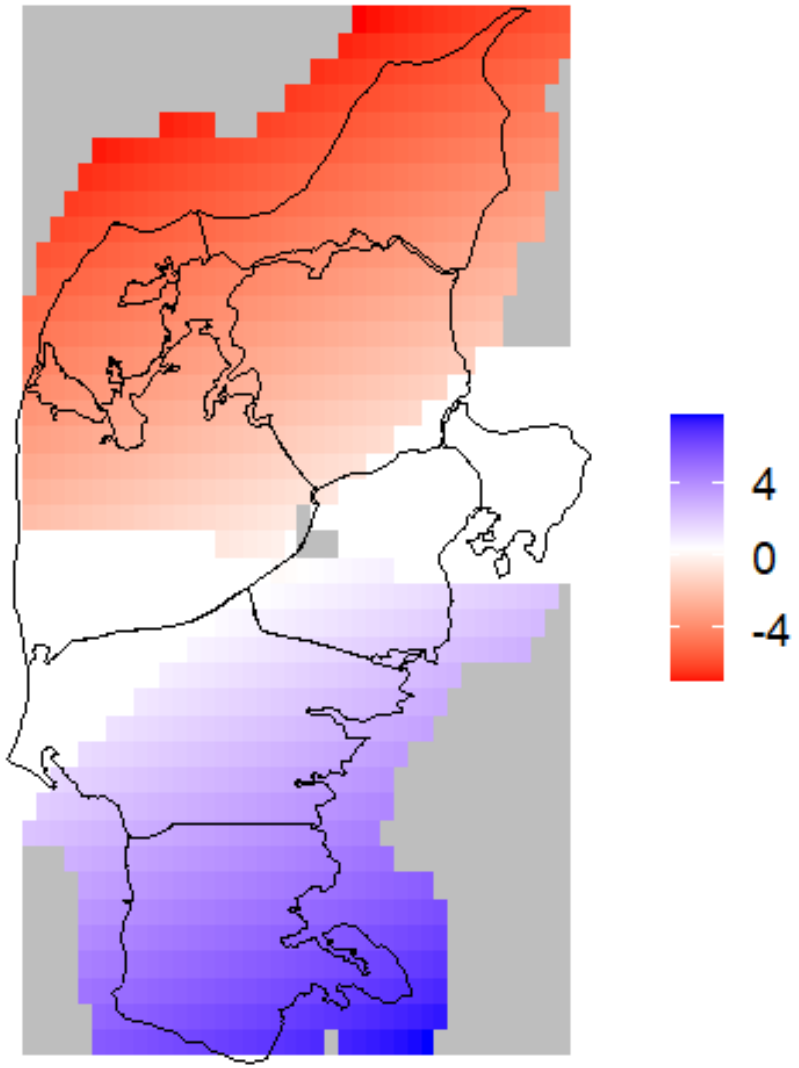
Fitted VOT
(white when p>0.05)



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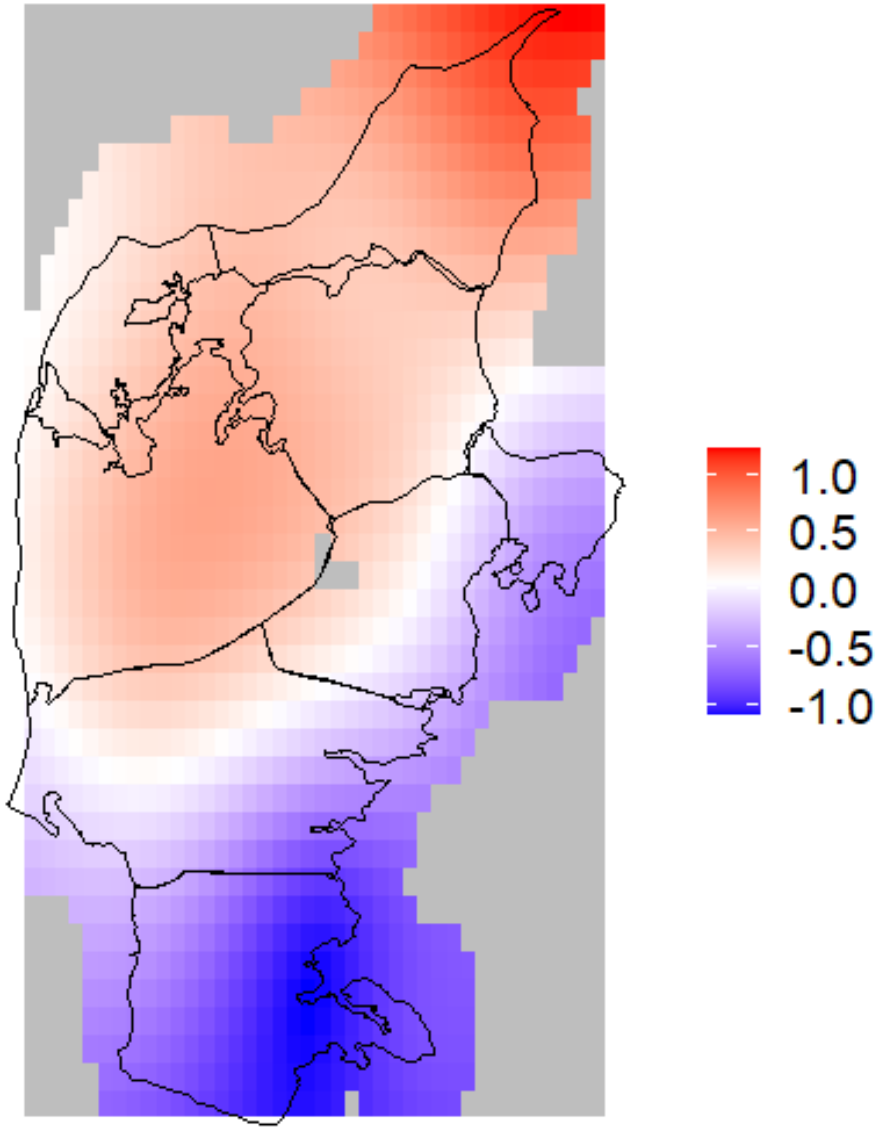
Fitted log likelihood of voicing



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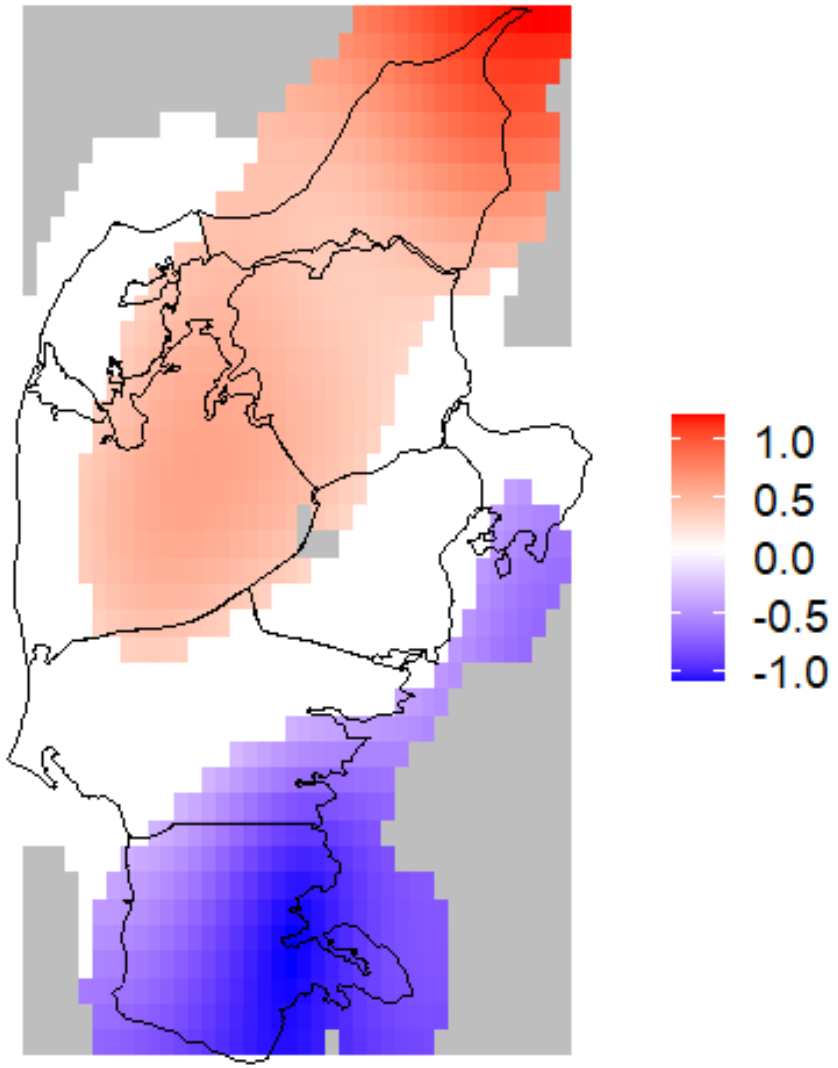
Fitted log likelihood of voicing (white when p>0.05)



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Discussion

- The realization of the laryngeal contrast in strong position **varied systematically** in traditional varieties of Danish spoken in Jutland
  - In the **north**, the contrast was relatively **voicing-oriented**
  - In the **south**, the contrast was relatively **aspiration-oriented**
  - In between, there was a **seemingly gradual cline**

- **This shows remarkable similarity to the variation in stop gradation**

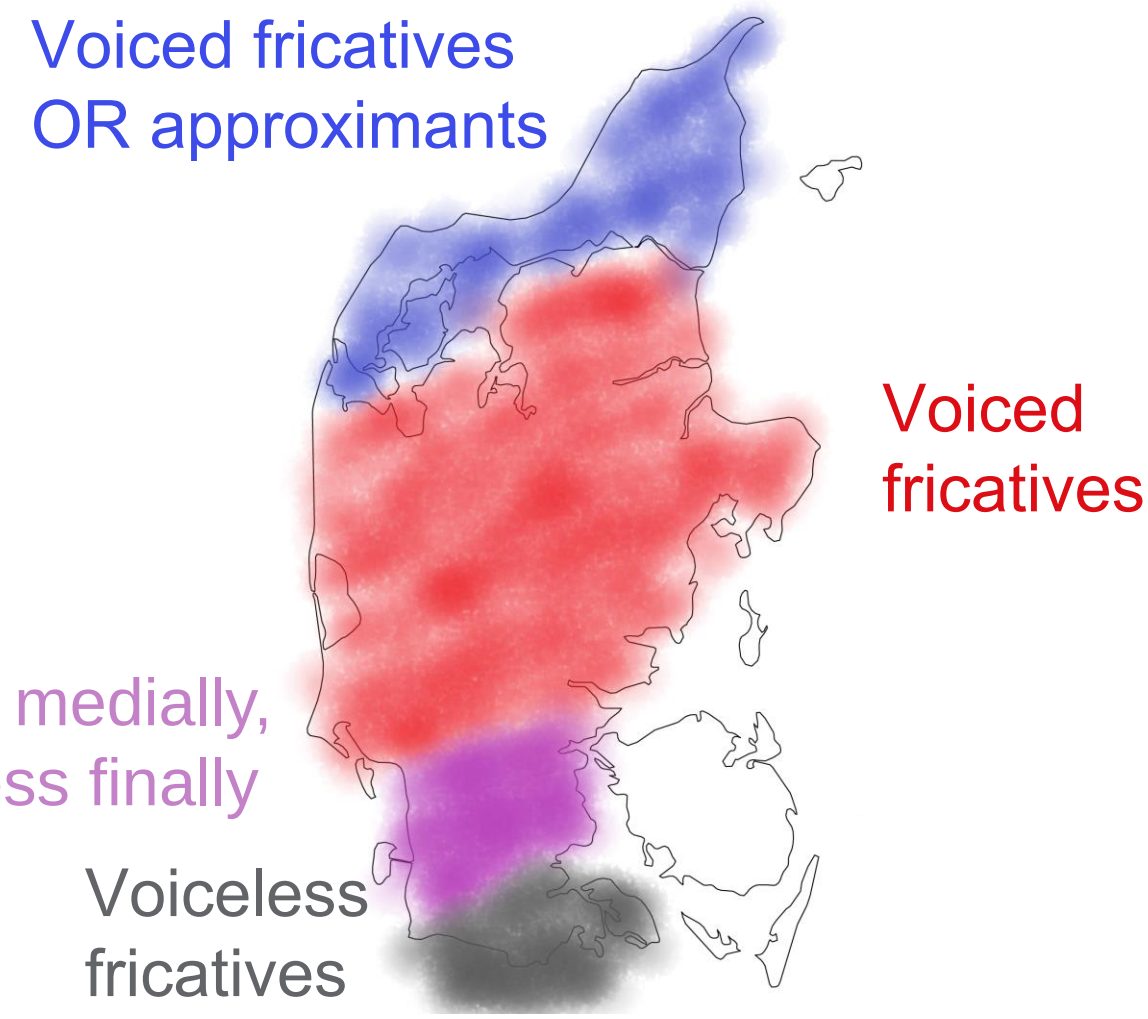
Discussion

This study

Shorter VOT

Longer VOT

Traditional dialectology



This study

More voicing

Less voicing

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Tak for opmærksomheden!
[ˈtʰɑk fʌ ʌpˈmæɐ̯ksʌmheɣˀn̩]

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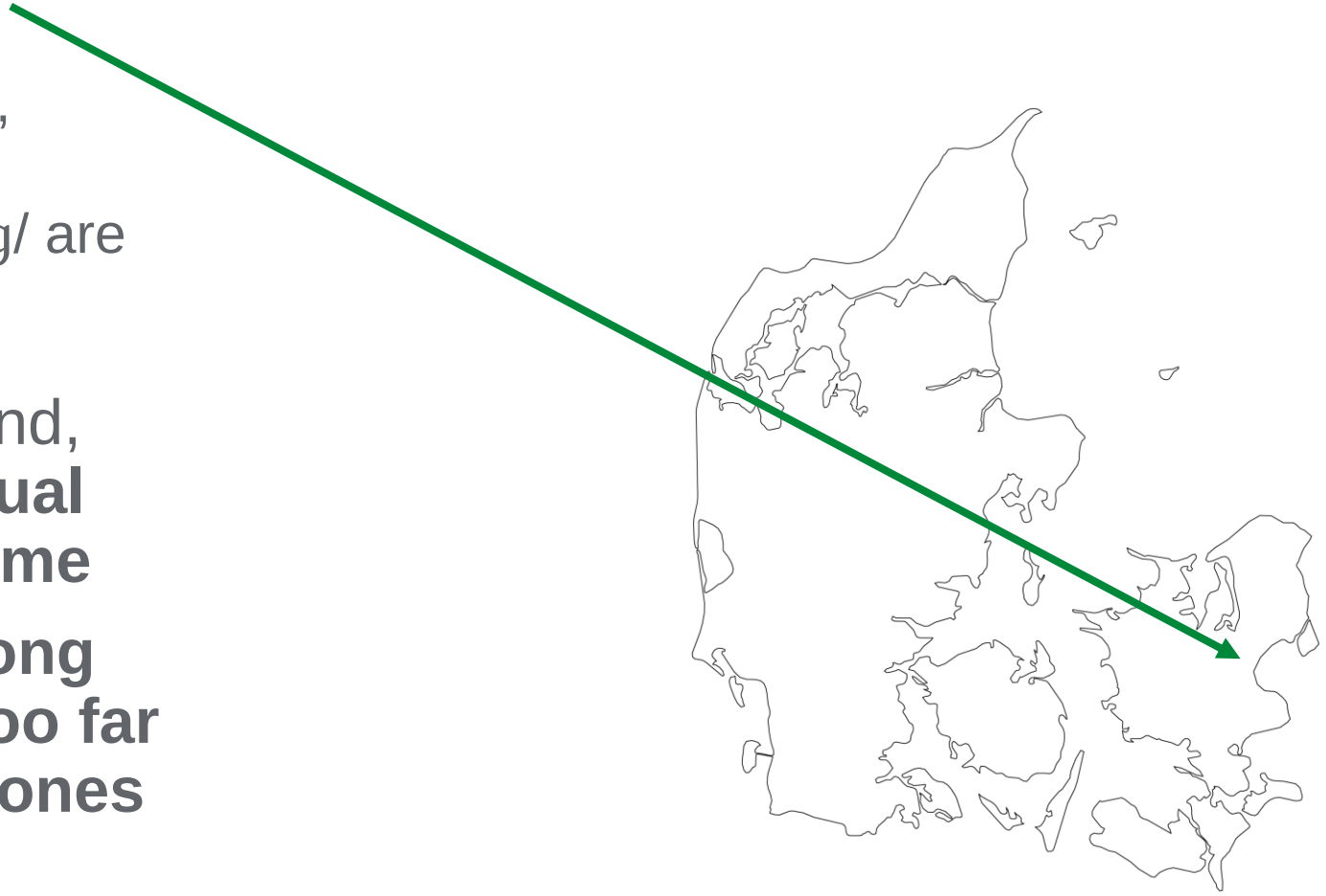
Appendix: Modern Standard Danish

- **What about Modern Standard Danish then?**
  - Strong /p t k/ are highly aspirated, /b d g/ are voiceless
  - Yet the weak ‘allophones’ of /b d g/ are generally **semivocalic**
- In the traditional dialects of Jutland, strong and weak forms were **actual allophones of the same phoneme**
- In Modern Standard Danish, **strong and weak forms have drifted too far apart and are no longer allophones**

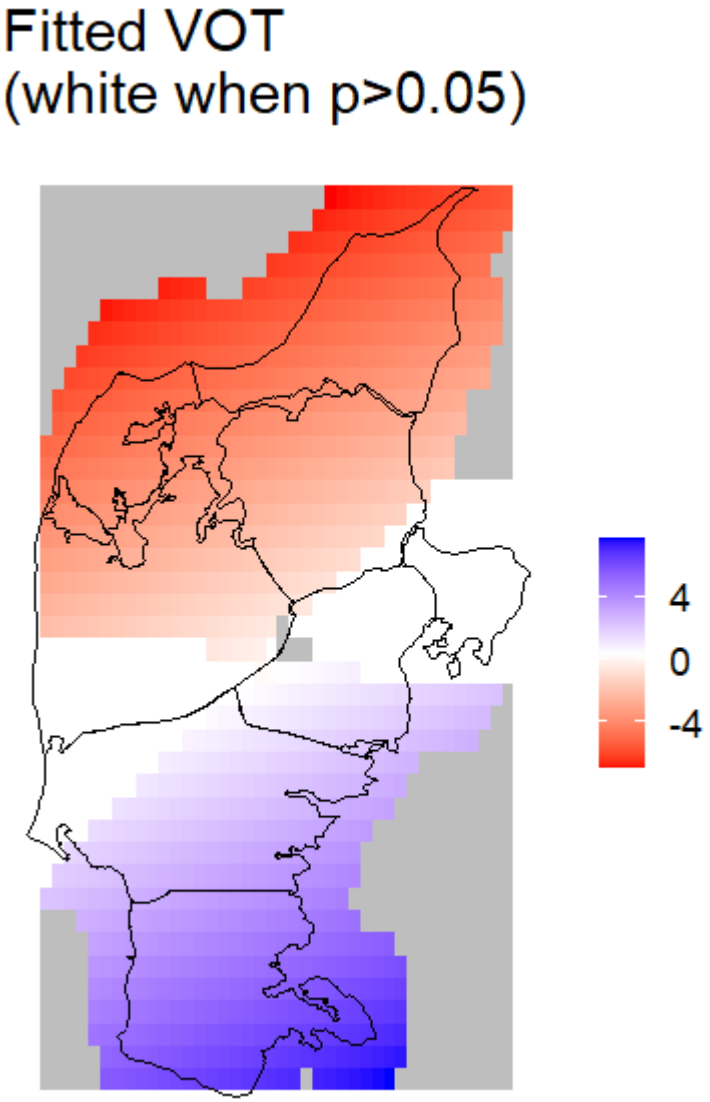


Appendix: Gradation examples

a.	[soˈliɣˀ]	*solid*	‘solid’
	[soˈlititʰeːˀt]	*soliditet*	‘solidity’
b.	[ˈpæːɪ̯ə]	*bage*	‘bake’
	[ˈpɑʊ̯væɐ̯k]	*bagværk*	‘baked goods’
	[ˈpɑkt]	*bagt*	‘baked’

Appendix: VOT model details

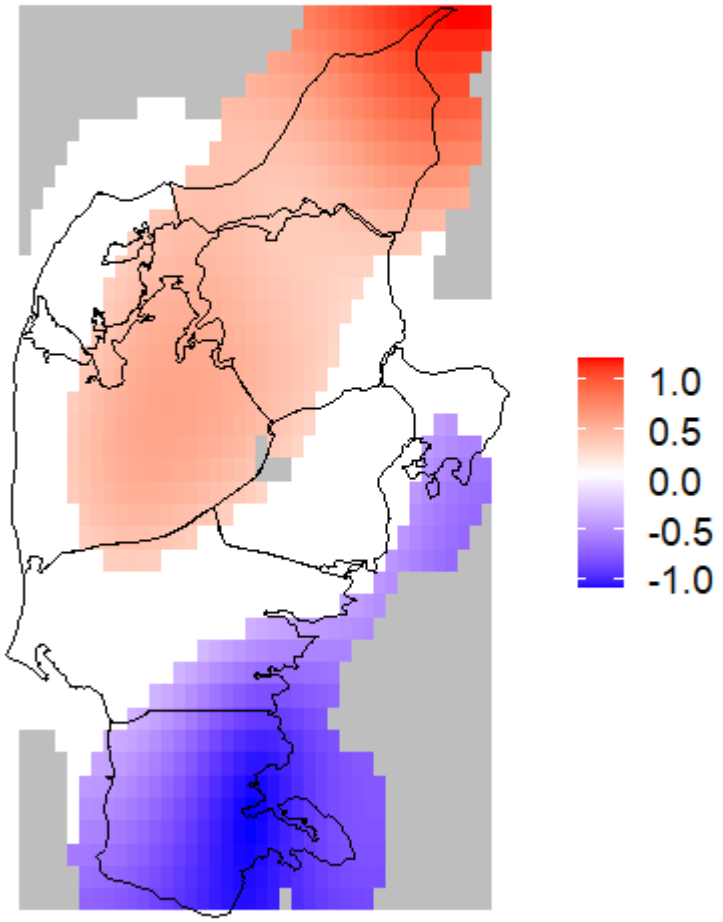
- Effect size of $R^2 = 0.41$
- All parametric coefficients (nuisance variables) are significant in the expected direction
- Geographical predictor significantly improves model fit, $\chi^2(3) = 21.5$, $p < 0.001$



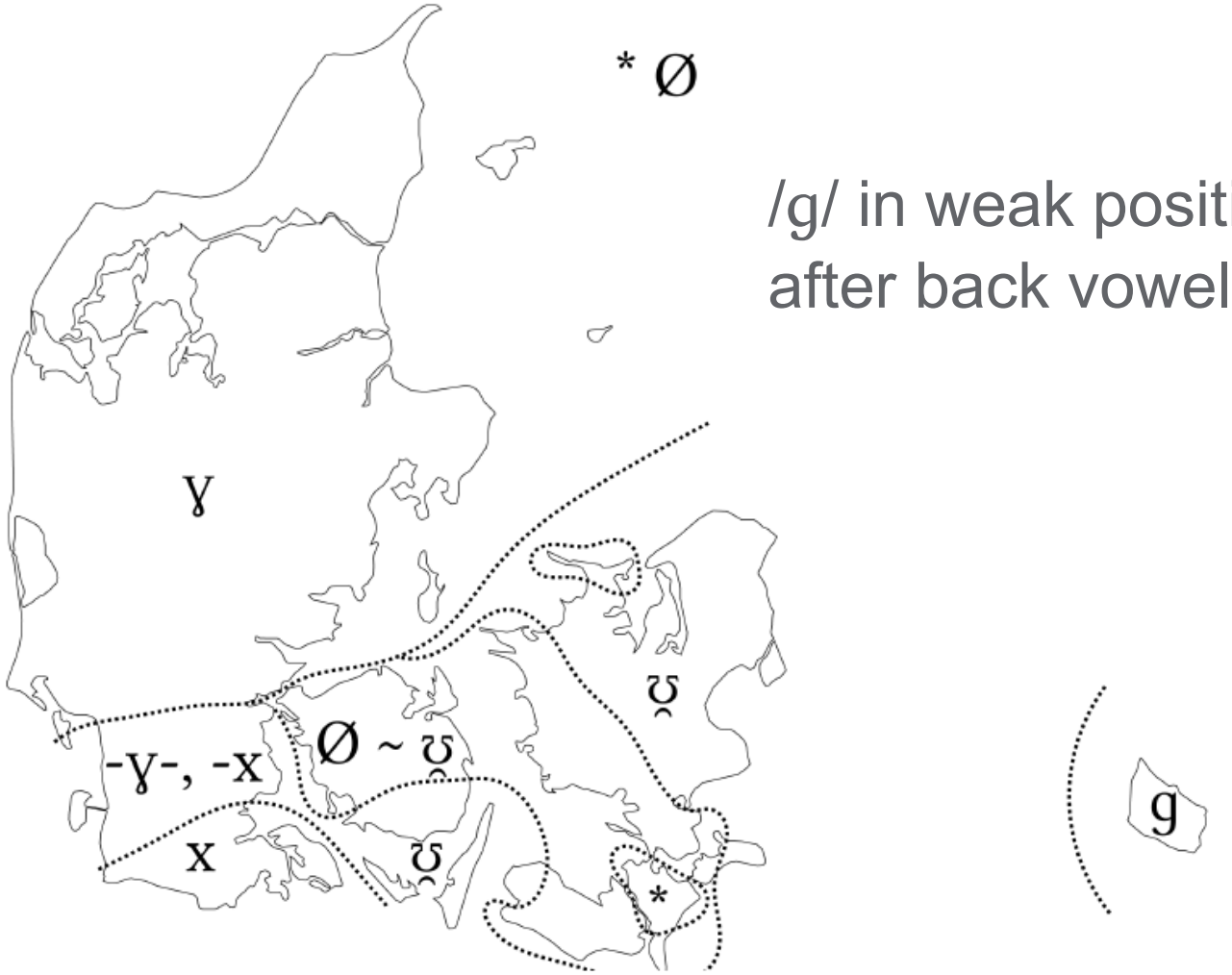
Appendix: Voicing model details

- Effect size of $R^2 = 0.31$
- Several parametric coefficients (nuisance variables) are significant in the expected direction
  - Place of articulation
  - Stress
  - Gender
  - Boundary
- Geographical predictor significantly improves model fit, $\chi^2(3) = 21.5$, $p < 0.001$

Fitted log likelihood of voicing
(white when p>0.05)



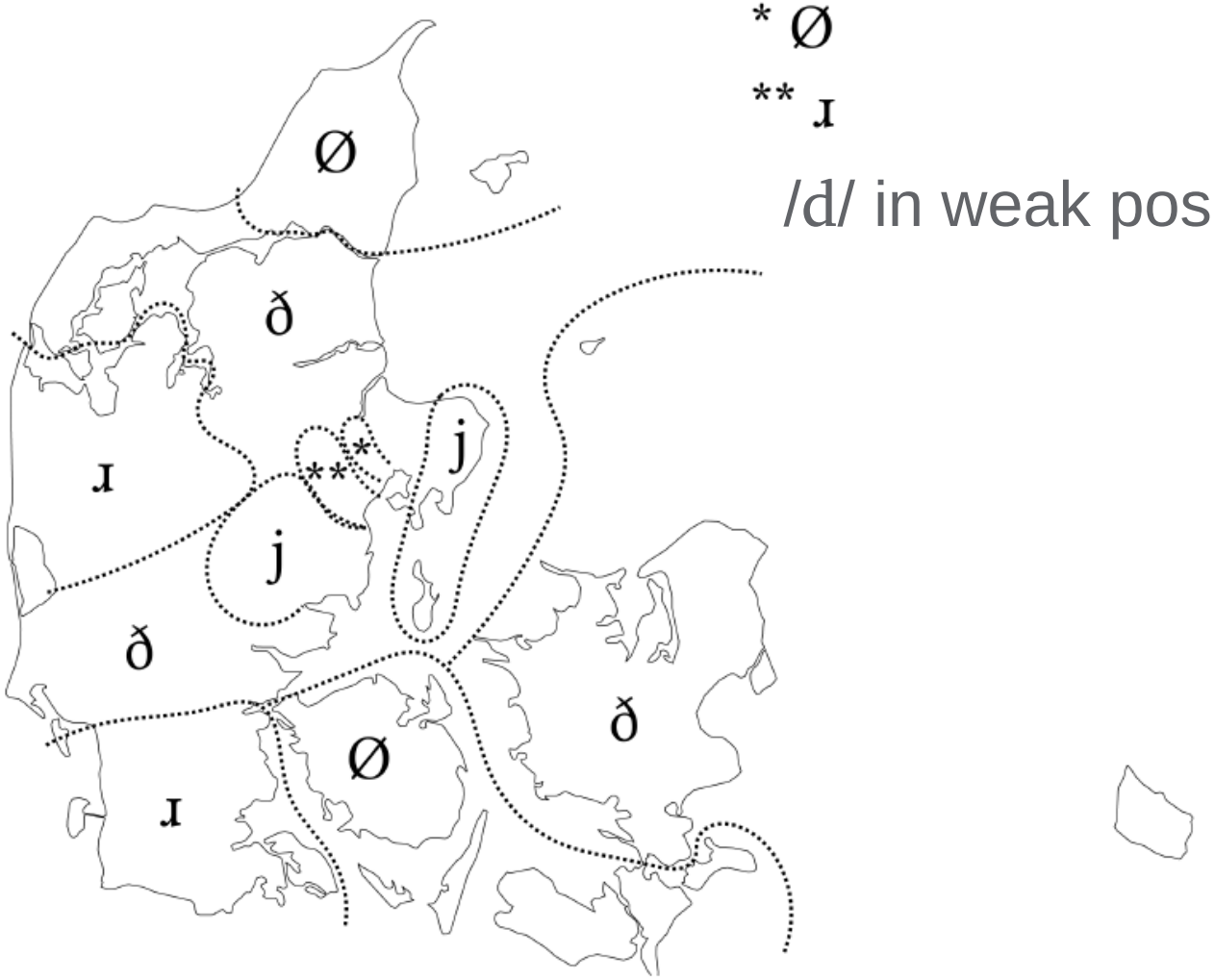
Appendix: More geographic data



/g/ in weak position
after back vowels

Bennike & Kristensen (1898–1912)

Appendix: More geographic data



* Ø

** ɹ

/d/ in weak position

Bennike & Kristensen (1898–1912)