Acoustic properties and regional variation of Saterland Frisian vowels

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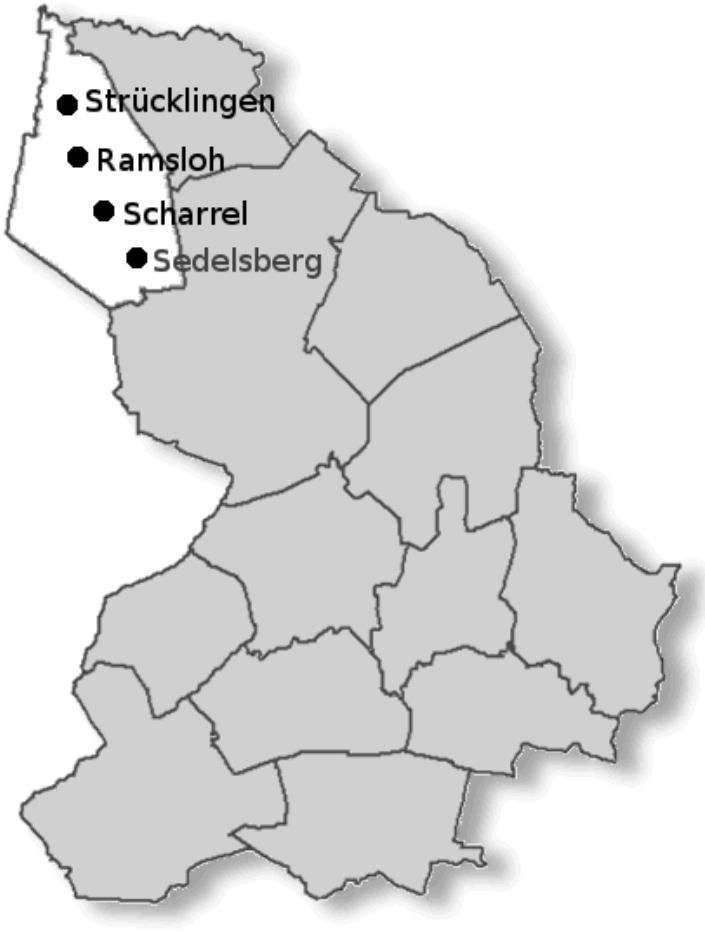
Introduction

Germany



District of Cloppenburg

Introduction

- Saterland Frisian is spoken in the municipality of Saterland (Strücklingen, Ramsloh and Scharrel) by 1500 to 2000 people.
- Speakers are trilingual: they speak Saterland Frisian, Low German and High German.
- Saterland Frisian is the last East Frisian language still spoken today.
- It is one of the smallest minority languages in Europe.

Vowel system

Monophthongs according to Fort (1980):

	front		central	back
close	i	y		u
	iː	yː		uː
close-mid	ɪ	ʏ		ʊ
	eː	øː		oː
open-mid	ɛ	œ		ɔ
	ɛː	œː	(ə)	ɔː
open			a aː	

See also Fort (1971, 2001), Kramer (1982, 1991), Tröster-Mutz (1997, 2002)

Vowel system

Diphthongs according to Fort (1980, 2001):

a͡ːi	y͡ːi	ɛ͡ːu(w)	i͡ːu(w)
o͡ːi	œ͡ːi	ɛ͡u(w)	i͡u(w)
ɔ͡ːi	ɛ͡ːi	e͡ːu(w)	ɪ͡u(w)
ɔ͡y	u͡ːi	a͡ːu	o͡ːu

See also Kramer (1982, 1991), Bussmann (2004)

Research questions – acoustic properties

1a. Are all 36 Saterland Frisian vowels still distinguished? Do we find mergers?

- Closed tense vowels are especially likely to merge due to a small functional load (see Tröster-Mutz 2002)

Research questions – acoustic properties

1b. Which supplementary acoustic variables (e.g. vowel inherent spectral change (VISC), Nearey & Assmann 1986) are employed to keep the vowels distinct?

- See Clements & Ridouane 2006, *distinctive feature enhancement*
- F0-dynamics and a further centralization in F1/F2 were found to aid the distinction among closed vowels in Saterland Frisian (see Heeringa et al. 2014)
- As within other large inventories duration (see Bohn 2004 on Fering) and VISC (see Fox & Jacewicz 2009, 2012 on American English and Strange & Bohn 1998 on German) may also be used to aid vowel distinction.

Research questions – regional variation

2a. Do Saterland Frisian vowels exhibit regional variation in spectral features?

- Regional varieties may show a *base-of-articulation-effect* (Bradlow 1995, Jacewicz, Fox & Salmons 2007)

2b. Do Saterland Frisian vowels exhibit regional variation in duration?

- Saterland Frisian speakers in Scharrel are generally believed to have the highest speech rate and in Ramsloh the lowest speech rate (cf. Siebs 1893).

Subjects

- Male speakers between 50 and 75 years old.
- All born and raised in Saterland; lived there the larger part of their life.
- 13 speakers from Ramsloh, 11 speakers from Scharrel, 11 speakers from Strücklingen.

Method

- Goal: to obtain all vowels in /hVt/ context.
- /hVt/ syllables were cued by reading aloud real rhyming monosyllabic Saterland Frisian words immediately preceding the production of the /hVt/ syllable (cf. Bohn 2004).
- Each such sequence was presented twice, thus two /hVt/ samples were obtained per speaker and per vowel.
- Sequences were presented in random order.

Sweet?

‘Schweiß’

Sweet?

H_t.

Strait?

‘(er) streut’

Strait?

H_t.

Data analysis

- For each /hVt/ we measured:
  - Vowel duration (milliseconds)
  - F1 and F2 at 20%, 50% and 80% (semitones)
  - VISC :

$$\sqrt{(F1_{50} - F1_{20})^2 + (F2_{50} - F2_{20})^2} + \sqrt{(F1_{80} - F1_{50})^2 + (F2_{80} - F2_{50})^2}$$

(cf. Fox & Jacewicz 2009 and Jin & Liu 2013)

Research question 1a

Are all 36 Saterland Frisian vowels still distinguished? Do we find mergers?

- For each Saterland Frisian location the 36 vowels were compared to each other.
- 36 vowels were pronounced twice by 11-13 speakers.
- We used mixed models with *vowel* as a fixed factor and random intercepts for *speaker*.
- The dependent variable is duration, a spectral feature or VISC.

Mergers

Two vowels were considered mergers, when no significant differences were found for:

- duration
- F1: 20%, 50%, 80%
- F2: 20%, 50%, 80%
- VISC

Mergers of monophthongs in Scharrel

	front		central	back
close	i	y		u
	iː	yː		uː
close-mid	ɪ	ʏ		ʊ
	eː	øː		oː
open-mid	ɛ	œ		ɔ
	ɛː	œː	(ə)	ɔː
open			a ~~aː~~	

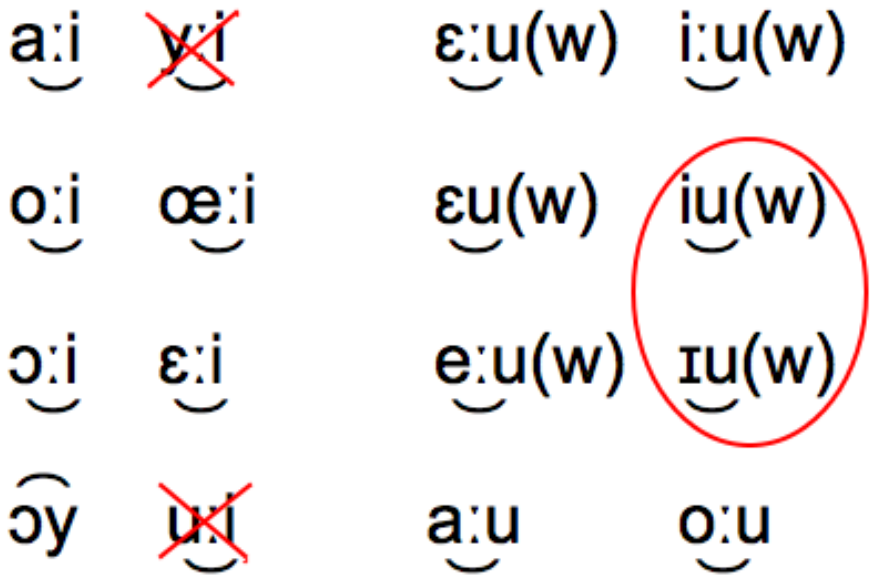
Mergers of monophthongs in Strücklingen

	front		central	back
close	i iː	y yː		u uː
close-mid	ɪ eː	ʏ øː		ʊ oː
open-mid	ɛ ɛː	œ œː	(ə)	ɔ ɔː
open			a aː	

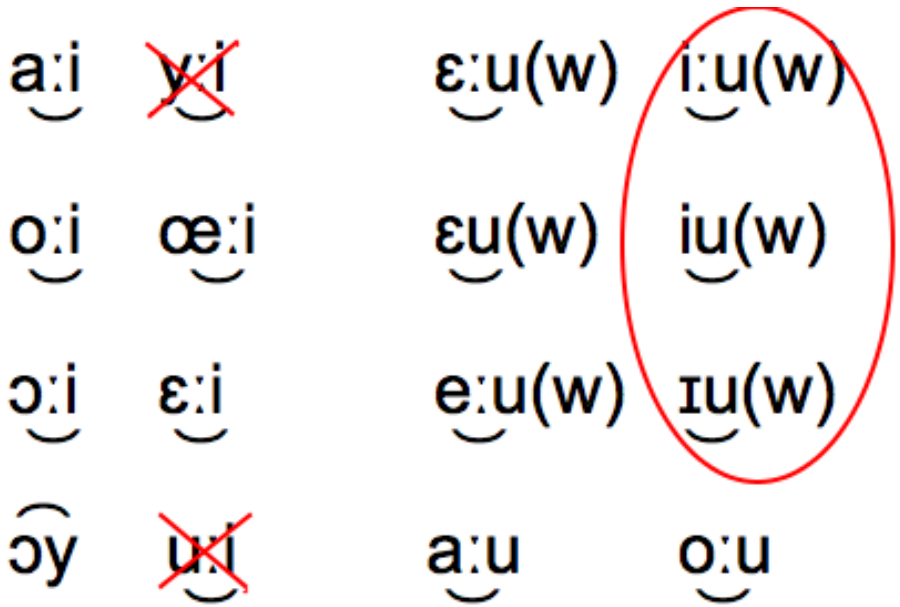
Mergers of monophthongs in Ramsloh

	front		central	back
close	i iː	y yː		u uː
close-mid	ɪ eː	ʏ øː		ʊ oː
open-mid	ɛ ɛː	œ œː	(ə)	ɔ ɔː
open			a aː	

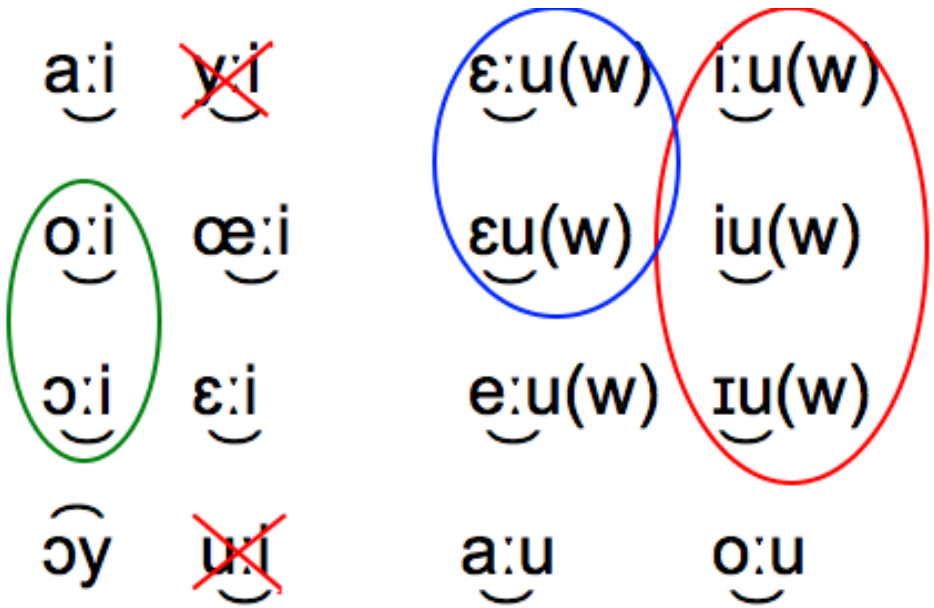
Mergers of diphthongs in Scharrel



Mergers of diphthongs in Strücklingen



Mergers of diphthongs in Ramsloh



Summary

	vowels not used	monoph-thongs merged	diph-thongs merged	vowels still used
Fort 1980				36
Scharrel	3	2	1	30
Strücklingen	2	3	2	29
Ramsloh	2	3	4	27

Research question 1b

Which supplementary acoustic variables (e.g. VISC) are employed to keep the vowels distinct?

- Linear discriminant analysis was used to obtain the percentage of correctly predicted vowels per location

Monophthongs

		Ramsloh	Scharrel	Strückl.
	$F1_{50} + F2_{50}$	64.3	68.5	68.6
	$F1_{20} + F2_{20} + F1_{80} + F2_{80}$	64.1	70.6	71.9
	$F1_{50} + F2_{50} + F1_{20} + F2_{20} + F1_{80} + F2_{80}$	69.2	73.6	73.6

	Dur	16.4	17.0	16.0
▷	Dur $+ F1_{50} + F2_{50}$	74.1	79.5	81.1
	Dur $+ F1_{20} + F2_{20} + F1_{80} + F2_{80}$	74.4	81.6	82.2
	Dur $+ F1_{50} + F2_{50} + F1_{20} + F2_{20} + F1_{80} + F2_{80}$	78.0	82.1	82.9

Diphthongs

		Ramsloh	Scharrel	Strückl.
	$F1_{50} + F2_{50}$	53.7	58.7	56.6
▷	$F1_{20} + F2_{20} + F1_{80} + F2_{80}$	70.5	74.1	69.0
	$F1_{50} + F2_{50} + F1_{20} + F2_{20} + F1_{80} + F2_{80}$	72.0	78.0	70.9

Dur	16.1	16.8	20.6
Dur $+ F1_{50} + F2_{50}$	57.5	65.4	58.2
Dur $+ F1_{20} + F2_{20} + F1_{80} + F2_{80}$	73.0	73.8	70.3
Dur $+ F1_{50} + F2_{50} + F1_{20} + F2_{20} + F1_{80} + F2_{80}$	75.2	78.3	71.5

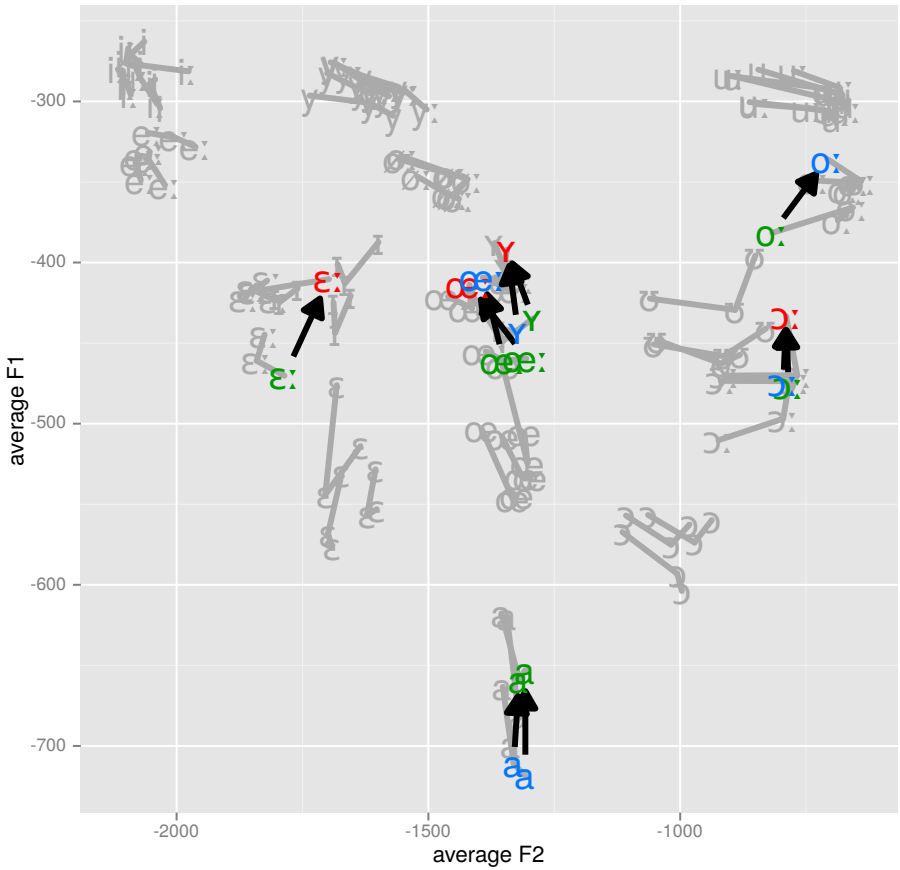
Research question 2a

Do Saterland Frisian vowels exhibit regional variation in spectral features?

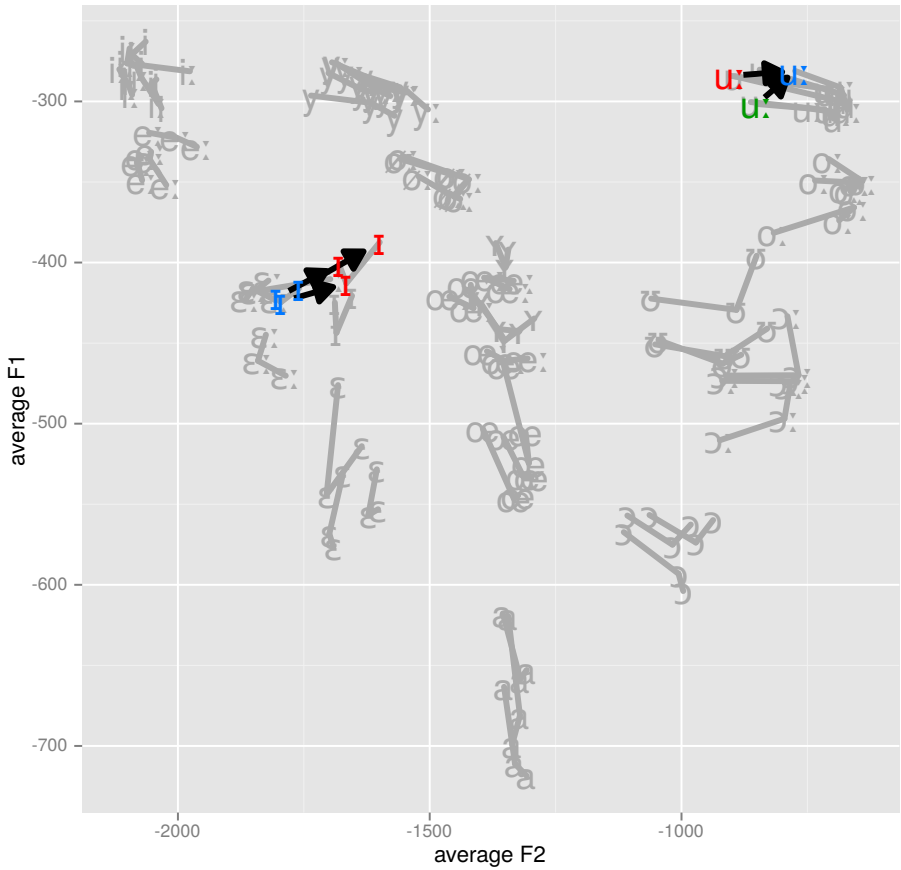
- Is there regional variation across the three villages in terms of location in the F1-F2-plane and the amount of VISC?

F1/F2 monophthongs

F1 location (20%, 50%, 80%)



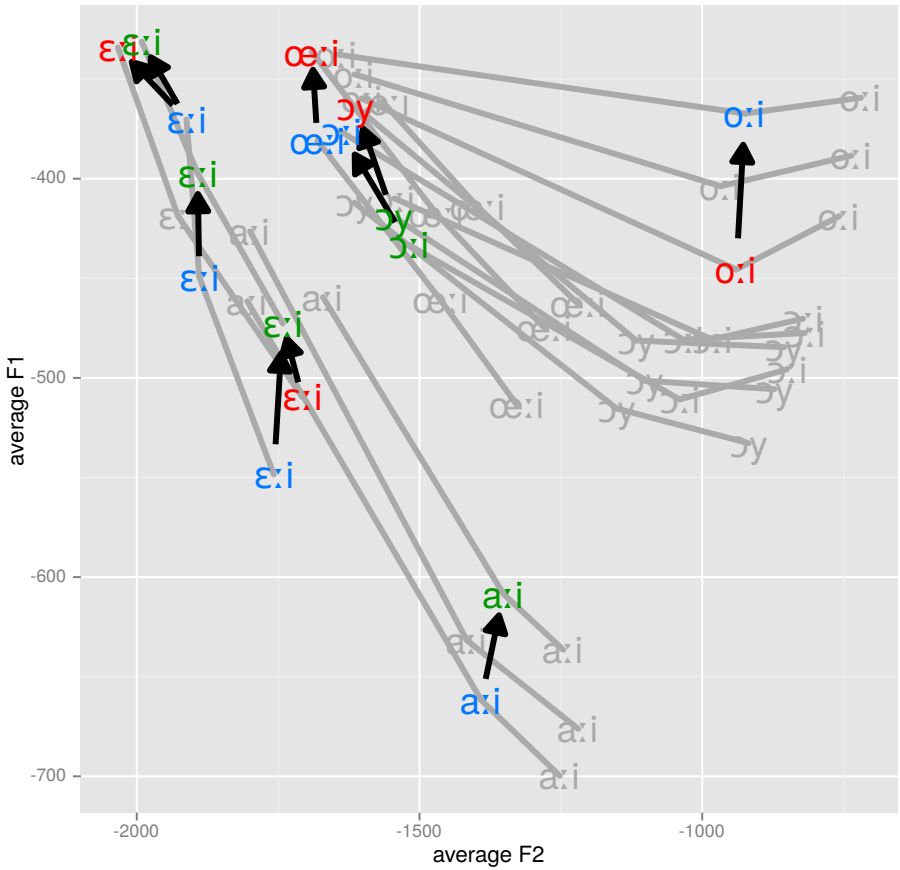
F2 location (20%, 50%, 80%)



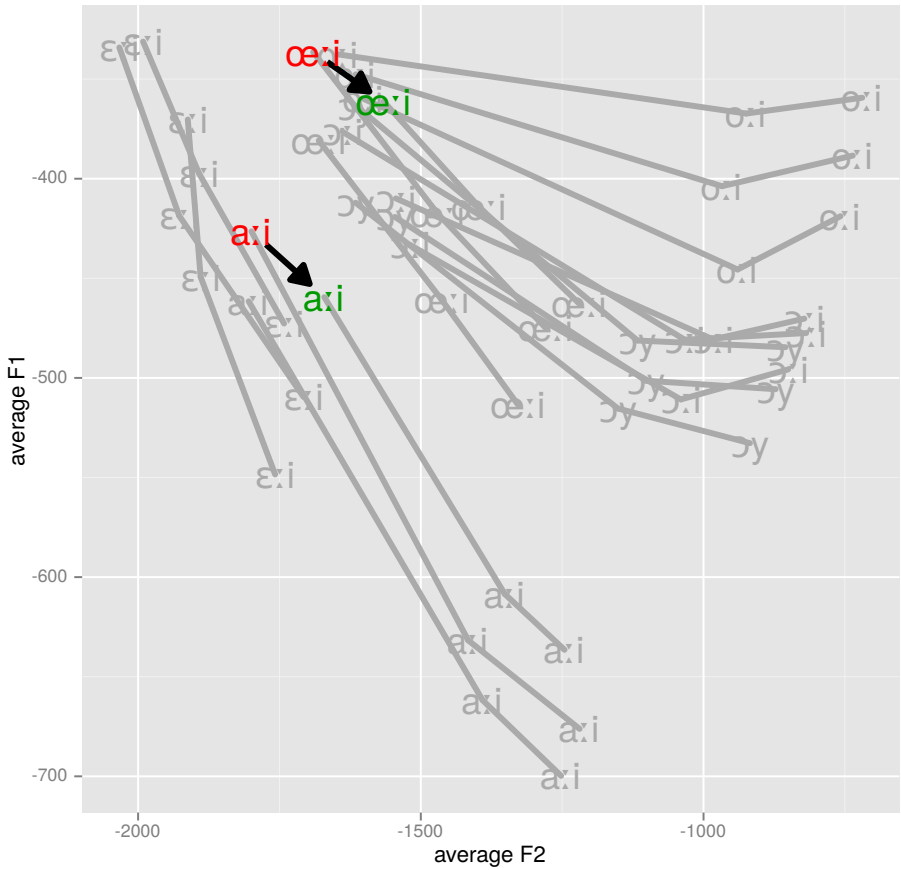
red: Ramsloh, green: Scharrel, blue: Strücklingen, A → B: A larger than B

F1/F2 diphthongs ending on [i] or [y]

F1 location (20%, 50%, 80%)



F2 location (20%, 50%, 80%)



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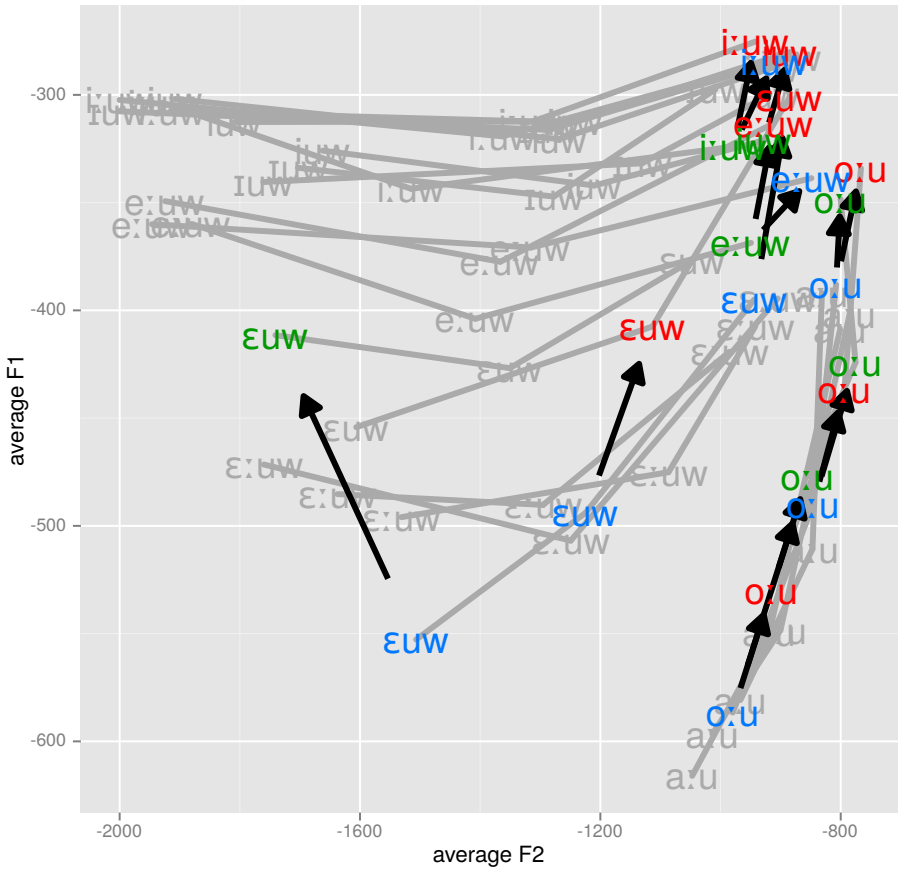
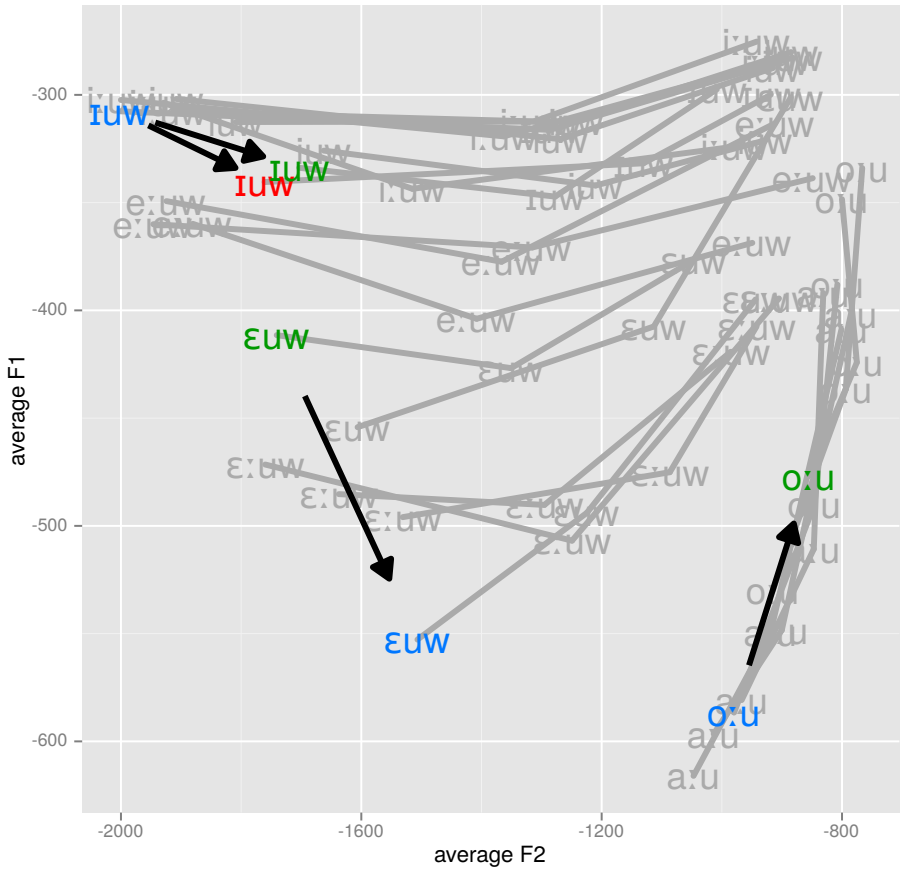
F1/F2 diphthongs ending on [u] or [uw]

F1 location (20%, 50%, 80%)



F2 location (20%, 50%, 80%)



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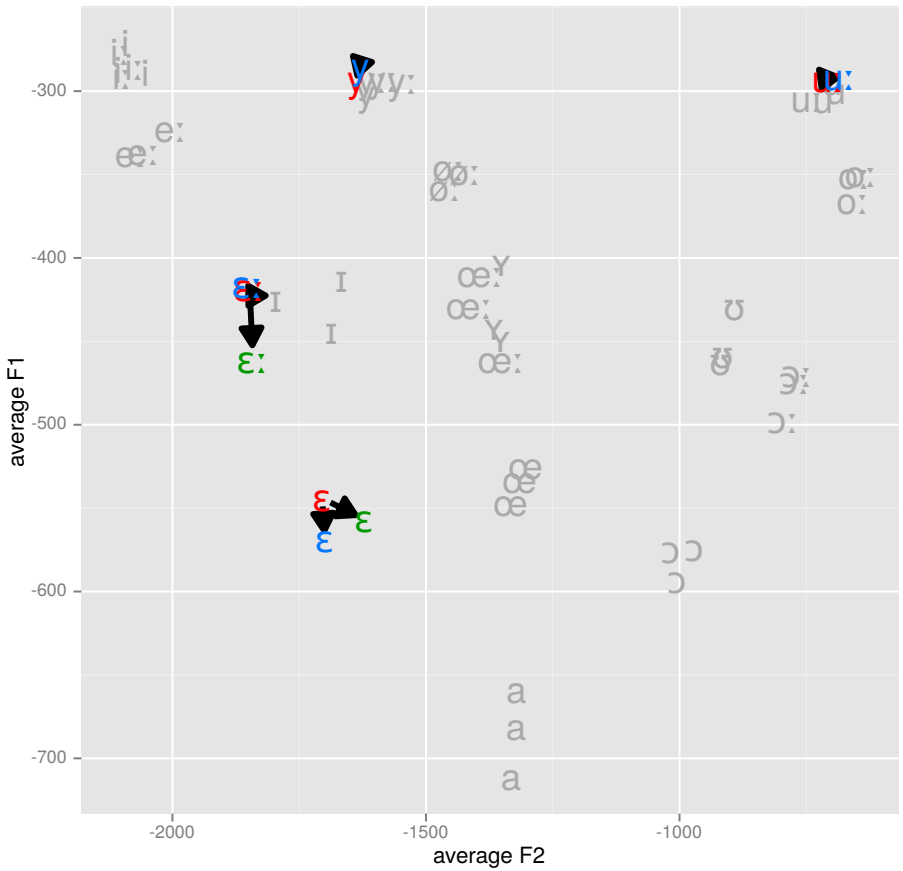
VISC monophthongs



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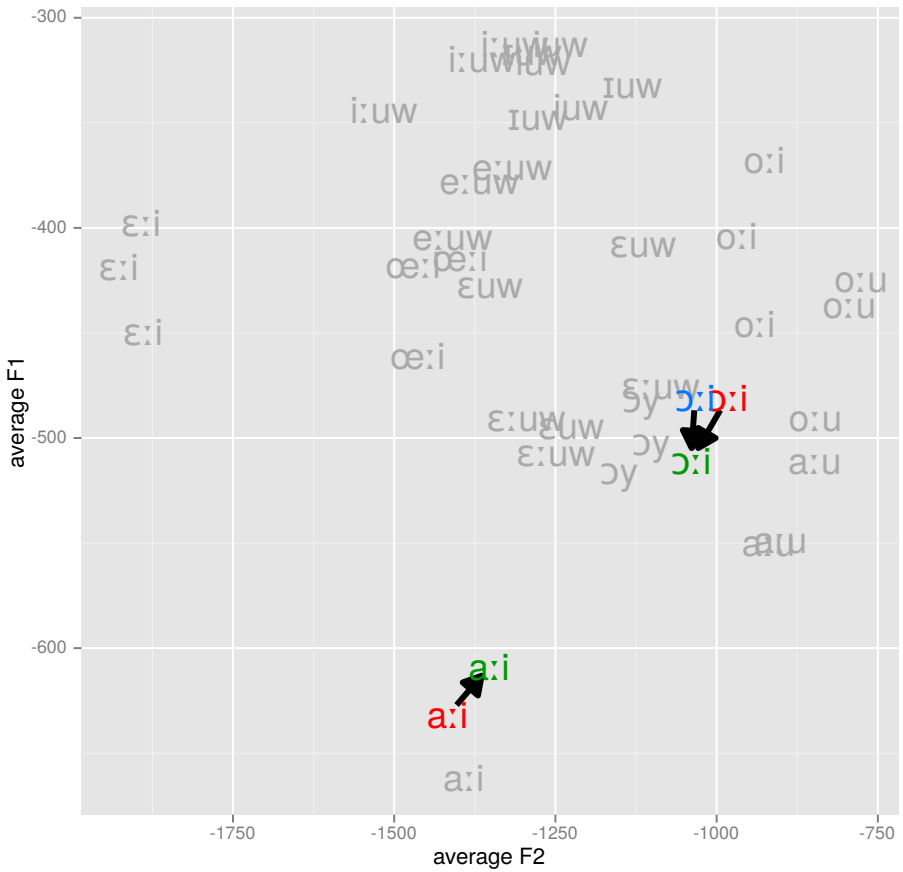
VISC diphthongs



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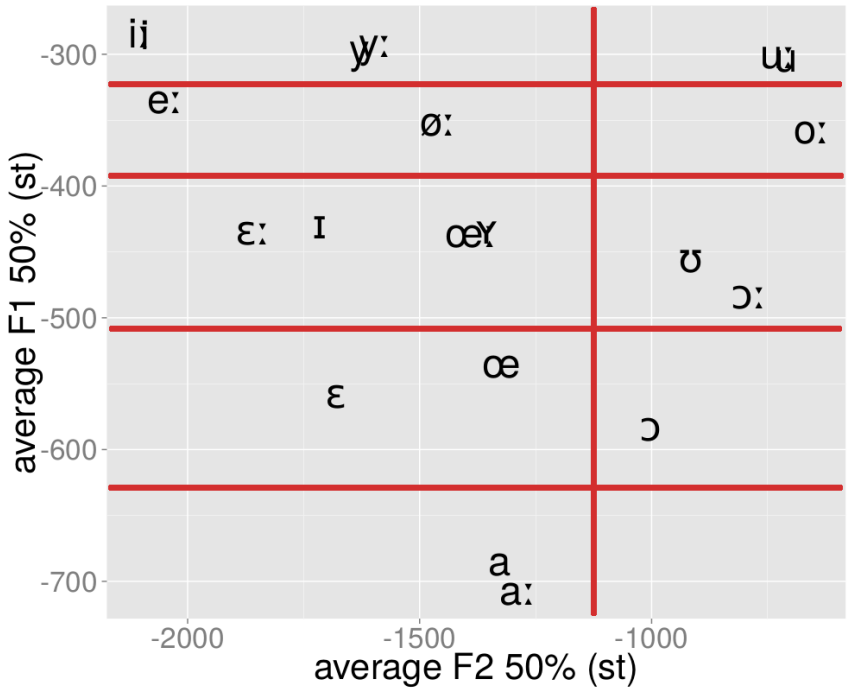
Analysis per category

Notation of monophthongs according to Fort (1980):



	front		back
close	iː	yː	uː
	i	y	u
near-close	eː	øː	oː
close-mid	ɪ	ʏ	ʊ
	ɛː	œː	ɔː
open-mid	ɛ	œ	ɔ
open	a		
	aː		

Analysis per category

- We distinguish the following categories:
  - monophthongs:
    - front/back
    - closed/near-close/close-mid/open-mid/open
    - tense/lax
  - diphthongs
- We used a linear mixed model for each acoustic variable and per category. *Location* is a fixed factor, random intercepts are included for *speaker* and *vowel*. *Location* is a random slope of *vowel* only when this improves the model (i.e. decreases the Akaike information criterion).

Analysis per category

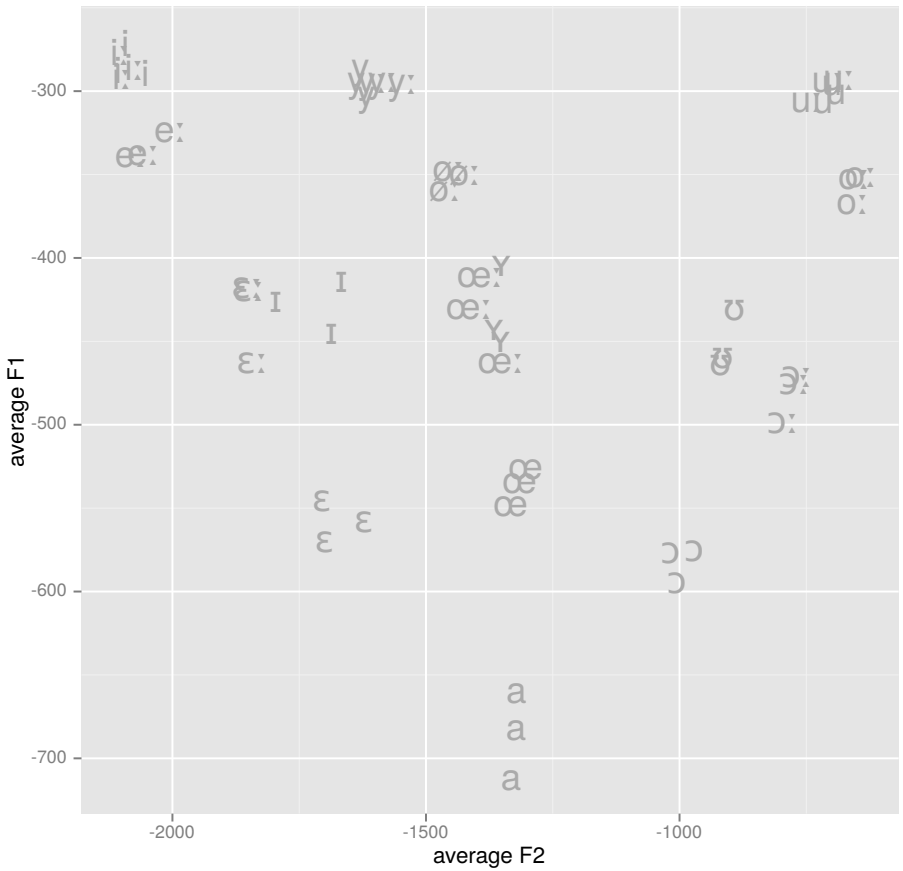
- Scharrel compared to Ramsloh:
  - front monophthongs have higher F1 (20%)
  - close-mid monophthongs have higher F1 (20%, 50%)
  - diphthongs have higher F1 (80%) and less VISC
- Scharrel compared to Strücklingen:
  - open monophthong [a] has lower F1 (20%, 50%)
- Ramsloh compared versus Strücklingen:
  - no systematic (categorical) differences found

Research question 2b

Do Saterland Frisian vowels exhibit regional variation in duration?

- Is there regional variation across the three villages in terms of duration?

Duration monophthongs



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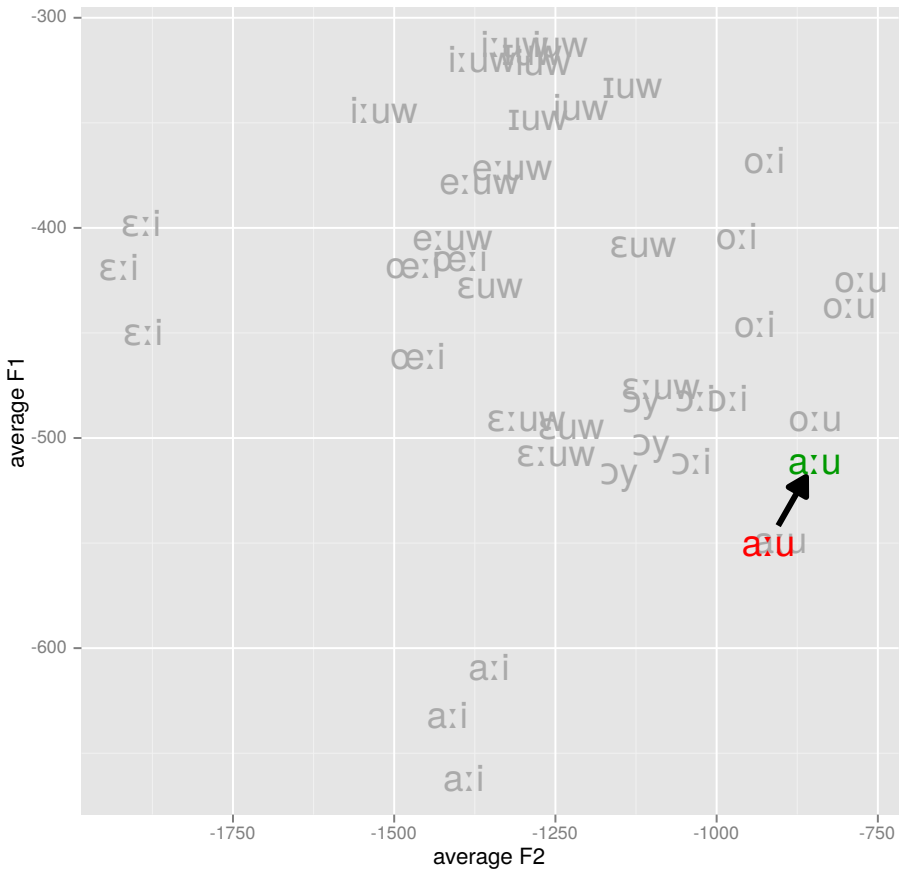
Duration diphthongs



red: Ramsloh, green: Scharrel, blue: Strücklingen, A → B: A larger than B

Conclusions – acoustic properties

1a. Are all 36 Saterland Frisian vowels still distinguished? Do we find mergers?

- Some qualities have merged, some have been dropped. 27 to 30 vowels can still be detected.
- High short tense vowels have merged with high long tense vowels; only in Scharrel short tense [i] is still shorter than long tense [iː].

Conclusions – acoustic properties

1b. Which supplementory acoustic variables (like VISC) may be employed to keep the vowels distinct?

- Monophthongs are truly monophthongal, they are well discriminated (74-82%) by means of duration and the vowel target (50%-Point). Adding further spectral information (VISC) increases the discrimination score by 1-4% only.
- Diphthongs are truly diphthongal, they are well discriminated (69-74%) by spectral information from the onset and the offset. Adding duration increases the discrimination score by 0.3-2.5% only.

Conclusions – regional variation

2a. Do Saterland Frisian vowels exhibit regional variation in spectral features?

- Especially Scharrel has systematic differences compared to the other two locations.
- Compared to Ramsloh F1 is higher in several vowel categories and dipthongs have less VISC. Compared to Strücklingen open vowel [a] has a lower F1.
- Ramsloh versus Strücklingen: no systematic differences were found.

Conclusions – regional variation

2b. Do Saterland Frisian vowels exhibit regional variation in duration?

- No significant regional differences were found.

Thanks!

	front		back
close	iː	yː	uː
	i	y	u
near-close	eː	øː	oː
close-mid	ɪ	ʏ	ʊ
	ɛː	œː	ɔː
open-mid	ɛ	œ	ɔ
open	a		
	aː		