REGIONAL VARIATION OF SATERLAND FRISIAN VOWELS

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ABSTRACT

This paper reports on the acoustic investigation of Saterland Frisian vowels, including their regional variation. The study aims at identifying merged vowel categories as well as supplementary acoustic dimensions, which enhance the discrimination of spectrally adjacent categories. All vowels were elicited in a /hVt/ frame. Acoustic measurements included vowel duration, mid-vowel F1 and F2, Vowel Inherent Spectral Change (VISC) [16], and the spectral rate of change [10]. Results confirm large inventories for the varieties of Saterland Frisian, although some vowel categories have undergone a merger. The comparison of spectral features of single vowel categories in the three varieties revealed an effect for Scharrel, in which most monophthongs are more centralized in the F1 dimension than in Strücklingen. These findings are discussed in light of the natives' perception of regional differences in speech rate.

Keywords: Saterland Frisian, regional variation, phonetic feature enhancement, VISC

1. INTRODUCTION

Saterland Frisian is spoken in Ramsloh, Scharrel, and Strücklingen, which constitute the municipality of Saterland, located in northwest Germany. Despite small geographic distances natives perceive the Saterland Frisian spoken in these villages as three distinct regional varieties. They seem to be highly aware of the small regional differences, which are described in the literature as being most evident in the use of different vowel qualities, vocalic durations, and overall speech rate [8, 14, 17]. Among the three villages, Scharrel is regarded as the most divergent variety [18].

With up to 20 distinct monophthongs and 16 diphthongs in stressed position, Saterland Frisian is reported to have an exceptionally large vowel inventory [7, 9, 14, 18] (see Figure 1). The high number of distinct vowel categories is partly due to the fact that vowel length is not linked to tenseness in Saterland Frisian. Both phonological features may occur independently. The reported inventory thus includes closed short tense /i, y, u/ as well as open-mid long lax vowels /ɛː, œː, ɔː/ [9, 14, 18]. As in other Frisian languages, the short tense vowels are especially likely to undergo a merger and become phonetic variants due to their low functional load and overall markedness [9, 21, 22]. Moreover, language contact with High German and Low German may further add to this development. According to Fort [8] the merger is least observable in Ramsloh, being the most conservative of the three varieties. In addition, the number of distinct diphthongal categories is disputed, ranging from 6 to 16 [3, 9, 14, 18].

Figure 1: Monophthongs and diphthongs of Saterland Frisian according to Fort [9]. /ə/ is restricted to unstressed syllables.

	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	

yːi̯	uːi̯	iːu̯(w)	ɛːu̯(w)
œːi̯	oːi̯	iu̯(w)	ɛu̯(w)
ɛːi̯	ɔːi̯	ɪu̯(w)	oːu̯
aːi̯	ɔy̯	eːu̯(w)	aːu̯

Because of the high number of distinct categories, Saterland Frisian is most likely to employ supplementary acoustic dimensions to support vowel distinction within the crowded vowel space (cf. phonetic feature enhancement [4]). [11] shows that f0-dynamics and additional centralization in F1 and F2 may be used to enhance distinctiveness among closed vowels in Saterland Frisian. As within other large inventories, vowel dynamics (i.e. Vowel Inherent Spectral Change (VISC) [16]) and vowel duration may constitute two additional possible enhancing cues as they have been attested in other languages (cf. [2, 10, 12, 20]).

This study is an acoustic phonetic investigation of the inventory of Saterland Frisian vowels and its regional variation. In particular, we examine (1) the depicted inventory and possible mergers, (2) supplementary acoustic dimensions that support vowel distinction, and (3) regional variation regarding durational differences as well as static and dynamic spectral features of corresponding categories.

2. METHOD

Recordings were made of 35 speakers (13 from Ramsloh, 11 from Scharrel, and 11 from Strücklingen). The informants were all born in Saterland and lived in the respective village all their lives. All speakers were trilingual with Saterland Frisian, High German, and Low German. They were male and aged between 50 and 75.

2.1. Stimuli and recording procedure

The 36 vowel categories depicted in Figure 1 were recorded in monosyllabic words in a /hVt/ context. The /hVt/ words were cued by instructing the informants to read aloud a rhyming monosyllabic Saterland Frisian word immediately preceding the production of the /hVt/ target word (e.g. *Poot* 'paw' – *Hoot*, cf. [2]). High German translations were given with every Saterland Frisian word. Speakers did not read the /hVt/ target word directly off the screen: Only the frame *H_t* was presented as an aid to build the target word. Where no rhyming monosyllabic trigger was available, an intermediate step was introduced to approach the target word in two steps, e.g. *Moite* 'effort' – *Moit* – *H_t*. Target words were elicited via rhymes because Saterland Frisian orthography is usually unknown and there is a possible influence of the written form on the production data.

For each speaker, the sequences of trigger and target words were presented in blocks in a controlled randomized order on a computer screen. Each sequence of a trigger and the rhyming target word was presented twice. Practice sequences preceded all blocks. Intonation was monitored for all target words, ensuring that all /hVt/ words were elicited with a falling contour. All recordings were made in a quiet room with a Tascam HD P2 digital recorder at a sampling rate of 48 kHz and a head-mounted microphone (DPA 4065 FR).

2.2. Acoustic analysis

Acoustic analysis was done in PRAAT [1]. Onset and offset of the vocalic segment were labeled manually for each /hVt/ syllable. Vowel onset was measured at the zero-crossing before the first positive peak in the periodic waveform. Vowel offset was set at the last negative-to-positive zero-crossing before an (abrupt) decrement in amplitude and/or the end of periodicity in the waveform before the stop closure. The frequencies of the first and second formant were estimated automatically with the help of a PRAAT script at three equidistant points (20%, 50% and 80%) over the course of the vowel's duration to allow for an analysis of formant dynamics. Window length was set to 0.025 seconds. Formant settings for the LPC analysis were adapted for each speaker individually in the script by de- or increasing the LPC order in steps of 1 (default order of 10) and/or the maximum frequency in steps of 500 Hz (default 5000 Hz). Outliers due to measurement errors were manually corrected. Formant frequencies were normalized, using a version[1] of the Watt and Fabricius method [5] modified by Flynn [6].

2.3. Dynamic spectral features

To analyze formant dynamics, the amount of vowel inherent spectral change was assessed as the trajectory length (TL) (1), calculated as the sum of the two vowel sections lengths (VSL_{50-20}, VSL_{80-50}) (2), i.e. the Euclidean distances between the measurement points in the F1-F2 plane [10, 13].

(1) $$TL = VSL_{50-20} + VSL_{80-50}$$

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

To account for dynamic changes in unnormalized time, the spectral rate of change (roc) was calculated for each vowel section length (e.g. VSL roc_{50-20}) separately (3) as well as for the overall trajectory length (TL roc) (4) [10, 15].

(3) $$VSL\ roc_{50-20} = \frac{VSL_{50-20}}{0.30 \times V_{dur}}$$

(4) $$TL\ roc = \frac{TL}{0.60 \times V_{dur}}$$

2.4. Statistical processing

For statistical processing the 36 vowels were compared to each other for each of the three villages, using mixed models with *vowel* as a fixed factor and random intercepts for *speaker*. The dependent variables were duration, F1 or F2 at the three measurement points, and the amount of VISC. If no significant differences were found for either of these dependent variables, two vowels were considered mergers

3. RESULTS

3.1. Merger

Table 1 shows the results for the analysis of merged categories. As predicted, the closed tense vowels /i y u/ and /iː yː uː/ have merged. The tripartite vowel contrast of long tense, short tense, and short lax monophthongs is thus reduced to a twofold distinction of short lax versus long tense monophthongs (/ɪ/ – /iː/, /ʏ/ – /yː/, /ʊ/ – /uː/).

The analysis of diphthongs reveals a merger of /ɪu̯w/ and /iu̯w/ for all varieties. Whereas /ɪu̯w/ and /iːu̯w/ show distinct F2 values in Scharrel and Ramsloh, they have merged in Strücklingen. In addition, Ramsloh shows the merger of /iu̯w/ and /iːu̯w/, which in Strücklingen and Scharrel are still distinguished by the frequency of the second formant at the temporal midpoint. Although Ramsloh is described as the most conservative of the three varieties [8], our analysis reveals two more mergers for this variety, /ɛu̯w/-/ɛːu̯w/ and /oːi̯/-/ ɔːi̯/, and thus the overall highest number of merged categories. /yːi̯/ and /uːi̯/ could not be elicited because the only two lexemes, in which they occur, were unknown to our speakers. /aː/ could not be elicited in Scharrel because it is generally not pronounced in closed syllables before an alveolar stop as in the target word [9].

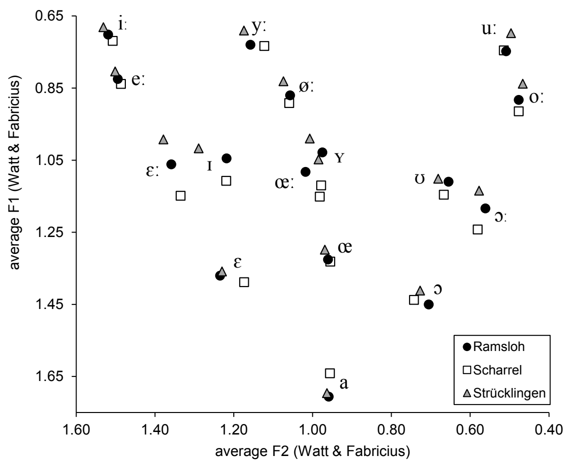
Table 1: Merged vowel categories in Saterland Frisian. S=Scharrel, St=Strücklingen, R=Ramsloh

	monophthongs merged	diphthongs merged	vowels not elicited
S	/i/-/iː/ /y/-/yː/ /u/-/uː/	/ɪu̯w/-/iu̯w/	/aː/ /yːi̯/, /uːi̯/
St	/i/-/iː/ /y/-/yː/ /u/-/uː/	/ɪu̯w/-/iu̯w/ /ɪu̯w/-/iːu̯w/	/yːi̯/, /uːi̯/
R	/i/-/iː/ /y/-/yː/ /u/-/uː/	/ɪu̯w/-/iu̯w/ /iːu̯w/-/iu̯w/ /ɛu̯w/-/ɛːu̯w/ /oːi̯/-/ɔːi̯/	/yːi̯/, /uːi̯/

3.2. Spectral properties and duration

Figure 2 shows the normalized mean first and second formant values of the monophthongs of the three Saterland Frisian villages measured at vowel midpoint. The comparison of static formant values of single vowel categories reveals a small but consistent variation in F1 (see also table 2). In Scharrel monophthongs are slightly more centralized in the F1 dimension than in Strücklingen. At the 80% point this distinction is significant for the back vowels only. Regarding the comparison of Ramsloh with Scharrel, there is a similar significant difference in F1 only for the close-mid vowels /ɛː œː ɔː/, which are more open in Scharrel than in Ramsloh. Only the open-mid vowels /ɛ œ ɔ/ do not follow the centralization pattern. They are produced with higher or similar F1 values in Scharrel compared to corresponding categories in the other two villages. This deviation from the overall pattern may enhance the perceptual contrast to the long lax close-mid vowels /ɛː œː ɔː/ and the short lax close-mid vowels /ɪ ʏ ʊ/.

Figure 2: Normalized mean values of the center frequencies of the monophthongs of Saterland Frisian.



In addition, we note an unexpected low position of the short lax vowels /ɪ ʏ ʊ/ within the F1-F2 plane. Unlike in other Germanic languages, suggested by orthographic representation and traditional grouping of contrasting categories, these vowels are closer to the close-mid lax vowels /ɛː œː ɔː/ in phonetic space than to the tense high vowels /iː yː uː/ or /eː øː oː/. Like in other Germanic languages, however, the tense vowels /iː yː uː/ are spectrally closest to /eː øː uː/. Their difference in F1 is accompanied by a significant difference in acoustic vowel duration, with the exception of the /yː/-/øː/ distinction in Ramsloh.

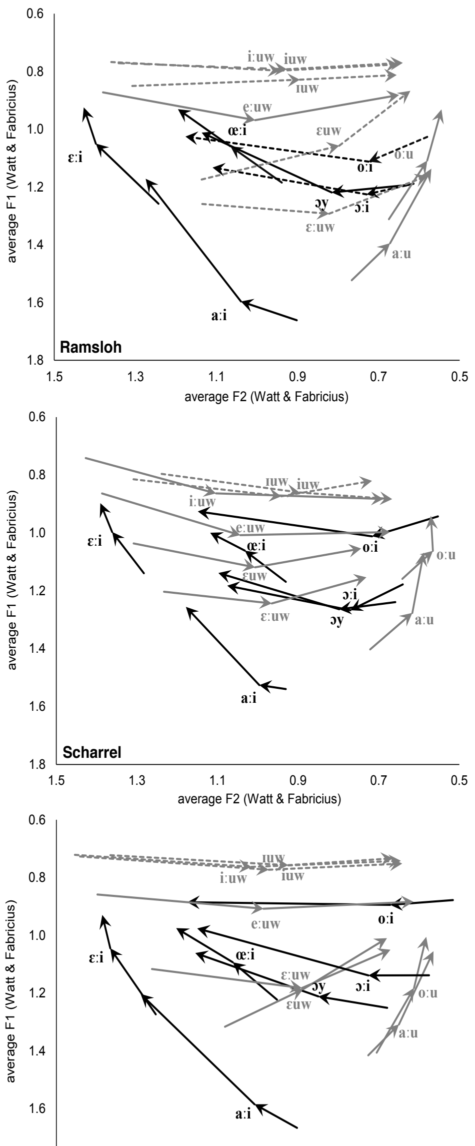
Table 2: Statistical results of the comparison of mean values. Only significant differences are listed. The level of significance is indicated by asterisks. S=Scharrel, St=Strücklingen, R=Ramsloh

	F1 50%
all vowels	St < S*
monophthongs	St < S**
front vowels	St < S**
back vowels	St < S*
close-mid /ɛː œː ɔː ɪ ʏ ʊ/	St < S*** R < S*

No significant cross-dialectal differences were found regarding acoustic vowel duration, the trajectory length, or the spectral rate of change.

Figure 3 displays the diphthong trajectories of the three varieties of Saterland Frisian. Each diphthong is depicted in the form of two consecutive

Figure 3: Comparison of mean diphthong trajectories measured over the central 60% (20%-50%-80%) of the vowel. Arrowheads mark the end of each vector. Denominations are placed at the 50% point. Black = trajectories closing to a high front vowel, grey = trajectories closing to a high back vowel. Dashed lines indicate categories involved in a merger.



vectors resulting from measurements at the 20%, 50%, and 80% point, showing its spectral change within the central 60%. Due to mergers we find a different number of distinct diphthongal categories for the three villages. No significant cross-dialectal differences were found for the comparison of diphthongs.

3.3. Phonetic variables for vowel distinction

A linear discriminant analysis was carried out to determine the percentage of correctly predicted vowels per location. In all three locations vowel duration and the center frequencies of F1 and F2 alone yielded a high percentage of correctly predicted monophthongs: 86.1% in Ramsloh, 92.1% in Scharrel, and 91.4% in Strücklingen. Adding further information such as vowel onglide (F1/F2 at 20%) and vowel offglide (F1/F2 at 80%) or the amount of VISC improved the model by no more than 2.2%. With 82.9% in Ramsloh, 74.9% in Scharrel, and 80.1% in Strücklingen, diphthongs were well predicted solely on grounds of vowel onglide and offglide. Adding the center frequencies increased the score by up to 3.9%, yielding a percentage of 84.2% in Ramsloh, 78.8% in Scharrel, and 82.0% in Strücklingen. Although vocalic duration serves as a good predictor together with vowel onglide and offglide (Ramsloh: 86.1%, Scharrel: 74.6%, Strücklingen: 81.6%), this combination is not preferred over a model, which is restricted to spectral information on the three measurement points.

4. CONCLUSION

The results confirm a complex inventory for the three varieties of Saterland Frisian. However, not the complete inventory as described in the literature was obtained. As was expected from [11], the short tense vowels have undergone a merger with neighboring categories and become phonetic variants. Contrary to Fort's [8] description of Ramsloh as the most conservative of the three varieties, Ramsloh shows the overall highest number of merged categories.

According to [8, 17], Scharrel speakers are generally perceived as speaking faster than speakers from Ramsloh and Strücklingen. This perception is not mirrored by larger vowel durations in our data. Furthermore, no information on speech rate can be drawn from durational differences in monosyllabic utterances due to phrase-final lengthening. We did, however, find that Scharrel monophthongs are more centralized in F1.

Like the variety of Northern Standard German and the North Frisian dialect of Fering (cf. [2, 20]), Saterland Frisian makes use of vowel duration and mid-vowel F1 and F2 rather than of dynamic spectral features to disambiguate neighboring monophthongs.

Following Bohn's [2] observations for Fering, the difference in acoustic duration of the spectrally adjacent high tense vowels /iː yː uː/ and /eː øː oː/ may reflect a tendency of Saterland Frisian to exploit the phenomenon of intrinsic vowel duration as an enhancing factor for the distinction of neighboring categories within the upper part of the vowel space.

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[1] The adapted version is referred to as *2mW&F* in [6].