Rhythmic variability in Swiss German dialects

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Abstract

Speech rhythm can be measured acoustically in terms of durational characteristics of consonantal and vocalic intervals. The present paper investigated how acoustically measurable rhythm varies across dialects of Swiss German. Rhythmic measurements (%V, ΔC, ΔV, varcoC, varcoV, rPVI-C, nPVI-C, nPVI-V) were carried out on four sentences of six speakers from eight Swiss dialects. Results indicate that there are significant differences across the dialects in some rhythm measures but not in others and that dialects can be grouped according to rhythmic characteristics.

Index Terms: Speech rhythm, rhythm metrics, Swiss German, dialectology

1. Introduction

Within the dialects of German, the Swiss German (SG) dialects belong to the Alemannic subgroup which, together with Bavarian and East Franconian, form Upper German. Rather than constituting one single dialect, SG comprehends a number of different dialects, which are frequently associated with the corresponding Canton, i.e. an administrative division. SG dialects are spoken by roughly 4.5 million people, making up approximately 64% of the Swiss population [1]. We encounter three major dialect groups: Low Alemannic, High Alemannic, and Highest Alemannic. The geolinguistic structuring of these dialects shows a Midland-Alpine as well as an East-West divide. The former divide, which amounts to a Low/High vs. Highest Alemannic split, largely reflects a difference between archaic and more modern forms used in the dialects [2]. Differences between East and West, on the other hand, mostly encompass discrepancies in the morphological realm.

Studies on the segmental and lexical features of the dialects are abundant and bear a long-standing tradition. In terms of prosodic descriptions, [3, 4, 5] investigated the durational and intonational behavior of principally four dialects: Bern (BE), Valais (VS), Zurich (ZH), and Grisons (GR). The results demonstrate distinct variation across the dialects in the context of temporal features on the segmental level. Speakers of the Western Dialects (BE and VS) show shorter phrases than speakers of Eastern Dialects (ZH and GR), whereas all dialects exhibit distinct lengthening not only phrase-finally, but also phrase-initially and in penultimate syllable position. Yet, VS speakers make least differences between the four positions in the phrase. ZH speakers exhibit much more pronounced phrase-initial and phrase-final lengthening. BE speakers exhibit distinct phrase-final lengthening and slow articulation rate. In terms of speech rhythm as a parameter for prosodic typology of Swiss German dialects, there is a clear lack of knowledge.

There are a number of studies that have tackled an application of rhythm metrics on dialectal data of other languages, however; some of them shall be reported on here. [6], for instance, examined rhythmic distinctions between dialects of British English and report that %V and VarcoV are most useful for a rhythmic discrimination of dialects; these metrics showed not only significant differences between languages, but also between within-language dialect groups. [7], too, examine inter-dialectal variability of British English dialects. They report that nPVI-V is a valid means for capturing rhythmic differences between the dialects and conclude that between-dialect variability can be captured better with measures from vowel durations as opposed to consonantal durations. [8] tests different rhythm metrics (particularly ΔC, %V, ΔV, and PVI) on 9 Italian dialects. It is reported that ΔC accurately reflects syllable complexity while nPVI-V is suited to capture vowel reduction.

2. Data and methods

In the current paper we attend to the question as to whether or not SG dialects differ in terms of rhythm and whether we can distill relevant acoustic cues that would account for these differences. To address this question we recorded 48 speakers of 8 different dialect regions. 2.1 discusses the selection of dialects and subjects, while 2.2. addresses data elicitation, labeling, and analysis.

2.1. Selection of dialects and subjects

The selection of the dialects is grounded in the geolinguistic structuring of SG dialects (see introduction). 4 Alpine dialects as well as 4 Midland dialects were selected. In the same vein, these 8 dialects can be categorized as 4 Eastern and 4 Western varieties. Figure 1 illustrates the selected dialects, explanations are given below.

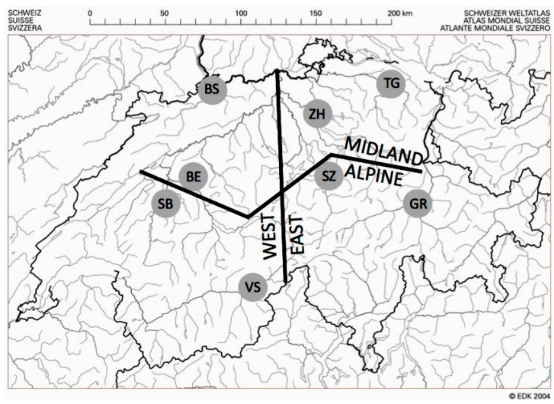

Figure 1: *Data of 48 speakers of 8 dialect regions were analyzed*

The dialects can be broken down as follows:

	West	East
Midland	**BS**: Basel **BE**: Bern	**TG:** Thurgau **ZH:** Zurich
Alpine	**SB:** Sensebezirk **VS:** Valais	**SZ:** Schwyz **GR:** Grisons

6 native speakers were analyzed per dialect, adding up to a total of 48 speakers. The informants claimed to speak the dialects in question on a daily basis and were recorded in the respective locations. Subjects vary between 17 and 69 years of age, the great majority being in their mid-twenties.

2.2. Data elicitation, labeling, and analysis

A number of phrases written in Standard German were shown to the subjects. They were asked to silently read them and next articulate sentence after sentence in their dialect. The phrases were simple and complex declaratives, WH-questions, and yes/no questions. A sample declarative is given below:

(1) Die Union von den Nonnen hat einen neuen Namen
(2) t uni'O:n fO d@ n'On:@ hEt @ 'n9j@ 'nam@
(3) The union of the nuns has a new name

(1) exhibits the Standard German phrase that was shown to the subjects, (2) exemplifies a Bernese realization thereof, transcribed in SAMPA, (3) provides the English translation. 4 of these phrases per subject were transcribed phonetically and labeled on the segmental level in *Praat* [9]. 4 sentences per subject * 48 subjects amounts to 192 sentences; each sentence on average consisted of roughly 30 segments, which adds up to approximately 5760 segments in total. Consecutive vowels or consecutive consonants were merged into vocalic and consonantal intervals, which provided the desired labeling format for a subsequent application of rhythm metrics and statistical analyses. The following metrics were calculated: %V, ΔC, ΔV [10], varcoC, varcoV [11], rPVI-C, nPVI-C, and nPVI-V [12]. rPVI-C and ΔC were transformed (ln) so as to fulfill the criteria of parametric tests [13].

3. Results

Results are presented as follows: 3.1 covers the findings on %V, 3.2 shows the results on vocalic variability while 3.3 attends to findings regarding consonantal variability. We processed the following statistics on our data: for each rhythm metric we first calculated a univariate ANOVA dialect by rhythm measure; second, we performed a t-test on Alpine/Midland dialects and thirdly, a t-test on Eastern/Western dialects. All t-tests were Bonferroni corrected and only significant results are reported.

3.1. %V

Figure 2 shows the boxplots of %V for each of the eight dialects. The horizontal line in the center of the figure illustrates the overall mean.

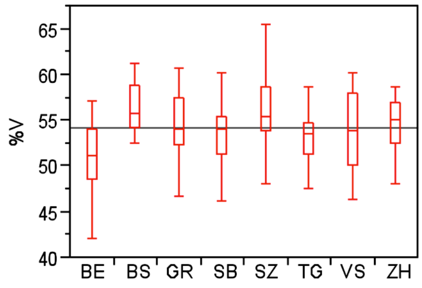

Figure 2: *Boxplots of the dialects' %V*

The boxplots show an overlap between the dialects, however, some dialects stick out as varying from one another – BS and SZ, for instance, exhibit the highest %V. An ANOVA revealed significant effects ($F(7, 184) = 5.8$, $p < .0001$) and post-hoc tests indicate that BS (M=56.4, SD=2.5) and SZ (M=56.3, SD=4.4) show significant differences to all other dialects; BE (M=51.2, SD=4) too, is significantly different from all other dialects, yet with the lowest %V value.

3.2. Vocalic variability

The results of the metrics concerning vocalic variability against the backdrop of detecting differences between the dialects and dialect groups are given below, in particular as regards the opposition between Alpine dialects (GR, SB, SZ, VS) vs. Midland dialects (BE, BS, TG, ZH), and the opposition between Eastern dialects (GR, SZ, TG, ZH) vs. Western dialects (BE, BS, SB, VS). Table 1 shows the results of the statistical tests concerning vocalic variability.

Rhythm measure	**Test**	**Factor**	**Result**
ΔV	ANOVA	Dialects	$F(7, 184) = 5.6$, $p < .0001$
ΔV	t-test	East/ West	$t(190) = -3.3$, $p = .0009$
nPVI-V	ANOVA	Dialects	$F(7, 184) = 4.6$, $p < .0001$
nPVI-V	t-test	Alpine/ Midland	$t(190) = 5.6$, $p < .0001$
varcoV	see below		

Table 1: *Results of statistical tests concerning vocalic variability.*

VarcoV will be given special attention since it yielded the highest number of significant post-hoc tests. Differences for varcoV are considerable, see Figure 3.

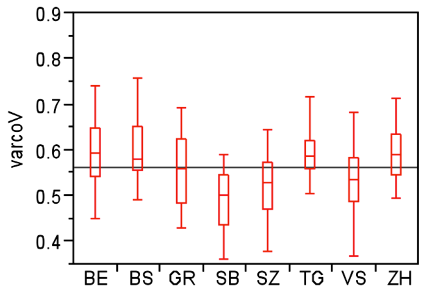

Figure 3: *Boxplots of the dialects' varcoV*

The boxplots shown in Figure 3 clearly suggest distinct differences between the dialects in terms of varcoV. It is particularly TG and BS that demonstrate high varcoV values, while SB demonstrates low values. An ANOVA reveals significant effects (F(7, 184) = 8.2, p < .0001) and post-hoc tests confirm significant differences, for instance, for TG (M=.61, SD=.08) and SB (M=.48, SD=.065) to all other dialects. To test whether there are significant differences in the varcoV values between Alpine (M=0.52, SD=0.08) and Midland (M=0.6, SD=0.07) varieties, a t-test was calculated. The boxplots of the data are presented in Figure 4.

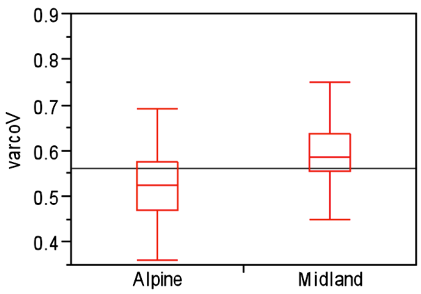

Figure 4: *Boxplots of the dialect groups' varcoV*

The boxplots show that the dialects groups strongly vary from one another (t(190) = 6.8, p < .0001).

3.3. Consonantal variability

The results of the metrics concerning consonantal variability against the backdrop of detecting differences between the dialects and dialect groups are given below, in particular as regards the opposition between Alpine dialects (GR, SB, SZ, VS) vs. Midland dialects (BE, BS, TG, ZH), and the opposition between Eastern dialects (GR, SZ, TG, ZH) vs. Western dialects (BE, BS, SB, VS). Table 2 shows the results of the statistical tests concerning consonantal variability.

Rhythm measure	Test	Factor	Result
rPVI-C	ANOVA	Dialects	F(7, 184) = 4.4, p = .0002
rPVI-C	t-test	East/West	t(190) = -4, p < .0001
nPVI-C	see below		

Table 2: *Results of statistical tests concerning consonantal variability*

nPVI-C is given special attention given that it yielded the highest number of significant post-hoc tests of a rate-normalized consonantal variability metric. Differences for nPVI-C are substantial, see Figure 5.

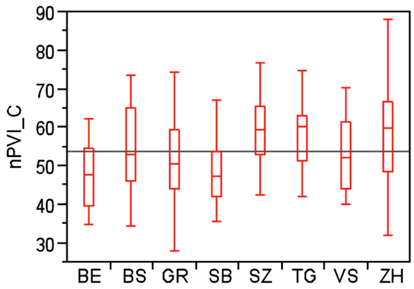

Figure 5: *Boxplots of the dialects' nPVI-C*

The boxplots illustrated in Figure 5 show variation between the dialects. While BS indicates values right around the overall mean, it is SZ and BE that diverge the most. A calculated ANOVA shows significant effects (F(7, 184) = 4.7, p < .0001). Subsequent post-hoc tests confirm that SZ (M=58.8, SD=8.7) and SB (M=47.9, SD=7.8) are significantly different to all other dialects. To test whether there are significant differences in the nPVI-C values between Eastern (M=56.7, SD=11.4) and Western (M=51, SD=9.4) varieties, a t-test was calculated. The boxplots of the data are presented in Figure 6.

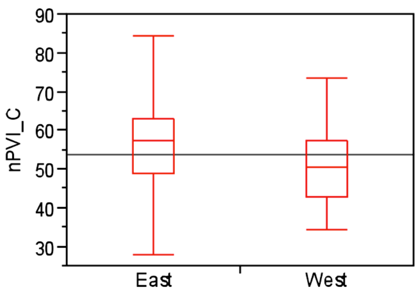

Figure 6: *Boxplots of the dialect groups' nPVI-C*

The boxplots indicate that the dialect groups strongly vary from one another (t(190) = -3.7, p = .0002).

4. Discussion

The results of this preliminary study confirm acoustically measurable rhythmic differences between Swiss German dialects in terms of %V, vocalic, and consonantal variability. On the one hand, results indicate that vocalic variability is a major discriminator between the individual dialects and between dialect groups. On the other hand, the findings underline that rhythmic variability is complex. Rhythm measures do not seem to vary uniformly across different dialects. With respect to the model of stress-timed and syllable-timed languages, where syllable-timed languages typically exhibit high %V, low consonantal and vocalic variability and stress-timed varieties supposedly behave the opposite way, we cannot detect such a pattern in the current dialectal data. For instance, a significantly higher nPVI-C for Eastern as opposed to Western dialects does not necessarily imply the same for varcoC (see 3.3). In other words, different rhythm metrics measure speech rhythm differently. We do, nevertheless, observe a wide variability between the dialects in terms of %V, vocalic and consonantal durations.

The dialects at hand vary with regard to their vocalic intervals – a finding that corroborates the applicability of %V as a cross-dialectal discriminator as found by [6]. BS, a Midland dialect, stands out with distinct %V values, which can be attributed to their (dialect-idiosyncratic) vowel lengthening in open syllables.

Not only does %V constitute a major discriminator between SG dialects; vocalic variability, even more so, seems to occupy a key role as shown by the results of ΔV, nPVI-V, and varcoV. The findings particularly underline the valid applicability of varcoV and nPVI-V to constitute cross-dialectal discriminators (cf. [6], [7], and [8]), given that the post-hoc tests of these ANOVAs exhibited the greatest number of significant effects. Moreover, these findings allow for a tentative grouping of SG dialects which is in line with other prosodic features. Not only do Alpine dialects show less vocalic variability as opposed to Midland dialects (as shown by the results of nPVI-V and varcoV); they also have a tendency of realizing non-reduced word-final syllables, i.e. retaining full vowels in otherwise unstressed environments – a feature which is not found in Midland dialects. Such full vocalic realization of otherwise unstressed segments has also been shown to contribute to differences on the intonational level (cf. [3]). As has repeatedly been pointed out [10, 14, 15], the nature of unstressed vowels may have an impact on the perception of speech rhythm, and this might be the case with SG dialects where timbre reduction and durational variability go hand in hand.

We encounter a further divide in that Eastern dialects show more variability in vocalic intervals than Western dialects, as suggested by the results of ΔV. Overall, we thus find that vocalic variability decisively discriminates not only the dialects amongst one another but also between the dialect groups.

When looking at the results of the tests that were run on consonantal variability, we may infer that consonantal variability possibly occupies a somewhat less critical role than vocalic variability as a rhythmic discriminator between SG dialects. Both, raw and normalized PVI-C indicate significant differences between the dialects and confirm that Eastern dialects exhibit more consonantal variability than Western dialects – yet, ΔC as well as varcoC did not yield significant effects, neither between the dialects nor dialect groups. Consonantal variability discriminates the dialects only partially and points to differences only between Eastern and Western varieties; Alpine and Midland dialects cannot be discriminated on the basis of consonantal variability.

In summary, we obtain a geolinguistic structuring of speech rhythm of the following order:

– Alpine-Western dialects (SB, VS) demonstrate relatively little vocalic and consonantal variability;

– Midland-Eastern dialects (ZH, TG) show relatively high vocalic and consonantal variability;

– North-Western dialects (BE, BS) as well as South-Eastern dialects (GR, SZ) to a greater or lesser extent fall in between these categories.

The question raised at this stage is whether or not these differences between the dialects are perceptually salient, i.e. can listeners identify SG dialects based on rhythmic features? That languages of different rhythm types can be identified based on rhythmic differences alone has been shown by [10]; whether this is possible for between Swiss dialect rhythmic variability remains unclear. Moreover, it would be worthwhile exploring language contact related factors contributing to the established geolinguistic structuring of speech rhythm in SG dialects, with VS being in contact with French, GR with Romansh, and BS and TG with German.

5. Conclusion

The current study showed that the variability of vocalic intervals occupies an important role for the discrimination of SG dialects in terms of rhythm metrics – a result that has also been found by [7]. Vocalic variability metrics confirmed effects between the dialects as well as between dialect groups (Midland vs. Alpine, East vs. West). Rhythmic differences can be established particularly in terms of an Alpine vs. Midland divide. Consonantal variability, on the other hand, seems to be somewhat less critical as a rhythmic discriminator for SG dialects; yet, it allows tracing some rhythmic differences as well.

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