



## Speech rhythm in multiethnolectal Zurich German

Marie-Anne Morand, Melissa Bruno, Nora Julmi, Sandra Schwab & Stephan Schmid

Phonetics Laboratory, Department of Computational Linguistics, University of Zurich

{marie-anne.morand, melissa.bruno, nora.julmi, sandra.schwab, stephan.schmid}@uzh.ch

### Abstract

Multiethnolects have been observed in (Western) Europe for about 30 years, also in Zurich – the biggest city in German-speaking Switzerland, characterized by ethnic and linguistic diversity. Speech rhythm appears to be a salient feature of several European multiethnolects and has been described as a ‘staccato’ rhythm. However, a sociophonetic investigation of rhythm in Swiss German multiethnolects is lacking so far.

To investigate rhythmic characteristics of multiethnolectal Zurich German, we recorded read speech of 48 adolescents of two schools in Zurich. Forty adolescents from a third school rated speech samples to indicate how multiethnolectal the speakers sound on a 7-point Likert scale. These rating scores were then correlated with various rhythm metrics ( $\%V$ ,  $\Delta C$ ,  $\Delta V$ ;  $varcoC$ ,  $varcoV$ ;  $nPVI-C$ ,  $nPVI-V$ ).

We found significant correlations between vowel variability measurements and rating scores as well as between syllable rate and rating scores. In contrast, we found no correlations with consonantal variability measurements. Our results support the view that multiethnolectal Zurich German uses less vowel reduction in unstressed syllables which leads to the impression of a ‘staccato’ rhythm of this variety.

**Index Terms:** Speech rhythm, multiethnolects, sociophonetics, Swiss German dialects

## 1. Introduction

The emergence of so-called multiethnolects in (Western) Europe can at least be dated back to Kotsinas’ work on *Rynkeby Swedish* in the 1980s [1]. Such varieties occur in cities with relatively high proportions of migrants. In this study, we investigate whether rating scores of how multiethnolectal speakers of Zurich German sound correlate with the ‘staccato’ rhythm, which has been associated with Swiss multiethnolects [2, p. 329]. In order to verify this claim empirically, we will analyze a corpus of multiethnolectal Zurich German by means of a number of rhythm metrics (§2.2).

Our contribution is organized as follows. §2 is dedicated to the study of speech rhythm, whereas §3 consists of a short description of suprasegmental features in multiethnolects. §4 introduces the data and methods used in our investigation; finally, §5 presents the results which will be discussed in §6.

## 2. Speech rhythm

### 2.1. The isochrony hypothesis

As is well-known, Pike [3] and Abercrombie [4] established the original ‘isochrony hypothesis’. According to this hypothesis, most languages of the world can be classified as either having a stress-timed rhythm or a syllable-timed rhythm. Thus, languages tend to show either equal durations of feet or accent

groups (stress-timing) or their syllables tend to have more or less equal durations (syllable-timing). For example, Germanic languages such as English or German are said to be stress-timed, whereas most Romance languages (e.g., Spanish or French) would be considered syllable-timed.

### 2.2. Rhythm metrics

Research in experimental phonetics has found no evidence in support of the isochrony hypothesis (see [5] and [6] for an overview). As a consequence, around the turn of the millennium a new version of the ‘rhythm class hypothesis’ was proposed by Ramus, Nespors, and Mehler [7]. In this view, the impression of rhythmic differences between languages is mainly due to two major phonological factors, namely syllable structure complexity and vowel reduction. Therefore, the study of linguistic rhythm should no longer focus on syllable or foot duration, but rather be based on “a quantification of consonantal and vocalic variability” [8, p. 338].

For this reason, Ramus, Nespors, and Mehler [7] suggested measuring the duration of vocalic and consonantal intervals (i.e., sequences of adjacent vowels or adjacent consonants, regardless of syllable boundaries). Based on these duration measurements, the following rhythm metrics can be calculated: i) the percentage of the duration of vocalic intervals in a sentence ( $\%V$ ), ii) the standard deviation of the duration of vocalic intervals in a sentence ( $\Delta V$ ), and iii) the standard deviation of the duration of consonantal intervals in a sentence ( $\Delta C$ ). According to the rhythm class hypothesis, it is expected that “stressed-timed languages show a higher  $\Delta C$  and a lower  $\%V$  than syllable-timed languages” [9, p. 232].

A slightly different view of speech rhythm was put forward by Grabe and Low [10]. While still measuring the durations of vocalic and consonantal intervals, they argued that global descriptive indices such as  $\%V$ ,  $\Delta C$ , and  $\Delta V$  are not suitable for explaining the dynamic nature of speech rhythm. Therefore, they proposed new rhythm metrics, namely the raw and normalized pairwise variability indices ( $rPVI/nPVI$ ), calculated as the mean of the duration differences of all subsequent vocalic and consonantal intervals.

Based on the insight that “the standard deviations of consonantal intervals ( $\Delta C$ ) are considerably affected by a higher speech rate, i.e. shorter average durations (meanC)”, Dellwo [9, p. 235] proposed two additional rhythm metrics,  $varcoV$  and  $varcoC$ . These metrics normalize for speech rate, as they calculate the variation coefficient rather than the standard deviations of the durations of vocalic and consonantal intervals (see, however, [11] for a critical evaluation of rhythm metrics in general).

In our study, we calculated all these metrics in order to verify the allegedly ‘staccato’ (i.e. syllable-timed) rhythm of Swiss German ethnolects.

### 2.3. Speech rhythm in (traditional) Swiss German dialects

‘Swiss German’ is an umbrella term used for the Alemannic dialects spoken in German-speaking Switzerland – Zurich German being one of these dialects.

The phonological nature of speech rhythm in Swiss German has been discussed mainly in the light of the typology of syllable and word languages [12, 13]. According to this view, word boundaries play only a minor role in southern Alemannic dialects as compared to German Standard German [14, p. 294]. Furthermore, “epenthesis and elision processes [in dialects], as well as syllabification and sandhi phenomena, optimize the syllable” [8, p. 336].

Conversely, the syllables of Swiss German dialects allow for rather complex consonant clusters. Moreover, they have distinctive vowel quantity, and duration has been shown to be the relevant phonetic correlate for the opposition of short and long vowels in Zurich German [15]. Vowel quantity is restricted to stressed syllables, and it has been pointed out that “like a word language, [traditional Swiss German] distinguishes between full vowels in stressed syllables and reduced vowels in unstressed syllables” [8, p. 342].

From a phonetic point of view, there is indeed evidence that Swiss German dialects rather behave like the alleged stress-timed languages. At least, this is suggested by an early pilot study on speech rhythm, where Zurich German patterns together with Standard German and English on the %*V* and the  $\Delta V/\Delta C$  planes, and not with the Romance languages French, Italian and Spanish [16, pp. 6–8]. Similarly, a later study found that “unpublished calculations of the Swiss German data used [...] with the Ramus, Nespore, and Mehler (1999) algorithm located Swiss German at a much more stress-timed position than Standard German” [8, p. 338].

Experimental studies have mainly focused on the considerable temporal variability of Swiss German dialects, highlighting that rhythm metrics are influenced by at least three factors: dialect, linguistic material, and speaker. First, Leemann et al. [17, p. 609] found significant differences between Alpine and Midland dialects with regard to *varcoV*. Second, Leemann et al. [18] compared eight Swiss German dialects and found that the phonotactic makeup of the sentences used in read speech had a major impact on the rhythm metrics. Third, Dellwo, Leemann and Kolly [19] found highly significant differences for %*V*, *varcoV* as well as *nPVI-V* between eight speakers of traditional Zurich German, using spontaneous speech data.

## 3. Rhythm in multiethnolects

At least since the turn of the millennium, new vernaculars of adolescents have emerged in (Western) European cities with a high degree of ethnic and linguistic diversity. Especially, multiethnolects of Germanic languages such as Swedish [20] English [21], and German [22] are well documented, but also *Multicultural Paris French* has been investigated [23].

### 3.1. Research on rhythm in European multiethnolects

Various multiethnolects have been claimed to differ in their speech rhythm as compared to traditional varieties of the same language. For instance, Kern [24] investigated the role and functions of rhythm in so-called *Türkendeutsch*. To do so, she compared the stress-timed rhythm of German (in Germany) to the syllable-timed rhythm of Turkish and investigated how these rhythm patterns are implemented in the speaking style

under investigation. Auer [22] also stated that a feature of German multiethnolects is their syllable-timed rhythm which sometimes implies a non-reduction of unstressed syllables.

Young [25] investigated rhythm variation in late-modern Stockholm Swedish and found statistical differences for an adaptation of the *nPVI* for vowels between speakers of so-called ‘racialized working class’ and ‘white working class’. He found low alternation (‘staccato’) for the former group and high alternation (‘non-staccato’) for the latter. This low alternation is therefore interpreted as being a characteristic feature of this Swedish multiethnolect.

French is usually grouped among the syllable-timed languages. Indeed, European French read speech has been shown to have relatively low  $\Delta C$  and high %*V* values due to less consonantal complexity [7, p. 273]; furthermore,  $\Delta V$  is also expected to be low as French lacks “diphthongization and/or vowel reduction” [26, p. 98]. Therefore, it was hypothesized that the French spoken by bilingual heritage speakers would be less syllable-timed (due to the influence of the alleged stress-timed nature of Arabic), but this hypothesis had to be rejected [26, p. 116] as the slight tendency towards lower %*V* values that was found in bilingual heritage speakers proved not to be statistically significant.

### 3.2. The rhythm of multiethnolectal Zurich German

So far, the literature review in §2.3 has shown that from a phonological point of view, Swiss German dialects bear traits of both syllable and word languages, while acoustic measurements would rather position them among the alleged stress-timed languages. However, a considerable amount of temporal variation has been found in particular in the vocalic domain.

It is precisely this vocalic variability that bears the potential of becoming socially meaningful in terms of sociophonetic indexicality. In particular, the impression of a ‘staccato’ rhythm appears to be a rather salient feature of ethnolectal Swiss German [2, p. 329]. More precisely, it has been claimed that the shortening of tense vowels as well as the missing reduction of unstressed syllables give the impression of a striking syllable-timed rhythm of ethnolectal Swiss German [9, p. 327].

Nevertheless, the impressionistic evaluation of ethnolectal speech as being more syllable-timed compared to the traditional dialects lacks an empirical validation so far (the only exception is a pilot study, in which a speaker of multiethnolectal Zurich German showed a lower vocalic variability – in terms of  $\Delta V$ , *varcoV*, and *nPVI-V* – than a speaker of traditional Zurich German; cf., [27]). The aim of our study is thus to fill this research gap on multiethnolectal Zurich German, correlating acoustic measurements from a larger number of speakers with rating scores of how multiethnolectal they are perceived.

### 3.3. Research hypotheses

Based on the literature review on Swiss German dialects (§2.3) and the preliminary findings on multiethnolectal Zurich German (§3.2), we assume that Swiss German dialects exhibit a considerable degree of rhythmic variability which is likely to be exploited as a socially meaningful marker of multiethnolectal speech. In particular, variability of vowel durations is predicted to be sensitive to such socioindexical differences. Instead, we do not expect any significant variability in consonant durations, as this would indicate phonotactic differences in the speech material, which is not the case given that the read sentences are identical for all speakers (cf., §4.3).

Therefore, we predict the following results:

- The more speakers sound multiethnolectal, the higher is their %*V* (due to less vowel reduction in unstressed syllables);
- The more speakers sound multiethnolectal, the lower is their  $\Delta V$ , *varcoV* and *nPVI-V* (due to less vowel reduction in unstressed syllables and smaller distinctions between long and short vowels);
- There is no relationship between how multiethnolectal a speaker sounds and  $\Delta C$ , *varcoC* and *nPVI-C* (due to the same material).

## 4. Data and methods

### 4.1. Speakers

Forty-eight adolescents were recorded at two different schools in the city of Zurich (28 females; mean age = 14.3 years;  $SD = 0.74$ ). Most of these adolescents ( $n = 39$ ) spoke additional or other languages than Zurich German before they entered kindergarten. The mother tongues of the group include – but are not limited to – the following (in alphabetical order): Albanian, Arabic, French, Portuguese, Punjabi, Serbian, Sinhalese, Somali, and Turkish. In many cases ( $n = 31$ ), both parents are citizens of another country than Switzerland.

### 4.2. Rating by peers

We conducted a perception experiment in a third school in the city of Zurich in which 40 adolescents rated short speech samples of the recorded speakers on a 7-point Likert scale on how multiethnolectal their speech sounds (1 = not at all, 7 = completely). The rating scores correspond to the mean values of all 40 raters. Rating scores vary between 1.45 and 6.01. On average, the speakers were given a 3.78 rating score ( $SD = 1.26$ ). The rating scores yield a clear continuum between traditional and multiethnolectal Zurich German, as the score gradually moves from one end of the continuum to the other.

The raters ranged in age from 14 to 16 at the time of the experiment (25 females, mean age = 14.8 years). Almost half of the raters ( $n = 19$ ) are bilinguals. The raters' (additional) mother tongues include – but are not limited to – English, Italian, Tamil, and Turkish (in alphabetical order).

### 4.3. Material

Read speech was recorded in a battery of carefully designed test sentences which contained 3 to 7 syllables (mean = 5.16;  $SD = 0.90$ ). In total, speakers read 100 sentences presented individually on a computer screen in random order. Zurich German is a non-standard variety; thus, the sentences were written according to the orthography principles established by Dieth [28] with which the adolescents were familiarized in advance.

For the recordings, a clip-on microphone (Sennheiser MKE 2-P) was connected via an audio interface (Zoom U-22) to a laptop computer. Recordings were made in a separate empty room at the adolescents' school using the software Speech-Recorder [29] at a sample rate of 44.1 kHz (16-bit encoding).

The short speech samples for the perception experiment were taken from a picture description task. These picture descriptions were recorded using a handy recorder (Zoom H2n). Short samples of 5 to 7 seconds were extracted from the middle of each description. During the perception experiment, peers listened to all these samples in random order.

## 4.4. Data analysis

Recordings were first segmented automatically using WebMAUS [30]; afterwards, segmentation was checked manually. Several sentences were excluded from analysis if speakers: i) said something different than presented, ii) used vowel/consonant epenthesis and elisions, and/or iii) hesitated or inserted pauses equal to or longer than 100 ms. These criteria led to the exclusion of 1851 sentences (38.6%). In total, 2949 sentences were analyzed. Per speaker, 37-84 sentences were analyzed (mean = 61).

## 5. Results

### 5.1. Syllable rate

As illustrated in Figure 1, there was a significant negative correlation between syllable rate and rating scores (Pearson  $r = -.354$ ,  $p = .014$ ).

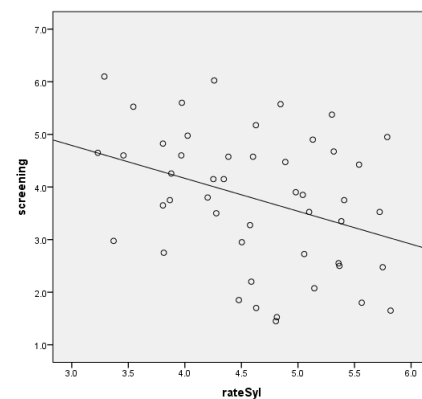


Figure 1: Rating scores as a function of syllable rate.

Adolescents that were rated as speaking more multiethnolectal spoke more slowly. Due to this correlation between speech rate and the rating scores, we decided to use the rate normalized rhythm metrics for vocalic (cf., §5.2) as well as for consonantal intervals (cf., §5.3), although Grabe and Low [10] recommend using the non-normalized *PVI-C* in the comparison of languages that might differ in consonant cluster complexity. Yet, as we are not dealing with different languages, we also applied the normalization for consonantal intervals.

### 5.2. Variability of the duration of vocalic intervals

To analyze vowel variability, we correlated %*V*,  $\Delta V$ , *varcoV*, and *nPVI-V* with the rating scores. As observed in Table 1, there are significant negative correlations between *varcoV* and rating scores as well as between *nPVI-V* and rating scores. %*V* and  $\Delta V$  showed no significant correlations with rating scores.

Table 1: Pearson correlations of vowel variability measurements and rating scores.

| Rhythm metrics | Pearson $r$ | $p$ -value |
|----------------|-------------|------------|
| % <i>V</i>     | .021        | .887       |
| $\Delta V$     | -.012       | .935       |
| <i>varcoV</i>  | -.467       | .001       |
| <i>nPVI-V</i>  | -.381       | .008       |

Figure 2 illustrates the negative correlation between  $nPVI-V$  and the rating score showing that speakers who were rated as speaking more multiethnolectal Zurich German show less variability in the duration of vocalic intervals.

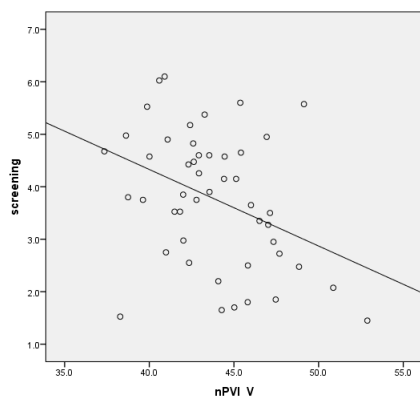


Figure 2: Rating score as a function of  $nPVI-V$ .

### 5.3. Variability of the duration of consonantal intervals

To analyze consonantal variability, we correlated  $\Delta C$ ,  $varcoC$  and  $nPVI-C$  with the rating scores. As shown in Table 2, there are no significant correlations between any of these variables and rating scores.

Table 2: Pearson correlations of consonantal variability measurements and rating scores.

| Rhythm metrics | Pearson $r$ | $p$ -value |
|----------------|-------------|------------|
| $\Delta C$     | .245        | .093       |
| $varcoC$       | -.183       | .213       |
| $nPVI-C$       | -.133       | .368       |

## 6. Discussion

Summarizing our results, we found significant correlations between syllable rate and rating scores as well as between measurements of vowel variability and rating scores. There were, however, no correlations between measurements of consonantal variability and rating scores.

The expected lack of significant correlations between consonant duration variability and rating scores can easily be explained by the nature of the data. Variability of consonant duration is supposed to reflect different degrees of consonant cluster complexity and is essentially designed to compare languages. In our case, instead, all speakers read the same sentences of the same language variety; therefore, the phonotactic complexity is identical.

A major finding of our study is that lower variability of the duration of vocalic intervals correlates with higher rating scores. Thus, adolescents who are perceived as speaking more multiethnolectal Zurich German in the perception experiment show less differences in the durations of vocalic intervals in read speech – a feature which has been associated with the perceived ‘staccato’ rhythm of multiethnolectal speech [25]. Conversely, the higher variability in the duration of vocalic intervals in speakers who are perceived as speaking less multiethnolectal Zurich German might be due to more vowel reduction in unstressed syllables as well as to larger duration

differences between long and short vowels in stressed syllables in comparison to speakers who are perceived as speaking more multiethnolectal Zurich German [15]. On the other hand, there is no significant correlation between  $\%V$  and rating scores. Similarly to  $\Delta C$ ,  $\%V$  is assumed to be an acoustic correlate of syllable structure complexity [7].

Comparing the  $nPVI-V$  values with those available in the literature, it is noteworthy that most values are between 40 and 50, thus lying in an area typically occupied by the alleged syllable-timed languages [10, p. 529; 31, p. 1320]. Although the involved mother tongues of the speakers might have different rhythmic properties, it appears that the syllable-timed rhythm is part of the multiethnolectal Zurich German ‘feature pool’ [21] which speakers make use of independently of their mother tongue(s).

Another interesting result of our study regards speech rate. The negative correlation between syllable rate and rating scores might be an indication of speech rate being another phonetic feature of multiethnolectal Zurich German. This is in line with a pilot study, in which the multiethnolectal speaker showed a lower articulation rate than the speaker of traditional Zurich German in terms of segments per second [27].

However, some limitations of the study should be noted. The findings are based on read speech which probably also affected rhythmic properties. Therefore, a comparison of the results to a small set of more spontaneous speech is planned to see if we can find similar trends. Furthermore, the rating scores are not based on the analyzed read speech, which is why we can only interpret correlations indirectly, without postulating a direct causal relationship between production and perception.

Finally, a more complete picture of Swiss German multiethnolects also needs to take into account segmental features. The present study investigated correlations of the perceived degree of multiethnolectal speech with rhythm metrics. However, there is reason to assume that segmental features such as voicing of lenis plosives also contribute to the makeup of multiethnolectal speech [2, 32]. In order to investigate the relative weight of various segmental and suprasegmental features in the perception of multiethnolectal speech, further perception experiments are planned in which these variables are systematically manipulated to investigate to which degree they are used as sociophonetic markers [33] in multiethnolectal Zurich German.

## 7. Acknowledgements

This research was supported by the Swiss National Science foundation (Grant No. 165798). We would like to thank all the speakers, raters, and their teachers for the participation in this study.

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