PITCH ACCENT REALISATION IN AUSTRIAN GERMAN

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ABSTRACT

Austrian German is known for its distinct prosody when compared with other varieties of German [11, 13, 8]. However, phonetic data on Austrian German varieties are sparse, especially in the prosodic domain. Northern and southern Standard German have been found to truncate falling pitch (in which the f0 contour of the pitch accent is only fully realised when enough sonorant material is available; i.e. the end of the f0 contour is cut off) but compress rising pitch accents (where the full f0 contour is realised regardless of the amount of sonorant material [2, 15]). These patterns are found to differ between languages [2]. Our study examines whether this is also the case across varieties. We extend previous research on nuclear pitch accent realisation to an Austrian German variety in order to establish whether (and how) it differs from other German varieties.

Keywords:
intonation, truncation, compression, Austrian German, pitch accent

1. INTRODUCTION

Austrian German prosody is not yet well-documented, but it is believed to differ from that of other varieties of German [11, 13, 8, 7]. Differences that have been documented include greater f0 range and slower speech tempo [12], later alignment of pre-nuclear rises [7], and more sentence and phrase-internal pauses [13]. In [13]'s comparison of German, Swiss and Austrian varieties, f0 reset between prosodic phrases differed depending on the type of phrase for Swiss and German but not for Austrian.

[2] investigated f0 realisation of falling vs. rising phrase-final pitch accents in Standard Southern British English (SSBE) and Northern Standard German (NSG) and the extent to which this depended on the duration of voicing during the pitch accent. She found that speakers of SSBE realised the entire range of the f0 trajectory on both falling and rising pitch accents, even when the duration of voicing was reduced, leading to successively steeper f0 contours. [2] referred to this pattern as *compression*. The NSG speakers in her study performed similarly on rising pitch accents, but showed a different pattern on falling pitch accents. Instead of compressing the entire range of the f0 trajectory into successively shorter voiced portions on falling pitch accents, the NSG speakers truncated the end of the f0 trajectories in words with less voicing. This pattern, in which the slopes of the f0 trajectories remain constant regardless of the duration of voicing, is referred to as *truncation*. A follow-up study by [15] confirmed the NSG pattern in a Southern German variety (that is, compression of rises and truncation of falls), but no such studies have been carried out for Austrian German.

Differences in pitch accent realisation (compression vs. truncation on rises vs. falls) may well contribute to the distinct prosody of Austrian German. The aim of this study was to extend [2]'s study to an Austrian German variety in order to establish whether (and how) it differs from other German varieties described in the literature.

2. METHOD

Participants were 10 native speakers of Austrian German from the city of Graz (aged 21 to 31, mean 25.5 years; 6 female), all of whom came from monolingual households and were functionally monolingual.

We used the tokens from [2] with the longest and shortest voicing durations (*Schiefer* /ˈʃiːfɐ/ vs. *Schiff* /ʃɪf/, respectively), leaving out the intermediate duration, as we were not interested in the presence of a gradient effect, and [3, pp .173-174] found that the intermediate and shortest word lengths behaved the same. In Standard German, /ɪ/ is a phonologically short, lax vowel, while /iː/ is a phonologically long, tense vowel. Austrian German tends to (at least partially) neutralise the vowel quality contrast in phonological tense-lax pairs while maintaining the quantity distinction [4, 8]. However, it is the durational (and not the tensity) contrast that is crucial to this study, because the aim is to investigate how pitch accent is realised when the time for doing so is restricted.

We adjusted [2]'s introductory paragraph and carrier sentences slightly to be more natural for speakers of Austrian German. At the beginning of the experiment, participants were required to read the introductory paragraph out loud: *Franz und Sisi schauen fern. Ein Lottogewinner wird vorgestellt. Sisi sagt: "Na, geh!" (Franz and Sisi are watching TV. The winner of a lottery is drawn. Sisi says, "No way!")*. For the remainder of the experiment, this introductory paragraph was presented visually above all target sentences. The carrier sentences were designed to elicit a phrase-final pitch accent on both rises (yes/no questions) and falls (declaratives):

Falls: Das ist doch der Herr [*target*]! Unser neuer Nachbar! (That's Mr. [*target*]! Our new neighbour!)

Rises: Ist das nicht der Herr [*target*]? Unser neuer Nachbar? (Isn't that Mr. [*target*]? Our new neighbour?)

All tokens (2 word lengths * 2 pitch accent patterns * 10 repetitions = 40 tokens per speaker) were presented in randomised order together with 2 repetitions each of 20 filler sentences. For the first three speakers, only 5 repetitions were recorded (= 20 tokens per speaker).

Recordings took place in a sound-treated booth using SpeechRecorder [1] (sampling rate of 44 100 Hz at 16 Bit; mono). Tokens were presented on an external monitor mounted on the outside window of the booth. Breaks were offered as necessary, and the recording took approximately 20 minutes. All participants were paid for their time thanks to funding provided by the LingLab at the Karl-Franzens-Universität Graz.

Data were automatically segmented and labelled using WebMAUS, with signal processing carried out in `emuR` and statistical analysis in `R` [5, 14, 9].

First, we extracted the voiced portions of all target words (i.e., those samples with a trackable f0 above 0 Hz). In order to compare our results with those of [2, 15], we calculated the duration of sonorant material in the same way as these previous studies. That is, for monosyllabic tokens we measured the duration of voicing, while for the bisyllabic tokens we added the duration of the intervocalic /f/ to the duration of voicing in both syllables for the final measure. [2]'s justification for this is that this intermediate voiceless duration is nonetheless part of the duration of the whole pitch accent[1].

We then measured f0 (in Hz) using the Schaefer-Vincent algorithm (function `ksvF0` in `emuR`) [10]. [2]'s subjects were all female, but because we recorded both males and females we speaker-normalised for sex-specific f0 differences by converting the f0 into semitones with a reference value of 1Hz using the formula in Equation 1.

$$(1) \quad 12 * log2\left(\frac{f0(Hz)}{1(Hz)}\right)$$

Following [2, 15, 3], we used *Rate of f0 change* as our measure of truncation versus compression. This measure was calculated by dividing the f0 excursion (f0 maximum - f0 minimum) on each word by the duration of sonorant material (in ms and measured as described above).

We calculated an RM-ANOVA using the `ez` package [6] with *Rate of change* as the dependent variable; *Length* (short vs. long word) and *Pitch accent* (fall vs. rise) as within factors and *Speaker* as a random factor.

If Austrian German behaves like Standard German, we should find (i) a main effect of *Length* on *Rate of f0 change*, reflecting compression of the f0 trajectory as tokens get shorter; and (ii) an interaction between *Length* and *Pitch accent*, given that this was only found in rising pitch accents. In other words, *Rate of f0 change* should increase as *Length* decreases on rises and the reverse should be true for falls.

[2] plotted, but did not test statistically, the effects of pitch accent and word length on f0 excursion. We decided to also test this statistically. As such, we calculated a second RM-ANOVA identical to the first but with *f0 excursion* as the dependent variable (without dividing it by the duration of sonorant material). If Austrian German realises rising and falling pitch accents in the same way that Standard German does, there should be i) a main effect of *Length* on *f0 excursion*, reflecting compression of the f0 trajectory as tokens get shorter; and (ii) an interaction between *Length* and *Pitch accent*, reflecting an effect of length on f0 excursion in falls but not in rises (given that falls were found in [2] to truncate and rises were found to compress).

3. RESULTS

3.1. Rate of f0 change

Figure 1 displays rate of f0 change (speaker means) as a function of word length and pitch accent. Rate of f0 change was greater for shorter word lengths than for longer word lengths for both falls and rises. However, the effect of word length appears to be much stronger on rising pitch accents.

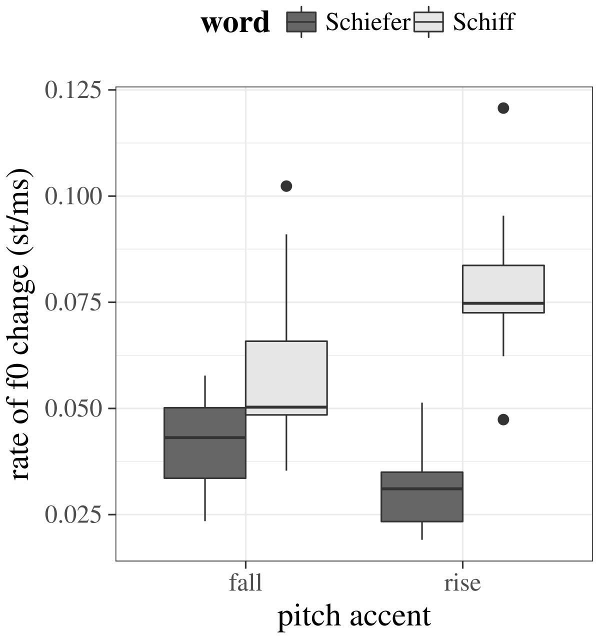

Figure 1: Rate of f0 change (st/ms, speaker means) of long words (dark grey) and short words (light grey) separately for falls (left) and rises (right)

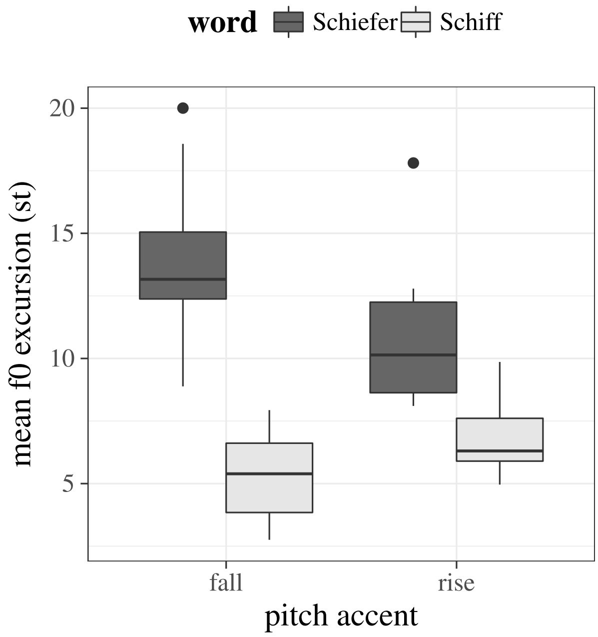

Figure 2: f0 excursion (in st, speaker means) of long words (dark grey) and short words (light grey) separately for falls (left) and rises (right)

Results of the RM-ANOVA revealed an effect of *Length* ($F(1,9) = 1.04, p < .001$) and an interaction between *Length* and *Pitch accent* ($F(1,9) = 20.83, p < 0.01$), but no main effect of *Pitch accent*. Post-hoc t-tests with Bonferroni corrections revealed effects of *Length* on both rising ($p < .001$) and falling ($p < .05$) pitch accents as well as an effect of *Pitch accent* on long words ($p < .001$).

3.2. f0 excursion

Figure 2 shows f0 excursion (speaker means) as a function of word length and pitch accent. f0 excursion was greater for longer word lengths than for shorter word lengths for both falls and rises. However, the effect of word length appears to be much stronger on falling pitch accents.

Results of the RM-ANOVA revealed an effect of *Length* ($F(1,9) = 2.99, p < .001$) and an interaction between *Length* and *Pitch accent* ($F(1,9) = 35.04, p < 0.001$), but no main effect of *Pitch accent*. Post-hoc t-tests with Bonferroni corrections revealed effects of *Length* on both rising ($p < .001$) and falling ($p < .001$) pitch accents as well as an effect of *Pitch accent* on long words ($p < .01$).

4. DISCUSSION

4.1. Rate of f0 change

Our data show an increased rate of f0 change as the amount of sonorant material (i.e. word length) shortens for both rising and falling pitch accents. That is, our data reveal that both rising and falling pitch accents in Austrian German are subject to compression, although rises appear to compress more than falls (see Figure 1). The slower rate of f0 change for rising pitch accents than for falling pitch accents on longer words is perhaps not surprising given the tendency for f0 declination, which would increase the rate of change on falling pitch accents but work against it on rises.

This pattern is rather different to the patterns found for the German varieties reported in [2, 15]. While both of these studies found rate of f0 change increased as word length decreased for rises (= compression), they found the reverse effect for falls: rate of f0 change decreased as word length decreased (= truncation).

At first glance, this result might be interpreted as Austrian German patterning cross-linguistically more with SSBE, which showed compression of both rising and falling pitch accents in [2]. However, [2] found little difference in the amount of compression of rising vs. falling accents in SSBE, whereas Figure 1 shows quite a difference in our data. As such, the phonetic realisation of falling vs. rising pitch accents in Austrian German appears to be different from both SSBE and Standard German.

4.2. f0 excursion

For the falling pitch accents in [2]'s NSG data, there was a visible decrease in f0 excursion as word length decreased. However, word length did not appear to affect f0 excursion on rising pitch accents: f0 excursion remained the same across all word lengths. This fits well with her conclusion that rising pitch accents are simply compressed for NSG while falling pitch accents are truncated.

However, this is not the pattern we found in our Austrian German data (see Figure 2), where f0 excursion was smaller in shorter than in longer words for both pitch accents, with the effect of word length greater on falls than on rises. It seems likely, then, that Austrian German compresses both falling and rising pitch accents, but that the compression has different phonetic realisations depending on pitch accent.

4.3. Different types of compression

In order to visualise how Austrian German speakers compress their rising and falling pitch accents, Figure 3 plots the f0 minimums and maximums (in st, mean across all repetitions and speakers) for each word length and pitch accent pattern as a function of the duration of sonorant material (see Section 2). In other words, f0 excursion, as described and tested above, is plotted against time.

Figure 3 reveals the following. Firstly, for both word lengths, f0 increases over the duration of a rising pitch accent and decreases over the duration of a falling pitch accent, whereas falling pitch accents on short words in NSG did not actually decrease in f0. Secondly, word length affects f0 excursion of both rises and falls, with the effect stronger for falls, whereas in [2], rising pitch accents in NSG differed in duration but not in f0 excursion. Finally, word length affects the slope of the f0 excursion for both rises and falls, in that shorter words have steeper slopes. That is, as sonorant material decreases, speakers do in fact realise more of the full f0 trajectory than they would if they were to simply truncate (in which case the two slopes would be parallel). Interestingly, while there is compression of the f0 trajectory in falls, reflected in the effect of word length on slope, the main difference is one of f0 excursion. For rises, on the other hand, there is much less difference in f0 excursion but a greater difference in slope depending on word length. Therefore, for rising pitch accents, the effect is predominantly one of compression of the timespan of the f0 trajectory, whereas for falling pitch accents we see what [3, p. 172] refer to as "compression in time plus narrowing in the frequency domain". The overall pattern shown in Figure 3 and described here is representative of all individual speakers. That is, all speakers show compression in time for both falling and rising pitch accents, with additional compression in frequency for falls.

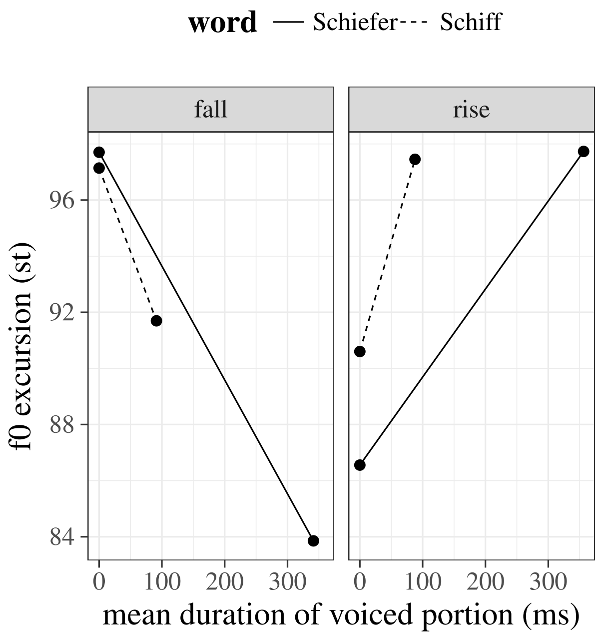

Figure 3: f0 excursion (min & max f0 in st, averaged acrossed all speakers and repetitions) of short words (dotted lines) and long words (solid lines) as a function of voicing duration for falls (left) and rises (right)

5. CONCLUSION

These data shed new light on the differences in the prosody of an Austrian German variety compared with Standard German. Our results show that, under increasing time pressure, Austrian German compresses both rising and falling pitch accents, unlike Standard German but similar to SSBE. Unlike SSBE, however, Austrian distinguishes between the rising and falling compression patterns. Rising pitch accents in Austrian behave like those in SSBE, in that the compression occurs primarily in the time domain. Falling pitch accents, however, additionally show compression of the f0 excursion itself. Future analysis will investigate individual variation in compression patterns.

6. REFERENCES

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[1] We carried out an additional analysis using only the voiced portions of both the monosyllabic and the bisyllabic tokens as durations, but found no difference in overall results to those reported here.