PROSODIC CHARACTERISTICS OF BULGARIAN-ACCENTED GERMAN

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Abstract: The present study investigates the prosodic characteristics of Bulgarian, Bulgarian-accented German and German spoken as L1. We recorded ten Bulgarian female learners, who read the fable "The North Wind and the Sun" in Bulgarian and German. We also recorded ten female native speakers of German as controls. The following durational parameters were obtained: mean accented syllable duration, accented vs. unaccented syllable duration ratio, and speaking rate. With respect to F0-related parameters, we obtained long-term distributional measures (mean, median, minimum, maximum, span in semitones, and standard deviations per IP) as well as linguistically relevant measures of tonal landmarks (local maxima and minima associated with prominent or non-prominent syllables). Additionally, we calculated the number of accented and unaccented syllables, IPs and pauses in each reading. Statistical analyses show that all F0-related LTD parameters in the speech of the Bulgarian learners of German were lower than in their L1 but higher than those of the native German speakers. With respect to the linguistic measures, we found that the Bulgarian speakers of German realized the majority of the linguistically relevant targets in a way which was very similar to the respective realizations in their mother tongue. The number of accented syllables, IPs and pauses was also higher in L2. Regarding duration, Bulgarian learners of German used slower articulation rate.

1 Introduction

The last few decades have witnessed a renewal of research interest into second-language prosody. Investigations have focused on a range of suprasegmental characteristics of L2 speech (see, among others, [1], [2], [3], [4], [5], [6], [7]), the main ones being fundamental frequency-related features and temporal features. Fundamental frequency-related features that have been studied include the realizations and uses of pitch contours, pitch accent choice, association and phonetic implementation, pitch level and pitch range variation. The latter have been investigated in the speech of talkers from diverse L1 backgrounds, and of learners who speak different L2 target languages by [6], [8], [9], [10], [11], [12], [13], [14], [15], [16]. Results obtained so far seem to point to a general tendency according to which L2 learners tend to use a lower pitch level and a compressed pitch span in the target language. As a common consequence of using a narrower pitch range, L2 speakers can be perceived as sounding dull and monotonous ([6], [11]). The explanation for this in [16] suggests that the use of a narrower range in the target language is due to the fact that learners are less confident when they speak the L2 than when they talk in their mother tongue. However, there are also findings showing that some speakers may use a higher F0 level or a wider span in the L2 (e.g., [6] for German vs. English). Therefore, the universality of the general tendency of using a compressed pitch range in the L2 is questionable, and the roles of the L1 and L2 pitch range norms are also subject to further investigation.

Research on the temporal characteristics of L2 speech has included speaking rates, the duration of segments, syllables, intonational phrases and pauses. Second-language speech has been shown to contain more pauses of longer duration ([17]) and slower and more variable speaking rates ([18], [19]). These durational characteristics have also been related to L1 and L2 fluency ([20], [21], [22]). The work of [23], [24] on speaking rates typical of L1 English monolinguals and L2 English bilinguals from diverse language backgrounds shows the importance

of L1 speaking rate and interspeaker variation as predictors of L2 speaking rate and the rate variability found in foreign language speech.

The present study investigates the amount of interference of L1 F0- and duration-related characteristics in the speech of advanced Bulgarian learners of German. It has been reported that Bulgarian male and female speakers use wider pitch range and are more variable compared to German speakers ([1]). Assuming that there is transfer of F0-related characteristics from the L1, we expect to find expansion of the L2 target norms for pitch range in our speakers' L2 productions. Alternatively, there may be adaptation of the native language pitch range to that of the target language. Besides, our aim is to provide data on speech and articulation rate in L1 Bulgarian and compare it with similar data for L1 and L2 German.

2 Method

2.1 Corpus

To test our predictions, we recorded ten Bulgarian speakers of German and ten German native speakers as controls. All speakers were female university students of comparable age and spoke the respective standard language varieties. The Bulgarian participants had some knowledge of the phonetics and phonology of German.

The material recorded was Aesop's fable The North Wind and the Sun, with the Bulgarians reading the text in Bulgarian as well as in German.

2.2 Measurements

First, syllable and Intonation Phrase (IP) boundaries as well as pauses were segmented and lexically stressed syllables were labelled manually in Praat [25]. Second, all accented syllables were marked and counted, including those in lexical words with double prominence and in prominent function words. We also counted the numbers of pauses and IPs per reading.

2.2.1 Pitch analyses

Pitch analysis was performed as follows. First, F0 was extracted automatically from all recordings by means of the ESPS algorithm ("get_f0" [26]) with time steps of 5 ms. Secondly, a manual inspection and correction of the extracted pitch contours was performed in Praat. The corrections included the removal of octave jumps as well as other artefacts. From the cleaned data the following F0 *long-term distributional (LTD) measures* per IP were calculated using Praat scripts: mean, median, minimum, maximum, standard deviation, and span. F0 was measured in semitones relative to 1 Hz.

Building on investigations by [9], we also measured specific tonal targets in the F0 contour which are linguistic in nature but which LTD measures fail to capture. These *linguistic measures* were obtained from the manually labelled pitch contours, following Mennen et al. [9] who distinguish between tonal landmarks (local maxima and minima) associated with prominent or non-prominent syllables and between initial and non-initial peaks. Every tonal landmark was identified auditorily and visually. Local maxima and minima were labelled H* and L* if they aligned with a stressed syllable. They were labelled with H and L if they aligned with an unstressed syllable. The first peak of a phrase was separately marked as H*i or Hi. The beginnings and the final landmarks were labelled separately: phrase initial F0 value was labelled as I, final lows as FL and final highs as FH. A Praat script was used to calculate the F0 value of each labelled landmark. The following level measures were calculated in semitones: prominent phrase-initial peaks (H*i), prominent non-initial peaks (H*), non-prominent initial peaks (Hi), non-initial non-prominent peaks (H), prominent valleys (L*), non-prominent valleys (L),

phrase-final lows (FL) and phrase-final highs (FH). In order to calculate pitch span (e.g. H*i–L, H*i–FL, H*–L, H*–FL), values for the respective linguistic landmark would have to be averaged per speaker. This would result in a small sample size (10 datapoints per language) which would undermine the validity of the study. Therefore, below we analyze only the linguistically relevant tonal landmarks.

2.2.2 Temporal features

The durations of the IPs, pauses and prominent syllables were extracted per reading, speaker and native/target language using Praat scripts. Mean duration of accented syllables as well as accented/unaccented syllable duration ratios were computed. In addition, we calculated two measurements of speaking rate: (a) speech rate (SR, the number of canonical syllables divided by the duration of the respective recording) and (b) articulation rate (AR, the number of canonical syllables divided by the sum of IP durations per recording).

2.3 Statistical analyses

For statistical validation, we used the software JMP 16 [27]. Linear mixed models (LMM) were fitted for the duration-related parameters, with the respective log-transformed measure as dependent variable, SPEAKER as random factor, and LANGUAGE (native language/target language) as fixed factor. Separate Tukey post-hoc tests were carried out per variable, if appropriate. The confidence level was set at $\alpha = .05$.

For the analyses of the F0-related parameters we used a nonparametric Kruskal-Wallis test because the data were not equally distributed. To determine differences between speaker groups we performed post-hoc Dunn's pairwise tests with Bonferroni adjustment.

3 Results

3.1 F0-related parameters

3.1.1 Long-term distributional measurements

Means and standard deviations in semitones (ST) for each of the F0-related parameters are presented in Table 1.

Following Ladd [28], we consider the measures for mean and median (related to pitch level) and span (the difference between maximum and minimum F0) to be attributes of pitch range, and the standard deviation (SD) – an attribute of pitch variation.

Table 1 – LTD measures (SD in parentheses)

parameter (ST)	BG_L1	DE_L2	DE_L1
mean	94.87 (2.6)	94.01 (2.2)	92.8 (1.7)
median	94.52 (2.7)	93.58 (2.3)	92.6 (1.8)
SD	60.01(8.8)	56.08 (10.9)	51.1 (6.6)
min F0	90.33 (2.1)	90.15 (2.02)	89.9 (1.8)
max F0	99.41 (3.6)	98.29 (3.7)	96.1 (1.9)
span	9.1 (3.7)	8.1 (4.1)	6.2 (1.9)

We found a main effect of LANGUAGE on all LTD measurements (see Table 1 and Figure 1). Post-hoc tests revealed significant differences between the three groups for mean ($\chi2(2) = 75.91$, $p < .0001$), median ($\chi2(2) = 63.03$, $p < .0001$), F0 maximum ($\chi2(2) = 92.74$, $p < .0001$), pitch span ($\chi2(2) = 78.80$, $p < .0001$) and pitch variation ($\chi2(2) = 90.63$, $p < .0001$) with the highest values for Bulgarian spoken as a native language (BG_L1), the lowest values for German spoken as a native language (DE_L1) and intermediate values for the target language - German (DE_L2). These findings indicate that the Bulgarian speakers use a narrower pitch range and are less variable in the target language than in their native language which confirms results in earlier studies (e.g. [10], [18]).

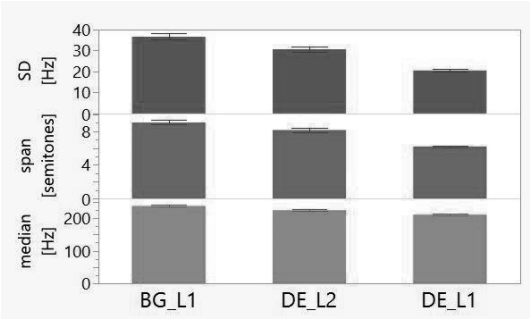

Figure 1 - Median, span and SD values for the three groups

3.1.2 Linguistic measures

Means and standard deviations in semitones (ST) for each of the tonal landmarks obtained from the linguistic measures are presented in Table 2. The average values in Hz for each landmark are plotted in Figure 2.

Table 2 – Linguistic measures (SD in parentheses)

tonal landmark [ST]	**BG_L1**	**DE_L2**	**DE_L1**
I	97.52 (2.8)	95.74 (2.33)	94.71 (1.45)
H*i	97.09 (2.9)	97.16 (3.04)	95.21 (1.24)
Hi	99.02 (3.6)	97.06 (2.6)	95.63 (1.7)
L*	92.19 (1.2)	91.76 (1.1)	90.65 (1.0)
L	92.08 (1.6)	92.07 (1.1)	90.89 (1.0)
H*	95.17 (2.6)	94.89 (2.6)	93.12 (1.1)
H	96.76 (2.4)	96.03 (2.5)	94.29 (1.3)
FL	89.37 (1.2)	90.04 (1.0)	89.61 (1.5)
FH	97.44 (2.5)	96.58 (2.2)	94.69 (1.0)

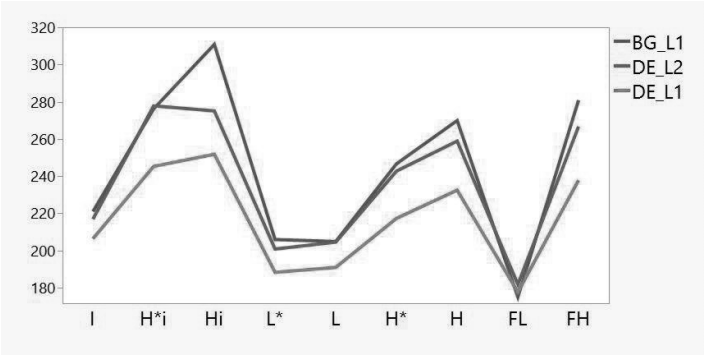

Figure 2 - Average values of each tonal landmark

The statistical analysis revealed a significant main effect of LANGUAGE on all linguistic measurements for level except on the final low (FL), where the speakers are near the floor of their physiological F0 range (see Table 3). Post-hoc tests revealed significant differences between the three groups for L* ($\chi2(2) = 70.56$, $p < .0001$) and FH ($\chi2(2) = 60.37$, $p < .0001$) with the highest values for BG_L1, the lowest values for DE_L1 and intermediate values for DE_L2. BG_L1 and DE_L2 have significantly higher values than DE_L1 for L ($\chi2(2) = 31.09$, $p < .0001$), Hi ($\chi2(2) = 18.99$, $p < .0001$), H*i ($\chi2(2) = 12.49$, $p < .0019$), H* ($\chi2(2) = 35.99$, $p < .0001$) and H ($\chi2(2) = 41.06$, $p < .0001$). With respect to the phrase initial landmark (I), BG_L1 has significantly higher values than DE_L1 ($\chi2(2) = 31.92$, $p < .0001$).

Table 3 – Language-group differences

tonal landmark	**significant differences**
I	BG_L1 > DE_L1
H*i	BG_L1 = DE_L2 > DE_L1
Hi	BG_L1 = DE_L2 > DE_L1
L*	BG_L1 > DE_L2 > DE_L1
L	BG_L1 = DE_L2 > DE_L1
H*	BG_L1 = DE_L2 > DE_L1
H	BG_L1 = DE_L2 > DE_L1
FL	n.s.
FH	BG_L1 > DE_L2 > DE_L1

3.2 Duration-related parameters

Means and standard deviations for each of the duration-related parameters are presented in Table 4.

We compared the duration-related parameters in native German readings (DE_L1) with those in the readings by the Bulgarian learners of German (DE_L2). We do not include BG_L1 in the analyses because of the differences between the respective texts in terms of number of words and syllables, syllable complexity, etc.

The Bulgarian speakers of German produced considerably more IPs and pauses than the native German speakers (27.2 vs. 18.9 IPs, and 20.6 vs. 12.1 pauses, respectively). They also produced more accented syllables than the natives (74.5 vs. 50.8). Both of these findings are in line with previous research (e.g. [17]).

Table 4 - Duration-related parameters for Bulgarian and German

Parameter	**BG_L1**	**DE_L2**	**DE_L1**
mean accented σ duration	218.3 (31.4)	300.2 (63.5)	235.5 (17.6)
accented/unaccented ratio	1.6 (0.1)	1.5 (0.2)	1.6 (0.1)
articulation rate	6.2 (1.1)	4.3 (0.8)	5.8 (0.5)
speech rate	5.1 (0.8)	3.5 (0.7)	5.0 (0.5)

There is no main effect of language with respect to the accented/unaccented syllable duration ratio in DE_L2 and DE_L1. This is not surprising given the similar ratio between accented and unaccented syllables in BG_L1. However, we found significant differences between accented syllable duration in DE_L1 and DE_L2 with longer durations in Bulgarian-accented German ($F [1, 18] = 9.62$, $p<0.0062$). As for speaking rate, the Bulgarian speakers of German were significantly slower than the German native speakers: speech rate ($F [1, 18] = 32.03$, $p<0.0001$), articulation rate ($F [1, 18] = 23.21$, $p<0.0001$). This also accounts for the longer accented syllable duration in their German productions.

4 Conclusions

In this study we investigated the prosodic characteristics of Bulgarian-accented L2 German compared to (a) L1 German, and (b) L1 Bulgarian. We used two types of F0-related measures: LTD measures and linguistic measures. With respect to the LTD measures, our analyses revealed that all F0-related parameters in the speech of the Bulgarian learners of German were lower than in their L1 but higher than those of the native German speakers. With respect to the linguistic measures, we found that the Bulgarian speakers of German realized the majority of the linguistically relevant targets in a way which was very similar to the respective realizations of these targets in their mother tongue. Thus, our first assumption that there is transfer of F0-related characteristics from the L1 and as a result the L2 target norms for pitch range will be expanded due to L1 influence was confirmed. This fact can explain some of the contradictory findings in the literature showing that some speakers may use a higher F0 level or a wider span in the L2, whereas others nay use a lower F0 level or a narrower span.

With regard to the duration-related parameters, we found that the Bulgarian speakers used slower articulation rate, more IPs and pauses in their L2 than the native speakers. They also failed to deaccentuate: we found more accented syllables in L2.

Our results suggest that the so-called L2 speaking style is influenced by L1 prosody with respect to both F0-related and duration-related features.

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6 Literature

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