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L1 Influences on Bulgarian-Accented German: Prosodic Units and Prenuclear Pitch Accents

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Abstract: This study investigates the L1 influence on the use of accentual patterns, choice of prenuclear pitch accent types and their realization on L2 prosody. We use Mennen's LILt model as a framework for our analysis. We recorded ten Bulgarian female speakers of German and ten female native German speakers who read Aesop's fable *The North Wind and the Sun*. We found that the tendency for the Bulgarian native speakers to use more pitch accents than German native speakers is transferred to the L2 German of the Bulgarian learners. L*+H was the most frequent prenuclear pitch accent used by all groups. We also found that the Bulgarian learners stressed more function words and tolerated more stress clashes than the native German speakers. When speaking German, under the influence of the statistical regularities that relate to prosodic word patterns in their mother tongue, Bulgarian learners phrased their L2 speech into a higher number of shorter prosodic words, and therefore realized more pitch accents and aligned the high tonal target earlier than the native speakers. Concerning the variable alignment of the high target, we propose the prosodic word or the two-syllable window as the tentative candidate for an anchorage region. Our findings can be explained with respect to age of learning, as proposed by LILt's general theoretical assumptions.

Keywords: Bulgarian; German; Bulgarian-accented German; intonation; prenuclear pitch accents; prosodic word; anchorage domain

1. Introduction

The suprasegmental characteristics of L2 speech have for a long time been ignored by educators and researchers alike. The former have tended to focus on the segmental system (the vowels and the consonants) of the foreign language, on the assumption that mastering the individual sounds is crucial, if not sufficient, for efficient communication in the L2 (e.g., Eckert and Barry 2002; Baker 2006; among many others). The latter have for a long time ignored investigation into L2 prosody, not least because of the lack of sound and consistent methodology for the contrastive study of suprasegmental features in speech (see Ulbrich and Mennen 2015 for an overview). Some of the most popular L2 learning models, such as the Speech Learning Model (Flege 1995, 2007; Flege and Bohn 2021), the Native Language Magnet model (Kuhl 1991, 1992, 2000), and the Perceptual Assimilation Model (Best 1995; Best and Tyler 2007) focus almost exclusively on the segmental level.

An important step towards the development of a comprehensive model of L2 prosody acquisition is the L2 Intonation Learning Theory (LILt) put forward by Mennen (2007, 2015). The theory attempts to offer an extensive account of the major suprasegmental problems experienced by L2 learners, especially those in the area of intonation. Mennen draws an important distinction between phonological representation and phonetic implementation. She hypothesizes that L2 learners first acquire the phonological patterns in the foreign language, and only afterwards try to master the phonetic implementations of those patterns.

Mennen distinguishes four dimensions along which L2 intonation may deviate. The first of these—the systemic dimension—deals with the inventory of structural prosodic

elements and their distribution. The categorical elements can be pitch accents, accentual units of different size, or boundary phenomena. This dimension also involves the ways in which structural elements such as pitch accents combine with one another—for example, what combinations of High (H) and Low (L) pitch targets are admissible in a given language. In addition, it also looks at tune–text association (Ladd 2008), that is, the way the tune is mapped onto the segmental string. The second dimension of the LILt model—the realizational, or phonetic, dimension—is concerned with the phonetic implementation of the categorical elements of the system: this may involve the actual alignment of pitch accents, their scaling (i.e., their relative height), and their shape, or slope, e.g., shallow vs. steep rises or falls. The third dimension in Mennen's LILt model is the semantic one: it deals with the ways in which the systemic elements are used to signal intonation functions. The fourth and final dimension of LILt—the frequency dimension—takes into account how often the structural elements are used. Each of LILt's four dimensions makes it possible to establish cross-language similarities and differences in intonation, on the basis of which predictions can be made about intonation deviations from the target norm which are likely to occur in L2 learners' speech. Based on existing L2 research, LILt also puts forward some general theoretical assumptions concerning L2 intonation acquisition in relation to learners' proficiency levels, ages of arrival and learning, L1 background, speaking style, etc. LILt can thus help predict "the relative difficulty learners would experience with certain L2 intonational parameters or dimensions, and to shed light on the principles, which govern the acquisition process of intonation such as the rate and order in which parameters of intonation develop in a L2" (Mennen 2015, p. 178).

Therefore, the LILt model provides a sound basis for the present study whose aim is to identify cross-linguistic differences and similarities in the use of accentual patterns, choice of prenuclear pitch accent types and their realization in the read speech of Bulgarian and German native speakers and Bulgarian learners of German, as well as to predict where deviations from the native norm are likely to occur.

1.1. Previous Comparative Research on Bulgarian and German Intonation

Until the end of the 20th century, comparative research on Bulgarian and German was carried out with the aim of establishing the main differences between the segmental systems of the two languages, predicting the problematic areas for Bulgarian learners of German and designing practice materials for use in the language classroom. Amongst the few suprasegmental features which were investigated was question intonation, which turned out to be a particularly problematic area. Comparative work on question intonation in the two languages focused on three topics. First, the goal has been, by means of perception testing and acoustic analysis, to identify and systematize the features and parameters which are similar or different in the intonation of questions in Bulgarian and German, and thus to find the specific structural properties of the 'Yes–No' questions (Simeonova 1997) and the 'Information' questions (Simeonova 1986; Grigorova 1996). Second, the functional load of questions in Bulgarian and German is pursued from the perceptual standpoint, specifically for cases in which the communicative goal of the question can be determined by intonation alone (Grigorova 1994, 1997; Misheva and Grigorova 1997). Third, based on the research carried out, a series of textbooks for Bulgarians (Simeonova 1972) and for Bulgarian advanced students of German (Simeonova 1985; Simeonova 2000; Simeonova et al. 2000) was published.

More recently, Bulgarian-accented German has been studied by Andreeva (2017) and Andreeva and Dimitrova (2022a, 2022b). Andreeva (2017) analyzed the prosodic marking of information structure by highly proficient Bulgarian speakers of German and compared the non-native patterns with production patterns in native German and native Bulgarian, drawing particular attention (a) to their similarities and differences in the semantic and realizational dimension and (b) to the specific contribution of global and local cues signalling the information structure. Additionally, she aimed to test whether Flege's SLM can be applied to aspects of the prosodic domain that are influenced by

information structure. With respect to the semantic dimension, Andreeva found that in both L1 and L2 German, given material always correlates with de-accentuation in post-nuclear position. In prenuclear position, Bulgarian speakers produce considerably more prenuclear accents than German speakers. Bulgarian speakers use more H* accents and German speakers use more L+H* to mark narrow focus in their L1. With respect to the realizational dimension, Andreeva found that Bulgarian speakers do not align the peak in narrow focus in a consistent manner in the target language. Since vowel length is not contrastive in Bulgarian segmental phonology, and since phonological duration has an impact on peak alignment, durational uncertainty may lead to peak alignment uncertainty. Bulgarian speakers of German transfer the differences/similarities in global tempo and spectral cues from their native into their target language. They also exploit F0-related novel cues to differentiate between focus conditions. They use later peak alignment, greater peak excursion, a greater amount of F0 change in the nuclear-accented syllable and suppress F0 in the prenuclear interval to establish a (greater) difference between contrastive and non-contrastive focus. A novel cue related to duration is established to mark the difference between narrow and broad focus in the target language: Bulgarian L2 speakers of German produce the accented vowel with longer duration in narrow focus (which was not the case in the L1 German data).

Andreeva and Dimitrova (2022b) investigated some prosodic characteristics of Bulgarian-accented L2 German compared to L1 German and L1 Bulgarian. All F0-related long-term distributional measures (mean and median pitch level, pitch span and pitch variation) in the speech of the Bulgarian learners of German were lower than in their L1, but higher than those of the native German speakers. These results corroborate the findings in Andreeva et al. (2015, 2014), who report the use of a wider pitch range and higher variability in two Slavic languages (Bulgarian and Polish) compared to two Germanic languages (German and English). With regard to the duration-related parameters, Andreeva and Dimitrova (2022b) found that the Bulgarian speakers used a slower articulation rate, more IPs and pauses and more pitch accents in their L2 than the native speakers. The strong correlation which was found between the L1 and L2 speaking rates of the Bulgarian speakers is evidence that the L1 speaking rate can indeed predict the speaking rate in L2, which is in accordance with the findings in Bradlow et al. (2017).

Building on investigations by Mennen et al. (2012), Andreeva and Dimitrova (2022a) also measured specific tonal targets in the F0 contour which are linguistic in nature, but which long-term distributional measures fail to capture. These linguistic measures are tonal landmarks (local maxima and minima) associated with prominent or non-prominent syllables and initial and non-initial peaks in intonation phrases. They 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.

In sum, the results in Andreeva and Dimitrova (2022a, 2022b) suggest that L2 speech is influenced by L1 prosody with respect to both F0-related and duration-related features.

1.2. Prosodic Word Patterns in Bulgarian

Descriptions of Bulgarian prosody have included units formed on the basis of the presence of stress. They have been called 'phonetic words' (Stojkov 1966; Misheva 1991) or 'accentual-rhythmic units' (Tilkov 1981). Stoykov's 'phonetic word' is characterized by the presence of one stressed syllable which can either be preceded or followed by a number of unstressed syllables. Tilkov's 'accentual-rhythmic unit' is also characterized by the presence of a single stress and, like Stoykov's phonetic word, can include both proclitic and enclitic syllables. In both Tilkov's (1981) and Misheva's (1991) analyses of corpora containing about 35,000 units, those comprising three syllables appear to be the most frequent, followed by four- and two-syllable units. Stress tends towards the middle of the units and is viewed as 'organizing' the unstressed syllables in them. In autosegmental-metrical terms, both the

accentual-rhythmic unit and the phonetic word correspond to the prosodic word, which consists of a content word and its clitics.

Bulgarian has an unbounded weight-insensitive lexical stress system. Lexical stress is not fixed for any lemma, but its position changes when various affixes are added. According to Bulgarian statistical surveys (Misheva 1991; Kotova and Yanakiev 2001), the most often lexically stressed syllable is the penultimate one. So, the penultimate position can possibly be considered as the default or regular position of stress in the language. Andreeva et al. (2019) show that stress on the penultimate syllable is also predominant in the prosodic word in Bulgarian spontaneous speech (see Figure 1).
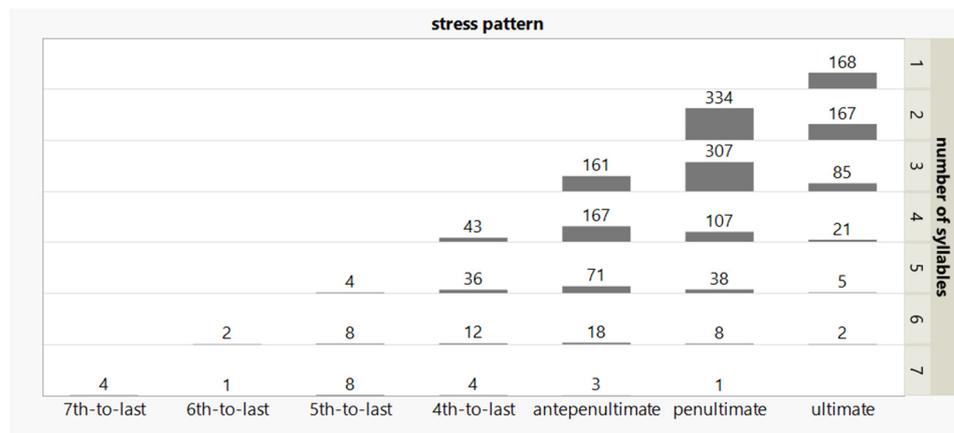

Figure 1. Stress patterns per number of syllables within the prosodic word (adapted from Andreeva et al. 2019).

As can be seen in Figure 1, the most frequent pattern in prosodic words consisting of two or three syllables is stress on the penultimate syllable. In prosodic words of more than three syllables, stress on the antepenultimate syllable predominates. There are some occurrences of prosodic words consisting of seven syllables which do not follow this pattern, but their number is negligible. In German, a language with a bounded weight-sensitive lexical stress system, the stress can be assigned to one of the last three full syllables of a prosodic word (see Domahs et al. 2008 and references therein).

The role of the prosodic word within the prosodic hierarchy in Bulgarian has remained outside the scope of previous research. Therefore, one of the aims of the present investigation is to shed light on its role in tonal alignment.

1.3. Aspects of Bulgarian and German Intonation: A Comparison within the LILt Model

The present study considers the L1 influence on the prosody of the Bulgarian-accented German of speakers at medium proficiency level within Mennen's (2015) LILt model. In the systemic dimension, Bulgarian and German have been described as having the same inventory of structural phonological elements: two prosodic constituents in the prosodic hierarchy—the intermediate phrase and the intonational phrase—six pitch accents (L*, H*, L*+H, L+H*, H+L*, H+!H*), two phrase accents (L− and H−), and one initial and two final boundary tones (%H, L%, H%) (Grice et al. 2005; Andreeva 2007). Regarding the frequency dimension, L*+H is the most frequent pitch accent in prenuclear position in both languages (Dimitrova and Andreeva 2017; Baumann et al. 2021). Other prenuclear accent types which are used less frequently in the two languages are H* and L+H*. Baumann et al. (2021) report limited use of L* in prenuclear position in German as well. With respect to the semantic dimension, it has been demonstrated that in the production (Braun 2006) and the processing (Braun and Biezma 2019) of prenuclear L*+H and L+H*, German informants prefer the former in contexts that trigger a contrastive topic interpretation. Using the concept of informativeness, which they define as relating to "both the information status of a referring expression and its role as part of a specific focus domain", Baumann et al.

(2021) conclude that informativeness does not affect the choice of prenuclear accent type, although they find a stronger (but non-significant) tendency for contrastive topics to be produced with L*+H rather than L+H*. No comparable data on the pragmatic-semantic interpretation of prenuclear accents in Bulgarian are available.

Concerning the realizational and/or systemic dimension, three phenomena are of interest: the realization of the prenuclear L*+H, the distribution of accents and the tolerance towards stress clashes. Dimitrova and Jun (2015) report on the variable alignment of the high trailing tone in the prenuclear L*+H in Bulgarian, which in their data was sometimes realized as far to the right as the second posttonic syllable. They suggest that the H tone may be a phrasal accent. Dimitrova and Andreeva (2017) argue that the H target is not separated by a fixed interval from the starred tone, as postulated by Pierrehumbert's invariance hypothesis (Pierrehumbert 1980). In German, the H target of the rising prenuclear accent aligns with the vowel in the post-accented syllable (Atterer and Ladd 2004; Mücke et al. 2009).

As regards accentuation, Andreeva (2017) found that Bulgarian speakers produce considerably more prenuclear accents than German native speakers, tending to accent nearly every content word.

With respect to stress clashes, they occur when two syllables bearing primary stress are adjacent in the same phonological domain, for example, in a phonological phrase (e.g., [θɜːˈtiːn ˈmen]$_{PhP}$). Dimitrova (1998) found that, in Bulgarian, adjective + noun phrase clashes were tolerated in more than 56% of her test items, in which there was a choice between two alternative (standard) stress patterns, one of which allowed avoidance of the clash. In German, Wagner and Fischenbeck (2002) report that in compounds stress clash resolution through stress shift is relatively rare and an alternative strategy is destressing of the secondary accent. However, Karen et al. (2011) found both perceptual and production experimental evidence that stress shift operates on a regular basis within and beyond word boundaries in order to prevent stress clashes and hence rhythmically irregular structures. Riester and Piontek (2015) found cases in a German radio news corpus where pitch accents are shifted from the noun to the adjective in order to prevent a focus-internal accent clash.

Taking into consideration the similarities and differences between Bulgarian and German prosody discussed so far, we use Mennen's (2015) LILt model and its assumptions regarding age of learning and language exposure to predict deviations. The research questions we set out to answer were the following:

Regarding the frequency dimension

- Do Bulgarian L2 speakers of German produce more pitch accents than German L1 speakers?
- Is L*+H the most frequent pitch accent in prenuclear position in both L1 and L2 German?

Regarding the realizational dimension

- Do Bulgarian L2 speakers of German tolerate more stress clashes than German L1 speakers?

Regarding the systemic dimension

- Does the prosodic word constitute an anchorage domain both in Bulgarian L1 and German L2 for the trailing tone of the L*+H pitch accent?

2. Materials and Methods

To answer our research questions, we recorded ten Bulgarian speakers of German at B2 level of proficiency, according to the Common European Framework of Reference for Languages, and ten German native speakers as controls. All speakers were female university students of comparable age (average 20.7 years) and spoke the respective standard language varieties. The Bulgarian participants were all foreign learners who started learning the language at the age of 13 at a German-language-medium school in Bulgaria. They had received between 5 and 7 years of German tuition and had some knowledge of the

phonetics and phonology of German. Since prosodic deviation in L2 can be due to learners' different levels of proficiency, different ages at which they started learning the language, different amount of experience with the L2, different speaking styles, etc., as suggested by LILt, we chose a homogeneous group of speakers with respect to these variables.

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 (see Appendices A and B). We obtained three data sets: (a) ten recordings of the fable by speakers of Bulgarian as L1 (BG_L1), (b) ten recordings of the same Bulgarian speakers reading the fable in German as L2 (DE_L2) and (c) ten recordings of the fable by speakers of German as L1 (DE_L1).

2.1. Measurements

First, syllable, prosodic word and phrase boundaries, as well as pauses, were segmented, and lexically stressed syllables were labeled manually in Praat. Second, all accented syllables were marked and counted, including those in lexical words with double prominence and in prominent function words.

2.1.1. Pitch Analyses

We labeled linguistically relevant tonal landmarks, slightly modifying the method proposed by Patterson (2000) and Mennen et al. (2012). We only labeled tonal landmarks aligned with stressed (L*, H*) and unstressed syllables (L, H), as well as final lows (FL) and highs (FH). Then, we marked the relevant prenuclear pitch accents based on the inventories proposed for Bulgarian (Andreeva 2007; Andreeva et al. 2016; Dimitrova and Jun 2015) and German (Grice et al. 2005). The pitch accents, accented syllables and intonation phrases were labeled by careful auditory inspection carried out by the two authors working together. Occasional disagreements were resolved after discussion and repeated listening. An example of the labeling is provided in Figure 2. For the DE_L2 data set, we do not claim that our ToBI labeling represents underlying (phonological) categories. The annotation used for this data set rather represents a systematization of the tonal landmarks (as defined above) according to the ToBI labeling conventions proposed in the literature (e.g., Silverman et al. 1992). The F0 values corresponding to the L* and H targets of the manually labeled L*+H were obtained in semitones relative to 1 Hz using Praat scripts. We also calculated the span between the low and the high target of these pitch accents.
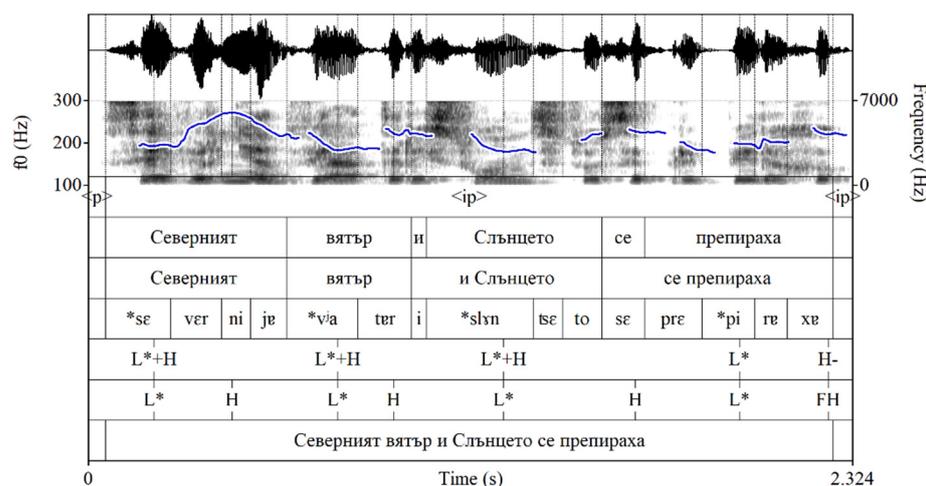

Figure 2. The utterance *Северният вятър и Слънцето се препираха* ('The North Wind and the Sun were disputing'), pronounced as a single intermediate phrase by a Bulgarian speaker. Labeling of the data: tier 1—intonation and intermediate phrase boundaries; tier 2—word boundaries; tier 3—prosodic word boundaries; tier 4—syllable boundaries (accented syllables marked with *); tier 5—ToBI labeling; tier 6—tonal landmarks; tier 7—Bulgarian text.

2.1.2. Temporal Features

The durations of the IPs, pauses and pitch-accented syllables were extracted per reading, speaker and native/target language using Praat scripts. In addition, we calculated the articulation rate (AR) for those IPs in which the L*+H pitch accent occurs. AR was computed as the number of canonical syllables divided by the duration of the respective IP. As a measure of peak alignment, the absolute temporal distance from the F0 peak to the accented syllable onset was calculated. In order to compensate for the influence of segmental durations on peak alignment, these absolute measures were converted to relative measures, taken as a proportion of syllable durations. We also counted the distance between the L and the H target and between the H target and the end of the prosodic word in terms of number of intervening syllables.

3. Results

3.1. Stress and Accentuation

In order to answer our research question regarding the frequency and realizational dimension, namely, whether the Bulgarian speakers of German produce more pitch accents and tolerate more stress clashes than the German native speakers, we first analyzed the stress and accentuation in the three data sets. Table 1 summarizes the total number of words, content (CW) and function (FW) words and syllables in the texts, as well as the mean number of all accented syllables and of the accented syllables in the content and function words.

Table 1. Words and syllables in the three data sets: exploratory statistics.

	BG_L1	DE_L1	DE_L2
No. words	91	108	108
No. content words	56	52	52
No. function words	35	56	56
No. syllables	200	180	180
Mean No. of accented syllables	63.5	50.8	74.5
Mean No. of accented syllables of CWs	55.2	46.5	58.6
Mean No. of accented syllables of FWs	8.3	4.3	15.9

The Bulgarian text of the fable *The North Wind and the Sun* consists of 91 words, of which 56 are content words and 35 are function words, giving a total of 200 syllables. Most content words in Bulgarian are single-stressed. However, three adverbs and two adjectives (one of them twice) occurred in their comparative or superlative forms, which in Bulgarian can be pronounced either with single or with double stress (Tilkov and Boyadzhiev 1977, p. 160). Lexically stressed syllables have the potential to receive a pitch accent (Lehiste 1970). The average number of accented syllables in the readings of the Bulgarian speakers was 63.5 (55.2 on content words, including double stress on some occurrences of the above-mentioned adverbs and adjectives, and 8.3 on function words, such as *те*—'they', *този*—'this one', *беше*—'was').

The German text of the fable consists of 108 words, of which 52 are content words and 56 are function words[1]. The total number of syllables is 180. The average number of accented syllables realized by the German native speakers is 50.8 (46.5 on content words and 4.3 on function words, such as *wer*—'who', *seinen*—'his', *sollte*—'should'). The Bulgarian learners of German on average realized 74.5 accents (58.6 on content words and 15.9 on function words). This tendency for overproduction of pitch accents in L2 speech has been observed in several L2 varieties for learners at different proficiency levels (e.g., Archibald 1997; Rasier and Hiligsmann 2007; Avesani et al. 2015). We also observed that the L2 speakers of German realized two accents on some compounds. For example, "North Wind" is a compound in German (*Nordwind*) and an adjective + noun phrase in Bulgarian (*северният вятър*). The native German speakers in our data always realized the word with a single pitch accent on the first element of the compound (see Figure 3a), while the L2

German speakers used two pitch accents on the two parts of the compound (see Figure 3b) in 21 out of the 40 realizations (52.5%). They showed the same tendency to use two pitch accents when pronouncing the word *Augenblicken*—'moments'. Bulgarian linguists in the field of word formation share the opinion that compounding is an atypical word-formation process for the Bulgarian language (and for Slavic languages in general) and point out its poor productivity (Radeva 2007, p. 57). It is more common in Germanic languages. This provides one possible explanation for the use of two pitch accents in the L2 by the Bulgarians.
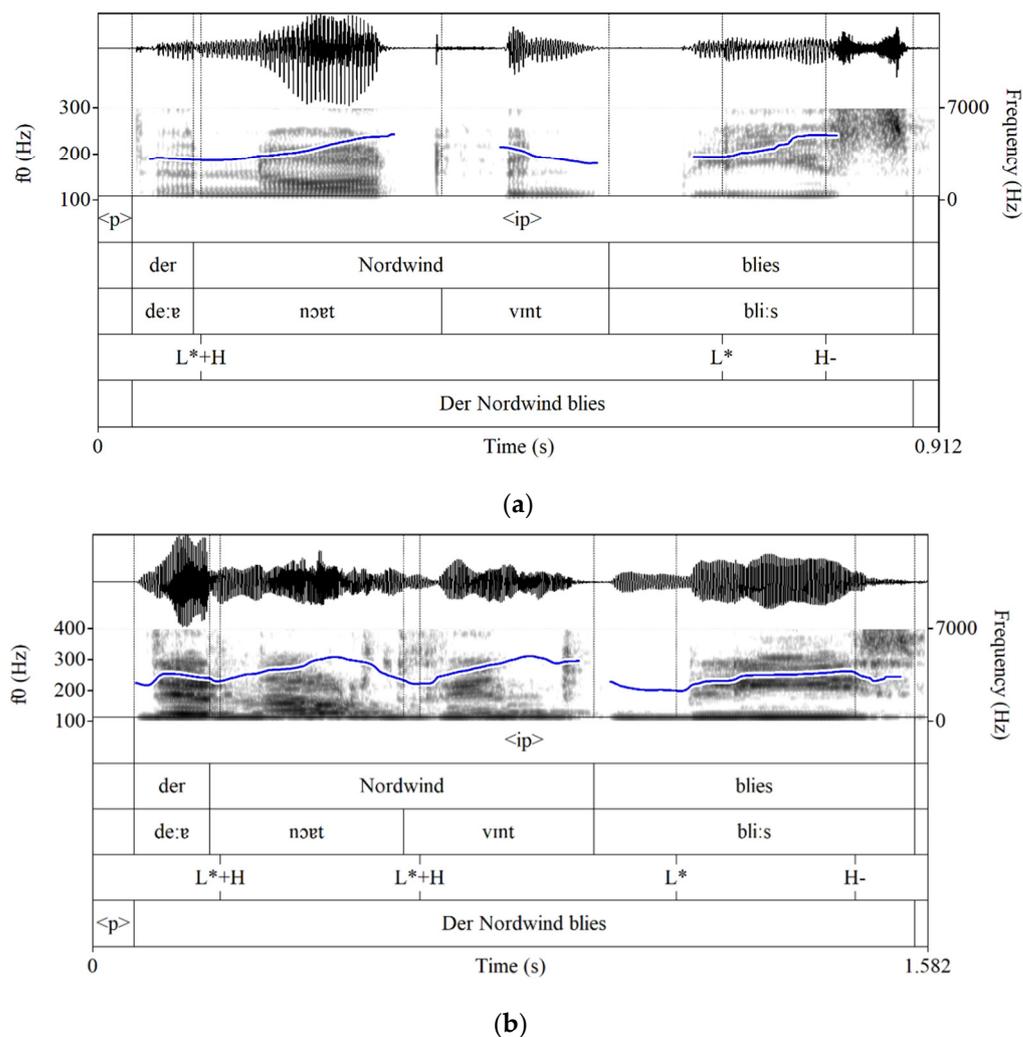

(**a**)

(**b**)

Figure 3. The phrase *der Nordwind blies* ('the North Wind blew') pronounced by (**a**) a native German speaker without stress clash and (**b**) a Bulgarian speaker of German with stress clash.

Another explanation comes from the greater tolerance in Bulgarian to stress clashes. Dimitrova (1998) found that in Bulgarian sentences with potential stress clash, the clash was tolerated in 56.3% of the cases. We found a similar amount of stress clashes—53% (59 realizations out of 110 potential ones in all readings) in our BG_L1 data. In DE_L2, realized stress clashes amounted to 53% of the 100 potential cases. In addition, we found 38 more clashes due to accent on a function word. In the DE_L1 data set, on the other hand, stress clashes constituted only 15% (15 realizations) of the 100 potential cases. This confirms previous findings and provides evidence that the greater tolerance of stress clashes in Bulgarian is transferred to the L2.

Last but not least, the average number of pitch accents on function words in the DE_L2 data set is considerably higher (15.9) than in DE_L1 (4.3) or in BG_L1 (8.3). This confirms the tendency to overuse pitch accents in the L2, commented on above.

We next analyze the types, frequencies and realizations of the prenuclear pitch accents in the three data sets.

3.2. Prenuclear Pitch Accent Types

In order to find out whether L*+H is the most frequent pitch accent in prenuclear position in both L1 and L2 German, we analyzed the pitch accent types used by the speakers in prenuclear position. We found five different pitch accent types, namely, L*+H, (!)H*, L*, L+H* and H+!H*. As can be seen in Figure 4, the choice of the pitch accent types and their relative frequency is comparable for the three data sets. However, as can be seen from Table 2, the Bulgarian speakers realized about 1.4 times more prenuclear accents in their Bulgarian readings (45.1 pitch accents on average per reading) and 1.5 times more accents in their German readings (47.6 pitch accents on average) than the German speakers (32.7 pitch accents on average). Thus, the tendency for Bulgarian speakers to use more prenuclear pitch accents than German speakers is carried over to their L2 as well.

Table 2. Number of prenuclear pitch accents in the three data sets.

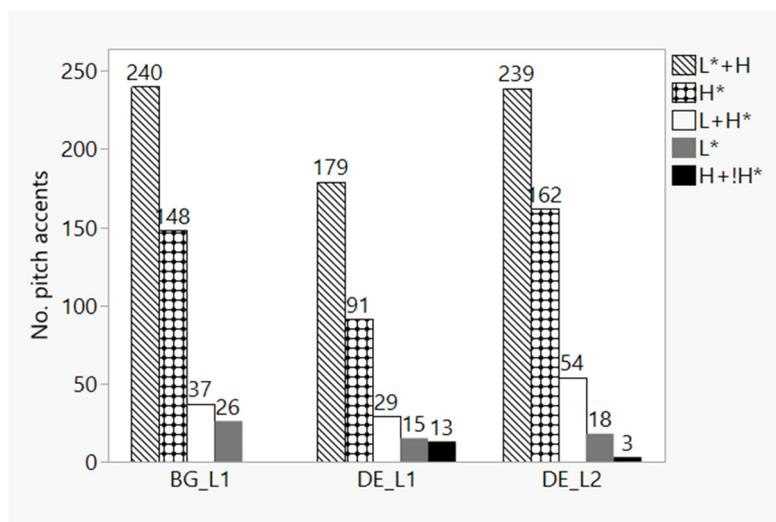|	Data Set		
	BG_L1	**DE_L1**	**DE_L2**
No. prenuclear pitch accents	451	327	476

Figure 4. Number of pitch accents in the three data sets.

In all three data sets, the predominant prenuclear pitch accent is L*+H: 240 occurrences (53%) for BG_L1, 179 (55%) for DE_L1 and 239 (50%) for DE_L2. The predominant use of L*+H in the DE_L1 data set is in line with the findings of Baumann et al. (2021), who report that sentence topics are consistently marked by rising prenuclear accents and not even given items are deaccented. Our findings also confirm Truckenbrodt's claim that L*+H is the neutral prenuclear accent type in German (Truckenbrodt 2002). However, the frequency of use of the different prenuclear accent types in our data differs from that in Baumann et al. (2021).

In Baumann et al.'s (2021) study, the second most frequently used prenuclear pitch accent in (L1) German was L+H* in 17.8% of all cases. In our data, it is H*: 91 occurrences (28%) for DE_L1 and 162 (34%) for DE_L2. In the Bulgarian L1 data set, H* was used 148 times (33%).

In our data, L+H* was the third most frequently used prenuclear pitch accent: it occurred 29 times (9%) in DE_L1 and 54 times (11%) in DE_L2. In BG_L1, it was used 37 times (8.2%). However, it must be noted that this pitch accent type was used predominantly by only two of the Bulgarian speakers both in their L1 and their L2 readings, which constitutes evidence of L1 transfer.

The differences in the choice of prenuclear pitch accent types in our data and in the data reported by Baumann et al. (2021) could be due to the different types of text used in the two experiments: while Baumann and colleagues analyzed separate read sentences, some of which were intended to elicit contrastivity, our speakers read a continuous text. The only prenuclear pitch accent type which is not found in all three data sets is H+!H*. It occurs only in our two German data sets: 13 times (4%) in DE_L1 and three times (1%) in DE_L2.

3.3. Realization of the Prenuclear L*+H

Concerning our research question about the prosodic word as an anchorage domain for the trailing tone of the L*+H pitch accent, we next focus on a comparison of the realizations of L*+H in the three data sets.

3.3.1. Alignment of the High Target with Respect to the Prosodic Word

As mentioned in Section 1.2, the role of the prosodic word has been neglected in research on Bulgarian intonation. On the other hand, the concept of the prosodic word (Tilkov's 'accentual rhythmic unit', Misheva's 'phonetic word') is to be found in virtually all descriptions of accentuation above the word level by Bulgarian scholars. In this study, one of our aims is to investigate if the variability of the high tonal target alignment described in Section 1.3 can be explained with reference to the prosodic word. It is also our purpose to explore the potential role of the prosodic word in the realizations of L*+H in L2 German. Following Welby and Lœvenbruck (2005, 2006), we postulate an anchorage domain for the trailing high tone of the L*+H, where it aligns with an unstressed syllable in the region up to the right boundary of a prosodic word.

Table 3 summarizes the realizations of the H target within and outside of the prosodic word in the three data sets. The Bulgarian speakers align the H target within the prosodic word, both in their L1 and in their L2 readings, more often than the L1 German speakers. However, the differences between the three data sets are relatively small.

Table 3. Realizations of the H target relative to the end of the prosodic word in the three data sets.

Position of the H Target	Data Set		
	BG_L1	DE_L1	DE_L2
Within the prosodic word	206 (93.6%)	118 (88.1%)	216 (99.0%)
Outside the prosodic word	14 (6.4%)	16 (11.9%)	2 (1.0%)

To explore the reasons for these differences (even though they are small), we analyzed the structure of the underlying prosodic words in the Bulgarian and German material used in the present experiment (Figure 5). In Bulgarian, two-, three- and four-syllable-long prosodic words predominate, which is in line with earlier findings (Tilkov 1981; Misheva 1991). There are very few instances of prosodic words containing five and six syllables, and no prosodic words of only one syllable. In German, on the other hand, the number of prosodic words containing one[2] to five syllables is almost equal, whereas prosodic words containing six syllables are fewer.
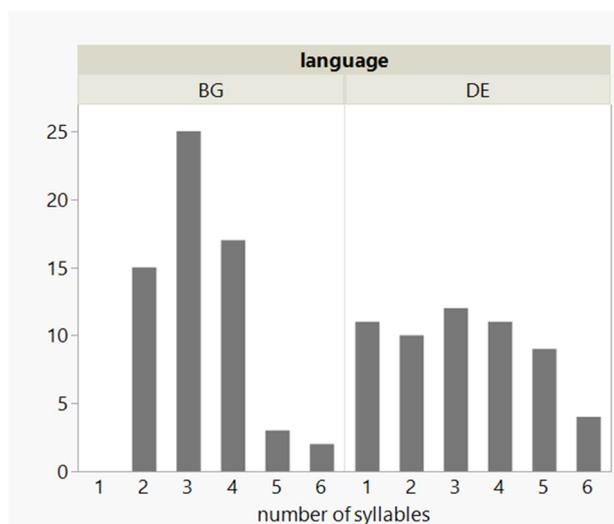
Figure 5. Number of syllables in the prosodic word in Bulgarian (**left**) and German (**right**).

Comparing the position of stress in the prosodic words in our material, it turns out that, in Bulgarian, penultimate and antepenultimate stress predominates, which is also in line with previous findings, whereas, in German, the distribution of the different stress patterns is more varied (Figure 6). Thus, on the systemic level, there are differences between the Bulgarian and the German material in terms of prosodic word structure.
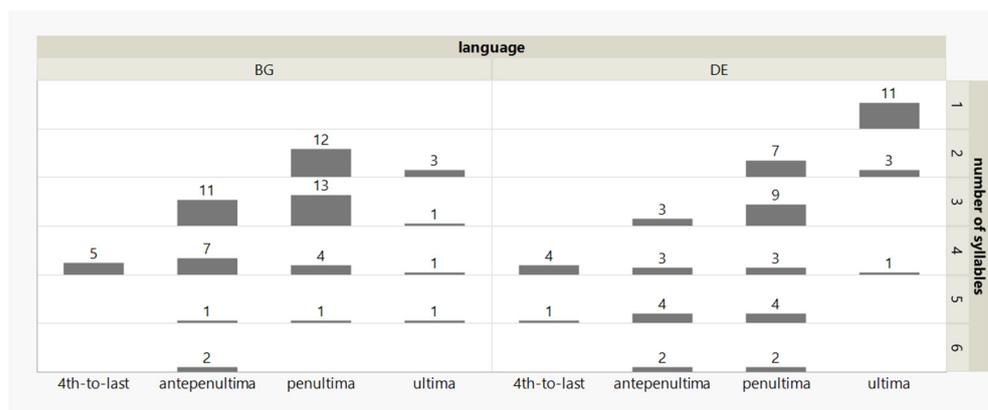

Figure 6. Stress position in the prosodic word in Bulgarian (**left**) and German (**right**).

In terms of realization, a closer look at the alignment of H with reference to the length of the prosodic word and the position of stress reveals that most cases of alignment of the high target outside the prosodic word can be explained by taking into account stress position. In BG_L1, DE_L1 and DE_L2, the default alignment of the H target is within the prosodic word. If stress is on the penultimate or antepenultimate syllable, the H target of the pitch accent can be aligned with the first syllable of the next prosodic word, if it is unstressed. In both languages, this can be a function word which can cliticize with a following or a preceding host (see Tilkov 1981 for Bulgarian) and, in Bulgarian, may be accompanied by vowel coalescence as well (e.g., слънцето е—'the sun is'—/ˈslɤntsɛto ɛ/ > [ˈslɤntsɛto ɛ̯]). Although we found differences in the structure of the prosodic word in our Bulgarian and German material, the smallest number of cases of H alignment outside the prosodic word was observed in DE_L2.

The above results indicate that the prosodic word does not provide an optimal explanation for the variability of the H target alignment of the prenuclear rising pitch accent and is therefore an unlikely anchorage region.

3.3.2. Height and Alignment of the Low and High Target

We next investigate the height and alignment of the low and high target of the L*+H prenuclear pitch accent with respect to the accented syllable.

With respect to pitch height, for both targets we observed the highest values for BG_L1, the lowest values for DE_L1 and intermediate values for DE_L2 (see Figure 7). In other words, the speakers from the three data sets used different register, namely, higher in BG_L1, lower in DE_L1 and intermediate in DE_L2.
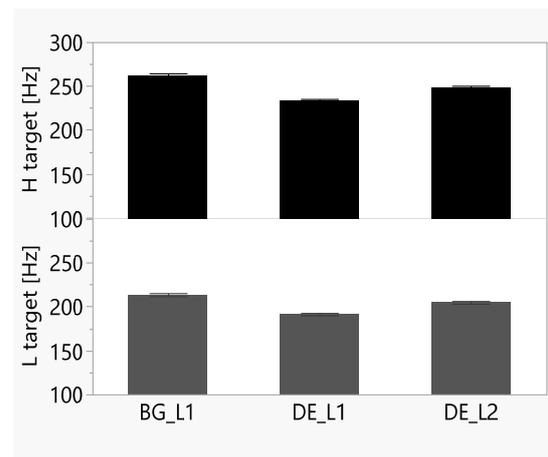

Figure 7. Mean pitch height (in Hz) of the L target (**lower panel**) and H target (**upper panel**) for the three data sets. Error bars represent standard errors.

With respect to the alignment of the low target, we found that the low target is aligned later in BG_L1 (about 57% from the beginning of the accented syllable) than in the German data sets (about 48% from the beginning of the accented syllable in both DE_L1 and DE_L2). It has been reported that German speakers align the L target within the consonant or even in the vowel of the accented syllable (Atterer and Ladd 2004; Mücke et al. 2009), which is in accordance with our findings. In our data, about half of the accented syllables in Bulgarian (56%) had a voiceless onset, whereas, in the German data, they were 11.8% in DE_L1 and 16.3% in DE_L2. Thus, the difference in the phonological make-up of the accented syllables can explain the later alignment of the low tonal target in Bulgarian found in our data (see Figure 8 lower panel).
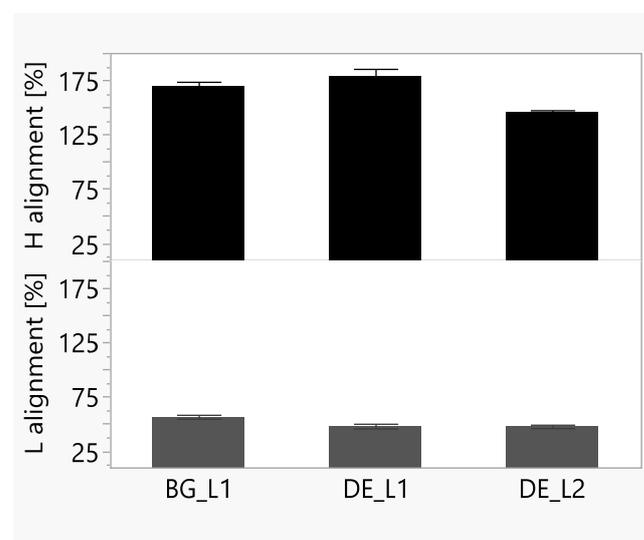

Figure 8. Mean alignment values (in %) of the L target (**lower panel**) and H target (**upper panel**) relative to the syllable onset for the three data sets. Error bars represent standard errors.

For the alignment of the H target we also found that the peak is aligned earlier in DE_L2 (145%, i.e., slightly before the middle of the post-accented syllable) than in the L1 data sets (170% vs. 179% for BG_L1 and DE_L1, respectively, i.e., within the second half of the post-accented syllable). Given that it has been reported previously that speech tempo influences the alignment of tonal targets (e.g., Silverman and Pierrehumbert 1990), we checked articulation rates in our data. We measured the articulation rate in all IPs in which prenuclear L*+H occurred. It turned out that the DE_L2 speakers whose articulation rate was the slowest also aligned the peak earlier with respect to the syllable onset, which contradicts previous findings that slower speech tempo results in later alignment (see Figure 8 upper panel).

Within the prosodic word, we also observed variation in the alignment of the high tonal target outside the post-accented syllable in the three datasets. Therefore, we measured the distance between the two tonal targets in terms of number of intervening syllables. This is shown in Table 4, where 0 indicates that the two targets are in adjacent syllables, 1 indicates that there is one syllable in between and 2 shows that there are two syllables which separate L from H. There are very few instances of more than two syllables separating the two targets; therefore, we report those together.

The Bulgarian speakers realized the H target in the syllable immediately following the accented syllable in 89.9% of cases in their German readings, unlike the native German speakers, who used such realizations in 75.9% of the L*+H prenuclear accents. In BG_L1, we observed the smallest proportion of realizations of L*+H with no intervening syllables between the two targets (72.5% of cases). From these data, we can conclude that, in more than 90% of cases (95.9% in BG_L1, 91.1% in DE_L1 and 99.5% in DE_L2), the H target is aligned within a window of two post-accented syllables. This window predicts the position of the high tonal target slightly better than the prosodic word.

Table 4. Number of intervening syllables between L* and H (in % in parenthesis) in the three data sets.

No. Intervening Syllables	Data Set		
	BG_L1	**DE_L1**	**DE_L2**
0	161 (72.5%)	110 (75.9%)	196 (89.9%)
1	52 (23.4%)	22 (15.2%)	21 (9.6%)
2	9 (4.1%)	10 (6.9%)	1 (0.5%)
3 or 4	0	3 (2.0%)	0

4. Discussion

In this study, we examined the choice of prenuclear pitch accent types, their distribution and the realization of the default prenuclear L*+H pitch accent in the read speech of Bulgarian and German native speakers and Bulgarian learners of German, drawing particular attention to their similarities and differences in the systemic, realizational and frequency dimension (Mennen 2015). The main question we asked is whether and to what extent the native language affects the non-native prosody of Bulgarian speakers of German at a medium level of proficiency.

Regarding the frequency dimension, namely, whether Bulgarian L2 speakers of German produce more pitch accents than German L1 speakers, we found that the Bulgarian learners of German used 1.5 times more pitch accents than the German native speakers, which confirms our expectations. The explanation for this is twofold. On the one hand, Andreeva and Dimitrova (2022a, 2022b) found that the Bulgarian learners produced more intonation phrases than the German native speakers (27.2 vs. 18.9) and, as a result, more nuclear accents. On the other hand, both speaker groups realized pitch accents on function words in prenuclear position as well. Optional accentuation on function words in German has been reported by Bögel (2021), Kügler (2018) and Zerbian and Böttcher (2019), among others. Despite the fact that there are fewer function words in the Bulgarian text which we used for data collection, the Bulgarian speakers used twice as many accents on them in

their native language compared to the accents put on function words by the native German speakers. Again, transferring the tendency to often accent function words to their German L2, the Bulgarian learners realized the pitch accent on a function word 3.7 times more often than the native German speakers.

Regarding the frequency dimension, from the prenuclear pitch accent types found in the three data sets, namely L*+H, H*, L+H*, L* and H+!H*, L*+H was the most frequently used, which is in line with Truckenbrodt (2002) and Baumann et al. (2021). What is more, compared to the German native speakers, the Bulgarians realized about 1.4 times more prenuclear accents in their Bulgarian readings and 1.5 times more prenuclear accents in their German readings. Thus, the tendency for the Bulgarian speakers to use more prenuclear pitch accents in Bulgarian than German speakers in German is transferred to the L2 German of the Bulgarian learners as well.

Our research question regarding the realizational dimension on whether Bulgarian L2 speakers of German tolerate more stress clashes than German L1 speakers was answered positively. We found that more than half of the potential cases of stress clash were tolerated in both BG_L1 and DE_L2, while in DE_L1 such cases constituted only 15% of the underlying stress clashes. In DE_L2, we found additional clashes due to additional accent placement on a function word. Stress clash tolerance provides further evidence of L1 transfer in the readings of Bulgarian learners of German.

Regarding the systemic dimension, our analysis shows that Bulgarian speakers use an anchorage domain both in Bulgarian L1 and German L2 for the trailing tone of the L*+H pitch accent. However, we did not find conclusive evidence about the exact region of the anchorage. Our analyses revealed that the H target occurs more often within the prosodic word in the BG_L1 and DE_L2 data set than in the DE_L1 data set, and that the H target is aligned earlier in DE_L2 compared to BG_L1 and DE_L1. However, we also found counterexamples in which the H spreads to the first or second syllable of the next prosodic word in the three data sets, although their amount for the DE_L2 data was negligible (only two cases). The finding that the Bulgarian speakers of German align the trailing tone significantly earlier than the native speakers, in spite of the fact that they have a significantly slower articulation rate compared to the native speakers, is surprising and contradicts previous findings that a slower speech tempo results in later alignment. We explain these findings in terms of L1 transfer: when speaking German, under the influence of the statistical regularities that relate to prosodic word patterns in their mother tongue, Bulgarian learners of German phrase their L2 speech into a higher number of shorter prosodic words, and therefore realize more pitch accents and align the high tonal target earlier than the native speakers.

Since we found additional variation of the trailing tone alignment within the prosodic word which cannot be explained in terms of prosodic word structure (stress position and number of syllables between the stressed syllable and the end of the prosodic word), we focused on the number of syllables between the two tonal targets of the prenuclear pitch accent. It turns out that the H is aligned within a window of two post-accented syllables in 95.9% of the cases in BG_L1, 91.1% in DE_L1 and 99.5% in DE_L2. This window predicts the position of the high tonal target slightly better than the prosodic word. However, it must be borne in mind that our results are based on read speech data, which does not control for many possible factors that can cause variability. Several studies have suggested that the specification for the alignment of tonal targets is a function of speech tempo, phonological vowel length, syllabic structure and segmental effects (intrinsic vowel duration, vowel quality, consonant voicing, etc.), adjacency to word and intonational boundaries, proximity to other tones, as well as dialectal background (Arvaniti et al. 1998; Jilka and Möbius 2007; Ladd et al. 2000; Möbius and Jilka 2007; Mücke et al. 2009; Prieto and Torreira 2007; Silverman and Pierrehumbert 1990, among others).

Turning back to the anchorage domain, it should be noted that the two-syllable window coincides with the default pattern for the prosodic word structure in Bulgarian, in which stress is on the penultimate syllable in two- and three-syllable prosodic words

and on the antepenultimate syllable in four-syllable prosodic words. Thus, the question of whether the prosodic word or the two-syllable window provides a better explanation for the variability of the alignment of the high trailing tone remains open. Evidence from more specifically designed experiments is needed to confirm or reject our predictions.

In conclusion, our results suggest that the L2 speech of Bulgarian learners of German at intermediate level is influenced by L1 intonation features in cases when there are differences between the mother tongue and the target language. In our case, this may be due to the age of learning. The LILt assumes that the age of first (regular) exposure to an L2 is an important factor in predicting overall success in acquiring L2 intonation (Mennen 2015, p. 180). The ten Bulgarian speakers of German all started learning the language relatively late at the age of 13 at a German-language-medium school in Bulgaria and were at B2 level of proficiency according to the Common European Framework of Reference for Languages when they took part in the experiment. Moreover, they reported relatively limited exposure to the L2 and almost no immersion in a German-speaking environment. Our results provide further evidence that 'the earlier the better' also applies to intonation learning, as suggested by LILt. Thus, in addition to the four dimensions put forward by LILt, its general assumptions provide a very useful basis for any investigation of L2 intonation.

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Appendix A

Северният вятър и Слънцето

Северният вятър и Слънцето се препираха кой е по-силен, когато един пътник, завит в топла дреха, мина покрай тях. Те решиха, че този, който пръв накара пътника да си свали дрехата, ще се счита по-силен от другия. Тогава Северният вятър започна да духа с всичка сила, но колкото по-силно вятърът духаше, толкова по-плътно пътникът увиваше дрехата около себе си. Най-после Северният вятър прекъсна усилията си. Тогава Слънцето започна да грее силно и пътникът веднага свали дрехата си. И така, Северният вятър беше принуден да признае, че Слънцето е по-силно от него.

Appendix B

Nordwind und Sonne

Einst stritten sich Nordwind und Sonne, wer von ihnen beiden wohl der Stärkere wäre, als ein Wanderer, der in einen warmen Mantel gehüllt war, des Weges daherkam. Sie wurden einig, dass derjenige für den Stärkeren gelten sollte, der den Wanderer zwingen würde, seinen Mantel abzunehmen. Der Nordwind blies mit aller Macht, aber je mehr er blies, desto fester hüllte sich der Wanderer in seinen Mantel ein. Endlich gab der Nordwind

den Kampf auf. Nun erwärmte die Sonne die Luft mit ihren freundlichen Strahlen, und schon nach wenigen Augenblicken zog der Wanderer seinen Mantel aus. Da musste der Nordwind zugeben, dass die Sonne von ihnen beiden der Stärkere war.

Notes

[1] The smaller number of function words in the Bulgarian text in comparison with the German one can be attributed, among other things, to the post-positioned article in the language.

[2] Note, however, that in our German data there were no L*+H prenuclear pitch accents realized on monosyllabic prosodic words.

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