Speech Prosody 2024
2-5 July 2024, Leiden, The Netherlands

Intonational Patterns under Time Pressure: Phonetic Strategies in Bulgarian Learners of German and English

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Abstract

Research on the second-language (L2) acquisition of intonation is a growing field but only few studies have (so far) focused on the fine phonetic detail of intonational patterns in the L2. The present study concentrates on the phonetic realization of nuclear intonation contours under time pressure, testing Bulgarian learners in their L2s German and English – two languages in which intonation contours are accommodated differently by native speakers (L1) when little sonorant material is available. In particular, nuclear falling contours (H* L-%) tend to be truncated in L1 German while they are compressed in L1 English. Here we recorded 14 Bulgarian learners in their L2s German and English (within subjects, language order counterbalanced) when producing utterances in a statement context. The target word, a surname placed at the end of the utterance, differed in the available sonorant material (disyllable vs. monosyllables with long and short vowels). Our findings showed that Bulgarian speakers primarily truncate nuclear falling movements ((L+)H* L-%) in both L2s, suggesting transfer irrespective of the target strategy. However, our data show substantial inter- and intra-individual variation which we will discuss, along with factors that might explain this variation.

Index Terms: intonation, compensation strategies, L2, Bulgarian, English, German, transfer, individual variation

1. Introduction

In her Intonation Learning Theory (LILt, [1]), Mennen introduces a crucial differentiation between phonological representation and phonetic implementation, suggesting that learners initially grasp the phonological pattern in the foreign language (L2) and subsequently focus on mastering the phonetic realization of these patterns. Hence, gradient cross-linguistic differences in intonation can significantly impact the correct production of L2 patterns and are more prone to cross-linguistic influences than categorical ones. Previous research has often demonstrated prosodic transfer from a learner's native language (L1) to the L2 – which, according to LILt, can be explained by cross-linguistic differences [2]. Learners have been shown to differ from L1 speakers with respect to pitch accent placement or pitch accent type ([3, 4]). Comparatively fewer studies have focused on the fine phonetic detail of intonational patterns in the L2. Those that did typically studied tonal alignment, either reporting earlier ([5, 6]) or later alignment ([7-10]) than in the target language – based on the L1 [11]. Little is known on how learners phonetically accommodate intonational contours under time pressure in the L2 (i.e., when there is little voicing as in words like 'ship' or in cases of tonal crowding at utterance endings [12, 13]).

Studying such intonational 'compensations strategies' is particularly interesting for L2 research, as L1 speakers of different – even typologically closely related languages and dialects – have been shown to prefer different strategies (e.g., [14-18]): When voiced material runs short, English speakers, for example, tend to accelerate sentence-final falling pitch contours by increasing the slope of the contour, which results in compressed intonation patterns [15, 16]. German, in turn, along with strategies of f0 peak retraction, largely crops falling contours, resulting in truncated intonation contours [15, 16], [19]. Both languages use durational lengthening to ease time pressure [16]. We here focus on English and German acquired as L2s, since these two languages are similar in several prosodic aspects [20], but accommodate intonational contours under time pressure differently. Including two L2s with asymmetrical compensation strategies allows us to disentangle prosodic transfer and adjustment from other interlanguage phenomena.

We study native Bulgarian learners for two main reasons: First, Bulgarian differs from German and English with respect to its vowel system. Different from German and English, vowel length is not contrastive in Bulgarian segmental phonology [21], which in turn has been shown to lead to non-target like productions in L2 German and English ([22, 23], for Bulgarian-accented German; [24, 25] for Bulgarian-accented English). The durational uncertainty in Bulgarian leaners may hinder them to use durational lengthening to adjust time pressure in L2 German and English.

Second, Bulgarian seems to resemble German in the f0-related compensation strategies, favouring a truncation mechanism (and is hence different from English). Even though no study has directly investigated compensation strategies in Bulgarian yet, the truncating strategy can be inferred from related studies: In particular, the intonation of syntactically and lexically unmarked confirmation-seeking Yes/No questions in Bulgarian is characterized by a rising-falling nuclear pitch if the nuclear syllable is not in a phrase-final position [26]-[30].Yet, if the nuclear syllable is phrase-final, the fall in the global rise-fall pattern is truncated. Taken together, Bulgarian seems to compensate for time pressure with an overall truncating strategy (like German, different from English), and has a vowel system with no length contrast (different from both German and English). Hence, analysing intonational contours produced by native speakers of Bulgarian in L2 English and German offers an interesting acquisition scenario, which requires adjustments on different linguistic levels (segmental and intonational). Also, different L2s have to be adjusted differently to reach the target.

To this end, we run a production experiment to investigate how advanced Bulgarian learners of German and English respond to time pressure on phrase-final intonational patterns in their L2s (as compared to their L1). We test whether Bulgarian

10.21437/SpeechProsody.2024-75

learners use the same strategy in both their L2s (as would be expected under the assumption of prosodic transfer), or whether they approach the target strategy to some extent (assimilation). Based on previous literature [1], [31], given the differences between Bulgarian and English, we predict that L1 Bulgarian and L2 English interact, which may result in a mixed pattern for L2 English. Given the similarities for Bulgarian and German, we expect positive transfer from L1 Bulgarian to L2 German.

2. Method

2.1. Materials

For a larger study, we constructed utterances in a statement and a question context, but we only report on the statements here. Following previous comparable studies on German and English ([15, 16]), the utterances were prompted by a short context in three languages (L1 Bulgarian, L2 German and L2 English) and resulted in nuclear falling contours (H* L% / L+H* L%).

The sentences contained 18 critical surnames (similar in the three languages) with different vowel quality (/a/, /i/ and /u/), extending the materials used in [16] by additional names. The surnames were placed in phrase-final, focused position, and differed in the availability of sonorant material. Specifically, there were three length conditions: disyllables (*long*), monosyllables with long vowel (*mid*) and monosyllables with short vowel (*short*), see Tab. 1. Each vowel was represented in two different surnames. Due to the phonological structure of Bulgarian, we only included surnames with /i/ in the *mid* condition and thus only 14 in number.

Table 1: *Examples of test items in Bulgarian, English, and German (the Cyrillic transliteration is in italics).*

	long	**mid**	**short**
/i/	Шийфер '*Shiyfer*' Sheafer *Schiefer*	Шийф '*Shiyf*' Sheaf *Schief*	Шиф '*Shif*' Shift *Schiff*
/a/	Шафер '*Shafer*' Sharfer *Schafer*	- Sharf *Schaaf*	Шаф '*Shaf*' Shuff *Schaff*
/u/	Шуфер '*Shufer*' Poosher *Schufer*	- Poosh *Schuuf*	Шуф '*Shuf*' Push *Schuff*

The syntactic structure of the utterances (1) was identical in all phrases. An appositional phrase following the target served as a control to indicate the underlying phonological contour (where the contour was truncated). We added 36 filler sentences with different surnames, placed in different phrase positions and introduced by different contexts, which resulted in 68 statements in total.

(1) carrier phrases (test items bolded)

Bulg.	Но това е господин **Шийфер** / **Шийф** / **Шиф**! Нашият нов колега! *No tova e gospodin Shiyfer / Shiyf / Shif! Nashiyat nov kolega!*
English	It's Mister **Sheafer** / **Sheaf** / **Shiff**! Our new neighbour!
German	Das ist doch Herr **Schiefer**/ **Schief** / **Schiff**! Unser neuer Nachbar!

2.2. Procedure

Participants were recorded individually in a quiet room at Sofia University. Before the recordings we captured socio-phonetic data in a background questionnaire (see Tab. 2). Each session lasted approximately one hour, including a perception task and the production of questions, which are not reported here. The third author was present the entire session. The experiment was presented with SoSci survey [32] and speakers were recorded via a a head mounted microphone on to a PC (44.1 kHz, 16 bit, stereo). Participants were presented with sentences they saw on a screen and were instructed to read the phrases aloud. The experiment started with the Bulgarian sentences, followed by the German or English block (order of languages counterbalanced). In the beginning of each language block the participants heard two productions of a native speaker.

2.3. Participants

Fourteen female native speakers of Bulgarian (aged between 19 and 22 years) provided the data. They came from different dialect regions (north-west [NW], north-east [NE], south-east [SE], south-west [SW]; Tab. 2), but spoke standard Bulgarian for the recordings. All speakers were students of German Studies at Sofia University and advanced learners of German and English (and thus multilingual just like the vast majority of Bulgarians). We captured their language proficiency (listening/speaking) in a questionnaire by self-assessment, on a scale from 1 (low) to 7 (high). The speakers rated themselves as advanced in both languages (L2 German: 5.57, SD = 0.53 vs L2 English: 5.20, SD = 0.79). Speakers also indicated dialectal background, other language skills and musical education.

Table 2: *Meta data for each speaker: proficiency in L2 German / English, other languages, musical education, and dialect region (by cardinal direction).*

speaker	**prof. Ger.**	**prof. Eng.**	**other lang.**	**music. educ.**	**dialect**
SP_02	6.0	4.5	dan	yes	NE
SP_03	4.5	4.0	/	yes	NE
SP_04	5.5	5.0	rus	yes	NW
SP_05	6.0	4.0	/	yes	NE
SP_06	6.0	4.0	/	yes	NW
SP_07	6.5	5.5	/	yes	NE/SE
SP_08	5.5	5.5	rus	yes	NE
SP_09	6.0	5.5	/	yes	NW
SP_10	5.0	6.0	/	no	NE/SE
SP_11	5.5	6.0	/	no	NE
SP_12	5.0	5.5	tur	no	NE
SP_13	5.5	6.5	rus/lit/ swe	yes	NE/SE
SP_14	5.0	6.0	/	yes	SW
SP_15	6.0	5.0	rus	yes	NE

3. Results

3.1. Dataset and annotation

Speakers mostly produced H*/L+H* L% in all languages (>98%), on which we will focus here. We labeled the boundaries of the phrases, words, syllables of 'mister *surname*', and the vowel of the target word. In addition, we labeled the pitch turning points (L/H) within the target word (see Fig. 3). Our final dataset comprised 651 utterances in total, see Tab. 3.

Table 3: *Number of data points per speaker group.*

	L1 Bulgarian	L2 English	L2 German
short	78	77	75
mid	29	76	80
long	79	81	76

3.2. Acoustic analysis of adjustment strategies

Fig. 1 shows the f0 contours over time (pooled for H*/L+H* L%) in each language for the sonorant portions (first and second vowel for long, and first vowel for the short and mid condition). Fig. 2 shows the predictions of the regression models (*lmers* [33], with *condition* and *language* as predictors) for the f0 excursion and the slope of the falling movement (Fig. 2.a, 2.b), the proportional alignment of the H-target with respect to the vowel (Fig. 2.c), and the duration of the first vowel (Fig. 2.d).

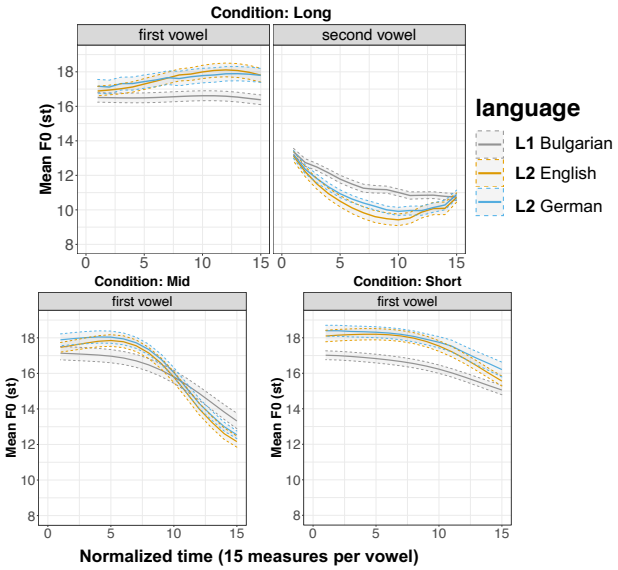

Figure 1: *f0 contours over time (sonorant portions).*

For the long condition (disyllabic word, reference level), speakers produced a falling movement of around 8 st on average, with the f0 peak (H-target) occurring late in the vowel (latest for L2 German, Fig. 2.c). The mid condition (monosyllable with long vowel) and the short condition (monosyllable with short vowel) offered successively less voiced material and hence had to be accommodated by the speakers: Speakers used similar **adjustment strategies** across all languages. In all languages, speakers significantly decreased their f0 excursion from the long to the short condition (Fig. 2a), suggesting truncation. At the same time, speakers also significantly shifted the H-target to the left (in monosyllables as compared to the long condition, cf. Fig. 2c), assumingly to ease the implementation of a falling movement. The slope of the nuclear fall significantly increased from the long to the mid condition, suggesting an acceleration of the contour. Hence, speakers additionally compressed mid contours, but this increase of the slope was significantly weaker for L1 Bulgarian as compared to the L2s (Fig. 2c, corroborated by a significant interaction between condition*language). The slope of the fall in the short condition did statistically not differ from the long condition, suggesting that in short vowels the shape of the contour was untouched. Rather than being compressed, the contour in the short condition was shifted left and truncated (Fig. 2a, 2c).

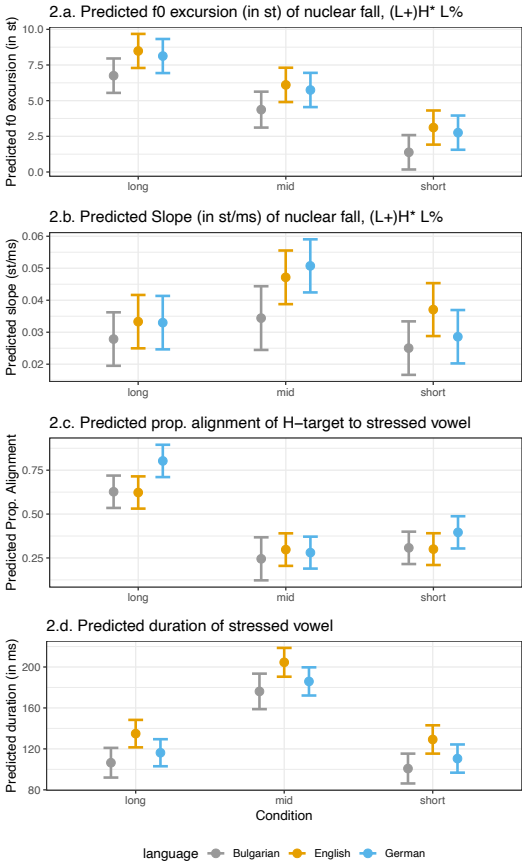

Figure 2: *Model predictions for (a) f0 excursion, (b) slope, (c) H-alignment and (d) duration of vowel across conditions.*

A factor that might have eased the realization of the fall in the mid condition (which speakers attempted in the L2s) is **vowel duration** (Fig. 2d). The vowel in the mid condition was significantly longer than in the long condition (in all languages). The vowel in the short condition did statistically not differ in its duration from the vowel in the disyllabic word. Hence, speakers did not lengthen the vowel in the short condition of the L2s, possibly to avoid confusion with the tense vowel quality or due to uncertainty with vowel duration. Hence, overall, we find a **truncating** strategy in all languages (substantial reduction of the extent of the fall), which is accompanied by a shift of the f0 peak to the left (**peak retraction**). In monosyllables with a long vowel, a substantial portion of the fall was realized, which was eased by a steeper slope (L2s only) and the realization of the long vowel.

While the overall strategy holds for all three languages, language-specific effects occurred: H-targets were lower in L1 as compared to the L2s (Fig. 1), resulting in a smaller excursion for L1 than L2 (Fig. 2.a). L1 Bulgarian speakers differentiated between the L2s with respect to two aspects: First, in L2 English, vowels were significantly longer than in L2 German (Fig. 2d). Second, while the compensation strategy in the two L2s did not differ in the mid condition (as confirmed by a GAMM ([34, 35])), we find a difference in the short condition: Towards the end of the vowel the slope becomes steeper in L2 English. This difference is small (~ 0.5 st), but significant (time point 9-15, as shown by the GAMM). It might show an attempt towards implementing the falling movement to meet the target strategy in English, which some speakers indeed succeeded in (see 3.3 for individual variation).

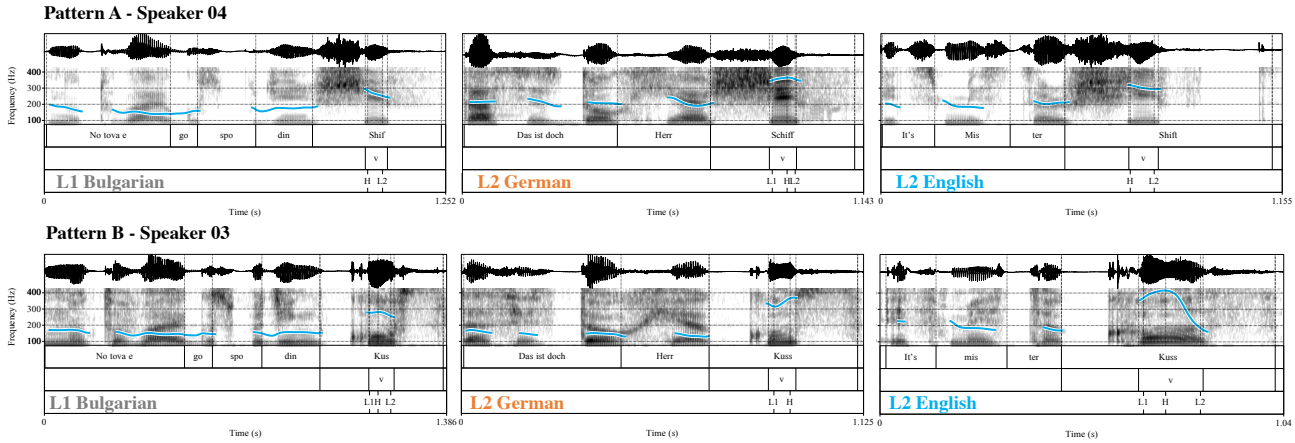

Figure 3: *Examples for individual compensation strategies (in short condition): SP04 shows truncation in all languages, while SP03 truncates in L1 Bulgarian and L2 German, but implements the fall in English (via compression and peak retraction).*

3.3. Individual differences

Beyond the general tendencies to accommodate time pressure in nuclear falling movements (see 3.1), our data show considerable individual variation in the choice of a strategy, particularly for the short condition ([36, 37]). In an attempt to systematize these individual differences in the short condition, we identified five patterns (two of which we illustrate in Fig. 3). Specifically, there were speakers who systematically truncated contours in all three languages (**Pattern A**, N = 3, SP04, SP06, SP09, upper panel in Fig. 3) – a strategy which might reflect transfer of the L1 Bulgarian strategy in both L2s. Another group, which comprised half of the speakers (N = 7, SP02, SP03, SP05, SP08, SP11, SP12, SP14, **Pattern B**, lower panel in Fig. 3) truncated in L1 Bulgarian and L2 German (which also might reflect transfer), but attempted to implement the fall to a considerable extent by compressing the contour in L2 English (towards assimilation). For Pattern C and D (N = 1 each), the speakers both truncated in L1. L2s were compressed (**Pattern C**, SP13), or were either compressed or truncated (**Pattern D**, SP07). For **Pattern E** (N = 2, SP10, SP15), speakers used no consistent compensation strategy in neither of the languages.

4. Discussion

We investigated the phonetic implementation of nuclear falling intonation contours (H*/L+H* L%) under time pressure – realized by Bulgarian learners in L2 German and English. The cross-linguistic differences in the phonetic responses to time pressure in L1 German and English ([15, 16, 19]) provide an ideal test case to study the dynamics of L2 acquisition of fine phonetic detail in light of assumptions made by LILt [1].

From related studies [26]-[30] we inferred that Bulgarian favours truncation. We here provided a first systematic analysis of the matter, showing that Bulgarian speakers systematically reduced the f0 excursion in nuclear falling movements when sonorant material runs short, along with retracting the f0 peak. The slope adjustment from bisyllables to monosyllables with long vowels (mid), observed even in truncating languages ([16] on German) is absent in Bulgarian – even though the long vowel would have allowed shape modifications. This corroborates a preference for truncation, instead of adjusting the slope.

For phonetic responses to time pressure in the L2s our main findings support our assumptions ([1, 31]): For L2 German, we predicted (positive) transfer for compensation strategies from L1 Bulgarian, which overall was the case as productions in L2 German were generally cropped along with peak retraction (Fig. 2). For L2 German, Bulgarian speakers additionally succeeded in adjusting patterns that required adjustment: The f0 peak was aligned late (see Fig. 2 for long condition), later than in L2 English and L1 Bulgarian. Given that German typically aligns later than English or Bulgarian [7], this might mirror the acquisition of alignment patterns in L2 German.

For L2 English, we predicted the L1 and L2 system to interact (based on cross-linguistic differences in compensation strategies). Indeed, the general pattern suggested truncation of the L2 English contours (contra our prediction, but in favour of prosodic transfer [1], or a general truncating strategy in any L2 (cf. [12] for discussion)). However, considering the individual variation (within and across speakers) allowed us to trace an emerging pattern in L2 English that points towards compression – at least for half of the speakers (Pattern B, Fig. 3), and hence corroborates our assumptions. Proficiency might be one explaining factor for this variation, with high proficient learners being closer to the target [13], but our data rules this out. In our data (similar to [12]) learners with comparable proficiency (self-report) accommodate differently (showing transfer or adjustment). Dialectal background could also play a role, and indeed it seems that speakers who originated from the West of Bulgaria consistently truncated in all languages, while speakers from the North-Eastern dialectal area mostly showed Pattern B (i.e., moving towards compression, hence adjustment in L2 English). So far, the decisive factors are unclear and we have to trust in future research, which has to consider age of onset, language aptitude, attitudes about the "sound" of a language, as well as acquisition context in order to clarify this issue.

Using the example of phonetic responses to time pressure, our study reveals an intricate (speaker-specific) interplay between L1 and L2 system(s) in the acquisition trajectory of the phonetics of L2 intonation, and is one of the few studies in this field to test existing theories of L2 intonation.

5. Acknowledgments

We are grateful to Jenny Yu for materials and discussion, Nathalie Elsässer, Melissa Hildebrand, Melanie Loes & Chiara Pletto for annotation, to Sofia University for enabling recordings, the Bulgarian National Science Fund (Кп-06-H40/11), the German Res. Foundation (232722074-SFB1102, and Trier Center for Language and Communication for funding.

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