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Short communication

Neutralization or truncation? The perception of two Russian pitch accents on utterance-final syllables [☆]

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Abstract

This paper presents the results of a perception experiment that was carried out to verify the hypothesis that in Russian the contrast between pitch accents LH*L and LH* on utterance-final syllables is neutralized. Recordings for the experiment were 10 sets of three short utterances with word stress in the ultimate, penultimate and antepenultimate syllable of the utterance-final word. These utterances were read aloud by four female and four male native speakers. They were asked to realize accents LH*L and LH* in the utterance-final word. After instructions and rehearsing, recordings were made separately for each of the two types. In the perception experiment, 30 native subjects listened to short utterances selected from the recordings and presented in 180 pairs: 120 pairs with ultimate stress and, in order to test whether listeners can hear the difference at all, 60 pairs with penultimate and antepenultimate word stress in utterance-final position. The 180 stimuli pairs consisted of short utterances with realizations of LH*L and LH* on the final word, each pair containing two same or two different types of pitch accent. The task was to compare two stimuli in a pair and to indicate on a score form whether two realizations in a stimulus pair count as passable imitations of each other and thus belong to the same type of pitch accent. The same/different judgments indicate that listeners successfully distinguished between the two pitch accents in the antepenultimate and penultimate conditions, but much less so in the ultimate condition. This suggests that the two accents are truncated in final position, but not neutralized.

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Keywords: Russian pitch accents; Truncation; Speech perception

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1. Background and hypothesis

Till the present day most descriptions and transcriptions of Russian intonation have been based on the holistic approach of Bryzgunova (1977, 1980, 1984). Non-holistic treatments are, for instance, Fougeron (1989), Kodzasov (1996, 1999), Nikolaeva (2000), Odé (1989), Svetozarova (1982). Recent works by Yokoyama (2001) and Igarashi (2002, 2004a,b) discuss issues on Russian intonation in an autosegmental phonological framework. In my view, Bryzgunova's broadly used classification into seven intonation constructions is not an adequate transcription tool for reasons extensively discussed in Keijsper (1992) and Odé (1992). At present, an alternative Transcription of Russian Intonation (ToRI) is under development in which Russian pitch accents will be expressed in unambiguous symbols, each symbol representing one type of pitch accent. ToRI will be a reproducible transcription system in the sense that a realistic intonation contour can be synthesized on the basis of the transcription symbols and the F_0 realization rules that are sensitive to the segmented context.

The hypothesis tested here is that the contrast between Russian rising pitch accents LH*L and LH*¹ with a low and high posttonic part, respectively, is neutralized² (Odé, 1989, p. 105) when realized on utterance-final syllables (for phonetic specifications of the accents see Section 2). For example, when the stressed syllable of the utterance-final word *véselo*³ in *býlo vésele* '(it) was fun' is realized with type LH*L, one of its interpretations can be a yes/no question: *býlo vésele?* 'was (it) fun?'; with type LH*, one of its interpretations can be the announcement of a soon following final accent: *býlo vésele i interésno* '(it) was fun and nice'. If the utterance-final word has ultimate word

stress, like *tepló* in *býlo tepló* '(it) was warm', the contrast between two pitch accents LH*L and LH* is claimed to be neutralized on utterance-final accented syllables.⁴ The utterance is then ambiguous and can be interpreted as a yes/no question: *býlo tepló?* 'was (it) warm?' or as the announcement of a soon following final accent: *býlo tepló i interésno* '(it) was warm and nice'. The examples can be represented in stylized pitch contours as shown in Fig. 1 (see also Figs. 2 and 3).

In order to verify the hypothesis I conducted a perception experiment. Two possible outcomes were expected: (1) the two types are indeed neutralized on utterance-final syllables, meaning that the discrete distinction between them is completely lost in this position; (2) truncation occurs, meaning that the distinction between the two types is impaired phonetically but intact phonologically. If truncation occurs, the posttonic part of the pitch configuration is "cut off" as indicated in the stylized contours in Fig. 1, that is, the posttonic part of types LH* and LH*L are unrealized on utterance-final syllables. An alternative would be compression: the full pitch configuration, including the posttonic part, is realized on the utterance-final syllable and the accent is intact both phonetically and phonologically. For a discussion of compression and truncation, see Ladd (1996, 132pp.).

2. Pitch accents LH*L and LH* defined

According to Odé's classification, Russian has six types of rising pitch accent, four types with large excursion, and two with normal excursion (for a full description see Odé, 1989, p. 119). Based on a thoroughly analysed corpus of 15 minutes (Odé, 1989, 115pp.), the experimentally verified accents LH*L and LH* discussed in this article have on average the following specifications: an excursion size of >15 semitones measured from the average low level reached by a given speaker in final falls, early timing (the end frequency of the rise is reached at the onset

¹ Note that the high posttonic part of accent LH* is not explicitly indicated in its symbol, since a type LH*H would imply that after the accented syllable pitch rises and this does not occur in Russian; transcribing the type as LH* implies that pitch remains on the same level.

² For this neutralization a separate symbol Rø- was used.

³ Throughout the article, transcriptions of text in Russian are according to the Library of Congress system.

⁴ Rising pitch accents LH* and LH*L correspond to the experimentally verified types of rising pitch accent originally named Rh- and Rl-, respectively, in Odé (1989).

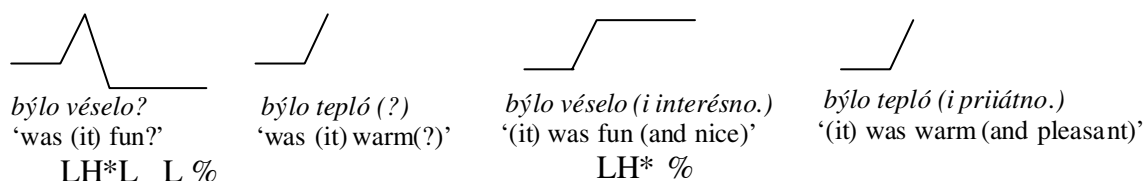


Fig. 1. Stylized pitch contours of types LH*L L% (left pair) and LH* % (right pair) realized in utterance-final words on antepenultimate and ultimate syllables.

of the accented vowel), and a great rate of change (75 semitones per second).

3. Recordings

Recordings were made in order to arrive at a set of short utterances with accents LH*L and LH* realized in words in utterance-final position with ultimate, penultimate and antepenultimate word stress. These utterances could then be used for the verification of the hypothesis in an experimental setting. The recording of these utterances was carried out in Moscow and St. Petersburg. The recordings were made on a Marantz CDR300 digital CD-recorder with a Sony electret stereo directional microphone.

Ten sets of three short utterances were composed in which a realization of test accents LH*L and LH* was appropriate in the utterance-final word. Per set, there were three different utterance-final words with different stress position: ultimate, penultimate and antepenultimate, the other words being the same. Each of the 30 utterances was presented on a separate card with the text of the utterances without punctuation marks in the Cyrillic alphabet, preceded by a number. Utterance-final words to be realized by native speakers with one of the two accents were underlined. An example is the following set of three utterances in transliteration with English translation:

- 11 *oná priédet na bal* 'she will come to the ball'
 12 *oná priédet na Páskhu* 'she will come at Easter'
 13 *oná priédet na kaníkuly* 'she will come on holiday'

The utterances had first been verified and tested by reading them aloud as to naturalness and correctness. The semantically neutral character was

also checked, as utterances with an emotional load were expected to influence the reading style. Two native linguists carried out this test and accepted the 10 sets. In order to have speakers concentrate on the melody only, one set of utterances consisted of reiterant speech in which the prosody is expected to be preserved (Nakatani and Schaffer, 1978): sequences of the syllable *ma*. The three word stress positions of the underlined last word on these cards were indicated with a stress marker: *má, máma, mámama*. Since the three cards with reiterant speech were read in one set with 27 other utterances with real words having more or less the same number of syllables, speakers had no problems in reading sequences of the syllable *ma* with the same prosodic structure.

The utterances were recorded in two sessions, one session for each type of pitch accent. In order to avoid confusion there were good breaks between the two sessions. Before recording, the 30 cards were shuffled and utterances thus appeared in a random order. As a guarantee that only the desired types of pitch accent were realized, detailed instructions with audio-examples were presented before each session and utterances were rehearsed before the actual production. In addition to the melodic information, the two accents were further specified with their possible interpretation: "yes/no question" for type LH*L and "the announcement of a soon following final accent" for type LH*. List intonation was avoided by asking speakers to read aloud the number preceding each utterance. Speakers were asked to repeat unsatisfactory (in their opinion) realizations, clearly indicating a rejected realization by saying *povtoriaiu* 'I repeat'. In the first session they read the 30 cards with a realization of type LH*L in the utterance-final word; in the second session, after the break,

they read the 30 cards with a realization of type LH*.

Eight experienced speakers, linguist-phoneticians in Moscow and St. Petersburg between 20

and 80 years of age, performed the task: four female speakers from St. Petersburg, two male speakers from Moscow and two male speakers from St. Petersburg. Not all speakers had lived

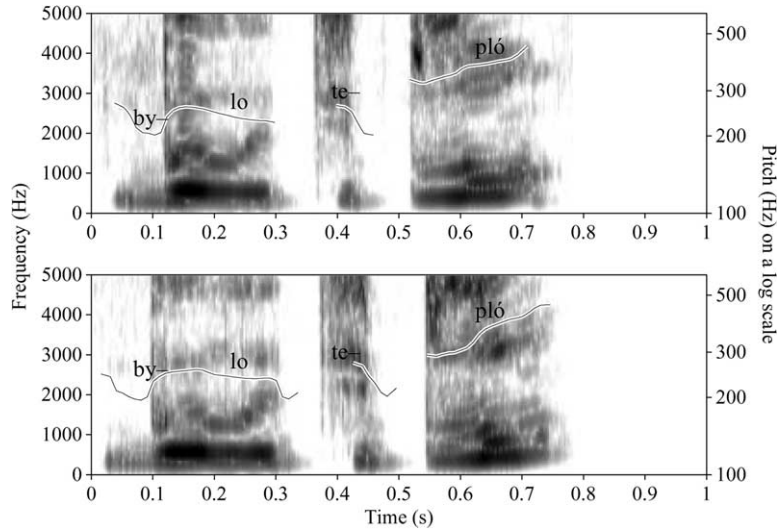


Fig. 2. Spectrogram and pitch contour on a logarithmic scale of the utterance *býlo tepló* '(it) was warm' realized by the same female speaker with pitch accents LH* (top) and LH*L (bottom; LH*L being slightly higher than the LH* realization) in the word *tepló* 'warm' in utterance-final position.

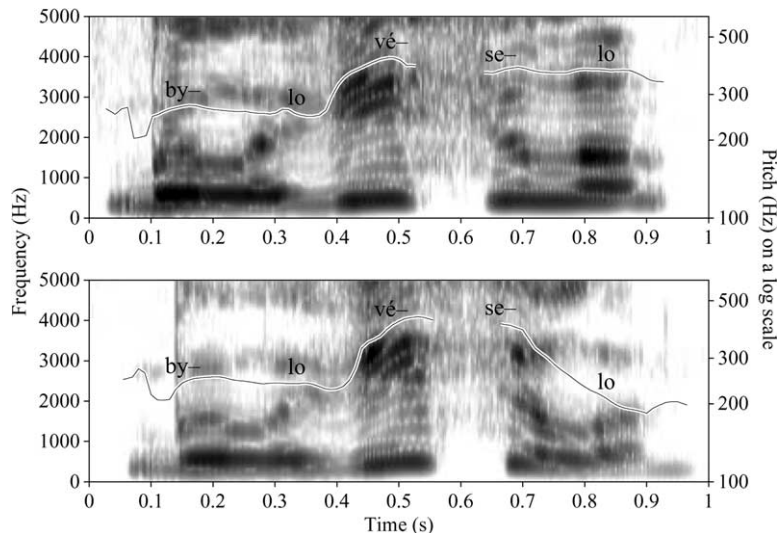


Fig. 3. Spectrogram and pitch contour on a logarithmic scale of the utterance *býlo vésele* '(it) was fun' realized by the same female speaker with pitch accents LH* (top) and LH*L (bottom) in the word *vésele* 'fun' with high (LH*) and low (LH*L) posttonic part in utterance-final position.

their whole life in the respective cities. During recording, no hesitations while reading the utterances occurred.

I listened carefully to the realizations of same pitch accents in utterance-final words and judged that perceptual differences between them could be ascribed to the idiosyncrasy of speakers without affecting the relevant features of the pitch accents. In Figs. 2 and 3, spectrograms and pitch contours of representative realizations are shown of one female speaker pronouncing utterances with words in utterance-final position with ultimate (Fig. 2) and antepenultimate (Fig. 3) stress position.⁵

4. Perception experiment

The perception experiment was conducted to verify the hypothesis that types LH*L and LH* occurring on utterance-final syllables are neutralized. Listeners fulfilled a paired-comparison task; pairs consisted of two stimuli containing realizations either of the same pitch accent or of different pitch accents. Utterances for the stimuli pairs were selected from the recordings described in Section 3. The perception experiment consisted of 180 pairs and 30 native listeners carried out the task.

4.1. Stimuli, instructions, listeners

There were 180 stimuli pairs: 120 pairs with ultimate stress (henceforth: u-pairs) and 60 pairs with penultimate and antepenultimate word stress in utterance-final position (henceforth: pa-pairs). The 120 u-pairs served to verify the hypothesis, the 60 pa-pairs as a control to test how well native listeners hear the difference between types LH*L and LH*. Two members of each pair were realized by two different female speakers, two different male speakers, or by one female and one male speaker.

The 120 u-pairs with ultimate stress consisted of stimuli as presented in Table 1. Twelve of the 120 u-pairs were in reiterant speech. The 60 pa-pairs

having word stress in the penultimate and antepenultimate syllable of the utterance-final word had the composition presented in Table 2. Six of the 60 pa-pairs were in reiterant speech. The 180 stimuli pairs were randomized and, with preceding numbers 1–180 read aloud, recorded onto an audio CD. Listeners were not supplied with the text of the clearly pronounced utterances; they were informed that there were also stimuli pairs in reiterant speech.

Before the actual experiment, listeners received written instructions with examples in which their task was explained: they were asked to listen to the pitch accent in the utterance-final words of each pair and to indicate whether the stimuli realized in a given pair were successful imitations of one another, and thus perceptually equivalent and belonging to the same type of pitch accent. This type of task was considered possible using two different speakers in one stimulus pair. The instructions were considered to be clear enough to prevent subjects from listening too analytically and concentrating on non-linguistically relevant differences.

In order to rehearse the task, 10 test pairs were presented, six of which were pairs with pitch accents on utterance-final syllables. After instructions and the practice session, participants were given the opportunity to ask questions. Although they were linguists, not all listeners were familiar with the term *tonal'nyi aktsent* 'pitch accent' used in the instructions, since the term is rarely used in the Russian literature. I therefore used the more common *frazovoe ili melodicheskoe udarenie* 'sentence or melodic accent' to explain the unfamiliar term.

On the audio CD, the 180 stimuli pairs were played in one run, each pair sounding once, so there was no possibility for repeated listening. The CD was played on a portable CD player through loudspeakers of good quality, or, if carried out individually, through headphones of good quality. On a scoreform, after the number of the given stimulus pair, listeners had to circle the letter S (*skhodnaia (para)* 'same (pair)') or N (*neskhodnaia(para)* 'different (pair)') within three seconds. The total duration of the experiment was 25 minutes.

⁵ The pictures are made using PRAAT version 4.3.16 (Boersma and Weenink, 2005).

Table 1
Composition of the 120 u-pairs for the perception experiment

Stress position	120 u-pairs		
	Ultimate		
Speakers pair	Female–female	Male–male	Female–male/male–female
Type LH* vs LH*	10 pairs	10 pairs	10 pairs
Type LH*L vs LH*L	10 pairs	10 pairs	10 pairs
Type LH* vs LH*L	10 pairs	10 pairs	10 pairs
Type LH*L vs LH*	10 pairs	10 pairs	10 pairs

Table 2
Composition of the 60 pa-pairs for the perception experiment

Stress position	60 pa-pairs					
	Penultimate			Antepenultimate		
Speakers pair	Female–female	Male–male	Female–male	Female–female	Male–male	Female–male
Type LH* vs LH*	3 pairs	3 pairs	3 pairs	2 pairs	2 pairs	2 pairs
Type LH*L vs LH*L	2 pairs	2 pairs	2 pairs	3 pairs	3 pairs	3 pairs
Type LH* vs LH*L or Type LH*L vs LH*	5 pairs	5 pairs	5 pairs	5 pairs	5 pairs	5 pairs

Thirty listeners fulfilled the task, 17 in Moscow (12 female and five male) and 13 in St. Petersburg (11 female and two male); all listeners were linguists between 20 and 80 years of age. Three listeners also participated in the recording task described in Section 3. The period between the recording and the experiment was three months.

4.2. Results

The results of the perception experiment are expressed in percentages and can be found in Figs. 4–6. The columns present the percentages of pairs indicated on the score form with the letter S (*skhodnaia (para)* ‘same (pair)’), that is, two members of a pair were perceived by the listeners as successful imitations of one another, and thus were perceptually equivalent realizations belonging to the same type of pitch accent. In the figures, exact percentages are indicated above the columns.

Fig. 4 presents the results in percentages of the 30 native listeners for the 120 stimuli pairs with utterance-final words having ultimate stress. Responses to the three stimulus types, that is, pairs with only type LH*, pairs with types LH*L vs

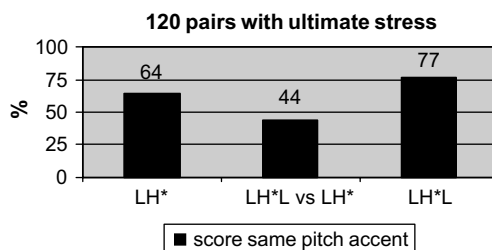


Fig. 4. Results in percentages of pairs indicated by 30 native listeners as realizations of the same pitch accent for 120 stimuli pairs with words in utterance-final position having ultimate stress.

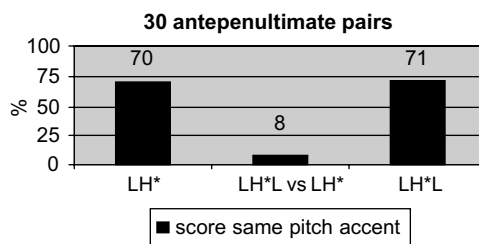


Fig. 5. Results in percentages of pairs indicated by 30 native listeners as realizations of the same pitch accent for 30 stimuli pairs with words in utterance-final position having antepenultimate stress.

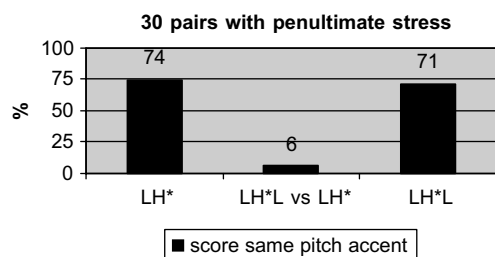


Fig. 6. Results in percentages of pairs indicated by 30 native listeners as realizations of the same pitch accent for 30 stimuli pairs with words in utterance-final position having penultimate stress.

LH*, and pairs with only type LH*L, differed significantly from each other as follows:

- only type LH* and types LH* vs LH*L: $\chi^2 = 98.44$, $df = 1$, $p < 0.001$;
- only type LH*L and types LH* vs LH*L: $\chi^2 = 268.44$, $df = 1$, $p < 0.001$;
- only type LH* and only type LH*L: $\chi^2 = 36.18$, $df = 1$, $p < 0.001$.

The results for the 12 pairs in reiterant speech were not significantly different from the other 108 pairs in real speech: according to the Student-*t* test for two samples, $t = 0.05982$, $df = 118$, $p \geq 0.05$. This issue will not further be dealt with.

Figs. 5 and 6 give the results in percentages for the 30 stimuli pairs with utterance-final words having antepenultimate and penultimate stress, respectively. Responses to the three stimulus types for the 60 pa-pairs taken together differed significantly from each other as follows:

- only type LH* and type LH* vs LH*L: $\chi^2 = 598.55$, $df = 1$, $p < 0.001$;
- only type LH*L and type LH* vs LH*L: $\chi^2 = 559.04$, $df = 1$, $p < 0.001$.

Only type LH* and only type LH*L do not differ significantly for pa-pairs: $\chi^2 = 0.05$, $df = 1$, $p \geq 0.05$.

Whether a pair had antepenultimate or penultimate stress had no effect on the responses: not significantly different are responses to pairs with

types LH* vs LH*L with penultimate and antepenultimate stress ($\chi^2 = 1.47$, $df = 1$, $p \geq 0.05$) and responses to pairs with only type LH* with penultimate and antepenultimate stress ($\chi^2 = 0.86$, $df = 1$, $p \geq 0.05$).

5. Discussion and conclusion

The results presented in Fig. 4 clearly show that pitch accents LH*L and LH* on utterance-final syllables are not neutralized and the hypothesis must be rejected. In this position, there is a significant difference between pairs with LH*L vs LH*L and LH* vs LH* on the one hand, and pairs with LH* vs LH*L on the other (see Section 4.2). Scores for the latter pairs are almost at chance level. If there were neutralization of the contrast between the two accents, the middle bar in Fig. 4 would have been at least as high as the other two bars with percentages for same accents. It must thus be concluded, that on utterance-final syllables truncation occurs: the posttonic part of the pitch configuration is “cut off” (see Section 1).

Though not systematically, an audible difference in the pretonic syllables, viz. a higher pitch level, was observed between realizations of accents LH* and LH*L in utterance-final words with ultimate stress when pronounced by the four female speakers. Indeed, by looking at the pictures of the pitch measurements for stimuli pairs with two realizations of LH*L pronounced by female speakers, I found that the usually abrupt rising pitch movement of type LH*L may start from a higher pitch level than the rising pitch movement of LH*. An example is presented in Figs. 7 and 8: accents LH* and LH*L both realized in the utterance *býlo tepló* ‘(it) was warm’ by a female speaker, in Fig. 7 with spectrogram, in Fig. 8 printed on top of each other. It is clearly visible that in the syllables preceding accent LH*L, pitch is realized at a higher level than in the syllables preceding accent LH*. Also, the highest pitch level measured in the voiced part of the syllable *-pló* in accent LH*L is realized higher and reached earlier (from 310 Hz to 465 Hz in 160 ms) than in accent LH* (from 200 to 430 Hz in 280 ms). One would then expect that the difference between LH* and

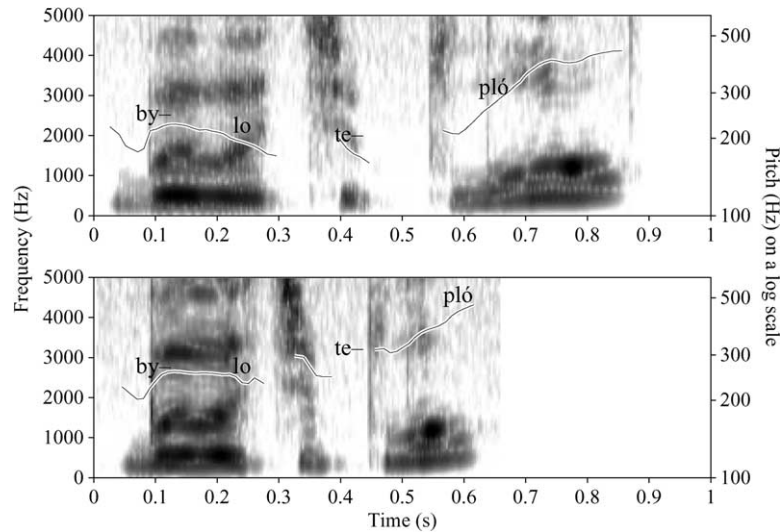


Fig. 7. Spectrogram and pitch contour on a logarithmic scale of the utterance *bylo tepló* '(it) was warm' realized by the same female speaker with pitch accents LH* (top) and LH*L (bottom) in the word *tepló* 'warm' in utterance-final position with ultimate word stress. The highest point in the realization of type LH*L is higher and reached earlier than in type LH*. See also Fig. 8.

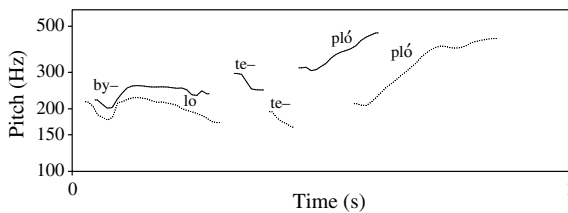


Fig. 8. On a logarithmic scale, on top of each other, pitch contours are presented of the utterance *bylo tepló* '(it) was warm' realized by the same female speaker as in Fig. 7 with pitch accents LH* (dotted line) and LH*L (plain line) in the word *tepló* 'warm' in utterance-final position with ultimate word stress. The highest point in the realization of type LH*L is higher and reached earlier than in type LH*. See also Fig. 7.

LH*L in stimuli pairs realized by two female speakers also scores higher. However, this is not confirmed by the results: 44% of the pairs with different accents pronounced by two female speakers were indicated as having the same accent, the same percentage as for two male speakers and for "mixed" pairs. It cannot be concluded that a higher pretonic part is an indication for a following realization of accent LH*L and is thus a phonetic feature of the type. This observation is evidence against complete neutralization, but even though not representing a systematic phenomenon, the

example described does also not support a straightforward truncation account.

The results for the 60 pa-stimuli pairs are presented in Figs. 5 and 6. In antepenultimate and penultimate stress position, listeners have a post-tonic part to hear the distinction between the two accents and can keep them apart. There was no significant difference between stimulus pairs with words having antepenultimate or penultimate stress in the utterance-final word (see Section 4.2). It can thus be concluded that listeners can discriminate quite well between types LH*L and LH* in both stress positions.

As an examination of Fig. 4 shows, there was a statistically significant difference between u-pairs with same pitch accents, LH* vs LH* or LH*L vs LH*L; between pa-pairs with same pitch accents the difference is statistically not significant (see Section 4.2).

Summarizing, from the results presented in Figs. 4–6 it can be concluded that there is no neutralization of Russian pitch accents LH*L and LH* realized on utterance-final syllables, contrary to the suggestion in Odé (1989, p. 105) the accents are truncated. This was also suggested by Igarashi (2002), who interpreted the phenomenon as truncation, but without experimental evidence.

The issue discussed in this article is important for the development of symbols for ToRI, a new manual Transcription of Russian Intonation. In ToRI, types of pitch accent according to Odé (1989) will be translated into unambiguous symbols expressing form and contextual function. Inspired by ToDI (Gussenhoven et al., 2003; Gussenhoven, 2005), the aim of ToRI is to produce an interactive research tool and learning module on the Internet. For a detailed description of ToRI the reader is referred to Odé (2003). For the development of a complete set of symbols for all Russian types of pitch accent, the present question had to be answered: is the contrast between Russian pitch accents LH*L and LH* neutralized or are the accents truncated on utterance-final syllables? This article has presented the answer. In the ToRI system, a set of pronunciation rules will be defined by time and fundamental frequency parameters that describe the actual realizations of Russian pitch phenomena, thus presenting the phonetic correlates of the symbols with phonetic specifications in average values. In ToRI it will be explicitly indicated that types LH* and LH*L are truncated on utterance-final syllables, and a pronunciation rule for the truncation phenomenon discussed in this article will be formulated.

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