

Are Pitch Contour and Quantity Independent Distinctive Features in Bosnian Serbian?

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Petra Wagner and Jelena Mandić

pwa@ikp.uni-bonn.de

This study investigates the independent phonological status of tonal and quantity contrasts in Bosnian Serbian, a Southern Slavic pitch accent language. Accents in Bosnian Serbian are characterised by falling vs. rising contours and long and short quantity, leading to four different accent types. Previous research suggests that pure tonal contrasts are hard to be distinguished on acoustic and perceptual grounds and may lose its distinctive function in Bosnian Serbian. However, our perception study shows that listeners are well able to distinguish between minimal pairs built upon pure tonal contrasts. In direct comparison, quantity is the more robust feature but quality contrasts are identified in the vast majority of cases.

1 Introduction

Bosnian Serbian¹ is a pitch accent language. Traditional grammars [9] distinguish four accent types: short falling, short rising, long falling, long rising. This system indicates an independent function of both quantity and the pitch contour within the phonetic and possibly also phonological system of the language. However, these distinctions are not marked in the orthography leading to the presence of many homographs. On the basis of this distinction, many prosodic minimal pairs can be identified, but there exist some doubts as to whether listeners are indeed able to differentiate meanings on the basis of these four accent types. I.e., the phonological

¹ The studies quoted in this paper are based on Serbo-Croatian. Nowadays, distinctions between a Serbian and Croatian language are felt to be necessary. Since this study was based on speakers of Serbian within Bosnia, we adopt the term Bosnian Serbian for the language under examination. The former standard Serbo-Croatian used the Neo-Stokavian accent system which is also actively used in Bosnian Serbian (Draga Zac, 2005, personal communication). Therefore, we rely on these earlier studies as a theoretical starting point.

status of these prosodic minimal pairs as true phonological minimal pairs is unclear.

2 The Accent System of Bosnian Serbian

The shape of the pitch accents in Bosnian Serbian is meaning distinctive. Unlike pure tone languages, however, tone placement is limited to certain syllables within the word. In Bosnian Serbian, the pitch accent is realised on the syllable carrying lexical stress. Thus, it can be described as a pitch accent language like Japanese or Swedish [7]. Accents are not represented in the orthography of the language, but they are represented in grammatical descriptions. Traditional descriptive grammars differentiate between four accents²

- short falling accent: \
- short rising accent: /
- long falling accent: \:
- long rising accent: /:

Within this system, quantity (short vs. long) and tone contour (rising vs. falling) appear to be independent distinctive features since there are no combinatorial restrictions: any contour can be combined with any quantity. There are some distributional restrictions concerning the placement of the different accent types (cf. Table 1). On monosyllabic words, only falling accents may occur. Apart from monosyllabic words, accents never occur on the ultimate syllable. Falling accents as well as rising accents can only occur on the first syllable of a word, other syllables may only carry rising accents. This restricts the slot for pure tonal contrasts on the first syllable of a lexical item, whereas quantity contrasts may occur almost everywhere and thus possess a high functional load. This circumstance may be regarded as support for the hypothesis that quantity contrasts are more stable than tonal contrasts in Bosnian Serbian.

² In order to simplify the transcription, rising accents are marked with [/] and falling ones with [\], quantity is transcribed in accordance with the SAMPA style using [:]. This approach differs from the standard notation in Serbo-Croatian grammars, where the following symbols are used: short falling [``], short rising: [^], long falling: [~] long rising: [^]

word length	1st syll	2nd syll	3rd syll	4th syll	5th syll
1 syll.	\, \:				
2 syll.	\, \:, /, /:	/, /:			
3 syll.	\, \:, /, /:	/, /:	/, /:		
4 syll.	\, \:, /, /:	/, /:	/, /:	/, /:	
5 syll.	\, \:, /, /:	/, /:	/, /:	/, /:	/, /:

Table 1: Distributional constraints for pitch accent placement in Bosnian Serbian.

The acoustic phonetic shape of the rising and falling accents looks very similar. In their extensive studies, [3, 4, 5, 6] collected many insights about the phonetic realisation of Serbo-Croatian pitch accents (cf. Table 2).

Altogether, tonal contrasts, especially those on short accents, appear to be hardly distinguishable on purely phonetic grounds. Figure 1 gives an example of a prosodic minimal pair based on a short rising vs. a short falling accent. It becomes clear, that the "rising" accent does not show a significant rise but rather a level intonation contour on the stressed syllable which contrasts with the falling contour of the falling accent. Also, the second syllable shows a falling contour in both words, even though it may look somewhat steeper in the case of the falling syllable. These circumstances lead [2] to the conclusion that tonal contrasts are about to lose their distinctiveness.

In their later studies from 1963-1986, Lehiste and Ivić postulate that the primary distinction between falling and rising accents lies in the fundamental frequency of the syllable following the accented syllable. According to them, a robust phonological distinction between falling and rising syllables demands phonological quantity. This argumentation would lead to an accent system distinguishing between short, long falling and long rising accents.

The fact that falling and rising accents are phonetically almost alike is further complicated by the complex interaction between lexical and utterance intonation: If the word accent interacts with the sentence intonation, the accents can be altered in such a way that the melodic oppositions vanish [6]. This again puts into question the phonological status of the pitch accent shape.

Also [1] come to the conclusion that in fluent speech speech, only quantity leads to robust phonemic contrast between words. In fluent speech, contrasts on pitch accents may be neutralised by the superimposed phrasal

	rising	falling
general properties	<ul style="list-style-type: none"> • lower peaks 	<ul style="list-style-type: none"> • mid-syllabic peak • higher peaks
short	<ul style="list-style-type: none"> • <i>peak in accented syllable</i> 	<ul style="list-style-type: none"> • <i>no consistent fall after peak</i> • <i>low subsequent syllable</i>
long	<ul style="list-style-type: none"> • peak at the end of accented or in subsequent syllable • higher following syllable 	<ul style="list-style-type: none"> • steep fall after peak

Table 2: Phonetic realisation of pitch accents in Bosnian Serbian. Prosodic contrasts which are phonetically similar are marked in italics.

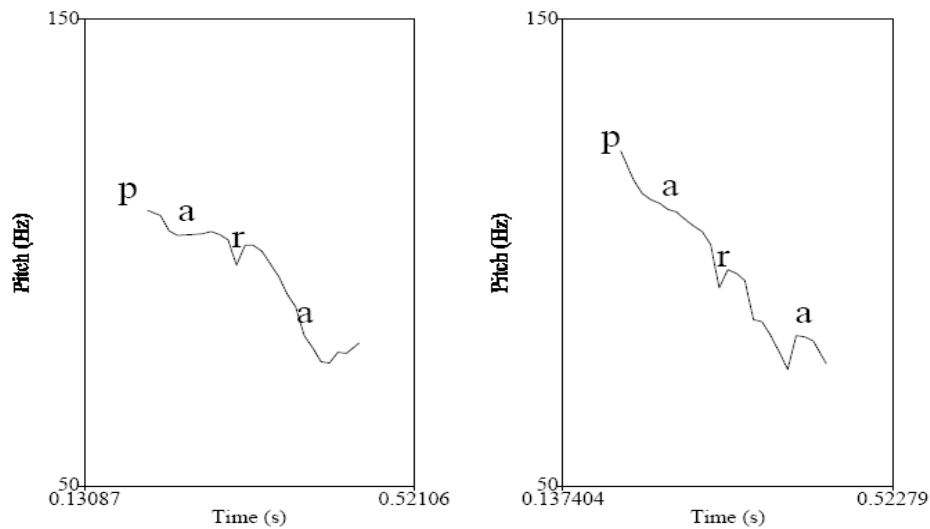


Figure 1: The minimal pair /para/ with a short rising tone (left: "money") and a short falling tone (right: "steam") on the first syllable.

accents. In these cases, tonal contrasts can only be perceived if the listeners are provided with additional contextual information. If this is correct in the majority of cases, the phonological status of rising and falling accents could be to an allophonic one.

[8] notices that contrary to tonal contrasts, quantity contrasts keep stable in an utterance environment.

Summing up, the phonetic evidence seems to support the hypothesis that pure tonal contrasts are not phonemic any more or are about to lose their meaning distinctive function in Bosnian Serbian, because

- True tonal contrasts occur in few environments, thus possessing low functional load
- Tonal contrasts are phonetically subtle and can be neutralised by utterance intonation
- Quantity contrasts are frequent and resistant against neutralisation

Maybe, the phonological system of Bosnian Serbian nowadays distinguishes only two accents (long vs. short) with allophonic tonal variations. If this were the case, tonal variation alone is not meaning distinctive any longer [1].

3 The Perception Study

On the basis of the previous studies, a perception experiment was carried out. In the perception experiment, native listeners were asked to identify the meaning of isolated words. Each word was one part of a prosodic minimal pair. We included the following types of prosodic contrasts:

- Tonal contrasts
 - Tonal contrasts on short syllables (short rising vs. short falling)
 - Tonal contrasts on long syllables (long rising vs. long falling)
- Quantity contrasts (e.g. long rising vs. short rising)
- Complex contrasts (e.g. long rising vs. short falling)

The tested hypotheses were the following ones:

- H1: Pure quantity contrasts are most robust - minimal pairs such as long falling vs. short falling should be clearly identifiable by the vast majority of listeners
- H2: Minimal pairs with a quantity plus tonal contrast such as long falling vs. short rising should be clearly distinguished
- H3: Pure tonal contrast should be less robust leading to frequent confusion of minimal pairs.
- H4: Tonal contrasts on short syllables should be the most difficult to be identified by listeners. These kind of minimal pairs are the most likely candidates for having become homonymns.

3.1 Data Preparation

It was decided to use only minimal pairs that fulfilled the criteria of being naturally occurring and well-known by a majority of native speakers. In order to guarantee this, a list of 78 pairs of homographs was presented to a group of 40 native speakers. Whenever a speaker considered a word on the list as unknown or highly infrequent in usage, it was deleted from the list. That way, the list was reduced to 34 prosodic minimal pairs. The native judges did not participate in the subsequent study. The following types of minimal pairs were gathered:

- Tonal contrasts: n=13

- Quantity contrasts: n=12
- Complex contrasts: n=9

The words were digitally recorded in isolation in an anechoic chamber by a native male speaker born and raised in Bosnia who has been a resident of Germany for more than 30 years. This procedure did not prevent any interaction with phrasal stress, though. The recordings were checked for correct pronunciation by three native speakers. In follow-up experiments, experimental data should also be checked for the phonetic realisation of the accent type. We only checked the pronunciation by phonetically naive listeners. A more refined analysis might have paid attention to a correct pronunciation of each accent type. Thus, we cannot be sure for our data that the speaker did indeed produce prototypical contours and quantities. We only took care that his productions were acknowledged as correct by other listeners.

3.2 The Perception Study

The words were presented to two listener groups. Listener group 1 (n=6) consisted of people living in Bosnia without any L2 competence and listener group 2 (n=12) consisted of long-term residents in Germany (> 10 years). The second group has a very good or near native competence in German. Some of the speakers in the second group consider themselves as being bilingual. Since German has phonemic quantity and is not a pitch accent language, it is expected, that the second group ought to be particularly sensitive for quantity contrasts and maybe less proficient in the detection of tonal contrasts.

The stimuli were presented to the subjects with the help of a simple GUI. The subjects listened to each word on the list via headphones after clicking a button. The listeners were allowed to listen to each stimulus several times. After listening to the stimulus, the subject was asked to type the German translation into a form presented next to the sound button. This procedure was necessary because accents are not represented in the Bosnian orthography. Since listeners in group 1 were not familiar with German, they were asked to make up a meaningful sentence where the word would fit in particularly well. The translation or contextual embedding yielded whether or not the word was identified "correctly" or not. Listeners were informed that words may occur more than once but do not have to. That way, it was made sure that subjects were not biased against giving the same answer twice. Also, they were informed that the list contained 68 words and that

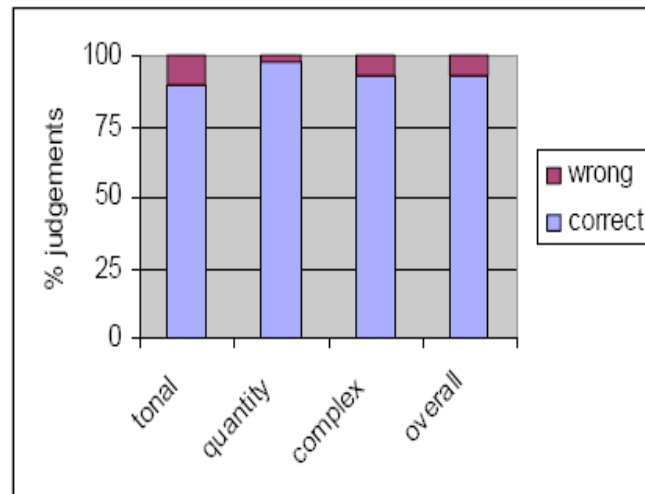


Figure 2: Results for the different contrast types

the words could be proper names, nouns, adverbs, adjectives, verbs and inflected forms. No further help or information was given. During the experiment, it was written down whether the subject hesitated or needed several repetitions to receive at an answer.

3.3 Results and Discussion

The following answers were given:

- 11 times, listeners claimed not to know/understand a word
- 1213 judgements
- 82 errors, overall error rate: 6.76%
- Tonal contrasts: 464 judgements, 48 errors (10.34%)
- Quantity contrasts: 425 judgements, 10 errors (2.35%)
- Complex contrasts: 324 judgements, 24 errors (7.4%)

The overall error rate was very low (6.76%), which strengthens the assumption that accent type in Bosnian Serbian is phonologically distinctive. The lowest error rate can be found for the quantity contrasts (2.35%). Compared with the other types of minimal pairs, subjects performed significantly better in pure quantity contrasts (χ^2 , $p < 0.001$). Against our

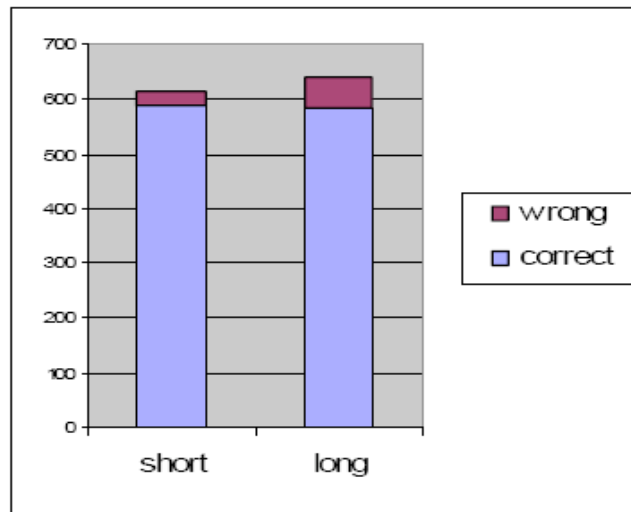


Figure 3: Results of short and long tonal contrast in comparison (total numbers)

expectations (H2), a higher error rate was found for the combined quantity and quality contrasts (7.4%) and the highest one - as expected - for the pure melodic contrasts (10.34%). There was no significant difference between the performance between pure tonal contrasts and complex tonal contrasts, where listeners could use quantity and tone in order to differentiate meanings. Also, no significant difference in performance could be found between subjects living in Germany and those living in Bosnia. However, it should be noted that the German residents were less secure and showed more hesitations during the perception study. In many cases, listener group 2 said that they were guessing rather than knowing. Overall error rates are illustrated in Figure 2. Despite the higher error rates, the subjects' performance is still good enough to assume that tonal minimal pairs are still valid phonological minimal pairs. In order to answer the doubtful status of short tonal contrasts, it was statistically tested, whether listeners made more errors on short tonal contrasts compared to long tonal contrasts. Results show, that even the opposite is the case: listeners performed better at identifying the words where the tonal contrast lies on a short syllable ($\chi^2, p < 0.05$; cf. Figure 3). With regard to our hypotheses H1-H4, these results can be interpreted in the following way:

- Quantity contrasts are very well identifiable (H1 confirmed)
- Tone/quantity interaction reduces identifiability rather than enhances it, so the expectation, that distinguish complex contrasts as well as

pure quantity contrasts, was wrong (H2 rejected)

- Tonal contrasts are the least reliable (H3 partly confirmed), but still identifiable in the vast majority of cases (H3 partly rejected)
- Tonal contrasts on short syllables are identified even better than tonal contrasts on long syllables (H4 rejected)

4 Conclusion

The results clearly support the traditional view that quantity and pitch contour are independent meaning distinctive features in Bosnian Serbian. Results are also in accordance with previous findings: quantity is the more robust phonological feature of the two. However, listeners are far from lost in those cases where pure tonal contrasts are involved. Obviously, they are still able to differentiate between the two, even if the tonal contrasts are realised on short syllables and hardly distinguishable from a phonetic point of view. It is well possible, that so far, experimental phonetic research has concentrated on the wrong parameters and that listeners use different cues. Still, it must be noted that listeners' performance is worse if a tonal contrast is involved. This even is the case of the complex contrasts, where the presence of a tonal contrast decreases performance despite the fact that listeners can use quantity as an additional auditory cue to differentiate the meaning of the words. Obviously, tonal contrasts make listeners less confident, leading to comparatively more wrong answers. This may be due to the fact the tonal contrasts are less reliable and can often be neutralised. However, error rates for pure tonal contrasts very low for both listener groups. This clearly indicates that tonal contrast is still actively used and perceived in contemporary Bosnian Serbian and can be regarded as a distinctive feature that is independent of quantity.

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