0. Introduction
An important issue in phonology is that of the extent to which the existence vs. lack of a given phonological contrast conditions the application of cross-linguistics tendencies. For instance: are vowels in contact with nasal consonants nasalized to different degrees depending on whether the language possesses or does not possess a phonological contrast between oral and nasalized vowels? (see Cohn 1993); does stress-induced lengthening operate differently in languages with and without contrastive vowel length?

In this paper we examine another case of this type: accentual peak alignment in languages with and without a lexical contrast. For a number of European stress languages it has been noted that nonfinal accentual peaks are aligned earlier under narrow focus than in neutral contexts. That is, peak alignment has a pragmatic function. Under our analysis, Serbo-Croatian is a language where peak alignment is a contrastive lexical feature (i.e. in some words the accentual peak occurs early with respect to the accented syllable and in other words it occurs late, in a lexically contrastive fashion). There are, however, some Serbo-Croatian dialects that lack this lexical contrast altogether. A comparison of both types of Serbo-Croatian dialects should then allow us to investigate the degree to which lexical specifications constraint cross-linguistic pragmatic tendencies in this respect.

1. Serbo-Croatian accentuation
Serbo-Croatian is often mentioned as an example of pitch-accent language. Traditional descriptions of Standard Serbo-Croatian distinguish four types of accent: long rise, short rise, long fall and short fall, as illustrated in (1). These accents are diacritically indicated in some dictionaries and other reference works (e.g. Benson 1971):

(1) The four accents of Serbo-Croatian
   Long rising accent: jéla ‘pine tree’, Péro ‘Peter’,
   Short rising accent: pèro ‘quill’, dòbra ‘good, fem.’
   Long falling accent: drâga ‘dear, fem.’

The long vs. short distinction is clearly due to a lexical contrast in vowel length, which is an independent property of the phonological system of the language, since it is found both in accented and in unaccented syllables (as noted in Browne
and McCawley 1973[1965]). Strictly speaking, then, there is a binary accentual contrast: rise (R) vs. fall (F), which, depending on whether it is realized on a long or a short vowel will result in a ‘long accent’ or in a ‘short accent’. In this paper, we adopt the view that Serbo-Croatian is fundamentally a stress-language. What makes Serbo-Croatian—or, rather, certain Serbo-Croatian dialects—different from other stress languages it the fact that is has a superimposed lexical contrast in the alignment of pitch-contours. Serbo-Croatian belong, thus, in the same typological category as Swedish (as analyzed in Bruce 1999) and has little in common with other languages like Tokyo Japanese (Pierrehumbert and Beckman 1988) and Western Basque (Hualde 1999, Hualde et al. 2000) to which the label “pitch-accent language” has also been applied. The four-way accentual contrast illustrated in (1) has then three basic ingredients:

1. Lexical stress. All major category words have stress on one of their syllables. The most general pattern is initial stress: *j’ezero* (F) ‘lake’, *z’a:stava* (F) ‘flag’, *r’a:zlika* (R) ‘difference’, *p’aprika* (R) ‘pepper’, *običaj* (F) ‘custom’, *običajima* (F) ‘custom, INSTpl’, *n’astavak* (R) ‘extension’, *r’a:spusni:štvo* (R) ‘debauchery’. Stress is phonologically contrastive because quite a few words have stress on a non-initial syllable. The second most common pattern is stress on the second syllable: *ban’a:na, im’a:nje* ‘estate’, *lak’oča* ‘lightness’, *lakočama* ‘lightness, GENpl’, *men’i* ‘menu’. Less commonly, stress on the third syllable is also found: *artilj’erija* ‘artillery’, *rezol’uccija* ‘resolution’, *rastoj’anje* ‘distance’, *asist’ent* ‘assistant’, *asist’entima* ‘assistant, INSTpl’, *salmon’ela* ‘salmonella’. From a synchronic point of view, the position of the stress does not appear to be predictable.

2. Vowel duration. Vowels can be either short or long phonologically. As mentioned (and shown in some of the examples above), the distinction is found in both stressed and unstressed syllables (although duration is also an important correlate of stress, Lehiste and Ivić 1986). A restriction, however, is that the first long vowel in the word must bear the stress. In other words, there is no vowel length contrast in pretonic position. (An algorithm that would account for the unmarked stress pattern would be “stress the leftmost syllable with a long vowel, otherwise the leftmost in the word”)

3. Early vs. late tonal peak alignment (= Falling accent vs. Rising accent). This contrast is made only in words with initial stress (which, as just mentioned, constitute the majority class). When placed in a position in the utterance where they receive a pitch-accent (in the sense of Pierrehumbert 1980, Ladd 1996, etc.) some words consistently show an early peak, within the stressed syllable, and some other words consistently show a late peak, on the posttonic syllable.

Rather similar differences in peak alignment have been shown to have a pragmatic function in other stress languages. In Spanish, for instance, prenuclear accents typically show a rise over the stressed syllable with the peak on the posttonic; but the peak coincides with the stressed syllable if the word is given narrow focus (Mota 1995, 1997, Face 2000, Nibert 2000, Hualde 2000, among
others). Thus in a neutral declarative sentence such as *le pidiéron el número* ‘they asked him/her for the number’ the word *pidiéron* will typically show a rise starting at the beginning of the stressed syllable –*dié*- and the accentual peak will coincide with the posttonic syllable –*ron*. If on the other hand, this sentence is uttered with contrastive focus on *pidiéron*, the peak will be reached within the tonic syllable and the pitch will fall on the posttonic. Very similar patterns have also been described for Greek (Botinis 1998) and other languages.

In Serbo-Croatian, on the other hand, the position of the peak with respect to the stressed vowel is a lexically-contrastive feature of words. Early peak (within the stressed syllable) is what is traditionally referred to as falling accent and late peak (on the posttonic) is called rising accent. Synchronically, accent-class is an unpredictable feature of words with initial stress. Thus, for instance, *z’a:stava* and *j’ezero* are realized with Falling accent (= early peak) and *r’a:zlika* and *p’aprika* are realized with Rising accent (= late peak, on the posttonic). (We adopt these examples from Inkelas and Zec 1988, whose analysis we discuss below).

The origin of the Serbo-Croatian pitch-accentual contrast and the reason why it is limited to words with initial stress is found in a historical shift of the stress one syllable to the left. This shift, instead of neutralizing the distinction between words which originally had initial stress and words which originally had stress on the second and ended up with initial stress after the shift, created an opposition between two classes of words with initial stress: *papr’ika* > *p’aprika* (Rising accent) vs. *j’ezero* (original initial stress, Falling accent). The nature of this non-neutralizing stress shift is still not well understood. Leftward movement of the stress did not create new contrasts when the shift was to a non-initial syllable:

(2) The Neo-Štokavian leftward stress shift

<table>
<thead>
<tr>
<th>Stage I</th>
<th>Stage II</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 0 0 0</td>
<td>0 0 0 0  = 0 0 0 0 (no change, early peak, F)</td>
</tr>
<tr>
<td>0 0 0 o</td>
<td>0 0 0 o  &gt; 0 0 0 o (late peak, R)</td>
</tr>
<tr>
<td>0 0 0 0</td>
<td>0 0 0 o  &gt; 0 0 0 o (stress on 2nd, non-contrastive late peak)</td>
</tr>
</tbody>
</table>

2. Other analyses

Inkelas and Zec (1988) develop an analysis of Serbo-Croatian prosody which differs from ours in important respects. In their analysis, Serbo-Croatian is a language where, at the lexical, underlying, level words differ in the position to which a H tone is linked. Stress is predictable and derived by rule from the underlying distribution of H tones. Specifically, they propose derivations with two crucial, ordered, steps: (a) the H tone spreads one syllable to the left from the
syllable to which it is underlyingly linked, and (b) stress is assigned to the leftmost of two syllables linked to a H tone, or to the only syllable with a H tone after vacuous application of the first step (words like assistant, with final stress are treated as exceptions to the spread rule). The analysis is summarized and exemplified in (3). Analyses where stress is predicted from underlying tones are also proposed in Bathin (1998) and Gvozdanović (1999).

(3) Serbo-Croatian stress and accent according to Inkelas and Zec (1988)

<table>
<thead>
<tr>
<th>URs</th>
<th>/jezero paprika raazlika/</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>H</td>
</tr>
<tr>
<td>Leftward spread</td>
<td>paprika raazlika</td>
</tr>
<tr>
<td></td>
<td>\ H \ H</td>
</tr>
<tr>
<td>Stress assignment</td>
<td>* * *</td>
</tr>
<tr>
<td></td>
<td>jezero (F) paprika (R) raazlika (R)</td>
</tr>
<tr>
<td></td>
<td>H \ H \ H</td>
</tr>
</tbody>
</table>

In our opinion, there are important reasons not to adopt this or a similar analysis. These reasons are both of a theoretical and of an empirical nature:

1. Firstly, starting with the purely theoretical reasons, it introduces a considerable degree of abstraction, assuming as it does underlying representations which differ from surface forms in nontrivial ways (see Cole and Hualde 1998).

2. Secondly, from the point of view of surface, observable facts, the claim that in words with a rising accent such as p'aprika (R) both stressed and post-stress syllables are assigned a H tone does not appear to agree well with the facts. Typically, words with a Rising accent are realized with a valley on the first syllable (a L tone). Perhaps most often the L tone extends over most of the stressed syllable and the pitch does not start to rise until the end of the stressed syllable. This is also true for words with long stressed vowels (long rising accent) (see Fig 1). As proposed by God evac (1999), a L+H configuration would more closely capture the observable contours. Given this, assigning stress on the basis of the tone-to-stress rule proposed by Inkelas and Zec 1989 becomes impossible.

One reason why this analysis is empirically inadequate is that, although it mimics the historical leftward shift, it does so incorrectly by conceptualizing as tone shift what historically was a stress shift (see Bethin 1998). Bethin’s (1998:164) proposal that “stress is placed on the syllable preceding the one with high tone or on the initial syllable” appears to be more compatible with the
surface facts (but it suggests two rather different mechanisms for stress placement).

3. Thirdly, Serbo-Croatian has a process of utterance-final deaccentuation. Quite consistently, the last word in neutral declarative sentence of two or more words appears without any visible pitch-movement (as can be seen in the figures included below). Whereas it is still unknown to what degree this deaccentuation process leads to the neutralization of lexical classes, at the very least these facts would require the introduction of a further degree of abstraction from the point of view of the analysis in (3), since lexical tones would have to be deleted in certain postlexical environments after they are shifted. This and other intonational facts are handled by Inkelas and Zec (1988) by means of postlexical rules which modify lexical tonal configurations.

4. Fourthly, some Serbo-Croatian dialects have lost the Rising/Falling contrast, thereby becoming more typical stress languages. It is not clear to us how this change would be captured in the Inkelas and Zec (1988) approach (is stress underlying in the innovative dialects? how are stress and pitch contours related in these dialects?). Under our view, it is simply the case that one of two lexical contrasts has been lost. Conservative dialects have both lexical stress and, in the case of words with initial stress, a lexical contrast in the type of tonal contour that the stressed syllable may receive. Innovative dialects also have lexical stress, but the alignment of tonal contours with stressed syllables is no longer used in a lexically-contrastive manner. We hypothesize that these innovative dialects, which include the Zagreb dialect, may have very similar or even essentially the same surface pitch contours as the conservative ones, such as the Belgrade dialect, but that the choice of pitch contours will be entirely determined by pragmatics. It is to testing this hypothesis that the rest of this paper will be devoted. In particular, for several European languages it has been observed that accentual peaks are aligned earlier under narrow focus than in neutral. Our hypothesis is that dialects such as Belgrade with preserve the lexical contrast between early and late peak with minimal influence from pragmatics (as claimed by Godevac 1999), but that the innovative dialects will show similar peak alignment effects as languages like Spanish, Greek, etc. when neutral and narrow focus conditions are compared. Furthermore the difference in alignment between these two pragmatic conditions in innovative dialects may resemble that between the two lexical classes of conservative dialects.

3. The experiment
3.1 Research questions
As just stated, the purpose of this experiment is to examine the factors conditioning accentual peak placement in Serbo-Croatian dialects with and without a lexical contrast involving this feature. The dialects that are compared are Belgrade and Zagreb. Two conditions are compared: broad focus and narrow focus. We formulate two related hypotheses:
Hypothesis I: For Belgrade speakers the position of the accentual peak is a lexically-contrastive feature. The existence of this contrast will prevent the manipulation of peak placement for pragmatic purposes. Peak placement is lexically determined.

Hypothesis II: For Zagreb speakers, who do not have a lexical contrast of this type, there will be much more freedom in the position of the accentual peak. In particular, we expect that for words in non-utterance-final position in declaratives the peak will occur much earlier in neutral sentences than under narrow focus, as have been observed for other European languages. Peak placement is pragmatically determined.

3.2 Methods
Twelve sentences with target words in initial position were constructed in order to test accentual peak alignment under two pragmatic contexts (neutral declarative vs. narrow focus) in two dialects of Serbo-Croatian, Belgrade and Zagreb. All of the target words were bisyllabic nouns with initial stress. These target words include all four traditionally recognized accents (long rise, long fall, short rise, and short fall). The sentences in which these words appear have the same number of syllables and the position of the following stress was kept constant so as to avoid possible stress clash effects on peak placement. Example sentences are given below in (4) with target words in bold. The full list of the test sentences is given in the appendix.

(4)   Mára je jela bana≈nu. ‘Mara (long rise) ate a banana’
      måli je jeo bananu. ‘a kid (long fall) ate a banana’
      mäjor je jeo bananu. ‘A major (short rise) ate a banana’
      ma ma je jela bananu. ‘Mom (short fall) ate a banana’

The target word is always utterance-initial, since this is the position where pitch excursions present maximum amplitude in the language. Every sentence was produced by our subjects under two pragmatic conditions: broad focus over the whole sentence and narrow, contrastive, focus on the target word. To obtain the broad focus rendition speakers were asked to imagine producing the sentence in a context where it would all represent new information, as in answering a question such as ‘What happened this morning?’ Narrow focus was elicited by providing a context which would require contrastive focus on the target word such as ‘Who ate a banana, was it Peter?’ Every sentence was repeated three times for each of the two contexts. We thus obtained (12x3x2) 72 sentences per speaker. Four speakers participated in the experiment, all four female and in their late twenties or early thirties. These four speakers represented two dialects. Two of the speakers (SM and AD) were from Belgrade and the other two (IR and RS) were from Zagreb. Speakers were recorded onto a DAT recorder in a soundproof booth in
the Phonetics Laboratory at the University of Illinois at Urbana-Champaign. The sentences were then analyzed with Entropic ESPS/WAVES+.

Segmentation of the target syllables for the purposes of measuring peak alignment was done manually based on waveform, spectrogram, pitch track and listening. Peak alignment was measured in relation to the end of the stressed vowel giving positive measurements for the peaks placed on posttonic and negative for the peaks placed within tonic. Peak alignment across the two dialects and across the two pragmatic conditions was compared.

3.3 Results

3.3.1 Peak placement: broad focus

Figure 1 shows representative pitch contours of rising and falling accents in broad focus for one of our Belgrade speakers. Peaks in all figures with pitch tracks are labeled with H on the labeling tier:

![Pitch track for target word Mara (a name) with a long rising accent (left panel) and mali 'a child' with a long falling accent (right panel). Both produced by Belgrade speaker SM.](image)

For both Belgrade speakers there is a clear distinction in the placement of peaks corresponding to accent types. Pitch peaks are on the posttonic for the majority of phonological rising accents and within the tonic for the majority of the falling accents. The distribution of pitch peaks for our two Belgrade speakers is best seen in the scatter plots given in Figure 2. In all scatter plots, the X-axis represents peak placement in seconds with reference to the end of the stressed vowel (vertical line = syllable boundary = zero). Words with phonological rising accents are represented as triangles and words with falling accents as squares. Tokens to the left of the vertical line (negative values) correspond to accentual peaks realized within the stressed syllables and tokens to the right of the line of to peaks realized on the posttonic. The Y-axis represents vowel duration.
Figure 2. Peak placement under broad focus for two Belgrade speakers.

A pitch contour for the same target word *mali* ‘a child’ (with falling accent in the Belgrade dialect) produced by one of our Zagreb speakers is given in figure 3:
It can be seen from the pitch contour that the peak is realized on the posttonic for this word. Since this word has a ‘falling accent’ in the Belgrade dialect, this is an indication that the fall/rise lexical contrast has been lost for this Zagreb speaker. The same pattern is in fact observed for the majority of the test words in this dialect. This is further evidenced by the scatter plots given in Figure 4 where the data points are divided according to “accent type” solely for ease of comparison with the Belgrade data:

Figure 4. Peak place for two Zagreb speakers in neutral.

It can be seen that for speaker IR all of the peaks are placed after the end of the stressed syllable in this condition. There are three tokens of peaks placed on the tonic for speaker RS. However, these tokens should not be interpreted as an indication of a phonological distinction since two of them belong in fact to words with a rising accent in the Belgrade dialect.

4.2. Peak placement: narrow focus
Figure 5 shows peak distribution under narrow focus for our two Belgrade speakers:

![Figure 5. Peak placement in narrow focus for two Belgrade speakers.](image)

For Belgrade speakers, the distinction between rising and falling contours is preserved under narrow focus. As can be seen in Figures 2 and 5, in words with rising accent the majority of peaks are realized well beyond the limits of the stressed syllable for both Belgrade speakers and under both conditions. Nevertheless, it can also be observed that the peak occurs somewhat earlier, closer to the stressed syllable, under narrow focus. In words with falling accent, on the other hand, the peak occurs much earlier, almost always within the stressed syllable. For these words too, the location of the peak is earlier in the narrow focus condition.

In (5), we give the average distance in ms. from the end of stressed syllable to the accentual peak by accent type (standard deviation given in parenthesis). Negative numbers indicate realization of peak within the stressed syllable.

(5) Belgrade subjects: Peak placement.

<table>
<thead>
<tr>
<th></th>
<th>SM</th>
<th>AD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long Rise</td>
<td>86 (19)</td>
<td>64 (14)</td>
</tr>
<tr>
<td>Short Rise</td>
<td>78 (22)</td>
<td>36 (43)</td>
</tr>
<tr>
<td>Long Fall</td>
<td>-65 (58)</td>
<td>-87 (27)</td>
</tr>
<tr>
<td>Short Fall</td>
<td>-20 (39)</td>
<td>-40 (22)</td>
</tr>
</tbody>
</table>

For both Zagreb speakers, there is a considerable shift of the peak from the posttonic onto the tonic under narrow focus. A representative pitch contour of a target word mali ‘a child’ under narrow focus is given in Figure 6 (cf. figure 3 for the same word under broad focus in the same dialect):
Figure 6. Pitch track for target word *mali* ‘a child’ under narrow focus in Zagreb dialect (speaker RS).

Figure 7 shows peak placement in narrow focus for our two Zagreb speakers for all tokens:

![Figure 7](image)

Figure 7. Peak place under narrow focus for two Zagreb speakers.

The tendency here is for the majority of peaks to be moved onto the tonic under narrow focus. Again, the tokens on the posttonic in this pragmatic condition should not be interpreted as examples of phonological ‘rising accents’ since they correspond to all four accent types in the Belgrade dialect.

It is clear from figures 4 and 7 that the positive and negative values of peaks (to the right or to the left of the end of the stressed vowel) correspond with the two pragmatic conditions and not with lexical marking. Under broad focus
majority of the peaks are on the posttonic while under narrow focus they are on the tonic.

In (6) we give average values in ms. for peak distance from the end of the stressed syllable for both pragmatic contexts for our two Zagreb speakers, pooling together all words, since clearly there is no fall/rise distinction for these two speakers. Each average value is thus over 36 tokens (standard deviation in parenthesis):

(6) Zagreb subjects: Peak placement

<table>
<thead>
<tr>
<th></th>
<th>IR</th>
<th>RS</th>
</tr>
</thead>
<tbody>
<tr>
<td>90 (22)</td>
<td>-37 (51)</td>
<td>51 (45)</td>
</tr>
</tbody>
</table>

5. Discussion

In neutral declarative sentences (broad focus), Zagreb speakers tend to place the accentual peak on the posttonic in sentence-initial words. Under a different pragmatic context (narrow focus), there is a strong tendency to shift peaks towards the middle of the stressed syllable. The placement of peak under these two pragmatic conditions for Zagreb speakers resembles the falling/rising lexical distinctions made by Belgrade speakers.

Belgrade speakers use distinct peak placement under both pragmatic conditions to indicate lexically contrastive information. Belgrade speakers show, nevertheless, some peak place variation due to the pragmatic context. Both Belgrade speakers tend to shift the peaks under narrow focus closer to the tonic for rising accents and closer to the beginning of the tonic for falling accents. An important observation is that the categorical lexical distinction between rising and falling accent is preserved under both conditions. That is the lexical contrast is never obliterated due to the shift of peaks induced by pragmatic factors.

6. Conclusions

The present investigation provides evidence for the different role that peak placement plays in the two Serbo-Croatian dialects that have been considered. In addition, it sheds light on the interaction of lexical and pragmatic factors in determining peak placement. In summary, hypothesis II is confirmed: Zagreb dialect appears to show the same variation in peak placement under broad and narrow focus as observed for other stress languages such as Spanish. The strong version of hypothesis I is not confirmed since we observed some variation in peak placement across two pragmatic conditions for the Belgrade dialect. However, this variation was much smaller than for the speakers of the Zagreb dialect (but in the same direction) and, thus, a weak version of this hypothesis is indeed confirmed. Whereas for Zagreb speakers accentual peak placement is purely determined by pragmatic factors, for Belgrade speakers both lexical class and, to a lesser extent, pragmatic factors contribute to the position of accentual peaks.
Appendix

1. Mára je jela bana\-nu.  ‘Mara ate a banana.’
2. Mâmâc je bio na stolu.  ‘A bait was on the table.’
3. Lânac je bio na stolu.  ‘A wreath was on the table.’
4. Mâli je jeo bananu.  ‘A kid ate a banana.’
5. Mâjka je jela bananu.  ‘Mother ate a banana.’
6. Mlâda je jela bananu.  ‘A bride ate a banana.’
7. Mâ\-jor je jeo bananu.  ‘A major ate a banana.’
8. Slâvuj je bio na stolu.  ‘A nightingale was on the table.’
9. Nâum je bio vazan.  ‘The intention was important.’
10. Mâmâ je jela bananu.  ‘Mom ate a banana.’
11. Râna je bila opasna.  ‘The wound was dangerous.’
12. Jânje je bilo veselo.  ‘The lamb was playful.’

Notes

1 There is some individual variation in the exact location of peaks for the four accent types. Speaker AD has peaks for short falling accents at the very end of the stressed vowel whereas speaker SM has these same peaks more within the tonic. Fairly clear distinctions between rises and falls are maintained for both speakers despite these different strategies.

2 Two things need to be stressed at this point. First of all, notice that the short and long labels do not correspond to the observed durations in a straightforward way. This is an issue that we leave for further research. Secondly, we believe that some of the outliers that appear on the ‘wrong side’ of the stressed vowel can be probably explained as resulting from segmental microperturbations, whereas some others could represent errors on the part of the speakers. But this point also requires further investigation.

3 Here, as well as in the peak distribution under broad focus, we can observe different strategies two speakers employ. Speaker AD shows more peak movement under this pragmatic condition than speaker SM. However, it seems that for speaker AD there is more of an interplay with vowel duration. This will be explored further in the near future.

References


Godevac, Svetlana. 1999. An autosegmental/metrical analysis of Serbo-Croatian intonation. Ms. The Ohio State University, Columbus, OH.


