

ACOUSTIC VS. LEXICAL JUDGEMENTS IN THE PERCEPTION OF FALLING ACCENTS
IN SERBO-CROATIAN: A PRELIMINARY STUDY

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ABSTRACT

This paper concentrates on the difference in duration between the long falling and short falling accent in Serbo-Croatian. Another aim of the study was to determine whether listeners who do not speak the language would be able to make acoustic distinction between the two, and if they would, whether they would shift their judgements from long to short at the same point or along the same lines as the speakers of Serbo-Croatian.

INTRODUCTION

In Serbo-Croatian (SC) the word accent consists of three elements: stress, length and pitch. The combination of these elements gives four accent types: short falling (↘); long falling (∧); short rising (↖) and long rising (↗).

There are some restrictions with regard to the distribution of the four accent types: in monosyllabic words only the falling accent can occur; the last syllable is never accented; polysyllabic words can carry the falling accent only on the first syllable. While tonal patterns (pitch) are associated with stressed syllables, "the quantity system is relatively more independent, since quantity contrasts also occur in unstressed syllables" /1/. Apart from numerous dialectal variations, two variations are acceptable in standard SC: optional short tonal distinction and optional or non-existent posttonal vowel length.

The fact that only the falling accent can occur in monosyllabic words has probably lead J. Gvozdanović /2/ to an imprecise conclusion that "monosyllabic prosodic words have no tone and accent, but can only have prominence in a phrase or a sentence". The very fact that a word has prominence (stress) requires that word to have one of the accents (hence, tone). A more precise statement pertaining to tone in monosyllabic words is given by Lehiste and Ivić /1/: "Monosyllabic words do not show tonal contrasts." This statement strikes closer to home, since in monosyllabic words, bearing only falling accents, the contrast can be primarily found in their duration and, possibly, fundamental frequency peak location /3,4,5,6/ and final fundamental frequency value of the accented vowel /7,8,9/. Lehiste and Ivić /1/ state the following: "From the point of view of the system the short and long rising accents differ from each other in terms of duration; in the same way, the two falling accents differ in

terms of duration. The cue value of the difference in the placement of fundamental frequency peak on the stressed syllable thus seems dependent on length...".

Most authors studying SC accents have dealt mainly with disyllabic or polysyllabic words and concentrated on the distinctions between long falling and long rising or short falling and short rising accents, probably due to the fact that these distinctions are richer, and depend on a number of variables.

The main aim of this study was to concentrate on the difference in duration between the long falling (LF) and short falling (SF) accent, keeping all other parameters constant. That the question of duration in these two types of accent is not trivial was shown by the studies of Magner and Matejka /10/ who, among other distinctions, tested the perception of native speakers of SC in an attempt to determine how much of the accentual system developed by V. Karadžić in the early 19th century and adopted as standard for SC, is in actual use and whether native speakers of the language who may not use all the distinctions in their own speech can still detect those differences and make lexical judgements based on them. They found that not all of their listeners could identify the distinction between the short and the long falling accent in the word *pas* when presented with the natural production of these words in sentences *Čiji je to pas tam* (Whose dog is that there) and *Čiji je to pas tam* (Whose belt is that there). Unfortunately, the authors do not provide any acoustic measurements, so it is not known from their reports what the duration of the accented vowel in the target words was. However, their results show that speakers of SC in most of the major cities can identify the difference between the long and the short accented vowel and conclude "that in their speech accentual quantity is meaningfully utilized and appears as a functional prosodic system". The authors have also found that even speakers who do not distinguish these two accents in their own speech (big cities), "are capable of identifying distinctions which they themselves do not implement...".

MATERIALS AND PROCEDURE

Preparation of test material: Two native speakers of SC from the city of Zagreb, who both utilize the long-short distinction in their speech, recorded several tokens of the word *pas* (belt) and *pas* (dog) in medial and final sentence positions

and in isolation, via a Crown 700 series taperecorder, using an Electro-Voice microphone (model 635A Dynamic Omnidirectional). The tokens were then sampled via an analog-to-digital converter with a rate of 12,500 samples per second. The samples were stored in a PDP-11 digital computer. A low-pass filter with the cut-off frequency of 5000 Hz and a slope of -48 dB per octave was used to filter out the 12,500 sampling frequency. Using the ILS package for acoustic analysis the tokens were displayed and the duration and fundamental frequency contour calculated and displayed. Table 1 shows vowel durations for different tokens of *pas* and *pas*.

Table 1. Duration of the five tokens of *pas* and five tokens of *pas* (in msec) in ascending order

| Accent type | SF (↘) | LF (∧) |
|-------------|--------|--------|
| | 90 | 170 |
| | 120 | 210 |
| (msec) | 130 | 220 |
| | 140 | 240 |
| | 140 | 250 |

As it can be seen from Table 1., the longest vowel bearing the SF accent was 140 msec and the shortest vowel bearing the LF accent was 170 msec long. These data are in agreement with those of Lehiste and Ivić /11/ for di- and polysyllabic words bearing short and long falling accents. It should also be reported here that, although most authors have found a slight rise, peak and then the fall of the fundamental frequency contour in samples of falling accents, no such movement of fundamental frequency was found in any of the tokens here. This can be explained by the fact that the consonant preceding the examined vowel was a voiceless stop (/p/) and it has been found (/12/ and an earlier study of this author) that in that case the peak occurs immediately after the onset of voicing.

One of the originally recorded sentences, *Ovo je krasan pas* (This is a beautiful belt), was chosen as the starting point for all the other test sentences. In that particular sentence the vowel in the word *pas* had a duration of 185 msec. Of these 185 msec 138 msec was the duration of the voiced interval and 47 msec was the duration of the whisper-like portion which could still be identified as vowel (/a/). In order to keep the relationship between the initial and final fundamental frequency value constant, the vowel was then shortened in such a way that individual complete pitch periods were removed from the stimulus. These pitch periods were extracted at regular intervals, using the in-house program for acoustic analysis, WENDY, on a VAX computer, at Haskins Laboratory, New Haven, CT. For each magnitude of reduction the periods were chosen so as to be equally distributed over the voiced period. By this method all the parameters except duration were kept constant. In this way 8 different tokens of *pas* were obtained, all incorporated into the same carrier sentence *Ovo je krasan pas* (This is a beautiful pas). Each of these 8 sentences was then recorded 4 more times, which yielded 40 test sentences. The sentences were randomized, with a silent interval of 3 seconds be-

tween subsequent sentences. Table 2. shows the 8 durations of the vowel in the word *pas* (including the whisper-like portion).

Table 2. Durations of the vowel /a/ in the word *pas*

| Stimulus | Duration (in msec) |
|----------|--------------------|
| 1 | 185 |
| 2 | 174 |
| 3 | 163 |
| 4 | 158 |
| 5 | 147 |
| 6 | 137 |
| 7 | 131 |
| 8 | 119 |

The experiment: There were two groups of subjects. One group consisted of 6 native speakers of SC. All the subjects in this group were born and raised in the city of Zagreb, and all of them utilize the long-short distinction in their own speech. The second group consisted of 8 Americans - seven students and one professor of linguistics. None of them speak SC.

Native speakers of SC were asked to make lexical judgements. Each subject was provided with answer sheet consisting of 40 pairs of words *životinja/po- pas* (animal/synonym for belt) and was asked to underline or circle the one which, in their judgement corresponded to the stimulus used in the sentence. The American subjects were asked to make acoustic judgements. It was explained to them before the test that all the sentences would be the same except for the last word, in which the duration of the vowel would vary. It was pointed out that they should only pay attention to the duration of that vowel. Each subject was provided with an answer sheet consisting of 40 blank lines on which he/she was asked to write L (for long) or S (for short), depending on their judgement of the duration of the vowel in the last word of the sentence.

Before the test both groups were presented with two sentences containing the longest vowel in the word *pas* followed by two sentences containing the shortest vowel in the word *pas*. These four sentences served as a training session for the American subjects and as control for the group of native speakers of SC. Those native speakers who could not make the distinction between the two extremes were not tested.

The sentences were presented to the listeners in a free space room via the Crown 700 series taperecorder, connected to a Z-400 Jans Zen electrostatic loudspeaker through the Crown D60 Model amplifier, at a comfortable listening level, approximately 2 meters from the listeners. Figure 1. shows pooled responses of native speakers of SC in terms of percentage of long (*pas*) and short (*pas*) responses to a particular vowel duration. As it can be seen from the Figure, the perception of the long-short distinction is very nearly categorical for native speakers of SC. The cross-over point is at stimulus 5, in which the duration of the vowel was 147 msec (43.33% *pas* and 56.67% *pas* responses). Stimulus 4 (vowel duration of 158 msec) elicited 80% *pas* and 20% *pas* responses while stimulus 6 (vowel duration of 137 msec) eli-

cited 86.67% *pās* responses and 13.33% *pās* responses.

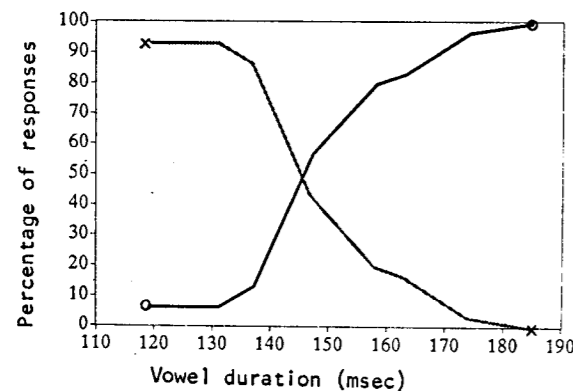


Figure 1. Pooled responses of native speakers of SC to eight different vowel durations (o - *pās*; x - *pās*)

With respect to their responses American subjects can be divided into two groups. Five out of 8 Americans made obviously random judgements of the vowel duration. No pattern was found that might indicate at least a tendency to label the stimuli with some consistency in accordance with their duration. Three out of 8 American subjects were non-random in their responses. Figure 2. shows pooled responses of these three listeners in terms of percentage of long and short responses to a particular vowel duration.

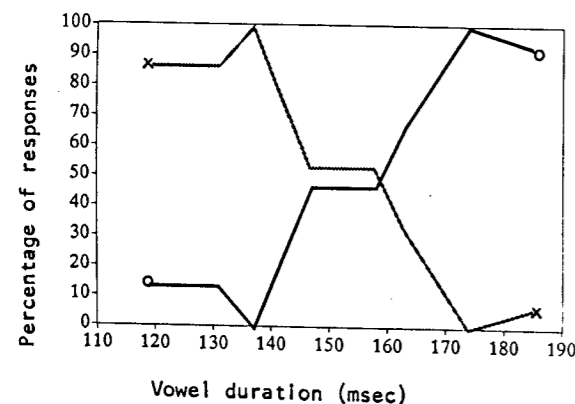


Figure 2. Pooled responses of 3 American subjects who had non-random responses to eight different vowel durations (o - long; x - short)

As it can be seen from the Figure, these 3 listeners exhibit a near categoricity of perception. Two things distinguish these listeners from the native speakers of SC. First of all, their responses are random for two stimuli, rather than one, which shows that their perception is not as categorical as that of native speakers of SC. The vowel duration of these two stimuli (4 and 5) was 158 and 147 msec, respectively, with 53.33% "short" and 46.67% "long" responses in each. Obviously, the significant shift in judgements from "long" to "short" occurs at the same point as for native speakers of SC while the point at which their responses become

random occurs earlier on the duration scale, than for the native speakers of SC. The other interesting detail that can be observed in Figure 2. is that these 3 American subjects are not entirely consistently shifting their judgements. Several unexpected peaks and valleys can be seen in Fig. 2. - 100% "short" or "long" judgements do not occur in responses to the stimuli of shortest or longest duration, respectively. Stimulus 1 elicited 93.33% "long" responses. Similarly, of the 3 stimuli predominantly labeled as "short", the longest one, stimulus 6, elicited 100% "short" responses, while the actually shorter stimuli 7 and 8 elicited 86.67% "short" responses each. Closer examination of the responses of these 3 listeners and the order of stimuli presentation shows that all tokens of stimulus 2 (100% "long" responses) and stimulus 6 (100% "short" responses) occur after the 12th position on the test tape. It appears that these listeners were actually in the process of establishing some sort of a reference scale in the first quarter of the test and all the inconsistencies are found in responses to stimuli presented as the first 12 test stimuli. This indicates that the more categorical perception of native speakers of SC is a result of their being more attentive to phonemic length which they use and hear in everyday communication. On the basis of these results and observations it can be expected that re-testing of the same 3 American subjects or providing them with a short pre-test session, which would include all durations, rather than just the extremes, would yield results closer to those obtained for native speakers of SC.

It should also be noted that 3 out of 5 tokens of stimulus 5 (vowel duration of 147 msec), to which random responses were given both by native speakers of SC and the 3 Americans, occurred very early in the test (positions 3, 8 and 9). Stimulus 5 was only slightly (7 msec) longer than the longest vowel bearing the SF accent, found in acoustical measurements preceding the experiment and in literature. The fact that the stimulus of such "borderline" duration was presented so early in the test might have contributed to the randomness of responses of the above mentioned subjects. It remains to be determined whether a pre-test session provided for the native speakers of SC would result in a clearer switch from *pās* to *pās* judgements, without randomness of responses in between. The acoustic measurements of natural productions of the words *pās* and *pās* carried out during the preparation for the experiment, as well as the data found in literature, show that the vowels bearing the LF accent are not shorter than 170 msec and that the vowels bearing the SF accent are not longer than 140 msec. The results of this study indicate that the native speakers of SC are more apt to label shorter-than-natural durations of vowels under LF accent as long than the longer-than-natural durations of vowels under SF accent as short. Even the fact that the word *pās* is more common than the word *pās* (which has become to be regarded as slightly archaic and is not frequently used in modern SC, did not cause a bias toward it in the judgements of native speakers of the language.

CONCLUSION

On the basis of the results of this pilot study the following conclusions can be drawn:

- Native speakers of SC, who utilize the long-short distinction (between the LF and the SF accent) in their own speech, exhibit categorical perception of this distinction when presented with words (in carrier sentence) which differ only in the duration of the vowel and when asked to make lexical judgements.
- The cross-over point, at which the judgements of native speakers of SC shift from long (*pās*) to short (*pās*) occurs at the stimulus with the vowel duration of 147 msec, which is slightly longer than the longest duration of the naturally produced vowel bearing the SF, found in literature and in preliminary acoustic measurements.
- American subjects, who do not speak SC, exhibit two types of perceptual behavior in their acoustic judgements of the duration of the target vowel - their responses are either entirely random or show a pattern similar to that found in the responses of native speakers of SC.
- American subjects whose responses are not random start to shift their judgements from "long" to "short" earlier than the native speakers of SC, i.e. at a longer stimulus (158 msec) but the significant switch occurs at the same point as for native speakers of SC (137 msec).
- There is evidence that native speakers of SC are more attentive to the long-short distinction than the American subjects, which can be attributed to the fact that vowel duration is phonemic in SC and native speakers of this language utilize it in their own speech and hear it in everyday communication.
- Testing of larger groups of subjects is necessary to determine which type of perceptual behavior is more characteristic for the Americans who do not speak SC.

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