PERCEPTION OF STANDARD CROATIAN PITCH ACCENTS BY SPEAKERS FROM PITCH ACCENT AND FROM STRESS ACCENT REGIOLECTS

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ABSTRACT

Previous acoustic studies have found that Croatian speakers use either standard four pitch-accent system (PA) or a stress accent (SA). The focus of the present study is on perception of four pitch accents: we tested how fast and how accurately the Croatian listeners from pitch and from stress system can perceive the words with correct and incorrect pitch accents, in total 80 tokens were tested. The results show that there is a significant difference in perception between listeners from the PA and listeners from the SA. PA listeners (N=67) recognise frequent words with an average reaction time of 1417 ms and with an average accuracy of 87.89 %, whereas SA listeners (N=90) react more slowly, with an average reaction time of 1625 ms and with an accuracy of 69.97 %. This suggests that pitch accents make word recognition difficult for the speakers who are from the stress accent regiolect.

Keywords: pitch-accent, stress-accent, perception, Croatian, word recognition

1. INTRODUCTION

Croatian is a South Slavic Language with the pitch-accent system containing four pitch accents and short or long post-accentual syllables [1, 2, 3]. Names for accents partly reflect their acoustics and they are called short falling (SF) e. g. [kíʃa] kȉša ‘rain’); long falling (LF), e.g. [sú:ntse] sûnce ‘sun’); short rising (SR) e.g. [rósá] ròsa ‘dew’); long rising (LR), ([trá:ʊá] tráva ‘grass’). Since IPA offers different opportunities for tone marking, we will use the possibility of marking the high tone of "rising" accents on both the accented and post-accented vowels, since there is no rise, but a high tone is spreading. Post-accentual length (L) is also marked in dictionaries and grammars, e.g. [mjése:ts] mjȅsēc ‘moon’. All Croatian dictionaries, both monolingual and bilingual, mark the four tones and long post-accentual vowels, although they are not commonly marked in standard orthography. Croatian pitch accents, when compared to some other Indo-European languages with pitch accents, are similar to those in Slovenian and Lithuanian, but differ from those in Swedish [4]. In contrast to tone languages, all pitch languages share a small phonological distinction in the distinctive role of pitch accent, with minimal pairs occurring infrequently in the same linguistic context, and with spoken dialects varying from pitch to stress accent [5]. While Croatian Standard is described with four pitch accents, fieldwork involving acoustically and/or perceptually analysed recordings of many Croatian speakers with the task of reading standard-written sentences revealed that less than half of Croatian speakers use all four accents [6, 7], and the use of post-accentual length is also rare [5, 8]. The four accents are mostly used in the Štokavian area in eastern Croatia (mainly Slavonia) and in Štokavian and Čakavian southern Croatia (Dalmatia), while in the Kajkavian area (north and central Croatia, including the capital Zagreb) and in the Čakavian northwest (Istria and Kvarner), most inhabitants use the stress accent system. Some Kajkavian and Čakavian dialects have a rising monosyllabic pitch accent called the "acute" [9], but this accent is used only in dialects and not in the standard variety spoken in towns. To refer to different standard varieties, we will use the term "regiolect", a colloquial variety of a standard language spoken in a particular region or town and influenced by the native dialect. To preserve the standard four pitch accents and post-accentual length, the teaching of four pitch accents is an inevitable part of study programs in Croatian language, phonetics, and acting [10]. It is also taught in elementary and high school [11, 12].

2. PREVIOUS WORK

Previous studies on the perception of Croatian pitch accents, as well as Serbo-Croatian which includes Štokavian pitch accents spoken in Serbian and Bosnian [13, 14, 15, 16], have investigated specific acoustic correlates (such as duration or tonal contour) and their effect on the perception of certain accent types, which accents and post-accentual lengths can be identified correctly, and which accents are preferred. Research on duration perception in monosyllabic words [17] suggests that the boundary between long falling (LF) and short rising (SF) accents occurs at 147 ms, and in another study [18], at 146 ms. In two-syllabic words [19], the boundary

is at 118 ms, with durations of 108 ms perceived as belonging to the correct SF category, and durations of 128 ms perceived as too long. There has also been some research on lexical tone perception [20, 21, 22, 23]. Study [21] demonstrates that the F0 peak, which occurs in the last 24% of the duration of the stressed vowel, serves as a cue for the perception of rising accents. Meanwhile, study [22] shows that the later position of the F0 peak and the larger rising range of the initial and final F0 in the stressed syllable determine the perception of a long rising accent. However, study [23] strongly criticizes these results and argues that the most important acoustic information for the perception of rising accents is not being considered – namely, the F0 on the post-stressed syllable. As a result, study [23] shows that a speaker who can identify their own accents with 100% accuracy cannot differentiate between a short rising and a short falling accent if the post-stressed syllable, including the voiced sound that precedes the vowel, is "cut off". The authors conclude that the first part of the contour is less informative than the second, which is supported by studies [24, 25] that show that tonal changes are not perceived if they occur at the beginning of the vowel, but rather at the transition from 2/3 to 3/3 of the vowel duration.

Other research [26] tested over 1600 speakers in 20 cities in Yugoslavia on the perception of minimal pairs. The results show that the tone difference on long vowels is maintained in some cities for some minimal pairs. For example, the difference between Lûka – lúka is perceived in Dubrovnik, and the difference between râdio – rádio is perceived in Osijek and Split but not in Dubrovnik. However, the difference between SR and SF on the first syllable of a word is poorly recognized in all Croatian cities.

Another study [27] tested accent recognition as metalinguistic ability and the results show that the accuracy of recognition of stressed syllables is 75%, and the accuracy for different pitch accents is 86.03% for LF, 65.52% for LR, 80.67% for SF and 61.25% for SR. Recognition of the same categories with pseudowords is 1 to 5% less than with existing words. Other results [18] show very similar results: stressed syllables are perceived with accuracy 77.50%, and pitch accent type in common words 72.58%, and in pseudowords 59.47%. There is also a big difference regarding the type of accent: LR 63.06%, SR 57.67%, LF 76.41%, SF 63.78%. The difference between [10] and [26] is in the recognition of LR and SF, while both papers give evidence that LF is recognised most accurately, and SR less accurately.

3. RESEARCH QUESTIONS

n this research, we attempt to answer the following research questions (RQ):

RQ1: Which accents in Croatian contribute to faster word processing, and which ones slow it down?

RQ2: Which word accents in Croatian are perceived with greater accuracy, and which with less?

RQ3: What is the difference in the processing of Croatian standard pitch accents between speakers/listeners from different Croatian regiolects, those with and without PA?

4. METHODOLOGY

4.1. Participants

200 native Croatian speakers (age range 18-54; mean 24.07) participated in a pitch-accent perception experiment. 82.6% of the participants were female, 16.4% were male, and 1% did not answer. Most participants had either completed their studies or were currently pursuing higher education, with 35% studying phonetics, 16% psychology, 14% linguistics, 11% Croatian, and 24% in other fields. Based on the data obtained from a survey about the participants' place of longest residence, place of elementary and high school education, and the origin of parents or guardians, the participants were classified into three groups for further analysis, based on the accent system that exists in their regiolects: the pitch accent system PA (N=67), accounting for 33.5%; the stress accent system SA (90), accounting for 45%; and the mixed system M (N=43), accounting for 21.5%. The mixed system includes individuals whose regiolect of at least one parent is different from the regiolect in which the speaker grew up and was educated, or who lived in two different regiolects with pitch and stress accent systems during primary and high school (years 6 to 18). To ensure that the data about the speaker's place of residence reliably points to the regiolect and accent system that listeners use in speech, one part of the participants (N=58) was tested by the authors for pitch accent production by reading sentences with target words containing the standard four pitch accents. The results of classification into three groups (PA, SA, M) based on data on residence and data obtained from production tests matched 84.48%. In cases where the data did not match (15.52%), the speakers were mostly classified by production assessment into PA or SA, and by data from the questionnaire, they were classified into a mixed system. Since the results based on the questionnaire coincide to a significant extent with the production testing, we can consider them reliable for further analysis and interpretation.

4.2. Stimuli

For stimuli, we used 20 accentually indisputable, common, disyllabic Croatian words with an initial accent, which were balanced in the accented vowel /a e i o u/. These words were selected during pre-testing where 74 participants were presented with a word displayed on the screen. The participants had to make a lexical decision as to whether the word was known or not. Frequent words that were identified as known with a recognition rate of over 99% and an average reaction time of 694 ms were selected. Rare words that were recognized as known by an average of 21% and had an average reaction time of 1408 ms were discarded.

Selected words with LF are 'škola' (school), 'sunce' (sun), 'meso' (meat), 'tajna' (secret), 'biljka' (plant); with LR 'glava' (head), 'vino' (wine), 'ruka' (hand), 'torba' (bag), 'leđa' (back); with SF 'kuća' (house), 'kiša' (rain), 'nebo' (sky), 'vatra' (fire), 'soba' (room); and with SR 'žena' (woman), 'voda' (water), 'magla' (fog), 'život' (life), 'bubreg' (kidney). All words were pronounced by phonetician Jordan Bićanić and recorded in an acoustic studio with all four pitch accents, one correct (C) and three false (F) accents. The total number of produced tokens was 80. All stimuli were verified by accentologist Blaženka Martinović. Figure 1 illustrates the tone movement and duration in four accents produced on the same word. The figure of tonal movement were generated using Praat [28].

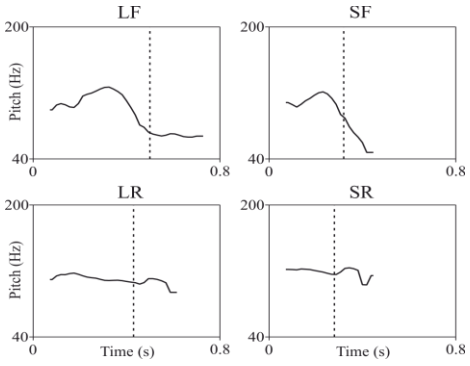

Figure 1: Pitch movement in the word 'glava' (head) produced with four pitch accents: LR is correct, other three are wrong; dotted line marks the syllable boundary

4.3. Procedure

The participants in this experiment took part through the online platform SoSci Survey. The questionnaire collected data on the participants' age, gender, place of origin, etc. It included practice tasks and experimental tasks. The acoustic stimulus was presented with a visual stimulus (a word) on the screen. The presentation of the stimuli was randomized, and each stimulus was presented once. Participants were explicitly asked to judge the correctness of the pitch accents of standard Croatian by forced choice using the keyboard (for the answer "correct," key "A," and for the answer "incorrect," key "L"). The responses about correctness, as well as the reaction time, were recorded. The reaction time was measured from the beginning of the token, and the duration of words varied between 626 and 689 ms.

5. RESULTS

5.1. Perception of correctness

When analysing the proportion of correct responses for all words pronounced with a particular accent (of which 1/4 have correct and 3/4 have false pitch accents), the data indicate that the highest recognition accuracy is for long accents (LF and LR), and significantly lower for short accents (SF and SR) (Figure 2). The overall analysis shows that PA listeners recognise frequent words with an average accuracy of 87.89%, whereas SA listeners recognise them with significantly lower accuracy of 69.97% ($Z=23.72$, $p<0.01$).

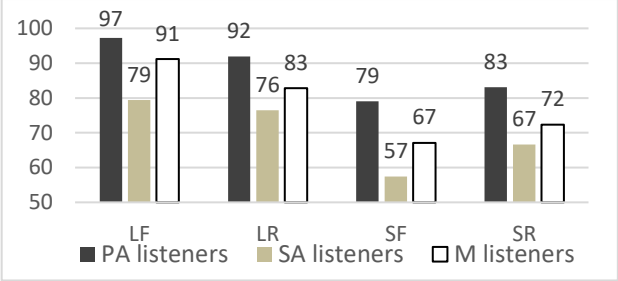

Figure 2: Results for all tokens: proportion of correct recognition (%) by listeners from PA, SA and M systems

The results, divided into two groups of words pronounced with correct and false accents (Figure 3), show a significant difference in recognition accuracy between different accent types. In both systems, for correctly pronounced words, the short falling accent is the most accurately recognised with 99.4% accuracy in the PA and 96% in the SA. The long falling accent follows in second place with 98.8% accuracy in the PA and 92% in the SA. The rising accents are the most difficult to recognise, with the long rising accent having the lowest score of 83% in the PA and 52% in the SA. The results for the short rising accent are 89% in the PA and 63% in the SA. Regarding the words pronounced with false pitch accents, the lowest recognition score is for the short falling accent with 72% by PA listeners and 45% by

SA listeners. This finding indicates that SF was not recognised as false on words where standard Croatian has three other accents.

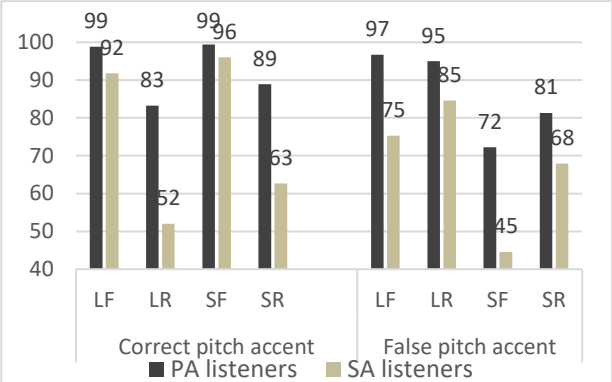

Figure 3: Proportion of correct recognition of words with correct and words with the false pitch accent: difference between PA and SA listeners

5.2. Reaction time

Analysis of the reaction time for all words spoken with a certain accent (with correct and incorrect pitch accents) shows that PA listeners recognize frequent words with an average reaction time of 1417 ms (sd 805) and SA listeners react more slowly, with an average reaction time of 1625 ms (sd 929) (t-test $p<0.01$). Meanwhile, results for M listeners are similar to those of PA listeners.

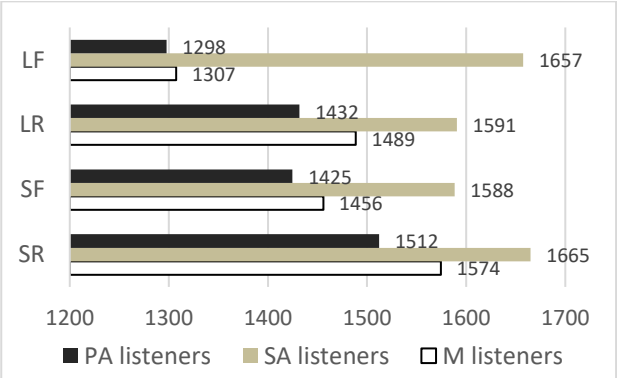

Figure 4: Results for all tokens: reaction time (ms) difference between listeners from PA, SA and M

When analysed by specific accent (see Figure 4), it can be concluded that SA listeners require a similar amount of time for all four accents, while PA listeners recognise LF accent very quickly, in only 1298ms. Recognition of LR and SF accents requires a similar amount of time, and SR accent recognition is slightly slower. When we distinguish between correctly and falsely pronounced accents, the reaction time data (Figure 5) give us interesting insight into processing: LR accent, as well as SR, take a long time to be processed on words where they are correct.

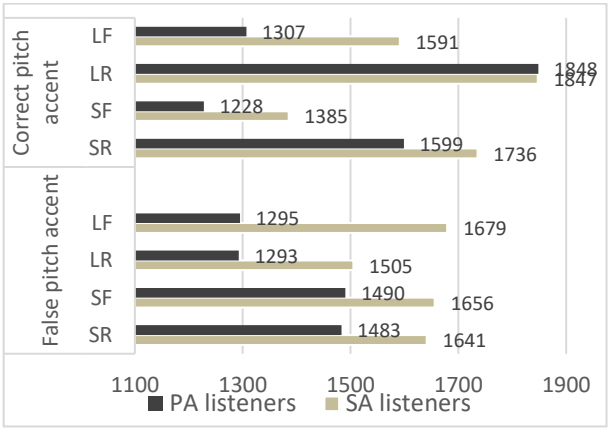

Figure 5: Reaction time for words with correct and words with the false pitch accent: difference between PA and SA listeners

6. DISSCUSSION

The fact that SF was not recognized as false, not only by SA listeners (which was expected) but also by PA listeners, suggests that the short falling accent (which is acoustically similar to stress accent [5]) strongly permeates standard Croatian and is also acceptable to PA speakers, as shown in previous research [29]. This is not unexpected because previous studies have shown that stress accent also exists in the speech of competent Croatian speakers (e.g., linguists, professors, actors) and if such SA occurs in the prescribed syllable in the word (as is the case in our research), listeners will still perceive it as standard [11]. The reaction time for short falling accent might suggest that SF sounds acceptable to all listeners, and it takes a long time to recognize it as an intruder.

7. CONCLUSION

Based on a significant sample size, our study has demonstrated that Croatian speakers who were raised and educated in areas with a stress accent system regiolect process and perceive the four "standard Croatian" pitch accents with considerably less accuracy and slower reaction times. These findings, along with previous research [2, 10, 11, 30, 31], suggest that the pitch accent system as the only variety in the standard language might be challenging and impractical. Instead, it may be more appropriate to accept the stress accent system as a part of the standard Croatian language. However, such a change would require a revision of the current accent norm.

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