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TOWARDS THE ACOUSTIC PHONETIC NATURE OF KET PROSODEMES

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One of the most striking typological features of the Ket, the last survivor of the Yeniseic language family, is the analysis of lexical tones [Werner 1996] or recently prosodemes [Vajda 2004]. This paper reports about ongoing research in re-analyzing the actual phonetic nature of these prosodic properties in Ket by means of acoustic phonetic analysis. It aims to present some preliminary results on a limited sample of four speakers showing that also easy obtainable overall acoustic parameters like pitch, duration and formant height can contribute to investigate speaker based maintenance of prosodic contrasts.

Introduction

The discussion [cf. Werner 1996; Vajda 2000] about the number of distinct tones/prosodemes already reflects certain areas of uncertainty in nature of the prosodic structure of Ket. So far these prosodic structures have been described by means of either two [Werner 1996] or three [Feer 1998] phonetic parameters.

In large parts I would set up the re-analysis of Ket prosodemes in a fairly 'agnostic' way. So rather than considering the entire discourse about Ket prosody I would just focus on the currently available and accessible data. Nevertheless, the main questions formulated at this point are: Do the pitch contours follow the predicted patterns [Werner 1996; Vajda 2000, 2004]? Vajda had stylized prosodeme (/tone) 1 as "high even", tone 2 as abrupt, "glottalized", tone 3 as "rising, falling" and tone 4 as "rising, high falling".

Are there co-factors active in prosodic lexical distinction? Often languages employ certain other than tonal/melodic characteristics, e.g. voice quality, that co-occur with specific tone(me)s, but are usually described as redundant. Nonetheless these 'redundant' informations (like voice quality, articulatory lowering, duration [cf. Vajda 2004: 8]) contribute to perceptional salience of a particular toneme/prosodeme. Are there overall prosodic features that are at least stable on the level of an individual speaker? Which are these?

Corpus & Method

The analyzed corpus consists of material which had been assembled and recorded by Heinrich Werner during fieldwork in the years 1968 to 1972. It comprises the wordlist elicitations of four subjects (four females) from four different villages. According to Vajda [2004] the one speaker (BM04) from Baklanixa belongs to the proposed variety of Central Ket the two speakers from Kellog (SK08) and Sulomaj (M07) belong to Southern Ket, and the fourth (VL05) from Vorgovo would already count as speaker of Yough. At time of the recording these speakers served as a kind of 'model' speakers and had therefore been evaluated as of high proficiency in their mother tongue [Werner 1996: 6].

The original reel-to-reel tapes were digitized at 96kHz 24bit and down-sampled to 48kHz 16bit. All acoustic analysis was carried out by means of PRAAT [Boersma & Weenink 2008]. Statistical analysis was carried out by means of PRAAT, MS Excel and R (the R-project).

Although the prosodemes have been also analyzed for disyllables the present investigation focuses on monosyllabic words, classified according to standard ascription of tones by Werner [2002]

Additionally sound files were labeled and transcribed according to the entries in Werner [2002]. As parameters served pitch (average F0), intensity, pitch range, pitch slope, length (duration), formant height (F1,F2), formant distance (F2-F1, F1-F0), and zero crossing rate (COV) were chosen as potentially meaningful. The parameters were measured A) as describing overall characteristics of periodic portions of a given utterance (usually here a word) and B) describing the vowel portions . The vowel portions were segmented manually and labeled – as reported here – following the XSAMPA [Wells 1995] convention.

Results

The present data pool comprises 901 cases, i.e. monosyllabic words as uttered in the wordlist by four speakers (BM04: 181/20.08%; KM07:258/28.63%; SK08: 293/ 32.51% VL05:169/ 18.75%).

In terms of vowel qualities, according to their phonemic standard adscription: 19 /@/, 78 /1/, 183 /a/, 59 /e/, 84 /E/, 159 /i/, 36 /o/, 70 /O/, 144 /u/, 2 /U/, 67 /V/. Although we find on the one hand /@/(19) exclusively and /e/(53) and /o/(35) only in tone-1 words, and on the other /O/(42) and /a/(67) in the majority in tone-2 words the sample is still too small for a distributional analysis of vowel qualities over the four

prosodic classes. So does a (Pearson's) Chi-squared test (based on X-squared table =372.2028, df=30, p(-value) < 2.2e-16) not support independency of one of the types (tones).
Also tonem-wise the data is skewed towards the 1rst (308/34.18%) and 2nd (312/34.62%) prosodeme. The other two types are at about half the frequency represented in the recordings (3rd: 133/14.76% and 4th: 148/16.42%).
As for the two different ways of analysis, it turn out, that measurements carried out on the segmented vowel portions appear to be more pronounced and articulated. Therefore this paper presents only analyses based on this approach.
Pitch contours as shown in Figure1 reveal the undoubted salience of the interrupted second glottalized toneme, but the similar length of tone 1 and as well as that of tone 2 and tone 4 too. Much more significant is the slope of the two “falling” tones vs. tone 1.

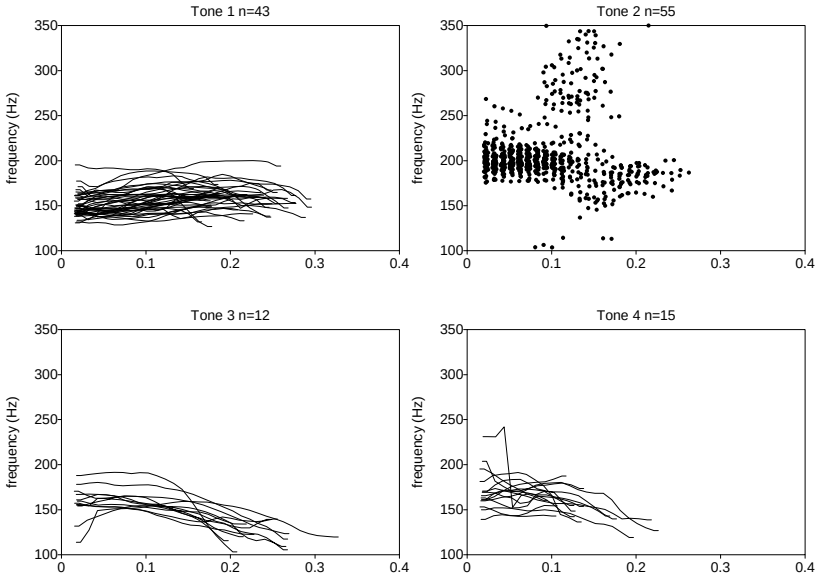

Figure 1: overlay plots of pitch contours of speaker (KM07)

Pitch in acoustic terms of fundamental frequency has been investigated as average (mean and median) values in order to investigate whether one

of the types shows a level (register) effect. Surprisingly in KM07 the second tone demonstrates a higher onset than tone 1 which would result also in a higher mean F0 (see Figure 3 upper left panel). Nonetheless the differences in slope (semitones/sec) between prosodeme 3 and 4 seem sometimes reversed, so e.g. for SK08 (Figure 3 lower left panel). Werner [1996] and Vajda [2000] had already discussed certain observations regarding a co-occurrence or correlation of durational contrasts as enhancement. It is remarkable that for BM04 there is no significant difference between vowel lengths (*and* mean pitch *and* pitch slope) of tone 3 and 4, while for VL05 although the length contrast Is not supported the pitch level contrast is clearly at work.

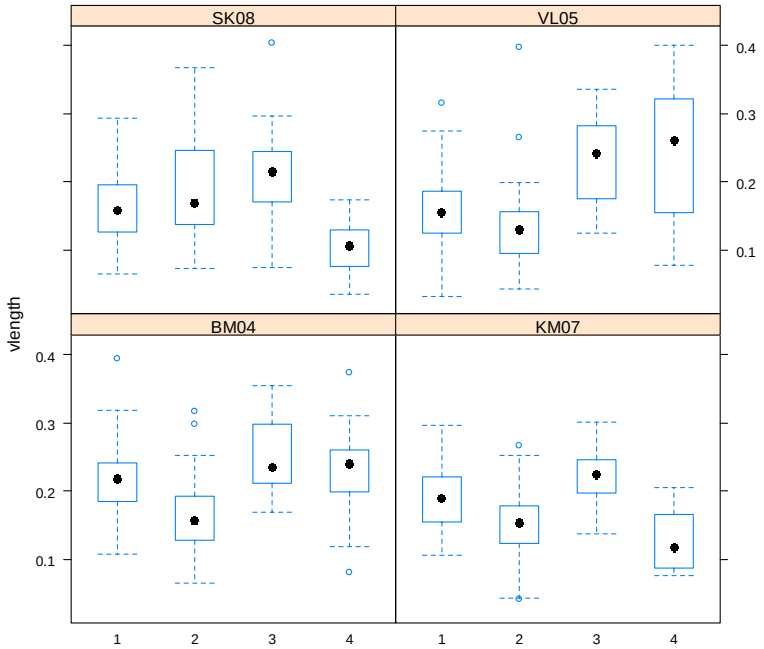

Figure 2: vowel portion lengths (in sec) grouped type (tone/prosodeme) and speaker

Whereas it remains necessary to look at the individual strategies of the speakers in maintaining a contrast it might be also important to look at the overall tendencies that remain for all 4 speakers. After z-

standardization pairwise comparisons using t-tests with pooled SD and

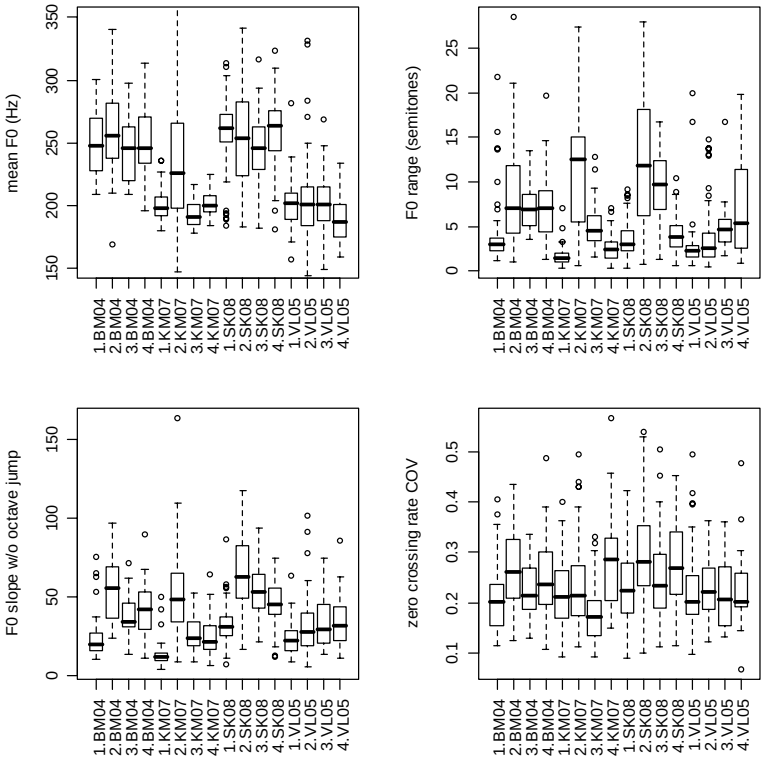

Figure 3: boxplots of non-standardized measures of mean F0, pitch range, pitch slope and coefficient of variance in zero crossing rate grouped by type (tone/prosodeme) and speaker.

false discovery rate control p-value adjustment method [Verhoeven 2005] was carried out. Intensity or loudness contrasts are only supported but reversed for the glottalized tone (2). First formant differences between tone 1 and 3 (p= 1.0e-10) and even between 3 and 4 (p=0.045) are significant, supporting insofar a hypothesis of backing for prosodeme 1 and suggesting to look further into vowel distributions for prosodeme 3 and 4. However, the average pitch differences between tone 1 and 3 (p=0.67) and tone 1 and 4 (p=0.74) and tone 3 and 4 (p=0.651) are non-

significant. There are significant durational differences between tone 1 and 3 (p=1.8e-11), as well as tone 3 and 4 (p=3.9e-13), but not between tone 1 and 4 (p=0.08.)

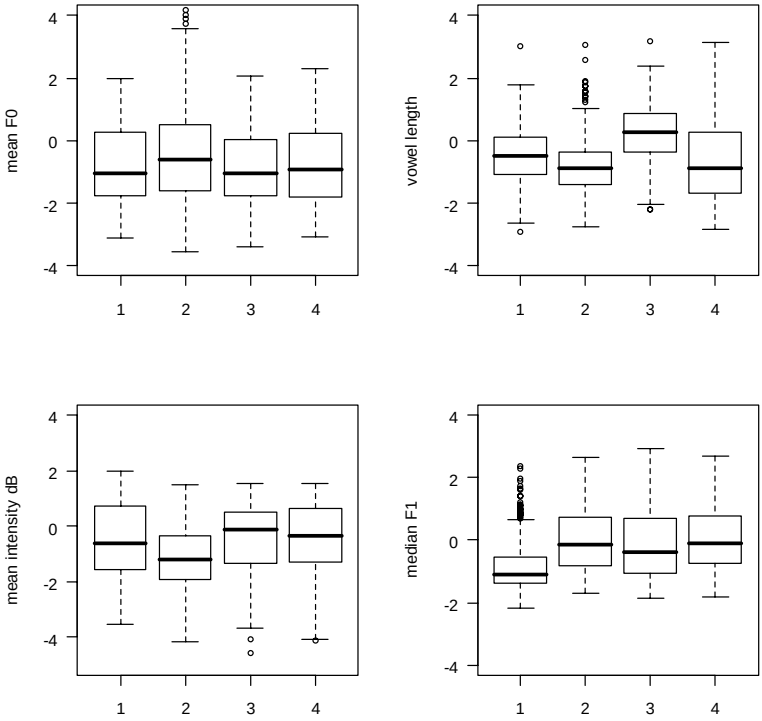

Figure 4: z-standardized values of mean fundamental frequency, vowel length, mean intensity and mean first formant value over all 4 speakers grouped by type (tone/prosodeme)

Discussion

Since the four speakers belong to three varieties of Ket –Yugh dialect continuum, we would expect at some point that this is reflected in prosodic structure. In fact the differences spotted here are more supportive of a speaker based analysis.

It has to be admitted that the current data situation does not allow to follow fully the current standards in terms of validity for individual tokens (words). However, since looking not at particular lexical items

but at types in terms of pre-classified tonemes/prosodemes the data is considered to be homogeneous enough to dare an analysis.
Another concern might be that the current results, since based on recordings of word list elicitations, they maybe also biased through recurrent list intonation, though as Werner [1996: 6] pointed out that exactly this was intended. In so far the difference in other context needs to be controlled in a similar way.
It becomes clear that such a data driven approach needs to broaden its base, which remains at this point though clear intended by the author.

Acknowledgments
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