ACOUSTIC CORRELATES OF ALLOPHONIC PLOSIVE VOICING IN ROMEYKA GREEK

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ABSTRACT

Romeyka is an endangered Greek variety spoken in north-eastern Turkey. Its phonological system differs in many ways from the other Greek varieties, and, to our knowledge, none of its properties have ever been investigated instrumentally ([1] documents Pontic Greek, which is spoken today in Greece by the descendants of refugees from Turkey who were relocated in the 1920s; however, Pontic differs substantially from Romeyka, which is still spoken in Turkey).

The aim of this paper is to present a preliminary investigation of the allophonic voicing of Romeyka plosives. At least in the native Greek lexicon, Romeyka does not seem to use voicing contrastively in plosives. We recorded word-initial and inter-sonorant plosives produced by three Romeyka speakers. The latter often show shorter/negative VOT, a substantially larger percentage of voicing into closure, and lower f_0 at the onset of the following vowel.

Keywords: acoustics of voicing, VOT, f_0, plosives, Romeyka

1. INTRODUCTION

Romeyka is an endangered language spoken in the Black Sea region of Turkey, mainly in the Trabzon province. It belongs to the Hellenic branch of the Indo-European language family. The number of speakers is supposed to be around five thousand according to the Turkish general census [2]; however, providing a precise figure may be difficult, since Romeyka speakers' attitude towards their language is influenced by sociological and political factors [3].

Only brief sketches of Romeyka phonetics and phonology exist. To the best of our knowledge, no aspect of them has ever been investigated instrumentally/quantitatively. [1] is a recent and detailed description of the phonetic structure of the Pontic Greek variety originating from Trabzon and nowadays spoken in Etoloakarnania, Greece by descendants of refugees from Turkey who were relocated there in the 1920s; however, this variety and Romeyka differ substantially, in all likeness because of the different language contact conditions (with Standard Greek for Pontic Greek as spoken in Etoloakarnania, and with Turkish for Romeyka).

1.1. Plosive voicing in Romeyka

In this paper we focus on some acoustic properties of voicing in Romeyka plosives. Previous descriptions say that voicing appears not to be contrastive in plosives, at least in the native Greek lexicon (loanwords from Turkish may preserve plosive voicing). This does not mean that plosives are uniformly voiceless or voiced. They are uniformly voiced after nasal consonants (e.g. [gonˈdo] *gondo* 'short'), and voiceless after voiceless consonants (e.g. [ndefˈtete] *ndeftete* 'how are you'). However, in other environments they show significant variability. Allophonic voicing of plosives has been impressionalistically reported in some descriptions of the Romeyka consonant system (cf. for example [4] p. 899: "The voice distinction is weakened for plosives, with underlying voiceless stops often realized as voiced"), but no previous sketch of Romeyka goes beyond this.

2. METHODOLOGY

To explore aspects of plosive voicing in Romeyka we recorded three speakers, with the goal of investigating three parameters related to plosive voicing/voicelessness, i.e., their VOT, proportion of the closure showing glottal pulses, and f_0 of the following vowel.

2.1. Subjects and material

Two female (aged 76 and 78) and one male (aged 78) Romeyka native speakers participated in this study. They are Turkish-Romeyka bilinguals who migrated to Istanbul from Trabzon thirty years ago. We observed them to dominantly use Romeyka at home and in their inner circle.

Given the preliminary nature of our study, we focussed on only two environments, the utterance-initial and the intervocalic one. Since most Romeyka words end in a vowel or a sonorant consonant, voicing in a word-initial but utterance-medial plosive would be comparable to that of a word-internal intervocalic plosive; as said above, voicing before nasals appears to be quite systematic, as is voicelessness after voiceless consonants; since very few Romeyka words end in an obstruent other than /s/, we did not consider word-final plosives.

We created a list of Romeyka words with either a word-initial plosive or an intervocalic plosive at the onset of the second syllable (e.g., *târağma* ‘mixing’ and *atârağo* ‘unmixable’). We strived to keep the rest of the environment (stress position, quality of the adjacent vowel(s)) as similar as possible. However, sometimes the ideal candidate was not available in the Romeyka lexicon and we decided not to use pseudowords, forcing us to occasionally relax these criteria. Romeyka has three contrastive places of articulation for plosives, i.e. bilabial, dental and velar. We tried to balance place evenly in our word list, which included a total of 40 items.

The speakers were recorded in a quiet room in Istanbul, where they produced the tokens in isolation. We asked them to repeat each word three times. A cardioid condenser microphone connected to a solid-state recorder was used to record their production at a sampling rate of 44.1 kHz onto a flash disc. The overall number of tokens we recorded was 326 (40 words by 3 repetitions by 3 speakers, minus some tokens that had to be discarded).

The digitized recordings were then imported into *Praat* [5] for analysis. We manually segmented and labelled the audio files. We annotated them for onset of plosive closure, offset of plosive closure and onset of voicing.

3. RESULTS

3.1. VOT

Voice Onset Time is one of the most widely adopted criteria to measure acoustic differences among different voicing categories within plosives [6, 7].

In Romeyka, utterance-initial plosives have on average a short positive VOT (Table 1).

Place	Mean VOT (ms)	SD
Bilabial	7	17
Dental	14	9
Velar	25	13

Table 1: Mean VOT of utterance-initial plosives

On the contrary, intervocalic plosives display negative VOT (Table 2).

Place	Mean VOT (ms)	SD
Bilabial	-10	15
Dental	-9	13
Velar	-12	24

Table 2: Mean VOT of intervocalic plosives

In fact, the moderately negative mean values of intervocalic /p t k/ result from combining what appear to be three distinct ways of realizing them. As Figure 1 shows, the statistical distribution of VOT values is anything but normal. Most consonants have a moderately negative VOT, but a fair proportion has moderately positive VOT, while a handful of plosives have substantially negative VOT.

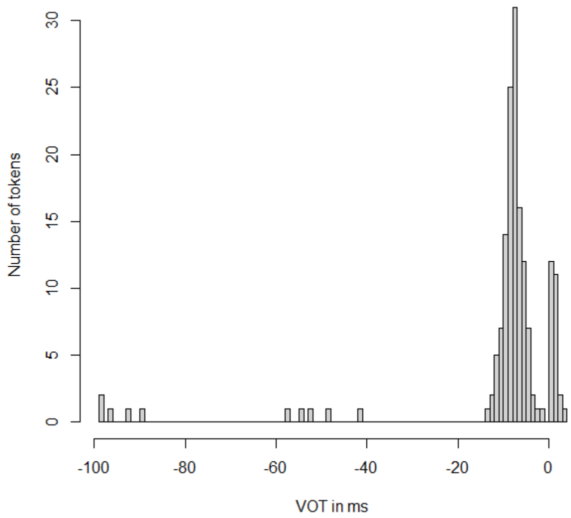

Figure 1: VOT intervocalically.

The statistical distribution of VOT in utterance-initial plosives is closer to a normal one, but sporadically VOT is amply negative (Figure 2).

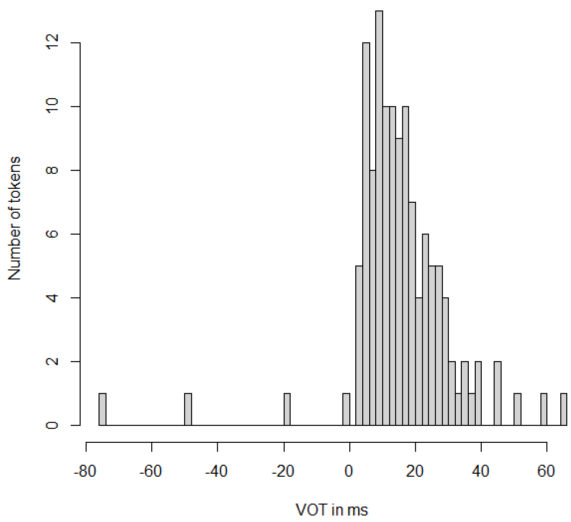

Figure 2: VOT utterance-initially.

3.2. Fraction of voicing into closure

The second parameter we used is the “fraction of locally unvoiced frames” measure in Praat’s Voice Report. It is an automated measure of the percentage of the voiced part of a segment. The reliability of this measure has been questioned [8] in the past, mainly due to the widely variable values it gives when Praat’s viewing window is scrolled and zoomed.

However, [9] has shown that, with the appropriate parameter setting, the results of Praat’s Voice Report become comparable to those obtained with manual segmentation of voicing. Therefore, we adopted [9]’s suggestion to reduce the time step of cross-correlated pitch to 0.001 seconds and use gender-specific pitch ranges (70-250 Hz for male speakers and 100-300 Hz for female speakers). We extracted the “fraction of locally unvoiced frames” of each intervocalic plosive from the onset to the offset of its closure. As for the utterance-initial plosives, the onset of their closure cannot be determined acoustically if they are voiceless (and they nearly always are in Romeyka), as they will produce no sound until the closure is released. This means that their closure duration cannot be directly measured. We used an indirect estimation; we assumed that the closure duration of each utterance-initial token was the same as the mean duration of word-initial but intervocalic plosives that we measured for a separate experiment, i.e. 91, 79 and 70 ms for /p, /t/ and /k/ respectively. This admittedly only provides a rough estimation of their real duration, but we believe it can at least highlight broad tendencies.

As with VOT, most utterance-initial plosives cluster around a prototypical value, that is complete or almost complete absence of voicing (Figure 3), while most intervocalic plosives range from mild to complete voicing (Figure 4).

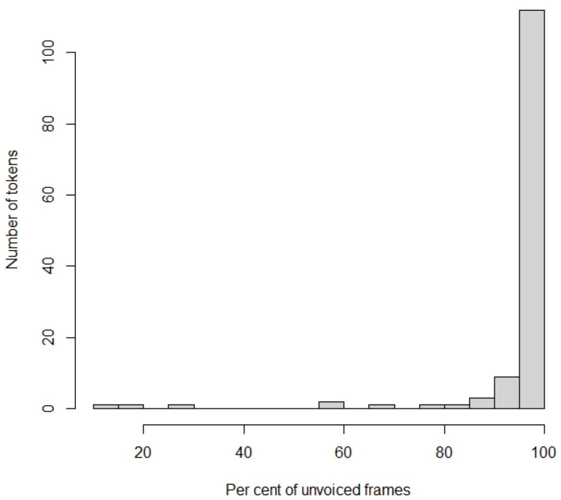

Figure 3: Fraction of locally unvoiced frames utterance-initially.

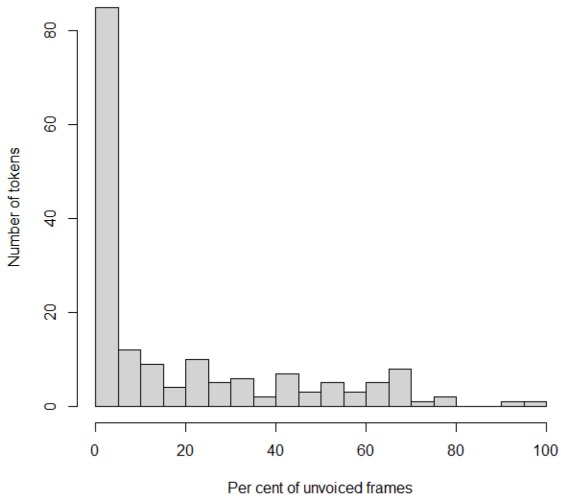

Figure 4: Fraction of locally unvoiced frames intervocalically.

3.3. F_0 of the following vowel

It has been often observed (see e.g. [10]) that voiced consonants tend to lower the fundamental frequency of following vowels. For each post-plosive vowel, we measured the interval between vowel onset and vowel midpoint, divided this interval by ten and extracted their f_0 values. The resulting f_0 contours are reported in Figures 5, 6 and 7.

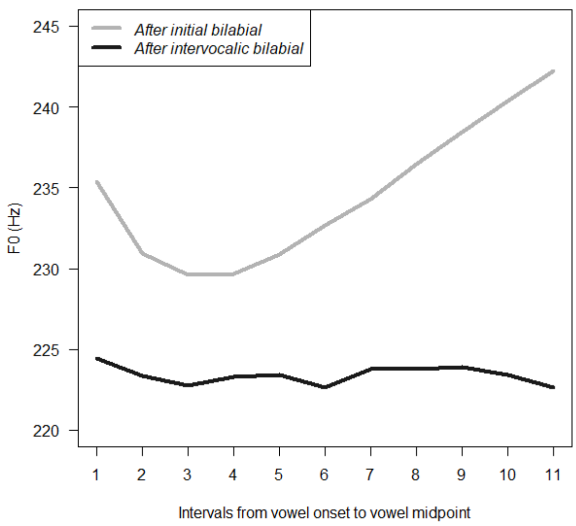

Figure 5: Mean f_0 after bilabial plosives

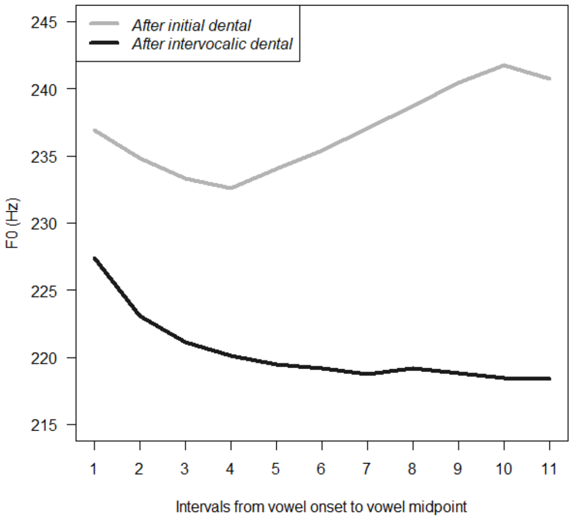

Figure 6: Mean f_0 after dental plosives.

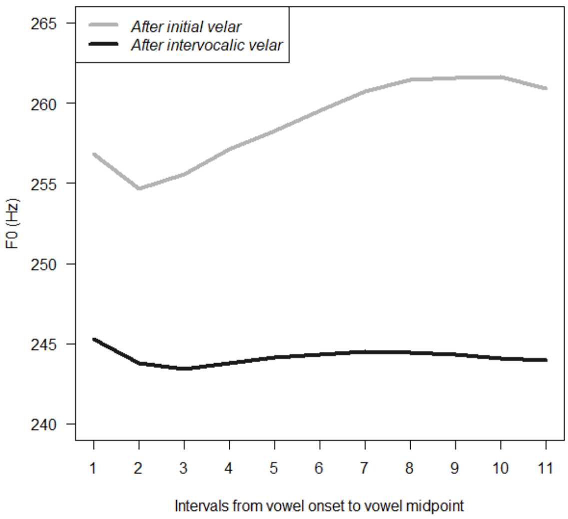

Figure 7: Mean f_0 after velar plosives.

4. DISCUSSION

The three indicators offer a broadly similar picture. As for plosives at the start of an utterance, in most cases they are unaspirated/weakly aspirated voiceless segments. Their VOT is almost always moderately positive, there is scarce if any acoustic trace of voicing during their closure, the fundamental frequency of the following vowel is not lowered. Nonetheless, occasionally a fully voiced initial plosive may occur (Figure 8).

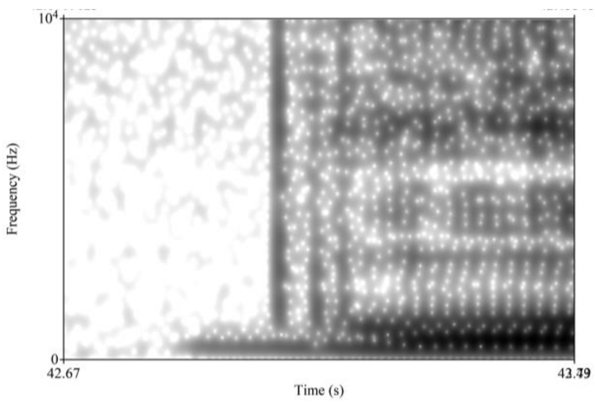

Figure 8: Initial portion [bo] of an utterance-initial token of the word *porta* /porta/ 'door', with voice bar clearly visible.

As for intervocalic plosives, they display more variability. The most common option is a segment with a moderate amount of voicing: moderately negative VOT, acoustic traces of voicing for most of the closure, some lowering of the following vowel's f_0. However, our data also show the less common but not rare occurrence of fully or nearly fully voiceless allophones, as well as of fully voiced allophones. We suspect that even the 'moderate voicing' tokens might in fact consist of two fairly distinct phonation types: some of them appear to have breathy voice throughout the consonant, while in others modal voicing is present at closure onset but then fades away, only to resume again shortly before the closure offset.

5. CONCLUSIONS

As our discussion suggested, several aspects of plosive voicing in Romeyka would deserve further investigation. Other aspects, such as the effect of stress on intervocalic voicing, have not been discussed at all. We plan to explore them in future research, as well as to examine other areas of Romeyka phonetics and phonology.

7. REFERENCES

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