

## Distributive and Acoustic Analysis of [q'] and [ʔ] Consonants in Megrelian

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### Abstract

The phonemic systems of Georgian and Zan (Megrelian-Laz) languages coincide with each other. The difference is minimal: 1) the so-called neutral vowel [ə]; 2) the glottal plosive (stop) consonant [ʔ],<sup>1</sup> which in the linguistic literature is qualified variously. It is shared that [ʔ] and dorso-uvular ejective [q'] are the allophones of one phoneme. It should be noted that [q'] falls within the system of fricatives; though following the fricative on-glide, it is characterized by occlusion as well. Here, too, the classification necessitates the consideration of syntagmatic level (e.g., in “harmonic” clusters [q'] will be found alongside the fricatives [ɣ] and [x]: [bɣ], [pɣ], [p'q']...). Because of that, some phoneticians used to qualify it as a “spirantoid” (Akhvlediani, 1999, pp. 90, 294).

Our synchronic distributive and experimental analysis shows that [q'] and [ʔ] are different phonemes. In particular, it has been stated that the distribution of [ʔ] is: #-V, V-V, #-v(ʒ), -S-v(ʒ) (and the same for [q']). Although for the [q'] : [ʔ] opposition there is no minimal pair, many examples of contrastive distributions are attested, on the basis of which we can consider [q'] and [ʔ] not as the positional variants of [q'] phoneme, but as two different phonemes in the Megrelian consonant system.

This is also confirmed by the typological point of view, because in the languages with glottalization, usually the /ʔ/ phoneme is presented. The paper will present a distributive and experimental-phonetic analysis of [q'] and [ʔ].

**Keywords:** Kartvelian languages; Megrelian consonant system; distributive and acoustic analysis.

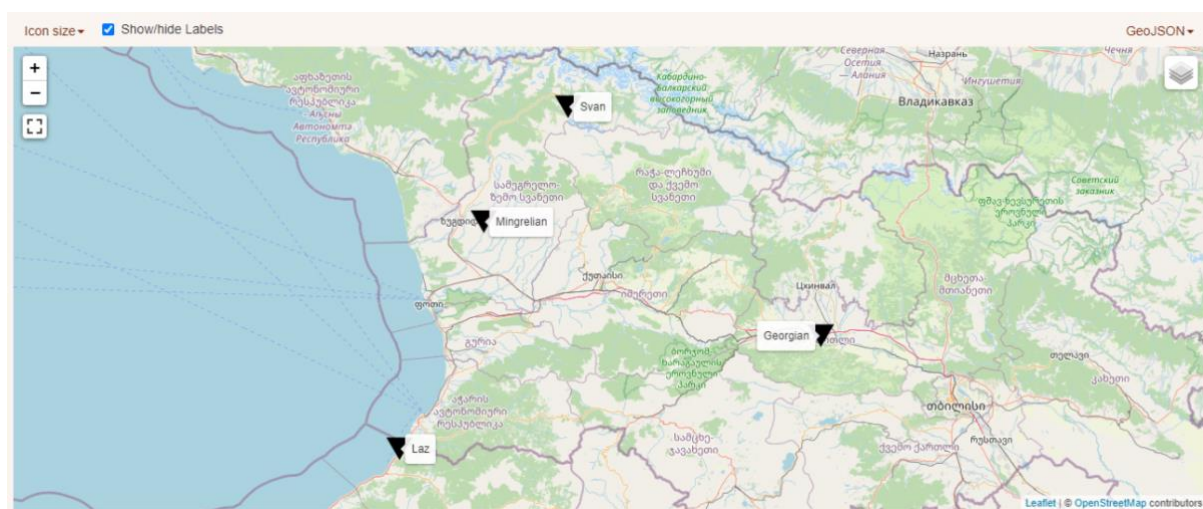
### 1 Introduction

Kartvelian languages – Georgian, Megrelian, Laz and Svan – are widespread in the South Caucasus region (see Picture 1). It is well known how interesting the structure of these languages is, from a phonematic, grammatical and typological point of view.

In what follows, we focus on the Georgian consonant system, which is comparable to the consonant system of Megrelian. Megrelian, like Georgian, is characterized by triple systems of stops. In comparison with some Georgian dialects, the sixth, postvelar triple is more deficient; /q/(/ʒ/) has been lost without a trace. This has been explained by the weakening of pharyngeal articulation and, on this basis, by a change of articulation, and sometimes, – by complete disfunction (Zghenti, 1953, pp.57-64). [ʔ] marks another important difference between the Megrelian and the Georgian consonant systems.<sup>2</sup>

<sup>1</sup> In the traditional Romanization of many languages the glottal stop is transcribed with an apostrophe (').

<sup>2</sup> For the description of the Georgian and Megrelian consonants, see Aronson 2005, Kartoziya et al. 2010.



Picture 1. The World Atlas of Language Structures Online – Family Kartvelian (Dryer and Haspelmath, 2013)

## 2 History of the Issue

Tsagareli (1880) was the first to note [ʔ] as characteristic of the Megrelian phoneme system. He also introduced the graphic symbol [ɣ] – for recording Megrelian texts. At the same time, Tsagareli has tried to clarify the articulation and acoustic nature of this sound. He writes: “sound [ʔ] has the same origin as [q’], however, the former is half weaker than the latter qualitatively, as well as quantitatively. In particular, while pronouncing this sound, it is not necessary to press the organs, participating in its pronunciation, against each other strongly. The base of tongue, rising, slightly touches the end of the soft palate. The air stream, overcoming this obstacle, emits sound [ʔ], which is less intensive by its pitch and length than sound [q’]” (Tsagareli, 1880, p.26). According to his observation, in the roots of words that Megrelian and Georgian have in common, in most cases, Georgian /q’/ is converted into [ʔ] in Megrelian. Tsagareli puts [ʔ] among glottals based on its place of articulation, and among voiceless fricatives based on its manner of articulation.

Kipshidze (1914, p.4) characterizes [q’] as glottal, *complex, voiceless* stop, and [ʔ] – as glottal, *simple, voiced* stop consonant, though, on the same page the author mentions [ʔ] among spirants (fricatives), too.

According to Zhghenti’s experimental data, it is clearly confirmed that “q’(g) is different from ʔ (ɣ) both quantitatively and qualitatively. It is not correct to consider ʔ as a voiceless spirant (fricative), neither is it an ejective stop of full value. But it is closer to an ejective because of momentary glottis occlusion and plosion” (Zhghenti, 1953, pp.61-62).

T. Gudava characterizes [ʔ] as a voiceless, ejective consonant, which is produced by the clicking of vocal folds. Diachronically, it is a secondary sound in Megrelian, its creation being connected to the sound q’. The transition q’→ʔ is explained by a disfunction of the pharyngeal triple (-, q, q’), though in Megrelian together with [ʔ], it is still represented as [q’], too. He notes that we can consider [ʔ] as a glottal stop in diverse positions.<sup>3</sup>

<sup>3</sup> Personal communication with Prof. T. Gudava (special course in Megrelian, Tbilisi State University, 1973-74).

In the compact yet extremely valuable work by Gudava and Gamkrelidze (1981, pp.202-242), a transparent and clear formula for the consonant clusters is presented; with regard to [q'] and [ʔ], it is said that the phoneme /q'/ combines two positional variants, [q'] and [ʔ].

In Gaprindashvili's opinion, [ʔ] is a non-ejective pulmonic egressive sound. In order to pronounce [ʔ], considered as a glottal stop, a pulmonic airstream is necessary. "Translaryngeality of this sound is the reason that in Iberian-Caucasian languages it shows a propensity towards transformation into fricative, as well as towards voicing. There is a ground to think that in several languages the consonants, considered as this sound, are produced not among the vocal folds, but much higher, in the lower part of the pharyngeal cavity" (Gaprindashvili, 1962).

These different, often mutually exclusive viewpoints, pushed us to conduct our own distributive and acoustic analysis of [q'] and [ʔ] in Megrelian.

### 3 Distributive analysis

Let us begin with the analysis of [ʔ]:

#### I. #-V \_ Initial position of a word before a vowel.

In the initial position [ʔ] is attested before all five vowels:

ʔa – "branch", "spray"

ʔɛrt'i – "twig"

ʔidiri – "to buy" (pidurenk - < vʔidurenk) "I am buying";<sup>4</sup>

ʔɔtua – "lamentations"

ʔude – "house"

#### II. V-V – Intervocal position.

The surrounding vowels can be represented by any variant, i.e. there may be the same vowel or a different one:

a-a: laʔapi – "play"

a-i: varaʔia – "pullet"

a-ɔ: giʔaʔɔtama – "to expell"

a-u: raʔua (braʔə) – "to banish, to send off, to shake out, to fluff up"

ɛ-ɛ: ʃɛʔɛri – "vine shoot"

ɛ-ɔ: geʔɔnua, ʔonua – "ingrafting"

ɛ-a: kɛʔana – "country"

i-i: gəriʔinapa (k'isəriʃi) – "crane the neck"

i-a: riʔali – "long, high"

i-u: ciʔua, gɛciʔua – "to swallow"

ɔ-ɔ: nɔʔɔri – "throat, gorge, jaws, pharynx"

ɔ-a: dɔʔafua (binɛriʃi) – "layerage of vine"

ɔ-ɛ: ɔʔɛ – "trumpet, horn"

ɔ-i: ɔʔia – "to agree, yes"

ɔ-u: nɔʔuri – "husk"

<sup>4</sup> In the verb stems, beginning with the consonant ʔ v+ʔ→ p'+ʔ is implied, by further losing of ʔ consonant. E.g., v-ʔidulenk → \*p'-ʔidulenk → p'-idulenk "I am buying"; v-ʔilunk → \*p'-ʔilunk → p'-ilunk "I am killing". From these examples it is clear that ʔ is a voiceless sound, if it were a voice consonant, positionally conditioned voice allomorph /b/ would be instead of ejective [p'].

u-u: nuʔu, nəʔu – “log”  
 u-i: duʔi – “elbow”

III. In the consonant clusters we meet [ʔ] only before /v/ (3):

ʔva – “forehead”  
 ʔvali – “cheese”  
 ʔvεε – “blind”  
 paʔvapi tərifi – “snow in flakes”  
 dzaʔvapi – “to bang”  
 biʔvali – “bloated”  
 rεʔvini – “to fidget”  
 pəʔvinapa – “shrivel”

If we look at the examples of canonical two-member clusters, we’ll see that /ʔ/ is met as word-initial as well as word-medial. There is the unique example in the non-canonical cluster: -mʔv-, tsimʔva, tsəmʔva – “strawberry” (cf. muʔi – “blackberry”).

Thus, as we see, the distribution of ʔ is: #-V, V-V, #-v-, -S-v-. The possibility that in Megrelian [ʔ] is indeed derived from [qʰ] and is of secondary origin, would indicate that among the Kartvelian languages [ʔ] is represented only in Megrelian-Laz., that is to say in Megrelian it has shifted towards the back (qʰ → ʔ) and has arisen as a laryngeal consonant of back production. It is yet to be confirmed whether [ʔ] is a positional variant of the /qʰ/ phoneme, i.e. whether it is an allophone of /qʰ/ or a different phoneme. In order to answer this question, we also need to examine the distribution of [qʰ] in Megrelian.

Many stems containing /qʰ/ are attested in Megrelian. /qʰ/ is found in the canonical four-member (e.g., rtʃʰqʰv – lɛrtʃʰqʰva – “saliva”, ntsʰqʰv – ntsʰqʰviri “collapsed”, three-member (e. g., rtʰqʰ – ɔrtʰqʰapu “belt”, ntʰqʰ – mɔtʰqʰɔri tʰqʰ – “wool”) and also two-member (e.g., tʰqʰ – tʰqʰa “forest”, tsʰqʰ – tsʰqʰu “well”) clusters.

Examples where qʰ and ʔ freely replace each other can also be found: e.g.: qʰazaxi || qʰazaqʰi || ʔazaxi – “peasant”, qʰarɛba || ʔarɛba – “movement”, qʰintua || ʔintua – “to swallow”, qʰurdgɛli || ʔurdgɛli – “rabbit”, etc.

The question could be raised of what the relationship is between the variants [qʰ] and [ʔ] in Megrelian. We could not see a minimal pair for the [qʰ] and [ʔ] opposition, but there are several examples of contrast distribution, providing grounds for considering [qʰ] and [ʔ] not the positional variants of one phoneme /qʰ/ but two different phonemes in the consonant system of Megrelian.

It is possible to meet /qʰ/, as well as /ʔ/, in the initial position of a word before different vowels, e.g.:

qʰantʃʰi – “silk moth”  
 qʰɛburi – “hearth”  
 qʰiari – “double-yoke”  
 qʰɔrqʰɛli – “throat, larynx”  
 qʰursua – “to fall silent”

Examples of **q'** appearing in the V-V position:

raq'alε – “complaint”

vaq'a – “horse”

dzabaq'ula – “middle decoration”, “wrapped around a pillow”

buq'uni – “wooden vessel barrel”

#-v- position:

q'vabua – “to feed”

q'vizali, q'vizili – “bluish”

q'vandgini – “to reproach”, “protest”, “grumble”

q'varili – “sterilized cock”

q'varani – “raven”

Thus, the distribution of **q'** is: #-V, V-V, #-v-.

We can observe the following:

1. In Megrelian [**q'**] does not change in the case, if it is a member of a “harmonic” cluster: e.g., Georg. t'q'avi (“leather”): Megr. – t'q'εbi, Georg. mts'q'εri (“quail”): Megr. – tʃ'q'ɔri, Georg. ts'q'alɔba (“mercy, favor”): Megr. tʃ'q'ɔlɔpua, Georg. mts'q'εmsi (“shepherd”): Megr. tʃ'q'ɪʃi, Georg. ts'q'vet'a (“interruption”): Megr. tʃ'q'vadua, etc.
2. In Megrelian [**q'**] is conserved even when there are two [**q'**]-s in the same word. E.g., Georgian q'iq'inεbs (“it croaks”): Megr. q'aq'alans, Georg. q'urq'uri (“curmurring”): Megr. q'urq'ini, etc.
3. [**q'**] is also evident in words recently borrowed from Georgian, such as: q'avari (“shrinkle”), q'ambari, dzaq'va (“pen-knife”), briq'vi (“stupid”), niq'vi (“sort of mushrooms”), sit'q'va (“word”), etc.

Thus,

- **q'** (ɣ) and ʔ (ʁ) are two independent phonemes in the consonant structure of the Megrelian language.
- Diachronically, /ʔ/ is a secondary sound, derived from **q'**, (**q'** → ʔ). At the first stage of the shift, there was a free alternation of **q'** and /ʔ/ variants, and after appearing in contrast positions, they were formed as the allophones of different phonemes.
- In the position of free alternation, the phonemic opposition is neutralized and we could have freely alternating allophones and phonemes as well. In this case, we have phonemes.
- It is interesting that typologically in the languages where glottalization is represented, phoneme /ʔ/ is also attested (Melikishvili, 2000) – i.e., as is the case in Megrelian.

## 4 Digital acoustic analysis

The digital acoustic analysis of Megrelian speech was performed using the following computer programs: Praat and WaveSurfer.

In the initial position, before a vowel, the consonant *q'* can be represented by the acoustic picture of a plosive (See Appendix, Fig. 3, 4, 5, 16, 23) or fricative (Fig. 1, 6, 17, 24).<sup>5</sup> The parameters of plosive [*q'*] are as follows: 10-35 ms (millisecond) noise of burst, and, as a rule, a silent period between burst and vowel onset (duration 5-20 ms); for a fricative variant [*χ'*], the noise is typically quite long in duration (55-100 ms) and is followed by a silent period (20-35 ms) or not.

For the onset of the following vowel, common to both variants is a great jitter perturbation of the vocal folds or laryngalization (“creaky voice”), which is expressed through a deformed F-pattern and, as a consequence, a slow rise in amplitude (slow rise time); generally, a vowel can begin with a low, even or high (although rarely) fundamental frequency (*f*<sub>0</sub>) and a slow, moderate or sharp rise in amplitude (fast rise time). Depending on the combination of these parameters at the vowel onset, there can be different variants: a) – with high fundamental frequency and fast rise time; b) – with low *f*<sub>0</sub> (possible with creaky voice) and slow rise time; c) – with low *f*<sub>0</sub> and fast rise time; d) – even *f*<sub>0</sub> and slow or fast rise time.

In the initial position, before the consonant *v*, a fricative picture for the consonant *q'*, with a duration of noise of 60-95 ms and with or without a silent period of 25-60 ms is more frequent; the instances of the plosive variant (noise 15-80 ms) are significantly reduced, and the silent period (20-60 ms) is about the same (Fig. 8, 20).

The voicing of [*v*] can begin with low, even or high *f*<sub>0</sub> or with “creaky voice” and slow or fast rise time. The degree of jitter perturbation of the vocal folds in comparison with the vowel onset is slightly lower: also, it should be noted that the plosive variant before a vowel is represented by a shorter noise.

In initial clusters (*t'q'* and *c'q'*), the consonant *q'*, as a rule, is represented only by noise (duration 25-70 ms) without closure and with a silent period of 15-55 ms. In case there is closure, its duration varies within 15-25 ms – and that of the silent period – within 10-15 ms (Fig. 4, 13, 18).

In intervocalic position, the consonant *q'* is realized as a fricative (noise duration 50-95 ms) or “spirantoid” [*χq'*] with closure noise, closure phase, burst impulse and silent period – total duration 70-100 ms (Fig. 16, 17, 23, 24).

As for the acoustic properties of /ʔ/, in the initial position, before a vowel, it is typical to find a glottal burst impulse with short low-frequency noise (See Appendix, Fig. 2) or without noise (Fig. 7, 11, 14, 21). Voicing begins with a great jitter perturbation of the vocal folds. At the vowel onset, depending on the character of the *f*<sub>0</sub> perturbation and the intensity increase dynamics, it is possible to identify different variants: a) – with high *f*<sub>0</sub> and fast rise time; b) with low *f*<sub>0</sub> and fast rise time; c) with even *f*<sub>0</sub> and fast rise time.

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<sup>5</sup> There is one case, when burst is followed by quite a long noise (Fig.10).

In the initial position, before [v], the properties are similar to the position before a vowel, but the difference is that, as a rule, the voicing for the consonant begins with low f0 and slow rise time (See Appendix, Fig. 8).

In the intervocalic position, /ʔ/ is represented acoustically as a voiced approximant with creaky voice (duration 50-90ms), in comparison with its neighboring vowels with small intensity and low f0 (See Appendix, Fig. 9, 12, 15, 19).

According to the dichotomic classification of glottalization (Lindau, 1984; Stevens, 1998; Wright et al., 2002), the stiff glottalized is produced by means of moderate medial compression and extreme longitudinal tension of the vocal folds, which corresponds to the beginning of voicing with sharp and high f0; the slack glottalized is characterized by little longitudinal tension of the vocal folds (f0), extreme medial compression (slow rise time) and the so-called “creaky voicing”. In other words, fast rise time at the vowel onset means moderate compression of the vocal folds, slow rise time extreme medial compression, high f0 extreme longitudinal tension and low f0 little longitudinal tension. As it is evident from the analyzed Megrelian material (Table 1, 2), the vowel onset following the initial glottalized sound with even f0 is frequent; consequently, this acoustic feature could correspond to the moderate longitudinal tension of the vocal folds.

The tables below show the correlation of the acoustic parameters of the vowel onset, following the [qʰ] and [ʔ] sounds, with vocal fold articulation:

Table 1. Correlation of the acoustic parameters with the articulation at vowel onset, following the initial /qʰ/ sound.

<i>Rise time</i> <i>F0</i>	Slow	Fast	
Low	+	+	Little longitudinal tension
Even	+	+	Moderate longitudinal tension
High	–	+	Extreme longitudinal tension
	Extreme medial compression	Moderate medial compression	<b><i>Vocal folds position</i></b>

Table 2. Correlation of the acoustic parameters with the articulation at vowel onset, following the initial /ʔ/ sound.

<i>Rise time</i> <i>F0</i>	Slow	Fast	
Low	–	+	Little longitudinal tension
Even	–	+	Moderate longitudinal tension
High	–	+	Extreme longitudinal tension
	Extreme medial compression	Moderate medial compression	<b><i>Vocal folds position</i></b>

From the tables, we can clearly see that after glottal plosion, high f0 at the vowel onset and fast rise time indicate the energetic plosion of the vocal folds that is achieved by means of the extreme longitudinal tension and moderate medial compression. But low f0 and slow rise time



or laryngalization (“creaky voicing”) at the vowel onset show little longitudinal tension and extreme medial compression of the vocal folds; at the beginning of the voicing low  $f_0$  and fast rise time mean little longitudinal tension and moderate medial compression of the vocal folds. Even  $f_0$  and fast rise time mean moderate longitudinal tension and extreme medial compression of the vocal folds.

The pronunciation of /ʔ/ in the initial position is characterized by only moderate medial compression and little, moderate or extreme longitudinal tension, whereas /qʰ/ is characterized by moderate as well as strong medial compression and little, moderate or extreme longitudinal tension.

So, unlike /qʰ/, for the articulation of /ʔ/ a strong medial compression of the vocal folds is not typical. At the same time, it is also noteworthy that neither /qʰ/ nor /ʔ/ are pronounced with extreme longitudinal tension and medial compression.

The Arabic glottal stop (ʔ), the so-called “hamza,” has a sharper increase in amplitude in the initial position compared to the Megrelian [ʔ] (See Appendix, Fig. 25, 26, 27). However, in intervocalic and final position, it retains the picture of a voiceless plosive (Appendix, Fig. 26, 27, 28).<sup>6</sup> The acoustic picture of the Megrelian intervocalic /ʔ/ is very much like that of the Arabic pharyngeal voiced fricative, which, because of its insignificant turbulent noise, can be qualified as approximant (Fig. 28, 29, 30).

## 5 Conclusion

Finally, on the basis of the distributive and experimental analyses presented above, we can say that: 1. Consonant /qʰ/ in Megrelian is optionally realized as a glottalized stop [qʰ], a fricative (χʰ), or as a “spirantoid” (Akhvlediani, 1999, pp.90, 294) [χqʰ] (only in intervocalic position). 2. Fricative articulation is more typical within clusters (tʰqʰ...) and in intervocalic position. 3. According to the acoustic picture, sound [ʔ] in Megrelian can be phonetically characterized as follows: in initial position as a glottal plosive, and in intervocalic position as a voiced pharyngeal approximant with laryngealization<sup>7</sup>. 4. The voicing should be promoted by the fact that for the pronunciation of this sound a moderate and not extreme medial compression of the vocal folds is typical. 5. The clearly complicated nature of the sound /ʔ/ is probably the reason behind different, sometimes even contradictory, descriptions (Tsagareli, 1889; Kipshidze, 1914).

## 6 References

- Akhvlediani, G. 1999. *Zogadi ponet'ik'is sapužvebi* [Foundations of general phonetics]. Kartvelologiuri bibliotek'a.
- Aronson, H. I. 2005. *Georgian: A Reading Grammar*. Chicago: Slavica.
- Chargeishvili, A. 1946. Kartuli tanxmovnebis „qʰ” da „q” biomekanik'is sak'itxebistvis [Biomechanic issues of Georgian consonants „qʰ” and „q”]. *Moambe*. 7(8), pp.537-542.
- Chikobava, A. 1942. *Saxelis pužis užvelesi agebuleba kartvelur enebši* [Ancient structure of noun basis in Kartvelian languages]. Tbilisi: Moambe.
- Fähnrich, H., Sardjveladze, Z. 2000. *Kartvelur enata et'imologiuri leksik'oni* [Etymological dictionary of Kartvelian languages]. Tbilisi: Tbilisi University Press.
- Gamkrelidze, T. 2000. *Rčeli kartvelologiuri šromebi* [Selected Kartvelologian works]. Tbilisi: Kartvelologiuri bibliotek'a.

<sup>6</sup> Arabic glottal stop is frequently realized as creaky voice in intervocalic position.

<sup>7</sup> It is analogous to voicing of *h* because of insignificant constriction.



- Gaprindashvili, Sh. 1962. Xšul-msk'dom tanxmovanta k'lasipik'aciistvis kartvelur enebši [Classification of plosives in Kartvelian languages]. *Iberian-Caucasian Linguistics*. **13**, pp.81-91.
- Gudava, T., Gamkrelidze, T. 1981. Tanxmovantk'omp'leksebi megrulši [Consonant clusters in Megrelian]. *Tbilisi State University Collection for Akaki Shanidze*. Tbilisi: Tbilisi University Press, pp.202-243.
- Imnadze, N. 1981. *Zanuri enis megruli dialekt'is bgeriti šedgeniloba [Phonematic structure of Megrelian dialect of Zan language]*. Tbilisi: Mecniereba.
- Kartozia, G., Gersamia, R., Lomia, M., Tskhadaia, T. 2010. *Megrulis lingvist'uri analizi [Linguistic Analysis of Megrelian]*. Tbilisi: Meridian.
- Khubua, M. 1937. *Megruli t'ekst'ebi [Megrelian texts]*. Tbilisi: Izdatelstvo Alademii Nauk Gruzinskoi SSR.
- Kipshidze, I. 1914. *Грамматика мингрельскаго (иверскаго) языка съ хрестоматіей и словаремъ [Grammar of Megrelian (Iberian) language with chrestomaty and dictionary]*. S-Peterburg: Tipografiia Imperatorskoï Akademii Nauk.
- Lindau, M. 1984. Phonetic Differences in Glottalic Consonants. *Journal of Phonetics*. **12**, pp.147-155.
- Melikishvili, I. 2000. *Kartvelur enata ponologiuri t'ip'ologiisatvis [Phonological typology of Kartvelian Languages]*. Tbilisi: Tbilisi State University.
- Stevens, K. N. 1998. *Acoustic Phonetics*. Cambridge: MIT Press.
- Tcharaia, P. 1997. *Megrul-kartuli leksik'oni [Megrelian-Georgian dictionary]*. Tbilisi: Tbilisi State University.
- Tsagareli, A. 1880. *Мингрельские этюды (Megrelian etudes)*. S-Peterburg: Tipografiia Imperatorskoï Akademii Nauk.
- Uturgaidze, T. 1976. *Kartuli enis ponemat'uri st'rukt'ura [Phonematic structure of Georgian language]*. Tbilisi: Mecniereba.
- Dryer, M.S. and Haspelmath, M. eds. 2013. *The World Atlas of Language Structures Online*. [Online]. [Accessed 22 December 2020]. Available from: <https://wals.info/language/family/kartvelian#8/42.254/42.750>
- Wright, R., Hargus, S. and Davis, K. 2002. On the categorization of ejectives: data from Witsuwit'en. *Journal of the International Phonetic Association*. **32**, pp.43-77.
- Zhghenti, S. 1953. *Č'anur-megrulis ponet'ik'a [Chan-Megrelian phonetics]*. Tbilisi: Tbilisi State University.

## Appendix<sup>8</sup>

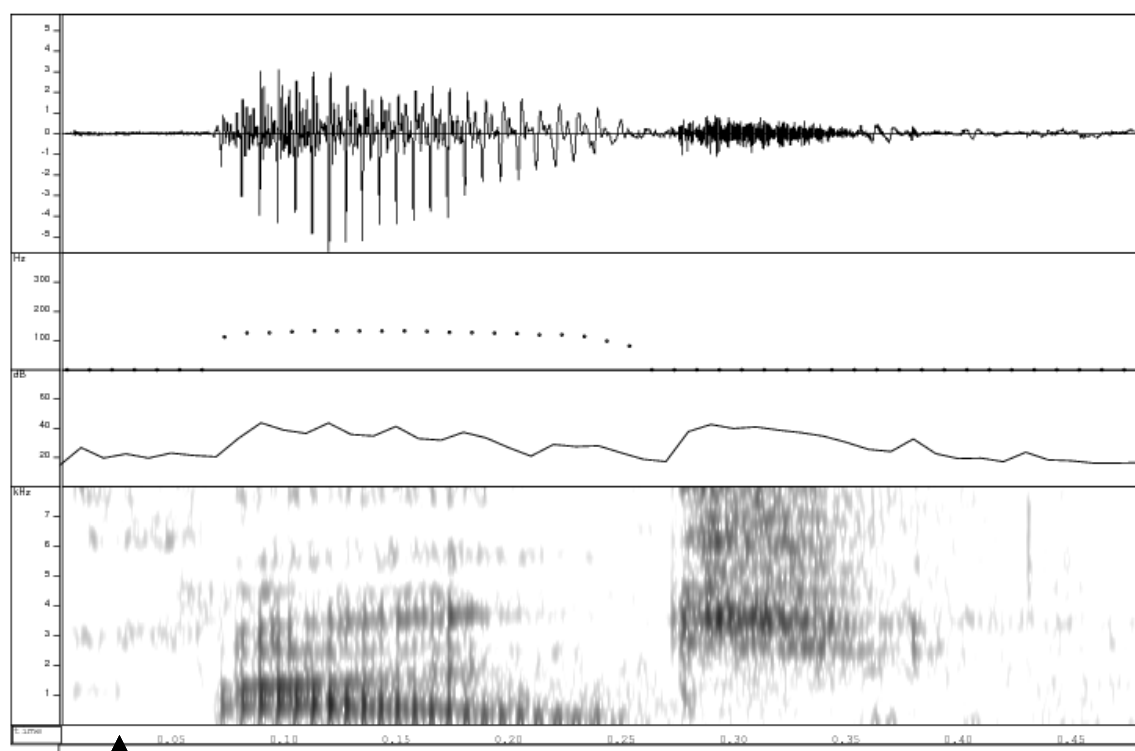


Figure 1. ჰერონი [xʰantʃa] (fricative) – “heron” (G. A. – male)

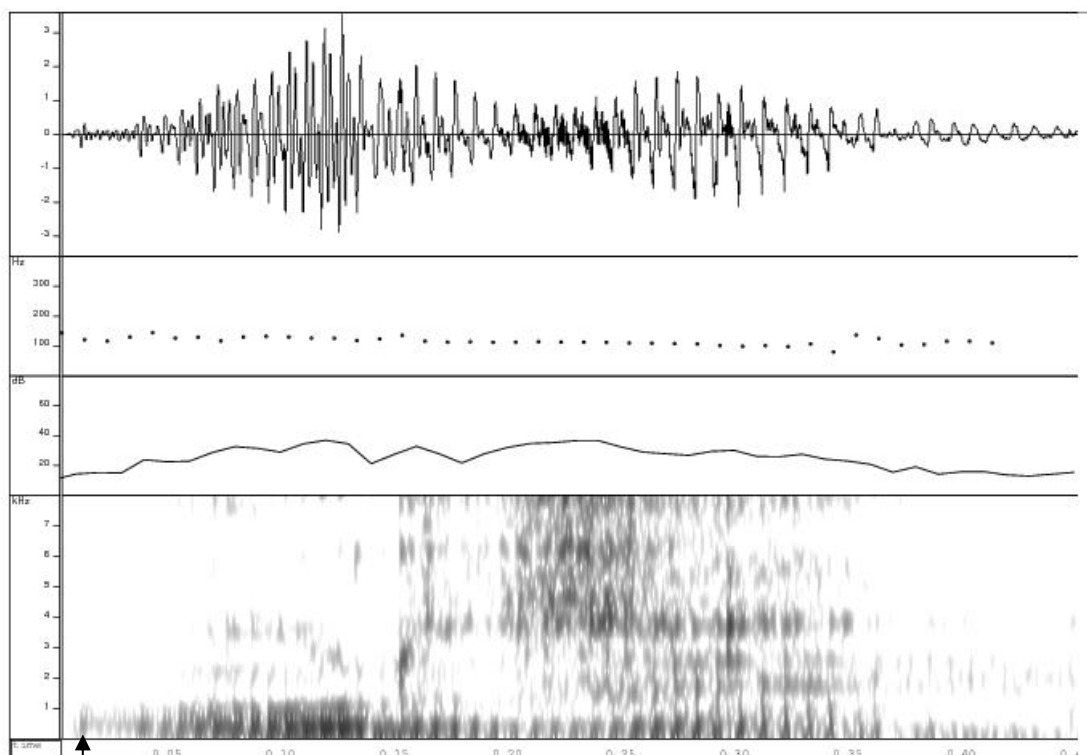


Figure 2. ურძენი [ʔurdzeni] (glottal plosive with noise) – “grape” (G. A. – male)

<sup>8</sup> The acoustic figures of analyzed audio material (spectrogram, waveform, pitch contour and power plot) are visualized by means of WaveSurfer.

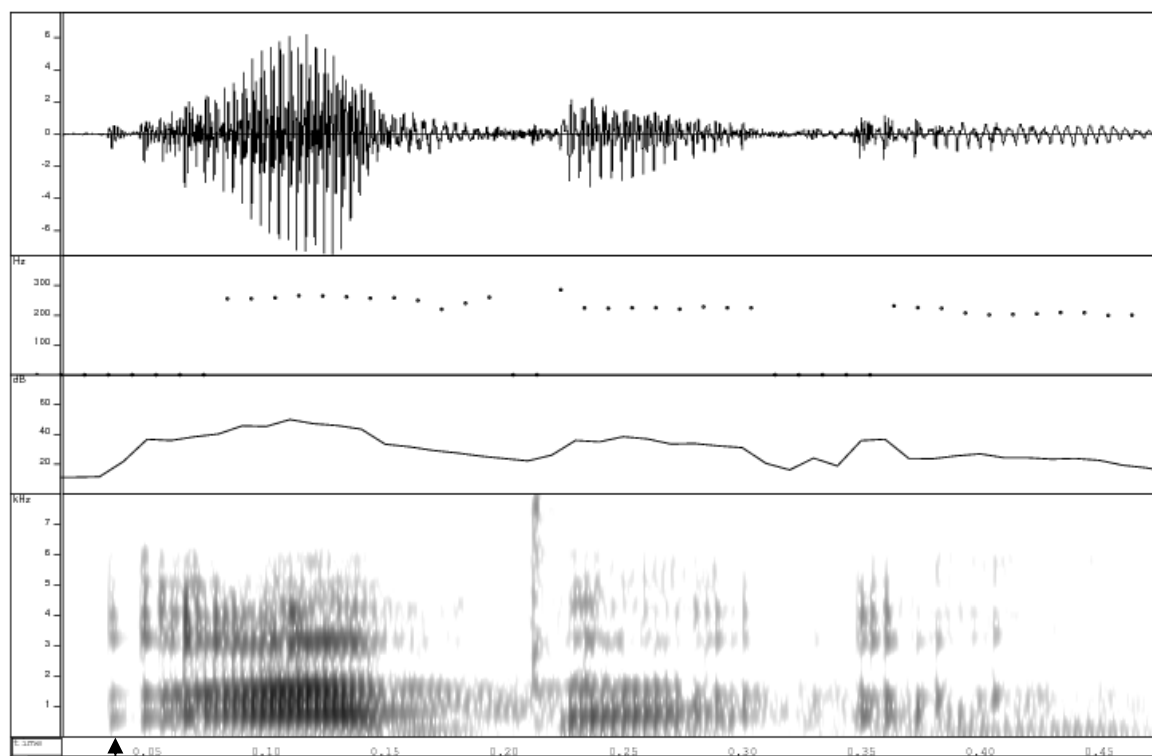


Figure 3. ყადაღა [q'adaɣa] (plosive) – “seizure” (T. A. – female)

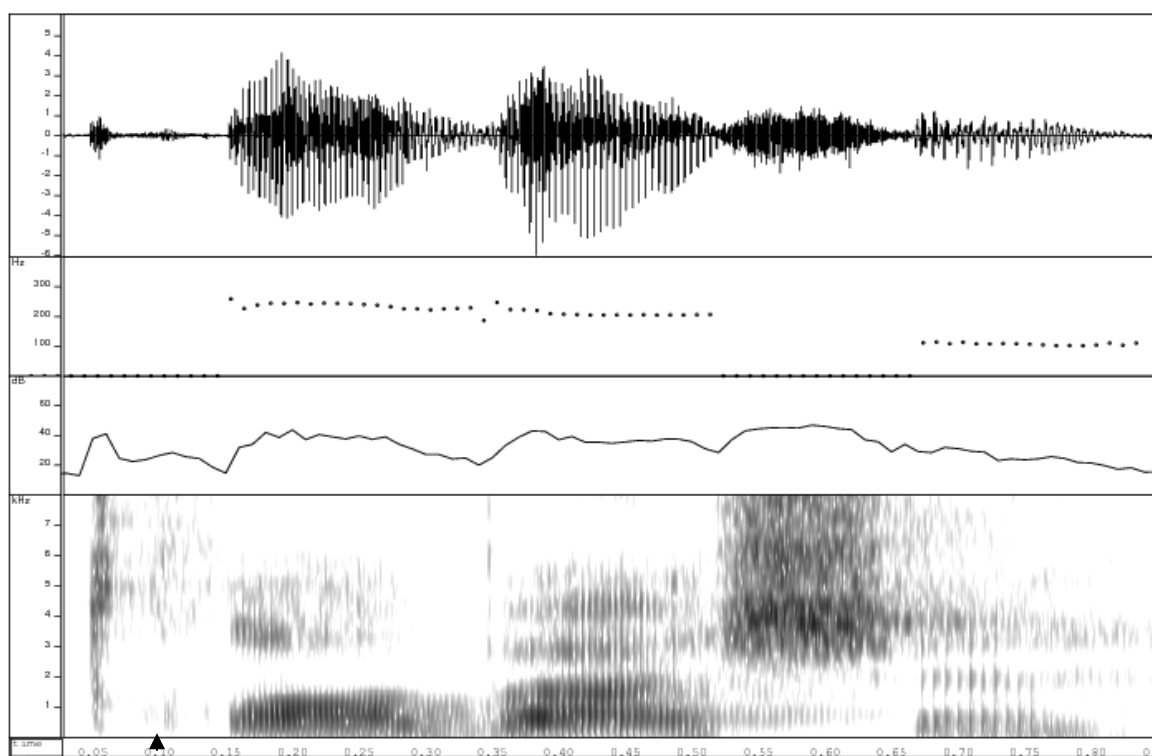


Figure 4. ტყობაზე [t'q'abafɛ] (plosive) – “secretly” (T. A. – female)

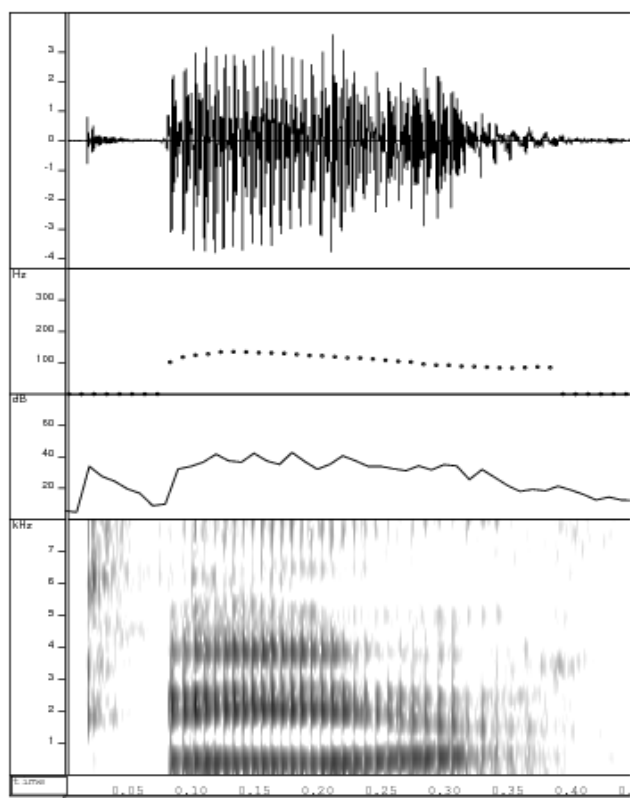


Figure 5. γos [q'ia] (plosive) – “abdomen” (G. Sh. – male)

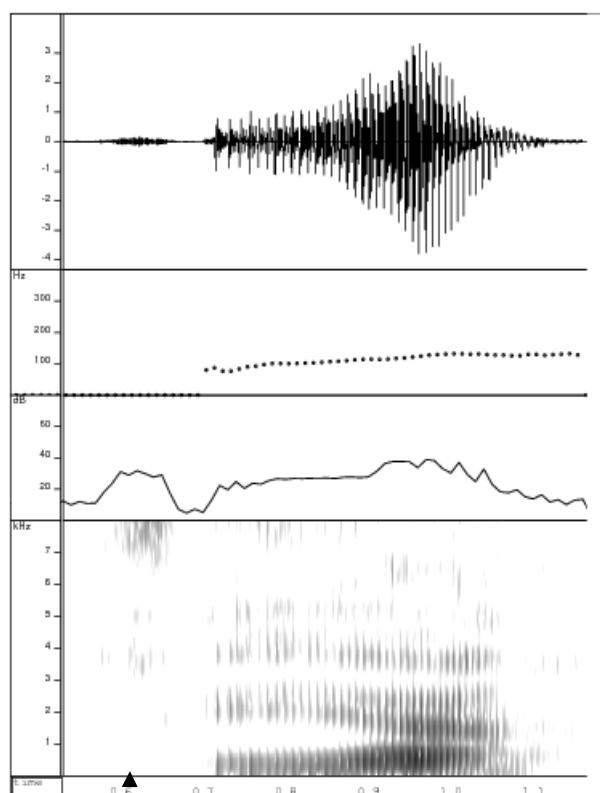


Figure 6. γos [χ'ia] (fricative) – “abdomen” (G. Sh. – male)

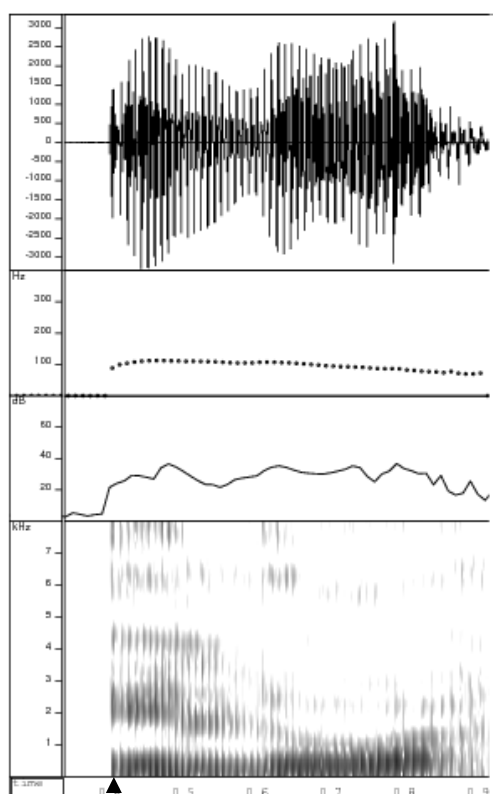


Figure 7. გილუა [ʔilua] (glottal plosive) – “croak” (G. Sh. – male)

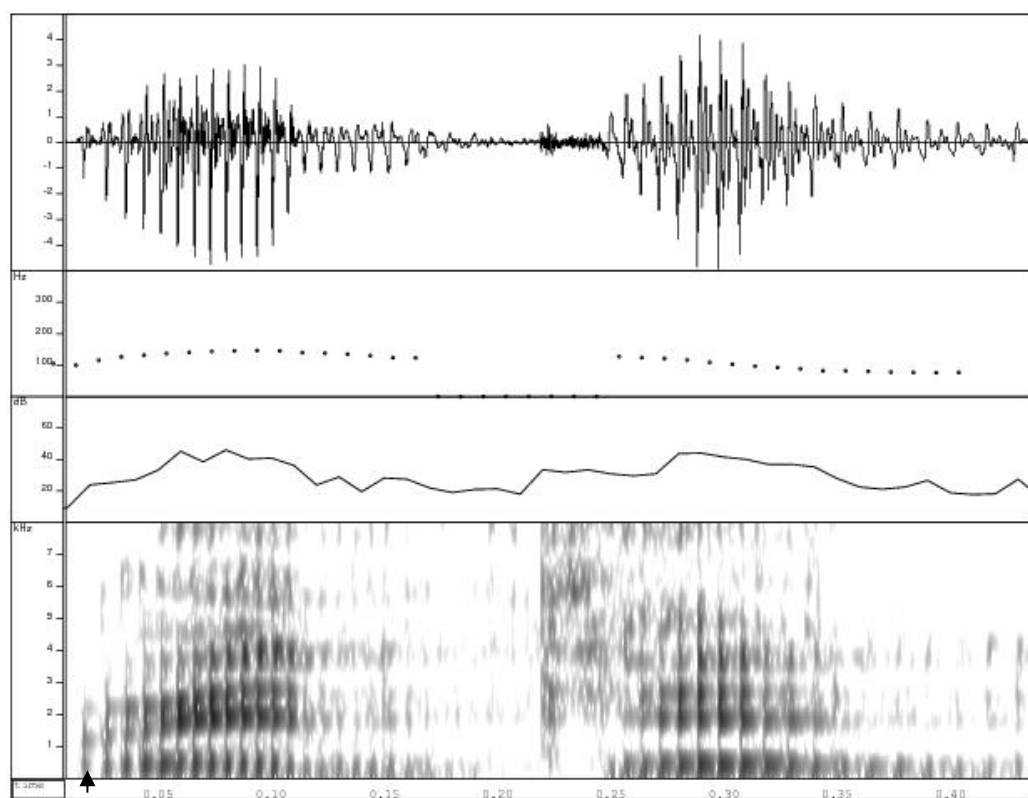


Figure 8. ყვინთელი [ʔvinteli] (glottal plosive) – “yellow” (G. Sh. – male)

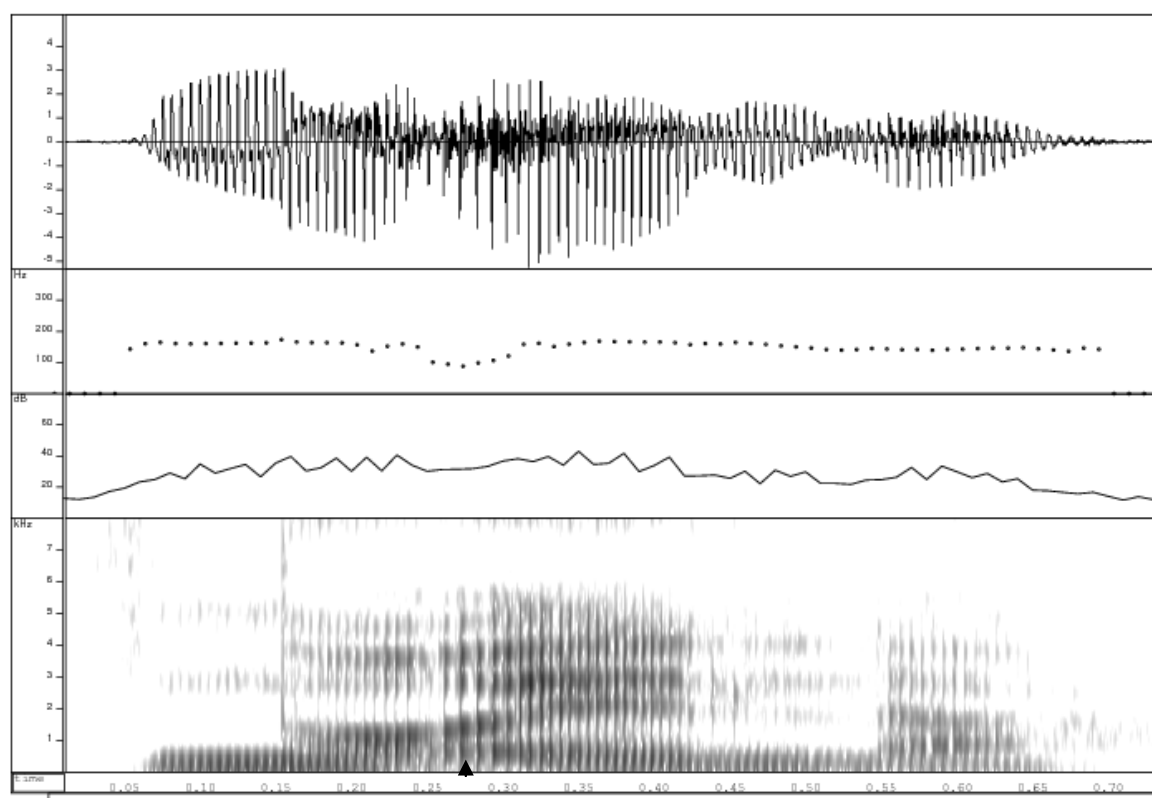


Figure 9. ნოჲენა [nɔʃena] (approximant) – “they have had” (L. G. – female)

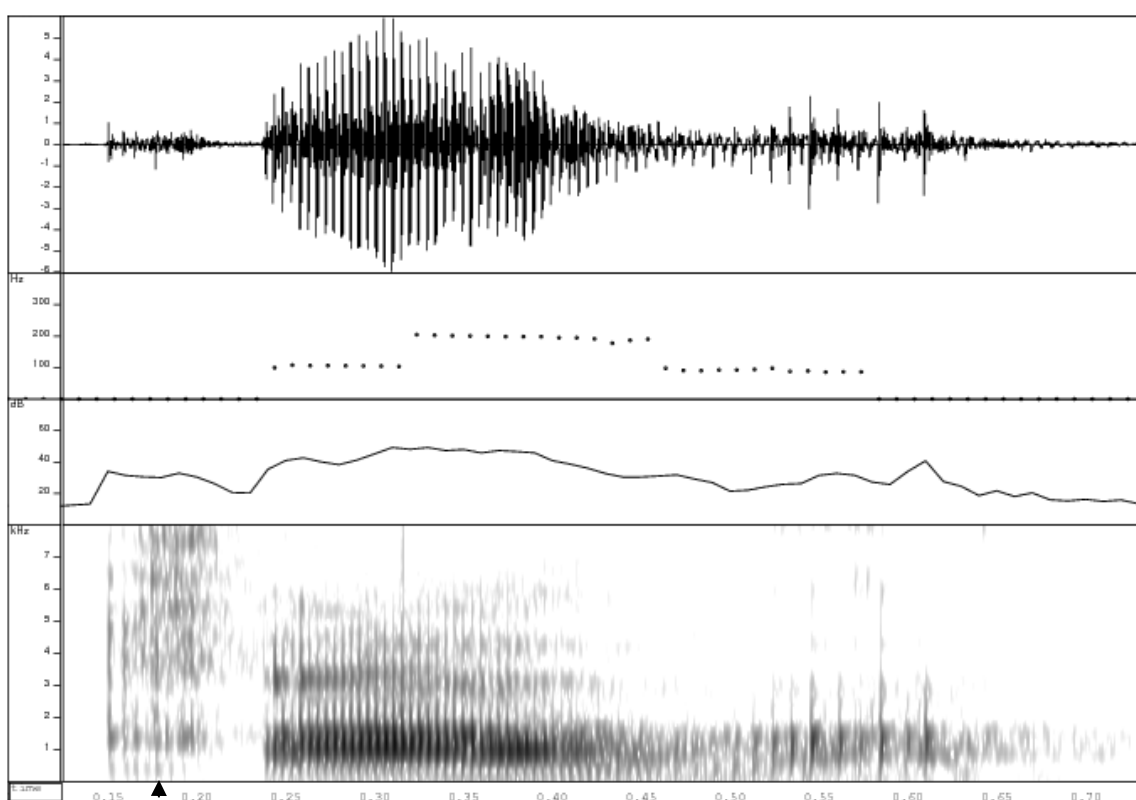


Figure 10. ყავა [qχ'ava] (plosive + fricative) – “coffee” (N. K. – female)

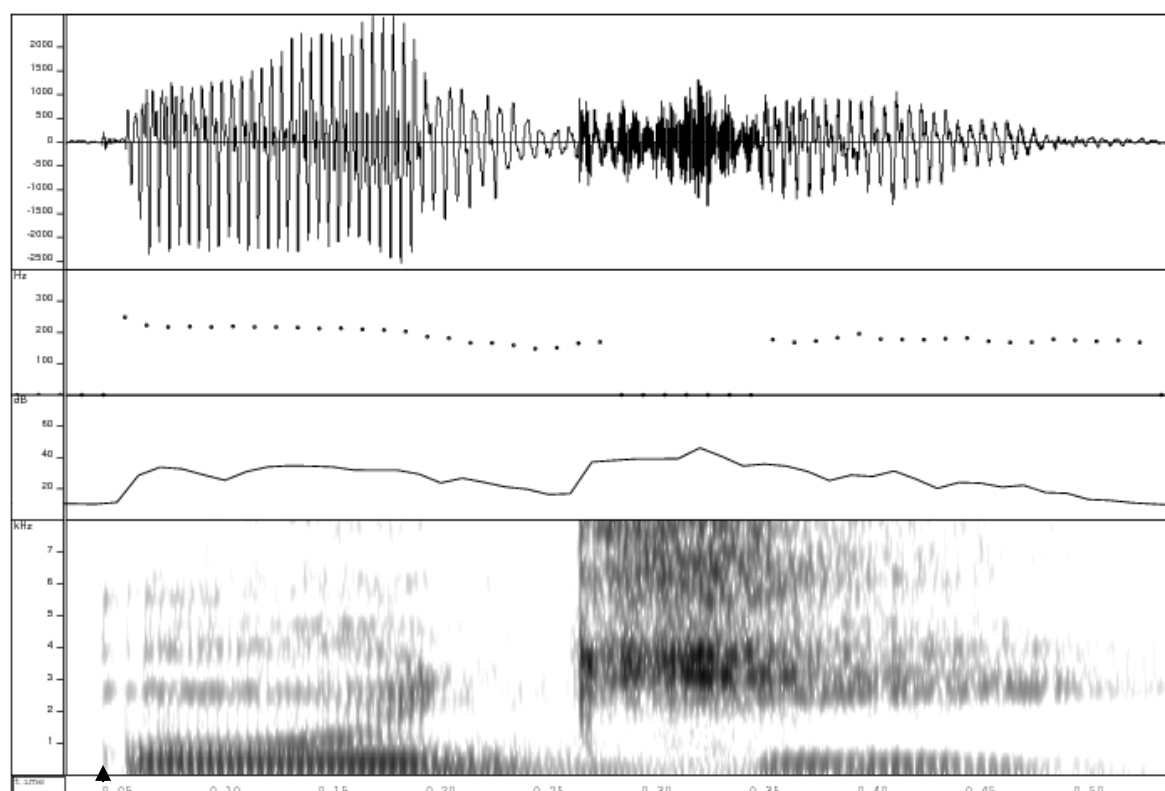


Figure 11. քշչո [ʔudzi] (glottal plosive) – “ear” (N. K. – female)

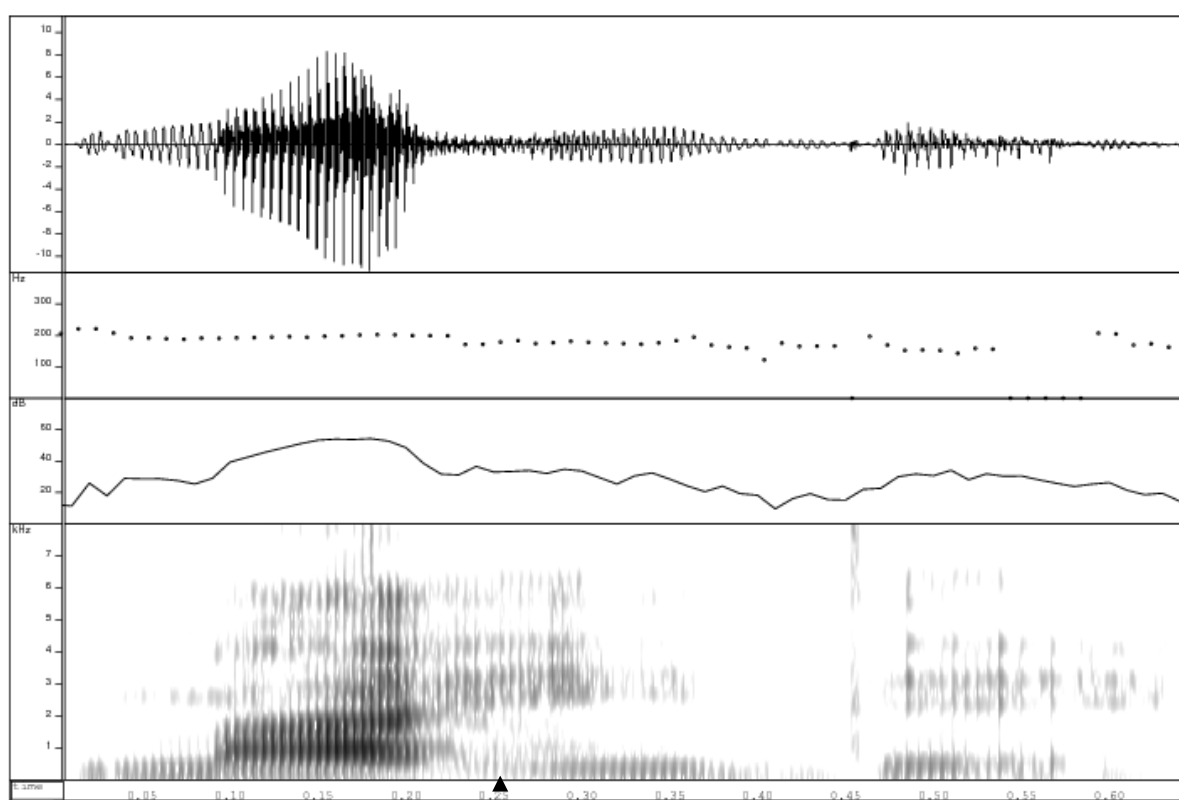


Figure 12. մաքօղ [maʔidɛ] (approximant) – “buyer” (N. K. – female)



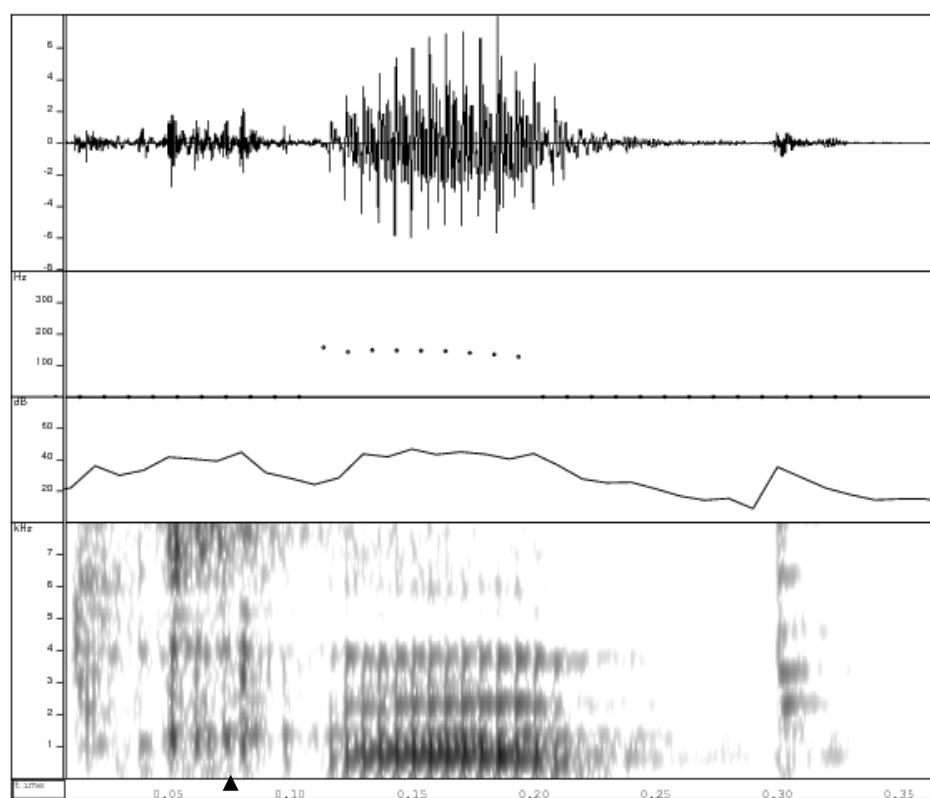


Figure 13. ႁႁႁႁ [tʰʁap'i] (fricative) – “dried plum juice” (L. G. – male)

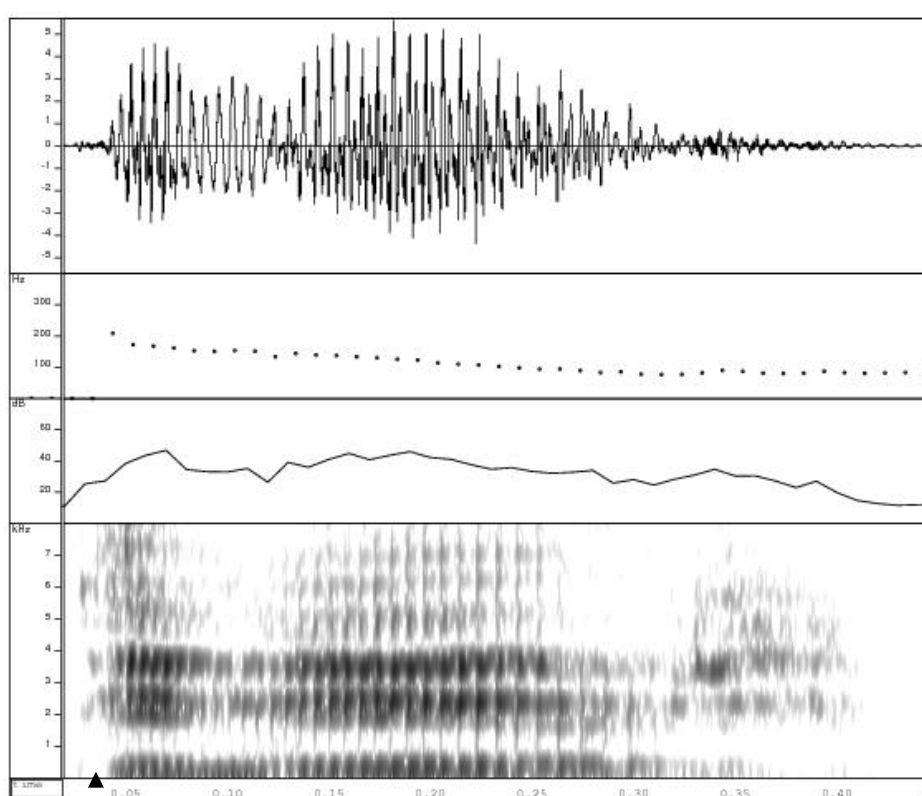


Figure 14. ႁႁႁႁ [ʔidiri] (glottal plosive) – “to buy” (L. G. – male)

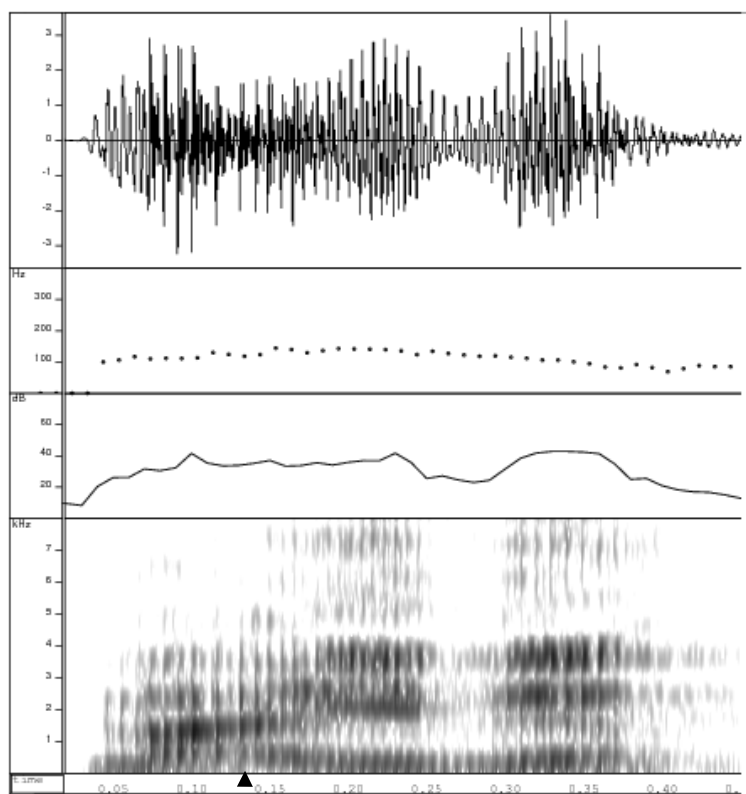


Figure 15. მახიდე [maḡide] (approximant) – “buyer” (L. G. – male)

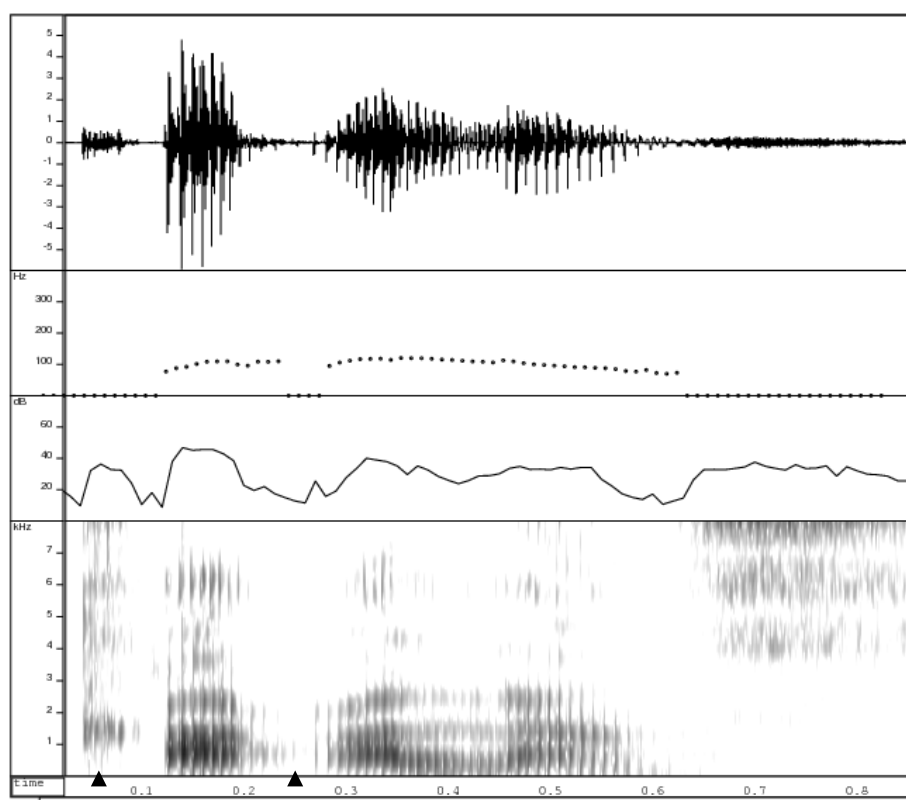


Figure 16. ყაყალანს [q'a xq'alans] (initial plosive; intervocalic “spirantoid”) – “it croaks” (G. Sh. – male)

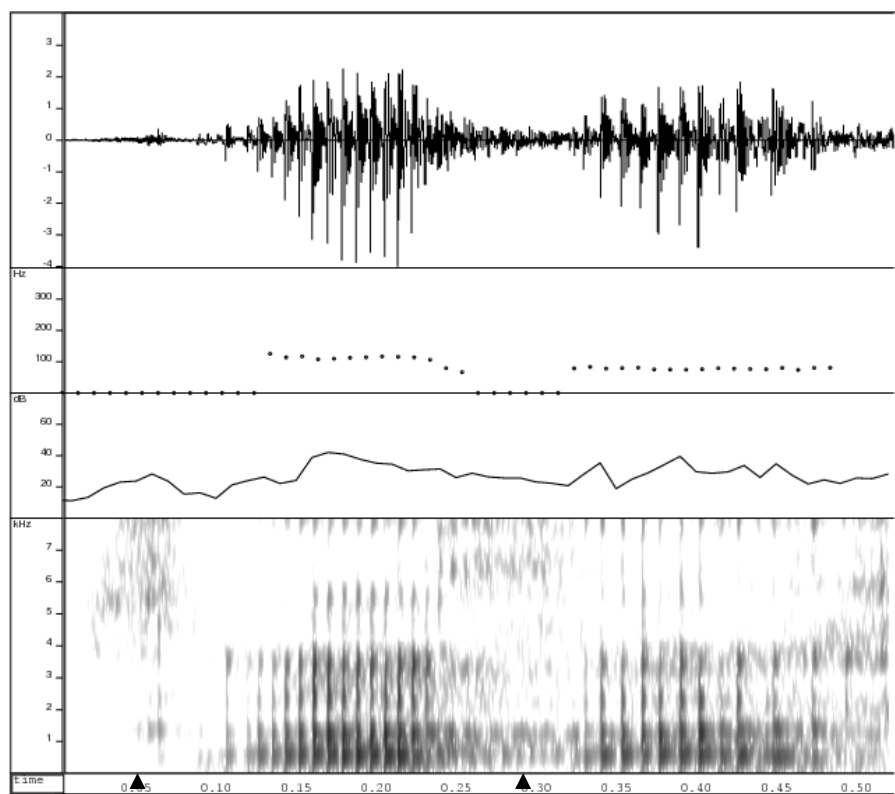


Figure 17. ყავალი [χ'aχ'ali] (fricatives) – “to racket” (L. D. – male)

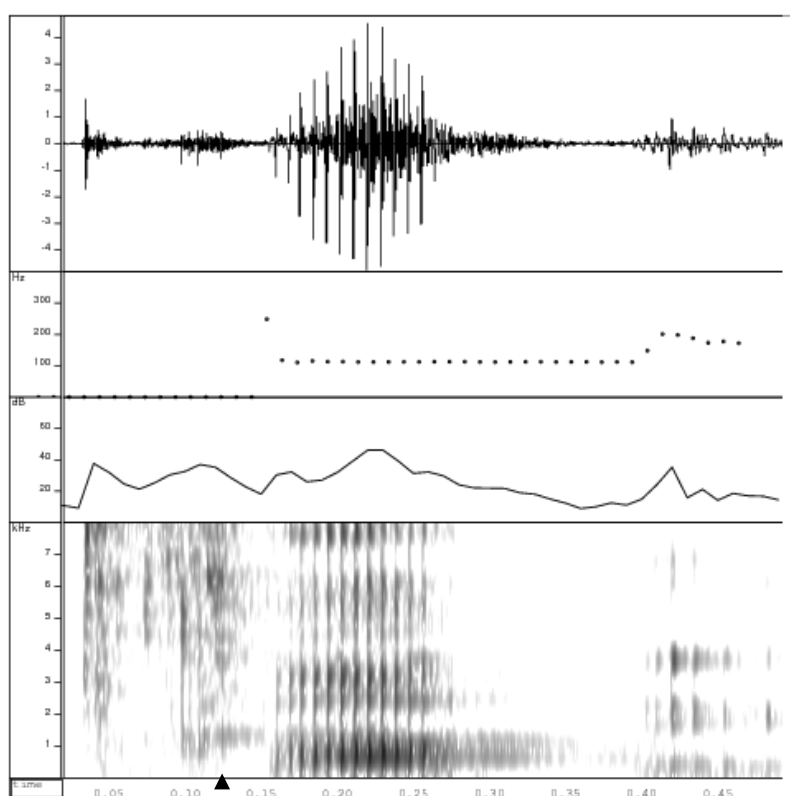


Figure 18. ტყაპი [t'χ'ap'i] (fricative) – “dried plum juice” (L. D. – male)

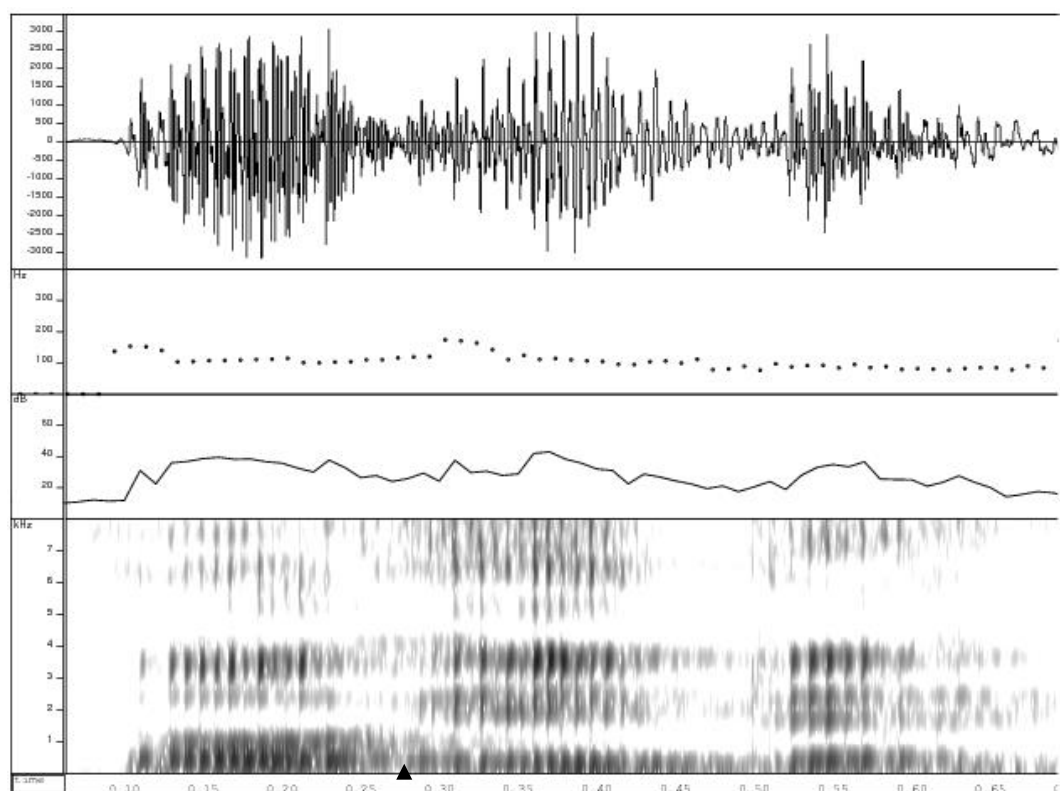


Figure 19. ლხიდე [აჩიდე] (approximant) – “to be bought” (L. D. – male)

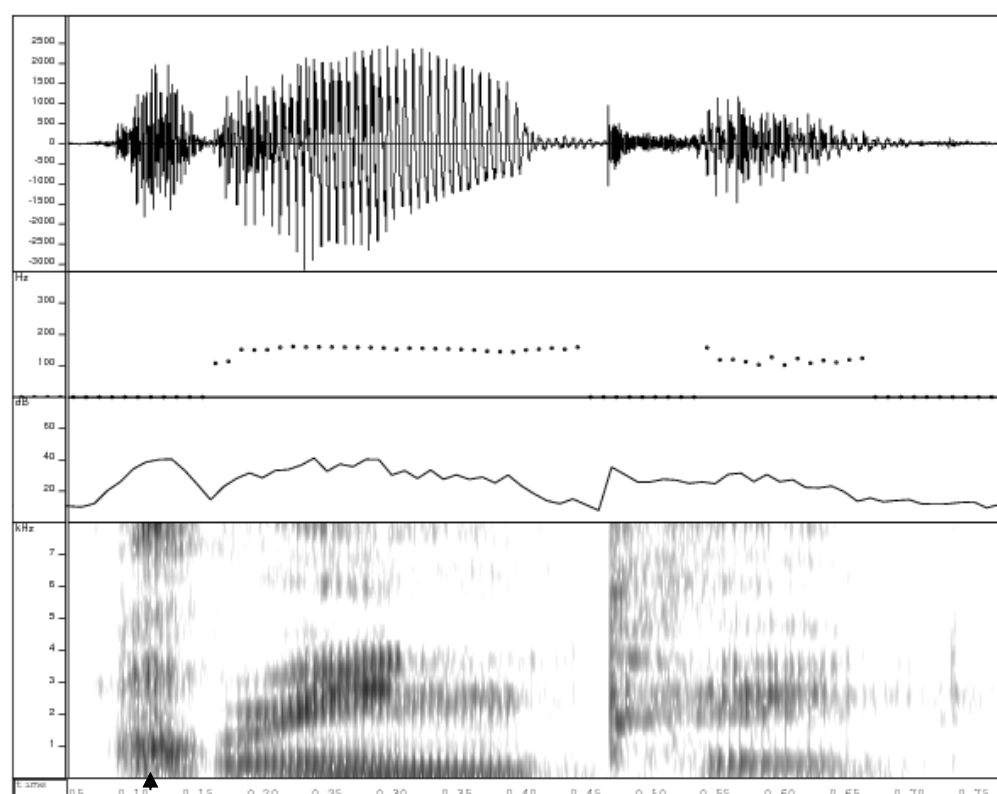


Figure 20. ყვითელი [q'vinteli] (plosive) – “yellow” (R. A. - male)

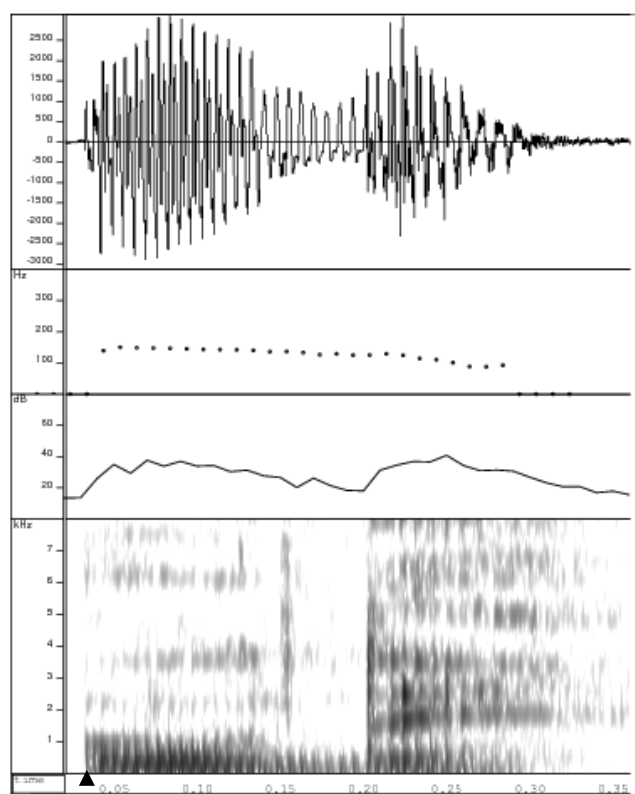


Figure 21. ჭუდე [ʔudɛ] (glottal plosive) – “house” (R. A. – male)

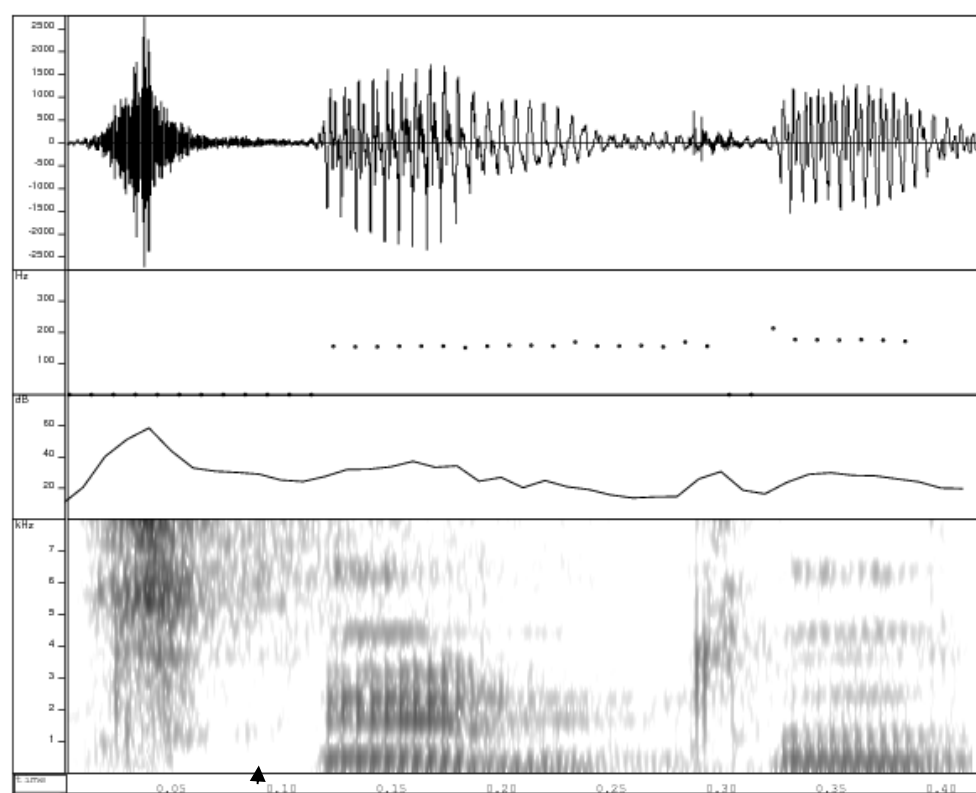


Figure 22. წყობუ [ts'χ'irt'u] (fricative) – “hen’s illness” (R. A. – male)

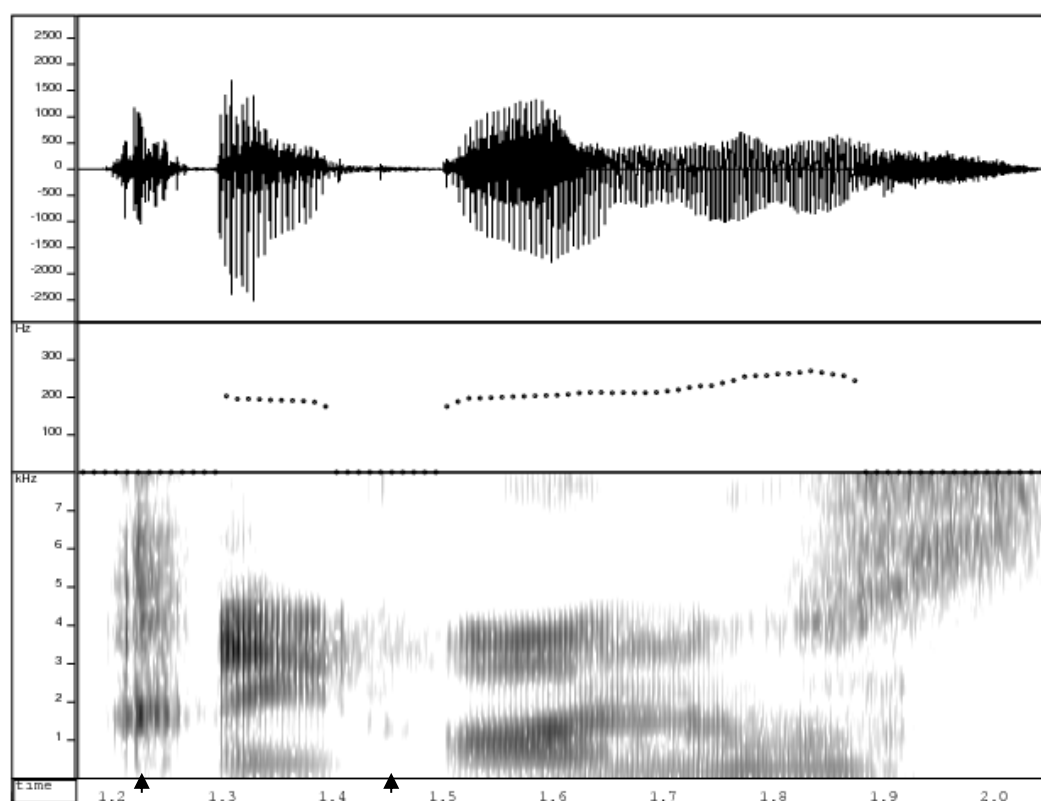


Figure 23. *ყოყონუნს* [q'i x'onuns] (initial plosive; intervocalic fricative) – “to eat in ugly manner” (T. T. – female)

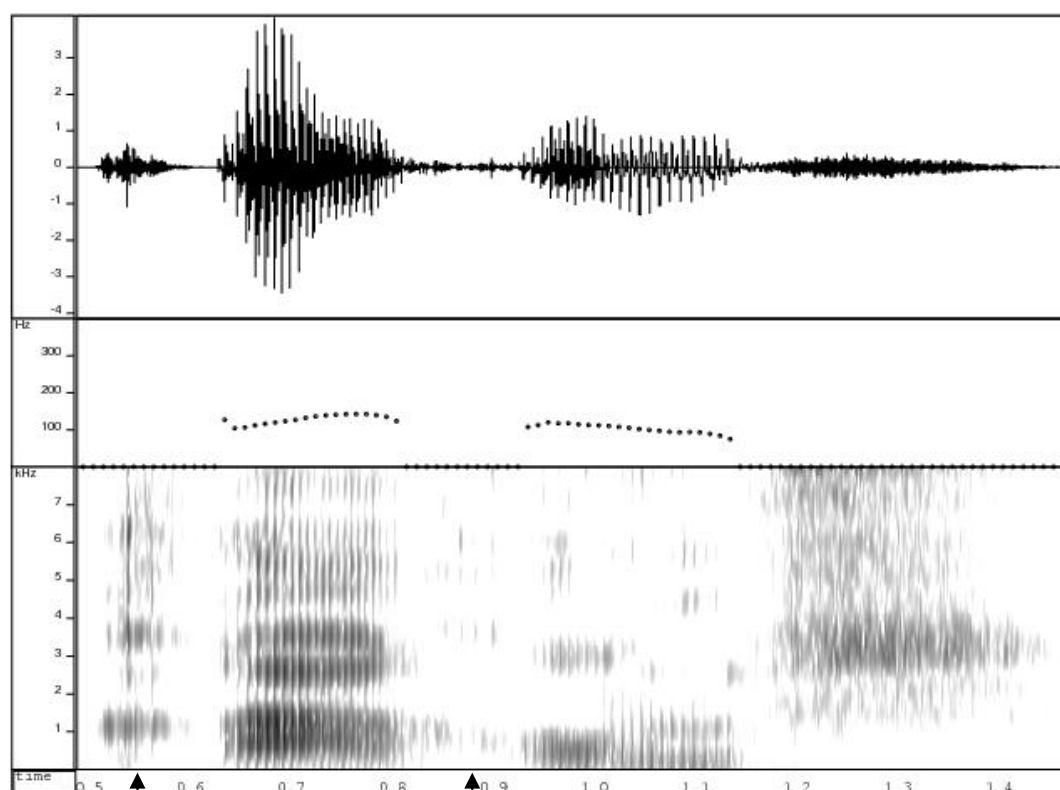


Figure 24. *ყაყუნს* [x'a x'uns] (initial and intervocalic fricative) – “he would eat much” (P. Ts. – male)

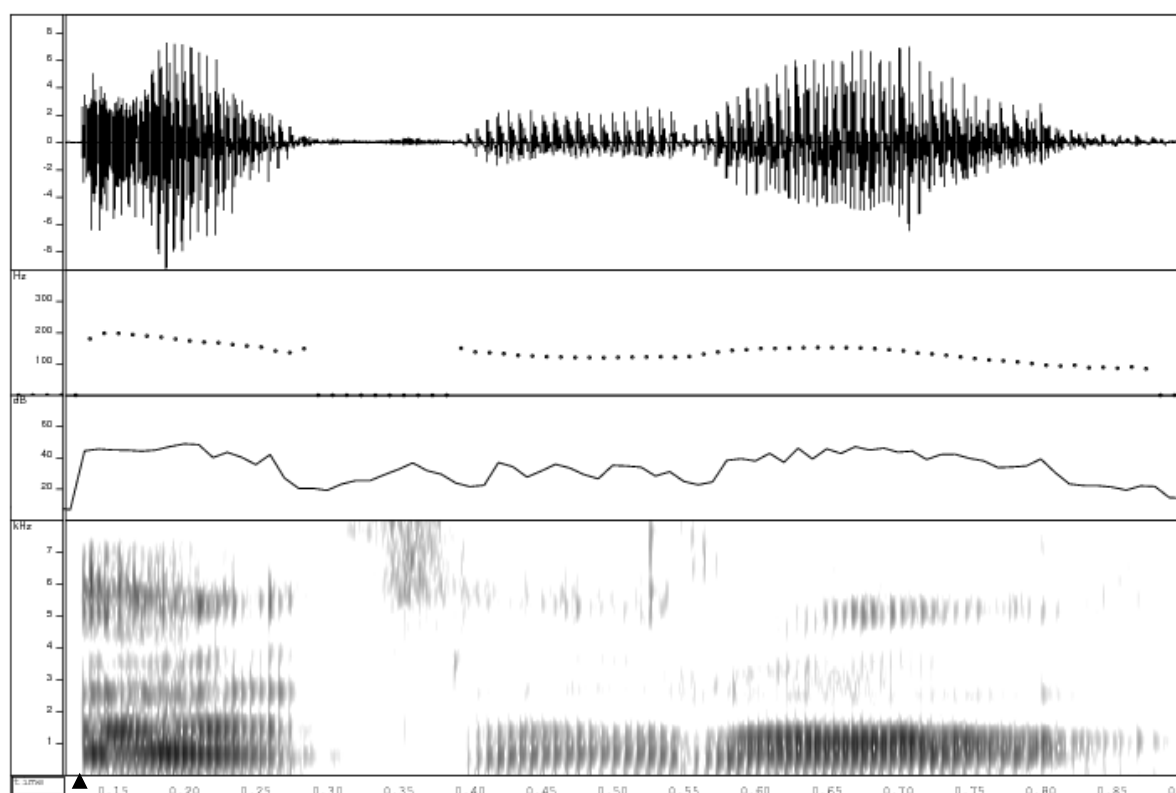


Figure 25. ʔatara [ʔaθara] (ʔ – glottal plosive, “hamza”) – “retelling, narration” (Egyptian Arabic)

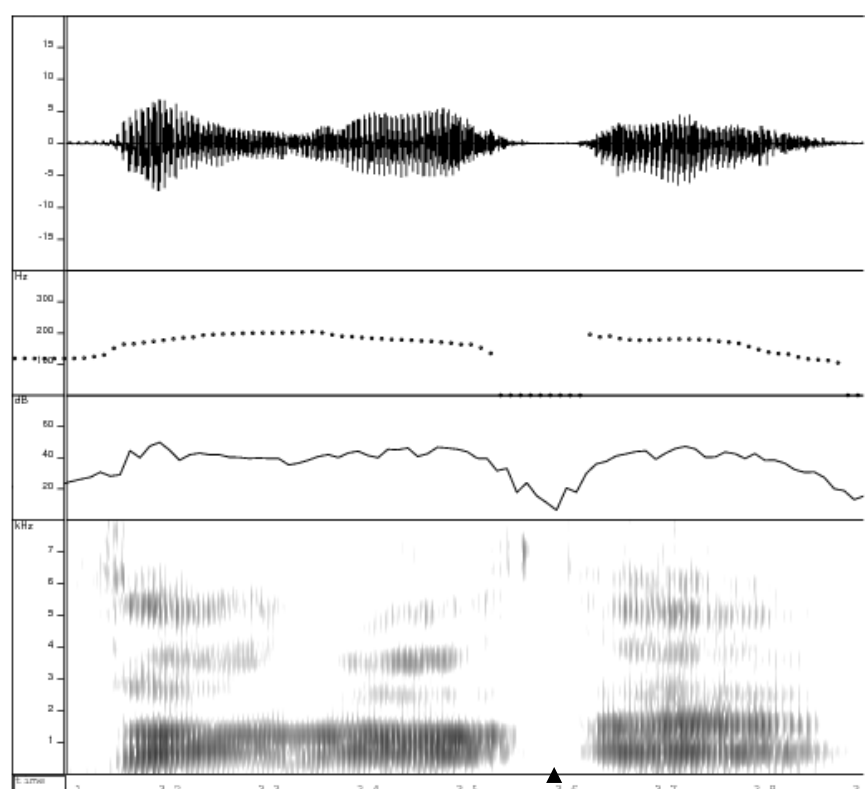


Figure 26. ɖaraʔa [ðaraʔa] (ʔ – glottal plosive, “hamza”) – “to create” (Egyptian Arabic)



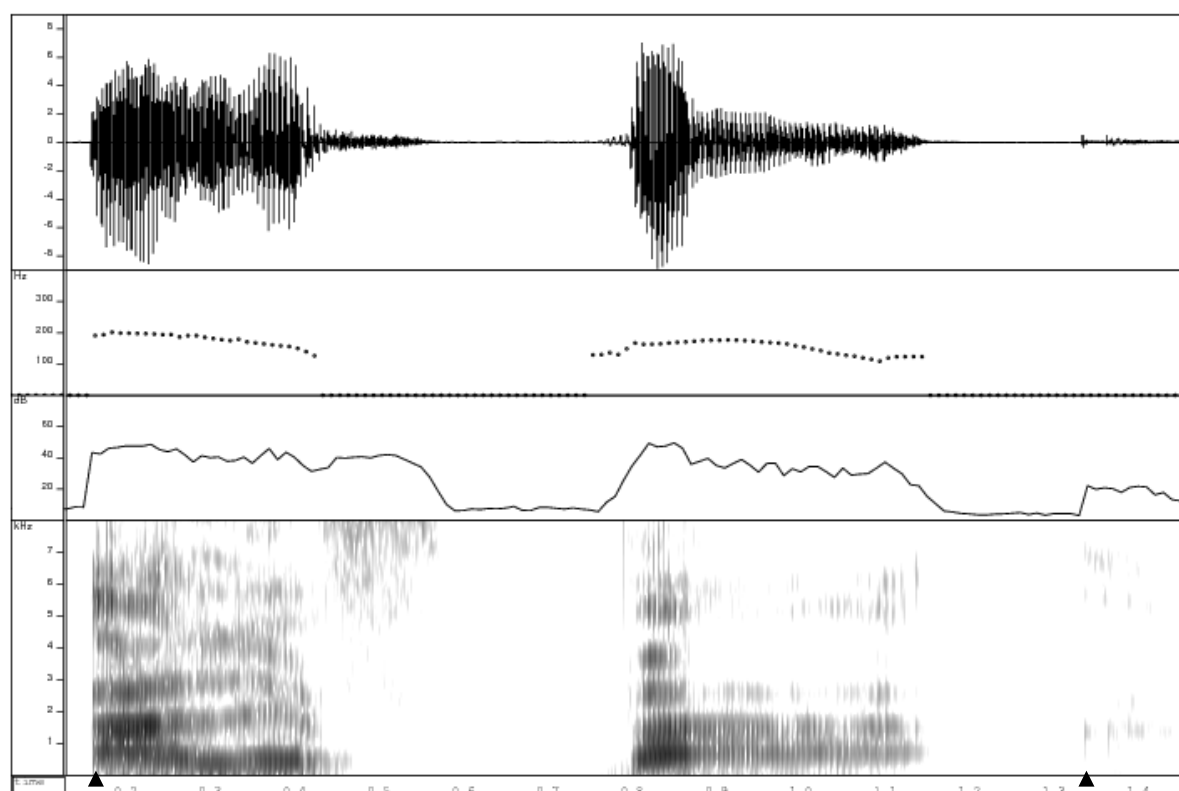


Figure 27. 'alifbā' [ʔalifba:ʔ] (ʔ – glottal plosive, “hamza”) – “alphabet” (Egyptian Arabic)

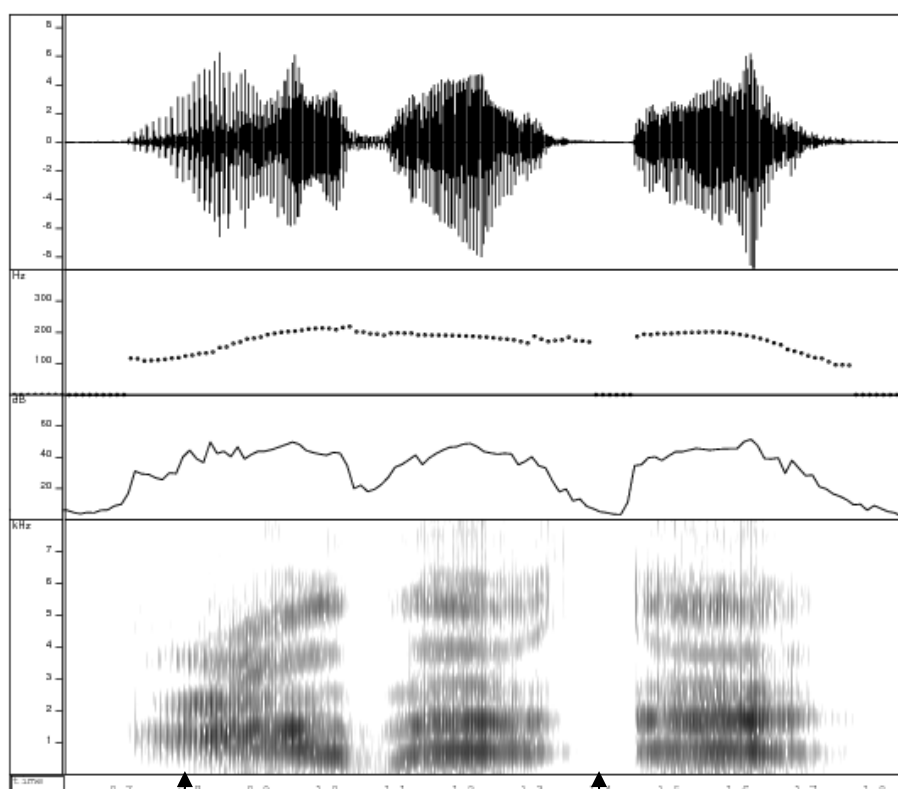


Figure 28. 'aba'a' [ʕabaʔa] (ʕ – pharyngeal approximant, “ayn”; ʔ – glottal plosive, “hamza”) – “to pay attention” (Egyptian Arabic)

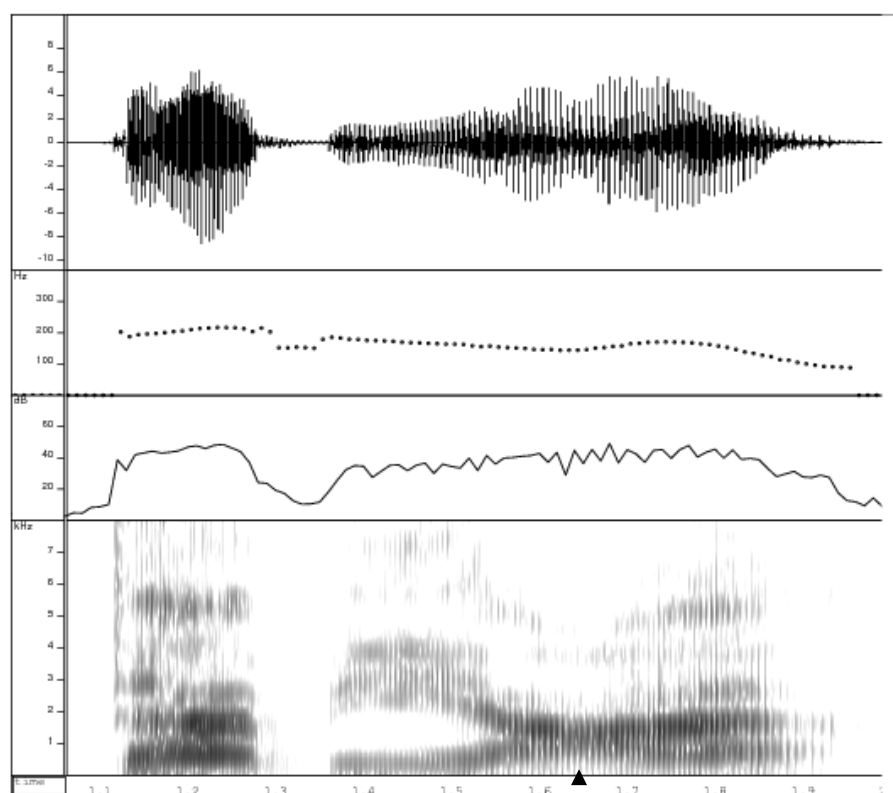


Figure 29. tabiʕa [tʰabi:ʕa] (ʕ – pharyngeal approximant, “ayn”) – “to follow” (Egyptian Arabic)

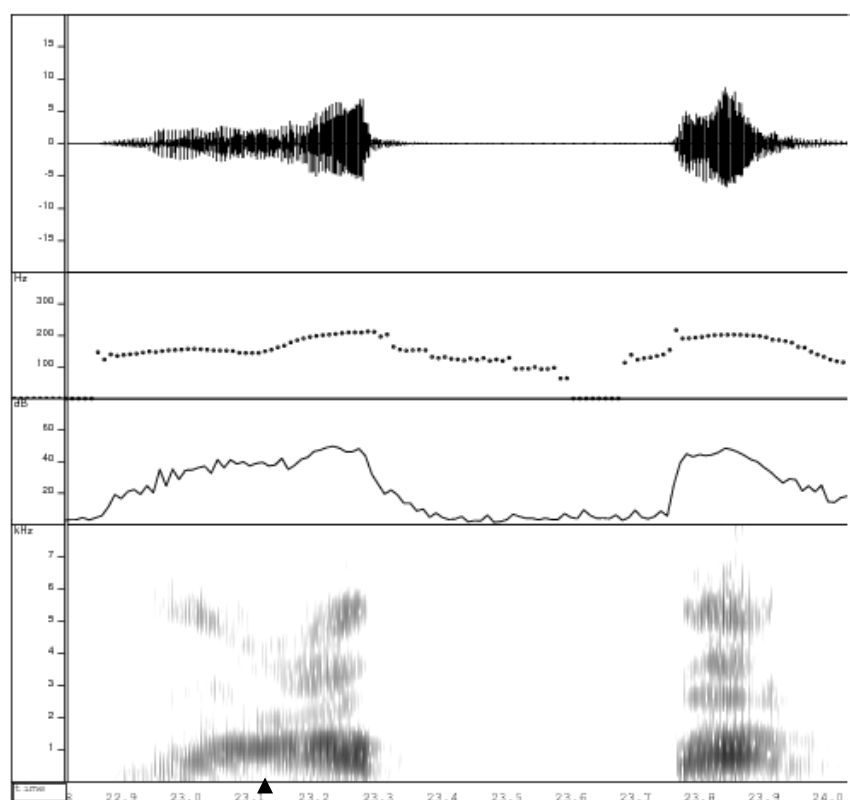


Figure 30. muʕabbar [muʕabbar] (ʕ – pharyngeal approximant, “ayn”) – “named” (Egyptian Arabic)