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**ACOUSTICAL REPRESENTATION OF ALLOPHONES OF THE
PHONEME /A/ OF THE TELEUT LANGUAGE**

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Abstract

The acoustic data of allophonic pronunciation of the hard set short vowel phoneme /a/ of the Teleut language is under discussion in the article. In our field research, the linguistic material is recorded Teleut speech of native speakers. The speakers of the Teleut language live in the Belovsky district, Kemerovo region, Russian Federation. The pronunciation of the following monosyllables: *mal* ‘horse’, *najm* ‘my friend’, *tash* ‘stone’, *haj* ‘summer’; and disyllables with identical vocal set: *pala* ‘child’, *tabax* ‘cup’, *tajda* ‘tomorrow’, *halbax* ‘wide’, *acha* ‘brother’ by three native Teleut speakers is analyzed. Position and combinative variants of the phoneme /a/ occurred in these word forms are identified and described. Praat is used for spectrography analysis of the allophones of the Teleut phoneme /a/. The following results obtained are under consideration. The articulatory settings of allophones of the open phoneme /a/ differ in their backward or forward tongue movement. Hence, the hard set short vowel phoneme /a/ may be produced as having the central articulatory setting. Moreover, variants of the Teleut phoneme /a/ may be characterized with the front articulatory setting. The experimental data do not always coincide with the auditory data analysis. The article also discusses the possible causes of this phenomenon. Thus, the article addresses not only the issues of speech acoustics, but also of speech production, and speech perception.

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Keywords: Vowels, teleut, acoustics, praat, speech perception, phonetics.



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1. Introduction

Teleuts are the small indigenous Turkic-speaking ethnic group living in southern Siberia. The largest group of Teleuts live in the Belovsky district of the Kemerovo region, along the Bolshoy and Maliy Bachat rivers (localities: Bekovo (Chelukhoevo), Zarechnoye, Verkhovskaya, Shanda, Cherta, Kamenka, Ulus). Currently, only those indigenous people, who live in the Kemerovo region, identify themselves Teleuts (or Bachat Teleuts, Bayattar, Bayat-Kizhi). They have retained their ethnic identity (Tybykova, 2016). The same thing cannot be said about other groups of Teleuts. The Altai people tend to identify themselves belonging to the unique nation, separate from Russians. The Teleuts living in the Altai or Russian environment consider themselves mostly the Altaian people (Chemchieva, 2017). The modern Bachat Teleut poet, Marina Tarasova, made this issue prominent for the Teleut local community appealing to them: ‘If you forget your mother language, you will be Russians with Teleut face...’.

So, there is a small group of Teleuts – the Altai group of Teleuts – living in the territory of the Republic Altai (localities: Ulus-Cherga, Myuta, Selenskiy district) along the river Katun and its tributary, Sema; another group of Teleuts, karaba, inhabit some territories of the Altai region (localities: Zarinsk, Krutoye, Ulus, Taraba and Yasashnoye, Kytmanovski district). All these ethnic Teleut groups were subjected to strong assimilation with neighbouring nations: Altai-Kizhi (in the Republic Altai); Russians, Altai-Kizhi, and Volga Tatars (in the Altai region). One more small group of Teleuts together with the Shor people live in the locality Teleuty, Zavodskoy district, Novokuznetsk, Kemerovo region. The name ‘Teleut language’ traditionally refers to the language spoken by Teleuts who live in the territory of the Kemerovo region along the Bolshoy and Maliy Bachat rivers. According to the 2010 census, the Teleut language is spoken by 1892 people out of a total of 2650 Teleuts (Urtegeshev, 2009, 2016). Thus, Teleut is the endangered language spoken by the small group of indigenous people in Siberia. Now, all the Teleuts are bilingual: they speak both Teleut and Russian.

The vocalism of the Teleut language was studied by Fisakova (1984, 1986) and by Gavrilin (1984, 1985, 1986). Fisakova (1984) determined the system of vowel phonemes and described their articulatory and acoustic quality: tongue position (height and backness), labialization, length, tenseness. The author identified eight short vowels (/a/, /□/, /I/, /ɤ/, /X/, /J/, /v/, /□/) and seven long vowel phonemes (/a:/, /□:/, /I:/, /X:/, /J:/, /v:/, /□:/), noting that not only do long vowels differ from short ones in their length, but also in a greater degree of tenseness. Gavrilin (1984) identified the same system of vowel phonemes. The phonetic descriptions of the Teleut vowels of both researchers are in line generally, but N. Gavrilin, in addition to characterizing vowels by tongue position, labialization, and length, took into account the degree of vowel openness (Gavrilin, 1985). According to Dobrynina (2019), in the formant structure of the vowel /a/, the dominant role is played by the frequencies found in the spectrum range: F₁ 554–675, F₂ 1290–1760 Hz. F₁ corresponds to the fourth or fifth vowel openness degree, i.e. the allophone of the vowel phoneme /a/ is half-broad or broad. The variants of the phoneme /a/ are stated in different horizontal tongue positions – from back to center. Labialization is often found in the first syllable. Researchers of the Turkic languages of southern Siberia argue there is such a trend of phonemes phonologically considered back to be realized central in fact (Selutina & Dobrynina, 2014). For instance, in current course of phonetic research, the phoneme /a/ of the Barabin-Tatar language is being described as central-back in terms of speech articulation (Ryzhikova, 2019).

2. Problem Statement

The Turkic languages have been spoken in southern Siberia since ancient times and these languages are the subject of study by many linguists. The relevance of studying the phonetics of southern Siberian Turkic languages in typological and comparative-historical aspects is characterized in two ways:

- the literary norms of the Turkic languages, such as Khakas and Altai, are still developing, so the description of the pronunciation base of the basic dialects plays a primary role;
- some languages and dialects (for example, Teleut, Telengit, Northern dialects of Altai) not supported by local authorities are endangered, therefore fixing their phonetics is a crucial task for typological and comparative-historical linguistics.

As stated above, the Teleut vocalism has not been fully studied by experimental phonetic methods and there are some contradictions in the description of Teleut vocal system. For example, when describing the phoneme /a/ according to static radiography (Gavrilin, 1985) and spectrography (Dobrynina, 2019), the phoneme in question is defined as central-back, basic, with approximately fourth-fifth degree of openness, not rounded, and not nasalized (Gavrilin, 1985); but in some cases, the allophones of the phoneme /a/ are labialized (Dobrynina, 2019). Perceptually, Fisakova (1984) gives the phoneme /a/ the following definition: short, broad, back, low, not rounded vowel. The phoneme /a/ occurs in all positions in the word.

Comparing the characteristics of vowels recorded by Fisakova and Gavrilin in the 1980s with the materials given recently would allow us to see the changes in the articulatory-acoustical base of Teleuts over the past decades and predict the ways of further development of the Teleut sound system. New data obtained by experimental phonetic methods of computer processing of speech using the Praat program could serve as an informative resource for studying the historical context of ethnic and language contacts in Siberia (Selutina, 2006).

3. Research Questions

This article aims to present the spectral analysis, i.e. the set of the most relevant spectral parameters for describing the formant characteristics, of allophones of the short Teleut vowel /a/. The first formant (F1) corresponds to moving up the tongue when producing the vowel, the second (F2) corresponds to vowel frontness.

The specific targets of the work are as follows:

- 1) to recognize the allophones of the phoneme /a/ through auditory perception of the selected word forms;
- 2) to determine the height of the vowel /a/;
- 3) to characterize horizontal movement of the tongue of the vowel /a/;
- 4) to find out the correlations between tongue positions and spectral patterns while producing the Teleut allophones of the phoneme /a/;
- 5) to identify frequency deviations (if any) on the vowel spectrum and their causes in the realization of two formants (F1, F2) in the speech of speakers;

6) to reveal the reasons for the discrepancy (if any) of the perceptual and experimental-acoustical approaches when describing allophones of the Teleut phoneme /a/.

4. Purpose of the Study

One and the same phoneme can be realized in speech in different ways. Such variants are called allophones (Bondarko, 1998). In order to determine the variants of the Teleut phoneme /a/, consider the vowel /a/ in different positions. The pronunciation of a vowel is affected by several factors: the adjacent consonants, the position in the word, and the action of the law of syllabic vowel harmony observed in all Turkic languages, according to which all words are explicitly subdivided into two classes belonging to hard or soft setting (Selutina, 2018).

Thus, despite the position and speaker differences in the pronunciation of allophones of the phoneme /a/, the crucial thing is to identify the common features that unite all the given allophones to be attributed to the same phoneme.

5. Research Methods

In our research, the formant structure of vowels of type /a/ is to be determined in the following monosyllables: *mal* 'horse', *najm* 'my friend', *tash* 'stone', *Maj* 'summer' and disyllabic words with the identical vocal set: *pala* 'child', *tabaḡ* 'cup', *tabda* 'tomorrow', *Malbaḡ* 'wide', *acha* 'brother'. Three native Teleut speakers' pronunciation of given word forms was recorded on a voice recorder in mp3 format, data was converted to wav format using Freemake Audio Converter. Audacity was used for processing audio files. The program Praat, created for the purposes of linguistic analysis, was chosen for decoding and acoustic analyzing materials. Thus, in total forty-two allophones of the phoneme /a/ are to be studied in detail. The measurements carried out on the stationary parts of vowel sounds are under discussion. UUFT (Universal unified phonetic transcription) – considered as more extended and expanded, compared to IPA (International phonetic Association), – is being used in our research (Urtegeshev, Selutina, Esenbaeva, Ryzhikova, & Dobrynina, 2009).

Speakers are women aged 60–65 years, native speakers of the Teleut language, who live permanently in the village of Bekovo, Belovsky district, Kemerovo region, Russian Federation. The speakers are:
TA – Tydykhova Alexandra, d.o.b. 1948,
TG – Tydykhova Galina, d.o.b. 1954,
CV – Chishtanova Valentina, d.o.b. 1939.

6. Findings

6.1. Monosyllables

For the Turkic languages, the division into hard and soft word settings is rather traditional thing. The palatal vowel harmony reveals in the fact that the subdivision of vowels depends on the setting of a word form. Allophones of the considered phoneme /a/ are realized only in hard word setting. Statistically, the phoneme /a/ is used more frequently in the Teleut speech compared to other vowels. It occurs in all

positions except the absolute beginning of the word, where it is always covered by a laryngeal consonant, like any other vowel in this position in the Teleut language.

All realizations of the Teleut short phoneme /a/ in the word forms under consideration seem to be similar to the Russian phoneme /a/ at first. Depending on the position and combinative conditions, the variants of the Teleut phoneme /a/ have the following formant values (Tables 1-2).

Table 01. Formant values of the phoneme /a/ occurred in monosyllables

Word form, meaning, speaker	Transcription, position in a word form	Spectrum of vowel /a/		
		F1	F2	Comment
tash 'stone' TA	tʃI'ɔyʃ cVc	531.3	1663.7	Vowels have 4th (sp. TA) and 5th (sp. TG, CV) openness degree; they are central (sp. TA, TG) or fronted-central (sp. CV).
tash 'stone' TG	tʃɪ cVc	732.6	1850.4	
tash 'stone' CV	tʃɔyʃ cVc	761.8	1969.8	
Maj 'summer' TA	Mʃɔyʃ cVc	541.5	2465.0	These allophones are fronted with 4th openness degree (all speakers).
Maj 'summer' TG	Mʃɪ cVc	542.0	2136.1	
Maj 'summer' CV	MʃɔyʃʙM cVc	523.5	2438.2	

The formant dispersion is fixed for F1: from 523.5 Hz (sp. CV, *Maj* 'summer') up to 762, 6 Hz (sp. TA, *najm* 'my friend'), which corresponds to the 4th and 5th degrees of openness, respectively, i.e. the allophones of the phoneme /a/ are broad.

As for defining given allophones of the sound type /a/ by their spectral envelope, there is no certainty here: there is a wide range of dispersion of F2 values – from 1140.0 Hz (sp. CV, *mal* 'horse') – to 2465.0 Hz (sp. TA, *Maj* 'summer'). The variants of the phoneme /a/ are stated as front, front-central, central, central-back and back, i.e. they are found in all horizontal tongue positions. There is position and combinative dependence of adjacent consonant on the vowel onset. So, in the position after the apical-mediopalatal stop \M\ (Selutina et al., 2011; Selutina, Urtegeshev, Ryzhikova, Dambyra, & Kechil-ool, 2014) in the word *Maj* 'summer', all speakers pronounce fronted vowel (F2 = 2136.1 – 2465.0) – [ɪ]. The fronted-central allophone (F2 = 1969.8 Hz) – [C] – may be realized in the position after apical, not palatalized stop consonant \t\ (sp. CV, *tash* 'stone'); but in this word position, it is more typical to observe central [ɪ], with the following format range: F2 = 1663.7 Hz (sp. TA, *tash* 'stone') – 1850.4 Hz (sp. TG, *tash* 'stone'). In the position after nasal consonants, there is a decrease in the second formant: after coronal stops like \n\, it is slightly weaker (F2 = 1540.7 Hz (sp. TG, *najm* 'my friend') – 1561.6 Hz (sp. TA, *najm* 'my friend'), and after labial consonants it is stronger (F2 = 1215.2 Hz (sp. TG, *mal* 'horse') – 1140.0 Hz (sp. CV, *mal* 'horse'), but there are exceptions to any rule (see Table 1).

In the pronunciation of some speakers, besides the vertical and horizontal tongue movements, the additional articulation – vibration of plica aryepiglottica – is found (sp. TA, CV, *Maj* 'summer'; sp. TA, *mal* 'horse' – in vowel onset); sp. TA, CV, *tash* 'stone'; sp. TA, TG, CV, *najm* 'my friend'). In vowel

offset of [a] in the word *tash* ‘stone’ pronounced by the sp. CV, the glottal stop is stated, before which the values of all formants are lowered (see Table 1).

6.2. Disyllables

Consider the short allophones of the phoneme /a/ in five disyllables with an identical vocal set: *pala* ‘child’, *tabax* ‘cup’, *tabda* ‘tomorrow’, *Malbaḵ* ‘wide’, *acha* ‘brother’.

Table 02. Formant values of the phoneme /a/ occurred in disyllables

Word form, meaning, speaker	Transcription, position in a word form	Spectrum of the vowel		
		F1	F2	Comment
tabda ‘tomorrow’ TA	tɪ'ndɪ'ʔɪ cVccvʔv	701.9	1620.6	The speakers TA and CV pronounce vowels with the 5th degree of openness, and sp. TG pronounces the allophone with 6th degree of openness. Vowels are: central (sp. TA, tabda ‘tomorrow’), central-back (sp. TG, tabda ‘tomorrow’), back (sp. CV, tabda ‘tomorrow’).
tabda ‘tomorrow’ TG	tɛzndɪ'ʔɪ cVccvʔv	897.2	1431.1	
tabda ‘tomorrow’ CV	tɑ'ʔɪndɑ'ʔɪ cVʔvccvʔv	689.3	1191.7	
tabda ‘tomorrow’ TA	tɪ'ndɪ'ʔɪ cvccVʔv	546.0	1765.1	In the pronunciation of sp. TA the vowel has 4th degree of openness, while that of sp. TG, CV is 5th. By tongue horizontal position vowel allophone may be central (sp. TA, tabda ‘tomorrow’), central-back (sp. TG, tabda ‘tomorrow’), back (sp. CV, tabda ‘tomorrow’).
tabda ‘tomorrow’ TG	tɛzndɪ'ʔɪ cvccVʔv	676.5	1478.6	
tabda ‘tomorrow’ CV	tɑ'ʔɪndɑ'ʔɪ cvʔvccVʔv	675.9	1058.7	
acha ‘brother’ TA	wɛ'ʔɪ Mʔ'aʔɪ cVʔvʔvʔvʔv	400.7	1760.7	Vowels pronounced by sp. TG and CV have 5th openness degree, while sp. TA pronounces the allophone with 3rd openness degree, and that of sp. CV is with 4th openness degree. Vowels are: central (sp. TA), central-back (sp. TG, CV).
acha ‘brother’ TG	wɔyʔɪM'aʔɪ cVʔvʔvʔvʔv	761.0	1479.2	
acha ‘brother’ CV	yɛʔɪyɛwMʔ'aʔɪ cVʔvʔvʔvʔv	708.0	1390.1	
acha ‘brother’ TA	wɛ'ʔɪ Mʔ'aʔɪ cvʔvʔvʔvʔv	586.6	1837.0	Vowels pronounced by sp. TG and CV have 5th openness degree, while sp. TA pronounces \a\ with 4th openness degree. In pronunciation of all speakers vowels are central.
acha ‘brother’ TG	wɔyʔɪM'aʔɪ cvʔvʔvʔvʔv	676.0	1780.2	
acha ‘brother’ CV	yɛʔɪyɛwMʔ'aʔɪ cvʔvʔvʔvʔv	689.7	1795.9	

the ambiguity of the phonetic formant analysis is being discussed in the literature (Maurer, D'heureuse, & Landis, 1999). As to the perception of these allophones by native speakers, it has been proved that '*the ordinary native speaker is, in fact, often unaware of the allophonic variations of his phonemes*' (Sharma, 2005).

Thus, to determine the allophones of the Teleut phoneme /a/, it is significant not only to consider the distribution of formant frequencies, but the way of their realization throughout the vowel, their correlation with other parameters, such as intensity, tenseness as well. Auditory analysis still plays an important role in determining the vowel.

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References

- Bondarko, L. V. (1998). *Fonetika sovremennogo russkogo yazyka* [Phonetics of the modern Russian language]. Edition of Saint Petersburg University: SPb.
- Chemchieva, A. P. (2017). Sub-ethnic groups of Altaians: contradictions and symbols of collective identity. *The new research of Tuva*, 1, 134–150.
- Dobrynina, A. A. (2019). Short vowels of the Teleut language according to F1 and F2 (experimental phonetic observation). *Languages and folklore of the indigenous peoples of Siberia*, 38, 58–65.
- Fisakova, G. G. (1984). The system of vowel phonemes in the Bachat Teleut language. *Research of sound systems of Siberian languages*, 30–34.
- Fisakova, G. G. (1986). Long vowels in the Bachat Teleut language. *Phonetics of languages of Siberia and neighboring regions*, 27–31.
- Gavrilin, N. V. (1984). The system of vowel phonemes in the Bachat Teleut language. *Phonetics of Siberian languages*, 67–73.
- Gavrilin, N. V. (1985). X-rays patterns of vowels in the Bachat Teleut language. *Phonetics of Siberian languages*, 59–68.
- Gavrilin, N. V. (1986). Length of vowels in monosyllabic quasi-homonyms in the Bachat Teleut language. *Phonetic structures in Siberian languages*, 47–55.
- Jannedy, S., & Weirich, M. (2017). Spectral moments vs. discrete cosine transformation coefficients: Evaluation of acoustic measures distinguishing two merging German fricatives. *JASA: The Journal of the Acoustical Society of America*, 142, 395. <https://doi.org/10.1121/1.4991347>
- Maurer, D., D'heureuse, C., & Landis, T. (1999). Formant Pattern Ambiguity of Vowel Sounds. *International Journal of Neuroscience*, 1543-5245. <http://www.tandfonline.com/loi/ines20>
- Ryzhikova, T. R. (2019). Articulatory-acoustic characteristics of the Barabin-Tatar vowel phoneme a /ʌ/ in the comparative aspect. *Siberian journal of Philology*, 2, 163–178.
- Selutina, I. I. (2006). Phonetic studies of Siberian languages: results and prospects. *Language situation and communicative learning strategies*, 20–36.
- Selutina, I. I., Urtegeshev, N. S., Letyagin, A. Y., Shevela, A. I., Dobrynina, A. A., & Esenbaeva, G. A. (2011). Artikulyatsionnyye bazy tyurkskikh yazykov Yuzhnoy Sibiri [Articulatory bases of Turkic ethnic groups in southern Siberia]. Novosibirsk.
- Selutina, I. I., & Dobrynina, A. A. (2014). Vowel correlations by degree of openness in dialects of the Altai-Kizhi dialect. *Nations and cultures of southern Siberia and adjacent territories*, 146–149.

- Selutina, I. I., Urtegeshev, N. S., Ryzhikova, T. R., Dambyra, I. D., & Kechil-ool, S. V. (2014). Pharyngization as a typological feature of phonological systems (based on the material of the Turkic languages of Southern Siberia) [Pharyngealization as a typological characteristic of phonological systems (based on the Turkic languages of southern Siberia)]. Novosibirsk: Institute of Philology SB RAS.
- Selutina, I. I. (2018). The principles of harmony systems in South Siberian Turkic languages. *Complexity of the languages of the Siberian area in a diachronic-typological perspective*, 101–118.
- Sharma, B. D. (2005). *Linguistics and Phonetics*. New Delhi: Anmol Publications Pvt.
- Tybykova, L. N. (2016). The Teleuts and Their Language. *Endangered Turkic Languages*. *Sibirskiy filologicheskiy zhurnal*, 3, 421–429.
- Urtegeshev, N. S. (2009). *The Teleut language*. Historical encyclopedia of Siberia.
- Urtegeshev, N. S., Selutina, I. I., Esenbaeva, G. A., Ryzhikova, T. R., & Dobrynina, A. A. (2009). Phonetic transcription standards of UUFT and IPA: system of correlations. *Ural-Altai studies*, 100–115.
- Urtegeshev, N. S. (2016). *The Teleut language*. Language and society: encyclopedia.