CHAPTER 1

Vowel Aspiration and Glottalisation across Udihe Dialects: Phonetics, Phonology, Evolution, Typology

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1 Introduction

The phonological status of vowel aspiration and glottalisation in Udihe, a moribund Tungusic language in the Far East of Russia with few speakers left, has long sparked controversy among researchers. These features developed out of intervocalic consonants but synchronically have been defined diversely as:

- consonants (Sunik, 1968, 1997; Girfanova, 1984; Kormušin, 1998);
- vowel features (Šneider, 1936, 1985 [1937]; Cincius, 1949; Zinder, 1948; Benzing, 1956; Simonov, 1988; Radčenko, 1988; Kyalundzyuga and Simonov, 1998; Nikolaeva, 2000; Nikolaeva and Tolskaya, 2001);
- laryngealised and pharyngealised accents (Radčenko, 1985, 1988; Perehval'skaja, 2010a);
- tones (Radčenko, 1985; Janhunen, 1999).

In this paper, I discuss the phonetic, structural, and typological features of Udihe aspiration and glottalisation on the basis of earlier research and our field study (2007, 2010). I consider a possible influence of language contact and language loss on the past and present evolution of these phenomena.

The paper is structured as follows. Section § 2 provides background data on the dialectal division and sociolinguistic situation of Udihe, its vowel system and the place of the discussed phenomena within it, and on the Udihe stress system. Methods and results of the field study are described in § 3 and § 4. Among other things, amendments to the evolutionary pathway leading first to aspiration and glottalisation and then to their loss are proposed. In § 5, the role of language obsolescence in the development of the two features is discussed. Section § 6 is devoted to the place of Udihe glottalisation (still preserved in the language, unlike aspiration) in word-prosodic typology. This uncommon type of word prosody is compared to the two "canonical" types (tone and stress), on the one hand, and to other similar uncommon cases like Danish stød, on the other. A summary of the main findings is given in § 7.

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2 Background and Earlier Research on Udihe and Its Phonology

Udihe (udih1248) is classified by Glottolog 4.4 (Hammarström et al., 2021) as a Central Eastern Tungusic language, together with Oroch and Kilen. It has a special status among the Tungusic languages both in terms of its genetic classification and present-day dialectal division and because of its unusual vowel system. These peculiarities have arisen to a large extent due to intensive contact with cognate and non-cognate languages.

2.1 *Sociolinguistic Features and Dialectal Classification of Udihe*

In typology, structural simplification is often linked to the intensity of contacts (Trudgill, 2001; Gil, Trudgill and Sampson, 2009). Udihe has participated in various contact scenarios throughout its history. Along with Oroch, the language and its speakers are seen by some as a mix between northern and southern Tungus-Manchu which has also assimilated some local unknown Paleo-Asiatic substrate. The innovative reduction of words in Udihe is argued to be one of the results of these interactions (Schmidt, 1928: 18; Kormušin, 1998: 11; Nikolaeva and Tolskaya, 2001: 12–13; Zgusta, 2015: 153–155).

Later Udihe was in long-lasting contact with Chinese, which gradually increased from Middle Ages to the end of the 19th century. Chinese economic and cultural influence was especially strong from the 19th century until 1936, when Russians (who received this area in 1860) relocated all the Chinese population from it (Nadarov, 1887; Nikolaeva and Tolskaya, 2001: 17–18; Khasanova, 2000). Udihe has, in fact, been called the most Sinicised Amur Tungusic idiom (Janhunen, 1999), and this trait is sometimes emphasised as being among the most important features to distinguish it from the closely related Oroch language (Schmidt, 1928: 17).

The Chinese influence, among other things, gave rise to the Ussuri variant of Chinese Pidgin Russian, originally used by Russians to communicate with local Tungus-Manchu populations when they first entered this area (Nichols, 1986; Shapiro, 2010; Perehval'skaja, 2014). The southernmost groups of Udihe underwent a complete language shift into Chinese. This gave rise to an ethnic group *Taz* on the Russian side (see Figure 1.1) and a group called (*Chinese*) *Kyakala* on the Chinese side of the Ussuri river. The latter apparently first shifted to a variety of Jurchenic and then to Chinese (Belikov and Perehval'skaja, 2002; Fu et al., 1999; Girfanova, 2015; Hölzl, 2018). Among still existing Udihe varieties, the most affected by Chinese are those of Bikin and Iman (see Figure 1.1). Their currently observed dialectal differences from the varieties to the north have been seen as directly stemming from this contact (Nikolaeva and Tolskaya, 2001: 18; Perehval'skaja, 2007).

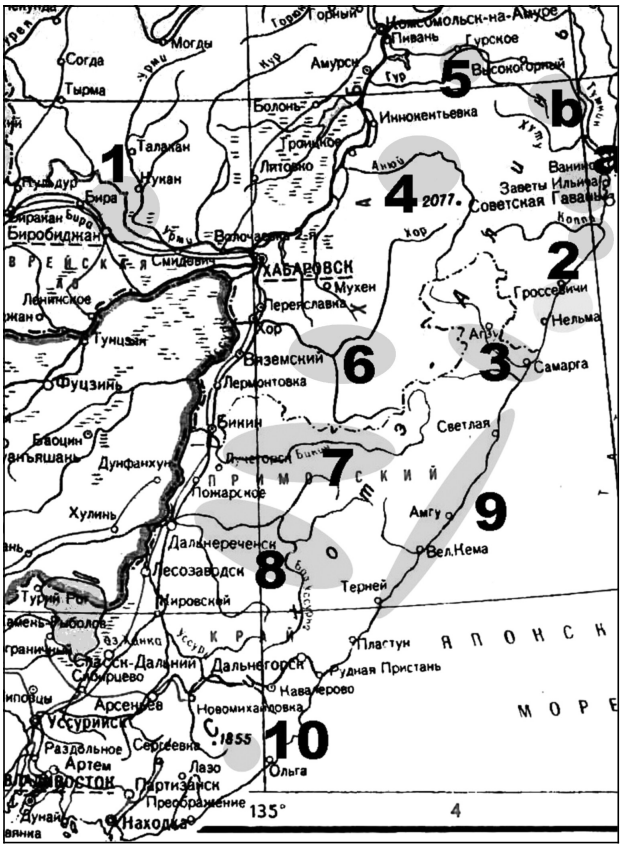

FIGURE 1.1 Udihe varieties according to Perehval'skaja (2010a). *Oroch-Udihe*: (2) Koppi. *Udihe*: (1) Kur-Urmi, (3) Samarga, (4) An'uj, (5) Khungari, (6) Khor, (7) Bikin, (8) Iman, (9) Sikhote-Alin, (10) Taz. *Oroch dialects in the Udihe area*: (a) Khadi, (b) Tumnin.

On the other hand, instead of a cluster of isoglosses consistently distinguishing between the northern and the southern "dialects", there are various phonetic, lexical, and morphological isoglosses covering different clusters of Udihe varieties (Kormušin, 1998: 13–14). Udihe dialects form a continuum with no clear boundary with the Oroch language. Some of them have also been in contact with adjacent cognate languages: Kur-Urmi Udihe with Even (Northern Tungusic) and Bikin Udihe with Nanai (Central Western Tungusic). Therefore, the term "dialect continuum" might be more appropriate for Udihe (Perehval'skaja, 2010a). The Udihe dialects distinguished in the latter work are presented in Figure 1.1.

FIGURE 1.2 Points of collection of Udihe phonetic data in 2007 are in red; the route of the field trip of 2010 with the points of collection of phonetic data is in black (see also § 3). Khabarovsk, the centre of the region, was the starting point of the two trips.

Since the 1930s, the influence of the Russian language in the area has been rapidly growing, especially because the children of local aboriginal populations were taken away from their families and sent to study in boarding schools for most of the year (Khasanova, 2000). Now Udihe is a nearly obsolete language. Our cross-dialectal field study of 2007 and 2010 across the settlements marked in Figure 1.2, discovered in total only about 40 speakers and semi-speakers of Udihe (cf. § 3), the most fluent of which are listed in the Appendix.

Vowel aspiration and glottalisation and their different evolutionary stages across varieties have served as an important argument in discussions on both the dialectal division of Udihe and the influence of language contact in its development. This is further addressed in § 5.

2.2 *The Udihe Vowel System*

The system of plain short and long vowel phonemes given in Table 1.1 is a brief summary of previous research (Šneider, 1936, 1985 [1937]; Cincius, 1949; Nikolaeva, 2000; Nikolaeva and Tolskaya, 2001; Simonov, 1988; Kormušin, 1998) and my own field data. Marginal phonemes are given in parentheses. Footnotes provide information about the main peculiarities of individual vowels.

All short and long umlaut vowels *ä* (æ), *ö* (ø), *ü* (y), as well as *e, e:* and most other long vowels in Udihe, are late developments with respect to the Proto-Tungusic system. Most long vowels have developed through the loss of an intervocalic consonant between two short vowels. Short umlaut vowels stem either from the shortening of the corresponding long vowels or from the fronting of back vowels in the context of front vowels.

Udihe features vowel harmony, where the vowel qualities of the following three groups co-occur with other vowel qualities within each group or with "neutral" vowel qualities *i, u*: (I) *a, ä, e*; (II) *o, ö, ü*; (III) *ə*. However, these rules have some exceptions, especially in suffixes (Šneider, 1936: 87–88).

Vowels can also form clusters of two and sometimes three vowels, which can be either pronounced in one syllable as diphthongs and triphthongs or distributed across several syllables, depending on the style and speed of speech (see § 2.4.1). Vowel clusters are usually rising (ending in *i* and *u*): *ai, äi, oi, öi, ui, üi, əi, au, äu, ou, öü, iu, əu*, although some falling clusters (esp. *ua, uə*) are also attested. Clusters usually contain short vowels, but combinations of long and short vowels, especially in modern Udihe, are also possible (see § 4.5). Vowel clusters can be divided by a morphemic boundary: *aja* 'good' > *aja=u-* '(to) like'.

Udihe manifests ongoing reduction of long vowels and simplification of vowel clusters, in the course of which some contrasts are being lost (see also §§ 2.4, 4.5), cf. monophtongisation processes *ie/iə > e:; io, eo, üö > ö:; ea, eä, ia, iä > ä:* in all varieties and *ua > a:, eu > u:* in Bikin, as well as ongoing mergers like *au/äu ≈ ou/öu ≈ əu, ai/äi ≈ oi/öi ≈ əi, oa ≈ ua* (Šneider, 1985 [1937]: 116–117; Kormušin, 1998: 42; Nikolaeva, 2000: 122; author's field data).

A unique feature of Udihe among Tungusic languages is that long vowels, diphthongs and triphthongs can also contain aspiration or glottalisation, or both, which is discussed in the next sections. It is important to note that one of the reasons for the disagreement between various phonetic and phonological accounts of aspiration and glottalisation, mentioned in § 1, is a dialectal heterogeneity of field data used in different studies. Šneider, Sunik, Simonov, and Radčenko interviewed Khor and An'uj speakers, Kormušin recorded Koppi, Samarga, Bikin, and Iman speakers, Girfanova worked with Khor and Bikin speakers, and Nikolaeva and Tolskaya with Bikin speakers. Moreover, the data

TABLE 1.1 Udihe vowel system (based primarily on Khor dialectal data)

	Front		**Non-front**	
	Non-rounded	**Rounded**	**Non-rounded**	**Rounded**
high	i iː[a]	(ü)[b] (üː)[b]		u uː[a]
mid	(e)[c] eː[d]	ö[e] öː[d, e]	ə əː	o oː[a, d]
low	ä äː[d]		a aː	

a word-initially, the first portion of these vowels is pronounced as a glide, i.e. the realisation is [ji], [wu], [wo], respectively;
b attested in very few words;
c in some accounts, *e* is considered as a phonetic variant of either /i/, /ä/, or /eː/, depending on the position;
d these long vowels are often pronounced as diphthongs: [iə], [üö], [uo], [eä ~ iä], respectively;
e not attested word-initially.
Note: All non-rounded front vowels and rounded high vowels also trigger a change into palatals for the preceding *t, d*, often for *n, l*, as well as the secondary palatalisation of all other consonants.

were collected in different periods: those by Šneider in the 1930s, by Kormušin and Sunik in the 1960–1970s, by Simonov and Radčenko in the 1980s, by Girfanova in the 1980–1990s, by Nikolaeva and Tolskaya in the 1990s.

2.3 *Reported Structural Properties of Aspiration and Glottalisation*

In the discussions on the status of Udihe aspiration and glottalisation, phonetic and structural arguments are often mixed. In what follows, I attempt to keep them apart for more clarity.

I first discuss the original phonological properties of these features, as described for Khor and An'uj Udihe in the 1930s.

Šneider (1936: 83; 1985 [1937]: 112–114; cf. also Cincius, 1949: 66) lists aspirated and glottalised counterparts of most vowel types. From the perspective of the vowel system presented in Table 1.1, which takes into account the corrections of later researchers, the inventory of original aspirated vowels in Khor would be *aʰ*, *äʰ*, *eʰ*, *öʰ*, *əʰ*, *oʰ*, *iʰ*, *uʰ* (usually transcribed as *aha*, *ehä*, *ihe*, *ühö*, *əhə*, *oho, ihi, uhu*), and that of glottalised vowels would be *ʾa*, *ʾo*, *ʾə*, *ʾi*, *ʾe*, *ʾä*, *ʾö*.[1] In both cases, vowels are intrinsically long.

1 In examples from my own field data below and some other specifically mentioned cases, glottalisation is marked after the vowel, as that is where it usually occurs now.

As said in § 2.2, certain types of diphthongs and triphthongs can also contain aspiration and glottalisation. Šneider (1936: 86) describes different variants of combinations of plain with aspirated or glottalised vowels in vowel clusters, cf. in diphthongs: *n'au* 'hen' vs. *ku'a* 'he has chiselled', *ahaini* 'he pursues' vs. *kuahani* 'he chiselled'. In triphthongs, also the combinations of two aspirated vowels were possible: *ŋuhahu* 'you (PL) are sleeping' (Šneider, 1985 [1937]: 117).

Like most Udihe plain long vowels, all aspirated and glottalised monophthongs and vowel clusters originate in combinations of short vowels with consonants between them. Aspiration usually stems from **V(C)sV*, where **C* can be **k*, **l*, **n*, **m*, **r*, **ŋ*, and glottalisation from **VkV* with certain types of vowels (cf. Cincius, 1949: 115–117, 194–203, 218–229). The pronunciation of **k* apparently varied between uvular [q] and velar [k].

For Khor and An'uj Udihe, both Šneider and Zinder (1948: 581) synchronically postulate single aspirated and laryngealised vowel phonemes, because, according to them, these complexes form a single syllable. Šneider (1985 [1937]: 115) mentions that also "interrupted-aspirated" vowels are possible and that the sequencing of aspiration and laryngealisation can differ: *b'aha* 'the one who found' (cognate to Evenki *bakača:*) vs. *ah'a* 'he pursued'.

With such an approach, the full vowel inventory in Udihe becomes very large, reaching ca. 70 phonemes, which stretches typological plausibility (Sunik, 1968: 212; Simonov, 1988: 50). For this reason, and also because aspiration and glottalisation derive from consonants and can still have consonant-like pronunciations in some contexts (cf. § 2.4), Sunik (1968) and Kormušin (1998) treat them as consonants *h* and *ʔ*. Moreover, Kormušin considers *h* to be an intervocalic consonant and *ʔ* a consonant following the vowel.

Ironically, in the 1930s, the consonantal interpretation had more justification than in later periods, when the phonetic realisation and some structural properties of the two features changed. For example, in Kormušin's time, no phonetic difference between the two types of "interrupted-aspirated" vowels (*Vh'V* vs. *V'hV*), reported by Šneider, was any more recorded.

In the general course of vowel reduction (see § 2.2), aspiration tends to disappear altogether (viz. § 2.4.1) and the inventory of glottalised vowels tends to shrink. For example, only three glottalised vowels *'a*, *'o*, (*'ə*) are distinguished in Khor by Simonov (1988: 63) and four, *'a*, *'o*, *'ə*, *'ä* in Bikin by Nikolaeva (2000: 118). This is also a result of a different phonemic analysis procedure as compared to Šneider's, but only partially.

Nikolaeva (2000: 120–121; Nikolaeva and Tolskaya, 2001: 42) brings forward several structural arguments against Kormušin's interpretation of glottalisation in Bikin as a consonant following a vowel:

– in the case of word-final glottalisation (*odo'* 'grandfather'), a glottal stop would be word-final, a position impossible for other consonants;
– clusters of three consonants, impossible in Udihe otherwise, would appear in cases like *ba'gdi* 'meat';
– a glottal stop would not occur word-initially, unlike other consonants;
– a glottal stop would follow just four types of vowels;
– glottalised vowels prosodically behave like long vowels rather than as combinations of a vowel and a consonant (Nikolaeva mentions stress rules, see § 6.2; also, as discussed below, both aspirated and glottalised vowels turn into plain long vowels in the course of reduction).

Aspiration and glottalisation were possible both in initial and in non-initial syllables and could occur more than once per word. Simonov (1988: 78) mentions, however, that there cannot be more than two "intensive" (i.e. plain long or aspirated) vowels in a word: the first one under the "initial stress" and the second one under the "final stress" (see §§ 2.5, 6.2 on stress), e.g. *čāla^{h}ni* 'he agreed'. Yet, the data of the 1930s still contain occasions of two aspirated or glottalised vowels per word, and not necessarily in the positions mentioned by Simonov for the "intensive" vowels, e.g. *ana'ꞑziga* 'boatꞑDIM' (Šneider, 1936: 16), *ətətəhəndihi* 'to the going one' (Šneider, 1936: 144). These cases, however, are extremely rare. Cases of more than two long, aspirated, or glottalised vowels per word have not been attested.

Radčenko (1988: 36–37) also notes the following important prosodic properties of aspiration and glottalisation:

– they typically serve as word edge markers, as they usually occur either in the first or in the last syllable of the stem (in these cases, Radčenko treats them as pharyngealised and laryngealised accents);
– they can also serve as syllabic boundary markers (in these cases, Radčenko treats them as consonants, e.g. *da'i* 'pipe' is transcribed by her as [daˀ-ji ~ da**h**-ji], but see § 2.4).

2.4 *Reported Phonetic Features of Plain Long, Aspirated, and Glottalised Vowels through Time*

The phonetic features of Udihe vowels have been described at different points in time. The first experimental study was conducted in 1933–1934 in Š'erba's phonetic laboratory in Leningrad by Zinder, Matusevič, and Šneider on the data from two Khor speakers (results on these data are reported in Šneider, 1936, 1985 [1937]; a ms. by Zinder and Matusevič, 1930s (extensively cited by Kormušin, 1998); Zinder, 1948; Baitchura, 1979, 1991). The second instrumental analysis was conducted by Radčenko (1988) and Simonov (1988) on data collected in 1985–1986 from a Khor speaker who was interviewed also in our study

(marked in Appendix as VT-f-1936). Published data, both acoustic and impressionistic, allow the phonetic evolution of plain long, aspirated, and glottalised vowels to be traced from the 1930s (in some cases, even from the end of the 19th century) to the 2000s, as shown below.

2.4.1 Aspirated Vowels (in Comparison with Plain Long Vowels)

In the experimental study of the 1930s, aspirated and glottalised vowels were durationally shorter than plain long vowels. Aspirated vowels were described as containing a voiced pharyngeal fricative in the middle (Zinder, 1948). Actually it is pronounced rather as a voiceless or voiced glottal fricative and is marked below as *h* [h ~ ɦ]. Šneider (1985 [1937]: 111), who considers all long monophthongs and polyphthongs monosyllabic (see above), at the same time describes plain long vowels as pronounced with two intensity peaks. The ratio between short and long plain vowels in Šneider's data, as calculated by Baitchura (1991), is about 1 : 2–2.5 in disyllabic words, and the duration of a long vowel in the first closed syllable is similar to that in the first open syllable.

In his data from 1964, Sunik (1968: 211–212; 1997: 238) attests occasional loss of aspiration (and glottalisation) in fast speech, as well as occasional long vowel shortening in the non-initial syllables. On the other hand, he still mentions the typical double-peakedness of long vowels, which apparently implies their bisyllabic character for him. Kormušin (1998: 50, 52), who worked on dialects other than Khor in 1964–1974, claims that Udihe long vowels and diphthongs are divided between two syllables only in very clear, emphasised speech. In this case, the second vowel of a word-final diphthong can also receive "stress" (on stress, see §§ 2.5, 6.2). In normal full or fast pronunciation, the two vowels usually form one syllable. In fast speech, long monophthongs become half-long and the second components of diphthongs are reduced, while final short vowels can elide: [ŋə-nə-ʒə-nə-ˈ**i**] > [ŋə-nə-ʒə-nˈə**i̯**] 'I go', [bu-də-ə-nˈˈ**i**] > [bu-dˈənʲ] 'he died'.

Kormušin (1998: 64–65, 83) also mentions style-dependent variability in the realisation of vowel aspiration. In emphasised pronunciation, one hears two vowels of similar duration divided by a phonetically voiced lower-glottis spirant *h* at the syllabic boundary: [a-ɦan-ta] 'woman'. In a normal full style of speech, a monosyllabic construct occurs where *h* is "a pharyngeal glide in the beginning of the second vowel": [aʱan-ta]. In fast speech, a monosyllabic long vowel followed by a voiceless fricative *h* is realised: [aːʰn-ta]. Kormušin notes that a palatalised [hʲ] is more often realised as a true consonant than a non-palatalised [h] (cf. § 4.2 on its current realisation as [j]).

In 1983, an ongoing loss of vowel aspiration in the non-initial syllables of Khor is attested also by Girfanova (1984: 92). The second instrumental study

from the same period by Radčenko (1988) and Simonov (1988) provides more details to the phonetic features of Khor vowels (although Simonov's account contains no phonetic graphs). A further evolution of vowels can be observed here.

First, Simonov (1988: 51, 54, 76) mentions the double-peakedness of plain long vowels only for the emphasised style of pronunciation or for certain word positions, e.g. in the first open syllable. In the first closed syllable, according to him, long monophthongs are already relatively short and always form a single syllable. On the other hand, he treats diphthongs, considered as monosyllabic by Šneider, as often divided by a syllable boundary. Like Kormušin, Simonov also claims that both parts of diphthongs can potentially carry stress (cf. §§ 2.5, 6.2).

Second, Simonov's description of aspirated vowels (1988: 52–55, 72–76) drastically differs from all others, as he sees aspiration as a secondary phonetic cue appearing in the second half of long vowels only in some positions. Only in emphatic pronunciation, aspiration is realised in the middle rather than in the end of the vowel. An abrupt rise in intensity towards the end of these vowels is claimed to be their primary phonetic cue. Plain long vowels are, in turn, described as equally intensive in all their parts. According to Simonov, this rise in intensity is accompanied by strong aspiration only either in the open penultimate syllable or in the word-initial syllable which is open or starts with a vowel. In the first closed syllable starting with a consonant or in the word-final syllable, aspiration is weak or absent. Simonov calls plain long vowels "intensive liquid", aspirated vowels "intensive strident", and glottalised vowels "weakly intensive abrupt".

Third, Simonov (1988: 54–55) calls plain long vowels phonetically "wide", while the aspirated vowels are defined as "narrow".

Radčenko (1988: 37–39; 1987) cites the ratio of 1 : 1.5 for short vs. long vowels and describes a typical realisation of aspiration as "the pharyngealised ending of a vowel". These vowels are claimed to contain a "plain" and a "pharyngealised mora", which is realised as in [aạ̣nta]. She calls such a realisation "a pharyngealised accent placed on the whole syllable" and mentions that these vowels carry low pitch. The latter is actually hard to see on her intonograms and was not observed in our data. Radčenko also mentions that aspirated vowels tend to lose aspiration and become plain long vowels.

Both Radčenko and Simonov observe that a clear consonantal *h* can occur only at the syllabic boundary before an aspirated vowel but not any more within it: [a**h**a-**h**i-ni] > [a:-**h**i-ni] 'he pursues'. Finally, Radčenko notes that *h* can occur in diphthongs as a syllabic boundary marker. These cases also include occurrences of an epenthetic non-etymological *h*. For example, Radčenko tran-

scribes *dai* 'pipe' as [dah-ji] (1988: 37), but see *dai* in Šneider (1936: 24) and Kormušin (1998: 225), as well as Proto-Tungusic **dɛi* (possibly, a Chinese loan) in Cincius (1975: 202, 1). The observation by Radčenko on the epenthetic laryngeals finds some support in the 19th century Udihe data (Nadarov 1887: 163–165), though. For example, 'pipe' was recorded there as *∂aгu ~ ∂au* ⟨dagi ~ dai⟩, which also indicates an optional non-etymological *h* at the syllabic boundary (cf. § 4.4).

On the other hand, the starting process of vowel aspiration loss can be also traced already to the 19th century. Nadarov usually depicts aspirated vowels as in *mogo* ⟨t**ogo**⟩ 'button', i.e. with a bisyllabic pronunciation [toɦo]. However, a variability between full and contracted forms can be seen in *я ~ яга* ⟨**ja** ~ **jaga**⟩ 'eye', *нюге ~ нio ~ нё* ⟨***nüge*** *~* ***nio*** *~* ***nö***⟩ 'nose' (cf. *jehœ*, *ŋyhɵ* in Šneider 1936).

2.4.2 Glottalised Vowels

Šneider (1936: 85–86; 1985 [1937]: 112, 115–116) describes glottalisation as a long vowel interrupted in the middle by full silence produced by a glottal stop. Zinder (1948: 581) characterises this sound as a glottal or a pharyngeal stop (marked below as *ʔ* [ʔ]). In a manuscript by Zinder and Matusevič (1930s: 25; cf. Kormušin, 1998: 53–54), free variation of a voiceless glottal stop and a voiced pharyngeal stop with a mean duration of 60 ms was claimed. Vowel duration before the stop was 30 ms and after the stop about 180 ms.

For diphthongs with the first "interrupted" vowel, Šneider describes the second vowel as directly following the glottal stop (see also Zinder and Matusevič, 1930: 27; cf. Kormušin, 1998: 59): *n'au* [naʔu] 'hen'. In diphthongs with the second "interrupted" vowel (relatively rare in Udihe), the glottal stop is pronounced inside the second vowel: *ku'a* [kuaʔa] 'he chiselled'.

As said in § 2.3, Šneider also attested two variants of the sequencing of aspiration and glottalisation: first a glottal stop and then a pharyngeal fricative: *b'aha* [baʔaɦa] 'the one who found', or vice versa: *ah'a* [aɦaʔa] 'he pursued'.

While the descriptions of the 1930s attest only the full glottal stop, later descriptions give a wider range of realisations for Udihe glottalised vowels.

Kormušin's (1998: 57–61, 83–84) data from the 1960–1970s allow us to trace the shift of laryngealisation from the beginning to the end of the vowel. In emphatic pronunciation, the feature is described as a lower-glottis voiced stop where both the closure and the burst are intensified. Longer occlusion brings about a shortening of the preceding vocalic part, while the stronger burst results in a lengthening of the subsequent vocalic part. Such a pronunciation can possibly explain the distribution of the durations of the vocalic parts around the glottal stop attested by Zinder and Matusevič.

In normal slow pronunciation, the sound is realised in Kormušin's time as a voiceless glottal stop, and its shift to the beginning of the vowel is attested, e.g. *ʾa* (*~a'i ~ a'*) 'beak'. In faster full-style realisations within a phrase, a glottal stop can still occur but the portion of a vowel after it is shortened, devoiced, or even absent in case of a diphthong, where the other vowel directly follows the glottal stop. For fast speech, Kormušin attests a shift of the glottal stop to the very end of the vowel, implosive realisations, or just creaky voice on vowels. Sunik (1968: 212) also attests an occasional loss of laryngealisation in fast speech.

The data of the 1980s report further evolution. Simonov (1988: 51–54, 76–77, 81) notes that a full glottal stop occurs only in emphatic pronunciation. He describes the main articulatory mechanism of glottalisation as an abrupt shift from the constricted to the relaxed state of the pharynx (or, rather, larynx; cf. Radčenko, 1988: 37).[2] In Simonov's data, either the first or the second portion of the vowel containing a glottal stop is shortened (they are never equal in duration), but *ʔ* hardly ever occurs before a vowel. In fast speech, glottalisation tends to be lost from non-initial word-final syllables. On the other hand, as in the case of *h*, Simonov attests an occasional epenthetic (non-etymological) glottal stop in sandhi between vowels belonging to different words and at the syllabic boundary within the same word.

Radčenko (1988: 36–37; 1987) also mentions the dampening of F1 and F2 in glottalised vowels and an abrupt rise with a subsequent dip of pitch in them.

Nikolaeva (2000: 117–118) and Nikolaeva and Tolskaya (2001: 39) no longer attest a full glottal stop in Bikin Udihe in 1991–1992: the most frequent realisation is just creaky voice. Nikolaeva notes that glottalised vowels are long and often fronted, with F2 consistently raised, as compared to plain vowels. This is similar to the effect of aspiration on vowel quality discussed above.

2.5 *Existing Accounts of Udihe Stress*

As said in § 2.3, Nikolaeva opposes plain long and glottalised vowels to short ones also on the basis of stress rules. A possible relation between vowel glottalisation and stress is further discussed in § 6.2. However, the actual properties of the Udihe word stress are not yet entirely clear.

Šneider (1936: 92; 1985 [1937]: 121–122), followed by other researchers (Sunik, 1968: 213; Kormušin, 1998: 84; Simonov, 1988: 66, 77–78), distinguishes word-initial dynamic (expiratory) stress and word-final high pitch-accent and claims that in a disyllabic word the "first stress" can be absent. A tetrasyllabic word

2 In recent articulatory accounts describing the activity of the lower vocal tract, larynx and pharynx are actually not distinguished as separate articulators (Esling et al., 2019).

in his account has a prosodic structure of two disyllabic words, with "final stresses" on the second and the last syllable. In general, the "final stress" (claimed to be stronger than the "initial" one) can fall on the last, penultimate, or antepenultimate syllable. Unstressed final short vowels can undergo reduction and elision.

Nikolaeva and Tolskaya (2001: 88–95) introduce the notions of the foot and the mora to Udihe. They define plain long and laryngealised vowels and the syllables containing them as bimoraic and all others (including the CVC syllables) as mononoraic. The foot is seen as right-headed and minimally bimoraic. Monosyllabic words with a short vowel either lengthen the vowel (*wa-* [wa:] 'kill') or form a disyllabic foot with another word (or its first part). The "initial stress" is contested and the "final stress" is claimed to fall either on the rightmost bimoraic vowel or else on the final vowel. As an exception, word-final vowels *i* and *u* are called extrametrical in inflectional affixes due to their frequent reduction and loss. Some suffixal clitics (e.g. *-da/-də/-do* 'and') with similar properties are also introduced. However, in emphatic pronunciation, all these elements can still bear stress. If the "primary stress" does not fall on the last syllable, the latter can receive a "secondary stress" in polysyllabic words. The authors still admit that the question of stress is far from being clear.

Additionally, Baitchura (1979, 1991) conducted measurements on Šneider's data (isolated di-, tri-, tetra-, and pentasyllabic words from two speakers) and discovered that word-final vowels invariably get the highest pitch, while other pitch movements on vowels are variable. He also found that in disyllabic words, the duration of the second short vowel is longer than the duration of the first short vowel. Besides, the duration of the short vowel after another short vowel is longer than after a long vowel, which can indicate a tendency towards isochrony. In words longer than two syllables, the penultimate short vowel has the longest duration out of all the short vowels in the word. Finally, Udihe exhibits polysyllabic shortening: the duration of vowels is in an inverse relation to the overall length of a word.

3 Cross-dialectal Field Study on Udihe Phonetics and Phonology

In 2007 and 2010, Elena Perekhvalskaya and I undertook a comparative field study of Udihe dialectal phonetics and phonology. The scope of this study was to visit the remaining speakers of all possible varieties and to collect comparable data on their phonetics and phonology by using a questionnaire specifically tailored for this purpose. The questionnaire, compiled by myself on the basis of

published data, included about 1000 phrases for elicitation. It contained data on the syntagmatic and paradigmatic features of all Udihe phonemes, including vowel aspiration and glottalisation, and on all known dialectal phonetic and phonological isoglosses. We collected phonetic data on the following varieties, from north to south (the names of the settlements where the data was collected are given in parentheses; cf. also Figure 1.2 and Appendix):

– Koppi, a transitory Oroch–Udihe variety (Ust'-Orochi);
– Khor (Gvas'ugi);
– Samarga (Agzu);
– Bikin (Krasnyj Yar);
– Iman (Rosh'ino).

In total, about 45 hours of recordings were obtained using an Olympus WS-310 digital recorder. Apart for the phonetic questionnaire, interviews included a questionnaire on verbal aspect, various narratives in Udihe and Russian, sociolinguistic interviews about the background of the speakers and their family ties. The main language of interaction was Russian. Elena Perekhvalskaya has been conducting fieldwork on Udihe for more than 30 years, she understands Udihe well and speaks it to a certain extent. She had previously worked with most of our Krasnyj Yar speakers. I had no previous field experience with Udihe. In total, we conducted interviews with 37 Udihes and 4 Orochs. The phonetic data could be obtained only from some of the Udihe speakers, as others (especially those from Iman) were not fluent enough in their native varieties. Sociolinguistic data on those speakers who supplied data for the phonetic questionnaire are provided in the Appendix.

During the collection of the phonetic questionnaire, speakers were either asked to translate the carrier word from Russian or were given a Udihe word directly, and then were asked to pronounce it several times both in isolation and in a phrasal context. The questionnaire was recorded in two main versions:

– full (~500–800 carrier words): 2 Khor, 1 Khor/Samarga, 1 Bikin, 1 Iman;
– short version, which included only the most important features and isoglosses (~200–400 words): 1 Koppi, 2 Khor, 1 Samarga, 4 Bikin, 1 Iman.

4 Udihe Aspiration and Glottalisation in Modern Udihe Varieties

This section provides an overview of the main pronunciation variants of vowel aspiration and glottalisation encountered in our phonetic study across Udihe varieties. First, the general evolutionary cline of the two features is presented, as extrapolated from the observed variability in their realisation (§ 4.1), then

the phonetic details at all evolutionary stages are discussed in depth (§§ 4.2–4.4). The structural phonological changes in the properties of aspiration and glottalisation from the 1930s to nowadays are summarised in § 4.5.

The discussion below is theoretically grounded within the framework of evolutionary phonology and sound change typology (Ohala, 1989; Blevins, 2004, 2015; Kapatsinski, 2018). Specifically, the source of language change is seen in the synchronic pool of variation gradually changing its structure in course of the repeated exposure of subsequent generations of speakers/listeners. Typical pathways of sound change are linked to articulatory, perceptual, and cognitive biases of speakers/listeners.

Language obsolescence can potentially influence the typical paths of language change in various ways. For example, speakers stop communicating in the language and do not adjust to each other's speech behaviour anymore, so an ongoing sound change is interrupted and does not manifest any progression through time (Kuznetsova and Markus, 2022). Pressure from dominating cognate languages can also change typical paths of sound change (Kuznetsova, 2015).

The present study shows that Udihe dialects manifest different stages of the evolution of aspiration and glottalisation. This is correlated with the overall degree of phonetic and phonological reduction and related innovations, which increase across the Udihe-Oroch dialectal continuum from the north to the south of the area (the Oroch language—a transitory Koppi variety—Khor Udihe—Samarga Udihe—Bikin Udihe—Iman Udihe). Apart from the two discussed features, a higher level of reduction is observed also in long vowel shortening and in the qualitative reduction of bi- and trivocalic clusters in the southernmost varieties. This rise in the degree of reduction and innovation seems to be at least partially correlated with the degree of language loss and the intensity of language contacts in each particular Udihe variety (cf. § 5).

4.1 *General Scheme of the Evolutionary Cline across Dialects*

Udihe data suggest that aspiration and glottalisation start as consonants, turn first into vocalic and then into word-prosodic features. During the process, the glottal fricative turns into aspiration and the glottal stop becomes creaky voice. Phonetically, the two features first occupy the central portion of a vowel or are placed closer to its beginning, later move to the end of a vowel or spread across it. Finally, aspiration disappears and glottalisation can be realised just through pitch lowering (which also tends to vanish). Perehval'skaja (2010a) proposes the following evolutionary paths of Udihe aspiration and glottalisation:

Aspiration: VsV > VhV > V^{h}V > VV^{h} > V: > V
Glottalisation: VqV > VʔV > V^{ʔ}V > V̰: > V:^{HL} > V:

On the basis of common Tungusic data on the origins of the two features (Cincius, 1949, see § 2.3), earlier phonetic research, and the present study (discussed in detail below), a refinement of the scheme is proposed in Table 1.2.

Table 1.3 presents the general distribution of variants encountered across the studied Udihe varieties. They are divided by the stages distinguished in Table 1.2. The most frequent variants are given in bold text. Variants in parentheses were mostly attested in the non-initial (especially, word-internal) syllables of polysyllabic words, where the degree of reduction of long vowels is higher than word-initially or word-finally.

These realisations are further discussed with examples in §§ 4.2–4.4.

TABLE 1.2 General schemes of the evolutionary stages of Udihe aspiration and glottalisation

	Stage						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Feature	**Proto-Tungusic original C (*s* or *k*)**	**Lenited C (*h* or *ʔ*) with full duration**	**Two Vs divided by: 1) ultra-short ^{h} or ^{ʔ}; 2) aspirated/glottalised middle part; >3) a pitch dip at the syllabic boundary**	**1) Aspirated/ glottalised part of a single long V; >2) a pitch dip in the end of a long V**	**1) Fully aspirated/ glottalised long V; >2) pitch dip on a long V**	**Plain long V**	**Plain short V**
Aspiration	V(C)sV	VhV [h~ɦ]	1) V$^{(h\sim ɦ)}$V 2) VV̰V	V̰V ~ VV̰ ~ VV^{h}	V̰:	V:	V
>pitch			>3) V^{H}V^{L}V^{H}				
Glottalisation	VkV [q~k]	VʔV [ʔ~x]	1) V^{ʔ}V ~ ^{Vʔ}V ~ V^{ʔV} 2) VV̰V	1) V̰V ~ VV̰	1) V̰:	V:	V
>pitch			>3) V^{H}V^{L}V^{H}	>2) V^{H}V^{L}			

Notes: C = consonant; V = vowel; VVV = vocalic cluster with an internal syllabic boundary; VV / V: = long vowel or diphthong; ">pitch" = phonetic realisations of aspiration / glottalisation through a pitch-based feature; H = higher pitch; L = lower pitch.

TABLE 1.3 Distribution of the attested variants of realisation of Udihe aspiration ("asp.") and glottalisation ("glot.") across the studied varieties

Variety	Feature	Stage						
		1	2	3	4	5	6	7
I. Koppi	asp.	**VsV**	**V(h~ɦ)V**	**(V$^{(h\sim ɦ)}$V)**	V̰V̰		(V:)	
	glot.	**VqV**	VxV					
II. Khor	asp.			V$^{(h\sim ɦ)}$V	V̰V ~ V̰V̰ ~ VV^{h}	V̰:	**V:**	V
	>pitch			>V^{H}V^{L}V^{H}				
	glot.			**V^{ʔ}V, V̰V**	**V̰V ~ V̰V̰**	V̰:	V:	
	>pitch				>V^{H}V^{L}			
III. Bikin,	asp.						**V:**	(V)
Samarga	glot.			V^{ʔ}V, V̰V	**V̰V ~ V̰V̰**	**V̰:**	**V:**	(V)
	>pitch			> V^{H}V^{L}V^{H}	> V^{H}V^{L}			
IV. Iman	asp.						**V:**	V
	glot.				V̰V ~ V̰V̰	V̰:	**V:**	**(V)**
	>pitch				> V^{H}V^{L}			

4.2 *Vowel Aspiration: Current Phonetic Realisation*

The Proto-Tungusic situation (a consonant *s*, optionally preceded by some other consonants, cf. § 2.2; Stage 1 in Tables 1.2–1.3) was attested only in the transitory Oroch to Udihe variety of Koppi. At the boundary between the first and the second syllable, the consonant does not elide, although it sometimes varies with *h*: ***nos****o* 'sable', ***nins****o* 'nose' (both are [nʲüɦö ~ nʲõʰ] in Khor Udihe), but ***naha*** 'skin' (nasa ~ naha was attested for Oroch in Cincius, 1975: 583, I; in Khor Udihe [nʲeɦä ~ nʲäh]). Figure 1.3 presents a case of phonetic variability: a slower realisation *gasa* [gasa] and a faster one *gaha* [g'äha] 'duck'.

In the non-initial syllables, Stages 2–3 are observed in Koppi: an often-voiced and short *h* [h~ɦ] showing a tendency to elision. In Figure 1.4, *damihi* 'tobacco' is first slowly pronounced as [damiɦi] (the duration of [-iɦi] is 390 ms), then faster as [damii] (for Oroch, *dāmisi ~ dāmihi* was attested in Cincius 1975: 195, I; in Khor Udihe, [dami] in our data). In the second pronunciation, the duration of [-ii] is 305 ms, which is comparable with the duration of plain long vowels (cf. with 275 ms in *too* by the same speaker in Figure 1.5). However, this [-ii] is pronounced with two intensity peaks, clearly heard and also seen in Figure 1.4, i.e. as a sequence of two short vowels rather than as a true long vowel. Such realisations of *h* are similar to what was observed for vowel aspiration in Khor in the 1930s (cf. § 2.4.1).

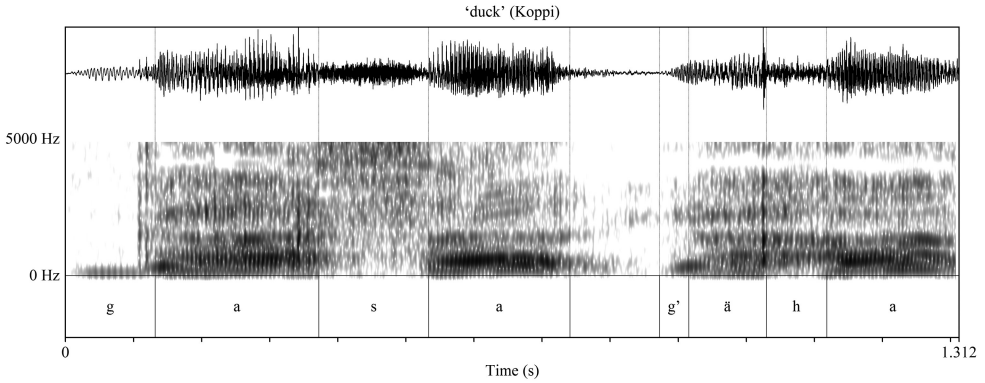

FIGURE 1.3 Koppi: 'duck' (PA-m-1930: slower *gasa* [gasa] ~ faster *gaha* [g'äha])

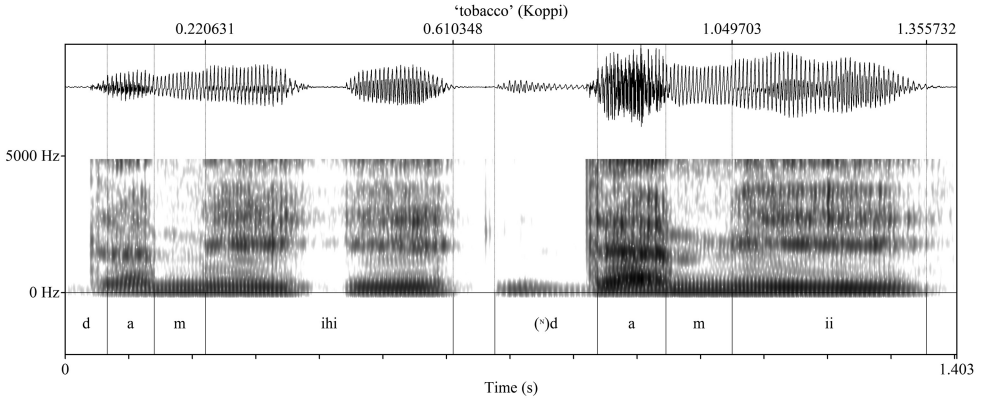

FIGURE 1.4 Koppi: *damihi* 'tobacco' (PA-m-1930: slower [damihi] ~ faster [damii])

In modern Khor, in turn, the picture is now different and represents a further shift along the evolutionary cline from the situation attested there in the 1930s. The double-peakedness no longer appears to be an integral feature of Khor long vowels. Besides, vowel aspiration is now extremely blurred in Khor.

Figure 1.5 presents an example of a pair *tō* [to:] 'fire'—*toho* [toɦo] 'button' in Koppi. The realisation of [-oɦo], with a duration of 441 ms, is similar to that of [-ihi] in Figure 1.4 (Stage 2–3 in Tables 1.2–1.3). Our Khor consultant VT-f-1936 already pronounced it as a single long vowel with very slight aspiration (Figure 1.6; Stage 5). In general, aspirated vowels were attested in very few monosyllabic words of the only two fluent Khor speakers we met (VT-f-1936 and DT-f-1933; see § 4.4 on the latter). In one occasion, the consultant VT-f-1936 also stated that a pronunciation like [ai^{h}kta] for 'larch tree' (Stage 4) was typ-

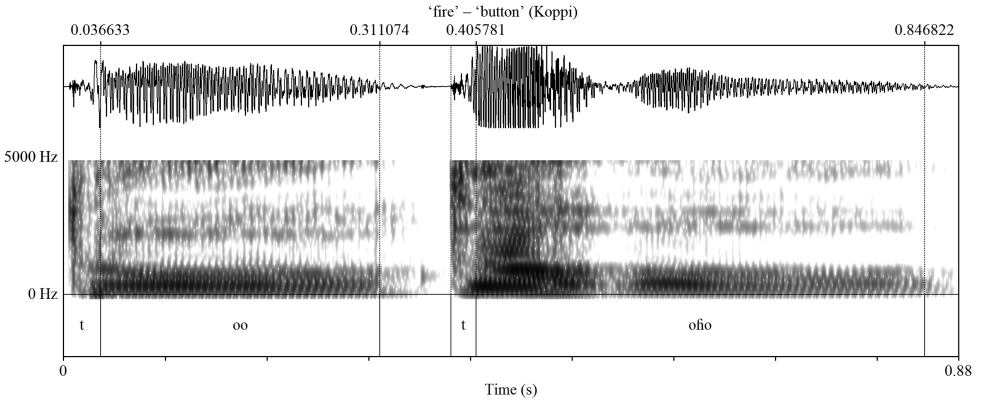

FIGURE 1.5 Koppi: *tō* [to:] 'fire'—*toho* [toɦo] 'button' (PA-m-1930: a consonant *h* [ɦ])

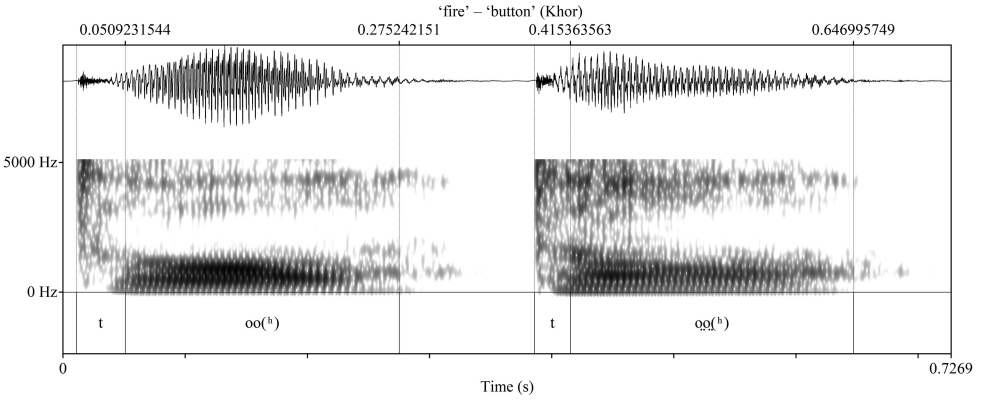

FIGURE 1.6 Khor: [to:] 'fire'—[to̤o̤] 'button' (VT-f-1936: vowel aspiration)

ical for old people. She herself generally pronounced it as [aikta] (Stage 6) in our data. In the data recorded from other Khor speakers, as well as in Bikin (cf. Figure 1.7), Samarga, and Iman data, no differences between the aspirated and the plain long vowels were found at all (full Stage 6). Vowel aspiration is, therefore, nearly lost from the modern Udihe language. The intermediate dynamics of its loss, traced from the end of the 19th century, was described in § 2.4.1 on the basis of earlier studies.

As also mentioned in § 2.4.1, Kormušin (1998: 64–65) noted that *h* was less prone to loss when palatalised. In our data, **hʲ* was indeed preserved as a consonant in Khor in some cases. However, it is now pronounced as [j] and can be said to have merged with the consonant /j/, i.e. **gasa* > **gahʲa* > *gaja* [gaj(ˑ)a] 'duck', with the same [j] as in *aja* [aj(ˑ)a] 'good'.

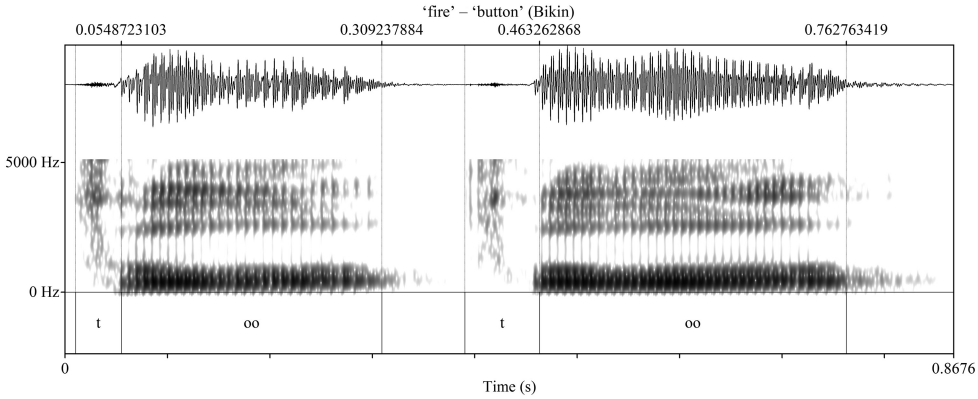

FIGURE 1.7 Bikin: [to:] 'fire'—[to:] 'button' (AE-M-1921: a plain long vowel)

An abrupt rise of intensity in aspirated vowels, claimed by Simonov (1988, cf. § 2.4.1) was not supported by our data (cf. Figures 1.6, 1.16, and intensity curves reported in Perehval'skaja, 2010a: 75), although our Khor speaker VT-F-1936 was the same one as interviewed by Simonov and Radčenko. Simonov provided no graphs and later (1998) admitted that it was not always possible to establish the vowel type clearly in case of aspirated vs. plain vowels, as vowel length and aspiration tend to disappear under the influence of Russian which lacks them.

On the other hand, Simonov's distinction of plain long vs. aspirated vowels as phonetically "wide" vs. "narrow" could indeed be grounded to some extent, at least word-initially and -finally. This, however, should be confirmed by vowel quality measurements. According to my auditory impressions, aspirated vowels (and plain vowels which result from them) are at least more fronted than the non-aspirated ones (cf. also Zinder, 1979: 196).

Our data also confirmed that plain long vowels often shorten in fast speech in all the studied Udihe varieties (especially in non-initial syllables; Stage 7), but are usually restored as long in careful pronunciation. This process can be considered as still phonetic rather than phonological, as also noted in earlier studies (cf. Nikolaeva, 2000: 115–116; Nikolaeva and Tolskaya, 2001: 38–39 on Bikin).

4.3 *Vowel Glottalisation: Current Phonetic Realisation*

Glottalisation generally manifests more stability across Udihe varieties than aspiration, probably because it is perceptually more salient.

In Koppi, a stop *k* [q] was attested (Stage 1 in Tables 1.2–1.3). The only sign in the direction of lenition is its occasional realisation as a fricative [x~χ], e.g.

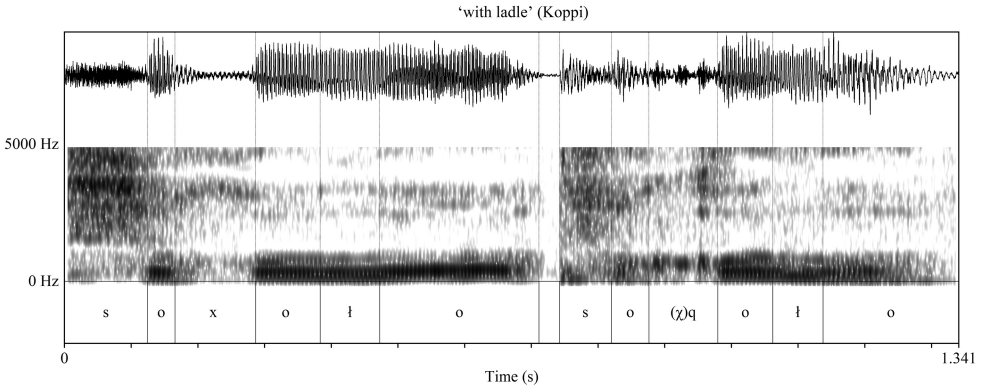

FIGURE 1.8 Koppi: *soqo-lo* 'with ladle' ⟨ladle-LOC⟩ (PA-m-1930: [soxoło ~ so(χ)qoło])

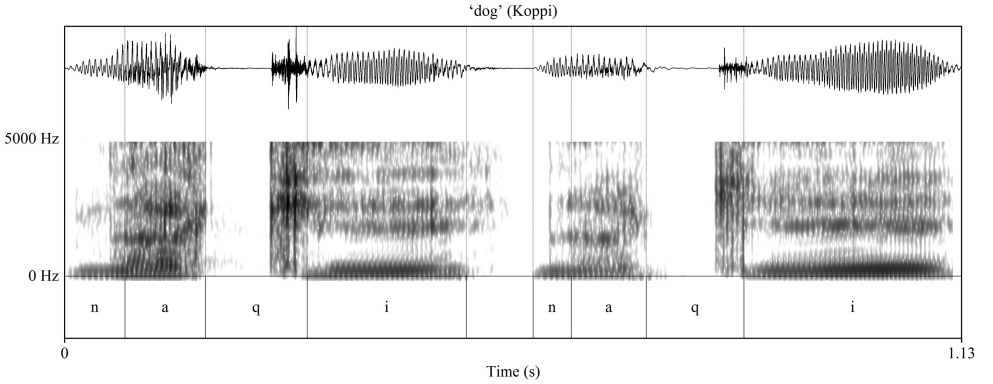

FIGURE 1.9 Koppi: *naqi* 'dog' (PA-m-1930: a consonant *k* [q])

soqo-lo [soxoło ~ so(χ)qoło] 'with ladle' (⟨ladle-LOC⟩; Figure 1.8), cf. with core Udihe *so'u ~ so'* 'ladle' (Kormušin, 1998: 57) originating from **sokovun* (Cincius, 1975: 105, 11), and a variation *k* ~ *x* in Tungus-Manchu languages in place of Udihe laryngealisation (Cincius, 1949: 218–219).

Usually the stop in Koppi still manifests both occlusion and burst and shows no durational shortening (cf. *naqi* 'dog' in Figure 1.9). Such a realisation (Stage 1–2) is more archaic that that attested for Khor in the 1930s, where a glottal stop between two vowels was reported (Stage 2, cf. § 2.4.2). Now the realisation of glottalisation in Khor is even more innovative and very variable: the most frequent variants reflect Stages 3–4. Figure 1.10 presents three subsequent pronunciations of *ina'i* 'dog': [inăi] ~ [inạ̈ʔ̈ji] ~ [inə̤(j)i̤], illustrating the variability between a short glottal stop inside the first vowel of a vowel cluster (Stage 3), a partially glottalised vowel cluster (Stage 4), and a plain vowel cluster (Stage 6). In current realisations with a glottal stop, the preceding part of the

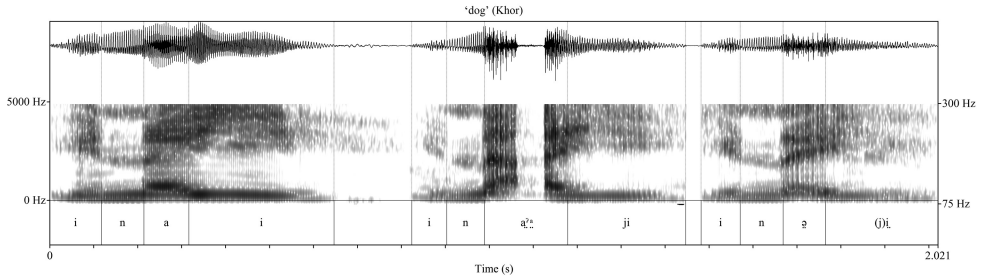

FIGURE 1.10 Khor: *ina'i* 'dog' (VT-f-1936: plain vowel cluster ~ glottal stop ~ partially glottalised vowel cluster)

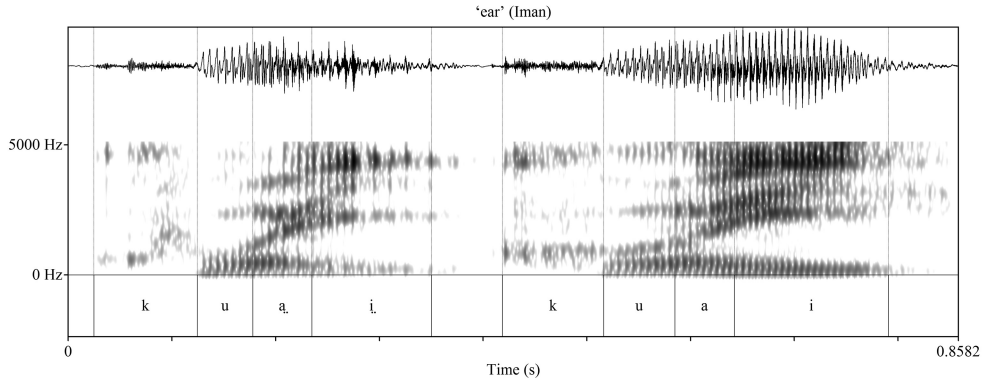

FIGURE 1.11 Iman: *kua'i* 'ear' (KD-m-1923: fully glottalised diphthong ~ plain diphthong)

vowel is usually longer than the following one, while it was vice versa in the 1930s (§ 2.4.2).

In other Udihe varieties, the same kind of variability is observed. However, the most conservative realisations with a full glottal stop hardly ever occur in Samarga, Bikin, or Iman. In Iman, any kind of glottalisation is extremely rare to hear. One such example is given in Figure 1.11, where the word *kua'i* 'ear' was pronounced in isolation as [kʊ̯ă̤i̤] ~ [kʊ̯ăi] (Stage 5 ~ 6).

In general, glottalisation is often accompanied by an abrupt dip of F_0. For example, Figure 1.12 presents a Khor realisation of *da'* 'cotton wool', where the central part of the long vowel is glottalised, i.e. [da̰a] (Stage 3). The pitch falls with the start of glottalisation and stays low over the last two thirds of the vowel. Figure 1.13 shows the same word pronounced by a Bikin speaker LS-f-1934 in a more innovative manner: glottalisation is in the end rather than in the middle of the vowel, being very short in the second repetition (Stage 4). Here, too, an F_0 dip is observed with the start of glottalisation, which is now at the very end of the vowel.

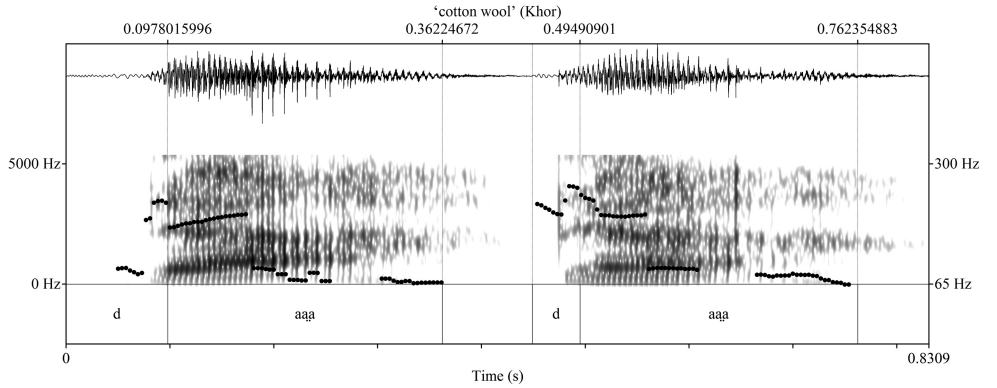

FIGURE 1.12 Khor: *da'* 'cotton wool' (VT-f-1936: glottalisation and pitch dip in the middle of a vowel)

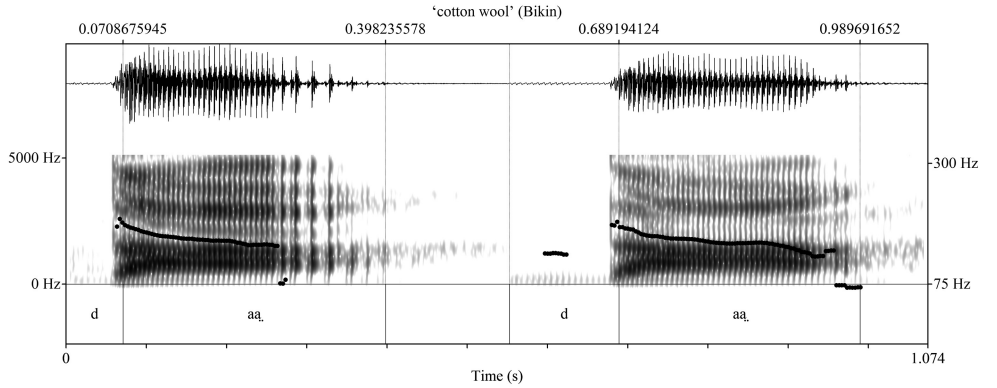

FIGURE 1.13 Bikin: *da'* 'cotton wool' (LS-f-1934: glottalisation and pitch dip in the end of a vowel)

Realisation of glottalisation by the means of pure pitch lowering is observed especially in the southernmost Udihe varieties. In Figure 1.14, the pitch dip entirely replaces glottalisation. In the first two repetitions of *da'* by a Bikin speaker AA-m-1934, the pitch is falling-rising (HLH) and divides the vowel into three parts [da^{H}a^{L}a^{H}], much like the glottalisation in Khor in Figure 1.12. It also gives an acoustic impression of a bisyllabic vowel (cf. § 4.4). In the third repetition, the pitch is falling (HL) and gives an acoustic impression of a long monosyllabic vowel, similar to the glottalisation at the end of the vowel in Figure 1.13.

Simonov (1988: 77) also reported that in the forms originally containing both aspiration and glottalisation (see § 2.4.2), the two could still be realised by some speakers in the 1980s: [b^{ʔ}a-^{ɦ}a̤-mi] *b'ahami* 'I found'. However, his main consultant (the same as VT-f-1936 in our study) could only pronounce it as [b^{ʔ}aa-mi]. This corresponds to our data: only the variants [ba^{ʔ}a-mi ~ baa̤-mi ~ ba^{H}a^{L}-mi] were recorded in the speech of VT-f-1936.

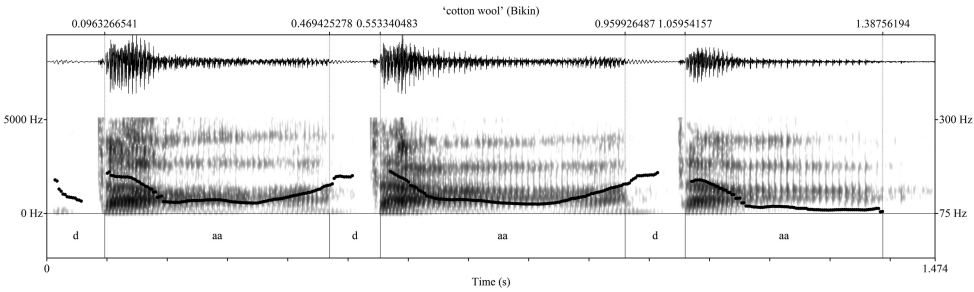

FIGURE 1.14 Bikin: *da'* 'cotton wool' (AA-m-1934: [da^{H}a^{L}a^{H}] (twice) ~ [da^{H}a^{L}])

4.4 *Aspiration and Glottalisation as Syllabicity Markers*

According to Simonov and Radčenko, both aspiration and glottalisation can also function as syllabicity markers, occurring in this function even in non-etymological positions as epenthetic consonants (cf. § 2.4). The cases of purely phonetic occasional epenthetic consonants will not be discussed, as they are hard to find in the data and were not specifically studied (see an example of a consonant *j* in this function in Figure 1.10).

As for the etymological laryngeals, I observed some cases demonstrating how their function of the syllabic boundary markers (Stage 3 in Tables 1.1–1.2) can be expressed through the falling-rising pitch (HLH) solely. Consider the two pronunciations of *ja'* 'plait' in Figure 1.15 by AA-m-1934. The first realisation [ja^{H}a^{L}a^{H}] resembles the first two pronunciations of *da'* [da^{H}a^{L}a^{H}] in Figure 1.14. The second repetition of *ja'* is slow: the speaker tries to make the word very clear to us by syllabifying it as [ja-a], with a short period of silence between the two *a*'s. This is a hiatus without any glottal catch (cf. with *ina'i* 'dog' in Figure 1.10), just a short break in the tension of vocal folds. It marks the syllabic boundary between the two *a*'s, obviously perceived well by this speaker.

A similar effect is attested in *toho* 'button' pronounced by a Khor speaker DT-f-1933 (Figure 1.16). In the first, the most careful, pronunciation, a clearly disyllabic structure [toɦo] with a voiced laryngeal fricative between the vowels is realised. In the second, faster, realisation, there is rather a vowel aspiration in the middle: [to̤o̤]. The disyllabic structure, however, is still clearly marked by a dip in both intensity and pitch. In the last token, there is no aspiration or intensity dip in the middle of the vowel any more, but the falling-rising (HLH) melody still marks the syllabic boundary. In these three tokens, the duration of **oho* is about 400–500 ms. Compare this with *tō* 'fire' by DT-f-1933 (Figure 1.17), where the duration of long monosyllabic [o:] is just ~150 ms and no intensity or pitch dips occur.

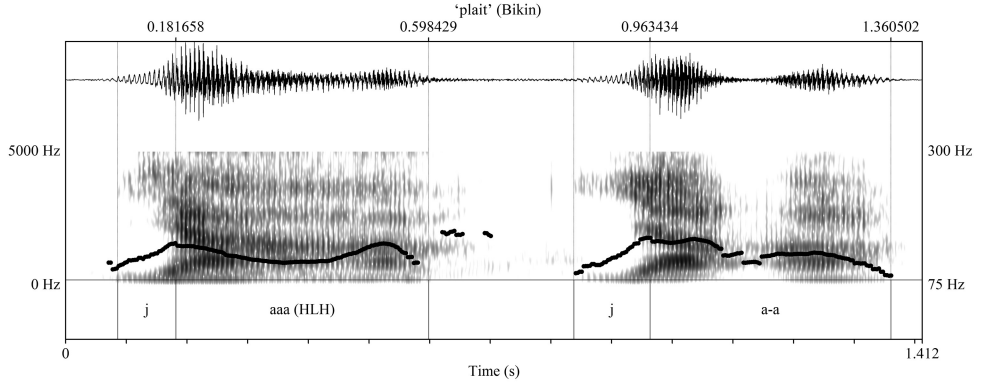

FIGURE 1.15 Bikin: *ja'* 'plait' (AA-m-1934: [ja^{H}a^{L}a^{H}] ~ [ja-a])

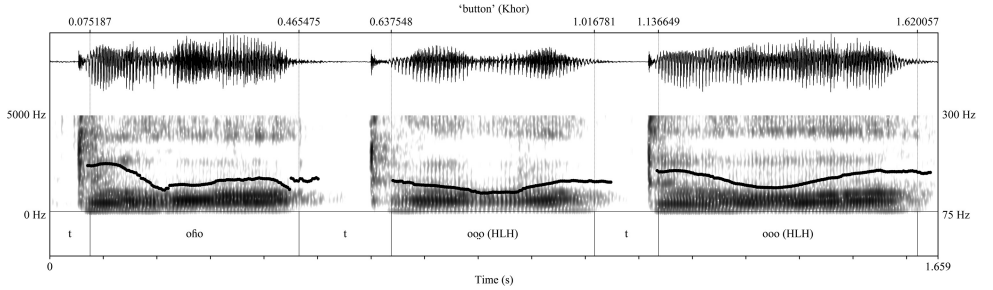

FIGURE 1.16 Khor: *toho* 'cotton wool' (DT-f-1933: [toɦo] ~ [to̤o̤o] ~ [to^{H}o^{L}o^{H}])

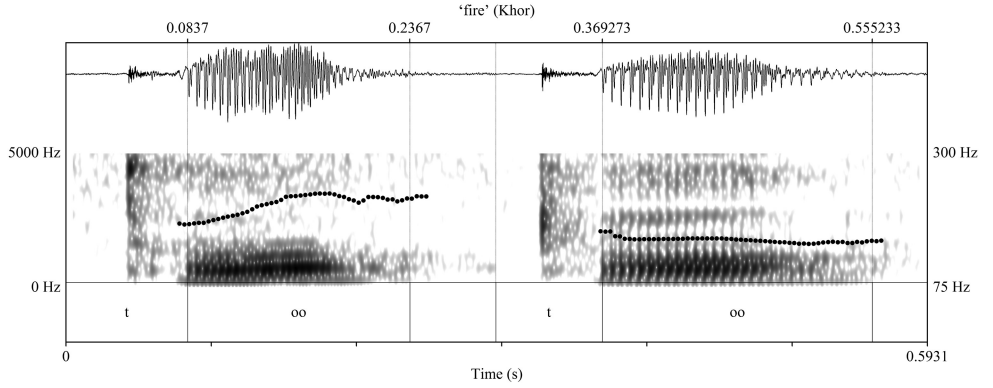

FIGURE 1.17 Khor: *tō* 'fire' (DT-f-1933: [to:])

To summarise, modern Udihe data do not confirm the statement by Šneider that long vowels and vowel clusters, including aspirated and glottalised, are always monosyllabic. Instead, the data rather give support to the observation by Simonov that different types of long vowels can be pronounced both as disyllabic and as monosyllabic, depending on the speed and style of speech, as well as on the speaker and on the prosodic position in a word. This is especially true for aspirated and glottalised monophthongs, as well as for various types of vowel clusters. Plain long vowels tend to be pronounced as monosyllabic.

4.5 *Current Structural Properties of Plain Long, Aspirated, and Glottalised Vowels*

Along with the phonetic development of different types of long vowels in current Udihe, there is an evolution also in their structural properties (examples below are given in Khor pronunciation, if not specified otherwise).

A Udihe word is often composed of short vowels only, e.g. *tuŋa* 'five', *ataxi* 'spider', *diɣanami* 'I speak'. Plain long, aspirated, and laryngealised vowels are attested in our data in the following positions:

1) monosyllables: *tō* 'fire', *(w)o'* 'poultry', *toho* [toɦo ~ toːʰ ~ ~ toː] 'button' ≈ *tō* (traces of aspiration remain only in very few Khor tokens);
2) polysyllables:
   – word-initially: *jāla* 'toad', *ibənə* 'Japanese', *a'sa* 'river branch', *pa'liɣi* 'black', *ānta* ~ [aːʰnta] 'woman' (in general, no clear aspiration is any more observed even in Khor polysyllables);
   – word-finally: *dilī* 'your head', *kawatigī* 'to your tent', *uma'* 'hook', *jəgdiɣə'* 'hero', *uligdiɣa'* 'beautiful';
   – word-internally: *ādāni* [aːdaːnʲ] 'it was cooked', *āsiɣēni* [äːsʲiɣʲenʲ] 'he recovered', *dagāmi* 'I was burning', *diɣanāmi* 'I was speaking'; glottalisation in this position is very rare: *digə'fə* 'along the shore', *əgbə'sini* 'he went to swim', *kua'i* 'ear' (see also below).

Plain long, aspirated, and laryngealised vowels used to have phonotactic restrictions as compared to short vowels (cf. § 2.3). At the same time, plain long vowels used to oppose various grammatical and lexical minimal pairs, e.g. *dili* 'head'—*dilī* 'my head', *ədə* 'spouse'—*ədə* 'weak'. At present, this functional load of plain long vowels became even heavier and their contexts widened, as most aspirated vowels merged with them (cf. § 2.4.1) and some diphthongs turned into long vowels as well (cf. § 2.2). On the other hand, long vowels in some positions tend to shorten. Consider the following examples:

– *c**aha**lai-ni* 'he agrees', *olok**to-ho**-mi* 'I boiled' > *cālaini*, *oloktōmi*;
– *ŋ**uhahu*** 'you (PL) are sleeping' > ***ŋuau***;
– *ətətə-mi* 'I work'—*ətətə-**hə**-mi* 'I worked' > *ətətə-mi*—*ətətā-mi*;

– *Ima* 'river Iman'—*im**a**ha* 'snow' > *Ima*—*imā*;
– *abd**e**hä* 'leave' > [abd**ä:** ~ abdä], *ki**o**ntoi-ni* '(fur) comes off' > [kʲ**ö:**ntoi̯nʲi] > (in varieties other than Khor, cf. Kormušin, 1998: 81) *könto-*.

The disappearance of aspiration also brought about new types of vowel clusters. For example, the combinations of plain long and short vowels became possible: ***a**h**a**hi**i**ni* 'he is chasing' > *āi**i**ni* [**a:i̯**nʲi ~ **a:i**nʲ]. On the other hand, complex vocalic clusters are often phonetically simplified in speech, e.g. by inserting epenthetic glides or by pronouncing vowels *i* and *u* as glides *j* and *w*: *tauini* [tau̯inʲi] 'he attaches'—*tauāni* [ta**w**a:nʲi] 'he attached', *mətəuini* [mətəu̯inʲi] 'he finishes'—*mətəuōni* [mətə**w**o:nʲi] 'he finished', *aui* [au̯i ~ au̯**j**i] 'your hat'.

Glottalised vowels, in turn, did not carry a significant functional load even at earlier periods, although they could express some grammatical meanings or oppose lexical minimal pairs: *zawa-ini* 'he takes'—*zaw**a**'* 'he has taken' (the meaning of perfect was expressed by glottalisation in Khor), *uma* 'marrow'—*uma'* 'hook'. In their current development, the following trends are observed.

a) Šneider's "interrupted-aspirated" vowels/diphthongs merge with their glottalised counterparts through the loss of aspiration: *b'a**h**ani* 'he found', *zaw**a**'hi* 'you have taken' > *b**a**'ni, zaw**a**'i*.
b) In those rare cases where both a glottalised and a plain long vowel used to occur in a word, there is a tendency to lose the plain long vowel and to retain the glottalised one: *k**ä**ba'u* 'narrow, tight' > *k**ä**ba'u*. This trend can also be observed in earlier sound changes: **arakī* (cf. [araqi] by PA-m-1950 in Koppi) > **ajakī* > *a'i* 'vodka' (Cincius, 1975: 48, 1). Unfortunately, my data did not contain cases like *ana'zig**a**'* 'boat-DIM' (cf. § 2.3), so it cannot be said whether two glottalised vowels per word are still possible.
c) Most attested diphthongs, as expected, are rising and of *V'V* type. In Khor data, also a rare falling diphthong of *VV'* type occurs in *bua'fa* 'along the road' (cf. also a syllabic boundary as [bu-'afa] in Simonov, 1988: 71). Forms like this, however, are not attested in other varieties. Nikolaeva (2000: 122) claims that vowel clusters with the second glottalised component, cited by Šneider (cf. § 2.3), are not possible in Bikin Udihe.

Still, trivocalic clusters with the second vowel glottalised exist in all Udihe varieties (and are cited also by Nikolaeva, 2000: 123). They emerged due to the diphthongisation of long *o*: after *k* and *g* (Kormušin, 1998: 42): *kua'i* ~ *koa'i* 'ear' < **korokto* 'auricle' (Cincius, 1975: 416, 1), *kua'isa* 'animal's leg with fur burnt from its surface' < **kōkčān-* 'hoof', apparently with a suffix, cf. Evenki *kokčilkan* 'hoofy' (Cincius, 1975: 405–406, 1). However, a tendency to "regularise" such clusters is also observed. For example, VT-f-1936 syllabified *kua'isa* as [ku-aʾi-sa], i.e. interpreted it as containing syllables with a short vowel and with a regular diphtong of the *V'V* type. Alternatively, *VV'*(*V*) clusters lose glottalisation altogether

TABLE 1.4 Attested realisations of 'boy' and 'white' across the Udihe varieties

Gloss	Etymology	Source data	Variants by current speakers
'boy'	**bagadi* 'legendary warrior hero' (C:62–62, I)	*bata* Khor (Š:19), *bāta* Bikin, Iman, Samarga (K:211)	*bāta* [ba:ta] (Koppi: PA; Khor: DT, LJ, KT; Bikin: LS, AA; Iman: KD, UG)
'white'	**čalban* 'birch tree' (C:380–381, II)	*caligi, cam biə* Khor (Š:22); *caligi* Iman ~ *cagʒa* Samarga (K:309)	*čaliɣi* [čalʲiɣʲi] (Khor: VT, DT, SP, KT); *caligi* [ʧalʲigʲi] (Bikin: AE, LS, AA, NP, Iman: KD) ~ [ʧalʲgʲi] (Iman: UG); *cagʒa* [cägɟä] (Koppi: PA, Samarga: KA)

(more often than the *V'V*(*V*) ones). Among our Bikin consultants, *kua'isa* was pronounced as [kᵾaᵢisa] only by NP-f-1922, but as [kᵾaisa] by LS-f-1934, AE-m-1921, AA-m-1934; see also Iman variability in *kua'i* in Figure 1.11.

(d) An important question in the definition of the current prosodic status of glottalisation (cf. § 6.3.2) is whether the latter can occur in new non-etymological positions. Perehval'skaja (2010b) notes that such glottalisation occasionally occurs in Bikin Udihe after *b, p, č/c* if followed by *a*, but the only two examples provided are ⟨*ba'ta*⟩ 'boy' and ⟨*ca'ligi*⟩ 'white'. I have checked the occurrences of these two words throughout the whole dataset and did not find any glottalised realisations. Table 1.4 provides all variants attested across our speakers (marked just by the two first letters of their codes, cf. Appendix), as well as in Šneider (1936) (Š) and Kormušin (1998) (K), together with Proto-Tungusic forms in Cincius (1975) (C). It could be the case that a diphthongoid realisation, typical to some extent to all Udihe long vowels, might have been perceived by Perehval'skaja as a trace of glottalisation. Anyway, confirmed cases of non-etymological glottalisation of Udihe long vowels were not found.

To summarise, vowel aspiration can be considered as nearly lost from modern Udihe. In turn, the functional properties of plain long and glottalised vowels have changed as compared to the 1930s. Most importantly, both types of vowels tend to strengthen their word-prosodic properties, some of which were noted already by Radčenko in the 1980s (see § 2.3).

First, the culminative properties of glottalisation become more prominent. More than one glottalisation per word hardly ever occurs. A combination of a glottalised and a plain long vowel in one word used to be extremely rare and tends to disappear through a tendency to lose a long vowel if there is also a glottalised one (*kāba'u* > *käba'u*).

Two plain long vowels or a long vowel and a vowel cluster can still occur in Udihe words. Such combinations have become even more frequent due to the merge of aspirated vowels and some diphthongs with the plain long vowels. However, especially when one of the two is word-internal, there is a phonetic tendency either to place both at word edges (*ādāni* > [a:da:nʲ]) or to reduce a word-internal long vowel or diphthong into a short vowel (*ādaini* > [a:dənʲi] 'it gets cooked'). Glottalisation already used to be rare in word-internal positions and now becomes even rarer (cf. a tendency to "regularise" the VV'(V) vowel clusters discussed above). All such processes strengthen the demarcative function of both plain long vowels and glottalised vowels in modern Udihe. Emerging word-prosodic properties of Udihe glottalisation are further addressed in the discussion of the typological context in § 6.

5 Language Loss as a Factor in the Most Recent Evolution of Udihe Aspiration and Glottalisation

As discussed in § 2.1, the development of Udihe phonology, as well as the emergence of its internal dialectal divisions, have been related by some researchers to intensive language contacts.

Specifically, Janhunen (1999) linked the emergence of vowel aspiration and laryngealisation (innovative and unique features of Udihe from a Tungusic perspective) to Chinese influence. He proposed distinguishing four Udihe tones: "neutral" (= short vowels), "lengthening" (= plain long vowels), "glottalising", and "pharyngealising". Radčenko (1985) also compared Udihe (and Nanai) glottalisation with Chinese tones, but rather from a general typological and evolutionary perspective, in line with Ivanov (1975). Janhunen, in turn, suggested a direct contact influence. Perehval'skaja (2010a) contested this, noting that northern Udihe varieties were not affected by the Chinese influence. She argued that the Chinese impact could be rather seen in a general simplification of the system of "phonations" in southern Udihe, where vowel aspiration was completely lost earlier than in Khor. The original rise of these features was considered by her to be a result of internal language drift.

The loss of vowel aspiration as an important dialectal feature which distinguishes southern Udihe from its northern varieties (cf. also Nikolaeva and Tolskaya, 2001: 7), however, could be questioned. Udihe is a nearly obsolete language, and the level of loss of vowel aspiration and glottalisation might better correlate with the degree of individual language attrition rather than with any dialectal grouping. Due to language shift, many phonological features untypical for Russian, including aspiration and glottalisation, are being lost in

younger Udihe speakers (Perehval'skaja, 1991; Kyalundzyuga and Simonov, 1998; Janhunen, 1999; Nikolaeva and Perekhvalskaya Milkova, 2001). Vowel aspiration is very subtle from the perceptual point of view and especially susceptible to loss. As said, at present, its traces were attested only in few mostly monosyllabic tokens of the two most fluent Khor speakers (VT-f-1936, DT-f-1933).

Glottalisation, in turn, even in the speech of these two consultants, was sometimes realised as a falling pitch, not attested for Khor in earlier studies (note that the speech of VT-f-1936 was studied also in the 1980s). Perehval'skaja (2010a) suggests a starting process of tonogesis here. However, such realisations seem just an occasional articulatory target undershoot (Lindblom, 1990) rather than a true development of tones in Udihe. This might happen, at least partially, due to the phonetic influence of the more reducing and "lax" pronunciation style of Russian as compared to Udihe. Besides, such undershoot occurs also in other languages with prosodic glottalisation, in different sociolinguistic situations (Danish, Livonian, Otomanguean; cf. § 6).

Moreover, the pitch dip in Udihe is not always directly linked to glottalisation. As discussed in § 4.4, it can also just mark the syllabic boundary between two short vowels in the case of both former *h* and former *ʔ*. Such a boundary simply tends to be lost when a monosyllabic long vowel or vowel cluster emerges.

Observations on the speech of other Udihe speakers give further support to the articulatory undershoot hypothesis. A speaker KT-m-1932 was born in the Samarga region but speaks a variety close to Khor, where his mother was born (cf. e.g. lexical data on 'white' from this speaker in Table 1.4). He is a very fluent Udihe speaker, but his usual pronunciation style is fast and reductive. In our recordings of his speech, no aspiration occurs. Glottalisation, too, is frequently absent and is never realised as a full glottal stop.

Our most competent Iman speaker KD-m-1923 was less fluent than the best speakers of other varieties (see Appendix). He realised glottalisation very infrequently, similarly to other Udihe speakers with the same level of language competence and irrespective of their origins.

At present, therefore, the presence of the traces of aspiration and the way of realisation of glottalisation across idiolects seem to correlate more strongly with the level of individual language competence in Udihe and with the style of pronunciation rather than with the speakers' dialectal background. As pointed out in § 2.1, the strict division of Udihe varieties into northern and southern is generally implausible also on other, non-phonological, grounds, and the situation should be rather described as a dialect continuum.

However, several Bikin speakers had as fluent and clear speech as some of the Khor ones, but still manifested a more advanced evolutionary stage of both

discussed features: no full glottal stops for glottalisation (creaky voice as its most typical realisation) and no traces of aspiration. As shown in § 2.1, southern Udihe had already been in an intensive contact with Chinese before the current shift into Russian. The innovative character of the realisation of aspiration and glottalisation in Bikin as compared to Khor, might, therefore, simply stem from Bikin's more intensive and longer contact situation. It does not necessarily indicate tonogenesis under the Chinese influence.

Note also that Kormušin (1998) still attested aspiration in Samarga, Bikin, and Iman speakers in the 1960–1970s. In the beginning of the 20th century, even disyllabic realisations with *h* (*nihö* 'nose', *nöhö* 'sable') were recorded for some of the southernmost Udihe groupings by Schmidt (1928: 48; cf. also Hölzl, 2018). This feature was apparently lost from the southern Udihe varieties only very recently, likely under the contact influence.

In principle, such features as Udihe vowel aspiration and glottalisation can further develop both into non-pitch word prosodies and into lexical pitch-accents or tones (see § 6). However, under the influence of the current majority language, the loss of both features seems a more likely development for Udihe.

6 Typological Word-Prosodic Properties of Udihe Glottalisation

Vowel aspiration has nearly been lost from modern Udihe and will not be discussed in detail below. The synchronic phonological status of glottalisation, however, presents an intriguing case. Its current phonetic and structural properties hardly allow it to be treated it as a consonant any more, and the most widespread interpretation considers it to be a vowel feature. However, as discussed above, glottalisation has a number of word-prosodic features, both phonetic and structural, and these features tend to strengthen.

The most cross-linguistically common types of word prosody are tone and stress. The relevance of accent as a separate category has also been discussed in a number of works (e.g. Hyman, 2009; Hulst, 2012; Gussenhoven, 2018). The relation of Udihe glottatisation to tone and stress is discussed in § 6.1 and § 6.2.

There also exist features which are structurally word-prosodic but cannot be considered as either tone (as they are not pitch-based) or stress (as they lack strict obligatoriness and/or culminativity), cf. Kuznetsova (2018). Prosodic glottalisation is one such feature. One of the most well-studied cases of this type is Danish stød: its detailed comparison with Udihe glottalisation along an array of phonetic and structural criteria is conducted in § 6.3.

A number of lesser-studied but similar cases of prosodic glottalisation and aspiration are found in the indigenous languages of the Americas and of

South Siberia. A detailed comparison such as with Danish is not possible here, but I will briefly discuss their main properties.

In many languages of the Americas, the laryngeals *ʔ* and *h* play a prominent role. These laryngeals also often manifest prosodic evolution: linking to stress, emergence of culminativity and word edge marking functions, prosodic spread through non-etymological positions, development of phonotactic differences from consonants, and eventually tonogenesis (viz. Silverman, 1997b; Avelino Becerra et al., 2016; DiCanio and Bennett, 2020).

For example, in Jalapa Mazatec (Silverman et al., 1995), an Otomanguean language of Mesoamerica, sequences *VʔV* and *VhV* were transformed into vowels with breathy and creaky phonations with many phonetic and functional features similar to Udihe. Also in Desano, an Eastern Tucanoan language of Brazil and Colombia, *ʔ* and *h* can appear in the syllable coda and cannot appear in the onset, in contrast to all other consonants, and are associated with the leftmost root vowel. Therefore, they were included in the inventory of lexical suprasegmentals along with tone, stress, and root nasal harmony by Silva (2016).

In the Otomanguean languages, breathy and creaky phonations often coexist with lexical tones, so phonations can be more clearly distinguished from tone than in the Udihe case (cf. § 6.1). Otomanguean phonations are pronounced in the initial, middle, or final part of the vowel, depending on the language. Tone, in turn, is realised on the remaining modal portion of the vowel, so the perceptual salience of both types of features is ensured. In systems where both the tonal system and the system of phonations is complex, pitch modulation as a phonetic cue is reserved only for tone. However, in simpler systems, where the tonal contrast is either neutralised in the syllables with phonations (e.g. in Yucatec Maya) or is totally absent from the language (e.g. in Ocotepec Mixe), the falling pitch, like in Udihe and Danish, can serve as a distinctive exponent of the glottalised phonation (Avelino Becerra, 2016; Herrera Zendejas, 2000; Silverman, 1997a). Avelino Becerra (2016: 172) describes such realisations as articulatory undershoot, as suggested also for Udihe in § 5.

In some toneless Otomanguean languages, the system of laryngeal contrasts interacting with vowel length can be extremely rich. For example, for Proto-Mixe-Zoque, Wichmann (1995: 67–68) reconstructs a contrast of short and long vowels, as well as and two laryngeal consonants *h* and *ʔ*. The latter originally preceded or followed other consonants and could occur word-finally after a vowel; *ʔ* could also occur intervocalically. In the living Mixe languages, the distribution of vowel length and laryngeal features is much more restricted, as in Udihe. For example, the Midland and Lowland Mixe languages can contain a selection of 6–8 syllable nucleus types from the following list: /V/, /V:/, /V:ˑ/,

/Vʰ/, /Vːʰ/, /Vˀ/, /Vːˀ/, /Vˀ V/, /Vˀ Vʰ/ (e.g. Wichmann, 1995: 18, 25–34; Romero-Méndez, 2009: 143–160). As in Udihe (§ 2.3), the interpretation of laryngeal features and length as vowel features leads to non-parsimonious vowel inventories of ca. 50 phonemes. Therefore, researchers generally prefer to see them as a part of the "syllable nucleus template" (Romero-Méndez, 2009: 54), i.e. essentially as word-prosodic features.

Vowel pharyngealisation in Tuvan and Tofa (e.g. Rassadin, 1971; Bičeldej, 2001) might be another relevant point of comparison. Unlike Udihe and the languages of the Americas, here it clearly has prosodic origins. It has developed in the short vowels of a closed syllable (usually before the obstruents) most likely under a contact influence of the Yeniseic and Samoyedic languages of Upper Yenisey or as a part of common Yeniseic substrate in both South Turkic and Samoyedic (e.g. Verner, 1972; Helimskij, 2000; Ivanov, 2000; Georg, 2008). Tuvan and Tofa pharyngealisation has usually been described as a vowel feature, similarly to Udihe. However, recent articulatory studies show that it is actually spread to the whole word, including consonants (Sel'utina et al., 2014). Therefore, it might be closer to that in "register" languages discussed below.

Note that glottalisation and aspiration can also play a role as phonetic exponents of tones, for example, in Mandarin Chinese or Vietnamese, or of pitch-accents, as in Latvian. However, as noted by Ivanov (1975), in such cases they sub-enter a broader system of pitch-based tones and serve just as secondary cues helping to distinguish certain tonemes. In this sense, their functional role in the word-prosodic system is very different from what is found in Udihe, Danish, or Otomanguean, and such cases are omitted from this discussion.

Similarly, I will not consider here cases like Livonian stød (e.g. Viitso, 1974, 1975; Kiparsky, 2017) or laryngealisation and pharyngealisation in Ket and other Yeniseic languages (e.g. Verner, 1972; Ivanov, 1975; Vajda, 2000). In both cases, laryngeal features partially originate from consonants and partially from a lost syllabic boundary and are synchronically word-prosodic. In Livonian, stød makes a subpart of a broader system of word-prosodic quantity. Ket laryngealisation and pharyngealisation function in a similar manner together with pitch and quantity within a complex bunch of exponents of word tones.

Another type of externally similar but functionally different cases constitute the so-called "register" (i.e. contrastive voice quality) languages, found e.g. in South-Eastern Asia or in Africa. In these languages, laryngeal and pharyngeal features also play a prosodic role as they stretch over certain prosodic domains. For example, in Chong, an Austroasiatic language of Thailand, modal, tense (creaky), breathy, and tense-breathy registers are distinguished (DiCanio, 2009). Bor Dinka, a West Nilotic language of Sudan, contrasts breathy, modal, creaky, and hollow (faucalised) voiced quality (Edmondson and Esling, 2006).

In a cognate variety of Agar Dinka, there are just two registers: breathy and creaky/modal. This corresponds to the two fundamental states of larynx: unconstricted/lax/lowered vs. constricted/tense/raised (Esling et al., 2019: 78–79). A principal difference of the prosodic voice quality (register) contrasts from the prosodic laryngeal features of Udihe, Danish, and Otomanguean is that voice quality is a longer-term (at least, a syllable-length) larynx postural setting (Esling et al., 2019: 2) rather than a single ballistic laryngeal action (cf. § 6.3).

6.1 *Udihe Glottalisation vs. Tone*

An evolutionary link between laryngeal features and tonogenesis is explored in a number of works. Both high/rising and falling/low tones can be linked to these features (viz. Ivanov, 1975, 2004: 19; Kirby and Brunelle, 2017). For example, vowel glottalisation resulted in high tone in some Athabascan languages, in low tone in others, while some varieties remained toneless (Hargus, 2016: 73). Aspiration may also either lower or raise tone (Gordon, 2016: 129).

Udihe glottalisation at present shares some structural properties of lexical tone: it is a local vowel-long phenomenon and carries a distinctive function. As mentioned in § 5, Janhunen has tried to equal length and "phonations" in Udihe to tones. However, at the present state of development, Udihe vowel length and glottalisation can hardly be defined as tones, at least according to the most common definitions of the term "tone". The main reason is that pitch movement is not their primary phonetic cue, as a typical definition for the tone would require (Hyman, 2009). The realisation of glottalisation is very variable, but glottal catch or creaky voice are still the most frequent cues. Realisations via pitch lowering, as said, rather manifest an occasional articulatory undershoot. Besides, pitch dips can simply mark syllabic boundaries, which tend to disappear along the formation of monosyllabic long vowels. As discussed in § 5, under the influence of Russian prosody, glottalisation tends to disappear from Udihe altogether rather than evolving into true tone.

6.2 *Relation of Plain Long and Glottalised Vowels to Stress in Udihe*

Prototypical word stress is characterised by two main structural features, obligatoriness and culminativity: each word should have one and only one primary lexical stress (Hyman, 2009). As said, plain long and especially glottalised vowels exhibit strengthening culminativity: there is a tendency to have only one such unit per word, preferably at the left or the right word edge. Two plain vowels per word are still not extremely rare. In this case, they tend to occupy both word edges. In many languages, the demarcative function is common also for stress. However, Udihe plain long and glottalised vowels are not strictly culminative and obligatory. Besides, their presence vs. absence can distin-

guish monosyllables, which is also not typical of stress. Therefore, they can hardly be considered as stress features.

However, as said in § 2.5, some researchers link the prosodic features of plain long and glottalised vowels to the stress rules. It is still a question, though, whether there is lexical stress in Udihe at all, and if so, what its exact relation to vowel length is.

A system with word-initial dynamic lexical stress and a word-final lexical pitch-accent, proposed by Šneider (see § 2.5), violates stress culminativity. It would be typologically unique and as such cannot be accepted by any modern phonological framework in the absence of very strong evidence.

A system with only word-final weight-sensitive stress expressed by a pitch rise, as proposed by Nikolaeva and Tolskaya, is more typologically plausible. However, it still suffers from a number of unclarities. The main cross-linguistic correlates of lexical stress are usually duration, intensity, and vowel quality rather than pitch (Gordon and van der Hulst, 2020). In fact, Nikolaeva and Tolskaya (2001: 91) also mention greater intensity and duration as potential correlates of Udihe word stress.

Besides, Udihe lexical stress has always been discussed on examples of single words taken in isolation. In this case, it is difficult to see whether the word-final pitch rise, described by most authors, is related to word-level or postlexical prominence. Nikolaeva and Tolskaya (2001: 94), for example, attribute a phrase-final pitch rise also to some types of sentence intonation and to the expression of sentence focus. On the other hand, they mention that two words can form a stress group where the first word lacks lexical stress: *solimi olokt'o* > [solʲim olokt'oˀ] 'he has cooked dried fish' (2001: 45–46).

Lexical stress in general is poorly described even in the most recent descriptive studies. First, it is not distinguished well from other types of sublexical (foot-level) and postlexical (phrasal, sentence) prominence. Second, depending on the native language(s) of researchers, descriptions can suffer from either "stress deafness", i.e. an inability to hear it (Dupoux et al., 2008), or "stress ghosting", i.e. a search for stress in systems which lack it (Tabain et al., 2014).

A proper acoustic study is still to be conducted on Udihe lexical stress. In our data, I observed a great variability of perceived word-level prominence: it was far more variable than the neat weight-sensitive system described by Nikolaeva and Tolskaya. Perceived prominence can easily fall on the last or the penultimate short vowel even when there are plain long or glottalised vowels in the antepenultimate position. In turn, word-initial long vowels hardly ever bear any prominence at all, cf. *dēlini* [deːlʲinʲˈi ~ deːlʲˈinʲ] 'he flies'. Nikolaeva and Tolskaya (2001: 91) also note that sentence-final words do not demonstrate any pitch raising.

My preliminary observations, summarised below, are illustrated by a pitch contour on a sentence from a spontaneous text by a Bikin speaker AA-m-1934, recorded by Elena Perekhvalskaya: *Tī || timadulə tāgēsi ŋənā, || solondoi ŋangada ī || bä'sawa* 'Tomorrow after having got up, leave; going upstream a little bit, reach the creek' (Figure 1.18).

My conclusion is that what has been previously described as a lexical stress in Udihe, might actually be a combination of effects of foot stress, on the one hand, and of accentual phrase stress plus sentence intonation, on the other. I understand the foot here strictly as the stress group, similarly to the Abercrombian foot or the cross-word foot in Articulatory Phonology (viz. Turk and Shattuck-Hufnagel, 2020: 16). Feet are right-headed and 1–3-syllabic; foot boundaries do not necessarily correspond to word boundaries. The main correlates of foot-level stress could be the higher duration of the foot-final vowel with respect to other vowels in the foot and also some degree of foot-final pitch fall (marked as L in the end of the feet in Figure 1.18). The foot structure of the phrase cited above in its particular pronunciation given in Figure 1.18 would look approximately as follows: (tī) (tima)(dulə) (tāgē)(si ŋənā) (solondoi) (ŋangada) (ī) (bä'sawa).

In turn, the higher-level accentual phrase (AP) boundaries, which coincide with some of the foot boundaries, are generally marked by higher pitch on the final vowel (marked as H in Figure 1.18). Phrase-final vowels are also significantly lengthened before a pause (marked by ||), more than the vowels which are foot-final but not phrase-final. For example, *timadulə* 'tomorrow' contains two feet. The 2nd and the 4th vowel are a bit longer and with a lower pitch than the 1st and the 3rd one. However, the whole word lacks any postlexical prominence and enters an AP with the following word. Therefore, it lacks any high pitch or significant phrase-final lengthening of the last vowel. The AP structure of the example above might look as follows: **(**(tī)**) (**(tima)(dulə) (tāgie)**) (**(si ŋənā)**) (**(solondoi)**) (**(ŋangada) (ī)**) (**(bä'sawa)**)**. The whole sentence ends with a high non-falling pitch (marked as H*). This looks indeed as the sentence focus marking described by Nikolaeva and Tolskaya, which in this case overshadows any lower level (foot-level or AP-level) phonetic prominence cues on *bä'sa-wa*.

Intensity does not seem to play an important role in prominence marking. Note, however, a low-intensity foot *ī* 'reach.IMP' which sounds much less prominent than any other foot in the sentence.

This is just a very preliminary sketch of how the rhythmic and intonational organisation of Udihe might look like. Udihe speech sounds very rhythmical. It seems to manifest more than one level of rhythmic organisation at which pitch and duration are active. Prominence marking in Udihe might indeed be

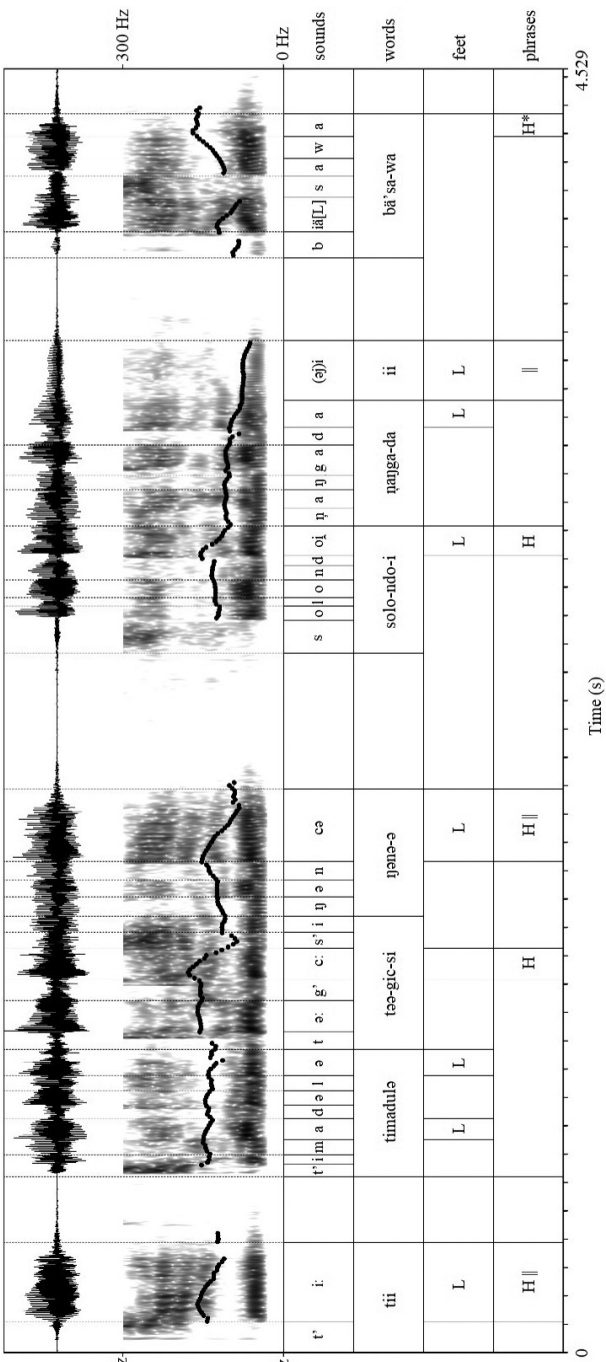

FIGURE 1.18 Bikin Udihe example from speaker AA-m-1934
tī tima-dulə tə̄-gē-si ŋənə-(j)ə solo-ndo-i
this morning-LOC sit-REP.(?)PST-CV.PST go-IMP go.upstream-SEM-PTC.PRES
ŋanga-da ī bə̆̄sa-wa
a.little-and reach.IMP creek-ACC
'Tomorrow after having got up, leave; going a little bit upstream, reach the creek'

at least to some extent weight-sensitive, cf. the foot- and phrase-level prominence anchored to the non-final long vowel in *tāgēsi*. On the other hand, in *ŋanga-da* ⟨a little-and⟩, foot-level prominence is expressed by a pitch fall on the final vowel and its longer duration. This "stressed" vowel actually belongs to *-da*, defined as a clitic by Nikolaeva and Tolskaya (cf. § 2.5). In *bä'sa-wa* 'creek-ACC', the highest pitch, which apparently expresses the nuclear intonational accent of the whole sentence, also falls on the final short vowel rather than on the "rightmost bimoraic vowel" (glottalised *ä'*) predicted by the same authors. In turn, a local pitch dip on the first syllable of *bä'sawa* is a cue of vowel glottalisation rather than of any kind of rhythmical prominence.

In any case, Udihe glottalisation and vowel length are functionally very different from any kind of rhythmic prominence observed in this language. First of all, both are clearly lexicalised and restricted to particular syllables, while "stresses" seem much less so. At the same time, long and glottalised vowels can apparently serve as anchors for rhythmic prominence at least at certain prosodic levels.

6.3 *Comparison of Udihe Glottalisation and Danish Stød*

A phonetic similarity between Udihe glottalisation and Danish stød was noted already in the phonetic study of the 1930s by Zinder and Matusevič (pp. 8–9; cf. Kormušin, 1998: 55–56). Udihe glottalisation manifests also many structural similarities to the stød, a laryngeal word prosody in Standard Danish which has sparked a lot of debates (cf. Grønnum et al., 2013; Itō and Mester, 2015; Kuznetsova, 2018, and references therein). The main similarities and differences are summarised in § 6.3.1 and § 6.3.2.

6.3.1 Similarities between Udihe Glottalisation and Stød

As discussed above, Udihe glottalisation has a very wide range of realisations, including glottal stop, creaky voice, and pitch lowering. Acoustic and EMG studies on stød have also showed an extreme variability in its acoustic features, timing, and the exact domain of realisation. Stød in modern Danish is usually realised as creaky voice: non-modal aperiodic vocal-fold vibrations with a perturbation in amplitude and an abrupt F_0 dip. Realisations vary in a range from a slightly compressed voice quality to a distinctly creaky voice, which under emphasis may become a complete glottal closure (Grønnum et al., 2013: 68–69). On the other hand, much like in Udihe, stød can occasionally lack both creaking and F_0 perturbation (Fischer-Jørgensen, 1989; Grønnum and Basbøll, 2007; Hansen, 2015). Exactly the same kind of phonetic variability, which includes also the realisations through a pitch dip, has been reported also for the Livonian stød not discussed in detail here (Tuisk, 2015; Wiik, 1989).

The articulatory mechanism behind stød has been described as a "ballistic" gesture of constricted glottis, a low-pass filtered muscular response to a transient stronger or weaker neural command. Once the command is executed, a reaction of the vocal folds is no longer controlled, hence the wide variation in acoustic realisation (Grønnum and Basbøll, 2007: 199–200). Udihe glottalisation impressionistically resembles such a "ballistic" articulatory gesture.

There is a historical link between Danish stød and pitch-accents in other Scandinavian languages, although it is not clear whether the former developed out of the latter, or vice versa, or the two developed from a common source. As discussed above, Udihe glottalisation also shows some potential for evolution into a pitch-accent (although it is likely to just be lost).

There are also a number of essential structural similarities:

– both features are realised only in heavy syllables (in Udihe, these are syllables with a long vowel, while in Danish they are syllables with a long vowel or closed by a sonorant);
– both co-occur with many types of vowels and vowel clusters, so treating them as vocalic features renders vowel inventories very large;
– both features are lexicalised, i.e. not entirely predictable and linked to certain morphemes and grammemes;
– the number of lexical minimal pairs defined by the presence vs. absence of glottalisation in both languages is very limited; both features are more active as derivational and inflectional morphemes.

Besides, both Udihe glottalisation and Danish stød can serve as anchors for the placement of higher-level prosodic prominence units ("stresses").

Both units also exhibit similar dynamic processes which contribute to the growing "simplification and generality" (Grønnum and Basbøll, 2007: 203) of their distribution rules:

– loss from prosodically weak (especially, word-internal) positions;
– ongoing development of the boundary signal (demarcative) function: Danish stød tends to mark the right edge of the word, while Udihe glottalised and plain long vowels can mark both edges.

6.3.2 Main Differences between Udihe Glottalisation and Stød

In spite of the striking similarities, there are also several important differences between the two features, which is also relevant to their typological status. First, Danish stød has a much higher density in discourse, for two reasons:

– stød has a wider distribution across different types of syllables: it co-exists with both short and long vowels, as well as with the sonorant coda, while Udihe glottalisation is restricted to (C)V:(C) syllables;

– stød is an unmarked (most frequent) prosody in heavy syllables, while Udihe glottalisation is relatively marked for heavy syllables in terms of both frequency and restrictions on vowel types.

Danish has clear lexicalised word stress, and stød occurs only in stressed syllables. Therefore, Danish can also be described as having a distinctive stress: "stød stress" vs. "non-stød stress" (Kuznetsova, 2018). In turn, as discussed in § 6.2, Udihe glottalisation seems more independent from any kind of rhythmical prominence, although it can apparently serve as an anchor for it.

Some Danish dialects also have lexical pitch-accents, and stød can co-exist with them as a clearly independent type of prosody (similarly, as said in the beginning of § 6, laryngeal features co-exist with tone in some Otomanguean languages). This is an important argument against considering the stød itself as a pitch-accent or tone, which is not relevant for Udihe glottalisation.

Besides, stød now exists also in non-etymological positions, as it has been expanding through the prosodic contexts which were already typical for it, e.g. through the final syllables of compounds (this phenomenon is called *nystød* 'new stød'). In turn, as discussed in § 4.5, no clear cases of non-etymological occurrences have been attested yet for Udihe glottalisation.

All the features of stød listed in this section contribute towards considering it as a "neither stress nor tone" word prosody rather than a consonant, a segmental feature, or tone (Grønnum et al., 2013; Kuznetsova, 2018). Udihe glottalisation, which lacks all these properties, makes a lesser strong case of this kind of prosody. It is much more restricted in terms of possible syllable structures and vowel types and uncommon in non-etymological positions. It also cannot be as clearly distinguished from pitch-accent as stød and has a less clear relation to stress. Therefore, it can be more easily considered simply as a feature of long vowels (as is done in most studies on Udihe) without running into major conceptual issues, as would be in case of stød. While the evolutionary vector of the two features is similar, Udihe glottalisation is at an earlier stage of prosodic development, as compared to stød.

On the other hand, Udihe glottalisation has already developed enough word-prosodic features to permit also this alternative analysis—as a laryngeal word prosody, a glottal lexical accent. Danish stød can serve as an iconic case of such accent, which should be included in word-prosodic typology along with stress-accent, pitch-accent, quantity accent, etc. (Hulst, 2011; 2014). Udihe glottalisation is a more borderline case of a similar kind.

7 Summary and Conclusions

Analysis of the phonetic and structural features of Udihe vowel aspiration and glottalisation, recorded from the end of the 19th century into the 2000s, allows us to give a more precise description of their phonetic and phonological evolution. Two main aspects of this evolution can be distinguished: a qualitative evolution of the features and a loss of the syllabic boundary between two former short vowels. These aspects are tightly interrelated, but can also be partially separated (see the stages of the phonetic evolutionary cline distinguished in Tables 1.2–1.3).

Within the qualitative evolution, Udihe intervocalic consonants (*C*)*s* and *k* first undergo lenition, which results in their move to the lower region of the vocal tract. While the glottal fricative *h* disappears faster (or turns into *j* in case of a palatalised [hʲ]), the glottal plosive *ʔ* remains for longer in the language. At the late stages of the development of the latter, it is often realised as vowel glottalisation (creaky voice) or even simply through a local pitch dip in a long vowel, without any acoustically visible traces of glottal catch. Eventually, also glottalisation tends to vanish.

The disappearance of the syllabic boundary accompanies several final stages of the development of the two features. Originally, laryngeals appeared at the syllabic boundary between two short vowels. Clearly disyllabic realisations of vowels with aspiration and glottalisation still occur. These cases manifest a tripartite phonetic structure, where two plain short vowels are divided by either a consonant [h] / [ʔ] or by an aspirated / glottalised portion of a vowel. Pitch lowering can occasionally entirely replace both laryngeals. In such cases, a tripartite melodic structure HLH is realised.

Together with a progressive loss of a clear syllabic boundary, the exact place of realisation of aspiration and glottalisation becomes more variable. Usually they tend to shift to the end of a long monophthong or spread throughout it. While aspiration vanishes altogether, glottalisation can be occasionally realised in monosyllabic realisations as a pitch dip (HL) in the middle or end of the vowel.

While some researchers have suggested the start of tonogenesis here, possibly under the Chinese influence (which had affected southern Udihe varieties), this question is far from being clear. First, a strong Chinese influence stopped in this area in 1936, and after that Udihe has been under a strong Russian influence. Those scarce data recorded by Nadarov and Schmidt on how aspiration and glottalisation were realised from the end of the 19th to the beginning of the 20th century, when Udihe was under Chinese influence, rather suggest typically disyllabic realisations, with laryngeals separating two short vowels. Second, no

purely pitch-based realisations were attested in the phonetic data from the 1930s to the 1980s; this seems an extremely recent development. Third, at least at present, the general degree of innovation in the realisation of aspiration and glottalisation more closely corresponds to the level of individual language attrition rather than to any kind of dialectal and Chinese contact-induced divisions. It is true that even the most fluent Bikin speakers showed no traces of aspiration, no realisations of full glottal stops, more cases of glottalisation loss, and more vowel reduction in general, as compared to the most fluent Khor speakers. This can be attributed to a more intensive language contact in the south of the Udihe area, which comprises not only the Russian influence at present but also the Chinese impact during an earlier period. However, it is not clear whether stronger phonetic and phonological reduction in this area can be specifically linked to the presence of tones in Chinese. It can be just due to the general situation of intensive contact, which often solicits simplifications and innovations in sound systems.

In any case, both in Khor and in Bikin, purely pitch-based realisations of vowel glottalisation appear relatively marginal and typical mostly of fast speech in unaccented phrasal positions. Vowel glottalisation remains the most prototypical phonetic cue. Pitch-based realisations seem to be a case of articulatory target undershoot, which could have recently become more widespread in the process of language loss and the growing influence of Russian "lax" articulation. Such realisations more likely signify the next-to-last stage of a complete loss of glottalisation, together with language obsolescence, rather than the beginning of tonogenesis.

The articulatory target undershoot hypothesis is supported also by the data on prosodic glottalisation from other similar languages: Danish, Livonian, some Otomanguean. There, too, the most typical realisation is creaky voice, and purely pitch-based realisations occur in case of articulatory undershoot. No incipient tonogenesis has been suggested for any of these languages so far.

Besides, Udihe long vowels generally have a more or less diphthongoid pronunciation (as falling diphthongs). This also sometimes gives an acoustic impression of a falling pitch, although no real pitch dip occurs. This might be the reason why glottalised vowels have been sometimes postulated in non-etymological positions. In this study, no cases of such vowels were found.

Monosyllabic glottalised vowels should be distinguished from cases when laryngeals (together with glides *j* and *w*) serve as phonetic syllabicity markers. In such cases, they can indeed can occur as epenthetic consonants outside their etymological positions. Pronunciation of long vowels and vowel clusters still greatly varies between poly- and monosyllabic. This can depend e.g. on the phrasal prominence level, the speed of speech, the idiolectal preferences. In

polysyllabic realisations, phonetic non-etymological laryngeals (especially *h*) and glides can occasionally occur at the syllable boundary.

Certain stages can be traced also in the change of the structural features of vowel length, aspiration and glottalisation. Plain long and especially glottalised vowels manifest a rise in their word-prosodic features, as compared to the situation of the 1930s. There is a tendency to have either one or two plain long or glottalised vowels per word. Such vowels tend to occupy the right and the left word edge, thus fulfilling demarcative prosodic function. Glottalised vowels now generally occur just once per word, which indicates a tendency for their strengthening prosodic culminativity. Plain long and glottalised vowels also manifest a tendency to attract rhythmical prominence. However, it is not entirely clear yet whether this is lexicalised word-level prominence (i.e. lexical stress) in Udihe, or e.g. an interaction of prominence at the foot level and at the postlexical level.

Udihe glottalisation at its present developmental stage manifests a type close to a rare "neither stress nor tone" lexical prosody. It is especially similar from the phonetic and structural point of view to the cases of some Otomanguean languages and the Danish stød. Such prosodies have "ballistically" realised laryngealisation as their main phonetic exponent and so cannot be considered as tones in the most common sense of this term. Given that they are not strictly culminative and obligatory and that their presence vs. absence can distinguish monosyllables, they are usually not considered as lexical stress either. However, they already have enough word-prosodic structural features to be treated as lexical prosodies rather than as segmental features. Danish stød is a classical example of such prosody. Udihe glottalisation lacks some of the structural properties of stød, so it is a lesser strong similar case, balancing between a vowel feature and a syllabic prosody. Most researchers consider it as a vowel feature, but some also note that the vowel inventory becomes too large in this case.

In spite of a potential for further word-prosodic development, the most likely evolutionary path for Udihe glottalisation is its complete disappearance, as it has already happened to vowel aspiration. Language contact and loss are extremely strong factors pushing the process in this direction.

Appendix: Sociolinguistic Data on the Udihe Speakers Who Provided Phonetic Data for the Study

The speaker code contains the gender and the birth year of a speaker. The language competence of speakers by default includes also fluent Russian in all cases apart from one, specified in the table. The competence of the speakers

in Udihe is roughly quantified in the following way (similar to Muslimov, 2005: 331): (1) a person can speak in the language without much code-switching and is able to produce long narratives; (2) a person produces short narratives and phrases, but code-switching in interaction is inevitable; (3) a person can generally understand the language, but produces only simple phrases and single words.

Variety	Speaker code	Birth place	Origins of parents	Recording place	Language competence	Amount of collected words
Koppi	PA-m-1930	Koppi river	Koppi river	Ust'-Orochi	Udihe/ Oroch(2)	~250
Khor	VT-f-1936	near Gvas'ugi	near Gvas'ugi	Gvas'ugi	Udihe (1)	~800
	DT-f-1933	Gvas'ugi	Gvas'ugi	Agzu (lives from 1954)	Udihe (1)	~800
	SP-f-1938	Gvas'ugi	near Gvas'ugi	Krasnyj Yar (lives from 1956)	Udihe (2); some Chinese (a husband was Chinese)	~200
	LJ-f-1948	Gvas'ugi	near Gvas'ugi	Gvas'ugi	Udihe (2)	~100
Khor/ Samarga?	KT-m-1932	Agzu	mother: Khor, father: Russian (did not live with family)	Agzu	Udihe (1)	~900
Samarga	KA-f-1932	Nel'ma	parents died early; in infancy spoke Udihe with a grandmother from Agzu	Agzu (lives from 1934)	Udihe (3)	~200
Bikin	LS-f-1934	Krasnyj Yar	Krasnyj Yar	Krasnyj Yar	Udihe (1)	~750
	AE-m-1921	near Krasnyj Yar (?)	father: Ulungu river (upper Bikin), mother: half-Udihe, half-Chinese	Krasnyj Yar	Udihe (1), some Chinese; not fluent in Russian	~350
	AA-m-1934	Krasnyj Yar	Krasnyj Yar (mother is half-Taz)	Krasnyj Yar	Udihe (1), some Chinese	~350
	NP-f-1922	Krasnyj Yar	Krasnyj Yar	Krasnyj Yar	Udihe (1)	~250
	KS-f-1930	near Krasnyj Yar	near Krasnyj Yar	Krasnyj Yar	Udihe (2)	~100 (mostly KS, with the help of IG)
	IG-m-1928	near Krasnyj Yar	near Krasnyj Yar	Krasnyj Yar	Udihe (2)	

(*cont.*)

Variety	Speaker code	Birth place	Origins of parents	Recording place	Language competence	Amount of collected words
Iman	KD-m-1923	Ostrovnoe (Sanchiheza)	mother: Khor (Gvas'ugi), father: Sanchiheza (died in 1932)	Rosh'ino (lives from 1975)	Udihe (2)	~550
	UG-f-1953	Ivanovichi (from 1954 in Sanchiheza)	mother: Sanchiheza, father: Ivanovichi	Rosh'ino (lives from 1999)	Udihe (3)	~100

Abbreviations

ACC	accusative
CV	converb
DIM	diminutive
IMP	imperative
LOC	locative
PTC	participle
PRES	present
PST	past
REP	repetitive
SEM	semelfactive

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