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# The Phonetic and Phonological Characteristics of Liquids in Khalkha Mongolian

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## 1. Introduction

Khalkha Mongolian, henceforth just Mongolian, has /ɮ/ and /r/ in its phonological system.<sup>1</sup> It is generally said that these are phonologically placed in liquids, and that /ɮ/ and /r/ are realized as the voiced dental lateral fricative [ɮ] and the voiced dental trill [r], respectively. However, these phonetic descriptions have not been sufficiently confirmed by acoustic analyses, especially regarding their voiceness. In addition, the phonological statuses of /ɮ/ and /r/ have not been adequately considered based on phonological phenomena.

This study addresses the phonetic and phonological characteristics of Mongolian /ɮ/ and /r/ by acoustic analyses and by observing phonotactic patterns. In conclusion, this study claims that Mongolian /ɮ/ and /r/ possess different characteristics in voicing, sonority, and phonotactic restriction.

## 2. Previous Studies

The list of Mongolian consonant phonemes is given in Table 1. Phonemes in parentheses occur only in loanwords and onomatopoeic words.

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<sup>1</sup> /ɮ/ can be expressed as /l/ because there is no phonological contrast between them in Mongolian. This paper adopts /ɮ/, focusing on the fact that this sound is pronounced as a fricative.

Table 1: Consonant phonemes<sup>2</sup>

strong stops <sup>3</sup>	(p), t, (k)
weak stops <sup>4</sup>	b, d, g, ɣ
strong affricates	ts, tʃ
weak affricates	dz, dʒ
fricatives	s, ʃ, x
nasals	m, n, ŋ
liquids	ʎ, (ɭ), r,
glides	w, j

Some previous studies claim that /ʎ/ in Mongolian is realized as the voiced dental lateral fricative [ʎ] (Tsoloo 1976: 104, Kuribayashi 1992: 505). However, other studies have found that /ʎ/ is often devoiced. Svantesson et al. (2005: 19) claim that [ʎ] tends to be devoiced at least partially, based on the acoustic data obtained by three Mongolian native speakers; more specifically, /ʎ/ is consistently devoiced in an informant, whereas it is at least partially voiced in the other two speakers. Kanaoka (2009: 23) demonstrates that /ʎ/ is often devoiced and becomes [ɭ] before a consonant or in word-final position. Moreover, Saitô (2004: 104) and Shiotani and Nakashima (2011: 3) utilize the phonetic symbol [ɭ] to represent /ʎ/. Janhunen (2012) expatiates on the phonetic realization of *l*, equivalent to /ʎ/ in this study, as follows:

The lateral (*l*) is likewise normally voiced, as in *ool* [o:l] ‘mountain,’ but can be devoiced before a strong consonant, as in *alt* [aɭt] ‘gold.’ A peculiarity of some dialects of the Khalkha group, notably modern Ulan Bator Khalkha, is that the lateral is in all positions pronounced with considerable fricative noise. [...]. The resulting fricolateral sound [ʎ] is still basically voiced, but it has a tendency to be devoiced, as in *oulaan* [oʎɑ:ŋ] ~ [oɭɑ:ŋ] ‘red.’ (Janhunen 2012: 30)

According to the descriptions above, it is unclear whether Mongolian /ʎ/ is voiced or voiceless. In addition, with the exception of Svantesson et al. (2005), no acoustic data was presented in the previous studies, and thus, these phonetic descriptions lack objective bases.

The /r/ phoneme is generally realized as a voiced dental trill [r]. However, it also has some phonetic variation. Svantesson et al. (2005: 20) report that /r/ is usually pronounced

<sup>2</sup> The palatalized consonants (/pʲ/), /bʲ/, /tʲ/, /dʲ/, /gʲ/, /xʲ/, /mʲ/, /nʲ/, /ʎʲ/, /rʲ/, and /wʲ/ are also regarded as phonemes in some previous studies.

<sup>3</sup> The strong stops and affricates are realized as aspirated consonants.

<sup>4</sup> The weak stops and affricates are usually realized as voiceless unaspirated consonants, but /b/, /bʲ/, /gʲ/, /g/, and /ɣ/ can be voiced and spirantized.

as a vibrant [r] or flap [ɾ] by two informants, but the other informant pronounces it as a fricative [ɹ] (often devoiced word-finally). Janhunen (2012) describes the phonetic realization of /r/ as follows:

Of the two liquids, the vibrant (*r*) is normally realized as a dental (alveolar) trill with several vibrations, as in *araa* [ara:] ‘molar tooth,’ *ar* [ar] ‘rear.’ In an unvoiced environment, such as before a strong (aspirated) stop, it can, however, be devoiced, in which case it can absorb the (pre)aspiration phase, as in *ert* [ɛɾt] ‘early.’ (Janhunen 2012: 30)

Phonologically, both /ɣ/ and /r/ are normally positioned in liquids (Svantesson et al. 2005, Janhunen 2012). However, it has not been sufficiently considered on the basis of phonological behavior that the fricative /ɣ/ truly has the same phonological status as the non-fricative /r/.

In the light of these facts, this study clarifies the phonetic and phonological characteristics of /ɣ/ and /r/ in Mongolian through acoustic analyses and by observing the phonotactic patterns.

### 3. Acoustic Analyses

#### 3.1 Acoustic Analyses for /ɣ/

Acoustic analyses were conducted in order to determine whether /ɣ/ and /r/ are voiced or voiceless, using praat (Boersma and Weenink 2021). At first, the three sound sources in (1), which were published in “Mongolian Grammar Module” in “TUFS Language Modules,” were utilized as the acoustic analysis data. The target sound /ɣ/ occurs at the intervocalic position in a morpheme (1a), the intervocalic position before a morpheme boundary (1b), and between /r/ and a vowel (1c). These positions are all expected to be in environments where /ɣ/ tends to be realized as voiced.

- (1) a. *tuxaiŋ uje-d manai aaw-iin tsaɣiŋ dɔɣɔɔ-ŋ zuu-ŋ tawi-ŋ*  
 relevant time-DAT 1PL.EXCL father-GEN salary seven-ATT hundred-ATT fifty-ATT  
*tögrog bai-ᠵee.*  
 Tugrik be-PST  
 ‘At that time, our father’s salary was seven hundred fifty Tugrik.’
- b. *oŋgots saj buu-ᠵaa.*  
 airplane just now land-DPST  
 ‘The airplane landed just now’
- c. *jamar maʃiŋ ir-ᠵee?*  
 what sort of car come-DPST  
 ‘What sort of car came?’

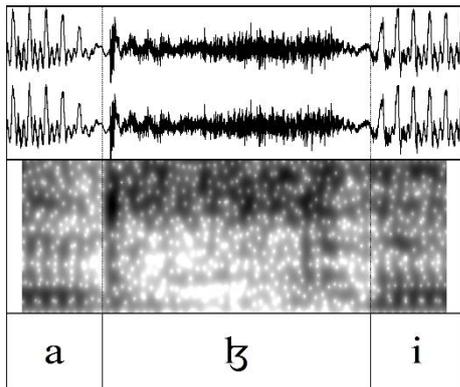


Figure 1 (a): /ɮ/ in *tsaɮiŋ*

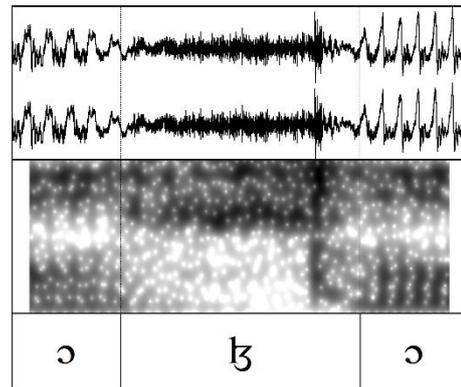


Figure 1 (b): /ɮ/ in *dɔɮɔɔ-ŋ*

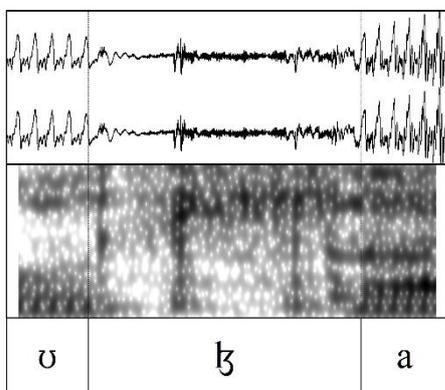


Figure 1 (c): /ɮ/ in *buu-ɮaa*

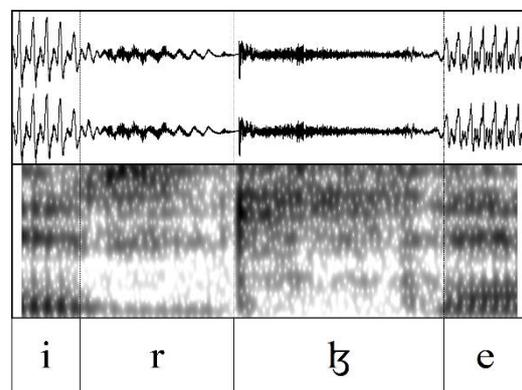


Figure 1 (d): /ɮ/ in *ir-ɮee*

The waveforms and spectrograms for /ɮ/ are depicted in Figure 1 (a–d). These show that in all tokens, neither a clear voice bar nor periodic waveform is observed during /ɮ/. This means that /ɮ/ in these tokens is realized not as the voiced fricative [ɮ] but as the voiceless fricative [ɬ]. Although voice bars can be seen near the boundary between /ɮ/ and the preceding or the following vowel in some tokens, these voice bars can be interpreted not as the voicing induced by /ɮ/ but as the residual or precedence of the voicing of the preceding or following vowel, since the voice bars are not salient and their duration is quite short.

Next, we address the variation of voicing in intervocalic /ɮ/ with more data. The target includes four words in (2), in which /ɮ/ occurs between /a/.

- (2) a. aɮax ‘to kill’  
 b. n<sup>h</sup>aɮax ‘to smear’  
 c. taɮax ‘to rob’  
 d. xaɮax ‘to get warm’

Using recorded sounds of these words, praat was employed to identify whether /ɮ/ was voiced. Voicing was determined by identifying the presence or absence of pitch curves and pulses, shown by the praat functions “show pitch” and “show pulses;” if pitch curve and pulses exist continuously or partially during /ɮ/, the sound was classified as “fully voiced” or “partially voiced,” respectively. If neither, the sound was judged as “voiceless.” The informants included nine Mongolian native speakers, who pronounced each word twice. Five tokens were excluded from the analysis because the second vowel was omitted and /ɮ/ was not located between two vowels. As a result, the number of tokens totaled 67.<sup>5</sup>

The result of the acoustic analysis is displayed in Table 2. Intervocalic /ɮ/ was the most frequently realized as partially voiced, followed by voiceless. Although the tendency of voicing varied among speakers, a speaker did not necessarily pronounce with a consistent voicing characteristic; the voicing feature differed from token to token even within individual speakers.

Table 2: Voicing of intervocalic /ɮ/

Word	Fully voiced	Partially voiced	Voiceless	Sum
aɮax	1	7	8	16
nʰaɮax	7	7	4	18
taɮax	1	9	8	18
xaɮax	4	7	4	15
Sum	13	30	24	67

The result that /ɮ/ tends to be pronounced with at least partial voicing is similar to the observation by Svantesson et al. (2005), mentioned in Section 2. This result may be interpreted to mean that /ɮ/ is a voiced sound. However, it is noteworthy that approximately 36% (24 out of 67) tokens were realized as fully voiceless sounds even in the intervocalic position, in which consonants are easily voiced. Given that /ɮ/ would be regarded as a voiced sound, it is difficult to explain why intervocalic /ɮ/ can be devoiced at any rate. Rather, it is natural to interpret that /ɮ/ is voiceless and can be voiced due to the voicing of the adjacent vowels. In other words, /ɮ/ is only passively voiced, rather than /ɮ/ actively functioning as a voiced sound.

### 3.2 Acoustic Analyses for /r/

In this section, the phonetic characteristics of /r/ are acoustically analyzed and compared with those of /ɮ/. Again, sound sources were obtained from the “Mongolian Grammar Module” in “TUFS Language Modules,” as in (3). The target sound /r/ occurs at the

<sup>5</sup> See Ueta (2016) for details of the experiment.

intervocalic position (3a) and between a vowel and a sonorant (/m/ or /ʒ/) (3b). These positions are expected to be environments where /r/ tends to be realized as voiced.

- (3) a. ud-ees xɔɪʃ bagʃ nar-iiŋ ɐrøən-d ir-eerei  
 noon-ABL after teacher PL-GEN room-DAT come-IMP  
 ‘Please come to the teachers’ room in the afternoon.’  
 b. jamar mafɪŋ ir-ʒee?  
 what sort of car come-DPST  
 ‘What sort of car came?’

The waveforms and spectrograms for /r/ are presented in Figure 2 (a–f). These show that most of /r/ were pronounced as voiced consonants, though some were trills [r], and others were approximants [ɹ]. Only one token was pronounced with only partial voicing, as illustrated in Figure 2 (c).

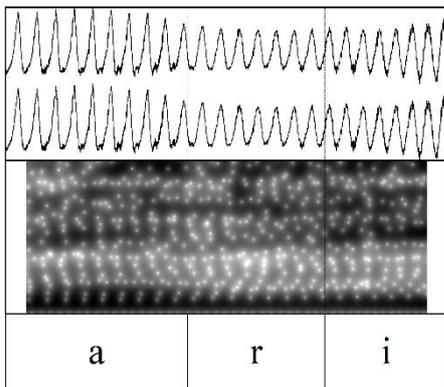


Figure 2 (a): /r/ in *nar-iiŋ*

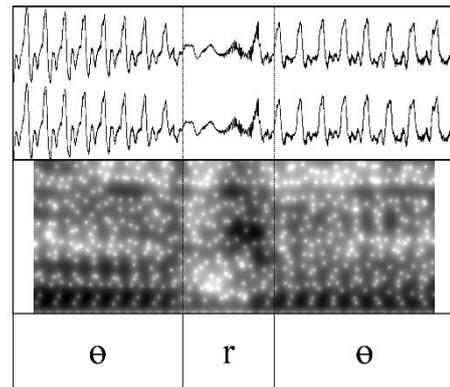


Figure 2 (b): /r/ in *ɐrøən-d*

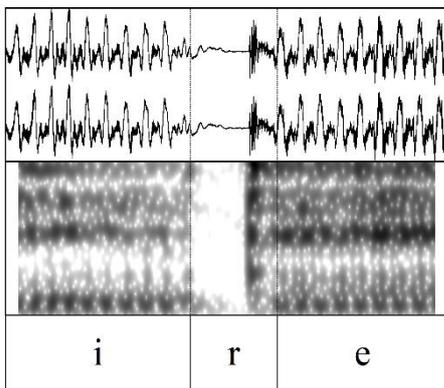


Figure 2 (c): /r/ in *ir-eerei*

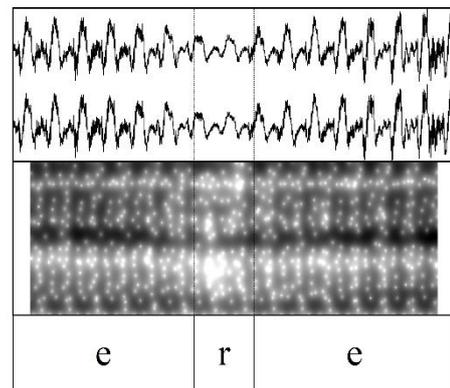


Figure 2 (d): /r/ in *ir-eerei*

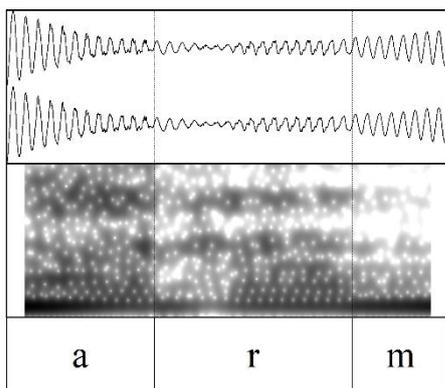


Figure 2 (e): /r/ in *jamar*

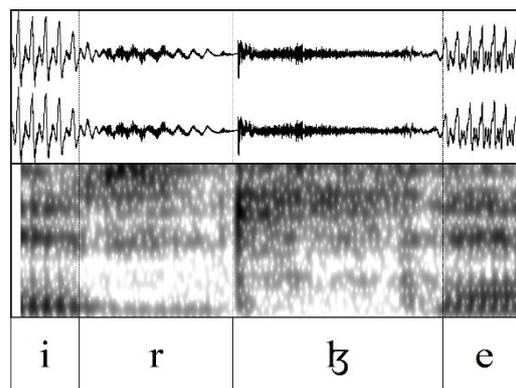


Figure 2 (f): /r/ in *ir-lee*

The acoustic analyses in Sections 3.1 and 3.2 reveal that /r/ is primarily voiced, whereas /l̥/ is voiceless. Figures 1 (c) and 2 (f), which are the same figures, express the contrast clearly; a voice bar and periodic waveforms can be observed during /r/ but not during /l̥/.

#### 4. /l̥/ and /r/ Following a Stop Consonant

In Mongolian, the possible coda is phonetically restricted; a consonant sequence whose sonority decreases can form a coda (4a), whereas one whose sonority increases cannot form a coda, and an epenthetic vowel is inserted between the consonants (4b).<sup>6</sup>

- (4) a. /ard/ [ɑrd] ‘the people’  
 b. /aad̥r/ [ɑ:d̥ɑr] ‘downpour’

In a stop+/l̥/ sequence, it is predicted that stop+[l̥ (l̥)] is not accepted as a coda, and a vowel is phonetically inserted between them because /l̥/ is assumed to have higher sonority than any stops. For example, word-final /t̥l̥/ and /d̥l̥/ are predicted to be pronounced as [t̥ɑl̥] and [d̥ɑl̥], respectively, and these forms are observed in practice (5a, 6a). However, these can be pronounced without a vowel insertion (5b, 6b). The numbers in (5) and (6) represent how often the pronunciation occurs out of 36 tokens (six informants read each word six times) obtained by the author’s experiment.<sup>7</sup>

- (5) a. /got̥l̥/ [got̥ɑl̥] ‘shoe’ 23/36  
 b. /got̥l̥/ [got̥l̥] ‘shoe’ 13/36

<sup>6</sup> The quality of epenthetic vowels is determined by vowel harmony. See Svantesson et al. (2005: 65–68) for details of the rule of the vowel insertion and syllabification.

<sup>7</sup> See Ueta (2020) for details of the experiment.

- (6) a. /bʊɔdʒ/ [bʊ:dǎʃ] ‘station’ 15/36  
 b. /bʊɔdʒ/ [bʊ:dʃ] ‘station’ 21/36

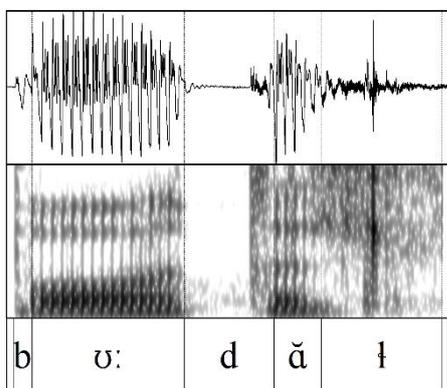


Figure 3 (a): /bʊɔdʒ/ [bʊ:dǎʃ]

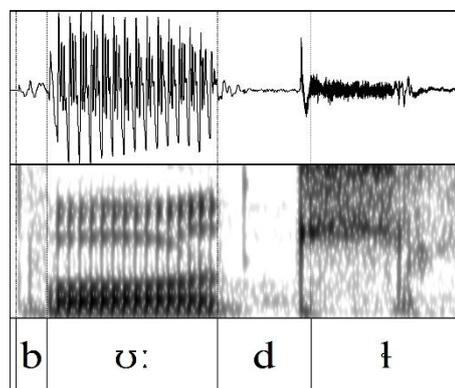


Figure 3 (b): /bʊɔdʒ/ [bʊ:dʃ]

Figures 3 (a, b) are the waveforms and spectrograms of /bʊɔdʒ/ uttered by an informant. There is a vowel between [d] and [ʃ] in Figure 3 (a), whereas there is no vowel at that place in Figure 3 (b). Whether a vowel occurs or not basically depends on the speaker, but both types can be obtained by a speaker.

This phenomenon can also be observed in stop+*/s/* sequences; because stop+*/s/* does not normally form a coda, it is predicted that an epenthetic vowel is inserted, as shown in (7a) and Figure 4 (a), and this form is actually observed. However, pronunciation without a vowel is also possible, as seen in (7b) and Figure 4 (b).

These facts suggest that /ʒ/ exhibits a parallelism to /s/ in that they can both be pronounced without a vowel insertion preceded by a stop.

- (7) a. /gʊɔds/ [gʊ:dǎs] ‘mattress’ 18/36  
 b. /gʊɔds/ [gʊ:dʃ] ‘mattress’ 18/36

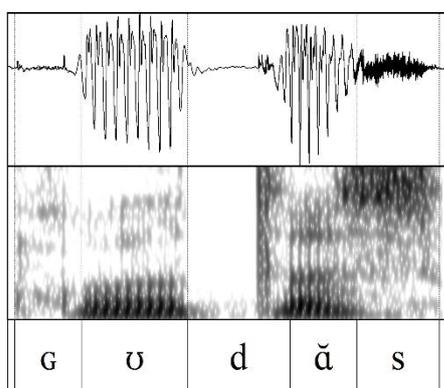


Figure 4 (a): /gʊɔds/ [gʊ:dǎs]

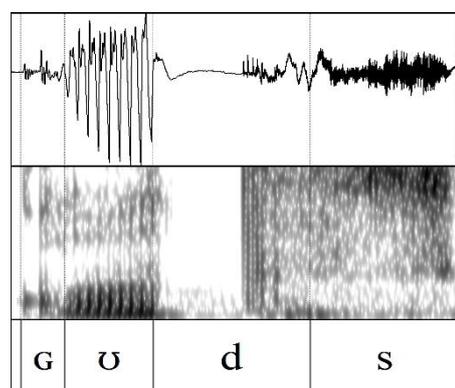


Figure 4 (b): /gʊɔds/ [gʊ:dʃ]

It is predicted that stop+/r/ sequences do not form a coda and that a vowel is epenthesized between them, since the sonority of /r/ is higher than any stops. However, there is no clear epenthetic vowel in some cases. Examples with an epenthetic vowel between a stop and /r/ are (8a), (9a), and Figure 5 (a), while (8b), (9b), and Figure 5 (b) are the ones without it.

- (8) a. /aadr/ [a:dǎ̃r] ‘downpour’ 22/36  
 b. /aadr/ [a:dr̥] ‘downpour’ 14/36

- (9) a. /baatr/ [ba:tǎ̃r] ‘hero’ 23/36  
 b. /baatr/ [ba:tr̥] ‘hero’ 13/36

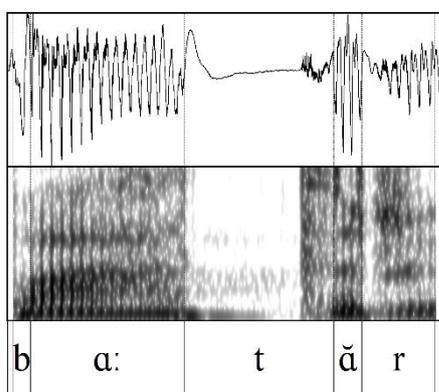


Figure 5 (a): /baatr / [ba:tǎ̃r]

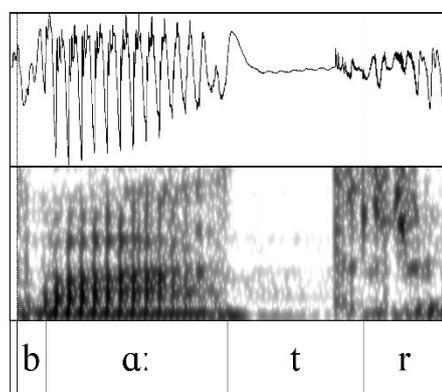


Figure 5 (b): /baatr/ [ba:tr̥]

From this result, /r/ appears to be similar to /ʁ/ (and /s/) in that it can be pronounced without an epenthetic vowel. However, the phonetic characteristics of /r/ differ from those of /ʁ/ and /s/. The majority of /r/ are realized as voiced, even when no epenthetic vowel exists, and at the same time, they are accompanied by a weak sound like a vowel, resulting in the clear increase in sonority from the stop to /r/. This suggests that a stop+/r/ sequence forms a syllable and /r/ can function as a syllabic consonant even in the absence of an epenthetic vowel. In contrast, /ʁ/ (and /s/) are necessarily voiceless and never followed by a vowel-like sound, suggesting that /ʁ/ (and /s/) are non-syllabic consonants. This difference is thought to derive from the differences of voicing and sonority; /r/ is voiced and has higher sonority, whereas /ʁ/ is voiceless and has lower sonority, as does /s/.

### 5. /ʁ/ and /r/ from the Perspective of Phonotactics

/ʁ/ does not generally occur word-initially in native Mongolian words (Yamakoshi 2012: 15). This is the same behavior as the other liquid /r/. However, word-initial /ʁ/ and /r/ are different in their acceptability. For example, according to Ozawa’s (1994) “*Modern Mongolian Dictionary*,” the number of words beginning with r (p in Cyrillic letter) totals

50, whereas the number of words with initial *ᠵ* (*ᠵ* in Cyrillic letter) is 228. Many of the words with initial *ᠵ* derive from Chinese or Russian, but there are quite a few words whose origins are not specified in Ozawa (1994). On the contrary, most of the words with initial *r* are loanwords from Russian or Tibetan, and there are few words whose origins are not specified. Although the number of words in a dictionary does not perfectly reveal the phonological status of the sound, it is certain that the word-initial /*ᠵ*/ is more widely accepted than word-initial /*r*/.

Phonetically, the words with initial /*r*/ tend to be pronounced with a prothetic vowel, as in (10a), and some words with the vowel have been established, as in (10b).<sup>8</sup> In contrast, the words with initial /*ᠵ*/ rarely accompany a prothetic vowel (10c). This suggests that the phonetic acceptabilities of word-initial [r] and [ᠵ (ɿ)] also differ.<sup>9</sup>

- (10)a. /radio/ [ɤradio] ‘radio’  
 b. /arfaan/ < Sanskrit. rasāyana ‘holy water’  
 c. /ᠵektər/ [ᠵektər] ‘lecturer’

In conclusion, these data indicate that, while /*ᠵ*/ is basically forbidden to occur word-initially in a similar fashion to /*r*/, the restriction for /*ᠵ*/ is less severe than for /*r*/, and thus, /*ᠵ*/ is allowed at any rate to occur in that position.

## 6. Conclusion

This study addressed the phonetic and phonological characteristics of Mongolian /*ᠵ*/ and /*r*/.

According to the acoustic analyses, /*ᠵ*/ is normally realized as the voiceless [ɿ] even in the intervocalic position and can be fully or partially voiced because of the voicing of the adjacent vowels, whereas /*r*/ is essentially pronounced as voiced [r]. In addition, the phonetic realization of stop + liquid sequences reveals that /*ᠵ*/ is voiceless and has lower sonority, and thus, it does not form a syllable with the preceding stop, while /*r*/ is voiced and has higher sonority, so it functions as a syllabic consonant. From the perspective of phonotactics, /*ᠵ*/ and /*r*/ differ in their acceptability in word-initial position.

In future research, it should be investigated whether /*ᠵ*/ contrasts with /*ɿ*/. According to Svantesson et al. (2005), Mongolian also has the phoneme /*ɿ*/, which occurs in loanwords from Tibetan. If /*ᠵ*/ is voiceless, determining whether /*ᠵ*/ and /*ɿ*/ can be differentiated will be an issue. Although Svantesson et al. (2005: 19–20) demonstrate that /*ᠵ*/ and /*ɿ*/ differ not only in voicing but also in the strength of friction, additional acoustic

<sup>8</sup> Paucity of the words with initial *r* and being established with a prothetic vowel are somewhat relevant; if a prothetic vowel is added word-initially, then *r* is no longer at word-initial position. Nevertheless, these can be independent of each other; the word *rafaan* ‘holy water,’ for example, is accepted as *arfaan*, but *rafaan* is also listed in Ozawa (1994).

<sup>9</sup> See Ueta (2014) for details of the frequency and the condition of the vowel prothesis.

and/or perceptual analyses are needed to clarify whether /ɮ/ and /ʎ/ are truly differentiated or have been merged.

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### Abbreviations

1: 1st person      ABL: ablative      ATT: attributive      DAT: dative  
DPST: direct past      EXCL: exclusive      GEN: genitive      IMP: imperative  
PL: plural      PST: past

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## Summary

The phonological system of Khalkha Mongolian includes /ɮ/ and /r/. It is generally assumed that these are phonologically placed in liquids, and that /ɮ/ and /r/ are realized as the voiced dental lateral fricative [ɮ] and the voiced dental trill [r], respectively. However, these phonetic descriptions have not been sufficiently confirmed through acoustic analyses, especially regarding their voiceness. In addition, the phonological statuses of /ɮ/ and /r/ have not been adequately considered on the basis of phonological phenomena.

This study addresses the phonetic and phonological characteristics of Mongolian /ɮ/ and /r/ through acoustic analyses and by observing phonotactic patterns. In conclusion, this study claims that Mongolian /ɮ/ and /r/ have distinct characteristics in voicing, sonority, and phonotactic restriction.

According to the acoustic analyses, /ɮ/ is normally realized as the voiceless [ɮ̥] even in the intervocalic position and can be fully or partially voiced because of the voicing of the adjacent vowels, whereas /r/ is essentially pronounced as voiced [r]. In addition, the phonetic realization of stop + liquid sequences reveals that /ɮ/ is voiceless and has lower sonority, and thus, it does not form a syllable with the preceding stop, while /r/ is voiced and has higher sonority, so it functions as a syllabic consonant. From the perspective of phonotactics, /ɮ/ and /r/ differ in their acceptability in word-initial position.

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