

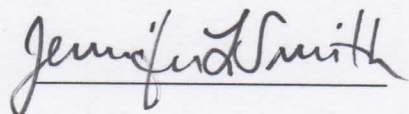
PHILOLOGICAL ANALYSIS OF OLD MONGOLIAN:
CONSONANT-VOWEL HARMONY WAS NOT UNIVERSALLY ENFORCED

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consonant-vowel harmony was not universally enforced**

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1: Introduction

1.1: Mongolic harmony systems

Mongolic languages provide an interesting arena for attempts to link diachronic studies to broad synchronic questions. A prime example is the origin of Halh Mongolian phonology from its ancestor Old Mongolian. In Halh, there is vowel harmony on the [+/-ATR] feature, which also controls dorsal consonant [+/-high] variation (Svantesson 1985, Goldsmith 1985). Under Halh V-C harmony [+high] velars are produced in a [+ATR] vocalic environment and [-high] uvulars are produced when vowels are [-ATR].

Old Mongolian also possessed both vowel and V-C harmony, but based on [+/-back] rather than [+/-ATR]. In Old Mongolian, [-back] vowels and [+high] velar consonants harmonize, and [+back] vowels harmonize with [-high] uvular consonants. While the most commonly used, cross-linguistically attested system of phonological features (Sagey 1986) is perfectly capable of describing both patterns (as I have just done), that description doesn't provide much insight into the phonological relationships taking place in either system, or what underlies the shift between them.

This study uses philological analysis to directly characterize Old Mongolian tokens that contain vowels and dorsal consonants in contemporary text sources. Irregularities in both C-V harmony involving the velar stop [k] and V-V harmony involving the back vowel [u] were identified through this method. This represents the first attempt to consider self-reported surface forms by speakers of Old Mongolian rather than relying on reconstruction from modern languages. The identification of irregulars in Old Mongolian harmony contradicts the traditional view from reconstruction work that V-V and C-V harmony was entirely regular. This different view of the Old Mongolian phonological landscape may have a significant impact on attempts to relate Mongolic phonology to bigger questions in linguistics.

1.2: Implications of Mongolic harmony

The explanation of the Mongolic vowel harmony systems has been approached in ways that have serious theoretical implications beyond the two

languages at hand. Svantesson (1985, 2008) considers the lack of phonologically represented assimilation under Sagey features for OM and Halh V-C harmony to be grounds for adoption of an entirely different feature system. Vaux (2001, 2002) argues that the maintenance of ATR harmony on epenthetic consonants in Halh cannot be successfully characterized in Optimality Theory, and connects this language pair to broader advocacy of a return to rule-based phonology. Ko (2011) operating under a different set of linguistic assumptions (contrastive hierarchy theory, Dresher 2009) concludes that ATR rather than back harmony should be the ancestral condition in reconstructed Old Mongolian (cf. Svantesson 1985, 1995). Ko's conclusion in turn supports the proposal that proto-Altaic possessed ATR (or 'RTR') harmony (Vaux 2009) and links Mongolic to that family.

A less exotic approach to the harmony shift in Mongolic could be application of a listener-based model of phonology (Ohala 1983, Kiparsky 1995). Listener-based phonology permits maintenance of the currently prevalent theories of phonology. Instead of changing the synchronic theoretical framework, listener-based phonology accounts for patterns that appear unnatural synchronically or across long time steps by factoring in repeated reanalysis of variation in inputs at each generation, without challenging current widely-accepted theories of motivation. A listener-based account lets synchronic universals determine behavior at a given point in time, while the accumulating diachronic effects then shape the inputs received by successive listeners operating on those same synchronic assumptions (Kiparsky 2008, 2006). Such an approach could well be applied to Mongolic to account for the otherwise hard to explain development of Halh harmony from the OM system.

However, while use of a listener-based model doesn't inherently *require* radically changing views of phonology, its ability to explain many phonological patterns has been claimed to have just such wide implications. Evolutionary Phonology (Blevins 2006) as a framework for diachronic sound change relies essentially on gathering of new typological evidence for support. Blevins (2004) and Haspelmath (2006) have claimed that if Evolutionary Phonology is accepted, the role of synchronic universals in phonology can be reduced to almost nothing. Therefore if a diachronic treatment of phonology is applied

even to the very discrete case of harmony in Mongolic, it may fall into broader groups of evidence whose interpretation has major consequences within phonology. In short, the characterization of OM and Halh harmony, and their relationship to each other, should not be taken lightly even though it is just a single case study—this case study ties into a much more widely impacting debate within phonology.

1.3: Access to contemporary Old Mongolian records

Despite the importance of getting the characterization of Old Mongolian right in order to draw conclusions about Mongolic that relate to bigger issues, OM data for phonological studies has typically been drawn from regular patterns indicated by reconstruction. This approach creates a problem because—as demonstrated by the radically different conclusions drawn by Svantesson (2008) and Ko (2011)—the forms generated are naturally subject to the parameters of the reconstruction process. This means that comparison of particular approaches to Mongolic is subject to the tautological influence of each initial phonological view producing results consistent with itself—unless another source of information is identified.

Very fortunately, an independent record of Old Mongolian phonology exists. While spoken in the Mongol Empire between about 1200 and 1400 c.e., Old Mongolian was recorded in at least four writing systems: Uyghur Mongolian (UM), ‘Phags-pa, Sino-Mongolian (SM), and Arabic Mongolian (AM) (Svantesson 2008). The sound categories represented in each system are well-characterized, and contemporary sources in each system have been successfully translated. Each system contains some degree of ambiguity on segment identity, including vowels and harmonic consonants. In past applications grapheme-to-phone ambiguity has been resolved either contextually or through extension of the front-back harmony pattern already described.

An intriguing possibility that seems not to have been explored is direct investigation of Old Mongolian phonology through contemporary written attestations. This source of data could be invaluable because it is independent of any particular reconstruction framework. As noted, independent data of this

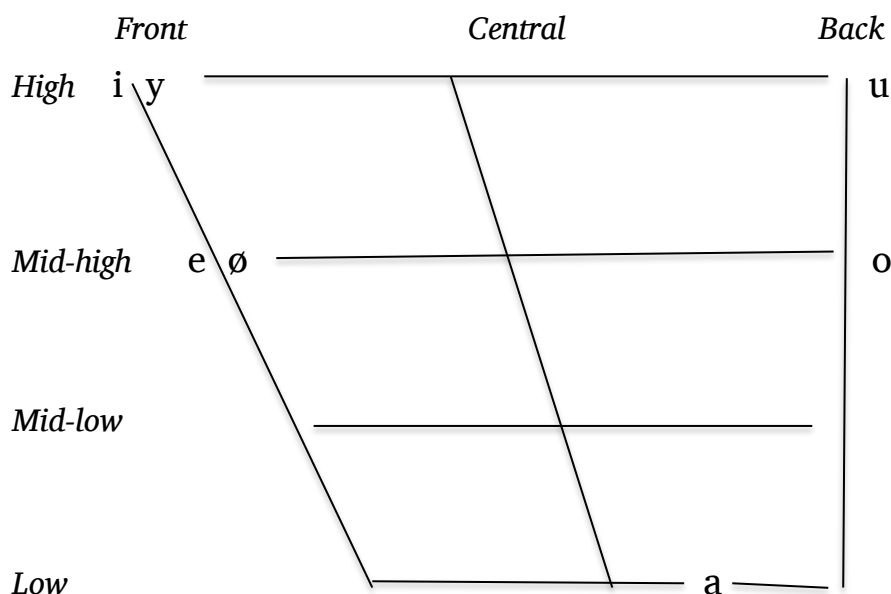
type could then help arbitrate the conflicts between different theoretical approaches to Mongolic. In this study I will compare points of ambiguity in written Old Mongolian for specific tokens that happen to be attested in two or more writing systems. Because not all four systems are ambiguous at the same points, it is possible to resolve ambiguity on harmonic segments in a number of tokens. Very interestingly, the philological data that I generate by this method indicate that Old Mongolian was not entirely regular in either V-V or C-V harmony. If irregularity of this type is indeed a more accurate snapshot of the shape of surface-produced Old Mongolian at a particular moment in time, it has serious implications for past and future studies on Mongolic and its relation to more fundamental questions of theory

2: Language Background

Old Mongolian is currently understood to have been a koiné language spoken during the period of the Mongol unification and expansion between 1200 and 1300 c.e., with written records persisting up to the late 1400s (Janhunen 2012). Koineization is proposed based on the content of historical reports, however, no attestations exist of specific dialects (or really, any Mongolic language) prior to the OM period (Janhunen 2003). Reconstruction from ten extant languages (Janhunen 2012, Svantesson et al 2008) indicates proto-Mongolic is similar to Old Mongolian as directly attested in historical records. This section characterizes the regular front-back Old Mongolian harmony pattern reconstructed by Poppe (1955) and Svantesson (2008) which is most frequently referenced in studies of the language. The structure of modern Halh is then also provided.

2.1: Old Mongolian Harmony

Reconstructions by Poppe (1955) and Svantesson et al (2008) agree on the description of a front-back vowel harmony in Old Mongolian, as well as variation among dorsal segments [k x ŋ] [q χ ŋ] that correlates to vowel harmony. The vowel phonemes of Old Mongolian are:



In regular OM, velar dorsals [k x ŋ] occur with front vowels [i y ø e], and uvulars [q χ ɴ] occur with back vowels [u o a]. This harmonization can be captured by the features [+ /-back] in vowels and [+ /-high] in dorsal consonants. [i] is treated as opaque and neutral in the reconstructed regular pattern (though see Section 4). While not operating on a single feature, this C-V interaction appears much easier to characterize than Halh's, as both segments possess both of the features that are interacting. The regular OM C-V harmony interactions are presented below:

(1) Old Mongolian C-V harmonization

- a) øk 'give' (v.) + tčy IMPRF → øk-tčy 'often gave'
- b) ol 'find' (v.) + uqsad PSTPRT → ol-uqsad 'found'
- c) ønke 'color' + ar INST → ønke-ker 'color.INST'
- d) harpa 'ten' + q ACC + a 'my' → harpa-qa 'my ten' (harpaq-qa)
- e) nar 'nice' + in GEN → nar-in 'fine'

Most work, however, deals only with the reconstructed, regular harmony system and treats [k/q] as a phoneme in perfect allophony. As described in Section 4, contemporary philological resources attest what seem to be frequent C-V harmony irregularities that may be useful in considering the development of the modern Halh system.

2.2: Halh structure

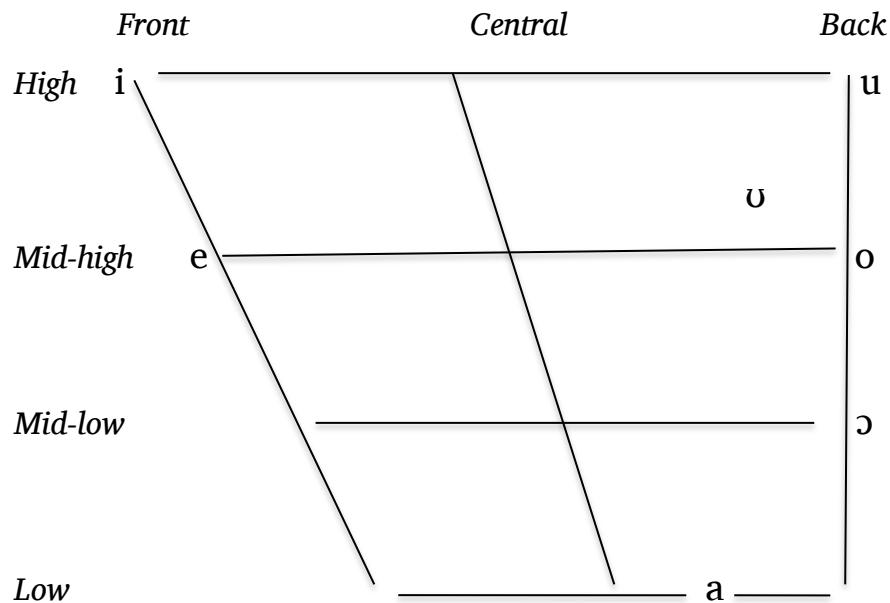
Halh (also 'Mongol,' 'Mongolian') is a Mongolic language spoken by about 2.1 million people in the nation of Mongolia (Lkhagvadulam 2010). Halh descends from Old Mongolian (also called 'Middle Mongol' and 'Classical Mongolian' (see de Rachelwitz 1999) referred to here as OM). Geographic contraction and reconquest between the 16th century and present day resulted in about 30 extant Mongolic languages (Svantesson et al 2008).

Halh is a suffixing agglutinative language with SOV order (Svantesson et al 2008, Poppe 1955). Halh is rich in derivational morphemes that typically occur as monomorphemic suffixes. Nouns may be inflected to eight cases, and

compounding is possible, but rare. Vowel harmony is not enforced across separate components of a compound word (Svantesson et al 2008).

2.2.1: Halh vowel system

Halh possesses seven basic vowels, which are:



The Halh vowels are organized into [+ATR] and [-ATR] classes for harmony. While Svantesson (2008, 1985) argues against formalization in terms of [+/-ATR] at all, and while irregularities can be noted to exist, within the boundaries of Sagey specifications “[+/-ATR] with irregularities” remains the most consistent description of the pattern.

[+ATR]	[-ATR]
u	ʊ
e	a
o	ɔ

[i] is harmonically [+ATR] when dominating other segments, but is neutral and opaque to [-ATR] harmonization; [i] therefore can occur anywhere in a [-ATR] word, and all segments right of [i] will then harmonize with [i] to be [+ATR].

X-ray articulography undertaken on Halh speakers demonstrates that [+ATR] vowels are produced with a wider pharynx than [-ATR] correspondents (Buraev, Bazheeva and Pavlova 1975, Cenggeltei 1959, Buraev 1959). Moomoo (1977) and Svantesson (1985) also identified greater tension in hyoglossi muscles in [-ATR vowels]. The hyoglossi pull the tongue backward, and the Lund University working group, including Svantesson et al (2008) that has investigated Mongolian phonology extensively has adopted a [+/-RTR] (retracted tongue root) formalization that is functionally the opposite of [+/-ATR]; for Mongolian anything characterized as [-RTR] is [+ATR] and vice versa. The [+/-RTR] feature has in more recent work (Svantesson et al 2008) been converted to a [pharyngeal] feature that is shared by dorsal consonants under an alternative feature system proposed by Wood (1975). Discussion of this approach is provided later in this section, but I will not employ it for this study.

2.2.2: Halh ATR harmony

Examples of harmony between root (leftmost) vowels and comitative suffix are presented below in examples (1)-(3). The comitative suffix has four forms that permit rounding harmony among non-high vowels as well as ATR harmony; not all morphemes are subject to rounding harmony, but all are subject to ATR harmony.

(2) [-ATR] root vowels triggering harmony

[ʊ]:

t̪ʊʒʊ ‘stone’ + tai COM → t̪ʊʒʊ-tai ‘with stone/of stone’

[a]:

t̪ʌat̪ʌ ‘aunt’ + tai COM → t̪ʌat̪ʌ-tai ‘with my aunt’

[ɔ]:

gɔl ‘river’ + tai COM → gɔl-tɔl¹ ‘with a river’

¹ Rounding harmony is also present here

² rounding harmony is also present here

³ /bi/ is produced as [bi] only in isolation; when affixed it appears as [-mi-] or [-n-]

⁴ /ta/ becomes [t̪ʌam] in some inflections

(3) [+ATR] root vowels triggering harmony

[u]:

duu ‘son’ + -tai COM → duu-tei ‘with a son’

[e]:

egt̃ ‘older sister’ + tai COM → egt̃-tei ‘with my sister’

[o]:

ol ‘mountain’ + tai COM → ol-toi² ‘with a mountain’

(4) [i] harmony:

bi ‘me’ + -ni GEN → mi-ni ‘mine’³

ta ‘you’ + -ni GEN → ta-ni ‘yours’

ta ‘you’ + -ruu ‘toward’ → t̃am-ruu⁴ ‘to you’

ta-ni ‘yours’ + -ruu ‘toward’ → ta-ni-roo ‘to yours/your location’

2.2.3 Halh **Regular** Vowel-Consonant interactions

In Halh, dorsal segments vary according to whether a word is harmonically [+ATR] or [-ATR]. The prevailing pattern is that velar dorsals [g x ŋ] occur in [+ATR] words and uvulars [G χ ʁ] occur in [-ATR words]. This relationship, even when perfectly consistent, is phonologically interesting because (under crosslinguistically supported Sagey features) while both vowels and dorsal consonants are DORSAL, the vowel sets are defined by [+/-ATR], a feature which the consonantal segments lack entirely. The velar-uvular distinction is captured by the [+/-high] feature, which vowels of course possess, but which does not define their harmonic distribution either in interaction with each other or with consonants. Examples (4)-(6) show dorsal consonants

² rounding harmony is also present here

³ /bi/ is produced as [bi] only in isolation; when affixed it appears as [-mi-] or [-n-]

⁴ /ta/ becomes [t̃am] in some inflections

harmonizing with each Halh vowel in monomorphemic words, while (10)-(12) show [i]-opacity during affixation of the accusative and reflexive-possessive morphemes

(5) [+ATR] and velar:

- a) ug ‘word’
- b) ed̥ʒ ‘mother’
- c) oŋg ‘color’
- d) tʃ^hix ‘ear’

(6) [-ATR] and uvular:

- a) uga- ‘wash’ (v.), ugaχ ‘to wash’
- b) saχ⁵ ‘protect/to protect’ (v.)
- c) mɔgɔi ‘snake’

(7) [i] opacity:

- a) aw ‘father’ + -g- ACC → awig ‘father.ACC’, *awig
- b) aw ‘father’ + -e POSS.REFL → awaa ‘my father’, *awee
- c) awig ‘father.ACC’ + -e POSS.REFL → awigee, ‘my father.ACC’
*awigaa

Epenthesis of [g/G] between vowels at morpheme boundaries is an additional source for examples of phonological variation, in this case on segments that are not represented in the underlying form. Examples of harmony on epenthetic dorsals are provided in (8)-(9).

- (8) aw ‘father’ + -tai- COM + -e REFL.POSS → aw.tai.gaa
*aw.tai.aa
*aw.tai.gaa

- (9) ed̥ʒ ‘mother’ + -tai- COM + -e REFL.POSS → ed̥ʒ.tei.gee
*ed̥ʒ.tei.gee

⁵ verb roots ending in {χ/x} do not change in the infinitive, but other roots have -χ, -x, -Vχ, or -Vx appended to form the infinitive in production

2.2.4 Halh Harmony violations

Even beyond the inherent interest of a potentially unnatural phonological process, Halh vowel-consonant harmony does not always occur as described in 2.2.3. While vowel-vowel harmony is extremely robust, violations of vowel-consonant harmony are noted to exist, although they have not been systematically collected. Several such examples in Halh are:

(10) $\text{n}\bar{\text{a}}\text{g}\bar{\text{a}}\text{ᠩ}$ ‘green/plant’; regular pattern predicts $^*\text{n}\bar{\text{a}}\text{g}\bar{\text{a}}\text{ᠩ}$

(11) $\text{ᠰ}\bar{\text{a}}\text{ᠩ}\bar{\text{x}}\bar{\text{a}}\text{ᠷ}$ ‘falcon’; regular pattern predicts $^*\text{ᠰ}\bar{\text{a}}\text{ᠩ}\bar{\text{x}}\bar{\text{a}}\text{ᠷ}$

(12) $\text{p}\bar{\text{u}}\bar{\text{ᠵ}}\bar{\text{a}}\text{ᠭ}$ ‘spring’; regular pattern predicts $^*\text{p}\bar{\text{u}}\bar{\text{ᠵ}}\bar{\text{a}}\text{ᠭ}$

Many linguists specializing in Mongolian have adopted exotic feature systems that help account for the modern Halh pattern (e.g. Van der Hulst 1987, Wood 1975, Poppe 1970, Cenggeltei 1963, Kojima 1938, Kljugin 1926). In particular, the Lund University (Sweden) working group that has produced key resources for this project use a [pharyngeal] or [RTR] feature (Wood 1975; Svantesson 1985) shared by dorsal consonants as well as vowels, that essentially licenses characterization of the Halh C-V harmony as simple assimilation. I avoid adopting any of these systems primarily because doing so involves a much larger assertion about their crosslinguistic applicability. In addition to the theoretical problems of changing feature systems entirely, doing so also just does not gain much ground for comparison of OM and Halh. If the [RTR] or [pharyngeal] feature makes Halh harmony neatly representable, it does not account for the Old Mongolian front-back harmony from which it arose, or simplify the transition between them. While the data produced in this experiment could be used to search for evidence that supports a characterization like that used by Svantesson, I will not adopt [RTR]/[pharyngeal] for my own description of the data because doing so gains relatively little simplification while imposing a large burden of formal justification.

3: Research Questions

3.1: Limits to philological information

Phonetic and phonological studies of natural language make use of a full range of acoustic and articulatory information. However, the current investigation into Old Mongolian irregularity is limited by the types of phonological information made available in written data data.

a) Lack of access to channel bias

As is discussed at much greater length in Section 4, Old Mongolian tokens that are recorded in several writing systems can be decoded to produce data that faithfully indicate (at best) a phonetic category that existed within the language. This process adds significant information to the recent and widely used reconstruction by Svantesson et al (2008) or the earlier reconstruction by Poppe (1954) that represent many consonants at the phoneme level only, and therefore fail to capture any exceptions to the proposed allophonic system. Clearly though, no method permits direct access to any OM acoustic data.

Because acoustic or articulographic information is lacking in the historical data, unnaturalness that depends on that data (e.g. coarticulation, phonetic precursors (Blevins 2004, Ohala 2004)) can be considered only speculatively. Moreton (2008a) provides the characterization of channel bias: “phonetically systematic errors in transmission between speaker and hearer” which is what is *unavailable* here. All the philological OM information that allows consideration of diachrony has necessarily been filtered through perception already—and provides no information about the gap between representation of speech and physical production as cited above.

b) Access to analytic bias

The companion to channel bias is analytic bias, which can be characterized (again in Moreton 2008a) as “cognitive biases which facilitate the learning of some phonological patterns and inhibit that of others.” Notably, analytic bias is not bound to ideas of phonetic naturalness or even Universal Grammar—it may address non-linguistic perceptual biases, for example, or inherent tendencies to group objects in a certain way regardless of perceptual salience—and so provides a unique sort of access to the underpinnings of UG

without having to make assumptions about it. Analytic bias may also be stated simply as the set of factors that define how language users happen to induce phonology from inputs.

The type of information available for OM through philological comparison essentially reflects the categorical (but not phonemic) perception of inputs for that language, and so might be used to make inferences about the analytical but not acoustic processes that underly Mongolic phonology.

3.2: Areas of investigation

My interest in direct characterization of Old Mongolian harmony can be broken down into several related questions, ranked in this section by increasing narrowness.

- a) **What phonological processes underly the transition between OM and Halh harmony?**
- b) **Why does OM consonant harmony shift to follow new Halh harmony classes rather than remaining separately front-back motivated or being simply lost?**
- c) **What is the precise nature of the phonological information available to Old Mongolian speakers and learners prior to the development of Halh?** (as opposed to reconstructed information that starts by incorporating Halh)
- d) **Was the Old Mongolian harmony system regularly and entirely front-back harmonic?** (as is currently supposed when making claims about versions of questions a-c)

As already noted, there has not been a systematic study of consonant-vowel harmony attested in actual Old Mongolian sources; work thus far instead references the reconstructed regular pattern, which is sufficiently reflective of the contemporary written form to permit the translation of those sources, but which makes no accounting for attested cases of potential irregularity.

A (relatively) large number of historical OM tokens exist, which have potential to yield contemporary phonetic information as reported by actual OM speakers. In this study I therefore propose to analyze that available OM written data to answer question (d) as a necessary precursor to reanalyzing the higher-

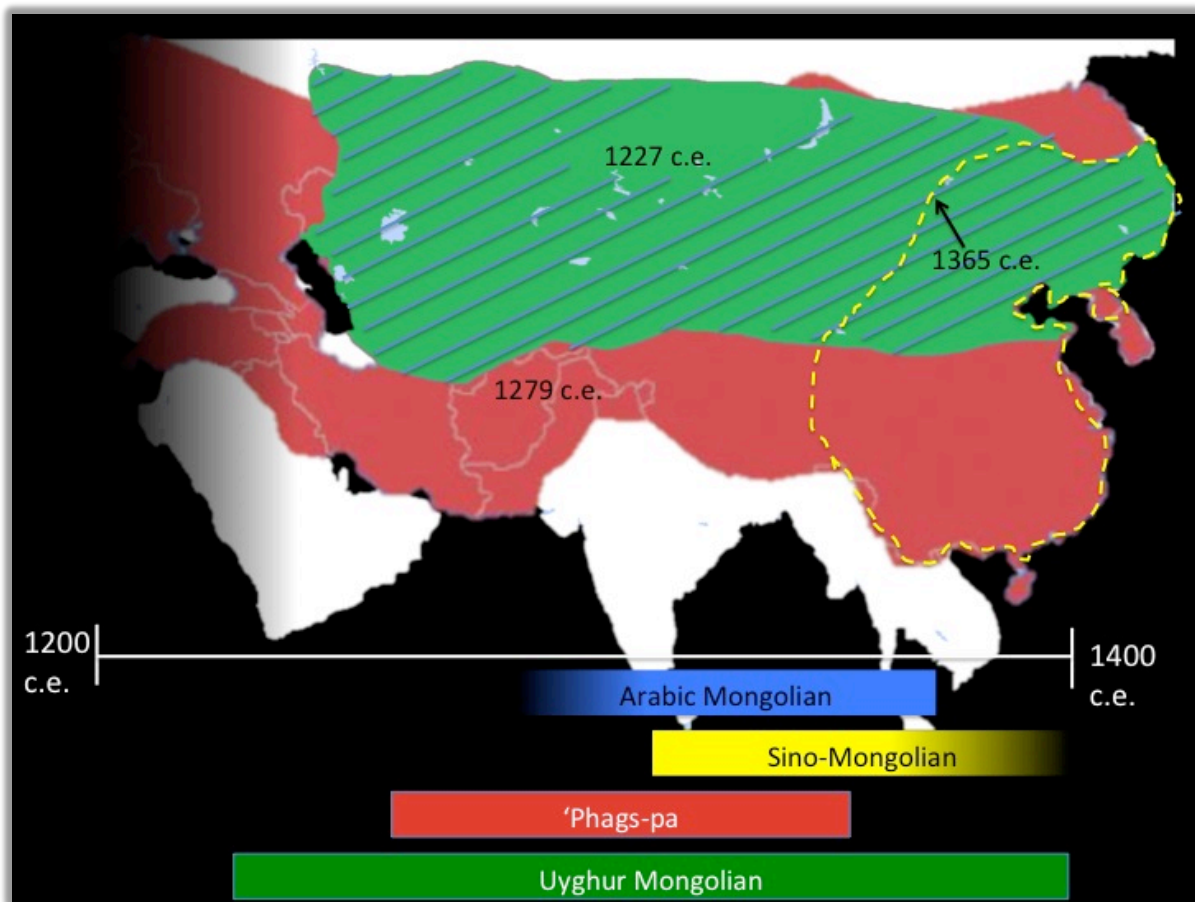
level questions. Although I will not yet attempt to answer those questions, I do propose a method through which OM's relationship to Halh can start to be basically characterized with the philological data as a starting point. This is asking the statistical question:

e) **Does OM irregularity predict Halh irregularity?** This question asks if a predictable relationship can be drawn between irregularities found in OM to irregularities identified in modern Halh. Although I again do not attempt to fully answer this question, in section (6) I provide an experimental proposal for doing so.

4: Philological Methods for Old Mongolian

Old Mongolian is attested in the four systems (in order of prevalence) of Uyghur Mongolian, 'Phag-spa, Sino-Mongolian and Arabic Mongolian. As each system reports different phonetic specifications, tokens that are reported in several writing systems can deciphered phonetically to the category level with some degree of exactitude. The four systems overlapped in usage at some points over the 200-year period in question; an overview of relative points of usage and contemporary distribution of the empire is provided in (13) before going into detail in sections 4.1-4.4. The process of comparison between scripts is then described in Section 4.5.

(13) Overview of usage for four grapheme systems in the Mongol Empire



Example 13: Usage periods of four principal scripts for OM and approximate boundaries of the empire around the time of adoption. AM was not widely adopted by Mongols and so is marked on the timeline but not the map. UM is still in use in modified form and 'Phags-pa is contemporarily reported to have fallen out of use after the death of Kublai Khan. Map outline sourced from Wikimedia Creative Commons, figure assembled by the author.

Sources of attestation are primarily internal governmental documents and memorial inscriptions. There are also significant numbers of diplomatic messages and education texts on the Mongolian language; these two sources are important because they have often included contemporary metalinguistic commentary that aided the specification of phonetic information under each writing system.

‘Phag-spa and Uyghur Mongolian both were used at times to transliterate Sanskrit and Tibetan religious terms and Chinese proper nouns, all of which are attested separately in the original systems and which provide another source of useful comparison in the original decoding of these scripts. Sino-Mongolian attested in *The Secret History of the Mongols* is used to provide instruction to Chinese speakers learning the Mongolian language, and so provides direct comparison of the same symbols when used to represent Yuan Chinese words and Mongolian syllables, in addition to didactic commentary.

As will be detailed in the following sections, consonant place of articulation and front-back vowel categories can be extracted from comparison of Uyghur Mongolian and ‘Phags-pa. Sino-Mongolian reflects vowel categories as well, but is of principal use along with Arabic Mongolian to determine manner of articulation of consonants. The outcome of specific comparisons between each of these four scripts is reflected in 4.5.2.

4.1: Uyghur Mongolian

Uyghur Mongolian (UM) derives (predictably) from the still-extant Uyghur script, which in turn originated from the semitic Syrian alphabet in the 9th century (Svantesson 2008, Poppe 1955). UM is a true alphabet, representing vowels and consonants with individual graphemes. According to a contemporary Chinese history (comp. Song 1370 ‘*Yuan shi*’ trans. 1976), this script was adopted in 1204 through direct instruction from a captured Uyghur military official. The earliest attested UM inscription is from 1227, and the system has remained in use (with some modifications to individual graphemes) until the present day, where it has recently been modified to include new symbols for representing foreign language contrasts under the heading of Modern Written Mongolian. While remaining in use, this system was almost

entirely abandoned in favor of Cyrillic in recent history, and remains relatively unpopular for regular use.

4.1.1: Uyghur Mongolian vowels

Uyghur Mongolian separately represents [a], [e], [i], [y], and [u] word-initially. The graphemic contrast between [a] and [e] is lost word-medially and word-finally, and the contrast between [y] and [u] is lost word-finally. There is no separate symbol for [o] or [ø]; [ø] is represented by the same symbol as [y] and [o] is represented by the symbol for [u]. Note, however that the front/back distinction between the [y/ø] and [u/o] graphemes is preserved even though the height distinction is not marked.









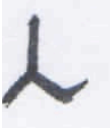



4.1.2: Uyghur Mongolian consonants

UM does not distinguish dorsal stops from affricates at the same place. Thus [k/x] and [q/χ] are represented by only one symbol each. Nasals [n] and [m] are represented by separate graphemes, but no distinct monographs exist for [ŋ] or [N]. It is possible that [ŋ] is represented by the digraph [nk], but it is unclear if a similar sequence [nq] or [nkq] represents [N]; nasals were transcribed accordingly, but excluded from discussion of OM velar/uvular harmony.




4.1.3: Uyghur Mongolian grapheme ambiguity

There is potential for multiple readings of some sequences because the graphemes in each UM word are connected, symbols for [a] [e] [n] and [q] are all represented visually by series of small dashes, *and* [a] and [e] are written with identical graphemes when not word-initial. As a result, it is technically possible for some UM grapheme sequences to be read in confusing ways (Example 14, next page); in these cases, inscriptions in other writing systems in addition to information about OM syllable structure (from Svantesson et al 2008) were relied on to determine the proper grapheme separations.





(14) Ambiguity on grapheme boundaries in an OM word





	[a]	[e]	[n]	[q]
word-initial				
word-medial				
word-final				






If a reader intends to write an OM-permissible hypothetical sequence [aqa]:

	a
	q
	a

however, other permissible interpretations include:

	a
	n
	a
	n

	a
	a
	a
	a

	e
	n
	a
	n
	a

Plus: naqa, *eqaa, *eaaaa, *aeaa, *eeeee, *nnnnn, *enqe, *anq, etc.

In these cases other sources are required to indicate the order of phones in the word in a way that permits useful interpretation of UM—also predictably, such cases of extreme ambiguity are rare.

4.2: 'Phags-pa

The 'Phags-pa script was introduced in 1269 following the death of Genghis Khan (Svantesson 2008). The script is a modified version of Tibetan, and was produced with the specific intention of faithfully representing the sound systems of Mongolian, Chinese and Tibetan, at the time all of which were spoken within the Mongol empire. 'Phag-spa was the official script of the empire for about 100 years; the last dated attestation is from 1368 (Poppe 1957).




4.2.1: ‘Phags-pa vowels

While ‘Phag-spa does not accomplish its goal of providing a fully unambiguous representation of Mongolian, it adds several key vowel contrasts that are not represented in Uyghur Mongolian. ‘Phag-spa represents [i] [y] [e] [ø] [u] and [o] faithfully with distinct monographs that are not subject to position or combination effects like UM (Jagunasutu 1987).



[a] has no written grapheme; it is represented graphically by blank space followed by an onset consonant with no vowel, or by a null grapheme word-initially (Jaganasutu 1989). The greater faithfulness of vowel contrasts in ‘Phags-pa is highly useful in resolving ambiguities present, especially on the important [a/e] distinction in Uyghur Mongolian. Example (15) demonstrates how [a] and [e] contrasts are represented in ‘Phags-pa.

(15) [a/e] contrast in ‘Phags-pa

Graphemes in isolation:

[a]	[e]	[t]	null
--			

Initial contrast

[at]	[et]
	

Final contrast

[teta]	[tete]	[tet]	[tat]
			

Note that when following a previous [a], a coda consonant is not distinguished from a second null-marked [a]—e.g. [at] will look identical to [ata], [tat] will look identical to [tata]. However, UM marks the presence of all

[a] and [e] segments; thus, when a token is attested in ‘Phags-pa and UM, it is possible to accurately identify every vowel.

4.2.2: ‘Phags-pa consonants

As in UM, ‘Phags-pa does not mark stop/fricative contrasts in dorsal consonants. However, it does faithfully distinguish [k] from [q] in all positions. Alveolar [n] and velar [ŋ] are both attested with distinct graphemes, but uvular [ɴ] is not indicated with a grapheme and does not have a consistent writing mechanism.

4.3: Arabic Mongolian

Arabic Mongolian is attested in two primary manuscripts: *Preamble to Literature* (al-Zamaksari, 14th century) with a dictionary of Arabic words glossed in Mongolian (all in the Arabic alphabet), and *Collection for the Turkish-Persian-Mongolian-Persian interpreter* (anon. 1343). Poppe has published analyses of both (1938, 1928) with full translations. Both sources are written or collected by second-language speakers of Mongolian.

4.3.1: Arabic Mongolian vowels

Arabic Mongolian does not expand on the Arabic vowel system which contains only [a i u]. Therefore, with regard to resolution of vowels Arabic is of little use. The sole contribution Arabic Mongolian may provide is again in resolution of [a/e] ambiguity; the Mongolian [e] vowel might be recorded in Arabic as either [i] or [a]. If a UM [a/e] case is transcribed [i] in Arabic, it is likely not [a].

There is a variety of vowel grapheme ambiguity operating on the distinction between [u] and [i] in initial position. Both of these segments are represented by the same grapheme <ᠠ> initially. <ᠠ> is also used to write [a] in non-initial positions, but initial [a] is written instead with <ᠠ᠊> (note the diacritic) so the ambiguity is only two-way. Fortunately because UM distinguishes [i] vs. [y/ø] and [u/o] and ‘Phags-pa distinguishes all five segments, this positional ambiguity in AM does not present an additional problem. Arabic Mongolian also in some cases omits vowels; in these instances, whichever vowel

was consistently indicated by other attestation was used. Arabic Mongolian overall should be treated skeptically as a source of positive identification for vowel categories; its greater use is in confirming consonant place of articulation and providing new information about manner of articulation (which is not represented in UM or ‘Phags-pa).

4.3.2: Arabic Mongolian Consonants

Arabic Mongolian faithfully marks velar and uvular place. Within uvular place (but not velar), Arabic Mongolian reflects stop articulation with a [q] grapheme and may reflect frication with a symbol that in Arabic indicates the voiced uvular approximant [ʁ]. However, this is not taken as independent evidence to resolve stop/fricative ambiguity without further information from Sino-Mongolian.

4.4: Sino-Mongolian

The Sino-Mongolian system is a large syllabary produced from Yuan Chinese characters. Its primary attestation is in *The Secret History of the Mongols*, which is claimed but not directly attested to have been transcribed in the 1390s from an unaccounted-for earlier version (de Rachewitz, 1965). Later versions of the first attested source for *The Secret History* have included reinterpretation of the original text (a literary historical account of Genghis Khan’s life and expansion of the empire) into a Mongolian-language textbook for Chinese speakers, which aids in providing meta-linguistic commentary. Other Sino-Mongolian glossaries exist that represent both Chinese and Mongolian with contemporary Chinese characters—it is likely that Sino-Mongolian texts were compiled by a mix of native and non-native speakers of Old Mongolian. Numerous symbols are used to represent each segment; phonetic interpretation of Yuan Chinese relies largely on a reconstruction by Pulleyblank (1991) based on a contemporary source *Pronunciation of the Central Plain* (Deqing, 1324). I use Pulleyblank’s interpretation as collected by Svantesson et al (2008).

4.4.1: Sino-Mongolian Vowels

Yuan Chinese has a vowel complement that is not similar to Old Mongolian; all Old Mongolian vowels are represented consistently by sets of Yuan characters, but those characters' vowel productions in Chinese were often quite different from what they were meant to represent (Example 15).

(15) Indirect Sino-Mongolian vowel representations

SM Character	Yuan Pronunciation (per Pulleyblank)	Sequence represented in OM
良	ljaŋ	leŋ
豁	xwɔ	xo

The fact that Sino-Mongolian is a syllabary makes analysis of its grapheme ambiguity a bit more difficult. For example, sets of SM characters that represent Old Mongolian syllables containing [o] and [a] *both* include characters that when read in Yuan Chinese are pronounced with [a] and [ɔ] vowels. The same is true of other vowel categories in SM; although Old Mongolian vowels represented by each particular set of SM characters is consistent, SM sets do not correspond to a single vowel in Yuan (Example 16).

(16) Pronunciation of SM characters in OM and Yuan Chinese

SM Character	Yuan Pronunciation	OM sequence
刺	la	la
哈	xɔ	xa
朵	tɔ	to
晃	xwaŋ	xoŋ

The large size of each set of characters and the mismatch of vowel identities between OM and Yuan Chinese means that it is plausible for a fluent, literate Yuan speaker to have made *ad hoc* syllable substitutions that do not conform to the usual representations reported by Pulleyblank (1991) and

Svantesson (2008). Due to this unspecified but potentially impactful influence of Chinese second-language or bilingual Mongolian speakers in recording Sino-Mongolian forms, SM was never used as the sole source of vowel identity. However, if an SM form contradicted others on vowel identity, that token was excluded from the corpus.

4.4.2 Sino-Mongolian Consonants

Sino-Mongolian does faithfully represent the stop/fricative distinction for velar consonants; all uvular consonants are represented as the uvular fricative [χ]. Together with Arabic, it provides at least some cues to the manner of articulation on dorsals that is not represented in the UM and ‘Phags-pa systems. Since Arabic distinguishes stops and fricatives at uvular place and Sino-Mongolian distinguishes stops and fricatives at velar place, it should be possible to resolve manner of articulation on these dorsals when represented in both SM and AM. However, both Sino-Mongolian and Arabic Mongolian should be viewed with greater caution as independent sources of phonological information due to our inability to assess the Mongolian language ability and history of individuals that recorded tokens in these systems.

4.5 Philological comparison and corpus assembly

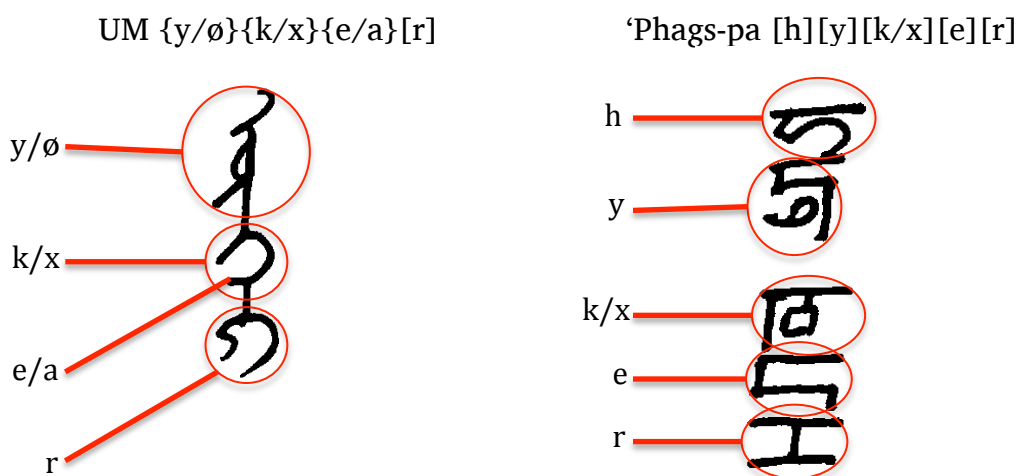
The four scripts discussed above were extant in an overlapping time range during the peak and contraction of the Mongol Empire (figure 1). Old Mongolian users themselves may have been familiar with several systems at once, especially in the case of Uyghur Mongolian being familiar to users of ‘Phags-Pa and Sino-Mongolian.

Svantesson et al (2008) compiled the full set of multiply-attested OM tokens, and transcribed them in the original source systems. Of about 400 tokens, 113 contained at least one dorsal segment. All of these tokens were transliterated for each system, and ambiguities were resolved as far as possible using the information provided by the systems each token was transcribed in. Of the 113 dorsal tokens, 9 were eliminated from the corpus due to contradiction between attestations. The process of comparison is briefly described in 4.5.1 and 4.5.2; results are reported in section 5.

4.5.1: Four-way overlap of grapheme systems

All dorsal tokens were attested in at least two writing systems. When one system is inherently ambiguous on a segment's identity and another is specific, the segment was interpreted as having the value given by the specific system. Some ambiguous segments could not be resolved, and are transcribed as {option1/option2}. No assumptions were made about the enforcement of harmony, and regular harmony was not used to resolve vowel or dorsal consonant identity in any cases. All dorsal tokens were attested in Uyghur Mongolian; examples (17)-(18) demonstrate the ability to resolve the minimum level of ambiguity possible for UM-attested tokens with each of 'Phags-pa, Arabic Mongolian, and Sino-Mongolian.

(17) Resolution of ambiguity between UM and 'Phags-pa

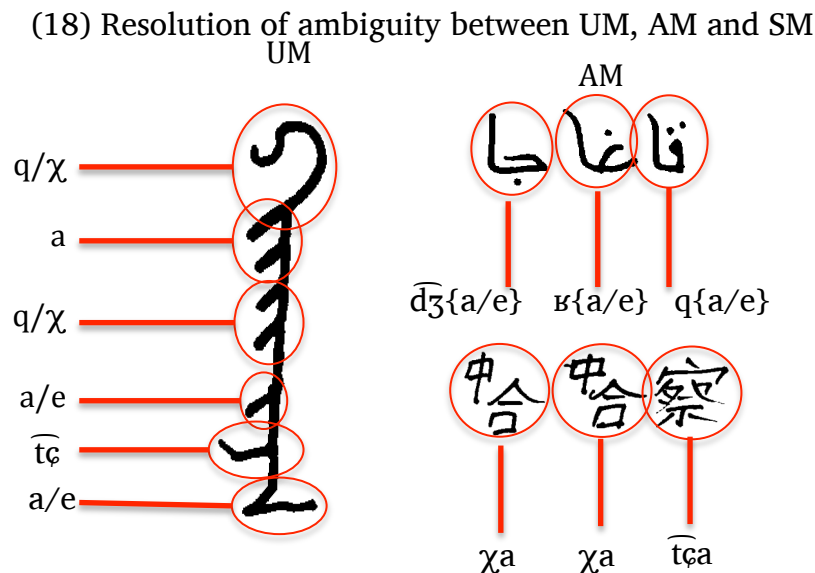


'Phags-pa unambiguously reports the expected harmonic identities for both vowels; other possible 'Phags-pa sequences that could have matched the UM word are presented below:



Note also that here ‘Phags-pa reported an [h] where UM has no grapheme. This was a frequent observation—UM omits a grapheme where other systems report an initial fricative. Sino-Mongolian and Arabic Mongolian when present in these cases indicated velar or uvular fricatives; these instances were recorded as {h/x} or {h/χ} when attested.

Recalling that Arabic Mongolian and Sino-Mongolian are both able to encode vowel identities but are more likely to be suspect in doing so, their primary contribution is in finding manner of articulation. Determination of dorsal frication through both AM and SM is shown in Example 18.



The second consonant is attested as a fricative in both AM and SM, and so is considered unambiguous; the initial consonant is [q] in AM and [χ] in SM; this consonant was transcribed as ambiguous. Importantly in Sino-Mongolian, the 中 (*zhōng*, ‘middle’) diacritic is an explicit uvular marker; the character lacking the marker is a [xa] segment (which is notably not harmonic even though velar-uvular harmony is explicitly marked).

4.5.2: Two-way overlap of grapheme systems

Although data from as many writing systems as possible is preferred, some productive conclusions can be drawn from the 8 possible two-way comparisons of grapheme systems. As already noted, for this study tokens that

were recorded only in the combination of Sino-Mongolian and Arabic Mongolian were excluded due to concerns over the potential for transcription error in vowels under those systems. However, questions that target other types of data might draw productive conclusions from any of the two- or three-way comparisons possible. The potential to resolve ambiguity through each possible two-way comparison is summarized in (19).

(19) Overview of ambiguity in possible comparisons of OM scripts

This chart is intended to be read by the column. For example $\{X/O\} \rightarrow [X], [O]$ indicates that ambiguity $\{X/O\}$ is present in the column language alone, and resolves to the given segments when combined with the row language.

	Uyghur Mongolian	‘Phags-Pa	Sino- Mongolian	Arabic Mongolian
UM		$\{a/\emptyset\} \rightarrow [a], [\emptyset]$	increased vowel fidelity; see 4.4.1	$\{e/i\} \rightarrow [i], \{e/a\}$ $\{y/u/\emptyset/o\} \rightarrow$ $\{y/\emptyset\}, \{u/o\}$
‘Phags- Pa	$\{e/a\} \rightarrow [e], [a]$ $\{y/\emptyset\} \rightarrow [y], [\emptyset]$ $\{o/u\} \rightarrow [o], [u]$			$\{e/i\} \rightarrow [i], [e]$ $\{y/u/\emptyset/o\} \rightarrow$ $[y], [\emptyset], [u], [o]$ $\{e/a\} \rightarrow [e], [a]$
SM	$\{k/x\} \rightarrow [k], [x]$	$\{k/x\} \rightarrow [k], [x]$ $\{a/\emptyset\} \rightarrow [a], [\emptyset]$		$\{k/x\} \rightarrow [k], [x]$
AM	$\{q/\chi\} \rightarrow [q], [\chi]$ $\{e/a\} \rightarrow [e]$	$\{q/\chi\} \rightarrow [q], [\chi]$ $\{a/\emptyset\} \rightarrow [a], [\emptyset]$	$\{q/\chi\} \rightarrow [q], [\chi]$	

5: Philology Results

As noted, of 113 dorsal tokens 102 could be resolved at least to the level consonantal place of articulation and complete specification on at least one vowel. From these 102 tokens, several cases of V-C harmony irregularity were discovered. In addition to 14 unambiguous irregular tokens, one pair of tokens with ambiguous vowels is included in the list because a velar consonant is attested in both forms, and vowel contrast is necessary to distinguish the two lexical items. It was therefore assumed that at least one of these tokens includes vowel disharmony, bringing the number of tokens with consonant disharmony to 15. All disharmonic forms are reported in (20).














(20) Philologically identified irregular OM forms

Regular form expected per Svantesson reconstruction	(my) philological irregular form	gloss
*t̥alqi	t̥alki	swallow (v.)
*et̥ike	at̥ika	father
*anqita	aŋkita	separate (adj.)
*t̥iqasu	t̥ikasu	fish
*t̥iryke	t̥iruka	heart
*yt̥xyr	yt̥ukur	point
*yky	yku	die (v.)
*kynty	kyntu	heavy
*tykyreŋ	tykurenk	full
*nøker	nykur	friend
*exyten	e{k/x}uden	door
*texy	teku	younger brother
*texesyn	tekesun	rope
*t̥erixyt	t̥erixut	soldiers
*neke/naka/neka/nake	n{a/e}k{a/e}	open (v.)
	n{a/e}k{a/e}	weave (v.)


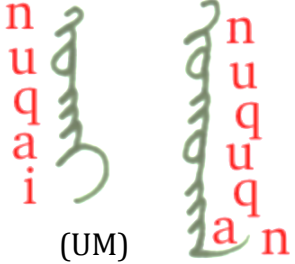
Although 15 of 102 (14.7%) dorsal tokens in the corpus are irregular and this appears to be a relatively high fraction of the available data, care must be taken due to the objectively small size of the irregular data set. When dealing with only 15 tokens, the potential impact of experimental error or even original transcription error in one of the data sources is very large. Because this study uses all known examples of OM words that are available in multiple scripts, it is not feasible to increase confidence by increasing the volume of data used. However, one source of support for characterization of OM irregularity as given in (19) is the existence of several near-minimal pairs with attested regular items. These pairings suggest that the regular ‘slot’ for versions of the identified Old Mongolian irregulars is already taken, and that the irregular segments are necessary to distinguish a unique form (although the rather remote possibility of homophony-plus-transcription-error is never able to be ruled out). These near-minimal pairs are reported in examples (21-25).

(21-25): Near-minimal pairs for cases of harmony irregularity; note that inscriptions are representative. Not every contributing script is shown, but resolved ambiguities are indicated at the appropriate point on whichever inscription is shown for demonstration.


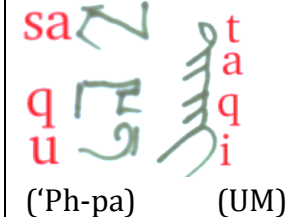
(21)

Philological form	Relevant inscriptions		Philological form
yku ‘die’ v. (irregular)	  y  k  u  (‘Ph.-pa)	   y   k   e  (‘Ph.-pa)	yk ‘give’ yke ‘word’ (regular)

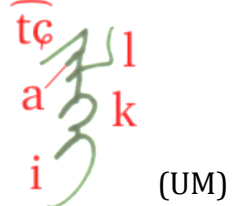
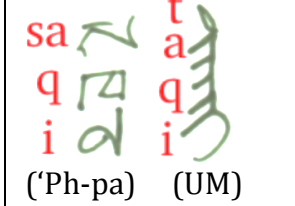
(22)

Philological form	Relevant inscriptions		Philological form
nykur 'friend' (irregular)			nuqai 'dog' nuquqan 'green' ⁶ (regular)

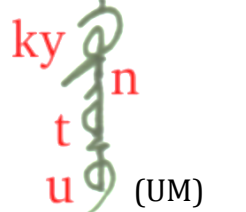
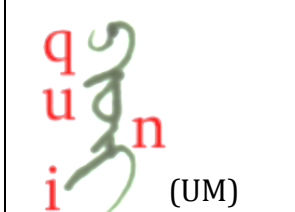
(23)

Philological form	Relevant inscriptions		Philological form
teku 'brother' (irregular)			saqu 'sit' v. taqi 'offer' v. (regular)

(24)

Philological form	Relevant inscriptions		Philological form
t̥alki 'swallow' v. (irregular)			saqi 'guard' v. taqi 'offer' v. (regular)

(25)

Philological form	Relevant inscriptions		Philological form
kyntu 'heavy' (irregular)			quni 'sheep' (regular)

⁶ the genitive -an is mandatory on this color adjective and the second [q] is likely epenthetic. A closer near-minimal comparison can be drawn between the root [nuqu] and the indicated irregular form

Although direct minimal pairs would be ideal to confirm that irregular cases are contrastive, no such example is attested. However, the given comparisons in (21)-(25) above help provide greater theoretical confidence for the occurrences of non-harmonic V-C sequences; they also help demonstrate the robustness of the distinction between graphemes reflecting those irregular sequences. Although it is certainly a possibility that literate native speakers can make an outright spelling error, the chance of a *transcription* error on these forms is low. The distribution of vowels and dorsal consonants in the irregular forms that were discovered is discussed in section 5.

6: Distribution of dorsal segments in Old Mongolian

This section is dedicated to systematic characterization of the irregularity of OM forms. As described in section 4, direct analysis of all available Old Mongolian inscriptions reveal 15 dorsal tokens that appear to be disharmonic as reported by multiple contemporary speakers, out of 102 total that contained at least one dorsal consonant each and were sufficiently unambiguous to use in analysis. These cases are in disagreement with the perfectly allophonic reconstruction of velars proposed by Svantesson et al. Interestingly, some written tokens possess disharmonic vocalic environments in addition to disharmonic placements of dorsal consonants. Although it becomes necessary to spend time accounting for irregularities in the vowel environment that are capable of confusing the question of V-C interaction, this section will conclude that the velar segment [k], and possibly also [x] occurring in [+back] vocalic environments is at the core of OM irregularity.

Many tokens contained more than one dorsal segment; in no case did a token unambiguously contain two consonants that are disharmonic with each other (e.g. [q] and [k] cooccurring in the same word). If disharmonic dorsal consonants are characterized as:

-any [+high] consonant that occurs in a word with at least one vowel that is specified [+back]

AND

-any [–high] consonant that occurs in a word with a vowel specified [–back],

there are 16 individual occurrences of disharmonic consonants within 15 words—most tokens contain only one dorsal consonant. **All** of these occurrences involve the first case, a [+high] consonant that cooccurs with a [+back] vowel (e.g. example 26).

(26) a [+high] velar consonant in disharmony with [+back] vowels

t̤iruka ‘heart’

All of these cases also involve some form of apparent vowel disharmony. Many potential vowel disharmony cases exist, so these are discussed in sections 5.1 and 5.2 to avoid confounding the investigation of consonant disharmony in 5.3.

6.1: [i]-transparency

A distinction can be drawn between [i] disharmony and other cases; unlike in Halh, **Old Mongolian [i] appears to be transparent**, with front-back harmony occurring across [i] without influence. Recalling that [i] is characterized in Halh and in a proposed regular pattern for OM as opaque, it is expected to sometimes occur after [+back] vowels, but to dictate [-back] harmony for all following vowels as in example 27:

- (27) *qujine ‘back’ /e/ harmonizes [-back] with [i], not [+back] with [u]
[q] in this token would not be treated as disharmonic based on [i]-opacity

Among OM tokens [i] is common but it does not obey this pattern. In fact, of 49 tokens containing [i] in the OM dorsal corpus, it is more frequently both followed and preceded by a back vowel than a front vowel (example 28, next page)

(28) Chart showing all attestations for vowel environments of [i]

		Specifications of vowels that precede [i]			
		[i]-initial	[-back]	[+ back]	
Specifications of vowels that follow [i]	[i]-final	t̃çin̄kis t̃çikin̄ ki bit̃çik̄ N = 4	t̃çerik̄ kei ykin̄ N = 3	t̃çalki taqi saqi qari qaqai ma{n/ŋ}klai mu{q/χ}ai nuqai qulqai	t̃çuqi qubi quni saqurin̄ qaut̃çin̄ qauli N = 15
	[-back]	irken nimken kit̃çike {x/χ/h}iry{x/k}er t̃çitk̄ør N = 5	ket̃çije kyiden N = 2	N = 0	
	[+ back]	il{q/χ}a nilqa mi{q/χ}a min{χ/q}an qit̃çaqar t̃çiqasu sibaqun	niqu niruqun si{ŋ/nk/n}qur {h}iru{χ/q}ar t̃çirqoqan N = 12	t̃çerixut kyisun N = 2	aŋkita at̃çika taqija aima{q/χ} uqija N = 5

These data do not support an opaque, harmony-driving [i], as vowels would most frequently fail to assimilate when following [i]—of 31 occurrences where [i] is followed by a non-[i] vowel, only 12 (38.7%) are [-back]. Similarly, [i] itself shows no evidence of assimilation when following other vowels, as when it occurs following a non-[i] vowel, only 9 out of 29 (31%) are

[–back] vowels. A parsimonious analysis of this data rules out [i]-opacity, but does not provide evidence for harmonic transparency, since all that is attested is a preponderance of back vowels both before and after [i]. To confirm that harmony occurs *across* [i], it is necessary to compare the predictions made by [i] vs. the preceding vowel for [+/-back] specification

6.1.1: Numerical tests of harmony

The harmonic transparency hypothesis is supported by considering [i]’s effectiveness as a predictor for the [+/-back] specification of the following vowel compared to effectiveness of the preceding non-[i] vowel. The first statistic is the same fraction reported above, [i] correctly predicts a [–back] vowel to the right only 38.7 percent of the time, lower than random chance (50%). This result suggests not only that [i] does not drive harmony, but that some other factor is responsible for maintaining the nonrandom harmony across [i].

The second statistic assesses whether features of non-[i] vowels are the factor that drives harmony across occurrences of [i]. For all instances in the corpus of words containing [i] plus a preceding and following non-[i] vowel (the two environments where this occurred are shown in example 28),

(29) harmonization environments included in this calculation

$$\begin{array}{l} -V_{\text{non-}i}CiCV_{\text{non-}i} \\ -V_{\text{non-}i}iCV_{\text{non-}i} \end{array}$$

Only a small sample of 9 tokens from the complete dorsal corpus provided this distribution. In these cases the preceding non-[i] vowel correctly predicts the next non-[i] vowel 78 percent of the time; the comparison of [i]’s predictive ability to non-[i] vowels’ predictive ability strongly suggests that harmony occurs, just that [i] takes no part in it. The 9 tokens are provided in (30) and are already included in (28).

(30) Cross-[i] harmonization

(a) harmonic examples

ket̃ije ‘when’

kyiden ‘cold’

aŋkita ‘separate’ (adj.)

at̃ika ‘father’

taqija ‘hen’

aima{q/χ} ‘district/province’

uqija ‘wash’ (v.)

(b) nonharmonic examples

t̃erixut ‘soldier.PL’

kyisun ‘navel’

Harmonic distribution of vowels following [i] appears to be nonrandom, and predicted beyond random chance by the harmonic group of the preceding non-[i] vowel. Thus we can conclude some support within the data for the stated hypothesis that harmony is active as described, but with [i] transparent and neutral rather than opaque and neutral. Svantesson et al (2008) discuss this possibility within their reconstruction, and Poppe (1955) reconstructed transparent [i] as well as investigated its occurrence in subsets of OM tokens.

Based on the current analysis of the complete set of known OM tokens, [i]-transparency is a supported hypothesis for the data generated by my approach to accessing contemporary phonological information. Additionally, in cases of potential consonant disharmony with [i] (where [q] follows [i]), there is not a consistent case to be made for an effect by intervening vowels; 12 such tokens exist and are presented in example (31).

(31) instances of potential [i]-[q] disharmony

(a) without intervening vowel

il{q/χ}a

nilqa

mi{q/χ}a

min{χ/q}an

t̃iqasu

niqu
 t̥ir̥qoqan

(b) with intervening vowel

qit̥caqar
 sibaqun
 niruqun
 {h}iru{χ/q}ar

The failure of [i] to enforce harmony on dorsal consonants does not seem to rely on proximity to the consonant. (31) also helps exclude the possibility that lack of [i]-[q/k] harmonization is a secondary effect of irregularity in vowel harmony; in instances where [i] and [q] are able to interact directly, there is still no difference from long-distance relationships in failure to assimilate.

As a result in consonant analysis, failure to harmonize [+high] when [i] is present will not be considered an occurrence of consonant disharmony. Much more interesting as a potential confounding factor for any conclusions about consonant disharmony are the 2 cases shown in (31b) in which a preceding non-[i] vowel fails to predict the [+/-back] specification of a following non-[i] vowel. This phenomenon is discussed further in section 5.2.

6.2: Vowel disharmony

Vowel disharmony *does* occur between vowels that usually harmonize, even if a number are ruled out thanks to [i]-transparency. Five cases of potential vowel disharmony (32) can be explained by [i]-transparency as described in 5.1.

(32) potential vowel disharmony eliminated from within cases of consonant disharmony by [i]-transparency

t̥alki	‘swallow’ (v.)
at̥ika	‘father’
aŋkita	‘separate’ (v.)
t̥ikas <u>u</u>	‘fish’
t̥iruka	‘heart’

However, [u], [y] and [e] occur in disharmony with each other in the remaining cases, and cannot be as easily accounted for. The extent of non-harmonic irregularity was considered by calculating the accuracy rate of all non-[i] vowels in the corpus at predicting harmony of the next following vowel—note that this is the same ‘statistic two’ calculated in 5.1, but extended to all occurrences of those vowels, not just tokens that happen to contain [i].

Of 74 tokens containing 2 or more non-[i] vowels, 65 are predictably harmonic while 9 fail to meet the criterion as expressed above—an accuracy rate of 87.8%. All 9 cases of vowel disharmony are associated with consonant disharmony, but this correlation has no meaning. Because all examples are drawn from a corpus of words containing harmonizing dorsal consonants, if two vowels fail to agree, the consonant necessarily is in disharmony with one of them. We have no evidence regarding whether vowel disharmony ever occurs independently of dorsal disharmony (i.e. independent of dorsals)—in order to investigate this it will be necessary to perform philological analysis as in section 3 on the Old Mongolian complete corpus in addition to the current dorsal corpus. However, it is evident in the data set that dorsal disharmony does occur independent of vowel disharmony: 6 of 15 cases of OM consonant disharmony are not accompanied by vowel disharmony. These instances of cooccurrence require that specifics of vowel harmonic environments remain in consideration.

Example 33 (next page) presents the 15 tokens that show CV disharmony, according to the three categories of disharmony that were observed.

(33) Philologically attested cases of C-V disharmony arranged according to vowel harmony

	Old Mongolian	gloss
vowels harmonic after [i] transparency; consonant disharmonic with all	t̃çalki	swallow (v.)
	at̃çika	father
	aṅkita	separate (adj.)
	t̃çikasu	fish
	t̃çiruka	heart
[+ high] [u] fails to harmonize with [+ high] [y]	yṯçukur	point
	yku	die (v.)
	kyntu	heavy
	tykurenk	full
	nykur	friend
[+ high] [u] fails to harmonize with [–high] [e]	e{k/x}uden	door
	teku	younger brother
	tekesun	rope
	t̃çerixut	soldiers
since stop place is unambiguous and words contrast, at least one token must be C-V disharmonic, both <i>may</i> be V-V disharmonic and therefore both may be C-V disharmonic	n{a/e}k{a/e}	open (v.)
	n{a/e}k{a/e}	weave (v.)

Only three vowels are involved in disharmony: the back vowel [u] and front vowels [y] and [e]. An interesting pattern emerges: [u] is always the first violator. As provided fully in example (33) and exemplified in (34)-(35), the violations of vowel harmony can be characterized as *[u] occurring where it should not*.

(34) [u] fails to harmonize after [e]:

teku ‘younger brother’

(35) [u] fails to harmonize after [e]

kyntu ‘heavy’

This pattern cannot be characterized as a case of [u] neutrality. First, all three of these vowels harmonize regularly in the large majority of tokens where they occur. Second, in examples 36-38 it can be seen that in the three (and only three) cases where irregular [u] occurs between two other vowels, two cases appear to harmonize *across* [u] and one case appears to be harmonically *blocked* by [u].

Front [e] harmonizing across [u]:

(36) e{k/x}uden ‘door’ rather than *e{k/x}udan

Front [y] and [e] harmonizing across [u]:

(37) tykurenk ‘full’ rather than *tykurank

Front [y] failing to harmonize across [u]

(38) ytçukur ‘point’ rather than *ytçukyr, *ytçykyr

[u] displays a specific behavior separate from the regular pattern of [+/-back] vowel harmonization it is usually subject to, and this **misbehaving [u]** is either a discrete phoneme that behaves transparently or is an additional instance of /u/’s [u] **allophone mandated by the environment of irregular dorsal [k]**. Because at present only irregular consonants are the target of investigation, the phonological nature of vowel

disharmony in ‘misbehaving [u]’ is discussed further only in the context of determining the environment for consonant disharmony of ‘misbehaving [k].’

6.3: Consonant disharmony

As noted in 5.1, only velar consonants occur in disharmonic contexts, and as noted in 4 the velar nasal is excluded from consideration due to ambiguity in the writing system. Also as described in 4 the written tokens are frequently ambiguous in distinguishing velar and uvular stops from fricatives, even when attested in several systems. Distributional evidence for the unambiguous stops and fricatives in the current data set suggests that the manner distinction is unimportant for the current purposes. 5.3.1 discusses the issue at greater length.

6.3.1: Manner of articulation in the distribution of dorsals

116 individual dorsal consonants (excluding nasals) occur in the corpus; only 11 of these instances are ambiguously attested after philological comparison, but almost all instances in at least one script. Stops occur word-initially (36 instances), word-medially (58 instances) and word-finally (7 instances). Fricatives occur less frequently in the initial (4 instances) and medial (5 instances) positions. Ambiguous stop-fricative segments occur word-medially (9 instances) and finally (1 instance). It is important to reiterate that the term ‘ambiguous’ here does not indicate that Old Mongolian phonology is ambiguous, only that the inscription data that happens to be available in OM for that token does not provide a means of making the distinction. The only ambiguous case of potentially high interest is the one in final position (Example 39).

(39) aima{q/χ} ‘*district*’

this example would provide the only case of a fricative occurring in the word-final environment, which would put it in complete contrastive distribution with the stop. Even if (38) does not indicate a word-final fricative, there is no positive indication of complementary distribution between stops and fricatives of each harmonic group with respect to vocalic environment. Due to the small

number of unambiguous fricative tokens it is not possible to compare velar stops to fricatives in every vocalic environment at the same time as environment with respect to word boundary. However, there is enough data to consider elements of the two factors separately.

As noted above, word boundary does not appear to produce an environment that influences distribution of stops and fricatives. Vowels within each harmonic group also demonstrate no evidence of triggering complementary distribution of stops and fricatives. As shown in examples 39-40, each stop occurs at least once in contact with each possible harmonic vowel, and fricatives similarly co-occur with [e y a u]. Limited data prevents drawing a clear conclusion about distribution with respect to fricative/stop distribution [ø] and [o]. However, in the absence of other positive evidence the same lack of data that prevents including [ø] and [o] in full analysis limits the extent of error they may cause in interpretation of consonant harmony in the present data.

(39) examples of velar stops and fricatives in shared environments

- a) [k] and [x] between instances of [e]
 - tekɛl 'gown' -emɛxɛl 'saddle'
- b) [k] and [x] between instances of [y]
 - kyl 'foot' -xyker 'ox'

(40) Examples of uvular stops and fricatives in shared environments

- a) [q] and [χ] between instances of [a]
 - saqal 'beard' -qaχalqa 'gate'
- b) [q] and [χ] adjacent to [u]
 - ququsun 'empty' -χula{q/χ}an 'red'

Since there is no attested pattern of stops and fricatives harmonizing differently with vowels of their regular harmonic class, two useful conclusions can be made. First, ambiguously attested segments do not present a problem for analysis of C-V harmony. As long as velar or uvular specification is identified for a particular segment, it will harmonize with surrounding vowels in the same manner regardless of whether the actual segment is a stop or a fricative. Second, little

can be made of the distinction between the behaviors of [k] and [x]. The small fraction of total velar tokens [x] accounts for in the corpus may simply be responsible for obscuring disharmonic occurrences of [x]. Based on the evidence presented in this section, the general observation for non-harmonic consonants is of ‘misbehaving velar’ rather than ‘misbehaving [k];’ environments for velars, either [x], [k], or {x/k} are considered in this context in 5.3.2

6.3.2: Environments for velar escape from harmony

Disharmonic velars occur in two different environments.

Environment 1: vowels harmonic, consonant disharmonic

In this environment vowels across the entire word are regularly harmonized with each other. The only source of irregularity is one or more disharmonic consonants. As described earlier in this section, this only occurs in cases of [+high] velar consonants in a [+back] vocalic environment. An example of this type of disharmony is presented in (41).

(41) back-harmonic vowel environment with velar consonant

-at̪çika ‘*father*’

(note again in 5.1 [i] was concluded to be neutral and transparent)

Only 3 instances of this type of consonant disharmony are recorded.

Environment 2: vowels disharmonic, consonant partially harmonic

In this environment there is V-V disharmony between vowels in the word that results in velar consonants agreeing with some vowels but not others. As has been described, this was found to occur only in cases where [+back] [u] accompanies –back [y] or [e]. Two examples are provided in (42) and (43).

(42) e/u disharmony

-teku ‘*younger brother*’

(43) y/u disharmony

-yku ‘*to die*’

There are 9 tokens containing this type of disharmony, as shown above in (33).

Environment 2 dominates both in number of disharmonic tokens and instances of disharmony between segments. Were this the *only* environment in which consonants are disharmonic, a simple conclusion could be reached that dorsals do indeed always harmonize regularly with the parent word, and that ‘consonant’ disagreement is the result of disharmonic [u]’s behavior only. However, disharmony does occur in Environment 1. A standard of parsimony then makes irregular behavior on [k]’s part a better candidate for explanation, separate from the process that places [u] disharmonically.

Importantly, even without making a claim about the phonological processes of OM speakers, the surface irregularities characterized in this section already help access the fundamental question of this paper as characterized in section 2—does irregularity in OM predict or help elaborate the source of irregularity and unnaturalness in Halh? The identified irregulars can obviously be tested as predictors of whether the same lexeme is irregular in the Halh system.

It is also now possible to attempt a diachronic approach to the development of Halh regular C-V harmony, based on the irregularity present in Old Mongolian. Under the investigative framework presented in section 3.2, we now have an answer to question (e) “*is C-V interaction in Old Mongolian actually regular?*” **no, it is not** (and we have some information about the nature of the irregularity). In addition to C-V irregularity, it has been shown that irregularity exists within the V-V harmony system of Old Mongolian as well, and might interact with C-V irregularity in driving patterns of reinterpretation. As stated most conservatively, we have evidence that language learners around the time of OM were exposed to at least some stimuli included [u] cooccurring with [e] and with velar consonants, as is the case in the modern Halh ATR harmony system. Further discussion of the theoretical issues to which interpretation of the the distributions described in this section may contribute is given in section 7.

6.4: Improving confidence in philological results

The obvious weakness of any conclusions drawn from the irregularity data presented here is the small number of tokens from which they are drawn. Confidence in analyses that are internal to the dorsal corpus characterized here

could be increased by extending research to the various contributing systems. Especially in the case of [u] disharmony, vowel distribution in tokens that lack dorsal consonants should be considered. About 300 additional tokens exist that are attested in several scripts (Svantesson 2008) and which could be philologically analyzed and considered for vowel distribution independent of dorsal consonants. Such an analysis could both increase confidence that establishment of vowel identities from written sources is not subject to systematic error, and confirm that [u] disharmony and [k] disharmony are independent.

Even if useful philological attestations of OM are exhausted, the accuracy of those attestations can be further confirmed by considering internal sources of error in each of the contributing scripts. If a script contains systematic patterns of irregularity in grapheme usage, those patterns must be very carefully considered to confirm that they are not contributing to the false identification of any of the irregular forms presented here. The positive potential of such continued analysis is that Arabic Mongolian and Sino-Mongolian could ultimately yield more extensive information. If the full Sino-Mongolian corpus, for example, is analyzed for the potential inconsistency in multiple characters used to represent a particular OM sequence and found to be *consistent*, then SM attestations could be used much more productively to resolve vowel identity as well as manner ambiguity.

Barring any drastic changes to the results presented here that any such further analysis might bring about, the direct result of my philological research on Old Mongolian has been the production of a ‘snapshot’ of the language at surface level. Within this snapshot, irregularities in the widely accepted V-V and V-C harmony patterns have been identified. The behavior of [k] and [u] that is identified here have not previously been considered in accounts of OM and its relationship to modern languages.

7: Old Mongolian irregularity in relation to bigger issues

As described in section 1, Old Mongolian and Mongolic phonology in general have been examined under vastly different sets of linguistic assumptions. Much of the continuing debate is around which framework is most accurate (or at least theoretically superior) for elaborating the relationship of OM to modern languages like Halh. In this section I propose four possible comparisons of OM to Halh that are also intended to avoid reliance on a particular phonological theory, and which therefore might be useful in comparing the predictions of such theories in attempting to deal with language universals.

All of the comparisons described briefly in 7.1-7.4 rely on access to acoustic (or pre-prepared phonological) data from modern languages. Such data could be acquired through use of a corpus like that reported by (Dawa et al 2006), though no modern Mongolic corpus has yet been made publicly accessible. An alternative is to collect acoustic data with a targeted stimulus passage based on modern forms of the identified OM irregulars.

7.1: Lexical irregularity

For the very small list of [15] irregular words in Old Mongolian, direct comparison to the Halh forms of the same lexeme could be made. Halh has of course been subject to a vowel shift from Old Mongolian as described in section 2. If modern Halh forms after vowel shifts, dorsal stop voicing, and all other changes are still predicted to possess harmony irregularity by whether they were previously irregular in OM, that relation might be considered support for the conclusion that irregularity is simply lexicalized. Statistically, if Halh irregularity is first independently characterized, this would be the observation that OM token irregularity is a better-than-random predictor of Halh token irregularity. The conclusion of lexicalization would also only be well-supported if OM token irregularity is a better predictor of Halh token irregularity than any *other* irregularity patterns that happen to be identified in Halh harmony.

7.2: Phonological irregularity

In contrast to 7.1, individual OM segments could also be tested for their ability to predict Halh irregularity. In OM [k] and [u] are associated with harmony irregularities. If their Halh ‘descendant’ segments [g] and [ʊ] are also effective predictors of irregularity when controlled for occurrence within OM irregular lexical items, a broad indication that irregularity is based in the phonological system might be given. Of course, the strength of such a claim relies on the specific phonological characterization that is then proposed, but no attempt to propose such a specific diachronic or synchronic account is yet made here.

7.3: Opaque irregularity

If Halh is found to possess harmony irregularity but no feature of OM irregularity is its most effective predictor, there are two options. One possibility is that the interaction of Halh and OM on irregularity is real but not able to be characterized by comparing OM irregularity directly to Halh irregularity. The other possibility is that Halh and OM both happen to possess irregular harmony systems on analogous groups of segments, but that the two systems arise through different processes. Like with 7.2, in both options for this section further exploration of such a phenomenon would proceed by proposing broader phonological characterizations of how each system functions.

7.4: Halh regular

It is certainly possible that Halh V-V and V-C harmony will be found to be entirely regular. If this is the case, there are implications for the view of irregularity and motivation in phonology and how they are treated across generations. An especially salient question if Halh harmony is entirely regular will be whether disharmony has been *eliminated* (‘corrected’) during the derivation from Old Mongolian, or whether the Halh regular system results from incorporation of OM irregular and regular patterns into a single new system.

7.5 Conclusion

This study examined Old Mongolian in a way that has not previously been done. Contrary to the usual assumptions for linguistic arguments that reference Old Mongolian V-V and V-C harmony, neither of those systems appear to have been entirely regular. In forms reported by actual OM speakers rather than through reconstruction, velar [k] occurs in [+back] vowel environments where uvular [q] is regularly expected. Vowel harmony was also identified where [+back] [u] rather than [-back] [y] occurred in front-harmonic words. These two disharmony patterns occur separately as well as together within single words. The implications of irregularity in Old Mongolian may be quite serious for linguistic theories that have previously worked from the assumption of regularity. Such major questions include Mongolic's membership in the proposed Altaic family, for which harmony has been proposed as an ancestral link, and conflicting views of how phonological interactions on multiple features actually function.

In order to improve the contribution of OM and its harmonic irregularities to actually answering these questions, further research should have two foci. First, continued effort should be given to ensuring that the limited number of attested irregular tokens identified in this paper are as confidently reported as possible. Second, once harmony irregularity is characterized in the [+/-ATR] and [+/-back] systems of modern Mongolic languages, OM irregularity both at the level of token and segment should be systematically compared to those systems. Especially if multiple extant languages can be considered, the potential for useful conclusions that employ the results of this paper to help adjudicate theoretical conflicts in analysis of Mongolic is quite high.

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