

Khalkha Mongolian RTR Harmony and ATR Palatalization in Ultrasound Imaging
Joshua Sims, jodasims@iu.edu
Indiana University

This paper argues that palatalized consonants in Khalkha Mongolian bear the feature [ATR], based on the phonological interaction of palatalization with Mongolian [RTR] vowel harmony, and supported by articulatory evidence from ultrasound imaging. This analysis follows the proposals of Cavar (2007) and Lulich & Cavar (2019) identifying palatalization with [ATR]. However, the proposed coexistence of [RTR] vowel harmony and [ATR] spreading locally offers challenging data to feature geometric accounts of vowel harmony.

In Khalkha Mongolian, the [ATR] segments /e o u/ alternate with the [RTR] segments /a ɔ ʊ/. Per Svantesson (2005), the feature [RTR] spreads rightward from the root to suffixes. Additionally, consonants may be palatalized, with most consonants having a plain and palatalized counterpart. However, palatalization is only distinctive in words with [RTR] vowels; per Svantesson (2005), palatalized consonants do not occur in ATR words. This paper proposes that these palatalized consonants are specified for [ATR], thus distinctive in [RTR] roots, but neutralized in [ATR] roots; accordingly, all consonants in [ATR] words are palatalized. Palatalized consonants also front preceding vowels. If these palatalized consonants bear [ATR], then they should also spread [ATR] to these vowels as well.

To support these claims, this paper presents data from ultrasound images of native speakers of Khalkha Mongolian, captured with a the Philips EPIQ 7G machine, using the Philips xMatrix x6-1 digital 3D/4D ultrasound transducer (see Lulich, Berkson and De Jong 2018). Data was taken from 7 Mongolian speakers from Ulaanbaatar, Mongolia, and used to determine tongue root advancement during vowels and consonants. Recorded tokens included all [RTR] vowels before plain and palatalized consonants, as well as all [ATR] vowels for comparison.

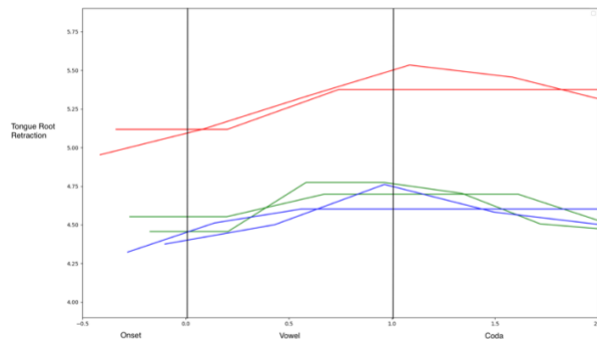
Ultrasound measurements confirm that palatalized consonants in coda position of [RTR] words are produced with advanced tongue root position consistent with that of [ATR] codas, and both are distinct from plain [RTR] consonants. Additionally, [RTR] vowels before palatalized consonants are both fronted and have [ATR] tongue root position. Figure 1 shows tongue root retraction over time for [RTR], [RTR] palatalized and [ATR] words. Distance in centimeters from the tendon of the genioglossus to the tongue root (Lulich et al., 2018) is shown on the x-axis, with time normalized to the duration of the vowel. Only [RTR] /tsʰɔŋ/ ‘rank’ has RTR articulation; both [RTR] palatalized /tʰɔŋʲ/ ‘mirror’ and [ATR] /toŋ/ ‘flame’ have ATR articulation (differing in tongue body position). Likewise, the palatalized coda /ŋʲ/ has the same tongue root advancement as the [ATR] /ŋ/. This aligns with the hypothesis that palatalized consonants are [ATR]. Figure 2 shows manual traces of midsagittal sections of the tongue. The tongue root is seen on the bottom left of the traces, with the oral cavity to the top right. In red, the [RTR] vowel in /tʰɔ:r/ ‘peach’ alone has retracted tongue root; in blue, [ATR] /po:r/ ‘kidney’ shows similar tongue root advancement to palatalized [RTR] /tsɔ:ri/ ‘cellar’, in green.

Languages where both [ATR] and [RTR] are active in vowel harmony are rare (Beltzung et al., 2015); in Turkana (Noske, 1996), either may be specified by suffixes and spread harmonically, blocking the other. However, Mongolian palatalization [ATR] is active only in local assimilation;

palatalized consonants do not block the spread of [RTR] to suffixes, even after assimilating [RTR] vowels in the root to [ATR] articulation. Under feature geometry, segments which are specified for a harmonic feature should be opaque to it (Odden, 1991). However under Articulatory Phonology, these palatalized words could actually exhibit a simultaneous [ATR] and [RTR] gesture, as has been proposed for Russian assimilatory palatalization (Oh et al. 2024).

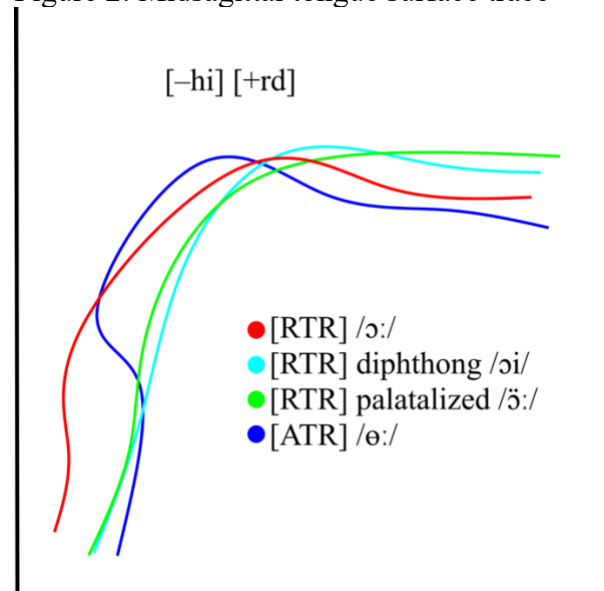
Figures and References:

Figure 1: Tongue root retraction over time



[RTR] /tsʰɔŋ/ 'rank', red
 [RTR] palatalized /tʰɔŋj/ 'mirror', green
 [ATR] /toŋ/ 'flame', blue

Figure 2: Midsagittal tongue surface trace



- Beltzung, J.-M., Patin, C., & Clements, G. N. (2015). The feature [ATR]. In A. Rialland, R. Ridouane, & H. van der Hulst (Eds.), *Features in Phonology and Phonetics: Posthumous Writings by Nick Clements and Coauthors* (pp. 217–246). De Gruyter Mouton.
<https://doi.org/10.1515/9783110399981-011>
- Cavar, M. E. (2007). [ATR] in Polish. *Journal of Slavic Linguistics*, 15(2), 207–228.
- Lulich, S. M., Berkson, K. H., & de Jong, K. (2018). Acquiring and visualizing 3D/4D ultrasound recordings of tongue motion. *Journal of Phonetics*, 71, 410–424.
<https://doi.org/10.1016/j.wocn.2018.10.001>
- Lulich, S. M., & Cavar, M. E. (2019). Phonetics of Polish “soft”-“hard” vowel allophony. *The Journal of the Acoustical Society of America*, 146(4), 2263–2278.
<https://doi.org/10.1121/1.5127834>
- Noske, M. (1996). ATR harmony in Turkana. *Studies in African Linguistics*, 25(1), 62–99.
<https://doi.org/10.32473/sal.v25i1.107404>
- Odden, D. (1991). Odden-VowelGeometry-1991.pdf. *Phonology*, 8(2), 261–289.
- Oh, S., Shaw, J., Durvasula, K., & Kochetov, A. (2024). Russian assimilatory palatalization is incomplete neutralization. *Laboratory Phonology*, 15(1), Article 1.
<https://doi.org/10.16995/labphon.10185>
- Svantesson, J.-O. (Ed.). (2005). *The phonology of Mongolian*. Oxford University Press.