Acoustic correlates of Mongolian stress are better explained by Default-To-Same than Default-To-Opposite: A preliminary investigation

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Background

Recent understandings of Khalkha Mongolian stress (*e.g.*, Bosson 1964, Poppe 1970, Walker 1997, Özçelik 2016) support a **default-to-opposite side (DOS)** stress pattern wherein stress falls:

On the leftmost light syllable	**'L L L**
On the only heavy (long nucleus) syllable	**L L 'H**
On the rightmost non-final heavy syllable	**L 'H H**

However, prior literature (*e.g.*, Prince 1983, Hammond 1986, Halle & Vergnaud 1987, Idsardi 1992, Hayes 1995) assumed a **default-to-same side (DSS)** system in which stress falls on the leftmost heavy syllable.

DOS assignment	**DSS** assignment
H 'H L	**'H H L**
/taː.'rɔː.ɮax/	/'taː.rɔː.ɮax/

None of the aforementioned studies supported their results with evidence that meets the best practice guidelines for disentangling the acoustic properties of phrase-level intonation from those of word-level stress (Roettger & Gordon 2000). Oftentimes, these studies looked only at words in isolation, from only one speaker, or without analyzing common acoustic correlates (pitch, intensity, duration) across vowels in a substantially-sized dataset.

Research questions:

1. **What acoustic correlate(s) appear to mark stress?**
2. **Which system best describes Khalkha Mongolian?**

Methods

7 native speakers (2 male, 5 female, aged 16–39) of Khalkha Mongolian were prompted to produce 52 words in **three contexts: isolation, phrase-initial, and phrase-medial.** The words chosen were of a variety of lengths (1–4 syll.) and phonotactic shapes (0–3 heavy syll. in various positions). 2848 vowel tokens were collected, each of which was measured for **pitch (mean F0), mean intensity, and duration** by a Praat script.

Phrase-medial prompt

Consider a situation in which your friend tells you:

Та өнөөдөр "ус" гэж хэлсэн.
You said "water" today.

In response, you say:

Үгүй, би <u>өчигдөр</u> "ус" гэж хэлсэн.
No, I said "water" <u>yesterday</u>.

Results 1

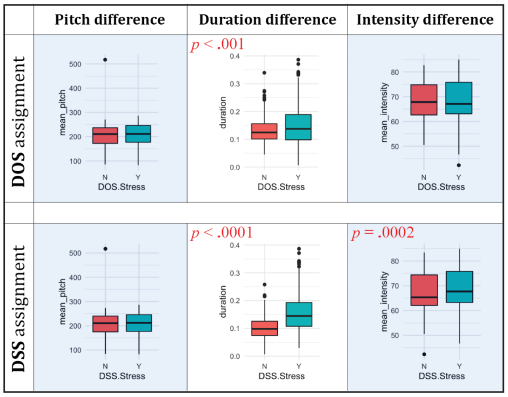

Fig. 1: Comparison of pitch, duration, and intensity between unstressed (N) and stressed (Y) heavy vowels (long/diphthong) in each analysis

Stressed heavy vowels under a **DOS** analysis are significantly longer than unstressed ones ($p < .001$), but are not higher in pitch nor higher in intensity (see **Fig. 1**, upper).

Under a **DSS** analysis, stressed heavy vowels are both significantly longer ($p < .0001$) and higher in intensity ($p = .0002$), but are not higher in pitch (see **Fig, 1**, lower).

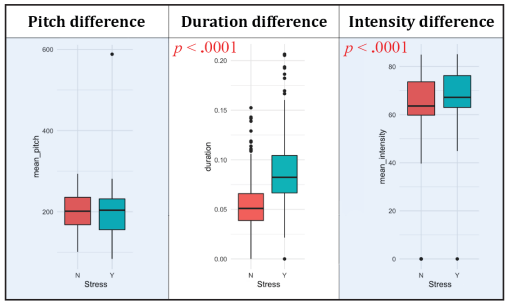

Fig. 2: Comparison of pitch, duration, and intensity between unstressed (N) and stressed (Y) light vowels (short), regardless of analysis

Stressed light vowels (leftmost in both **DOS** and **DSS**) have significantly longer duration and higher intensity than unstressed ones, but the difference in pitch is not significant ($p < .0001$, $p < .0001$, $p = .298$,), see **Fig. 2**).

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Models:
DOSM: stress.dos ~ mean_intensity*** + duration*** + (1 | speaker)
DSSM: stress.dss ~ mean_intensity*** + duration*** + (1 | speaker)
      npar    AIC    BIC  logLik deviance  Chisq Df Pr(>Chisq)
DOSM    4 3248.6 3272.4 -1620.3   3240.6
DSSM    4 2930.8 2954.6 -1461.4   2922.8 317.78  0
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The deviance of the DSS model is lower than that of the DOS model (2922.8 < 3240.6), indicating that the acoustic correlates made better predictions in the DSS model.

Results 2

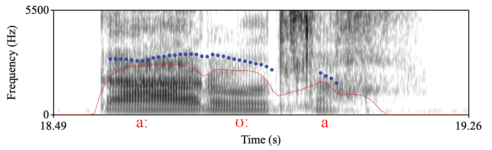

Fig. 3: Spectrogram and F0 track of /taː.rɔː.ɮax/ 'adjust'

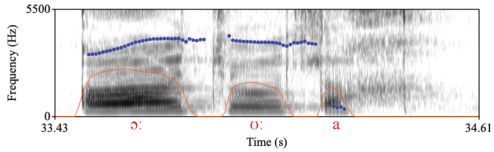

Fig. 4: Spectrogram and F0 track of /gɔː.ʧɔː.ɮax/ 'pour'

Fig. 3 and **Fig. 4** each show a word of the shape HHL produced by a female speaker. For both words, the first vowel is longer and louder than the second vowel, supporting the **DSS** model (**'HHL**) as a better fit than the **DOS** model (**H'HL**).

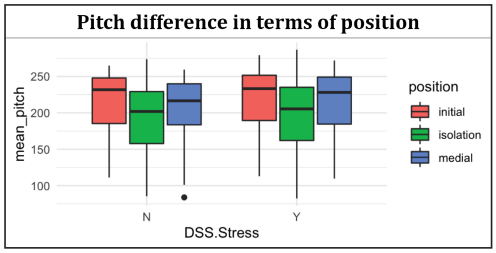

Fig. 5: A comparison of the pitch of unstressed (N) and stressed (Y) vowels of words between phrase-initial, isolation, and phrase-medial position in the DSS analysis shows that **F0 is consistently lower in isolation than in the context of a phrase**

Conclusions

The acoustic correlates of duration and intensity support a **left-aligned DSS** assignment of stress in Mongolian rather than a **right-aligned DOS** assignment, an analysis found in the most recent literature (*e.g.*, Walker 1997). Pitch is not a significant property signaling stress in either the DSS or DOS analysis.

These findings support Gordon's (2000) conjecture that the **DOS** pattern is nonexistent and that all languages that are claimed to have **DOS** stress systems would be recategorized with a closer look at the acoustics.

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