Iambic/Trochaic Law and bidirectional tone sandhi in Jieyang

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1 Application of Iambic/Trochaic Law to complex tone languages

According to the Iambic/Trochaic Law, there is a perceptual universal where initial prominence is generally signalled with intensity while final prominence with duration based on extralinguistic evidence (e.g. Bolton 1894, Woodrow 1909). Hayes (1985, 1995) adopted the durational asymmetry between the two types of rhythmic grouping into linguistics for advocating an asymmetric foot inventory to explain the rhythmic structure in linguistics with stress, widely cited as Metrical Stress Theory. However, its application to languages typically considered as tonal is mostly unknown. Considering tonal languages spoken in Asia, the more diverse tonal contrast may also interact with tone sandhi and other phenomena described as stress-sensitive (Chen 2000:285). In particular, the distinction between left and right tonal prominence displayed in bidirectional tone sandhi resembles that of a metrical distinction between iambic and trochaic rhythm.

This paper adopts Jieyang (Southern Min, Teoswa) as a platform for acoustic measurements over the course of a minimal prosodic domain of two syllables. Duration and intensity will be used to indicate whether metrical prominence based on predictions of Iambic/Trochaic Law aligns with tonal prominence in what sense and to what extent if metrical prominence is phonetically meaningful to signalling rhythm in complex tone languages.

2 Predictions of Iambic/Trochaic Law on bidirectional sandhi in Jieyang

As in (1), the six lexical tones in Jieyang for sonorant-final syllables are H(igh), M(id) and L(ow), HM, MH and LM (Xu 2007). Given any disyllabic unit, either the tone on the first or second syllable undergoes sandhi, regardless of the tonal content of the trigger. Anterior sandhi modifies the tone on the first syllable whereas posterior sandhi modifies the tone on the second. For example, /HM.MH/ manifests as different tonal combinations depending on the type of sandhi it undergoes - anterior sandhi as [LM.MH] 'water infrastructure' and posterior sandhi as [HM.L] 'to keep watching'.

(1)

Citation tone	M, HM, LM, H, MH, L
Anterior sandhi	M, MH/LM, HM/ML, L
Posterior sandhi	L, LM

Based on the Iambic/Trochaic Law, explicit hypotheses of how left and right-dominant sandhi fit as iambic and trochaic rhythm types in terms of duration and intensity are made as in (2).

(2) Hypothesis 1. There is a durational asymmetry between the two sandhi types, where initial prominence is signalled by intensity and final prominence is signalled by duration.

Hypothesis 2. Sandhi syllables are less prominent than citation syllables in the same syllable position. It compares the relative prominence of the syllables in sandhi positions to those in citation positions.

Hypothesis 3. The type of prominence that the prosodic heads of each rhythmic type adopts depends on the rhythmic type that they pattern with. It compares the relative prominence between the citation syllables of both sandhi types, and between the sandhi syllables of both sandhi types.

3 Results and discussion

A total of 1440 tokens of data (6 tones x 6 tones x 2 syllables x 2 sandhi types x 5 iterations x 2 speakers) was submitted into linear mixed-effects models in R (R core team 2018) for both total syllable duration and maximal intensity, which contain a fixed effect of sandhi type and syllable position, and random effects of speaker, word (as a subset of speaker) and iteration.

Results show that, first, there is a duration asymmetry between the two sandhi types. Anterior sandhi prefers duration contrast to signal final prominence ($p < 2E\text{-}16$) whereas posterior sandhi prefers intensity contrast to signal initial prominence ($p < 2E\text{-}16$). Each sandhi type also uses the other acoustic cue but results are not as significant. Thus, anterior and posterior sandhi map neatly with iambic and trochaic rhythmic types respectively.

Second, results of sandhi-citation comparisons show that the second syllable of anterior sandhi is longer than the second syllable of posterior sandhi ($p = 6.86E\text{-}12$), whilst the first syllable of posterior sandhi is non-significantly different from the first syllable of anterior sandhi for intensity ($p = 0.894$). This agrees with the metrical view that prosodic heads are more prominent than non-heads in terms of duration.

Third, sandhi-sandhi and citation-citation comparisons show that the first syllable of anterior sandhi is shorter ($p = 6.14E\text{-}04$) but louder ($p = 4.99E\text{-}09$) than the second syllable of posterior sandhi, indicating that the non-head of anterior sandhi is shorter than that of posterior sandhi and the non-head of posterior sandhi is quieter than that of anterior sandhi. Similarly, the second syllable of anterior sandhi is longer ($p = 1.57E\text{-}05$) but quieter ($p = 0.00353$) than the first syllable of posterior sandhi, indicating that the head of anterior sandhi is longer than that of posterior sandhi and the head of posterior sandhi is louder than that of anterior sandhi. This is also what the metrical view would predict - Since iambs prefer uneven feet, the head needs to be longer and the non-head needs to be shorter to meet the rhythmic ideal. Also, given trochees' tendency to adopt intensity to signal prominence, the head needs to be louder and the non-head needs to be quieter.

Thus far, the duration and intensity contrasts found for the two sandhi types largely match the predictions based on the Iambic/Trochaic Law.

4 Conclusion

This paper has shown a brief summary for applying the Iambic/Trochaic Law to complex tone languages like Jieyang. With bidirectional tone sandhi on top of its six-tone inventory, duration and intensity measurements could be obtained and fitted into linear mixed-effect regression models to examine whether duration and intensity contrasts of the two sandhi types match the predictions based on the Iambic/Trochaic Law, and the results provide novel support for the Law. A final caveat is that, while the disyllabic units in the stimuli are controlled for tonal combinations, the segmental make-up is imperfect. The above represents the basic analysis focusing on reporting the main results. Different statistical means for reducing such 'noise' should also be carefully considered.

Selected references

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