Strong and Weak Low Tones in Peñoles Mixtec

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Introduction: In this talk, I will show how Gradient Symbolic Representations (GSR) can account for the variable association of floating L tones in Peñoles Mixtec, an indigenous language of Mexico. The advantage of GSR over alternatives such as Co-Phonology or Constraint Indexation is that GSR has the ability to deal with both phonological and lexical exceptionalities while assuming a fully modular grammar. Furthermore, different exceptionalities of the same morpheme can fall out from constraint violations rather than independent stipulations. This enables GSR to handle the complexities of Peñoles Mixtec floating L association, which has thus far not received a formal explanation.

Empirical data: In Peñoles Mixtec, the major word categories all consist of so-called "couplets", disyllabic roots that optionally take clitics. The phonological shapes of the two couplets that have floating L tones are H.H^{L} and Ø.Ø^{L}, and given that the floating L is in principle an independent unit that associates to the right, there is no a priori reason why it would show different phonological behaviour depending on tones to its left. However, this is precisely what we find, as illustrated below in data from Daly & Hyman (2007).

(1) H.H^{L} + Ø.Ø → H.H Ø.Ø
/níʔí^{L} + kɨtɨ/ → [níʔí kɨtɨ]
POT.find animal
'the animal will find'

(2) Ø.Ø^{L} + Ø.Ø → Ø.Ø L.Ø
/koko^{L} + kɨtɨ/ → [koko kɨ̀tɨ]
POT.swallow animal
'the animal will swallow'

The floating L in (1) fails to associate and is deleted, whereas the L in (2) associates, despite the identical target. While Ø.Ø^{L} can always associate its L to the next tone-bearing unit, H.H^{L} cannot associate its L in all cases, as summarised in (3), with L-deletion underlined.

(3) a. H.H^{L} + H.H$^{(L)}$ → H.H LH.H$^{(L)}$
b. H.H^{L} + H.Ø → H.H LH.Ø
c. H.H^{L} + Ø.H → H.H L.H
d. H.H^{L} + Ø.Ø$^{(L)}$ → <u>H.H Ø.Ø$^{(L)}$</u>
e. Ø.Ø^{L} + H.H$^{(L)}$ → Ø.Ø LH.H$^{(L)}$
f. Ø.Ø^{L} + H.Ø → Ø.Ø LH.Ø
g. Ø.Ø^{L} + Ø.H → Ø.Ø L.H
h. Ø.Ø^{L} + Ø.Ø$^{(L)}$ → Ø.Ø L.Ø$^{(L)}$

Furthermore, while Peñoles Mixtec is mostly a VSO language, NPs can be fronted and appear before the verb. In this case, low tone deletion applies in an additional context, see (4c).

(4) a. [H.H^{L}]$_{\text{Fronted NP}}$ + [H.H$^{(L)}$]$_{\text{Verb}}$ → H.H LH.H
b. [H.H^{L}]$_{\text{Fronted NP}}$ + [H.Ø]$_{\text{Verb}}$ → H.H LH.Ø
c. [H.H^{L}]$_{\text{Fronted NP}}$ + [Ø.H]$_{\text{Verb}}$ → <u>H.H Ø.H</u>
d. [H.H^{L}]$_{\text{Fronted NP}}$ + [Ø.Ø$^{(L)}$]$_{\text{Verb}}$ → <u>H.H Ø.Ø</u>

As such, association/deletion of L depends on the preceding tones (1 ≠ 2), the following tones (3a ≠ 3d), *and* the word order (3c Verb-initial ≠ 4c NP-initial).

Floating L tone association also shows morpheme-specific effects. Generally speaking, L cannot associate to toneless enclitics, only to H-toned ones. However, toneless /-k^{w}e/ PL is an exception. Interestingly, although /-k^{w}e/ is an exceptional target for L tone association, it is an exceptional *non*-undergoer of another phonological process, High Tone Spreading, which only affects couplets/clitics *without* H. As such, /-k^{w}e/ behaves in the phonology as if it has H, even though it never surfaces with a high tone.

Theoretical background: The GSR approach (Smolensky & Goldrick, 2016) assumes that symbolic units in phonology (segments, tones, etc.) have activities, ranging between 0 and 1, where 1 indicates full activity. A weakly active unit with e.g. an activity of 0.5 is present in the input, but is deleted or made fully active in the output. Either option would only violate MAX or DEP by half. This is implemented in Gradient Harmonic Grammar (cf. Hsu, 2022), in which the gradient activity of GSR is combined with the weighted constraints of Harmonic Grammar. The optimal candidate is then the one with the least negative harmony score.

Analysis: I assume that L after H.H is weak with an activity of 0.5, whereas L is fully active after Ø.Ø roots. This difference in activity is not stored in the lexicon but instead enforced by two constraints; one forces L to weaken, the other forces it to weaken to 0.5 specifically. At the phrasal level, then, weak and strong L behave differently with respect to the same constraints. Consider the tableaux below that show the data seen previously in (1) and (2).

/níʔí$^{L0.5}$ kɨtɨ/	MAX-L 10	DEP-L 10	DEP-A 1	H
☞ a. níʔí kɨtɨ	−0.5			−5
b. níʔí kɨ̀tɨ		−0.5	−1	−6

/koko^{L1} kɨtɨ/	MAX-L 10	DEP-A 1	H
a. koko kɨtɨ	−1		−10
☞ b. koko kɨ̀tɨ		−1	−1

For weak $L_{0.5}$, deletion and association both violate their respective constraint by half, but association also requires an epenthetic association line. In contrast, strong L_1 cannot violate DEP-L and instead fully violates MAX-L if deleted, making association always the best option. When preceded by other couplets, i.e. (3a-c), the weak floating L will associate rather than be deleted. The generalisation is that all of those couplets contain H, so there is extra pressure to satisfy an OCP-H constraint by having the L associate. In the tableau below, candidate a. would violate the OCP and hence fares worse than candidate b. that involves tonal association.

H.H$^{L0.5}$ Ø.H	OCP -H 10	MAX-L 10	DEP-L 10	DEP-A 1	H
a. H.H Ø.H	−1	−0.5			−15
☞ b. H.H L.H			−0.5	−1	−6

The only data not yet accounted for is (4c). I assume NP-fronting entails that there is a higher prosodic boundary between the L and the rightmost couplet than in (3), so that the OCP-constraint that is active across said boundary need not be the same as the one active between mere prosodic words. Between phrases, the OCP is sensitive only to the immediately following tone-bearing unit, hence ensuring that (4c) and (4d) are the same in terms of L tone association.

GSR can also capture the morpheme-specific phonology of /-kʷe/ PL. I argue that this morpheme in fact does have a H, but that it is so weak that it is always optimal to delete it through the course of derivation, given that a MAX violation will always be lower than a DEP violation would be. The initial presence of the underlying H would nevertheless enable L tone association and block High Tone Spreading. In this fashion, enriching representations with gradience captures multiple morpheme-specific effects that would otherwise remain unrelated.

Summary: GSR can model phonological and lexical exceptionalities with the same, modular mechanism of gradient representations. The diverse phonological behaviour of floating L in Peñoles Mixtec can be understood as instances of a strong and weak floating L, and the exceptional behaviour of /-kʷe/ is captured by assuming it has a weak H underlyingly that is inevitably deleted but nevertheless phonologically active.

Daly, John P., & Hyman, Larry M. (2007). On the Representation of Tone in Peñoles Mixtec. *International Journal of American Linguistics*, *73*(2), 165–207.
Hsu, Benjamin. (2022). Gradient symbolic representations in Harmonic Grammar. *Language & Linguistics Compass*, e12473.
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