

## Well-formed tone mappings with local, inviolable surface constraints

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A problem which has long avoided a satisfying solution is how to capture cross-linguistic variation in ‘tone-mapping’ phenomena, or how tone melodies are realized over strings of tone-bearing units (TBUs). Early autosegmental work (Goldsmith 1976, Clements and Ford 1979, Pulleyblank 1986), which made directional association a primitive of the theory, was criticized by Zoll (2003) for failing to capture tone-specific association behavior. Zoll (2003) instead argues for violable, toneme-specific constraints evaluated globally over candidates in OT, at the cost of naturally capturing directionality. Both miss the generalization that language-specific tone-mapping well-formedness constraints (WFCs) over the surface structures are fundamentally *local*. The current proposal captures locality by characterizing tone-mapping patterns with a restricted set of *inviolable, language-specific* constraints. These constraints capture *both* directionality and tone-specific association behavior within the same framework while maintaining a restrictive typology.

To start, in Kukuya, HL-melody words have a L plateau on the right, suggesting left-to-right association. However, LH-melody words have a L plateau on the left.

### (1) Kukuya word tone patterns (Zoll, 2003)

- |                 |     |                        |    |                                   |            |
|-----------------|-----|------------------------|----|-----------------------------------|------------|
| a. kâ ‘to pick’ | H-L | b. sámà ‘conversation’ | HL | c. káràgà ‘to be entangled’       | HLL        |
| d. sǎ ‘knot’    | L-H | e. kàrà ‘paralytic’    | LH | f. m <sup>w</sup> àrògí ‘brother’ | LLH (*LHH) |
| g. bá ‘palms’   | H   | h. bágá ‘show knives’  | HH | i. bálágá ‘fence’                 | HHH        |

As Zoll (2003) observes, directional analyses require ad-hoc rules to capture the LLH forms. She instead analyzes them with a highly-ranked CLASH constraint against adjacent H-toned TBUs.

However, directionality cannot be entirely abandoned. Take, for example, Type  $\alpha$  words in Wan Japanese (Breteler, 2013; Kubozono, 2011), in which all TBUs (in the *bunsetsu*, a domain including certain suffixes) are H-toned, save for a penultimate L tone.

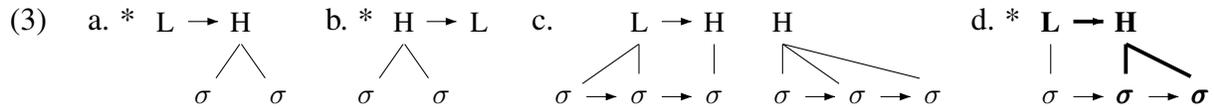
### (2) Wan Japanese (all words with ‘-nga’ NOMINATIVE suffix) (Breteler, 2013)

- |                            |      |                                  |       |
|----------------------------|------|----------------------------------|-------|
| a. ká-nga ‘child’          | LH   | b. mídù-nga ‘water’              | HLH   |
| c. tátámì-nga ‘tatami mat’ | HHLH | d. mídúkúmì-nga ‘glutinous rice’ | HHHLH |

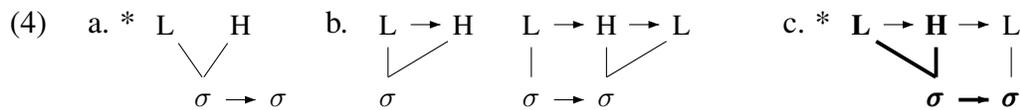
Kubozono (2011) analyzes Wan autosegmentally with right-to-left tone association, as the initial H consistently plateaus, whereas the L and second H are assigned one TBU each. In contrast, Zoll (2003)’s theory cannot distinguish between HHLH and \*HLHH, as both violate CLASH equally. It would thus require an ad-hoc accentual analysis in which L is underlyingly associated to exactly where right-to-left directionality would assign it. Either that, or it would need to adopt some sort of ALIGN constraint (Yip 2002), which are problematic typologically (Eisner 1997, McCarthy 2003), partly because they are evaluated *globally*.

What both analyses miss is that language-specific WFCs are, on the surface, fundamentally *local* over autosegmental structures. The current proposal captures this by characterizing directionality and toneme-specific association with inviolable, language-specific *banned substructure* constraints. Such constraints have been posited for string-based phonotactics (Heinz, 2010; Heinz et al., 2011; McMullin and Hansson, to appear), and are attractive for multiple reasons. For one, they provide a restrictive theory of phonotactics. Two, they have a straightforward cognitive interpretation of well-formedness being evaluated locally over individual substructures (Rogers et al., 2013). Additionally, their theoretical learning properties are well-understood (Heinz, 2010; Jardine, in press).

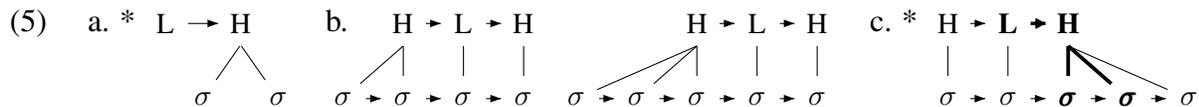
We can interpret banned substructure constraints over autosegmental representations (ARs) as banned *subgraphs*, as ARs are graphs (Goldsmith, 1976). For example, Zoll (2003)’s CLASH constraint can be reanalyzed as two inviolable constraints, one banning multiple association of a nonfinal H tone (3a), and one banning multiple association of a noninitial H tone (3b). Licit forms (3c) in Kukuya do not contain these structures as subgraphs, whereas the illicit AR corresponding to \*LHH (3d) contains (3a) (highlighted in bold). In the following, adjacency is explicitly marked with arrows in the representation; the absence of an arrow between units on a tier means they may be nonadjacent. Full specification of TBUs to tones is assumed, as is the OCP (i.e., no adjacent, identical melody autosegments). Without loss of generality,  $\sigma$  will be assumed to be the TBU.



That contours in Kukuya only surface on the left edge can also be captured in this way:



The analysis of the restriction on H spread as two separate constraints in (3) makes the prediction that these constraints may appear independently. This is exactly the analysis for Wan Japanese, as only the nonfinal H is allowed to spread. Thus, (3a), but not (b), is present in Wan:



Thus, banned substructure constraints over ARs offer a unified analysis of both directional and quality-based conditions on tone mapping. They do so *locally*, as well-formedness is decided by a form’s constituent substructures. Future work can explore how this property can be preserved when studying transformations from underlying to surface forms (c.f. Chandlee 2014). Additionally, future work can develop a theory of learning these constraints based on results in learning banned substructure constraints over strings (Heinz, 2010) and learning local graphs (López et al., 2012).

**Selected references:** • Breteler, J. M. W. (2013). A stratal OT analysis of the intonation of Japanese dialects with multiple intonational classes. Master’s thesis, Utrecht University. • Heinz, J. (2010). Learning long-distance phonotactics. *Linguistic Inquiry*, 41:623–661. • Heinz, J., Rawal, C., and Tanner, H. G. (2011). Tier-based strictly local constraints for phonology. In *Proceedings of the 49th Annual Meeting of the Association for Computational Linguistics*, pages 58–64, Portland, Oregon, USA. Association for Computational Linguistics. • Jardine, A. (in press). Learning tiers for long-distance phonotactics. In *Proceedings of the 6th Conference on Generative Approaches to Language Acquisition North America (GALANA 2015)*. • Kubozono, H. (2011). Kikaijima nanbu, chuubu chiiki no akusento [The accent of southern and central Kikai-jima]. In *General Study for Research and Conservation of Endangered Dialects in Japan: Research Report on the Kikaijima Dialects*, pages 51–70. Tokyo: National Institute for Japanese Language and Linguistics. • López, D., Calera-Rubio, J., and Gallego-Sánchez, A.-J. (2012). Inference of  $k$ -testable directed acyclic graph languages. In *Proceedings of the 11th International Conference on Grammatical Inference (ICGI 2012)*, JMLR Workshop Proceedings. • McMullin, K. and Hansson, G. O. (to appear). Long-distance phonotactics as Tier-Based Strictly 2-Local languages. In

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