Exploring the typology of quantity-insensitive stress systems without gradient constraints

Jeff Heinz, Greg Kobele, and Jason Riggle*

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1 Metrical typology and quadratic constraints

1.1 Introduction

- Gordon (2003) develops a typological analysis of quantity insensitive stress systems in Optimality Theory (Prince and Smolensky, 1993) in which he uses 12 constraints that generate a 152-language factorial typology.
- This system did not employ metrical feet, but was based on the moraic grid (Liberman, 1975; Prince, 1983), where gridmarks on level 1 represent secondary stress, level 2 represents primary stress and so on.
- Today we present another non-foot, moraic-grid based constraint system for quantity-insensitive languages that differs from Gordon in the fundamental way described below.

1.2 Quadratic Constraints

- Gordon's system uses "gradient" alignment constraints that are **quadratic** in the sense that the number of violations grows as a quadratic function of the length of the word.

(1) Example: ALIGN ALL σ LEFT: Each Syllable should be aligned with the left edge of a word.

$$\begin{array}{r} * \\ ** \\ *** \\ **** \\ ***** \end{array}$$

A word with six syllables, $[\sigma\sigma\sigma\sigma\sigma\sigma]$, incurs fifteen violations of this constraint.[1].

*The authors may be contacted at jheinz@humnet.ucla.edu (Jeff), kobele@humnet.ucla.edu (Greg), and jriggle@uchicago.edu (Jason). We'd like to thank the members of the 2004 Fall UCLA and U Chicago Phonology Seminars for their input.

[1]It is quadratic because a word with $n+1$ syllables will have $(n^2+n)/2$ violations

- This is opposed to the constraints such as NoCoda which may be multiply violated in a single form, but where the number of violations is bounded by a linear function of the length of the word.
- There are three problems with quadratic constraints.
  - They make anomalous predictions like tone-centering (cf Eisner (1997)) and a range of predictions that McCarthy (2003) discusses.
  - They are categorically more powerful than the vast majority of other constraints that phonologists employ in their analyses.
  - They are formally too complex to compute optimization over, with any of the current proposals for so doing in the literature.
- Are quadratic constraints necessary for the description of phonology?
  - In this talk, we ask whether these constraints are necessary for an adequate description of quantity insensitive stress systems.
  - We show that we do not need quadratic constraints to describe the typology of quantity-insensitive languages.

1.3 The Role of Quadratic Constraints in Gordon 2003

1.3.1 The Effects

- Align X1 Left/Right play a crucial role in the typology of QI stress systems in Gordon's typology.

(2) **AlignX1Left** each stressed syllable incurs n violations, where n is the number of syllables which separate it from the **left** edge of the word.

AlignX1Right each stressed syllable incurs n violations, where n is the number of syllables which separate it from the **right** edge of the word.

- These constraints have the following three effects.
  - They push every stress towards the specified edge of the word.
  - They position Lapses/Clashes towards the edges of a word. Note candidate (b) below is co-harmonically bounded by candidates (a) and (c).

(3)

/σσσσσσσσσ/	Align X1 Left	Al X1 Right
a. σ́σσ̀σσ̀σσ̀σ	15	17
b. σ́σσ̀σσσ̀σσ̀σ	14	18
c. σ́σσ̀σσ̀σσσ̀σ	13	19

  - They minimize the number of stresses in a word, yielding, for example, single and dual stress systems.

(4)

/σσσσσ/		Align X1 Left	*Lapse
☞	a. σ́σσσσ		***
	b. σσ́σσ̀σ	****!	

1.4 Can we capture the attested systems without quadratic constraints?

- Yes.
  - To push the stresses toward the edge of a word, we use FirstStressLeft and LastStressRight, which penalize unstressed syllables at word edges
  - To position lapses near word edges, we innovated positional markedness constraints which penalize all lapses, but charge only half-price for lapses in salient positions (such as at edges)
  - To minimize the number of stresses in a word, we use a simple stress economy constraint No Stress
  - All of our constraints are defined in the appendix, and we will delay discussion of our positional markedness innovation until §3
- Some observations:
  - Ten of our constraints produce a 62-language typology, covering all the attested single and dual stress systems.
  - The addition of three more constraints (the lapse constraints) yields the binary and ternary languages.
  - In total, there are 288 languages in our typology.
- Furthermore, by implementing a QI stress system with no quadratic constraints, we have eliminated problems of non-computability.
- But have we eliminated anomalous predictions?
- Because we eliminated quadratic constraints we can answer this question rigorously by implementing this system and using algorithms from Riggle (2004b) to help computing the typologies.

2 Testing Typologies and Anomalous Predictions

- Our system, and Gordon's, view the placement of lapses and of main stress as independent. Kager (2001) however has suggested that they are not:

> Cross-linguistically, local ternary intervals are restricted to two contexts: they are (i) adjacent to the right edge: [eg] Pintupi 201010100; [and] (ii) adjacent to the peak: [eg] Garawa 200101010, Piro 101010020.

- In order to capture his restriction on the positioning of laspes and clashes, we adopted his suggestion that lapses are licensed at peaks (main stress) and at the right edge.
- We took Kager's non-quadratic constraints Lapse-at-Peak and Lapse-Right to position the lapses.

(5) **Lapse at Peak** incurs one violation if there is a lapse that is not adjacent to a peak.

Lapse at Right incurs one violation if there is lapse not at the right word boundary.

- These constraints give rise to a range of somewhat odd typological predictions the most interesting one being that languages could exist in which the main stress switches sides to license lapses.
- A QI stress pattern for a language generated by these constraints.

(6)

	Stress Pattern	Main Stress
8σ	$\sigma\grave{\sigma}\sigma\grave{\sigma}\acute{\sigma}\sigma\sigma$	Left
7σ	$\sigma\acute{\sigma}\sigma\grave{\sigma}\sigma\grave{\sigma}\sigma$	Right
6σ	$\sigma\grave{\sigma}\sigma\acute{\sigma}\sigma\sigma$	Left
5σ	$\sigma\acute{\sigma}\sigma\grave{\sigma}\sigma$	Right
4σ	$\sigma\acute{\sigma}\sigma\sigma$	Left
3σ	$\sigma\acute{\sigma}\sigma$	–
2σ	$\acute{\sigma}\sigma$	–

2.1 Lapses Attract Peaks

- Though Lapse-at-Peak is intended to license lapses, in languages with words with one lapse at the right edge, peaks, which are usally leftmost, can jump to the right.
- Consider the ranking Lapse-at-Peak, Lapse-at-Right $\gg$ MainStressLeft $\gg$ MainStressRight.

Main Stress Left Main Stress falls on the leftmost secondary stressed syllable.

Main Stress Right Main Stress falls on the rightmost secondary stressed syllable.

(7)

$/\sigma\sigma\sigma\sigma\sigma\sigma\sigma/$	Lapse at Peak	Lapse at Right	Main Stress Left	Main Stress Right
☞ a. $\sigma\acute{\sigma}\sigma\grave{\sigma}\sigma\grave{\sigma}\sigma$				*
b. $\sigma\grave{\sigma}\sigma\grave{\sigma}\sigma\acute{\sigma}\sigma$			*!	

(8)

$/\sigma\sigma\sigma\sigma\sigma\sigma/$	Lapse at Peak	Lapse at Right	Main Stress Left	Main Stress Right
☞ a. $\sigma\grave{\sigma}\sigma\acute{\sigma}\sigma\sigma$			*	
b. $\sigma\acute{\sigma}\sigma\grave{\sigma}\sigma\sigma$	*!			*

- Whichever main stress placement constraints are used, this ranking configuration leads to main-stress flipping.
- This is a consequence of the fact that lapses are licensed at the right edge (which is immobile) and at the main stress (which is mobile). Since the main stress can move to alleviate violations of Lapse-at-Peak, it does.
- The lesson: not only do peaks licenses lapses, but constraint interaction leads to lapses licensing peaks.

3 Building positional markedness into constraints

3.1 Positioning lapses near edges

- The range of constraints that we implemented to generate the metrical typology are listed in appendix A. For the current discussion we'll focus on one constraint to illustrate our basic approach.
- LapseNearRight (and her sister LapseNearLeft) are inspired by Kager's Lapse-at-Right constraint. In Kager's system there is the general *Lapse constraint which penalizes lapses everywhere in addition toLapse-at-Right.

  Lapse Near Right incurs one violation if a lapse occurs among the final and penultimate syllables, or among the penultimate and antepenultimate syllables, or among the antepenultimate and pre-antepenultimate syllables. It incurs two violations for lapses ocurring elsewhere.

  Lapse Near Left incurs one violation if a lapse occurs among the first and second, or among the second or third syllables in a word. It incurs two violations for lapses ocurring elsewhere.

- Unlike Kager's Lapse-at-Right which positions lapses exactly at the right edge our LapseNearRight charges half-price for violations that are in the vicinity of the right edge.

(9)

/σσσσσσ/	LapseNearRight
a. σ́σσ̀σσ̀	**
b. σ́σσ̀σσ σ̀	*

- In other words, our scheme generates the licensing of marked structures in salient positions using constraints that charge half-price for violations in those positions.
- These constraints position lapses in longer words in much the same fashion as Gordon's Align X1 Left/Right constraints.

(10)

/σσσσσσσσσ/	LapseNearLeft	LapseNearRight
a. σ́σσ̀σσ̀σσ̀σ	*	**
b. σ́σσ̀σσσ̀σσ̀σ	**	**
c. σ́σσ̀σσ̀σσσ̀σ	**	*

- In effect, we propose that all *Lapse constraints penalize all lapses. Rather than getting lapses for free at privileged positions, our constraint charges you for every lapse, but charges less for lapses at salient positions. This obviates the need for a general *Lapse constraint.

3.2 Typological consequences of incorporating the general into the specific

- In our typological exploration, including *Lapse with positional lapse constraints such as Kager's Lapse-Right gave rise to a range of anomalous languages with gratuitous lapses when Lapse-Right ≫NoStress≫ *Lapse.
- This gratuitous violation scenario came up with several constraints whenever other constraints could intervene between a general markedness constraint and a positionally-specific version of the same constraint.
- We found that these odd predictions could be avoided if we incorporated the general markedness constraint and the positional markedness constraint into a single entity like LapseNearRight.
- By incorporating the basic *Lapse into every positionally specific lapse constraint we are able to eliminate the general *Lapse constraint and do away with the problem of gratuitous violations.
- This is in keeping with Gouskova's (2003) proposals that the most general markedness constraint in any scale of markedness can be eliminated

3.3 Summary

- Our LapseNearRight constraint distinguishes two levels of violation: cheap violations near the right edge and expensive ones everywhere else. The exact location of lapses near the right edge falls out from the interaction of other constraints in the system.
- This same innovation is incorporated in our NoFinalFoot constraint and our ClashAtInitial and ClashNearRight constraints.
- We also incorporated the notion of variable levels of violation into our FirstStressLeft and LastStressRight constraints such that each constraint is better satisfied if the syllable being aligned to the edge is the one bearing main stress. This allowed us to do away with explicit independent constraints on main stress placement.[2]

[2]This also accounts for the fact that in dual systems that prohibit clashes so that shorter words only bear

4 Conclusion

- Quadratic constraints are not necessary to account for the attested quantity insensitive stress systems.
- Since all of our constraints can be expressed as finite state transducers, we can compute and compare typologies.
- In section 2 we gave an example of this, showing that any straight-forward implementation of Kager's observations predicts anomalous languages.
- In section 3, we offer an innovation in constraint building, which is a novel interpretation of positional markedness.

A Definitions of our Constraints

First Stress Left incurs two violations for every X0 between the left word boundary and the leftmost stressed syllable. An additional violation is scored if the leftmost stressed syllable is secondary stressed.

Last Stress Right incurs two violations for every X0 between the right word boundary and the rightmost stressed syllable. An additional violation is scored if the rightmost stressed syllable is secondary stressed.

No Initial Stress incurs a violation if the initial syllable bears stress.

Have Initial Stress incurs a violation if the initial syllable does not bear stress.

No Final Stress incurs a violation if the final syllable bears stress.

No Final Foot incurs two violations if the final syllable bears stress, and one violation if the penultimate syllable bears stress and the final syllable does not.

No Stress incurs a violation for each stressed syllable.

No Extended Lapse incurs a violation for every sequence of three unstressed syllables.

No Extended Lapse Right incurs a violation if the last three syllables of a sequence is unstressed.

Clash at Initial incurs one violation if there is clash between the initial and peninitial syllables, and two violations if there is a clash elsewhere.

Clash Near Right incurs one violation if there is a clash between the final and penultimate syllables, one violation if there is a clash between the penultimate and antepenultimate syllables, and two violations if there is a clash elsewhere.

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one stress, the position of stress is always the position the main stress, and not the secondary stress, takes in larger words. For example, Lower Serbian places main stress initially and secondary stress on the penult, but in trisyllabic words the initial syllable, and not the penult is stressed.

Lapse Near Left incurs one violation if a lapse occurs among the first and second, or among the second or third syllables in a word. It incurs two violations for lapses ocurring elsewhere.

Lapse Near Right incurs one violation if a lapse occurs among the final and penultimate syllables, or among the penultimate and antepenultimate syllables, or among the antepenultimate and pre-antepenultimate syllables. It incurs two violations for lapses ocurring elsewhere.

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