Learnability of Derivationally Opaque Processes in the Gestural Harmony Model

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### Introduction

- With correct gestural strength settings, Gestural Harmony Model can generate both stepwise and saltatory height harmonies.
- Task: set constriction degree targets and blending strengths for vowel and dorsal consonant gestures such that learner reproduces teacher’s vowel raising pattern.
- Patterns tested:
  - Four-height stepwise raising before high vowel trigger (Nzebi-like)
  - Four-height saltatory raising before high vowel trigger (unattested)
- Ran 100 models of each type until convergence.

### The Gestural Gradual Learning Algorithm

- **Stepwise Height Harmony**
  - For assimilation of X to Y, Y’s gestural strength must be exponentially higher than that of X.
  - For X to resist assimilation to Y, X’s gestural strength must be exponentially higher than that of Y.
- **Saltatory Height Harmony**
  - Saltation requires three overpowering relationships:
    1. Dorsal /g/ must overpower the strongest vowel to fully resist lenition (/g/ → /l/).
    2. High vowels overpower low-mid vowels to trigger their full assimilation (/l/, /l/ → /l/, /l/).

### A Gestural Model of Height Harmony

- **Stepwise**: Learning rules for stepwise harmony model.
  - Width = Target
  - Strength = Target
  - Strength\(^*\) = Blended Target
- **Saltation**: Learning rules for saltation harmony model.
  - Strength = Target
  - Strength\(^*\) = Blended Target

### Overall Results

- **Stepwise raising** takes substantially faster to learn than saltation raising.
- **Saltation** takes ~5.3 times as many iterations to learn.
- Hard-to-learn saltatory patterns are more likely to be mislearned across generations.

### Alternatives

- Two approaches to generating chain shifting and saltatory pattern in Harmonic Grammar:
  - Scalar and distinct faithfulness
  - Faithfulness (Gnanadesikan 1997): faithfulness violated by shifts along feature scale
- **MaxEnt Generational Stability Model (O’Hara 2020, in prep):**
  - Maximum Entropy Harmonic Grammar learner with each trained model used as teacher to train next generation of learner.
  - Hard-to-learn patterns are less stable across generations.
  - **Stability**: Proportion of 100 models in which a pattern remains the same for 10 generations.
  - **Stepwise** and saltation harmonies:
    - Scalar Faithfulness 0% 34%
    - Distinct Faithfulness 28% 100%