Today's topics:

- **Constraint-based approaches to phonological variation**
- **Learning a constraint ranking**

Background preparation:

- Hayes & Moore-Cantwell (in prep.), Ch 1, Ch 2 to §2.5

0. Today's objectives

After today's class, you should be able to:

- Explain the problems that phonological variation poses for classic OT
- Explain and apply some approaches to modeling variation:
  - Partial constraint rankings
  - Stochastic OT
- Relate patterns in child phonology to ROTB and the L1 Initial State

0. Squib check-in

- Any questions or clarifications about squib proposals?
  - Due **W Apr 15, 11:59pm**, in Canvas Assignments

1. Phonological variation in classic OT

Discussion

- What does it mean if there are **two** possible surface forms of a given word?
  - What does this look like in the world? (What do we call this?)
  - What does a constraint-based grammar have to do to represent this situation?
    - What would it take for classic OT to do this? Does this provide enough flexibility?
    - What can we add to our model to improve on the predictions of classic OT?

1. Phonological variation in classic OT

- Consider a language with **free variation** in onset clusters: tolerating them vs. avoiding by epenthesis
  - How would **tied constraints** address this?
  - What **ranking** would we need for the following set of constraints?

/pla/	MAX	*COMPONS	DEP
→ (a) pla		*	
→ (b) pəla			*
(c) pa	*		

1. Phonological variation in classic OT

- Now we have an OT grammar that can produce more than one output for a given input
  - An extension: Models that allow for **partial rankings** in the grammar of a language (Anttila and others; this is one implementation of **cogrammars**)

- What aspects of phonological variation are still not being addressed here?

1. Phonological variation in classic OT

- Aspects of phonological variation that are still not being addressed here
  - How can we model variation with particular **frequencies** among output forms?
  - How can we account for the fact that variation is sensitive to **social factors**?

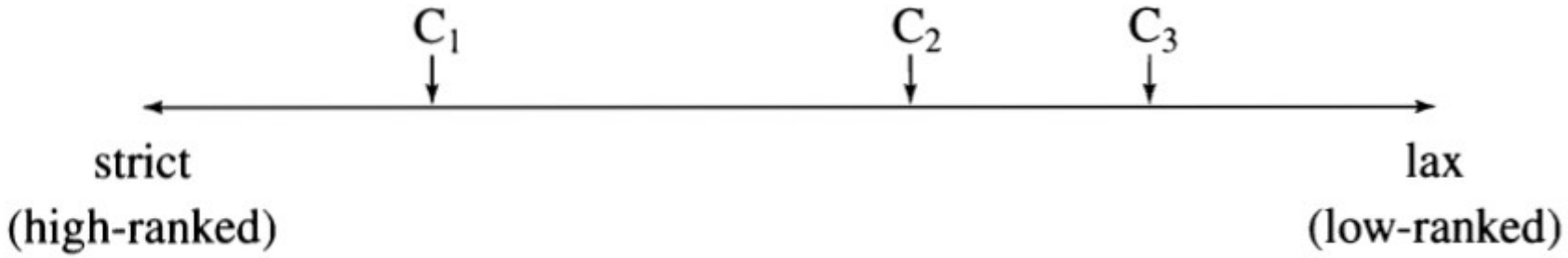
2. Stochastic models

- In a **stochastic model**, rankings/weightings are numerical and chosen probabilistically from some distribution of values
  (Boersma, Hayes, Flemming, Zuraw, Goldwater & Johnson, …)
- This provides a way to implement **variable rankings** that have **different frequencies**

2. Stochastic models

- A simple example (from Boersma & Hayes 2001): Stochastic OT
  - Each constraint's rank is represented as a point on a number line: the **ranking value**
  - These are still rankings, not weights: a higher number means constraint domination

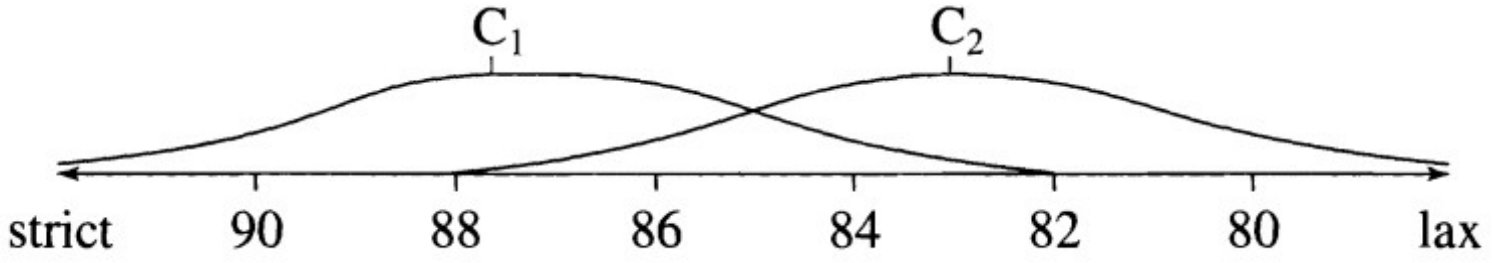
(1) *Categorical ranking of constraints (C) along a continuous scale*



2. Stochastic models

- A simple example (from Boersma & Hayes 2001): Stochastic OT
  - Each time the grammar picks an output, every constraint's ranking value is (separately) adjusted according to a normal distribution (bell curve) around the ranking value → **selection point**

(6) *Overlapping ranking distributions*



2. Stochastic models

- A simple example (from Boersma & Hayes 2001): Stochastic OT
  - The **distance** between the ranking values of C_1 and C_2 determines ***how often*** the grammar will choose selection points that **reverse** their relative ranking → Variation with probabilities!
  - From H&B discussion of ex (6) above:
    - Ranking values: C1 = 87.7, C2 = 83.1
    - Evaluation noise (SD) = 2.0
    - Relative ranking: C_1 » C_2 94.8%, C_2 » C_1 5.2%

2. Stochastic models

- MaxEnt OT is also a stochastic model
  - We will look at the details next time
  - As you read: Consider the differences from Stochastic OT as described above

- Is the “social piece” in place yet?

3. Child phonology in OT

- Problems with **modeling children's developing phonological grammar** were one motivation for moving from a rule-based framework to a constraint-based one (OT)
  - What were some of the problems we identified for modeling child phonology using rules?

3. Child phonology in OT

- Child A (age 2) produces…
  the target (adult) form *play* [plej] as [pej]
  the target (adult) form *other* [ʌðə] as [ʌdə]
  - What is the difference between A's grammar and the adult grammar in a rule-based approach?
  - In OT?

3. Child phonology in OT

- Does the OT approach to phonological acquisition solve any of the problems presented by the rule-based approach?
  - Does phonology learning in OT raise any new problems or questions?

3. Child phonology in OT

- Based on your analysis of the *play* and *other* examples:

  Assuming a standard OT model with an innate constraint set, what **general** type of constraint is ranked **high**, and what type is ranked **low**, in the **Initial State** (before acquisition begins)?

3. Child phonology in OT

- Can we make any **generalizations** about *how* the child and adult rankings differ?

Child: Markedness » Faithfulness

*ComplexOnset » NoDeletion

NoFricative » Ident[±cont]

Adult: Faithfulness » Markedness

NoDeletion » *ComplexOnset

Ident[±cont] » NoFricative

4. Richness of the Base, revisited

- Remember our hypothetical language in which all morphemes have the shape /CV/, /CVCV/, /CVCVCV/, etc. Two consonants never occur adjacent to one another.
  - Assuming this pattern is productive, what ranking or rankings can we determine among the constraints *ComplexOnset, Max, and Dep?

4. Richness of the Base, revisited

- Hypothetical language in which all morphemes have the shape /CV/, /CVCV/, /CVCVCV/, etc. Two consonants never occur adjacent to one another.
  - Assuming this pattern is productive, what ranking or rankings can we determine among the constraints *ComplexOnset, Max, and Dep?
  - Is there a connection between this result and the conclusion we reached about the **Initial State ranking** in phonological acquisition?

5. Learning a constraint-based grammar

- Initial state: **M » F**
- What does the learner have to do now? How?

5. Learning an OT grammar

Some proposals:

- **Error-driven** constraint demotion
  (Tesar & Smolensky 1993, 1998, 2000)
  - Learner notices error (wrong winner) and changes ranking by demoting L-constraints **below** W-constraints
- **The Gradual Learning Algorithm (GLA)**
  (Boersma 1997, 1998, Boersma & Hayes 2001)
  - Still error-driven, but rankings change **gradually**

5. Learning an OT grammar

- **The Gradual Learning Algorithm (GLA)** (Boersma 1997, 1998, Boersma & Hayes 2001)

  A model of:

  - The gradual reranking of constraints during grammar learning
  - When stochastic: The learning of constraint rankings/weightings that are represented as chosen from a distribution

- A **stochastic grammar** basically has to be constructed with a **learning algorithm**!

6. For next time

- Finish Hayes & Moore-Cantwell (in prep.), Ch 2
- Be thinking about ways in which the MaxEnt OT model they adopt is different from
  - classic OT
  - Stochastic OT