Optimality Theory Introduction

From Rules to Constraint Based Grammars
Make Up Lecture

special thanks to Gaja Jarosz for some material
Goal

• To set you up for success when you learn about/work with OT in upper level linguistic courses in our department
  – This is a very basic introduction

• Familiarize you with
  – the idea behind OT
  – the parts of OT
    • including some terminology
  – the way the parts work together
What linguistic theory is after

• Characterizing what is and is not a possible human language
  – What are the legal combinations of linguistic units?
  – Impossible vs. Possible mappings
    • We study particular languages to get at what the universal principles might be.
  – What does that knowledge look like?
Pluralization Revisited

Spoken Forms:
• kæt+s → kæts
• dog
• klæs

Make a noun plural by adding an “s” sound.
Pluralization Revisited

Spoken Forms:

- $kæt+s \rightarrow kæts$
- $dog+s \rightarrow dogz$
- $klæs$

Make a noun plural by adding an “s” or a “z” sound.
Pluralization Revisited

Spoken Forms:

- kæt+s → kæts
- dog+s → dogz
- klæs+s → klæsiz

Make a noun plural by adding an “s” or a “z” or an “iz” sound.
A Single Underlying Form

• At spoken level: variations on plural marker
  – Systematic variation

• At mental representation level: single plural marker

  \[
  S \rightarrow \begin{align*}
    s & \quad \text{if noun ends in [-voice]} \\
    z & \quad \text{if noun ends in [+voice]} \\
    Iz & \quad \text{if noun ends in a “strident” C}
  \end{align*}
  \]
Phonological Re-write Rules

Voicing assimilation: $s \rightarrow z / [+\text{voice}]$ ___

Epenthesis: $\emptyset \rightarrow [l] / C___C$
Phonological Re-write Rules

dog+s → dogs
    → dogz  Voicing assimilation: s → z

klæs+s → klæss
    → klæsís  Epenthesis: ∅ → [ɪ] / C_C
    → klæsɪz  Voicing assimilation: s → z
Generalizations About the Input

• Other examples of allomorphy from class
  indefinite article: a/an
  past tense: -ed/-d/-t

• One underlying form

• Surface forms result from rule application
Generalizations in the Output

• However, application of some rewrite rules seem subject to certain conditions on the output.

• Rules + output constraints
  – something like:
    \[ V \rightarrow \emptyset / C\_\_C \]
    Condition: block if result violates constraint *CCC
  – “Do X, Unless Y”
  – “Do X, Only If Z”
Generalizations in the Output

• Appear to be generalizations at the surface level
• Early Child Phonology (some utterances of Timmy)
  
  [pæ]  ‘book’ [11 months]
  [həkʰa] ‘key’ [11 months]
  [bæː]  ‘bird’ [15 months]
  [ka]  ‘cup’ [15 months]
  [ʔəma] ‘moon’ [15 months]
  [pæ]  ‘baby’ [16 months]
  [pæ]  ‘block’ [16 months]
  [pæ]  ‘boat’ [16 months]
  [kakhʰi] ‘cookie’ [16 months]
  [nəmæ] ‘Simon’ [16 months]

Note: child language is fraught with variation – it’s not in general possible to predict the exact output for each word, but it is possible to narrow the possibilities to a small set. Focus here on what processes are observed rather than on predicting exactly which process applies in a particular situation.
Generalizations in the Output

- Appear to be generalizations at the surface level
- Early Child Phonology (some utterances of Timmy)

  - [həkʰa] ‘key’ [11 months] insert syllable, shorten diphthong
  - [bæː] ‘bird’ [15 months] coda drop
  - [ka] ‘cup’ [15 months] coda drop
  - [ʔəma] ‘moon’ [15 months] epenthesis
  - [pæ] ‘baby’ [16 months] unstressed syllable drop
  - [pæ] ‘block’ [16 months] C-cluster simplification, coda drop
  - [pæ] ‘boat’ [16 months] coda drop
  - [kakʰi] ‘cookie’ [16 months]
  - [nʌmæ] ‘Simon’ [16 months] coda drop

**Note:** child language is fraught with variation – it’s not in general possible to predict the exact output for each word, but it is possible to narrow the possibilities to a small set. Focus here on what processes are observed rather than on predicting exactly which process applies in a particular situation.
Different Means to the Same End

• Pressure towards CV syllables: coda dropping, consonant-cluster simplification, epenthesis
  – other observed processes (e.g. devoicing) preserve CV syllable structure

• The conspiracy puzzle: Why should all the rewrite rules conspire together to achieve the same output?
Optimality Theory
Prince & Smolensky (1993)

- Competition among ranked constraints
- A surface form is the resolution of conflicting constraints
  - not the result of rewrite rules
- Predicts “Do X, Unless Y” and “Do X, Only If Z” type patterns
- Focus on how forms surface
  - vs. how forms change
an analogy

- We deal with conflicting constraints all the time:
  - John, Mary, and Jane are meeting up for lunch.
    - John has Celiac’s (no gluten)
    - Mary is dabbling with becoming vegetarian
    - Jane broke up with one of the waiters at One World
    - Mary doesn’t want to drive

<table>
<thead>
<tr>
<th></th>
<th>gluten-free options</th>
<th>avoid seeing ex</th>
<th>walking distance</th>
<th>tasty vegetarian options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sam’s Bagels in Charles Village</td>
<td>*</td>
<td>ok</td>
<td>ok</td>
<td>ok</td>
</tr>
<tr>
<td>Ruby Tuesday’s in Charles Village</td>
<td>ok</td>
<td>ok</td>
<td>ok</td>
<td>*</td>
</tr>
<tr>
<td>Sushi Hana in Towson</td>
<td>ok</td>
<td>ok</td>
<td>*</td>
<td>ok</td>
</tr>
<tr>
<td>One World in Roland Park</td>
<td>ok</td>
<td>*</td>
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</tr>
</tbody>
</table>
Two Families of Constraints

**MARKEDNESS** Constraints

• Make your output as unmarked as possible
  – minimizing cognitive/articulatory effort
  – maximizing discriminability

• How do we know what patterns are unmarked?
  – evidence from language typology
  – evidence from developmental trajectory

**FAITHFULNESS** Constraints

• Make your output as faithful to the input as possible
• necessary to prevent us from just saying “ba”

• Constraints are posited to be universal; languages are organized differently b/c they differ wrt constraint ranking.
• Prediction 1: mappings that violate faithfulness AND result in a more marked pattern are impossible
• Prediction 2: We should see real-life languages that correspond to different rankings.
Reading Constraint Tableaux

<table>
<thead>
<tr>
<th>/input/</th>
<th>constraint 1</th>
<th>constraint 2</th>
<th>constraint 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>output candidate 1</td>
<td>*!</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>output candidate 2</td>
<td>*</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>output candidate 3</td>
<td>**!</td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

- The input is listed in slashes ‘/’ in the top leftmost cell of the tableau.
- The pointing finger ‘♀’ identifies the winning output candidate.
- Constraints are ranked left to right (highest to lowest).
- The constraint ranking above can be written: constraint 1 » constraint 2 » constraint 3.
- A ‘!’ indicates the fatal violation for the candidate (so the winning candidate should not have a ‘!’ in its violation profile).
- How many possible rankings of the three constraints are there?
- Which output candidate wins under each of the rankings?
An OT Analysis

Pluralization of “dog” revisited:
Markedness Constraints:
* [+voice][-voice]

<table>
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<tr>
<th>Input: dog+s</th>
<th>Outputs: dogs, dogz, . . .</th>
</tr>
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<tbody>
<tr>
<td>/dogs/</td>
<td>*[+voice][-voice]</td>
</tr>
<tr>
<td>dogs</td>
<td>*!</td>
</tr>
<tr>
<td>❁ dogz</td>
<td>*</td>
</tr>
<tr>
<td>(more . . .)</td>
<td>. . .</td>
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An OT Analysis

Pluralization of “cat” revisited:

Markedness Constraints:

* [+voice][-voice]

Input: kæt+s

Outputs: cats, catz, . . .

<table>
<thead>
<tr>
<th>/kæts/</th>
<th>* [+voice][-voice]</th>
<th>FAITH</th>
</tr>
</thead>
<tbody>
<tr>
<td>☹ kæts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>kætz</td>
<td></td>
<td>*!</td>
</tr>
<tr>
<td>(more . . .)</td>
<td></td>
<td>. . .</td>
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Consider the opposite ranking

Pluralization of “dog” when FAITH dominates *[+voice][-voice]  

*Under this ranking, it’s more important to be faithful, so the faithful candidate wins. This isn’t the ranking in English.*

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<td></td>
</tr>
<tr>
<td>dogz</td>
<td>*!</td>
</tr>
<tr>
<td><em>(more . . .)</em></td>
<td>. . .</td>
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Consider the opposite ranking

Pluralization of “cat” when 
FAITH dominates *[+voice][−voice]

kæts → kætz is an impossible mapping, no matter what the ranking, because it is both less faithful AND more marked.

Input: kæt+s Outputs: cats, catz, . . .

<table>
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<th>/kæts/</th>
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<td></td>
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• Wait, what about “classes”?
  – Originally, the plan was to work it out in the homework. Since I didn’t spend as much time as planned on the last slides, I have replaced that question. If you like, you can try to work it out yourself using:
    *[+voice][-voice] – don’t have a voiced segment followed by an unvoiced segment
    *[+strident][+strident] – don’t have two stridents in a row
    *Epenthesis – don’t add segments to the output that weren’t in the input
    Faith-voice – don’t change the voicing in the output to be different from that in the input
  • Remember, though, this is a toy example intended to illustrate how constraint interaction works. The real story for English plurals will be more refined.
Summary

• OT posits that . . .
  – language involves constraints, not rules
  – the constraints are violable
  – often the constraints are in conflict
  – each language ranks the constraints in importance
  – a surface form is optimal if it incurs the least serious violations