LINGUISTICS 321 **Lecture #10**
Phonology

RULES AND CONSTRAINT: DERIVATIONAL vs. CONTSTRAINT-BASED APPROACHES TO PHONOLOGY: INTRODUCTION TO *OPTIMALITY THEORY*

A. Additional phonological concepts relevant to the comparing of the two approaches:

1. **Markedness**: Those characteristics of languages that are considered to be more complex and/or universally rarer in languages. "It is an abstract property, referring to the *unusualness* or difficulty of a sound or process". (Odden, 2005)

   In the contrast /p/:/b/ in English, /b/ is characterized by the presence of voicing, while /p/ lacks voicing.

   In the contrast /p^h/ : /p/ in Thai, /p^h/ has aspiration, while /p/ lacks it.

   The opposition member which is characterized by the presence of a mark is said to be *marked*, while the member which is characterized with the absence of the mark is said to be *unmarked*.

2. **Morphophonemics**: Analysis and classification of the *phonological* factors which affect the pronunciation of morphemes or, correspondingly, the *grammatical factors* which affect the pronunciation of phonemes.

B. Rules and constraints

OPTIMALITY THEORY (OT) holds that there is a set of possible *pronunciations* for any particular *form*.

Form = INPUT
Pronunciation = OUTPUT

The specific generalizations of a language are expressed in the selection of the *best candidate pronunciation* for some input.

The selection of the optimal candidate is accomplished by *constraints* on the mapping from input to output.

Derivational Approach: the surface forms are derived by ordered rules (each rule, except the first one, applies to the output of the preceding rule).

Constraint-based Approach: the surface forms are constrained – forms not conforming to these constraints are rejected.

Two premises of the theory:

1. The phonology of any language is determined by the ranking of the set of universal constraints → *constraint hierarchy*.

2. Constraint can be violated: if there are *contradictory constraints*, the one that is ranked higher will have priority, the other(s) will be violated.

These premises explain why languages have different phonologies.

There are two forces at work for determining the optimal output:

a. Faithfulness → the force that attempts to make the *output* identical to the *input*.
b. Unmarked way of pronunciation of the forms.

The interaction of these two forces determines the *output*.
These two forces are represented by *universal constraints* – languages rank them *differently*.

There are three constraints representing Faithfulness:

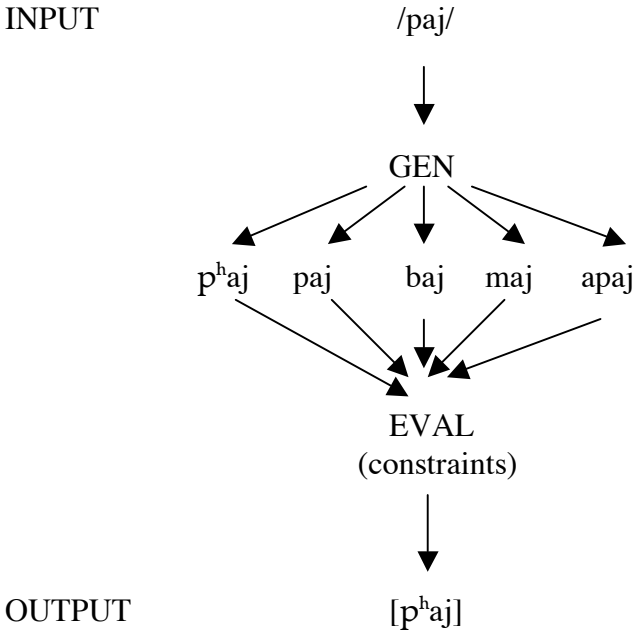
a. MAX-IO: each segment in the input (I) has a corresponding segment in the output (O)
   Deletion of segments is prohibited.
b. DEP-IO: each segment in the output has a corresponding segment in the input; the output is *dependent* on the input, and the constraint is violated by an inserted segment.
   Insertion of segments is prohibited.
c. IDENT (F): every feature (F) of the input segment is *identical* to every feature in the output segment.
   A segment in the input is identical to the corresponding segment in the output.

EVAL (Evaluation): the operation of evaluating the possible output forms. The evaluations are presented in *tableaux*.
Constraints are shown in *columns*, the forms to be evaluated are shown in *rows*.
Constraint violation: *
Winning candidate: ☞

Constraint ranking is encoded with the left-to-right ordering of constraints
The violation eliminates that form: *!
Shaded cells: in that column the constraints are *irrelevant* to the fate of the from in that row.

The Formal Model (p.67)

1. GEN	for a given input, the GENERATOR creates a candidate set of potential outputs
2. EVAL	from the candidate set, the EVALUATOR selects the best (optimal) output for that input
3. CON	EVAL uses the language particular ranking of constraints from the universal set of CONSTRAINTS



C. Example: Aspiration (in English)

Assumptions:
- aspiration is absent in the input
- candidate pronunciation can occur freely

Aspiration Constraint: Syllable-initial voiceless stops must be aspirated if the syllable is stressed.

pie [p^{h}aj]

Input: /paj/

Candidate pronunciations: [paj] and [p^{h}aj]

The Aspiration Constraint will select the second candidate: [p^{h}aj]

Tableau: Analysis of [p^{h}aj]

/paj/	Aspiration
☞ [p^{h}aj]	
[paj]	*

Constraint violation: *
Winning candidate: ☞

Problem: What about words like [spaj] ?

Since the Aspiration Constraint is unviolated, it could surface as * [sp^{h}aj] – a choice between the candidates is impossible.

Tableau: Analysis of [s**paj**]

/spaj/	Aspiration
[sp^{h}aj]	
[spaj]	

There are two solutions to this problem:

i. including a second constraint – Antiaspiration Constraint:
Consonants after [s] are not aspirated.

Tableau: Analysis of [s**paj**]

/spaj/	Aspiration	Antiaspiration
[**sp^{h}aj**]		*
☞ [**spaj**]		

Problem with this approach:
The Antiaspiration Constraint simply recapitulates, in the negative, the Aspiration Constraint.

The Antiaspiration Constraint misses the *general fact about phonological derivation*s:

> Forms are what they appear to be, unless there is a reason to believe otherwise, i.e., outputs do not differ from inputs, unless they are forced to.

ii. Posit a general FAITHULNESS constraint.

Faithfulness Constraint: The output is identical to the input.

To account for the fact that this constraint can be violated in forms like [**p^{h}aj**]**,** we assume that *constraints differ in their importance*.

In English, Aspiration is more important than the Faithfulness Constraint.

Aspiration outranks the Faithfulness Constraint

A violation of a higher-ranked constraint has a greater effect than a lower-ranked constraint.

Tableau: Analysis of [**p^{h}aj**]

	/paj/	Aspiration	Faithfulness
☞	[**p^{h}aj**]		*
	[**paj**]	*!	

NOTE: Constraint ranking is encoded with the left-to-right ordering of constraints; Both candidates get a violation, but the higher violation is the telling one: indicated by **!**
(see above)

Notice, that the violation of the general Faithfulness Constraint is irrelevant because of the violation of the higher-ranked aspiration. This is indicated with shading the lower-ranked constraint.

Tableau: Analysis of [**spaj**]

/spaj/	Aspiration	Faithfulness
[**sp^{h}aj**]		*!
☞ [**spaj**]		

Here Faithfulness is relevant, because there is no violation of aspiration.

Approach (ii) is superior to Approach (i), because

- the Faithfulness Constraint does not recapitulate any part of the Aspiration Constraint
- the Faithfulness Constraint is a direct reflection of the inertia of the input

Proper mapping from INPUT to OUTPUT

↓

GEN (=generate)

Aspiration example: so far only Aspiration has been allowed in the mapping from INPUTS to OUTPUTS.

However, phonological generalizations govern *other properties* of sounds as well.

Three approaches could be taken here:

i. Languages differ in terms of what properties GEN can manipulate.
For example, English can manipulate Aspiration, French could not.
Problem: this approach would expand the domain in which OT could treat phonological generalizations.

ii. Maintain the universality of GEN, but limit it in some ways.
Two types of limit:

a. substantive – it would prevent GEN from manipulating phonetic properties that never figure in some phonological generalization: For example, assuming (falsely), that there were no generalizations in any language that affected the nasality of vowels → i.e., disallowing GEN from altering the nasality of a vowel.
b. formal – not allowing GEN such as */t/ → [r] / ___ [ɒ]

iii. Enrich our understanding of Faithfulness: For example, nothing but the Aspiration value should be affected.

If the Faithfulness Constraint is *decomposed* into separate constraints requiring faithfulness to the INPUT, then we must specify the different rankings of those constraints with respect to Aspiration.

D. Faithfulness constraint decomposed

Faithfulness (Aspiration)
The output is identical to the input with respect to Aspiration.

Faithfulness (Voicing)
The output is identical to the input with respect to Voicing.

Faithfulness (POA)

The output is identical to the input with respect to Place of Articulation.

Faithfulness (MOA)

The output is identical to the input with respect to Manner of Articulation

Faithfulness (Vowels) [preliminary]

The output is identical to the input with respect to the number of vowels.

These subconstraints are abbreviated as F(X)

Tableau: Faithfulness (X)

/paj/	F(VOI)	F(POA)	F(MOA)	F(V)	ASP	F(ASP)
☞ [p^{h}aj]						*
[paj]					*!	
[baj]	*!					
[maj]			*!			
[apaj]				*!		

Here, alternative candidates are ruled out by higher-ranked faithfulness constraints.

X >> F(X)

(>> indicates ranking)

What if the inputs were /p^{h}aj/ and /sp^{h}aj/?

In OT literature: "richness of base"

Tableau: Aspiration in input

/sp^{h}aj/	F ({others})	ASP	F(ASP)
[spaj]			*!
☞ [sp^{h}aj]			

We have to limit the distribution of underlying aspiration on the surface:

NoAspiration Constraint: Nothing is aspirated

This constraint must be ranked by the Aspiration constraint to ensure that stops in English (see above) are aspirated. It also must outrank Faith (ASP) to ensure that no aspiration will occur after /s/.

Tableaux: NoASPIRATION constraint exemplified

/paj/	ASP	NoASP	F(ASP)
[paj]	*!		
☞ [p^{h}aj]		*	*

/ p^{h}aj /	ASP	NoASP	F(ASP)
[paj]	*!		*
☞ [p^{h}aj]		*	

/ spaj /	ASP	NoASP	F(ASP)
☞ [spaj]	*!		
[sp^{h}aj]		*!	*
/ sp^{h}aj /	ASP	NoASP	F(ASP)
☞ [spaj]	*!		*
[sp^{h}aj]		*!	

By positing the NoAspiration constraint, we successfully deal with inputs with aspiration, and use the same theoretical devices: *constraints* and *ranking*.

E. Choosing between rules and constraints:

In a derivational approach, sometimes *both* -- rules and constraints -- are needed. Further, in a rule-based phonology, constraints are also needed to account for the *well-formedness* of morphemes having only a single form.

Duplication Problem:

αvoice - αvoice : Sequences of obstruents within the syllable must agree for voicing (English)

*[æbs] *[æpz] *[zti:] *[sbi:] ungrammatical

[ɔks] *ox* [ædz] *adze* grammatical

A constraint-base approach will apply to *all* forms, regardless of the forms being derived or not.

F. The mechanism of OT (p. 16):

1. UG includes
   - a linguistic alphabet
   - a set of constraints
   - two functions, GEN and EVAL
2. The grammar of a particular language includes
   - basic forms fro motphemes (from which inputs are constructed)
   - a ranking for the constraints in CON
3. For each input
   - GEN creates a candidate set of potential outputs
   - EVAL selects the optimal candidate from that set

G. SUMMARY: The rise of OT

OT proposes that UG contains a set of violable constraints:

↓

universal properties of language

Differences between constraint rankings result in different patterns, giving rise to systematic variation between languages.

Important: *All languages have access to exactly the same set of constraints.*

OT views…
• UG as a set of violable constraints • the grammars of specific languages as the language-specific ranking of those constraints

In order to understand the rapid and widespread acceptance of OT, one must understand the theoretical research in linguistics in the late 80's.

Great advances in the 70s and continuing into the 80's – resulting in the non-linear representation that now is widely accepted.

There was great hope that the characterization of alternations would be simplified – this did not happen.

Efforts were directed at formally restricting the possible types of alternations. These effort were unsuccessful, because
- the formal models included alternations that are both unattested and unlikely
- there were counter examples

Generative phonology:

This model looks neat, until the role of constraints is added.

Phonology in the 70's and 80's:

constraints hold here ⟹ UR

constraints hold here ⟹ rules

constraints hold here ⟹ PR

Assumption: constraints are unviolable!
Result: frustration with their role in grammar, for it is difficult to find a constraint that is never violated.

In derivational phonology it is assumed that the grammar with fewer rules is simpler than a grammar with more rules; i.e., the fewer rules, the better the analysis.

But: would this mean that the simpler grammar would be the one where there are no rules, i.e., *all inputs are identical to all outputs*.

Problem: no simple grammars without phonological rules have ever been found.

Why should complexity be a problem?

OT: redefines the role of constraints.

All constraints are violable.

Problematic issues (addressed by OT):

i. It defines a clear and limited role for constraints
   - each constraint is universal
   - constraints are ranked in EVAL

ii. It eliminates the rule component entirely

- different constraint ranking in EVAL express language variability

iii. It focuses research directly on language universals
- each constraint is universal

iv. It resolves the "nonuniversality of universals" problem
Universals don't play the same role in every language!

Question: is there an input at all?
Recent works have argued that instead of input representations, morphemes are best expressed as constraints themselves. As such, they may be ranked with respect to other (non-morphemic) constraints.

H. How does OT address the issues that concerns linguists (p. 17)?

a. LANGUAGE VARIATION is characterized as different rankings of the same set of constraints.
b. SPECIFIC PATTERNS are derived from language-particular rankings of these constraints.
c. UNIVERSALS are present in the universal – but violable – constraints.
d. MARKEDNESS is inherent in the model.

- each constraint is a markedness statement
- specific aspects of markedness result from ranking.

I. Applications of OT

First language acquisition:

Under OT, acquiring a language is acquiring the *constraint ranking* of that language. Since constraints interact, a particular ranking of constraints may not be noticed by the learner: some constraints will be ranked incorrectly, to be re-ranked when further data is available.
This predicts specific stages that a child might go through, each of which would reflect *the incorrect dominance of some universal constraint*.

This prediction is different from that of a rule-based model, in which a child might incorrectly learn a language-specific rule, which in itself may have little claim to universality.

Second language acquisition:

When an adult learns a second language, it is spoken with some degree of accent. Understanding the nature of accent is complex – too many variables!

OT provides a guide to identifying patterns we might expect in specific accents, by identifying the constraint ranking of the native language and second language.

Language acquisition summary (L1 and L2):

1. early grammar (L1)
2. learner's grammar (L2)

} → *at every stage of their development reflect <u>possible</u> grammars*; *these grammars differ from adult language or L1 <u>in predictable ways</u>*;

A crucial part of the acquisition process (L1 or L2) involves *re-ranking the constraints on the basis of positive evidence*.

Additional applications of OT:

- poetics
- behavior of borrowed words
- language change
- natural language perception
- natural language production
- computational modeling of language

} Study pp. 30-32.