

# Introduction to constraint-based phonology

ACTL Summer School 2018

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DAY 1

Phonotactics, alternations & some OT basics

# Introduction

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# Introduction

Phonological learning; experimental phonology; prosody/intonation;  
Singapore English

- Dissertation: *On the relationship between phonotactic learning and alternation learning* (Uni. California, Los Angeles)



Kie Zuraw



Megha Sundara



Bruce Hayes

# Goals for this mini-course

- Introduction to phonological analysis
- Focus on constraint-based phonology – Optimality Theory and its cousins
- Provide a foundation to allow you to engage independently with the theoretical phonological literature
- Brief introduction to some areas of some current areas of research within constraint-based frameworks: (by no means exhaustive!)
  - Typology & variation

# What I'm assuming you know:

- Speech sounds (IPA) and phonetic features
- (Maybe): some intro to linguistics phonemic analysis (allophones vs. phonemes)

NB: I'm providing some suggested further readings related to each day's topic, but there's no expectation that to do these before we meet each day, and we won't address these directly in each class.

- You won't need to worry too much about features for the course, but knowing these will be helpful for just thinking about data.

# Before we start:

- What is your area in linguistics?
- Have you taken intro phonetics and know the IPA, and how to classify speech sounds according to phonetic features?
- Have you taken some kind of introductory phonology module? (beyond what might be covered in intro linguistics)
- Are you familiar with rule-based phonology?
- Are you familiar at all with Optimality Theory?

# Tentative schedule

- M: Alternations, phonotactics & OT intro
- T: OT Intro II
- W: More on constraints and constraint interaction
- Th: Conspiracies & typology in OT
- F: Variation in constraint grammars

We'll see how  
this goes in  
terms of time!

- Slides will be posted on:

<https://www.adamjchong.com/actl---2018.html>

# Some key terms:

- **Phoneme vs. allophone (classical notions)**

- phonemes → contrastive sounds                      /p/
- allophones → predictable from context              [p] vs. [p<sup>h</sup>]  
(e.g. aspiration in English)

- **Morpheme:** minimal unit of meaning (e.g. past tense in English, -s)



# Doing phonological analysis

- Goal: coming up with the generalization that accounts for the distribution/patterning of sounds in a language (dataset)
  - What is predictable from context?
  - What is not predictable?
- The claim: speakers implicitly know these patterns in their minds, and have well-formedness intuitions about whether a particular word sounds 'strange' in their native language - productive

# Bread and butter of phonology:

## *Phonological alternations*

- ... a **morpheme** (like the English regular plural suffix) can have multiple **allomorphs** (*allo-* comes from Ancient Greek *állos* meaning ‘other’).
- When a morpheme has more than one allomorph, we say that it **alternates**
- We can also say that a **phoneme alternates** when it surfaces with different **allophones** in different allomorphs of some morpheme.

# More key ideas:

- **Contrastive distribution:** a pair (set) of sounds occurs in the **same** environments.
  - E.g. in English: [spok] ‘spoke’ vs. [p<sup>h</sup>op] ‘pope’
  - [p] and [k] are in the same environment (after [o], at the end of the word, o\_#) → allophones of the different phonemes
- **Complementary distribution:** a pair (set) of sounds occur in **different** (non-overlapping) environments.
  - E.g. in English: [spok] ‘spoke’ vs. [p<sup>h</sup>op] ‘pope’
  - [p] and [p<sup>h</sup>] do not occur in the same environment → allophones of the same phoneme (category)
  - Given a particular context/environment -> predictable what you should get!

# Diving in: English plural

['pi-z]	'peas'	['dɒg-z]	'dogs'	['mit-s]	'mitts'
['gɒŋ-z]	'gongs'	['læb-z]	'labs'	['blɒk-s]	'blokes'
['dɒl-z]	'dolls'	['sɒlɪd-z]	'solids'	['kɒf-s]	'coughs'
['pæn-z]	'pans'	['weɪv-z]	'waves'	['slæp-s]	'slaps'
['plʌm-z]	'plums'	['saɪð-z]	'scythes'	['mɪθ-s]	'myths'
['stɑː-z]	'stars'				

# Other assumptions

- We're assuming some kind of **underlying representation** (form) – what we think is represented in speakers' minds.
- What we see on the surface then is a **surface representation** (form) – what is pronounced.
- So part of understanding phonology is understanding how underlying forms are produced as surface forms – what changes and why?
  - Note: This is NOT the only possibility!

# More of the same? English past tense

['wɔ:k-t]	'walked'	['lɔ:g-d]	'logged'
['hɪs-t]	'hissed'	['fɪz-d]	'fizzed'
['lɒp-t]	'lopped'	['lɒb-d]	'lobbed'
['tʃeɪf-t]	'chafed'	['ʃeɪv-d]	'shaved'
		['plæn-d]	'planned'
		['mo-d]	'mowed'

Now what about the past tense morpheme?

# Bread and butter of phonologists:

## *Phonological alternations*

- ... a **morpheme** (like the English regular plural suffix) can have multiple **allomorphs** (*allo-* comes from Ancient Greek *állos* meaning ‘other’).
- When a morpheme has more than one allomorph, we say that it **alternates**
  - “The English plural suffix alternates [-s] after non-strident voiceless sounds, and [-z] elsewhere.”
  - “In the English regular plural suffix, we observe an alternation among [-s], and [-z]”
- We can also say that a **phoneme alternates** when it surfaces with different allophones in different allomorphs of some morpheme.
  - “In English, /z/ alternates between [z] and [s]. This can be observed in the regular plural suffix, and also the possessive suffix.”

# Accounting for these with rules

- ‘Dynamic’ generalizations (alternations)
  - ‘dynamic’: a single morpheme has more than one phonological form – overt evidence
- In rule-based phonology (*Sound Patterns of English (SPE)*, Chomsky & Halle, 1968):
  - Phonological rules: **A -> B / C\_\_D**
  - CAD (C\_D)** = structural description – configuration that triggers the rule
  - A -> B** = structural change



## EXERCISES:

Russian stops

# How would you account for these?

['æftə]	'after'	['ædz]	'adze'
['læps]	'lapse'	['æbdəmən]	'abdomen'
['lɪsp]	'lisp'	['ʌlɡbi]	'rugby'
['wɪsk]	'whisk'	['hʌzbənd]	'husband'
['wɪskə]	'whisker'	['mægdələn]	'Magdalene'
['stɑː]	'star'	['wɪzdəm]	'wisdom'
['spɪə]	'spear'		

BUT \*['læbs], ['sbiə], etc.

How would you rule out unattested roots?

# 'Static' generalizations (phonotactics)

- 'Static': purely distributional information about observed forms in the lexicon
- **In UG classes: you may have stated these as phonemic rules (much like the ones that deal with alternations)**

**But you have to deal with figuring out what is the underlying form!  
Why is this a little weird?**

## EXERCISES:

Ayjininka nasals

# On MSCs

- In traditional phonemic analysis, you'd account for using a rule that ensures the lexicon only contains phonotactically legal forms
  - **Morpheme Structure Constraints (MSCs): constraints on the phonological make-up of morphemes in the lexicon**
  - **Or Morpheme structure rules: across-the-board rules**
- These are a tad strange: no one is claiming in the first place that the lexicon contains a form like /sbiɹ/ that is repaired to [spiɹ].
- Why would a learner ever posit such an underlying form if they only ever heard the form with agreeing voicing?

# Duplication problem

“In many respects, [lexical redundancy rules] [AC: a.k.a. MSCs] seem to be exactly like ordinary phonological rules, in form and function” (Chomsky and Halle 1968: 382).

This became known as the **Duplication Problem** - the same generalization is stated twice – MSCs and phonological rules

In English: the voicing alternation and the static distribution of obstruent clusters seems to derive from the same generalization – Obstruent clusters have to agree in voicing.

# Constraints lurking around the place

## Yawelmani:

a. /xat-hin/ → [xat.hin] 'eats'  
/gop-hin/ → [gop.hin] 'cares for a baby'

. = syllable boundary

/ʔa:ml-hin/ → [ʔa:mi.l.hin] 'helps'  
/logw-hin/ → [lo.giw.hin] 'pulverizes'  
/paʔt-hin/ → [pa.ʔit.hin] 'fights'

What rule accounts for  
vowel-insertion here?

b. /giti:n-hnil/ → [gi.ti:n.nil] 'hold.under.arm-  
passive.consequent.adjunctive'

What rule accounts for  
h-deletion here?

# Conspiracies

- The two rules you have in Yawelmani – seem to be doing the same thing: what is it?
- The rules conspire to resolve triconsonantal clusters.
  - Either by deleting a consonant or inserting a vowel.
- \*CCC -> a **markedness constraint** – triconsonantal clusters are dispreferred (typologically)
- (see Kenstowicz & Kissberth 1979)



# Constraints as triggers and blockers in rule-based analyses

- In the '70s, constraints were used in rule-based frameworks as context-free rules (i.e. applied across the board!)
- Could either trigger (cause a rule to occur) or block (stop a rule from occurring)
- Seemed to solve the 'conspiracy' issue
- Gives a theoretical status to the notion of 'markedness'
  - Some structures are preferred cross-linguistically over others

- Going back to **Ayjininka nasals**

- How might you account for the distribution using a morpheme structure constraint?

# Where rule-based models fall short

- **Duplication problem:** No real connection between MSCs and rules, even though they did the same thing
- **Accounting for ‘conspiracies’:** No real connection between different rules that seemed to be functioning in the same way despite being different processes

# A 'conceptual crisis'

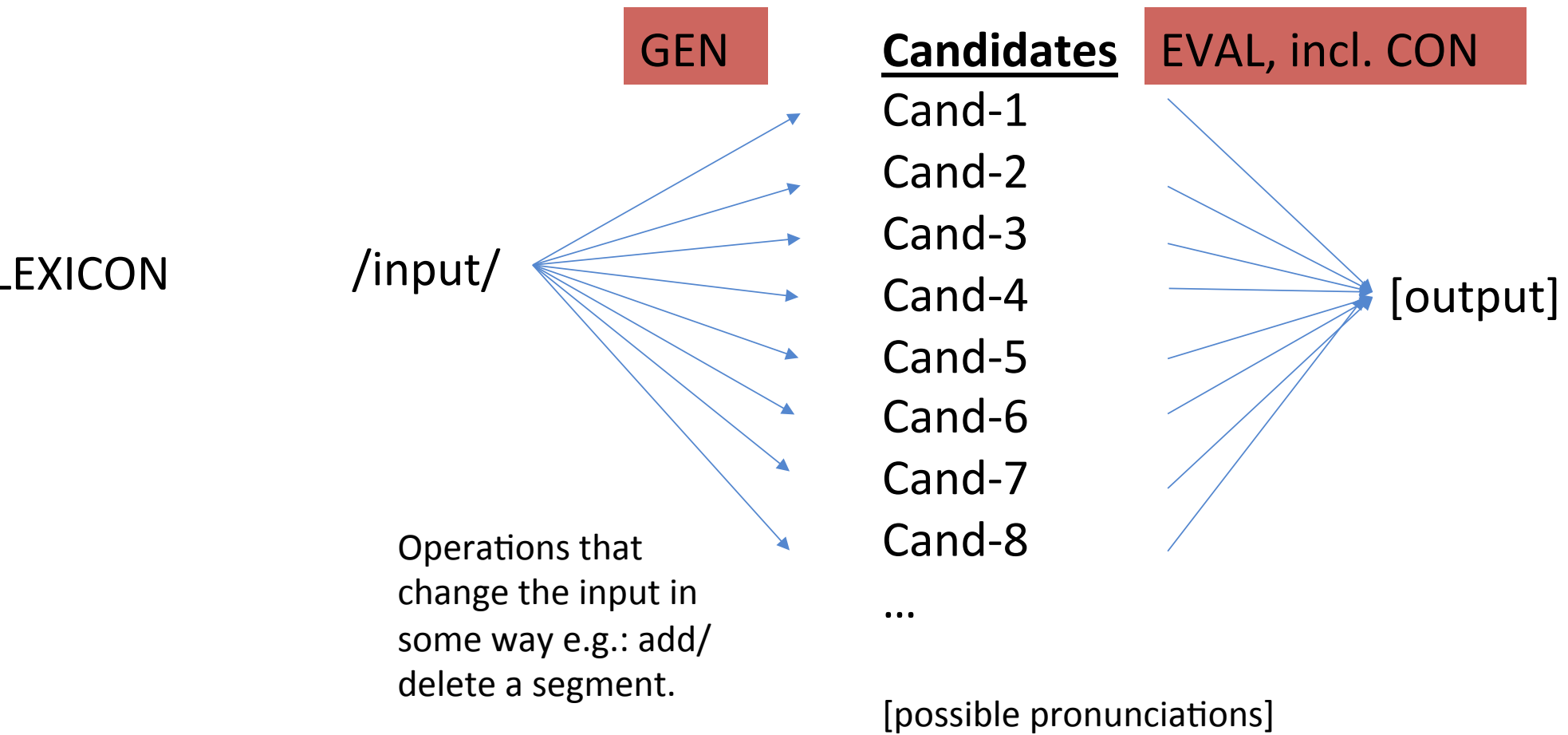
“What is clear is that any serious theory of phonology must rely heavily on wellformedness constraints [...]. What remains in dispute, or in subformal obscurity, is the character of the interaction among the posited well-formedness constraints, as well as the relation between such constraints and whatever derivational rules they are meant to influence. Given the pervasiveness of this unclarity, and the extent to which it impedes understanding even the most basic functioning of the grammar, it is not excessively dramatic to speak of the issues surrounding the role of well-formedness constraints as involving a kind of conceptual crisis at the center of phonological thought.”

(Prince & Smolensky 1993/2004, p. 1)

# Optimality Theory (OT)

- Prince & Smolensky (1993/2004) - Available online as PDF (ROA)
- A **constraint**-based approach to grammar
  - The grammar imposes restrictions on how a form should be pronounced
  - Dispenses with rules!
- This course: *Classical* OT (but we'll see some variation on this on Friday)
- Key idea: both dynamic and static generalizations captured with same mechanism (we'll see how this works tomorrow)

# Architecture of OT



# GEN(erator)

- GEN is the component of the grammar that creates the candidate set.
  - Possible pronunciations of a given input
- Free to posit any amount of structure (*Freedom of analysis*)
- Only restriction: assumed elements from universal set of linguistic structures (e.g. segmental structure, features etc.)

# EVALuator

- This is where the action is at!
- Role of EVAL akin to a filter – based on whatever criteria (i.e. constraints) filters out the various candidates proposed by GEN to produce the best one (i.e. optimal).
- Does this by assigning the violations of each candidate has against a set of language specific hierarchy of a set of universal constraints



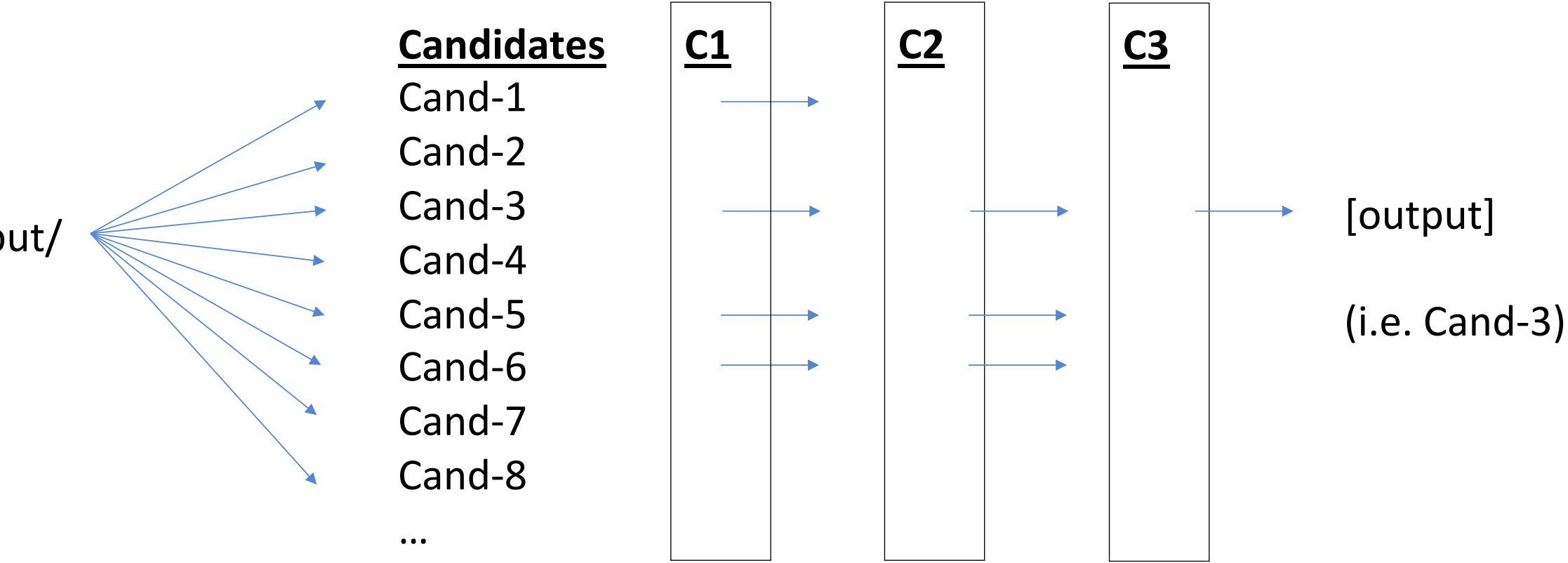
# CON(straints)

- A part of EVAL
- Constraints = restrictions of forms of words/morphemes (candidates produced by GEN)
- Basically require a particular candidate to satisfy some conditions
- Assumed to be a universal inventory: innate/part of UG (though some constraints might be universal templates, filled in by language-specific morphemes, etc.).

# Constraints as filters

- You can think of constraints as filters
- They whittle down a candidate set until you have a unique candidate left!

# How do constraints work in an OT grammar?



# Let's see how this might work with a real life example: what to eat?

Restaurant choice	Duck & Waffle	Dishoom	Four Seasons Chinese	Roti King	McDonald's
Expensive?	\$\$\$\$	\$\$\$	\$\$	\$	\$
Average Deliciousness rating	4/5	4.5/5	3.5/5	4.5/5	1.5/5
Good For Groups	Y	N	Y	N	Y
Takes Reservations	Y	Y (before 6pm)	Y	N	N
Spicy?	N	Y	N	Y	N

Let's see how this might work with a real life example – think of it as a decision tree

Restaurant?	BeDELICIOUS
a. Roti King	
b. Dishoom	
c. McDonald's	
d. Four Seasons	
e. Duck & Waffle	

Operationalizing some constraints into binary categories:

**BeDelicious:** Scores above 3 out of 5 on average rating

**Exp:** More than \$\$

# Constraints

- Violable: *constraints can be violable ('soft constraints')*, but as much as possible this should be minimal
  - No candidate will, in principle, satisfy ALL constraints
- Strictly-ranked: *a violation of a higher-ranked constraint trumps that of a lower-ranked one.* (i.e. it can't be offset by a lower ranked violation)
- Cross-linguistic differences arise from differences in the ranking of these constraints wrt each other
- Phonology: an **optimization** problem (hence the name!)

# Summary

- Generalizations: alternations and phonotactics
- Constraints in grammar – a short history

# Next time:

- Tuesday: More on constraints, details about Faithfulness constraints and correspondence theory
- Wednesday/Thursday: More on constraints and constraint interaction
  - What are some nice effects that you get with OT?
    - TETU – low ranked constraints act up! (Wednesday)
    - Heterogeneity of process/homogeneity of targets (Thursday)



# Further resources on OT introductions

- Prince, A. & Smolensky, P. (1993/2004). *Optimality Theory: Constraint interaction in Generative Grammar*. ROA  
[<http://roa.rutgers.edu/files/537-0802/537-0802-PRINCE-0-0.PDF>]
- Kager, R. (1999). *Optimality Theory*. Cambridge: CUP.
- McCarthy, J.J. (2002). *A thematic guide to Optimality Theory*. Cambridge: CUP.
- McCarthy, J.J. (2008). *Doing Optimality Theory*. Oxford: Blackwell.
- Rutgers Optimality Archive: ROA [<http://roa.rutgers.edu/>]
- Kenstowicz, M. & Kisseberth, C. (1979). *Generative Phonology*. San Diego: Academic Press.