Introduction to constraint-based phonology

ACTL Summer School 2018

Adam J. Chong
a.chong@qmul.ac.uk

DAY 2
More on OT

So far… (note some changes)

- ~~M: Phonotactics and alternations; Intro to OT~~
- T: More on OT (finish up basic mechanics)
- W: Constraint interaction: TETU + Contrast
- Th: Typological variation continued - conspiracies;
  Constraint approaches to within-lg. variation I
- F: Constraint approaches to within-lg. variation II; Wrap-up

Quick recap:

- Differences between static and dynamic generalizations
- How these were accounted for in rule-based frameworks
- Optimality Theory (OT): parallel constraint-based framework
  - GEN, EVAL/CON
  - Phonology = optimization problem

Today

- A theory of CON = constraints

Constraints: overview

- Markedness constraints are constraints on the *output* (they generally require articulatory ease, or perceptual clarity, or other "natural" drives).
- e.g., *CCC (marked because middle consonant is hard to perceive)

- Faithfulness constraints are constraints on the *relationship* between the input and the output (they require similarity).

Markedness constraints

- Markedness – old notion in phonology

- The idea that some forms are better than others, because:
  - They're easier to produce, perceive, process
  - Typologically more common
  - Simpler

- Relative concept: something is marked relative to some other comparable linguistic structure (Unmarked > Marked)

Markedness constraints

- In OT, constraints can be formulated to penalize marked structures
  - E.g. Syllables must have an onset
  - E.g. Vowels should be oral, etc.

- They restrict what a SURFACE form should look like

- Markedness constraints can only look at the output (i.e. possible candidates spit out by GEN) and not the input

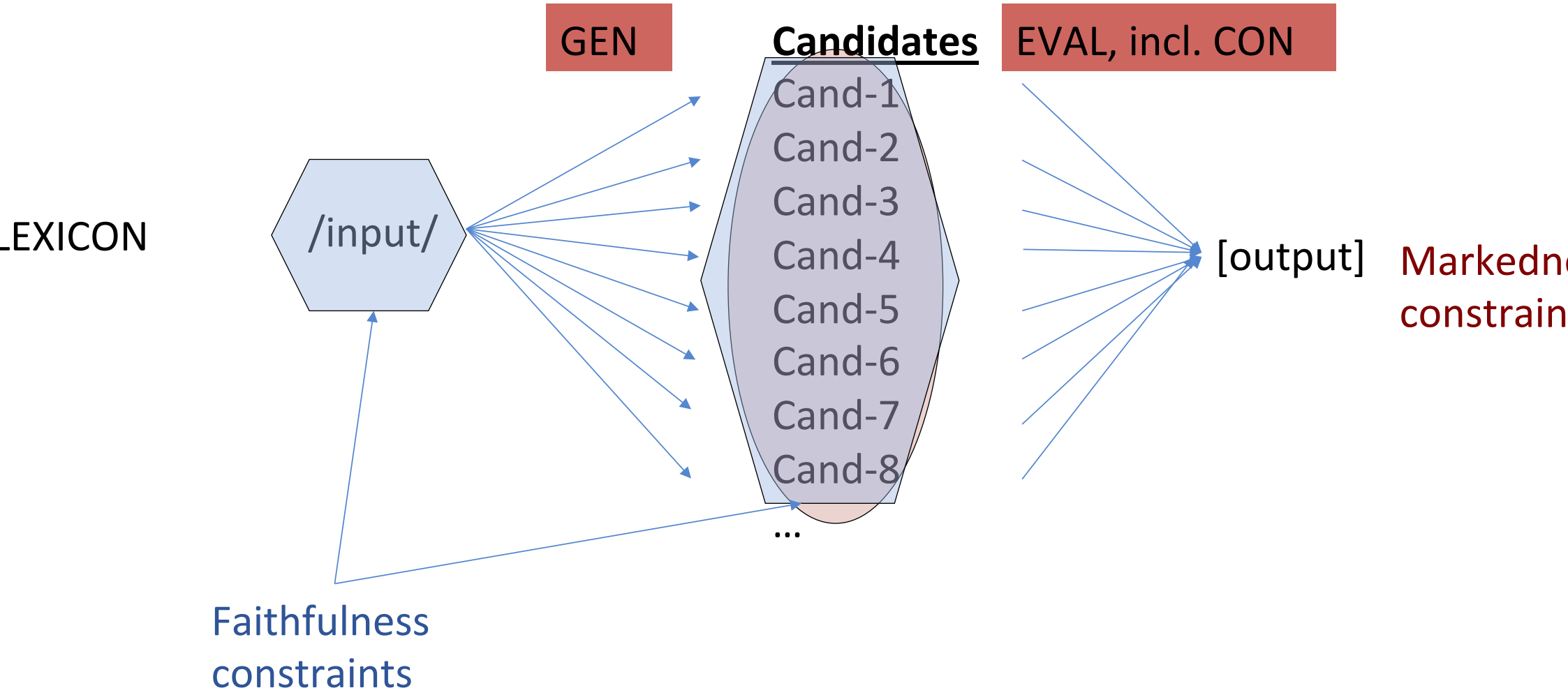
Markedness constraints

- What happens if we just had markedness constraints?
- What's to stop a language from just keep simplifying a form until it is the least marked?
- What one needs is a counterweight against markedness constraints!

Faithfulness constraints

- Prefer surface forms that are like underlying forms (serves to protect contrasts)
- Refers to the both the INPUT and OUTPUT
- All else being equal, faithfulness constraints prefer identity between the input and output
- So while candidates that can deviate from the input to satisfy markedness constraints, faithfulness constraints counteract this effect – conflict!

Architecture of OT



A detour into formalism

- Standard way to present analysis is in **tableau** (plural: **tableaux**): contains input, candidates (from GEN), constraints and constraint violations

Linear order = ranking: Constraint A ≫ Constraint B ≫ etc.
≫ = 'dominates' or 'is ranked higher than' or 'outranks'

/input/	CONSTRAINT-A	CONSTRAINT-B	CONSTRAINT-C	CONSTRAINT-D
☞ a. Candidate A				*
b. Candidate B	*!	*		
c. Candidate C			*!	
d. Candidate D		*!		*

Not all possible candidates are shown!

Note that not all constraints are shown!

A detour into formalism

- Standard way to present analysis is in **tableau** (plural: **tableaux**): contains input, candidates (from GEN), constraints and constraint violations

e put a little right-pointing finger next to the candidate that wins!

/input/	CONSTRAINT-A	CONSTRAINT-B	CONSTRAINT-C	CONSTRAINT-D
☞ a. Candidate A				*
b. Candidate B	*!	*		
c. Candidate C			*!	
d. Candidate D		*!		*

ch asterisk in each cell = that particular candidate (row) violates that particular constraint (column) once
e ! = **fatal** violation (violation that rules out the candidate)
e greyed columns = cells that don't matter in determining the winning candidate

Revisiting English obstruent cluster voicing

Let’s see how a single constraint grammar can account for both static and dynamic patterns in English

Let’s put this together with an example: Russian devoicing

genitive singular	***nominative sing.***		***gen. sg.***	***nom. sg.***	
[vagona]	[vagon]	‘wagon’	[pruda]	[prut]	‘pond’
[avtomobilʲa]	[avtomobilʲ]	‘car’	[soldata]	[soldat]	‘soldier’
[vet͡ʃera]	[vet͡ʃer]	‘evening’	[xleba]	[xlep]	‘bread’
[muʒa]	[muʃ]	‘husband’	[griba]	[grip]	‘mushroom’
[karandaʃa]	[karandaʃ]	‘pencil’			
[raza]	[ras]	‘time’			
[lesa]	[les]	‘forest’			
[vraga]	[vrak]	‘enemy’			
[uroka]	[urok]	‘lesson’			

Generalization

genitive singular	***nominative sing.***	
[vagona]	[vagon]	‘wagon’
[avtomobilʲa]	[avtomobilʲ]	‘car’
[vet͡ʃera]	[vet͡ʃer]	‘evening’
[muʒa]	[muʃ]	‘husband’
[karandaʃa]	[karandaʃ]	‘pencil’
[raza]	[ras]	‘time’
[lesa]	[les]	‘forest’
[vraga]	[vrak]	‘enemy’
[uroka]	[urok]	‘lesson’

gen. sg.	***nom. sg.***	
[pruda]	[prut]	‘pond’
[soldata]	[soldat]	‘soldier’
[xleba]	[xlep]	‘bread’
[griba]	[grip]	‘mushroom’

No voiced obstruents in at the end of the word!

Russian generalizations

- In Russian, voiced obstruents are dispreferred (they violate some kind of markedness constraint).
- Russian avoids (i.e. repairs) voiced obstruents in coda position.
- Markedness constraint: *VOICED-CODA

- We also need a constraint against changing anything: FAITH
  - We'll just have this general faithfulness constraint for now
  - i.e. Don't change anything!

Working through the analysis

Input: /vrag/	*VOICED-CODA	FAITH
a. [vrag]		
☞ b. [vrak]		

Evaluation of *Voiced-Coda

- *VOICED-CODA = no voiced coda obstruents

Input: /vrag/	*VOICED-CODA	FAITH
a. [vrag]	Violates (once)	
☞ b. [vrak]	No violation	

- Why can't it just be "no voiced codas"?

Evaluation of FAITH

- FAITH: Don't change anything!

Input: /vrag/	*VOICED-CODA	FAITH
a. [vrag]	Violates (once)	No violation
☞ b. [vrak]	No violation	Violates (once)

Assigning violations - *

- Assign an * each time a candidate violates a given constraint

Input: /vrag/	*VOICED-CODA	FAITH
a. [vrag]	*	
☞ b. [vrak]		*

- If a constraint is not violated by a given candidate, you just leave the cell blank.

Assigning violations - *

- Assign an * each time a candidate violates a given constraint

Input: /vrag/	*VOICED-CODA	FAITH
a. [vrag]	*	
☞ b. [vrak]		*

- If a constraint is not violated by a given candidate, you just leave the cell blank.

Fatal violation

- Assign your fatal violation with !
  - Fatal = the constraint that knocks out that candidate in the competition

Input: /vrag/	*VOICED-CODA	FAITH
a. [vrag]	*!	
☞ b. [vrak]		*

This is called a RANKING argument

What would the re-ranking of constraints look like?

Input: /vrag/	FAITH	*VOICED-CODA
💣 a. [vrag]		*
☹ b. [vrak]	*!	

- This isn't to say that this is not a possible language – it's just not the ranking that reflects this language.
- In fact: you SHOULD see languages with this pattern given the possible rankings (Thursday – Typology)

Other symbols commonly used in OT tableaux

- 💣: candidate that is not the correct surface form but that wins under the constraint ranking shown [which must therefore be wrong or incomplete!]
- ☹: candidate that should have won (is the correct surface form) but doesn't win in this incorrect/incomplete tableau
- People do use different symbols for these – it's best to define them in a paper to be maximally clear!

Does the input matter?

- We've changed the input here, is the output the same?

Input: /vrak/	*VOICED-CODA	FAITH
a. [vrag]	*!	*
b. [vrak]		

Richness of the base

- There are no constraints that constrain what appears in the lexicon

(i.e. there are no MSCs)

- Remember! Generalizations are stated over outputs!

- Phonological contrast: result of constraint ranking (we'll see more of this on Thursday)

Richness of the base

- In practical terms:

For the most part, your analysis should guarantee the correct output regardless of the input forms!

Wait…how do we decide what is an underlying form?

- **Lexicon Optimization:** (Prince & Smolensky, 1993: 209)

If there is no evidence otherwise (e.g. alternations), assume that the input is closest to the output

- Pick the most 'harmonic' input (as compared to other hypothetical inputs that could have produced the same output) – incurs the least violations of faithfulness

Illustration (From: McCarthy, 2002)

- In English, no words begin with [ŋ].

Input: /ŋaʊ/	*#ŋ	FAITH
a. [ŋaʊ]	!*	
☞ b. [naʊ]		*

Illustration (From: McCarthy, 2002)

- Compare each possible mapping:

		*#ŋ	FAITH
Input: /naʊ/	a. [ŋaʊ]	!*	*
	☞ b. [naʊ]		
Input: /ŋaʊ/	a. [ŋaʊ]	!*	
	☞ b. [naʊ]		*

Which maps more harmonically – i.e. incurs fewer violations of faithfulness?

Upshot: OT characteristics

- The same system accounts for static and dynamic phonology – constraints
- The burden of explanation is located primarily on CON
- Parallel model – not a serial model – there's only one derivation

More on constraint ranking

- **Transitivity**: if A >> B, and B >>C, then A >> C
- **Irreflexivity**: A cannot dominate A
- **Asymmetry**: if A >> B, then B cannot dominate A

An aside about defining constraints

- Consider the following constraint definitions:
  - NoCoda1: Assign a violation if the candidate contains a coda.
  - NoCoda2: Assign a violation for every coda.

- How many times does a candidate like [bak.pad] violate each constraint?

- What is the issue here?

An aside about defining constraints

- Upshot: A good constraint should make it very clear how violations are assessed and assigned

- McCarthy (2008) (*Doing OT*) has a really nice discussion of how to define your constraints

More on Faithfulness constraints

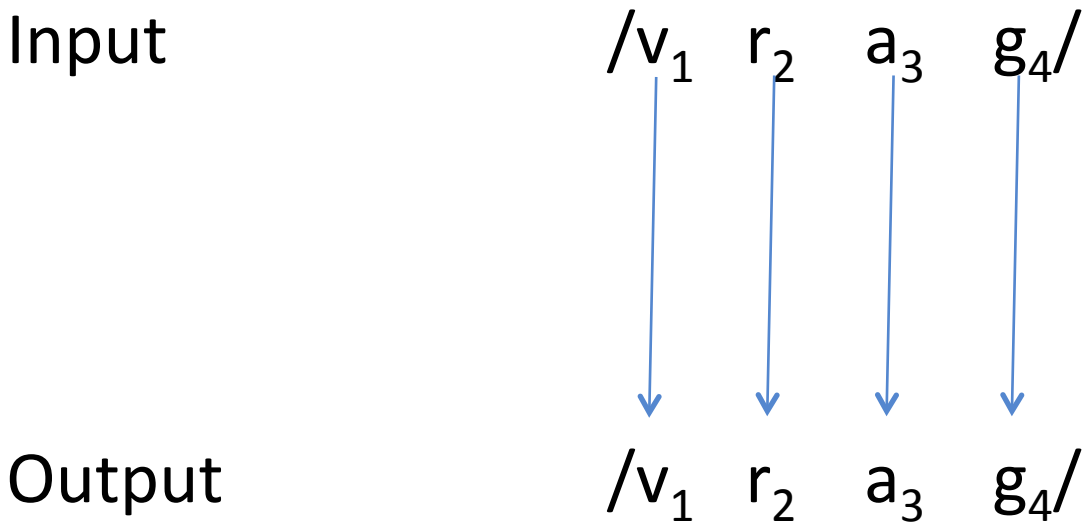
- So far we've left Faithfulness constraints as 'don't change'
- But there are MANY ways in which changes can be made between input and output!
- **Candidate generation:** This set is technically infinite!
  - The set of candidates is the set of all possible output forms, employing every combination of
  - changing feature values. (e.g. [+voice] -> [-voice])
  - deleting segments
  - inserting segments
  - swapping segments' order
  - fusing and splitting segments

A theory of faithfulness: Correspondence

- Faithfulness constraints (unlike markedness ones): evaluate the change between input and output
  - So it's basically evaluating the mapping between from one form to another potential form

- Correspondence Theory (McCarthy & Prince, 1995, 1999)
  - Each segment, feature, constituent etc. in the input has some correspondence with a segment, feature, constituent in the output

Visualizing correspondence



- Each segment in the input has some correspondent in the output.

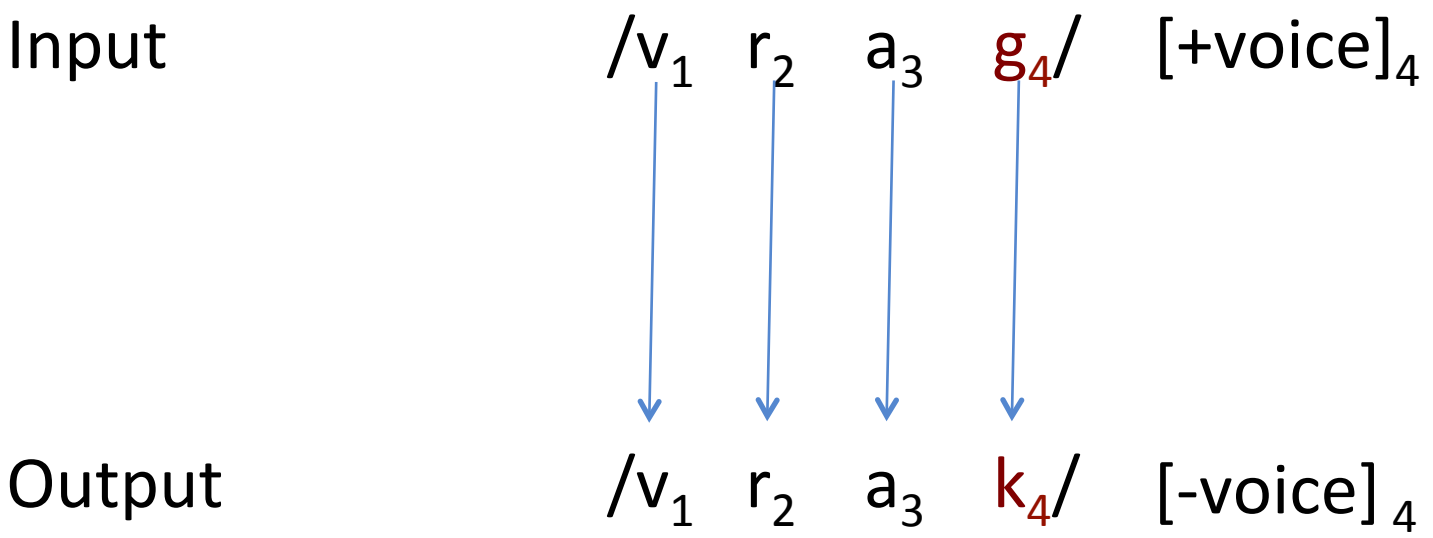
Identity (IDENT-IO[FEAT])

Identity between input and output segment

Mitigates against: changing feature values. (e.g. [+voice] -> [-voice])

Definition: Assign one violation for every change in the feature X that is in the input that is not in the output

Visualizing correspondence

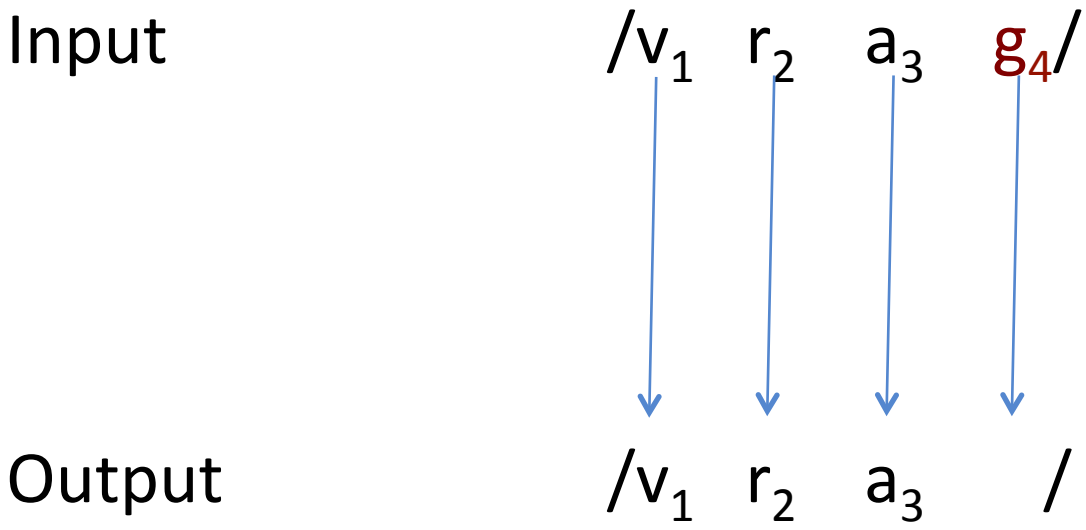


- Each segment in the input has some correspondent in the output.

Maximality (MAX)

- You'll often see MAX-IO (IO = INPUT-OUTPUT)
- Every input segment must have a corresponding output (i.e. Don't delete!)
- Definition: Assign one violation mark for every segment in the input that does not have a correspondent segment in the output

Visualizing correspondence



- Each segment in the input has some correspondent in the output.
- /g_4/ does not have a correspondent in the output – so this candidate violates Max

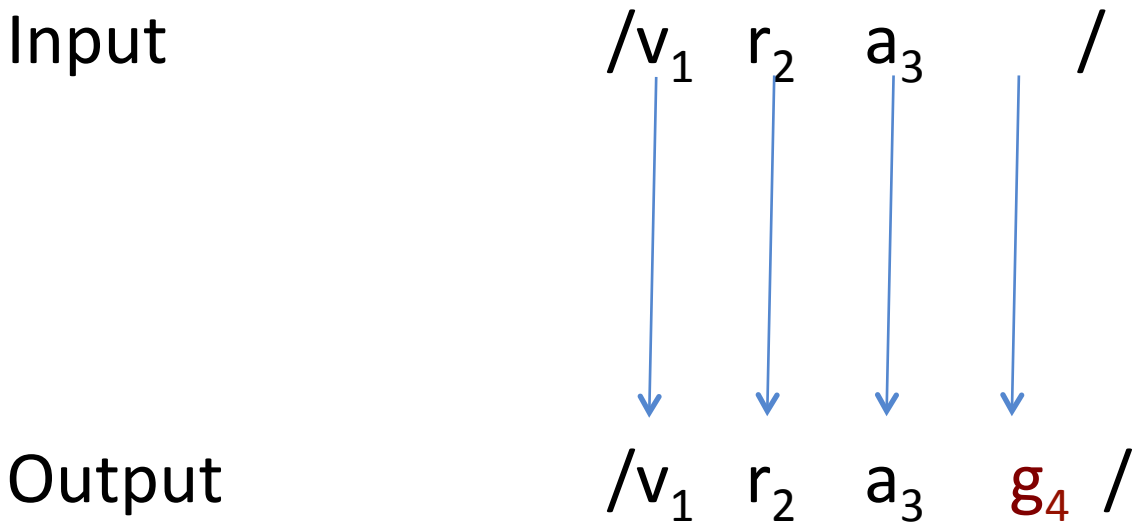
Dependence (DEP)

- You'll often see DEP-IO (IO = INPUT-OUTPUT)

- Every output segment must have an input correspondent (i.e. Don't insert/epenthesize!)

- Definition: Assign one violation mark for every segment in the output that does not have a correspondent segment in the input

Visualizing correspondence



- Each segment in the input has some correspondent in the output.
- /g_4/ does not have a correspondent in the input – so this candidate violates Dep

Other Faithfulness constraints

- Integrity: Splitting is penalized by **INTEGRITY**
- Uniformity: Coalescing is penalized by the constraint **UNIFORMITY**
- Linearity: Reordering (metathesis) is penalized by the constraint **LINEARITY**
  - Technically, LINEARITY would penalize coalescence too, since the precedence relationships would be lost by merging two sounds.

Illustrating UNIFORMITY

- /$b_1a_2i_3$ / → [$b_1e_{2,3}$]

/$b_1a_2i_3$ /	*VV	MAX-IO	UNIFORMITY
a. $b_1a_2i_3$	*!		
b. b_1a_2		*!	
c. b_1i_3		*!	
☞d. $b_1e_{2,3}$			*

Is faithfulness just possible between input and output?

- No – faithfulness constraints have been proposed for other types of correspondences

- Base-Reduplicant (BR): In reduplication, the correspondence between the base and the reduplicant

- Output-Output (OO): 'phonological faithfulness relation between derived output and an output base' (Benua, 1997: 7)

Illustration: Base-Red faithfulness

Overapplication of nasalization in Malay: In Malay (Austronesian): within a word, all vocoids (vowels + semivowels) that follow a nasal are nasalized. Vocoids that are not in this position are oral. (Mc&P, 1995; 1999)

[waŋĩ] ‘fragrant’ *[w̃ãŋĩ], *[waŋı]

But, when the stem is reduplicated as an intensifier:

[waŋĩ] ‘fragrant’ → [w̃ãŋĩ-w̃ãŋĩ] ‘very fragrant’

Illustration: Base-Red faithfulness

Constraints:

*NV_{oral}: Assign one violation mark for every oral vocoid that follows a nasal in the same word (gradient)

*V_{nasal}: Assign one violation mark for every vocoid with the feature nasal

IDENT-IO(nas): Assign one violation mark for every change in the feature value of [nasal] between input and output.

Illustration: Base-Red faithfulness

/waŋĩ/	*NV$_{ORAL}$	*V$_{NASAL}$	IDENT-IO(NAS)
☞a. waŋĩ		*	
b. w̃ãŋĩ		**!*	**
c. waŋɪ	*!		*
d. wãŋĩ		**!	*

Illustration: Base-Red faithfulness

High-ranking:

Ident-BR(nasal): Assign one violation mark for every feature [nasal] in the base that has a different value in the reduplicant. (i.e. total identity in [nasal] between base and reduplicant)

/RED+waŋĩ/	IDENT-BR(NAS)	*NV$_{ORAL}$	*V$_{NASAL}$	IDENT-IO(NAS)
a. waŋĩ-waŋĩ		*!*	**	
☞ b. w̃ãŋĩ-w̃ãŋĩ			******	**
c. waŋĩ-w̃ãŋĩ	*!*		****	**

Illustration: Output-output faithfulness

An example from acquisition:

Hayes (2004): in Modern Greek [xe] is an illegal sequence – [x] alternates to [ç] in this context.

[exo] "I have" but [eçete] "You-pl. have" *[exete]

/ex-ete/	*xe	IDENT(PLACE)
☞ a. [eçete]		*
b. [exete]	*!	

Illustration: Output-output faithfulness

BUT: Kazazis (1969) notes that in the speech of Marina, a 4 yo M.G. learning child, [exete] is produced instead!

Child: [exo] "I have" and [exete] "You-pl. have" *[eçete]

The idea is that the child is being faithful to the verbal paradigm (the other verb forms in the conjugation), ie. another output!

/ex-ete/	OO-FAITH ([exo])	*xe	IDENT(PLACE)
a. [eçete]	*!		*
☞ b. [exete]		*	

Summary

- More on the mechanics of OT
- Faithfulness constraints – Correspondence theory
- **Tomorrow** – constraint interaction effects
  - Harmonic bounding
  - TETU
  - Contrast
- **Thursday** – Variation I: Typology/Conspiracies, constraint approaches to within-lg. variation I
- **Friday** – Variation II: Constraint approaches to within-lg. variation II; wrap-up

References

- Hayes, B. (2004). Phonological Acquisition in Optimality Theory: the early stages. In Kager, R., Pater, J., & Zonneveld, W. (eds.). *Fixing priorities: Constraints in phonological acquisition.* Cambridge: CUP.
- McCarthy, J.J., & Prince, A. (1995). Faithfulness and reduplicative identity. *UMOP 18: Papers in Optimality Theory*
- McCarthy, J.J., & Prince, A. (1999). Faithfulness and identity in prosodic morphology. *The prosody-morphology interface,* 9.
- McCarthy, J.J. (2002). *A thematic guide to Optimality Theory*. Cambridge: CUP.