Class 12
Introduction to Opacity

3/22/18

1 Introduction to Opacity

- **Review:** Cyclic effects are cases where processes do/do not apply contrary to expectation because of the influence of morphologically related words.

→ Opacity effects are essentially cases where processes do/do not apply contrary to expectation because of the way they interact with other processes, independent of morphological influences.

  - Cyclic effects can be thought of approximately as morphologically-induced opacity.
  - Non-transparent reduplication-phonology interactions can also be thought of as opacity caused by the properties of reduplication.

- Opacity was originally defined by Kiparsky (1971, 1973) in terms of rule application:

(1) A process $\mathbb{P}$ of the form A→B / C_D is **opaque** if there are surface structures with either of the following characteristics:

  a. **Instances of A in the environment C_D** [*counter-feeding interaction*]
     ⇝ $\mathbb{P}$ is non-surface-*true* (underapplication opacity)
  b. **Instances of B derived by $\mathbb{P}$ in environments other than C_D** [*counter-bleeding interaction*]
     ⇝ $\mathbb{P}$ is non-surface-*apparent* (overapplication opacity)

  - Over-/under-application and non-surface-true/apparent labels due to McCarthy (1999).

- In rule-based terms, such cases can usually be analyzed by saying that some other process $\mathbb{Q}$ applies after $\mathbb{P}$ which obscures the operation of $\mathbb{P}$.

1. **Counter-feeding**: process $\mathbb{Q}$ introduces instances of CAD, to which process $\mathbb{P}$ would have applied if given another chance.

(2) Counter-feeding rule ordering interaction

		/CAD/	/CXD/	
1.	$\mathbb{P}$: A→B / C_D	*CBD*	—	(← *not yet applicable*)
2.	$\mathbb{Q}$: X→A	—	*CAD*	(← *too late for* $\mathbb{P}$ *to apply*)
		[CBD]	[CAD]	

2. **Counter-bleeding**: process $\mathbb{Q}$ removes part of the context (i.e. affects C and/or D), making it unclear why process $\mathbb{P}$ applied in the first place.

(3) Counter-bleeding rule ordering interaction

		/CAD/	/CAX/
1.	$\mathbb{P}$: A→B / C_D	*CBD*	—
2.	$\mathbb{Q}$: D→X	*CBX* (← *no longer clear why* $\mathbb{P}$ *applied*)	—
		[CBX]	[CAX]

- The ordering analysis can be recapitulated by Stratal OT and other serial theories.
  - However, what differentiates opacity from cyclicity is that the non-transparency of process application cannot be tied to morphology.
  - Therefore, process separation by stratum is generally *ad hoc* w.r.t. non-cyclic opacity.

- Classical Parallel OT has serious trouble with some kinds of opacity, because it deals only with the evaluation of surface structures.
  - Opaque processes are by definition those which are either non-surface-true or non-surface-apparent.
  - Nevertheless, there are some types of opacity which standard OT can handle, and some others which we have speculative answers for.

2 Counter-feeding opacity: Raising, syncope, and vocalization in Bedouin Hijazi Arabic

- Two classic examples of counter-feeding/underapplication opacity come from Bedouin Hijazi Arabic (Al-Mozainy 1981).[1]
- Parallel OT cannot derive these interactions using just the constraints involved in the independent processes.
  - For one sub-type, though, it can derive the correct result if we allow a more powerful type of faithfulness constraint.
- While Stratal OT can in principle derive all of these types of interactions, the need to fit each process into a specific stratum might not actually jive with the data in this case.

[1] Data below lifted from 24.962 handout from Edward (Flemming 2013).

2.1 Syncope and raising — counter-feeding on focus

- This dialect has syncope of high vowels in open syllables: $V_{[+high]} \rightarrow \emptyset$ / _CV
  - Similar to Levantine Arabic, but no blocking of first-syllable syncope in #CiCiC#

(4) High vowel syncope — passive verbs w/ underlying /C[i]CiC/ stems (· represents syncope site)

Underlying stem	3sg.masc	3sg.fem	1sg	
/ħizim/	ħ·zim	ħiz·m-at	ħ·zim-t	'be tied'
/ħifir/	ħ·fir	ħif·r-at	ħ·fir-t	'be dug'
/ʃirib/	ʃ·rib	ʃir·b-at	ʃ·rib-t	'be drunk'
/libis/	l·bis	lib·s-at	l·bis-t	'be tied'

  - Applies productively to loanwords: e.g. [s·linder] 'cylinder'

- Short low /a/ becomes high [i] in non-final open syllables: /a/ → [i] / _CV

(5) Vowel raising — active verbs w/ underlying /C[a]CiC/ stems (underline represents raising site)

Underlying stem	3sg.masc	3sg.fem	1sg	
/samiʕ/	s̲imiʕ	sam·ʕ-at	s̲imiʕ-t	'hear'
/ʃarib/	ʃ̲irib	ʃar·b-at	ʃ̲irib-t	'drink'
/labis/	l̲ibis	lab·s-at	l̲ibis-t	'tie'
/salim/	s̲ilim	sal·m-at	s̲ilim-t	(not sure what the right gloss is here)

- In these cases, /a/ → [i] raising has introduced [i] into an open syllable. This is normally the position where [i] → Ø, but we do not observe deletion.

(6) Raising and deletion in passive vs. active

Passive 3sg.masc	vs.	Active 3sg.masc	
/ʃirib/ → ʃ·rib		/ʃarib/ → ʃ̲irib	(not *ʃ·̲rib)
/libis/ → l·bis		/labis/ → l̲ibis	(not *l·̲bis)

  - ⋆ It's worth considering whether an anti-homophony condition could be blocking deletion in the active...

- **Standard analysis:** high vowel deletion applies *before* low vowel raising (counter-feeding interaction).

(7) Counter-feeding rule ordering interaction

	Passive 3sg.masc	Active 3sg.masc	
	/ʃirib-Ø/	/ʃarib-Ø/	
1. High vowel deletion	*ʃ·rib*	—	(← *not yet applicable*)
2. Low vowel raising	—	*ʃ̲irib*	(← *too late for HVD to apply*)
	[ʃrib]	[ʃirib]	

- We can see that if we reversed the order, we'd get a transparent feeding interaction:

(8) Feeding rule ordering interaction in Arabic′

	Passive 3sg.masc	Active 3sg.masc
	/ʃirib-Ø/	/ʃarib-Ø/
1. Low vowel raising	—	*ʃi̲rib*
2. High vowel deletion	*ʃ·rib*	*ʃ·̲rib*
	[ʃrib]	[ʃrib]

- This type of counter-feeding interaction is called *counter-feeding on **focus***, because both processes affect the same segment (the "focus" of the rules).
- This type of interaction is consistent with Parallel OT if we allow a certain type of faithfulness constraint.

2.2 Raising and vocalization — counter-feeding on environment

- In the same dialect, raising can underapply as well:
  - → Raising fails to apply to syllables made open by a glide vocalization process (Johnstone 1967:14).
    - NB: As far as I can tell Al-Mozainy (1981) doesn't talk about cases like these.

- Many Arabic languages have an underlying contrast between final vowels and glides, e.g.

(9) Palestinian Arabic

a. Underlying glide: *dalu* 'pail' ∼ *dalw-ak* 'your pail' ⇒ /dal**w**/

b. Underlying vowel: *ʔabu* 'father' ∼ *ʔabuː-k* (**ʔabw-ak*) 'your father' ⇒ /(ʔ)ab**u**(ː)/

⋆ (Maybe it's really just a difference between short and long vowels?)

- Glides are vocalized if not adjacent to a vowel.
  - /dalw/ → [dalu]

- Low vowels that surface in open syllables due to glide vocalization do not undergo raising:
  - /badw/ 'bedouin' → [b**a**du], not *[b**i**du]

→ **Rule ordering analysis:** Raising > Glide vocalization (counter-feeding)

- This type of counter-feeding interaction is called *counter-feeding on **environment***, because the two processes affect different segments, where one of those segments forms part of the environment for the other process.
- This type of interaction is not amenable to the same faithfulness-based P OT account as counter-feeding on focus.

3 Parallel OT

3.1 Basic constraints in Parallel OT won't work

- In both of these cases, the interaction of the basic constraints we need for the processes independently can only yield **transparent** interactions in Parallel OT, i.e. **feeding** or **bleeding**.

→ This is obviously not what we want.

(10) Process rankings

a. High vowel deletion: *i/_CV ≫ MAXV-IO
b. Low vowel raising: *a/_CV ≫ IDENT[low]-IO
c. Vocalization: W//V ≫ IDENT[syllabic]-IO

- Notation below:
  - $\{\mathbb{M}_1 \gg \mathbb{F}_1\}$ = process that must apply first in the rule-ordering analysis **(HVD)**
  - $\{\mathbb{M}_2 \gg \mathbb{F}_2\}$ = process that must apply second in the rule-ordering analysis **(LVR)**

- There is no way to rank the constraints which is consistent with the basic processes that will derive the counter-feeding result.

(11) If both $\mathbb{M} \gg \mathbb{F}$ → feeding interaction

/ʃarib-Ø/	*i/_CV	*a/_CV	MAXV-IO	IDENT[low]-IO
a. ʃarib		*!		
b. ☹ ʃirib	*!			*
c. 💣 ʃrib			*	

(12) If $\{\mathbb{M}_2 \gg \mathbb{F}_2\} \gg \{\mathbb{M}_1 \gg \mathbb{F}_1\}$ → feeding interaction

/ʃarib-Ø/	*a/_CV	IDENT[low]-IO	*i/_CV	MAXV-IO
a. ʃarib	*!			
b. ☹ ʃirib		*!	*	
c. 💣 ʃrib				*

(13) If $\{\mathbb{M}_1 \gg \mathbb{F}_1\} \gg \{\mathbb{M}_2 \gg \mathbb{F}_2\}$ → bleeding interaction

/ʃarib-Ø/	*i/_CV	MAXV-IO	*a/_CV	IDENT[low]-IO
a. 💣 ʃarib			*	
b. ☹ ʃirib	*!			*
c. ʃrib		*!		

- In order to get candidate (b) with these constraints, you would need MAXV-IO ($\mathbb{F}_1$) and *a/_CV ($\mathbb{M}_2$) to dominate both *i/_CV ($\mathbb{M}_1$) and IDENT[low]-IO ($\mathbb{F}_2$).

→ But this would include the ranking MAXV-IO ≫ *i/_CV, which would mean that high vowel deletion should *never* apply. So this won't work either.

3.2 A workable Parallel OT analysis for counter-feeding on focus

- One way to state the generalization behind the syncope-raising interaction is that underlying /i/ is allowed to delete, but underlying /a/ is not.
- We can write a faithfulness constraint that captures this generalization:

(14) **MAXV$_{[+low]}$-IO:**
Assign a violation * for each [+low] vowel in the input that lacks a correspondent in the output.

- Note the similarity with the constraint MAXV́-BD/IO from our analysis of cyclicity w.r.t. syncope in Levantine Arabic:
  - There is some property associated with a segment in the input that qualifies it for special faithfulness in the output, even if that property itself is not required to be maintained.

- When this constraint and $\mathbb{M}_2$ both dominate $\mathbb{M}_1$, we can derive counter-feeding.
  - When $\mathbb{M}_2 \gg \mathbb{M}_1$ or the two are both undominated, this yields feeding.
  - MAXV$_{[+low]}$-IO essentially blocks the second part of the feeding interaction, hence counter-feeding.

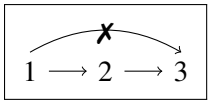
(15) Counter-feeding with MAXV$_{[+low]}$-IO

/ʃarib-Ø/	MAXV$_{[+low]}$-IO	*a/_CV	IDENT[low]-IO	*i/_CV	MAXV-IO
a. ʃarib		*!			
b. ☞ ʃirib			*	*	
c. ʃrib	*!				*

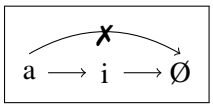
- This interaction is essentially a simple "chain shift":

(16) Simple chain shifts

a. Schematic ($1 \rightarrow 2$; $2 \rightarrow 3$; $1 \nrightarrow 3$)



b. Arabic deletion and raising (a → i ; i → Ø ; a ↛ Ø)



- MAXV$_{[+low]}$-IO is basically a simplified version of a more general type of faithfulness constraint which regulates how many steps along a scale you are allowed to take.
  - i.e., it doesn't penalize a movement of one step along the scale, but it does penalize a movement of two steps.
  - Often called "distantial faithfulness" or "scalar faithfulness" (Gnanadesikan 1997; cf. Kirchner 1996).

3.3 This won't work for counter-feeding on environment

- If we had some constraint equivalent to MAXV$_{[+low]}$-IO, then we could derive the right result for the raising-vocalization interaction too. But it's not at all obvious what that constraint would be.

(17) Counter-feeding on environment: raising-vocalization interaction

/badw/		ℂ	W//V	IDENT[syllabic]-IO	*a/_CV	IDENT[low]-IO
a. badw			*!			
b. ☞ badu				*	*(!)	
c. (💣) bidu		*!		*		*
d. bidw			*!			*

⋆ In this case, there might be something going on with agreement for [±back]. If there were raising, you would get *iCu* ([+high,-back]...[+high,+back]). There's some evidence to think that *iCu* sequences are dispreferred in at least some varieties of Arabic. But this wouldn't extend to cases where /j/ vocalizes (which I assume exist?), and the general problem still holds.

- There's no obvious way to extend the MAXV$_{[+low]}$-IO–type of analysis to cases of counter-feeding on environment, because the two processes normally refer to different features.

- One common approach has been to use constraint conjunction (Kirchner 1996, *a.o*):

(18) **IDENT[syllabic]-IO & IDENT[low]-IO**
Assign a violation * if IDENT[syllabic]-IO and IDENT[low]-IO are **both** violated (in some local domain).

→ This is an extremely powerful device, and there are problematic issues around locality.

- Perhaps a better approach would be to 'divide and conquer', finding individual solutions to different cases, rather than trying to find a 'one size fits all' approach to general kinds of formal interactions.

4 Stratal OT

- A Stratal OT analysis in principle *can* use just the basic constraints to derive these sorts of counter-feeding interactions, by recapitulating the rule-ordering analysis.

4.1 Analysis

- The Stratal OT analysis of the counter-feeding syncope-raising interaction requires the following rankings:

(19) a. Level 1: *i/_CV, IDENT[low]-IO ≫ MAXV-IO ≫ *a/_CV
b. Level 2: *a/_CV, MAXV-IO ≫ IDENT[low]-IO, *i/_CV

Ingredients of these rankings:

- At the first level:
  1. The process that must apply first in the rule-ordering analysis (the one that counter-feeds) is active (i.e. $\mathbb{M}_1 \gg \mathbb{F}_1$).
     → High vowel deletion **active**: *i/_CV ≫ MAXV-IO
  2. The process that must apply second is inactive (i.e. $\mathbb{F}_2 \gg \mathbb{M}_2$).
     → Low vowel raising **inactive**: IDENT[low]-IO ≫ *a/_CV
- At a subsequent level:
  1. The first process is turned off (i.e. $\mathbb{F}_1 \gg \mathbb{M}_1$).
     → High vowel deletion **inactive**: MAXV-IO ≫ *i/_CV
  2. The second process is turned on (i.e. $\mathbb{M}_2 \gg \mathbb{F}_2$).
     → Low vowel raising **active**: *a/_CV ≫ IDENT[low]-IO

⋆ At least for counter-feeding on focus:
- ○ At first level, $\mathbb{F}_2$ (IDENT[low]-IO) must also dominate $\mathbb{F}_1$ (MAXV-IO), so that it is preferable to perform the normal repair (here, *high vowel deletion*) rather than to make the change in the other direction (here, *lowering to a*).
- ○ Likewise, at second level, $\mathbb{F}_1$ (MAXV-IO) must also dominate $\mathbb{F}_2$ (IDENT[low]-IO), so you get raising rather than deletion.

(20) Treatment of underlying /a/ in open syllable (counter-feeding interaction)

Level 1: High vowel deletion is active **(does not apply here)**, Low vowel raising is inactive

/ʃarib-Ø/		*i/_CV	IDENT[low]-IO	MAXV-IO	*a/_CV
a.	☞ ʃarib				*
b.	ʃirib	*!	*!		
c.	ʃrib			*!	

↪ Level 2: Low vowel raising is active **(applies here)**, High vowel deletion is inactive

/ʃarib/		*a/_CV	MAXV-IO	IDENT[low]-IO	*i/_CV
a.	ʃarib	*!			
b.	☞ ʃirib			*	*
c.	ʃrib		*!		

(21) Treatment of underlying /i/ in open syllable (no process interaction)

Level 1: High vowel deletion is active **(applies here)**, Low vowel raising is inactive

/ʃirib-Ø/		*i/_CV	IDENT[low]-IO	MAXV-IO	*a/_CV
a.	ʃarib		*!		*
b.	ʃirib	*!			
c. ☞	ʃrib			*	

↪ Level 2: Low vowel raising is active **(does not apply here)**, High vowel deletion is inactive

/ʃrib/		*a/_CV	MAXV-IO	IDENT[low]-IO	*i/_CV
a.	ʃarib	*!			
b.	ʃirib				*!
c. ☞	ʃrib				

4.2 A problem with the actual data

- In the abstract, this analysis works formally. However, there's a potential problem with associating these rankings with the right levels within a restrictive 3-level Stratal OT.

(22) Problem with level ordering and syncope-raising interaction

a. High vowel deletion obligatorily occurs across word boundaries (Al-Mozainy 1981:49–51)
→ //...**VCiC**#VCV...// → [...**VC·C**#VCV...]

b. Low vowel raising applies "sporadically" across word boundaries (Al-Mozainy 1981:54)
→ //...**VCaC**#VCV...// → [...**VCi̲C**#VCV...] ∼ [...**VCaC**#VCV...]

- In order for a process to apply across word boundaries, it must be active at the *post-lexical* level.
  - Therefore, high vowel deletion must be active at the post-lexical level.
  - And so must low vowel raising (at least variably).
- If the two processes are active in the same stratum (regardless of which one), we can derive only a feeding or bleeding pattern (as we saw with the basic P OT analysis).
  - This is the wrong result.
- If we assume that low vowel raising really doesn't apply at the post-lexical level, then we're in even worse shape, since we have the wrong ordering of processes.
  - Low vowel raising would apply in an earlier stratum, and thus should feed high vowel deletion in the later stratum.

⇒ Therefore, for this case, Stratal OT is incorrectly restrictive. By requiring exactly three distinct levels which are tied to the morphology, we cannot bring to bear stratal re-ranking in the necessary way.

- Stratal OT can still derive the right result by using the special faithfulness constraint MAXV$_{[+low]}$-IO. But since Parallel OT can achieve the right result with this constraint without doing any stratal re-ranking, that is a mark in favor of P OT over Stratal OT.

⋆ **NB:** Parallel OT doesn't have a great way of distinguishing between lexical and post-lexical phonology.

References

Al-Mozainy, Hamza Qublan. 1981. Vowel Alternations in a Bedouin Hijazi Arabic Dialect: Abstractness and Stress. PhD Dissertation, University of Texas at Austin.

Flemming, Edward. 2013. Opacity. Lecture notes, 24.962 Advanced Phonology, MIT, April 23, 2013.

Gnanadesikan, Amalia Elisabeth. 1997. Phonology with Ternary Scales. PhD Dissertation, University of Massachusetts, Amherst.

Johnstone, T. M. 1967. Aspects of Syllabication in the Spoken Arabic of 'Anaiza. *Bulletin of the School of Oriental and African Studies, University of London* 30(1):1–16.

Kiparsky, Paul. 1971. Historical Linguistics. In W. O. Dingwall (ed.), *A Survey of Linguistic Science*, 577–642. College Park, Maryland: Linguistics Program, University of Maryland.

———. 1973. Phonological Representations. In Osamu Fujimura (ed.), *Three Dimensions of Linguistic Theory*, 3–136. Tokyo: TEC.

Kirchner, Robert. 1996. Synchronic Chain Shifts in Optimality Theory. *Linguistic Inquiry* 27(2):341–350.

McCarthy, John J. 1999. Sympathy and Phonological Opacity. *Phonology* 16(3):331–399.