

## Where's Opacity?

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### 1. Overview of this talk

- Doubts about phonological opacity first emerged in reaction to *SPE* during the 1970's. Some work in Optimality Theory has recently revived these doubts.
- In this talk, I'll try to clarify the issue, situate it within the topic of this workshop, and present evidence in support of the thesis that some opaque processes belong in the phonology.

### 2. What's opacity?

The term and the definition come from Kiparsky (1973):

(1) Opacity (minus the neutralization clause (c))

A phonological rule  $P$  of the form  $A \rightarrow B / C\_D$  is *opaque* if there are surface structures with any of the following characteristics:

- a. instances of  $A$  in the environment  $C\_D$ , or
- b. instances of  $B$  derived by  $P$  that occur in environments other than  $C\_D$ .

#### *Opacity in a nutshell*

Process  $P$  is opaque if the fact that it *has* applied or the conditions that account for *how* it applied or *why* it did or did not apply are not present in the output of the grammar as a result of interaction with another process.

### 3. Example: Stress-epenthesis interaction in Levantine Arabic

(Main sources: Abu-Salim 1982: 196ff., Farwaneh 1995: 132ff.)

(2) Levantine Arabic stress in words without epenthetic vowels

a. Stress a final superheavy syllable (CV:C or CVCC)

|             |           |               |
|-------------|-----------|---------------|
| /ban-a:t/   | ba'na:t   | 'girls'       |
| /ʔalam-e:n/ | ʔala'me:n | 'pens (dual)' |
| /maħall/    | ma'ħall   | 'place'       |

b. Else stress a heavy penult:

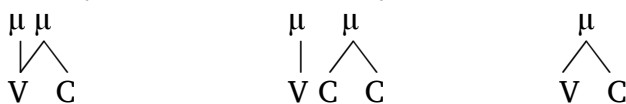
|              |           |                                |
|--------------|-----------|--------------------------------|
| /katab-na/   | ka'tabna  | 'we wrote'                     |
| /katab-l-ak/ | ka'tablak | 'he wrote to/for you (m. sg.)' |
| /maka:tib/   | ma'ka:tib | 'offices'                      |

c. Else stress the antepenult:

|               |            |                  |
|---------------|------------|------------------|
| /katab-u/     | 'katabu    | 'they wrote'     |
| /katab-it/    | 'katabit   | 'she wrote'      |
| /ma-dras-ah/  | 'madrasah  | 'school'         |
| /ʕallam-at-o/ | ʕal'lamato | 'she taught him' |

(3) Weight of final syllables (after Broselow et al. 1997: 57)

a. CV:C syllables      b. CVCC syllables      c. Final CVC syllables



(4) Stress-epenthesis interaction, Part I<sup>1</sup>

But an epenthetic vowel in the penult acts like it isn't there:

|              |             |                   |
|--------------|-------------|-------------------|
| /katab-l-ha/ | ka'tabilha  | 'he wrote to her' |
|              | *kata'bilha |                   |

If we just look at surface structure, we can't explain why [ka'tabilha] doesn't have stress on the penult. Epenthesis hides the conditions that caused stress to apply in the way that it did.

#### (5) Levantine stress-epenthesis interaction II

An epenthetic vowel that breaks up final CVCC acts like it isn't there:

|              |             |  |
|--------------|-------------|--|
| /katab-t/    | ka'tabit    | 'I wrote' (cf. ['katabit] 'she wrote' from /katab-it/) |
| /ma katab-ʃ/ | ma ka'tabiʃ | 'he didn't write'                                      |
|              | *ma 'kabiʃ  |  |

If we just look at surface structure, we can't explain why [ka'tabit] 'I wrote' doesn't have stress on the antepenult.

### 4. Emerging skepticism about opacity in the 1970's

#### *The abstractness/opacity connection*

- *SPE* was criticized for its overly abstract underlying representations — e.g., /iixt/ → [ɪɔjt] *right*, with an underlying velar fricative to account for affrication rather than frication of /t/ in [ɪɔjtʃəs] *righteous*, \*[ɪɔjʃəs] (Chomsky and Halle 1968: 233-234).
- Abstract underlying representations require opaque rules — /t/ → [ʃ] is blocked by the covert preceding velar fricative, just as it's blocked by the overt preceding alveolar fricative in [kwɛstʃən] *question*.

#### *Natural Generative Phonology*

- The proponents of Natural Generative Phonology (NGP) proposed to eliminate abstractness by constraining rules (Hooper [Bybee] 1976, 1979, Vennemann 1972, 1974). Authentic phonological rules had to meet both of the conditions in (6).

#### (6) Conditions on rules in NGP

##### a. True Generalization Condition

Rules must express exceptionless, surface-true generalizations.

##### b. No Ordering Condition

A rule applies to any form that meets its structural description.

- Under these premises, Levantine Arabic stress could not be phonological.
  - There is no exceptionless, surface-true generalization about the distribution of stress.
  - The No Ordering Condition is violated because stress has to be ordered after epenthesis.

(Clarification: Natural Phonology (Stampe) ≠ NGP. Natural Phonology allowed opaque rule ordering. In fact, Donegan and Stampe (1979: 145ff.) contains a long discussion of opacity in Natural Phonology, with plenty of examples of opaque interactions among “natural processes” in English.)

#### *What NGP offered instead*

- Alternations that would require opaque rules were taken out of the phonology entirely.
- Generally, they were analyzed by simply listing the alternants in the lexicon (Hooper [Bybee] 1976: 127-131, Hudson 1974), though lexical redundancy rules were posited for semisystematic alternations.
- NGP, then, would analyze the Levantine Arabic stress system in the same way as, say, Russian: some combination of lexical listing and unproductive morphologically-governed rules.

#### *The question: Where's opacity?*

- In what part of the grammar are opaque alternations analyzed? In the phonology or in the lexicon and morphology?

### 5. Opacity in OT

- Optimality Theory (Prince and Smolensky 1993/2004) shares Natural Generative Phonology's view of the importance of surface structure. (I am referring to “classic OT” — markedness, faithfulness, one grammar, one pass through GEN and EVAL.)
- There are also important differences between OT and NGP (discussed later).
- It has been recognized since the beginning of OT that opacity presents a challenge. I'll use the Levantine stress example to explain why.

*Illustration of the opacity issue in OT using Levantine Arabic*

- We'll look first at a classic OT analysis of stress in words without epenthetic vowels, then at the effects of epenthesis.
- Basic analysis is more or less the same as in Prince and Smolensky's (1993/2004) account of Latin stress:

(7) Feet are moraic trochees: ('H) or ('LL)

| /katab-na/      | RHYTHMTYPE = TROCHEE<br>[≡ * (σ <sup>1</sup> σ) <sub>foot</sub> ] | WEIGHT-TO-STRESS<br>[≡ *unstressed H] | RHYTHMTYPE = IAMB<br>[≡ * ('σσ) <sub>foot</sub> ] | PARSE-σ<br>[≡ *unfooted σ] |
|-----------------|---|---------------------------------------|---|----------------------------|
| a. → ka('tab)na |   |                                       | *   | **                         |
| b. (ka'tab)na   | *W  |                                       | L   | *L                         |
| c. ('katab)na   |   | *W                                    | *   | *L                         |

(Comparative tableau format from Prince (2002).)

(8) Foot at right, but final syllable extrametrical

| /katab-u/      | NON-FINALITY(foot)<br>[≡ *σ <sub>foot</sub> ↘ <sub>word</sub> ] | ALIGN-RIGHT(foot, word)<br>[≡ * <sub>foot</sub> ...σ... <sub>word</sub> ] |
|----------------|---|---|
| a. → ('kata)bu |   | *   |
| b. ka('tabu)   | *W  | L   |

- But this grammar won't get /katab-l-ha/ → [ka'tabilha]:

(9) Failure with opaque [ka'tabilha]

| /katab-l-ha/      | RHTY = TROCH | WT-TO-STR | NON-FIN(foot) | RHTY = IAMB | PARSE-σ | ALIGN-R(foot, word) |
|-------------------|--------------|-----------|---------------|-------------|---------|---------------------|
| a. → ka('tabil)ha |              | *         |               | *           | **      | *                   |
| b. kata('bil)ha   |              | L         |               | *           | ***W    | *                   |

- And it won't get /katab-t/ → [ka'tabit]:

(10) Failure with opaque [ka'tabit]

| /katab-t/       | RHTY = TROCH | WT-TO-STR | NON-FIN(foot) | RHTY = IAMB | PARSE-σ | ALIGN-R(foot, word) |
|-----------------|--------------|-----------|---------------|-------------|---------|---------------------|
| a. → ka('tabit) |              |           | *             | *           | *       |                     |
| b. ('kata)bit   |              |           | L             | *           | *       | *W                  |

*Doubting opacity*

- The problems of accommodating opaque processes in classic OT have led some to claim that opaque processes are in general outside the scope of the phonology (Green 2004, 2005, Mielke et al. 2003, Potts and Pullum 2002: 391, Sanders 2002, 2003).
- If they're right, then there is no "opacity problem" for classic OT because opaque processes (unless they can be reanalyzed as transparent) are not in the phonological grammar.
- Their answer to "where's opacity?" is the same as NGP's: in the lexicon and/or the morphology.

*Where we go next*

- I'll argue that there has to be a place for opacity in the phonology.
- I'll discuss Levantine Arabic stress and two opaque processes in an Arabian Bedouin dialect.
- I'll present various forms of external evidence for the productivity and regularity of these opaque processes. (Also see Odden (2005: 277ff.) for recent discussion.)

## 6. Stress in Levantine Arabic

### *The issue*

- Levantine Arabic stress is opaque because of how it interacts with epenthesis.
- Does this move it outside the phonology's sphere of responsibility?
- Is it lexically listed and/or governed by morphological rules?
- In other words, is Levantine stress more like English, Russian, and Spanish, or more like Finnish, French, and Turkish?

### *Form of arguments in this section*

- Compare Levantine Arabic, which has opaque stress-epenthesis interaction, with Arabic varieties that have transparent stress-epenthesis interaction, such as Egyptian. (From now on, I'll call these "transparent dialects".)
- If opaque and transparent processes are analyzed in very different ways, then the Levantine speakers should behave differently from the speakers of transparent dialects.

### *Stress Deafness*

- Speakers of some languages find it difficult to perceive the location of stress.
- This is correlated with noncontrastiveness of stress in the language (Dupoux et al. 1997) and other factors (Altmann 2006, Peperkamp and Dupoux 2002).
- If opaque stress in Levantine Arabic is analyzed lexically and morphologically (like English or Spanish), whereas stress in transparent dialects is analyzed purely phonologically (like French or Finnish), then Levantine speakers should exhibit less stress deafness than speakers of transparent dialects.
- Altmann's (2006) cross-linguistic study (presented at MFM 14) included 10 Arabic speakers. The study design treated them alike, but Altmann (p.c.) has supplied information about their geographical origins.
- Overall, the Arabic speakers were the poorest of all language groups in perceiving the stress location (worse than the French or Turkish speakers).
- There was no difference between the speakers of Levantine Arabic and the speakers of Arabic varieties with transparent stress.
- The three Levantine speakers got 33%, 50%, and 72% right (chance is 34.5% over all word lengths in the stimuli).
- As for transparent dialects, the two Egyptians got 65% and 69% right, the Yemenis got 34% and 46% right, etc. (Stress in the Egyptian and Yemeni varieties is analyzed in Watson (2002).)

### *Transfer of processes to a second language*

- Native-language phonological processes are often transferred to a second language.
- Lexicalized and morphologized alternations aren't usually transferred.
- Stampe (1973) uses this criterion to distinguish natural processes from learned rules. E.g., English speakers don't transfer velar softening (*electric/electricity*) but they may transfer *r*-dropping or *t*-flapping.
- Arabic-speaking students of ESL often assign stress to English words in conformity with their native system: *dic'tate*, *subma'rine*, *car'pentry*, *'dramatic*.
- There is no difference between Levantine speakers and Egyptian speakers in this respect (Anani 1989, Ibrahim 1986, Youssef and Mazurkewich 1998).

### *Summary*

If opaque processes require a fundamentally different mode of analysis than transparent processes, we expect to find differences between Arabic speakers with opaque and transparent stress systems in stress deafness and transfer to a second language. Speakers with opaque stress should be less stress-deaf and less likely to transfer their native stress system to L2. These differences are not observed. There is no support for analyzing opaque and transparent stress in different grammatical components.

## 7. Syncope and raising in Bedouin Arabic: The phenomena

- Syncope of high vowels and raising of low vowels in open non-final syllables are typical of Bedouin dialects. The material here comes from Al-Mozainy (1981).

### (11) Raising/syncope interaction in Bedouin Arabic<sup>2</sup>

#### a. Short high vowels syncope in non-final open syllables

|               |          |                     |
|---------------|----------|---------------------|
| /kitib/       | ktib     | 'it was written'    |
| /ti-rsil-u:n/ | tirslu:n | 'you (m. sg.) send' |
| /ja-gʃud-u:n/ | jagʃdu:n | 'you (m. pl.) sit'  |

#### b. But not if they're derived by /a/ to [i] raising, which also occurs in the same context<sup>3</sup>

|            |         |               |
|------------|---------|---------------|
| /gadir/    | gidir   | 'he was able' |
| /katab/    | kitab   | 'he wrote'    |
| /katab-na/ | kitabna | 'we wrote'    |

If we just look at surface structure, we can't understand why these examples have [i]s in open syllables. Raising hides the reason why syncope doesn't affect these vowels.

### (12) Raising/epenthesis interaction in Bedouin Arabic

|        |       |          |                        |
|--------|-------|----------|------------------------|
| /gabr/ | gabir | 'grave'  | cf. [gabri] 'my grave' |
| /gabl/ | gabil | 'before' |                        |

If we just look at surface structure, we can't understand why there are [a]s in open syllables. Epenthesis hides the conditions that make raising inapplicable.

### (13) Syncope/epenthesis interaction in Bedouin Arabic

|         |        |          |                       |
|---------|--------|----------|-----------------------|
| /libn/  | libin  | 'clay'   | cf. [libni] 'my clay' |
| /gitʃn/ | gitʃin | 'cotton' |                       |
| /gidr/  | gidir  | 'pot'    |                       |

- If we just look at surface structure, we can't understand why there are [i]s in open syllables. Epenthesis hides the conditions that make syncope inapplicable.

## 8. Syncope and raising in Bedouin Arabic: The evidence

### *The issue*

- Syncope and raising are opaque processes in Bedouin Arabic. Are they part of the phonology or are they relegated to the lexicon and morphology?
- A lot of evidence points toward the phonology.

### *Syncope at phrase level*

- Syncope occurs between as well as within words (Al-Mozainy 1981: 51)

### (14) Phrase-level syncope

|                            |                      |                                |
|----------------------------|----------------------|--------------------------------|
| /ka:tib al-ʒawa:b/         | ka:tbalʒiwa:b        | 'writing the letter'           |
| /tiʃtʃu:nih al-muse:ʃi:di/ | tiʃtʃu:nhalmse:ʃi:di | 'you give it to the Musai`idi' |

- Processes that apply in external sandhi are productive practically by definition.
- A lexicalized or morphologized process that applies in external sandhi is only possible with something like Hayes's (1990) precompilation mechanism, but that's not applicable here. (Precompilation only works when the process's context is defined morphosyntactically, like the Celtic mutations.)

### *Syncope and raising in loan words*

- Syncope and raising are productive in borrowed words (Al-Mozainy 1981: 84ff.):

| (15) | Source word | Source language  | Borrowed word | Gloss      | Process |
|------|-------------|------------------|---------------|------------|---------|
|      | cylinder    | English          | slinder       | ibid.      | Syncope |
|      | ʔalhudaydah | Yemeni Arabic    | ʔalhdaydah    | 'Hudayda'  | Syncope |
|      | kabak       | Turkish          | kibak         | 'cufflink' | Raising |
|      | ʔalʕaqabah  | Jordanian Arabic | ʔalʕqibah     | 'Aqaba'    | Raising |
|      | madrasah    | Standard Arabic  | madrisah      | 'school'   | Raising |
|      | qatʕar      | Standard Arabic  | gitʕar        | 'Qatar'    | Raising |

### Spelling

- The idea that spelling can be used to tap phonological knowledge goes back to Sapir's "The psychological reality of phonemes".
- The written variety of Arabic is called Modern Standard Arabic (MSA). The short vowels of MSA are different from spoken Arabic, and spelling vowels correctly is usually a challenge for children and adults.
- Nonetheless, Al-Mozainy (1981: 85) says:
 

"A large sample of children's spelling was collected, ranging from the first grade to the sixth. What was found is that, although children delete high short vowels and raise the low short ones when they speak, in their spelling the deleted vowels are present and the vowels that are raised in their speech are written as low vowels."

### Play languages

- Al-Mozainy (1981: 86ff.) devotes much attention to play-language evidence for the raising process and the underlying representations that it presupposes.
- To use this evidence, we need some further details about raising:

(16) Raising is blocked ...

a. ... by an adjacent guttural consonant ...

|       |                |       |              |
|-------|----------------|-------|--------------|
| ʕabad | 'he worshiped' | hakam | 'he ruled'   |
| ʕanam | 'sheep'        | ʕadaʕ | 'he cheated' |
| sahab | 'he pulled'    | naʕas | 'he dozed'   |
| naʕal | 'palm trees'   | baʕal | 'mule'       |

b. ... unless the next syllable contains a high vowel.

|       |                 |        |                     |
|-------|-----------------|--------|---------------------|
| hilim | 'he dreamt'     | ʕitʕij | 'he became thirsty' |
| fihim | 'he understood' |        |                     |

(17) Raising is also blocked by a following coronal sonorant plus [a].

|       |                 |       |         |
|-------|-----------------|-------|---------|
| sarag | 'he stole'      | balah | 'dates' |
| manaʕ | 'he prohibited' |       |         |

- The play languages alter these conditions. The vowels in the play-language forms are raised or not, exactly in conformity with these generalizations. (Al-Mozainy's main consultants were illiterate, so influence from MSA or the writing system could not have been a factor.)

### A naturally occurring play language

Consonants of the root are permuted, but the word's template doesn't change (McCarthy 1982). The roots of interest to us now are those that contain gutturals or coronal sonorants:

(18) Play language forms of /dafaʕ/ → [difaʕ] 'he pushed'

|              |  |
|--------------|--|
| With raising | Without raising (because of adjacent guttural) |
| fidaʕ        | daʕaf, ʕadaf, faʕad, ʕafad                     |

(19) Play language forms of /hakam/ → [hakam] 'he ruled'<sup>4</sup>

|              |  |
|--------------|--|
| With raising | Without raising (because of adjacent guttural) |
| kimah, mikah | hamak, mahak, kaham                            |

(20) Play language forms of /ðʕarab/ → [ðʕarab] 'he hit'

|                                |   |
|--------------------------------|---|
| With raising                   | Without raising (because of following [ra]) |
| ribaðʕ, biðʕar, riðʕab, ðʕibar | baraðʕ                                      |



## 9. Are these processes really opaque in the way that matters?

*OT ≠ NGP*

- There are three relevant differences:
  - 1) Unlike NGP, OT doesn't insist that authentic linguistic generalizations have to be surface-true. In OT, a constraint can be active even when dominated.
  - 2) OT has faithfulness constraints.
  - 3) Richer representational theories post-1970 allow for the possibility of reanalyzing some opaque processes as transparent.
- Before concluding that classic OT can't accommodate opaque processes, we need to show that the processes discussed are opaque in a way that's relevant to OT.
- That involves showing that they can't be analyzed using only faithfulness and markedness constraints in a single grammar with a single pass through GEN and EVAL.
- We'll look first at approaches to opacity in OT based on elaborating the faithfulness constraints, and then we'll look at approaches based on elaborating the representational theory.

## 10. Faithfulness-based approaches to accommodating opacity in classic OT

*A faithfulness-based approach to Levantine Arabic stress-epenthesis opacity*

- Alderete (1999) proposes to deal with stress-epenthesis interactions by introducing the following faithfulness constraints:

(26) a. HEAD-DEP( $\sigma$ )

Every segment in a stressed syllable in the output must have an input correspondent. (*Inter alia*, forbids stressing epenthetic vowels.)

b. HEAD-DEP(*foot*)

Every segment in a stress foot in the output must have an input correspondent. (*Inter alia*, forbids footing epenthetic vowels.)

- HEAD-DEP( $\sigma$ ) solves the problem with opaque [ka'tabilha] by dominating WEIGHT-TO-STRESS:

(27) Opacity problem solved with HEAD-DEP( $\sigma$ )?

| /katab-l-ha/      | HEAD-DEP( $\sigma$ ) | HEAD-DEP( <i>foot</i> ) | WT-TO-STR | NON-FIN( <i>foot</i> ) | PARSE- $\sigma$ | ALIGN-R |
|-------------------|----------------------|-------------------------|-----------|------------------------|-----------------|---------|
| a. → ka('tabil)ha |                      |                         | *         |                        | **              | *       |
| b. kata('bil)ha   | *W                   |                         | L         |                        | ***W            | *       |

- But neither HEAD-DEP( $\sigma$ ) nor HEAD-DEP(*foot*) will help with Levantine Arabic's other opaque stress-epenthesis interaction, /katab-t/ → [ka('tabit)]:

(28) Opacity problem not solved after all

| /katab-t/       | HEAD-DEP( $\sigma$ ) | HEAD-DEP( <i>foot</i> ) | WT-TO-STR | NON-FIN( <i>foot</i> ) | PARSE- $\sigma$ | ALIGN-R |
|-----------------|----------------------|-------------------------|-----------|------------------------|-----------------|---------|
| a. → ka('tabit) |                      | *                       |           | *                      | *               |         |
| b. ('kata)bit   |                      | L                       |           | L                      | *               | *W      |

*A faithfulness-based approach to the opaque interaction of raising and syncope in Bedouin Arabic*

- The approach is based on local conjunction of faithfulness constraints (Ito and Mester 2003, Kirchner 1996, Moreton and Smolensky 2002).
- The local conjunction of constraints CONST1 and CONST2 in the domain  $\delta$ , written [CONST1 & CONST2] <sub>$\delta$</sub> , is a constraint that is violated once by any instance of  $\delta$  that contains violations of CONST1 and CONST2 (Smolensky 1995, 1997, 2006).

- The unwanted mapping /a/ → ∅ can be prevented with the conjoined constraint [MAX([+low]) & MAX]<sub>segment</sub> — that is, you can't delete [+low] and the segment that contains it. (This won't affect the mappings that actually occur, /a/ → [i] and /i/ → ∅.)
- Since a conjoined faithfulness constraint is also a faithfulness constraint, this analysis stays entirely within the confines of classic OT.

### Problems with local conjunction

- It's also necessary to prevent mappings like these:  
 /gabr/ → \*[gibir] (raising and epenthesis)  
 /libn/ → \*[lbin] (syncope and epenthesis)
- So what about conjoining DEP with another constraint in the domain of adjacent syllables?<sup>6</sup>

(29) Conjoined constraints intended to handle interaction of epenthesis with raising and syncope

a. No epenthesis and raising in adjacent syllables:

[MAX([+low]) & DEP]<sub>adjacent syllables</sub>

b. No epenthesis and syncope in adjacent syllables:

[MAX & DEP]<sub>adjacent syllables</sub>

- This won't work. It can't distinguish between cases where the *following* syllable has an epenthetic vowel and the *preceding* syllable has one:

(30) Syncope and raising compatible with *preceding* epenthetic vowel (domain of conjunction in boldface)<sup>7</sup>

|                   |                         |                                |
|-------------------|-------------------------|--------------------------------|
| /zabr samiʃ/      | <b>z</b> abur simiʃ     | 'Jabr heard'                   |
| /zabr simiʃ/      | <b>z</b> abur smiʃ      | 'Jabr was heard'               |
| /sʰagr samiʃ/     | sʰ <b>a</b> gur simiʃ   | 'Saqr (or a falcon) heard'     |
| /sʰagr samiʃ/     | sʰ <b>a</b> gur smiʃ    | 'Saqr (or a falcon) was heard' |
| /tʰarad ʁanam-ih/ | tʰarad <b>i</b> ʁnim-ih | 'he pursued his sheep'         |

### The reason for this problem

- Local conjunction tries to use proximity as a proxy for interaction. This works often enough to be tempting, but it doesn't work in general.
- Raising and epenthesis (or syncope and epenthesis) *can* occur in close proximity — (30) shows that. What they can't do is interact like /gabr/ → \*[gibir] (or /libn/ → \*[lbin]).
- The problem in (30) is not a mere glitch, to be solved with a more sophisticated theory of the domains of conjunction. Rather, it's a basic failure of principle (McCarthy 1999, 2002, 2007).
- This kind of opacity is a matter of forbidden process interaction, not forbidden process proximity.

### The general character of this problem

- Changing the domain of conjunction or the constraints that are conjoined leads to implausible predictions:
  - [MAX([+low]) & DEP]<sub>word</sub> blocks raising if a vowel has been epenthesized anywhere in the same word. No language works this way.
  - [MAX([+low]) & MAX(voice)]<sub>adjacent syllables</sub> blocks raising if there has been consonant devoicing in the same syllable or in the syllable on either side. No language works this way.
- Local conjunction of faithfulness constraints can analyze some cases of opacity, but it overpredicts the range of possible opaque interactions.
- There are similar problems with local conjunction of two markedness constraints and of markedness with faithfulness.
- Proposals to constrain local conjunction have not been successful in addressing these objections.

## 11. Representational approaches to accommodating opacity in classic OT

### *A representational approach to Levantine Arabic stress-epenthesis opacity*

- There are good reasons to think that epenthetic vowels in some languages might be prosodically defective — lacking moraic structure, for instance (Farwaneh 1995, Hagstrom 1997, Hall 2003, Piggott 1995).
- That will work fine for [ka(ˈtabil)ha], since if the syllable [bil] counts as light, WEIGHT-TO-STRESS is not violated.
- But this won't help with the [ka(ˈtabit)] problem. Solving that problem requires that the [tab] sequence somehow count as a *heavy* syllable in surface structure.
- A further issue raised at MFM 14: for some speakers of Levantine Arabic, epenthetic and underlying [i]s are acoustically indistinguishable (Gouskova and Hall forthcoming). This argues against a representational distinction (unless phonetic interpretation is allowed to consistently neutralize distinctions present in the output of the phonology).

### *A representational approach to Bedouin Arabic raising-syncope opacity*

- The idea is that raising does not produce a high vowel — essentially, [i] from /a/ is not the same as [i] from /i/.
- But Al-Mozainy (1981: 71) makes it clear that [gidir] from /gadir/ 'he was able' is homophonous with [gidir] from /gidr/ 'pot'. So that can't be right.
- Richer representational approaches to opacity, such as turbidity (Goldrick 2000, Goldrick and Smolensky 1998, Uffmann at MFM 14) or colored containment (van Oostendorp 2006), may eventually turn out to be adequate, but there's lots more work to be done in showing that.

## 12. Conclusion: Where's opacity?

- Some of it is in the phonology. It's not limited to the lexicon or the morphology. It's not limited to word phonology either — external sandhi processes can be opaque too.
- NGP and the OT opacity-skeptics are of course right that some cases of opacity don't belong in the phonology — Bedouin Arabic guttural metathesis is a good example. They draw a sharp line between what is and what is not in the phonology, but the line is in the wrong place.
- What's the best way to analyze opacity in OT? I've pointed out some problems with a couple of popular approaches. The proposal I present in McCarthy (2007) is quasi-derivational, but significantly different from other (quasi-)derivational approaches.

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## 14. Notes

<sup>1</sup> Epenthetic vowels do get stressed in the penult if they break up a CCCC cluster: /katab-t-l-ha/ → [katab'tilha] ‘I wrote to her’.

<sup>2</sup> Throughout, I've simplified the transcriptions of Bedouin Arabic by not showing the color differences in short high vowels, palatalization of velars, or pharyngealization of [r].

<sup>3</sup> Low vowels are deletable in a different context: /katab-at/ → [ktibat] ‘she wrote’; /ʔinkasar-at/ → [ʔinksarat] ‘it (f.) broke’. This process is related to optimizing iambic foot structure (McCarthy 2003, 2007).

<sup>4</sup> These forms were obtained from Al-Mozainy (p.c.).

<sup>5</sup> These data were obtained from Al-Mozainy (p.c.). He described all of these play-language forms as “not natural”, but with a clear preference for the forms in column 2 over the forms in column 3.

<sup>6</sup> There's a technical problem with conjoining MAX and DEP, because their loci of violation are at different levels of representation.

<sup>7</sup> The first four examples were obtained from Al-Mozainy (p.c.). The last is from Al-Mozainy (1981).