Opacity and Cyclicity

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Phonological opacity and paradigmatic effects ("synchronic analogy") have long been of interest in relation to change, naturalness, and the phonology/morphology interface. Their investigation has now acquired a new urgency, because they call into question OT's postulate that constraints are evaluated in parallel. Conceptually, parallelism is one of the basic and most interesting tenets of OT, and so there are good methodological reasons to try hard to save it in the face of such recalcitrant data. The price to be paid for it is the introduction of otherwise unneeded powerful new types of Faithfulness constraints, such as *Output/Output (O/O) constraints*, *Paradigm Uniformity constraints*, and *Sympathy constraints*, which have turned out to compromise the OT program very severely.

The alternative to this approach is to abandon full parallelism in favor of stratified constraint systems. This has the compensating advantage of maintaining a restrictive and well-defined constraint inventory, as originally envisaged in OT. More importantly, it achieves some genuine explanations by relating the stratification motivated by opacity and cyclicity to the intrinsic morphological and prosodic constituency of words and phrases, as characterized by the Stem, Word, and Postlexical levels of Lexical Phonology and Morphology (Booij 1996; 1997; Orgun 1996; Bermudez-Otero 1999). I shall refer to this approach as LPM-OT, and outline how it offers a superior account of the benchmark data that Kager 1999 discusses in Ch. 6 of his book.[1]

LPM-OT's goal is to reduce cyclicity to I/O faithfulness, and opacity to interlevel constraint masking. Thus, if α is the constraint system of some domain (say, stems) and β the constraint system of a larger domain (word level or postlexical) then β's markedness constraints can render α opaque. These are the *only* sources

[1] A more detailed discussion of these matters will be found in Chs. 1 and 6 of Kiparsky (to appear).

of cyclic effects and opacity: there are no O/O constraints, no paradigm uniformity constraints, and no sympathy constraints. The intrinsic seriality of LPM-OT provides a handle on opaque and cyclic constraint interactions without retreating to the unconstrained ordering theory of pre-OT days. The insights of both OT and LPM can be retained — and new insights emerge from their combination which are not available under either of them on their own.

Kager 1999 discusses both opacity and paradigm effects with a set of Levantine Arabic data that have figured prominently in phonological theorizing since Brame 1974 and Kenstowicz's work from the 1980's. It involves the interaction of three phonological processes: stress, deletion of *i* in open syllables, and epenthesis of *i* before stray consonants. They are illustrated in [1] with forms of the verb /fihim/ 'understood' and the noun /fihm/ 'understanding', both pronounced *fíhim* in isolation. Of particular interest is the three-way contrast before consonantal suffixes, here represented by the bold-faced forms with 1.Pl. *-na*. They illustrate the interaction of two regular processes of Arabic: stress, which falls on heavy penults, and the deletion of unstressed high vowels (here *i*) in open syllables *(HV-deletion)*.

[1] a. /fihim/ 'understood'

i.	fíhim il-wálad	'he understood the boy'
ii.	fíhim	'he understood'
iii.	**fhím-na**	'we understood' *(transparent HV-Deletion and stress)*
iv.	**fihím-na**	'he understood us' *(why no HV-Deletion?)*

b. /fihm/ 'understanding'

i.	fíhm il-wálad	'the boy's understanding'
ii.	fíhim	'understanding'
iii.	**fíhim-na**	'our understanding' *(why antepenult stress?)*

From a naively parallelistic point of view, we would expect the output [1a.iii] *fhím-na* for all three forms, regardless of whether the input representation is /fihim-na/ or /fihm-na/.

Traditional grammar talks about the two other forms as follows. It says that in [1b.iii] *fíhimna*, from underlying /fihm-na/, the epenthetic *-i-* "does not count" for stress (or: it is "not phonological"). For [1a.iv] *fihímna*, it says that *i* is retained by analogy to its base form *fíhim* 'he understood'. These statements translate respectively into rule ordering in SPE-type phonology, and into transderivational

constraints in parallel OT. I shall argue that one translation is as stipulative as the other, whereas LPM-OT provides a true explanation of these data.

Let us begin with [1b.iii] *fíhimna*. Rule-based phonology can certainly derive it by ordering stress assignment before epenthesis, but offers no insight into *why* these processes are ordered so and not the other way round.

Parallel OT has nothing better to offer. Kager 1999 proposes that stress on the epenthetic vowel in *fíhimna* from /fihm-na/ is prevented by a constraint HEAD-DEP(O/I) that prohibits stress on epenthetic vowels ("every vowel in the output prosodic head has a correspondent in the input"). By dominating the constraints responsible for stress, HEAD-DEP(O/I) rules out the penult-stressed **fihímna*, and other, undominated constraints select *fíhimna*. There are two main objections to this solution (apart from the stipulative character of the constraint itself). First, epenthetic vowels in Arabic are not just unstressable, they are *invisible to stress*. Words of the form CVCVCV get antepenult stress in Arabic, *except if one of the vowels is epenthetic*; contrast [2a] and [2b].

[2]	a.	/katab-at/	*kátabat*	'she wrote'	(transparent antepenult stress)
	b.	/katab-t/	*katábit (*kátabit)*	'I wrote'	(opaque penult stress)

HEAD-DEP(O/I) only prevents epenthetic vowels from being stressed; what is required for *katábit* is to exclude them from the syllable count altogether, so that it is evaluated as /katabt/, where the final superheavy syllable receives the stress in the usual fashion.

The second objection to HEAD-DEP(O/I) is that it does not relate the opacity of stress to anything else. In particular, it misses the generalization that *all* processes of word phonology ignore epenthetic vowels. For example, closed syllables are shortened even though postlexical epenthesis opens them,

[3]	a.	/šáaf-at/	*šáaf-at*	'she saw'	(transparent retention of length)
	b.	/šáaf-t/	*šífit (*šáafit)*	'I saw'	(opaque shortening)

and epenthetic *i* differs from underlying vowels in not blocking the spread of "emphasis" (Erwin 1963:83, for Iraqi Arabic).

[4]	a.	/rubaṭ-at/	*rubaṭat*	'she fastened'	(spread blocked by *a*)
	b.	/rubaṭ-t/	*rubaṭiṭ*	'I fastened'	(opaque spread across *i*)

McCarthy's theory of sympathy (1997, 1999), discussed by Kager in Ch. 9, offers a more general approach to opacity on parallelist assumptions, which escapes the first objection just raised. *Sympathy constraints* require Faithfulness to a *sympathy candidate* (marked by ❁), which is defined as the optimal candidate that obeys a designated Faithfulness constraint, the *Selector Constraint* (marked by ✯).[2] For the opaque interaction between epenthesis and stress in Palestinian Arabic, we need a constraint ❁IDENT-STRESS that requires Faithfulness to the stress of the optimal candidate that has no epenthesis; thus it is satisfied by candidates that have the same stress on the same syllable as the losing candidates ❁*fíhmna* and ❁*katábt*. Assume that the selector constraint that selects these candidates is ✯DEP-(I/O)-V. Let us suppose that vowel epenthesis is compelled by a constraint *COMPLEX that bans tautosyllabic consonant clusters. Then the ranking in [5] has the same effect as ordering stress before epenthesis.

[5]

Opaque stress		*COMPLEX	❁IDENT-STRESS	✯DEP-(I/O)-V
Input: fihm-na				
1a.	fhímna		*	*
1b. ☞	fíhimna			*
1c. ❁	fíhmna	*		
Input: katab-t				
2a.	kátabit		*	*
2b. ☞	katábit			*
2c. ❁	katábt	*		

The optimal candidates that satisfy ✯DEP-(I/O)-V in [5] are (1c) *fíhmna* and (2c) *katábt*. The constraints in [5] select the optimal candidate that has the same stress as these candidates (as required by ❁IDENT-STRESS), which gives (1b) *fíhimna* and (2b) *katábit*. Thus, the sympathy analysis gives a unified analysis for the fact that epenthetic vowels are themselves unstressed *(fíhimna)* and for the fact that epenthetic vowels are "skipped" by stress assignment *(katábit)*, recapturing rule ordering theory's prediction that these phenomena are related in terms of the invisibility of epenthetic vowels, and doing so within a strictly parallel constraint system — obviously a good result.

[2] McCarthy 1999 modifies his original proposal in favor of a conceptually rather different and somewhat more restricted theory, where evaluation is based on comparison of the unfaithful mappings associated with candidates. Because Cumulativity has the same results as original sympathy in the case at hand, I will not dwell on it here.

However, like Kager's HEAD-DEP(O/I) constraint, sympathy misses the generalization that epenthesis (like all postlexical processes) is invisible to all word phonology. For example, the data in [3] require a separate sympathy constraint (referring to the *same* Selector constraint) to "borrow" the opaque shortening in /šáaf-t/ *šífit* 'I saw' from the same failed candidate **šift*.

[6]

Opaque shortening	*COMPLEX	❁IDENT-LENGTH	✯DEP-(I/O)-V
Input: šáaf-t			
a. šáafit		*	*
b. ☞ šífit			*
c. ❁ šíft	*		

Another sympathy constraint is required for the emphasis contrast in [4]. In Kiparsky (to appear) I show that once we look at entire phonological systems, not just toy examples of a few interacting constraints, sympathy results in very serious loss of generalization. I also show that sympathy predicts non-occurring types of constraint interactions (such as mutual non-bleeding), that it cannot characterize certain actually occurring types of constraint interactions, and that it is incompatible with Richness of the Base.[3] To give the point its customary epistemological twist: a hypothetical language learner endowed with sympathy theory will look for generalizations that do not and could not exist, and fail to detect generalizations that do exist.

LPM-OT, on the other hand, straightforwardly predicts these constraint interactions from independent, multiply convergent morphological and phonological evidence. The reason epenthesis is invisible to stress in Arabic is that these processes are respectively postlexical and lexical. The abundant evidence that shows the postlexical status of epenthesis includes contrasts like [1a.i] *fíhim il-wálad* vs. [1b.i] *fíhm il-wálad*, which show that sandhi is based on unepenthesized forms, not on the citation form, which entails that epenthesis does not apply in the lexical phonology. As for stress, the fact that it is lexical follows from the fact that it is confined to words, and of course from its cyclicity evinced by the data in [1] and discussed again below. It then follows that, since postlexical phonology is intrinsically invisible to word phonology, epenthesis in particular is invisible to stress:

[3]The latter point has been made independently by Itô & Mester in recent unpublished work.

[7] Lexical stress: [fíhm-na]
Postlexical epenthesis: [fíhim-na]

In the postlexical constraint system, I/O Faithfulness to stress is ranked high and the place of stress is retained in the face of the new syllable structure.

The point can be further sharpened as follows. In addition to the postlexical epenthesis which we have seen so far, Arabic has *lexical* epenthesis under limited conditions, in satisfaction of prosodic minimality in imperatives (see [8a]), and of syllabification requirements in *four-consonant* clusters (see [8b]).

[8]	a.	/ktib/	*ʔiktib*	* *ʔiktíb*	‘write! (m.sg)’
	b.	/katab-t-l-ha/	*katabtílha*	**katábtilha*	‘I wrote for her’

These lexical epenthetic vowels are all *visible* in the lexical phonology (that is their *raison d’être*, after all) and so they get the word stress under the same conditions as underlying vowels do. But sympathy does not know how to distinguish stem-level and word-level epenthetic vowels from postlexical epenthetic vowels, for every output vowel that has no correspondent in the input is by definition a violation of ✯DEP-(I/O)-V. Putting it somewhat differently, sympathy theory’s way of reconstructing constraint interaction ignores the relevant *functional* groupings of processes (stem-level, word-level, and postlexical) and posits irrelevant *material* groupings (all instances of a given type of Faithfulness violation, such as all epentheses, all deletions, all lengthenings, all shortening, and all changes of a given feature). It is like a department store that puts all metal items on the first floor, all plastic items on the second floor, all wooden items on the third floor, and so forth. These are no doubt important categories for the manufacturer (sound change), but they do not necessarily provide the relevant groupings for the user (the grammatical system). The way processes interact depends their functional organization in the grammar into domains, which define a hierarchy of phonological levels. The result of neglecting it is loss of generalizations, and a lack of restrictiveness. LPM-OT continues to give the right results for these cases as well.

Turning now to the paradigmatic effect in *fihímna* (cf. [1a.iv]), Brame (1974) modeled it with an analysis where Stress Assigment, High Vowel Deletion, and Pre-stress Destressing apply cyclically in that order.

[9] SPE-style cyclic derivation according to Brame (1974)

first cycle	fíhim	fíhim	fhím-na
second cycle	—	fihím-na	—
	'he understood'	'he understood us'	'we understood'

While Brame's derivational rules can be readily replaced by constraints, a lasting insight of his study is that the contrast between *i*-Deletion in *fhím-na* 'we understood' and the failure of *i*-Deletion in *fihím-na* 'he understood us' is connected with the fact that subject and object suffixes belong to different layers of morphology. A mass of phonological and morphological evidence shows that subject endings are attached at the stem level, and that object/possessive suffixes are attached at the word level (Kenstowicz 1983):

[10]	[[[fihim]$_{Stem}$ na]$_{Stem}$]$_{Word}$	'we understood'
	[[[fihim]$_{Stem}$]$_{Word}$ na]$_{Word}$	'he understood us'
	[[[fihm]$_{Stem}$]$_{Word}$ na]$_{Word}$	'our understanding'

It is important that the morphological distinction between stem-level and word-level endings (e.g. subject and object endings) can be learned from core data. For example, closed-syllable shortening of CVVC- stems takes place before stem-level endings (Kenstowicz 1986):

[11]	a.	*fhímna*	'we understood'	*sta-šár-na*	'we consulted'
	b.	*fihímna*	'he understood us'	*sta-šáar-na*	'he consulted us'

Among other arguments noted by Kenstowicz for the systematic status of the morphological distinction between subject and object endings is deletion of post-tonic non-final *a* in the dialect of Tripoli (Northern Lebanon). As the contrast in [12] shows, it is blocked before object endings.

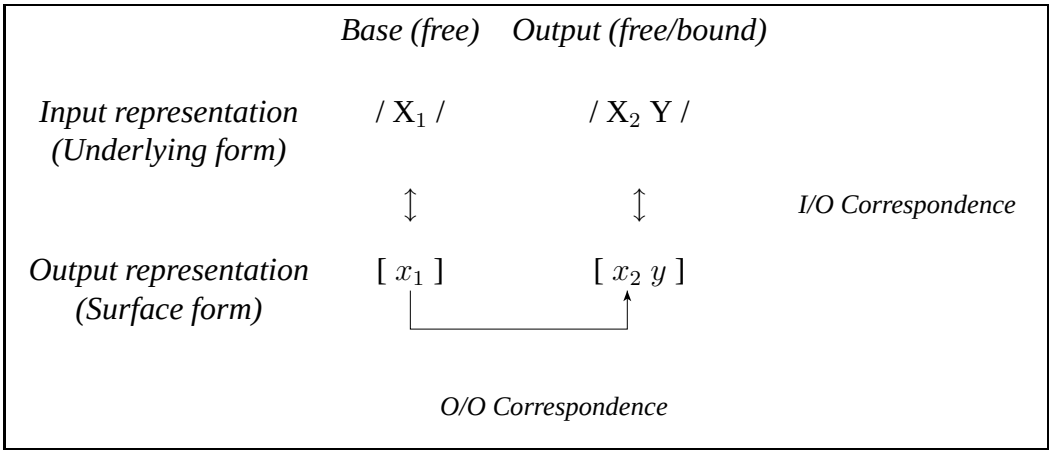
[12]	a.	*ḍárab*	'he hit'	
	b.	*ḍárbet*	'she hit'	(*a* → ∅ in unstressed light syllables)
	c.	*ḍárabik*	'he hit you (f.)'	(no *a* → ∅ before object suffixes)

Moreover, a weakening process *a* → *i* in unstressed closed syllables is also blocked before object endings, as in these forms from /ʔallam/ 'teach' (Kenstowicz and Abdul-Karim 1980:60):

[13]	a.	ʔ*illám-na*	'we taught'	(*a* → *i* in unstressed closed syllables)
	b.	ʔ*allám-na*	'he taught us'	(no *a* → *i* before object suffixes)

The core insight behind Brame's cyclic analysis has never been called into question, but each theory reflects it in its own way. Parallel OT can no more accommodate cyclic stress application than it can accommodate epenthesis applying "before" stress. Kager 1999 proposes to account for these data in terms of an O(utput)/O(utput) constraint of the sort introduced by Benua (1995, 1997) and others as an extension of Correspondence Theory. O/O constraints are correspondence constraints that relate output representations of bases (which must be independent words) to Output representations of their derivatives (which may be free or bound occurrences). They are ranked among other constraints, and they are in principle universal, i.e. part of every constraint system, though of course they have visible effects only insofar as they dominate the constraints that could defeat them.

[14]



The generalization behind cyclicity is that the pronunciation of big words depends on the pronunciation of the smaller words that they contain, but not conversely; for example *fihím-na* 'he understood us' retains the *-i-* of the first syllable because of *fíhim* 'he understood'. To explain why *fhím-na* 'we understood' does not retain its vowel, Brame assumed that the stem *fihim* is not a cyclic domain, in consequence of what he called the Natural Bracketing Hypothesis:

[15] *Natural Bracketing Hypothesis:*

A substring ψ of a string ϕ is a domain of cyclic rule application in phonology only if it shows up elsewhere as an independent word sequence which enters compositionally into the determination of the meaning of ϕ.

Brame's Natural Bracketing Hypothesis has played a central role in OT theorizing, and O/O constraint theory (unlike paradigm uniformity theories such as Lexical Conservatism) is expressly designed to derive it. Kager does this by defining the key relation of Base as follows:

[16] B is the *Base* of A iff

a. A contains a subset of the grammatical features of B, and

b. B is a free-standing output form — a word.

Taken literally, [16] is obviously too restrictive. In the Philadelphia dialect data discussed by Kager, the "Tensing" of /æ/ before tautosyllabic fricatives and front nasals (as in Nom.Sg. *p[A]ss*) is transferred to the inflected forms, where the fricative is an onset. By [16a], Nom.Sg. *pAss* is not a Base of Plural or Genitive *pAsses*. By [16b], the stem *pAss-* is not a Base either. Thus, [16] does not allow for transfer of Tensing in the inflected forms.[4] At the root of this problem is the fact that parallel OT attempts to deal with the morphology/phonology interface without a theory of morphology.

For Arabic, Kager formulates an O/O constraint HEADMAX-BA (see [17a]), which dominates and thereby supersedes the markedness constraint [17b] (which would otherwise effect deletion of *i* because it on its part dominates the Faithfulness constraint [17c]).

[17] a. HEADMAX-BA: Every segment in the base prosodic head has a correspondent in the affixed form.

b. NO [i]: /i/ is not allowed in light syllables.

c. MAX-(IO): Every segment in the input has a correspondent in the output.

The O/O constraint HEADMAX-BA accounts for the difference between [1a.*(iii)*] *fhím-na* 'we understood' and [1a.*(iv)*] *fihím-na* 'he understood us' as follows. The Base of *fihím-na* 'he understood us' is *fihím* 'he understood us', for the relation

[4]Kager trustingly accepts Benua's (1995) claim that Philadelphia æ-Tensing is an allophonic alternation which is transferred in word-level truncation and in word-level derivation. The tensed vowel is, of course, distinctive in this dialect, and tensing is demonstrably a stem-level phonological process (Labov 1993, Kiparsky 1988, 1995).

between these two forms satisfies both [16a] and [16b]. The form *fhím-na* 'we understood', however, has no Base. The form *fíhim* 'he understood' is not its Base because it fails [16a], and the form *fíhim-* 'understand' is not its Base because it fails [16b]. HEADMAX-BA therefore blocks deletion of *i* in *fihím-na*, but not in *fhím-na*.

[18]

Palestinian	HEADMAX-BA	NO [i]	MAX-(IO)
Input: /fihim, -na/, Base: [fí.him]			
1a. ☞ fi.hím.na		*	
1b. fhím.na	*		*
Input: /fihim, -na/, Base: *none*			
2a. fi.hím.na		*	*
2b. ☞ fhím.na			*

In LPM-OT it is neither necessary nor even possible to assume that the bare stem *fihim* is not a cyclic domain. *Every* stem, being a prosodically parsed category like the prosodic word, is a cyclic domain.[5] The difference between subject suffixes and object suffixes is not that the former are "non-cyclic" and the latter are "cyclic", as in Brame's analysis, but that they belong to different layers of morphology, respectively the STEM LEVEL and the WORD LEVEL. In *fhím-na* 'we understood' the initial stress of *fíhim* is eliminated at the stem level, so *i* is deletable at the word level. In *fihím-na* 'he understood us', the input to the word-level is *fíhim* 'he understood', where the stress protects the *í* from deletion.

In this approach, the contrast between *fihím-na* and *fhím-na* follows on the assumption that stress applies both to stems and to words, and that subject and object endings belong to the stem and word level, respectively. The stress on the first syllable of *fíhim* then protects the vowel from being deleted when an object ending is added:

[19]	stem level	fíhim	fíhim	fíhim
	stem level	—	—	fihím-na
	word level	fíhim	fihím-na	fhím+na
		'he understood'	'he understood us'	'we understood'

[5]Of course *roots*, such as /fhm/, are not cyclic domains. This is why they need not satisfy stem-level constraints such as those on syllable structure or prosodic form.

The word-level constraint system is (in this respect) isomorphic to Kager's constraint system; Kager's O/O constraint HEADMAX-BA is simply replaced by a standard I/O correspondence constraint MAX-V́, which requires the stressed vowel of the input to have a correspondent in the output.

[20]

Word Level	MAX-V́	NO [i]	MAX-(IO)
Input: [fí.him] na			
1a. ☞ fi.hím.na		*	
1b. fhím.na	*		*
Input: [fi.hím.na]			
2a. fi.hím.na		*	*
2b. ☞ fhím.na			*

There are, however, empirical differences. Facts show that the contrast between subject endings and object/possessive endings is a matter of stems vs. words, as LPM-OT predicts, and not of free vs. bound forms, as the transderivational O/O theory predicts. The inner layer of suffixation includes, with the subject endings, also the "singulative" suffix, which turns collective/mass nouns into count nouns. Kager (1999) discusses the following data from the Tripoli dialect that we encountered in [12]:

[21] a. *báʔar* 'cattle'
b. *báʔr-a* 'a cow' ($a \rightarrow \emptyset$ applies)
c. *báʔar-i* 'my cattle' ($a \rightarrow \emptyset$ does not apply)

[21b] illustrates that the singulative suffix *-a* belongs to the inner morphological layer, and [21c] illustrates that the possessive suffix *-i* belongs to the outer layer. Clearly, both forms are compositionally related to the free form *báʔar* 'cattle'. Kager claims that "no base can be identified for *báʔr-a* 'a cow', because it cannot be compositionally related (due to a conflict in number inflection with that of the plural *báʔar* 'cattle')." In fact, there is no conflict in number inflection, for *báʔar* 'cattle' is *not* a plural. Rather, it is a collective noun, from which the count noun *báʔr-a* 'a cow' is formed by the "singulative" or "unit" suffix *-a* (Cowell 1964:215, 297; Erwin 1963:165). The relation between collective nouns and singulatives *báʔar* 'cattle' and *báʔr-a* 'a cow' is morphologically and semantically parallel to the relation between mass nouns and count nouns, such as *laḥam* 'meat' and *laḥm-a* 'a piece of meat', and to the relation between verbal

action nouns and "instance nouns", such as *dafur* 'kicking', *dafra* 'a kick' (Erwin 1963:164-5).[6] Mass nouns and verbal action nouns take singular verb agreement; collective nouns usually take singular verb agreement as well.[7] Agreement thus reveals that collective nouns, like mass nouns and verbal action nouns are not inherently plural. Thus there is no conflict of grammatical features between them and the count/instance/singulative nouns. Therefore, the relation between collectives and singulatives conforms to both parts of the definition of the Base relation in [16] just as well as the relation between the noun and its possessive form does. Both the singulative suffix *-a* in [21b] and the possessive suffix *-i* in [21c] are added to free stems to which they are compositionally related, i.e. to Bases. Therefore, the systematic phonological difference between them cannot be due to a O/O constraint.

The real morphological difference between the singulative *-a* and the possessive suffix *-i* in [21c] which accounts for their contrasting phonological effect on the stem is not a matter of boundness or compositionality. Rather, they belong to different layers of affixation, associated with different rankings of Faithfulness constraints. The count/instance/singulative suffix belongs in the stem-level layer of affixation, along with the suffixes that mark subject agreement, noun plurals and duals, and certain derivational categories such as feminine *-a* and (in Mesopotamian dialects) the occupational suffix *-či* borrowed from Turkish. The possessive and object suffixes belong in the second, or word-level layer of affixation, which follow stem-level suffixes in the order of affixation, and are structurally more loosely connected with the stem, with the phonological consequences noted above. Other endings in this class are the postposition *-l* and the negation marker *-š*.

Let us now turn to some of the conceptual differences between the LPM-OT and O/O-OT approaches. An important point relates to learnability. A fundamen-

[6]The English translations are therefore not a reliable guide to the meanings of the Arabic collectives. Erwin makes this explicit by stating specifically that "although some collectives are best translated by an English singular noun ('wood'), some by a plural noun ('eggs'), and some by either according to the context ('chicken(s)'), the varying English translations are determined by the structure of English and should not be taken as reflecting similar distinctions among Iraqi collectives." (Erwin 1963:166). These comments apply equally to other Arabic dialects, including that of Tripoli.

[7]They *may* take plural agreement "most commonly when the verb or pronoun does not follow the noun closely, or refers to a noun in a previous utterance, and when the collective might be viewed as a collection of entities, rather than as a species…" (Erwin 1963:326). The same is true of English collective nouns, such as *team* and *livestock*, of course.

tal assumption of LPM is that acquiring the stem-level phonology is tantamount to learning the constraints on lexical (underlying) representations (Kiparsky 1982). Though this is conceptually akin to OT's Lexicon Optimization and Richness of the Base, it differs in relating the lexicon specifically to the STEM LEVEL constraint system, which can crucially differ from the word-level and postlexical constraint systems. For example, the acquisition of an underlying form such as /fihim/ involves learning that NO [i] is crucially dominated at the stem level. Learning that open syllables occur freely in underlying forms is tantamount to learning the stem-level ranking MAX-V $\gg$ NO [i], and so on.[8] Acquiring the constraint rankings at the word level and at the postlexical level involves learning what happens to material that is combined at those levels. For example, to learn that unstressed high vowels in light syllables are deleted is to learn the ranking MAX-$\acute{\text{V}}$ $\gg$ NO [i] $\gg$ MAX-V. If the learner knows (by the above reasoning or in some other way) that the ranking at the stem level is MAX-V $\gg$ NO [i], the other ranking cannot hold until the word level. Learning additional conditions under which unstressed vowels delete or fail to delete involves establishing further rankings, and so on. On this view, it is markedness and I/O faithfulness constraints that have to be ranked in acquisition. There are no additional O/O constraints or sympathy constraint to rank. Putting the point another way, we have not simply replaced the stipulative ranking of an O/O constraint by the equally stipulative ranking of an I/O constraint; rather we have derived the effect of the O/O constraint from something that can be learned from more basic data plus independently given principles of grammar. Core distributional data, potentially independent of the analogical effects that they explain, allow the learner to infer the constraint rankings which encode whether vowels delete and under what conditions.

This is a good result because the view that stems are domains of constraint evaluation is supported by phonological evidence independent of issues of opaque and cyclic constraint interaction. Indeed, the well-documented existence of well-formedness constraints that hold specifically for stems (briefly discussed by Kager in Ch. 9 in connection with Yokuts morpheme structure) is a major problem for parallelism, and constitutes another telling body of evidence for the stratification of phonology that LPM-OT envisages.

Unlike ordering theories and sympathy theory, LPM-OT it relates morphology to phonology in such a way that level differences motivated by phonological opacity predict morphological consequences (e.g. affix ordering) and vice versa.

[8] Of course, the possibility of derived-environment processes complicates the picture. No such problems arise in the Arabic data under discussion, as far as I can tell.

Thus LPM-OT allows the morphology to tell the learner what phonological behavior to expect. Moreover, it shares with ordering theories another virtue, which sympathy lacks. This is the transitivity property: if A is opaque w.r.t. B, and B is opaque w.r.t. C, then ordering theories and level theories (including those with an arbitrary number of levels) predict that A is opaque w.r.t. C. On the other hand, from sympathy theory nothing can be concluded in such a case about the relation between A and C.

Moreover, LPM-OT does not posit an arbitrary number of levels in a language. The categories "stem" and "word" are special in being anchored in the universal prosodic hierarchy, their status in UG is comparable to the status of such categories as "noun" and "verb". Unlike classical rule ordering theory and sympathy theory, where the orderings and rankings respectively are unconstrained, this imposes a small upper limit on the depth of opaque interactions.

Kager's discussion of epenthesis (1999, Ch. 6), and of compensatory lengthening (Ch. 9) points to another class of problems for parallel OT for which LPM-OT provides a solution: the need for transderivational faithfulness to intermediate derived phonological properties — aspects of the phonological representation which by Richness of the Base cannot be guaranteed to be present in underlying representations. In a much discussed pattern, an anaptyctic vowel is inserted *before* an unsyllabifiable consonant in one group of Arabic dialects, and after it in another. In Kiparsky (to appear) I show that the epenthesis site is explainable on the basis of the dialect's syllabification. The descriptive generalization is that the anaptyctic vowel is inserted *before* a stray consonant in those dialects where stray consonants are moraic in the word phonology, and after it in those where they are not. In my analysis, the explanation for this generalization is that epenthesis is governed by syllabic faithfulness: the locus of insertion is chosen so that moraic consonants remain moraic and non-moraic consonants remain non-moraic. But this explanation depends on an intermediate level of syllabification, that of the lexical phonology, at which there are no epenthetic vowels.

The generalization that the epenthetic vowel is inserted before or after stray consonants cannot even be coherently articulated on the assumptions of strict parallelism. It presupposes a stage of some kind at which there are unsyllabified consonants, which are then syllabified by epenthesis. Under parallelism there are no such things as "stray consonants", no intermediate stages, and there is no question of epenthesis "applying" to a partially syllabified form. Rather, the output with epenthesis must simply be the optimal syllabification of the input under the constraint rankings of the language. On these assumptions, the generalization that

the place of epenthesis depends on the moraic status of the consonant has no place in the analysis. Kager naturally rejects it, but his constraint system has nothing even that good to replace it with. It does not relate the fact that /fihm/ is realized as *fihim* rather than as **fihmi* to the fact that /himl-na/ is realized as *hímil-na* rather than as **hímli-na*, or to the fact that /n-katal/ is realized as *in-kátal* rather than as **ni-kátal*. This loss of generalization is avoided in the LPM analysis.

According to Kager, the epenthesis pattern /fihm/ → *fíhim* (instead of **fíhmi*) is motivated by the constraint ALIGN-R, which requires alignment of the right edge of a word with a syllable boundary. The major problem is not so much with ALIGN-R as with the parallel version of OT in which it is embedded, which forces it to be defined on output representations. It is immediately evident that ALIGN-R selects the wrong site for vowel epenthesis in consonant clusters that arise across word boundaries. Arabic freely resyllabifies across word boundaries, and the main pattern of epenthesis across word boundaries and within words is the same. Given an input VC][CCV, ALIGN-R then predicts as the optimal output candidate VC.][CiCV, which satisfies *both* ALIGN-R *and* syllabic well-formedness constraints. The actual outcome in Palestinian, however, is V.C][iC.CV, just as in the word-internal case VCCCV → V.CiC.CV. For example, [1b.i] /fihim l-walad/ → *fíhi.m il.wálad*. Here the end of the first word does *not* coincide with a syllable boundary, an output that incurs an ALIGN-R violation not enforced by any higher-ranking constraint. Onset clusters within a morpheme behave the same way as bimorphemic onset clusters. The epenthesis sites predicted by ALIGN-R simply do not materialize. The overarching generalization is that epenthesis works the same way across words as within words. Since epenthesis is postlexical, this is exactly what LPM-OT predicts.

The constraint table in [22] shows what goes wrong in Kager's analysis here.[9]

[9]The base form [il.wá.lad] indicated in the table is the actual output form; we are assuming here for the sake of the argument that Kager's constraints are capable of deriving it, which in point of fact they are not.

[22]

	ALIGN-R	*CLUSTER	HEADMAX-BA	NO [i]	HEAD-DEP(O/I)	MAX-BA	WSP
Input: /fihim l-walad/, Base: [fí.him, wá.lad, il.wá.lad]							
a. ☞ *[fí.him.][li.wá.lad]				*		*	**
b. *correct* [fí.hi.m][il.wá.lad]	*			*			**
c. *[fíhm.][li.wá.lad]		*		*		**	*
d. *[fíh.m][il.wá.lad]	*					*	**

This is not a minor bookkeeping problem: the desired form (b) in [22] is thrown out by the undominated constraint ALIGN-R, but demoting ALIGN-R would result in massive misgeneration elsewhere, and would not even help in the case at hand, since the optimal form would then turn out to be (d) *[fíh.mil.wá.lad], which is also wrong.

The parallel view is well motivated by its ability to handle top-down effects in metrical parsing, and we would not want to lose these advantages. One would therefore hope to replace the traditional generalization by an equally insightful or better one, but the fully parallel version of OT does not offer one. The serial relation between lexical and postlexical phonology, inherent in LPM-OT, is capable of expressing it, while retaining the insights that parallelism offers. Ironically, then, parallelism undermines the major achievement of OT, which is precisely to integrate naturalness and markedness into phonology, while LPM, which did not particularly have naturalness as a theoretical goal, provides an essential tool for salvaging this aspect of the OT program.

To sum up: although opacity is logically independent of paradigmatic effects, the same LPM-OT principles are in a position to provide the solution to both. In contrast, parallel OT requires separate theories of paradigmatic effects and of opacity. Uncontroversially, it must invoke at least two different new constraint types (more, according to some authors), devised expressly for the purpose of circumventing the consequences of straightforward parallel OT. In addition to these gains, LPM-OT's integration of morphology and phonology has beneficial consequences for learnability and provides a solution to the problems raised by faithfulness to derived phonological properties and by constraints on lexical representations.

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