

Accent, Syllable Structure, and Morphology in Ancient Greek

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1 Opacity and cyclicity

Introduction. In ancient Greek, the pitch accent of most words depends on the syllabification assigned to underlying representations, while a smaller, morphologically identifiable class of derived words is accented on the basis of the *surface* syllable structure, which results from certain contraction and deletion processes. Noyer 1997 proposes a cyclic analysis of these facts and argues that they are incompatible with parallel OT assumptions. His central claim is that the pre-surface syllabification to which accent is assigned in the bulk of the Greek vocabulary does not occur at a “level privileged by UG,” such as the word level or the “cycle-final” level, but simply at an arbitrary point in the derivation. (p. 502). The implication is that extrinsic rule ordering is required to do justice to the accent system. Thus, Noyer’s work presents a challenge to any version of OT phonology. In this paper, I take up the challenge and argue that, although fully parallel OT may not be up to dealing with these accentual facts, the stratal version of OT based on Lexical Phonology and Phonology (stratal OT, or LPM-OT, Kiparsky 2000, to appear) provides a much better analysis of them than phonology with ordered rules does.

Thus, Greek accentuation and syllabification bear on two theoretically problematic issues: PHONOLOGICAL OPACITY and CYCLICITY.

To understand how the accentual constraints interact with the rest of the phonology and morphology we need an accurate formulation of the accentual constraints themselves and of the phonological representations to which they apply. These are, in fact, of considerable interest in their own right and have been the subject of an extensive literature already. In particular, we shall be concerned with the nature of so-called recessive accent, and with the distribution of so-called circumflex and acute “intonations” (phonologically a matter of whether the pitch accent falls on the first or second mora of a long vowel or diphthong e.g. $\tilde{\eta} = \acute{\epsilon}\epsilon$, $\acute{\eta} = \epsilon\acute{\epsilon}$).¹

¹On short nuclei, the distinction between acute and circumflex is neutralized.

The problem. The phenomenon at stake in Greek is a systematic accentual difference between two classes of words. Sommerstein 1973 identified them as respectively simple words and compounds words, and proposed the following generalization.

- (1) Simple words are accented on the basis of the syllabification applied to *underlying* representations, whereas derived words are accented on the basis of the *output* syllabification.

For example, the circumflex accent (i.e. accent on on the first mora) of Nom.Sg. *plóus* ‘sailing, voyage’ (πλοῦς) must be assigned at the level of underlying disyllabic /pló.-os/. Otherwise we shall have **plóús* (*πλούς), by the general rule that word-final accented long vowels get acute intonation in the nominative and accusative cases (compare *poús* πούς ‘foot’). On the other hand, the accent of the compound Gen.Sg. *pe.rí.plou* (περίπλου) ‘sailing round, circumnavigation’ must be assigned at the level of the surface (contracted) syllabification, because it violates the “Law of Limitation” (see below) at the pre-contraction level of representation. If accent were assigned before contraction in this form, the outcome would be /pe.ri.+pló.ou/, which would surface as **pe.ri.plóu* (*περιπλοῦ).

Noyer accepts Sommerstein’s generalization (with some emendations that we will come to later), and constructs from it an argument for serialism, the gist of which is as follows. Certain phonological processes that interact with syllabification, such as contraction, *s*-deletion, and stray erasure, apply cyclically. The syllabification on which accentuation is based ignores some of those processes. Therefore accent must be assigned on a given cycle of word formation prior to the application of those processes. In Noyer’s words: “If indeed syllabification shows cyclic effects, it must be ordered before contraction on each cycle, with the result that the output of each successive cycle is a contracted form. The syllabification needed for accentuation is therefore neither the surface form nor some privileged representation produced at the end of a cycle of word formation. Rather, this syllabification is merely an arbitrary intermediate derivational stage.”

Of course, Noyer’s claim that the cyclic phonological rules are extrinsically ordered is tied to the specific theory of phonology that he adopts, which evidently does not countenance a word level. On stratal OT assumptions, they must in fact be word-level processes. Stratal OT further entails, correctly, that the accentual processes that ignore these processes, and are made opaque by them, take effect at the stem level. I will join this result to a morphological analysis of the relevant derivational processes to obtain a theoretical explanation for why a class of derived forms are accented as stems, while the rest are unaccented as stems and receive a default accent at the word level. I will argue that the latter subclass, which is accented transparently, consists of exactly those derived words which lose their inherent accent by a morphological deaccentuation process and then receive recessive accent by default. This revised generalization will lead directly to my stratal OT account of Greek. The stratal OT alternative thus leads to a more serious revision of Sommerstein’s generalization. Contraction and accent do interact opaquely in all simple words, but the accentual behavior of derived

words depends on their morphological class in an interesting way.

In the next section I review the basic generalizations about Greek word accentuation and formulate a constraint system that covers them.

2 The core generalizations

Recessive accent. The unmarked accent pattern of Greek words is RECESSIVE ACCENT. The recessively accented syllable is determined as follows:

- (2) RECESSIVE ACCENT: The accent falls on the penult if the final syllable is heavy, otherwise on the antepenult.

Here is how (2) locates the pitch accent in some representative words.²

- | | | | | |
|-----|----|----------------------|-----------|---------------------|
| (3) | a. | <i>ánth.roo.pos</i> | ἄνθρωπος | ‘person’ (Nom.Sg.) |
| | b. | <i>anth.roó.poon</i> | ἄνθρώπων | ‘persons’ (Gen.Pl.) |
| | c. | <i>sóo.ma</i> | σῶμα | ‘body’ (Nom.Sg.) |
| | d. | <i>soó.ma.ta</i> | σώματα | ‘bodies’ (Nom.Pl.) |
| | e. | <i>soo.má.toon</i> | σώματων | ‘bodies’ (Gen.Pl.) |
| | f. | <i>e.paí.deu.sa</i> | ἐπαίδευσά | ‘I educated’ (Aor.) |
| | g. | <i>pai.deú.oo</i> | παιδεύω | ‘I educate’ (Pres.) |

To apply (2) correctly it is necessary to know that word-final consonants are weightless (extrametrical) in Greek phonology. Therefore, in word-final position, both -V and -VC rhymes make light syllables, whereas -VCC is heavy, as are -VV and -VVC. For example, for purposes of the Greek accent rules (3f) *e.paí.deu.sa* ‘I educated’ and *e.paí.deu.san* ‘they educated’ are equivalent.

Recessive accent is mandatory for finite verbs and for certain morphological classes of nominals (such as most types of neuter nouns). No word can have the accent further to the left than the recessive accent, but in many words it is further to the right, either on a syllable fixed lexically for the stem, or (in consonant stems) on a syllable determined by the case ending.

A syllable containing a long vowel or diphthong can bear one of two accents, or “intonations”, either acute (phonologically V \acute{V}) or circumflex (V \grave{V}). Their distribution is predictable in non-final syllables:

- (4) An accented two-mora syllable is acute
- in the antepenult, and
 - in the penult if and only if the final syllable is bimoraic.

²For readability, I represent the vowels by transliterating the Greek orthography, not in phonological transcription. Accordingly, for ω I write *oo*, and for *ou*, *ou*. Phonologically, ω corresponds to / ω / and *ou* corresponds both to / ou / and to / oo /. This shortcut is harmless in the present context because accentuation does not depend on vowel quality in any way.

The reader may have noticed that the descriptive generalization about accent placement in (2) was formulated in terms of syllable weight, and the one about intonation in (4) was formulated in terms of the mora count. This reflects a profound generalization discovered by Steriade 1988b. Greek accentuation depends on the following three-way syllabic distinction.

- (5) a. Light syllables: -V
 b. Heavy syllables with one accentable mora (one tone-bearing unit): -VC
 c. Heavy syllables with two accentable moras: -VV

From now on I will use the term *mora* exclusively to refer to an accentable mora or TBU, not to a unit of syllable weight. What Steriade found is that heavy one-mora syllables pattern with heavy two-mora syllables with regard to accent placement, but with light one-mora syllables with regard to the determination of acute versus circumflex intonation.

The place of accent depends on syllable weight. That the location of the accented syllable depends on the weight of syllables, not on how many moras they have, is shown by recessive accent, clitic accentuation, and the historical change known as Wheeler's Law. The data in (6) illustrate recessive accent with left-headed compounds with a governing prepositions or verb, showing that the final monomoraic heavy -VCC syllables in (6a) pattern with the final bimoraic heavy -VVC syllables in (6b), and differ from the final monomoraic light -VC syllables in (6c).

- (6) a. -VC(C): *lipó+thriks* λιπόθριξ 'balding', *epí+teks* ἐπίτεξ 'about to deliver', *ep+éeluks* ἐπῆλυξ 'overshadowing', *philo+kólaks* φιλοκόλαξ 'fond of flatterers' (penult)
 b. -VV(C): *lipó+naus* λιπόνους 'deserting the fleet', *epí+phroon* ἐπίφρων 'thoughtful', *philo+lákoon* φιλόλακων 'fond of Spartans', *philo+meétoor* φιλομήτωρ 'fond of one's mother', *philó+pais* φιλόπαις 'fond of children' (penult)
 c. -V(C): *ép+okhos* ἔποχος 'mounted', *ép+eelus* ἔπηλυσ 'incomer', *philó+sophos* φιλόσοφος 'lover of wisdom', *phíl+oinos* φίλοινος 'wine-lover' (antepenult)

In clitic accentuation, final monomoraic heavy -VCC syllables (as in in (7a)) pattern with final bimoraic heavy -VVC syllables (as in in (7b)), and differ from final monomoraic light -VC syllables (as in (7c)).

- (7) a. -VC(C): *phóiniks tinós* 'someone's phoenix'
 b. -VV(C): *dáimoon tinós* 'someone's demigod'
 c. -V(C): *óikós tinos* 'someone's house'

Finally, Wheeler's Law is an accent retraction which applies in dactylic sequences, where the heavy syllable can be either bimoraic or monomoraic (viz. — ◡ ◡ → —

◌ ◌, as in Dat.Pl. *patrasí → patrásī ‘fathers’). This process is less probative for present purposes because it has evidently been morphologized in the synchronic system of classical Greek, and it has even been argued that it was a morphological process from the beginning (Kuryłowicz 1952); see Probert 2000 for extensive discussion of Wheeler’s Law and its aftermath in Greek.

Intonation depends on the mora count. Acute vs. circumflex intonation, on the other hand, depends on moras, not on syllable weight. The most obvious reflection of this generalization is that acute and circumflex contrast only on two-mora (-VV or -VVC) syllables. More interestingly, it is revealed by the descriptive generalization in (8).

- (8)
- a. Acute (V́) is obligatory before two syllables or a two-mora syllable,
 - b. circumflex (V̂V) is obligatory elsewhere, except that
 - c. word-final syllables must be acute in nominative and accusative forms.

For example, in (8), word-final heavy -VC(C) syllables differ from heavy -VV(C) syllables, and instead go with with monomoraic light -V(C) syllables. (Remember that final consonants are extrametrical, a status here symbolized by parenthesization, e.g. -(C).)

- (9)
- a. -VC(C): *katéelips* κατῆλιψ ‘terrace’, *katóoruks* κατῶρυξ ‘dug in’, *philo+spéelunks* φιλοσπηλυγξ ‘fond of caves’ (circumflex)
 - b. -VV(C): *kat+éérees* κατήρης ‘fitted out’, *philo+meétoor* φιλομήτωρ ‘loving one’s mother’, *meéteer* μήτηρ ‘mother’ (acute)
 - c. -V(C): *kat+éemar* κατῆμαρ ‘day by day’, *kat+éídon* κατέειδον ‘I looked down’, *héemar* ἥμαρ ‘day’, *óinos* οἶνος ‘wine’ (circumflex)

Steriade’s analysis. We will now consider two important previous generative theories of Greek accentuation. Steriade’s (1988b) theory (also assumed by Noyer for most of his discussion) posits the foot formation rules in (10).

- (10)
- a. A word-final consonant is extrametrical.
 - b. A word-final light syllable is extrametrical.
 - c. A syllabic trochee is built at the right edge of the word.

Recessive accent falls on the head of the foot so constructed.

For the intonation of nonfinal syllables, Steriade proposes the rules paraphrased in (11):

- (11) PHONOLOGICAL INTONATION RULE (Steriade):
- a. A word-final monomoraic syllable is extrametrical.

- b. An bimoraic accented syllable is right-headed (viz. VV́, or ‘acute’) if it is followed by at least one (non-extrametrical) mora. Otherwise it is left-headed (viz. V̂V, ‘circumflex’).

The workings of (10) and (11) are illustrated in (12), where the parentheses show the resulting foot structure.

- (12) Footing by syllabic trochees:
- a. (*ánth.roo*)pos
 - b. anth(roó.poon) (acute)
 - c. (sóo)ma (circumflex)
 - d. (soó.ma)ta (acute)
 - e. soo(má.toon)
 - f. e(paí.deu)sa (acute)
 - g. pai(deú.oo) (acute)
 - h. pee(né.lops)

Steriade’s rules reflect the three-way distinction in syllable types straightforwardly, in that (10b) is formulated in terms of syllable weight, and (11a) is formulated in terms of the mora count. The difference is dramatized in words of the type (9a), such as *katéelips*. Because *-lips* is heavy, it is not extrametrical by (10b), so it gets footed by (10c); this ensures that the penult rather than antepenult gets the accent (i.e. *ka(tée.lips)* like *anth(roó.poon)*, not **(ká.tee)lips*, like *(ánth.roo)pos*). But because *-lips* is monomoraic, it is extrametrical by (11a), hence invisible to (11b), so that the accented vowel of *katéelips* has a circumflex (unlike that of *anthroópoon*).

The Sauzet/Golston proposal. An alternative due to Golston (1989), based on an earlier proposal by Sauzet (1989), is to construct *moraic* (rather than syllabic) trochees at the right edge. Moraic trochees are feet containing either a heavy syllable or two light syllables. If the last syllable is light and the one before it is heavy, the foot is built on the penult, and the final short syllable is left unfooted.³ In this solution, the “extrametricality” of final -V and -VC syllables is no longer needed, though it remains the case that final consonants do not count (just as line-final consonants don’t count in determining quantity in Greek versification). Recessive accent falls immediately to the left of the last foot, and if there is nothing to the left of the last foot, then on the leftmost element of the last foot. Sauzet and Golston implement this idea by positing a pitch accent H*L, where *L associates to the peak and H to the syllable that precedes it; this autosegmental refinement of the analysis could easily be incorporated into my analysis as well, but I will not do so, largely in order to keep the exposition simple.

- (13) RECESSIVE ACCENT RULE (adapted from Sauzet/Golston):
 Accent the mora immediately to the left of the final foot, otherwise [i.e. if there is no such mora], accent the leftmost element of the final foot.

³Alternatively, it could be adjoined either to the foot, or to a superordinate metrical constituent such as the prosodic word. From the data it is hard to decide between these alternatives, but in (14a,c) below I have arbitrarily chosen the former.

The footing that results from (13) is different but the output accentuation is the same.

(14) Footing by moraic trochees:

- a. *ánth(roo)pos*
- b. *anthró(po)on*
- c. *(só)ma*
- d. *soó(ma.ta)*
- e. *soo.má(too)n*
- f. *e.paí(deu)sa*
- g. *pai.deú(oo)*
- h. *pee.né(lop)s*

In the Sauzet/Golston analysis, the penult accent of words ending in clusters (e.g. (14h) *peenélops* πηνέλοψ ‘a kind of duck’, *lipó-thriks* λιπόθριξ ‘balding’) follows directly, but the circumflex intonation of their long penults (e.g. *katéelips* κατῆλιψ ‘terrace’, *kéeruks* κῆρουξ ‘herald’, *óinops* οἴνοψ ‘wine-colored’) is not predicted. Golston proposes a special defooting rule which applies *after* accent is assigned and *before* intonation is determined. This solution depends crucially on opaque rule ordering, and is not available in an OT analysis (including stratal OT).

The present analysis. Adopting the idea that a moraic trochee is built at the right edge, two constraints derive the basic recessive accent pattern, including the distribution of acute and circumflex in non-final syllables. The first constraint, IDENT(Acc), imposes accentual faithfulness on footed moras. It is an I/O constraint which requires footed moras to have the same pitch accent in the input and in the output. In the data under consideration here, IDENT(Acc) prevents recessive accent from landing on the final foot. (Later we will see that it has another, equally important function: it allows for distinctive accentuation and intonation on the final foot, by protecting lexical accents on it from being overridden by other accent constraints.) IDENT(Acc) dominates the second constraint, ALIGN, which requires the head of a foot to bear the pitch accent. As usual, ALIGN is evaluated gradiently. In longer words, it ensures that the pitch accent falls *as close to* the head of the foot as possible without actually hitting it, which is to say, on the immediately preceding mora (the “Law of Limitation”). Where there is no mora to the left of the foot, so that IDENT(Acc) is perforce violated, ALIGN ensures that the accent is assigned to the head itself. The two constraints are summarized, in the order of their ranking, in (15).

- (15) a. IDENT(Acc): Corresponding segments in a foot have the same pitch.
b. ALIGN: The head of a foot must bear a pitch accent.

In addition, undominated constraints which I will not formulate explicitly here require every word to have one and only one pitch accent, and assign a moraic trochee to the right edge.

(16)

	IDENT(Acc)	ALIGN
1. Input: [anthroopo-s]		
1a. ☞ án(throo)pos		*
1b. an(thróo)pos	*	
1c. an(throó)pos	*	*
2. Input: [anthroopo-oon]		
2a. án.throo(poo)n		***
2b. an.thróo(poo)n		**
2c. ☞ an.throó(poo)n		*
2d. an.throo(póo)n	*	
2e. an.throo(poó)n	*	*
3. Input: [soomat]		
3a. ☞ (sóo)mat	*	*
3b. (soó)mat	*	**
4. Input: [soomat-a]		
4a. sóo(ma.ta)		**
4b. ☞ soó(ma.ta)		*
4c. soo(má.ta)	*	
4d. soo(ma.tá)	*	*
5. Input: [soomat-oon]		
5a. sóo.ma(too)n		***
5b. soó.ma(too)n		**
5c. ☞ soo.má(too)n		*
5d. soo.ma(tóo)n	*	
5e. soo.ma(toó)n	*	*
6. Input: [lipo(thrik)s]		
6a. lí.po(thrik)s		**
6b. ☞ li.pó(thrik)s		*
6c. li.po(thrík)s	*	

This much suffices for the main cases, but once again the type (9a) *ka.tée(lip)s* causes trouble. The above constraints predict **ka.teé(lip)s*, with the wrong intonation. My I proposed remedy is a constraint which is in a way the converse of Steriade's (11b), and essentially equivalent to the traditional so-called “σωτηρία” Law. It precludes acute penult accent (V \acute{V}) if the final syllable is monomoraic (don't forget that a mora here means a tone-bearing unit, not a unit of syllable weight).

(17) * $\mu\acute{\iota}.\mu$]: No acute before a word-final mora.

This constraint, which dominates the other two, is unviolated in Greek. In the present data, it is needed only for words like *ka.tée(lip)s*. It also comes into play in the derivation for words of type 1 and 3 in (16), but as the tableau shows, these can be had simply by ALIGN). Other data that we will come to later will show that it is, in fact, independently required. Still, from a theoretical point of view, it is obviously unsatisfactory; it remains to be seen whether it can be put on a more principled footing. The

following tableau incorporates this new constraint and completes our account of the basic recessive accent pattern.

(18)

	*[μ́.μ]	IDENT(Acc)	ALIGN
7. Input: [katee(lip)s]			
7a.	ká.tee(lip)s		***
7b. ☞	ka.tée(lip)s		**
7c.	ka.teé(lip)s	*	*
7d.	ka.tee(líp)s	*	

This said, it should be emphasized that, for purposes of the following discussion, little depends on the specific mechanism that drives accent and intonation assignment. The essential points to be made below concern the interaction of accentuation with syllabification and with morphology, and these should survive any constraint-based reanalysis of the descriptive generalizations concerning recessive accent, on which all solutions of course agree.

Morphologically determined accent and intonation in final syllables. In final syllables too, the intonation is largely predictable, but this time by *morphological* conditions. The most important one is stated (for the time being as a descriptive generalization) in (19).

(19) A two-mora word-final syllable is acute in nominative and accusative case forms (the direct cases).

This morphological acute pre-empts the circumflex otherwise required by ALIGN, which surfaces in other case forms (genitive, dative, vocative), verbs, and elsewhere. Examples of the intonational contrast in the noun declension are given in (20).

- (20) a. *po.d-óús* ποδοῦς ‘feet’ (A.Pl.) *po.d-óon* ποδῶν (G.Pl.)
 b. *phu.g-éé-n* φυγῆν ‘flight’ (A.Sg.) *phu.g-éé-s* φυγῆς (G.Sg.)
 c. *zeús* Ζεῦς ‘Zeus’ (Nom.) *zéu* Ζεῦ (Voc.)
 d. *hipp-eú-s* ἵππεύς ‘horseman’ (Nom.) *hipp-éu* ἵππεῦ (Voc.)

The intonation contrast is manifested on the case ending in (20a), on the theme vowel that determines the inflectional class of the stem in (20b), on the root syllable itself in (20c), and on the derivational suffix in (20d). Therefore, it is not an inherent property of any particular case morpheme, but a morphophonological property associated with the direct cases, *qua* morphological categories. Just how it should be handled is difficult to decide: perhaps by a morphologically triggered alignment constraint, or by a floating accent anchored to the right edge of the word. What is clear is that the final acute intonation of the strong cases is a marked intonation on final syllables, and circumflex by ALIGN is the default.

As a matter of fact, morphological right-edge accent is practically the *only* kind of lexically marked accent in Greek. It has been long recognized that the overwhelming

majority of basic stems in Greek are either recessively accented, or accented on the stem-final syllable (Kuryłowicz 1952:131 ff., Steriade 1988b). Penult accent hardly occurs in underived stems, though many inherently accented derivational suffixes can yield stems with penult accent. For example, nonderived words with penult accent, such as a hypothetical **peléku-s*, do not occur, although there are many derived words with penult accent, such as *anthroop-ísk-o-s* ἀνθρωπίσκος ‘little person’.⁴ Once morphology is taken into account, stems can be divided into accented and unaccented stems, the former with a lexically associated stem-final accent, the latter with recessive accent. Both are preserved as far as the undominated constraints on accent and intonation permit.

With these generalizations in mind, let us return to the morphological distribution of opaque and transparent accentuation, on which the whole argument rests. We will then retrace the steps of Noyer’s argument and confront it with an alternative couched in the stratal OT framework.

3 The morphological distribution of opaque accentuation

Opaque accentuation in simple words. In underived words, accent is assigned, in ordering terms, “before” vowel contraction, and is made opaque by it. This generalization will now be demonstrated for recessive accent (ALIGN), for the morphological intonation constraint (19), and for a third accentual constraint which we have not yet introduced.

Recall that finite verbs always get recessive accent. The finite verb forms in (21) show that recessive accent works on the basis of the pre-contracted syllabification, and that it is opaque in the output representations:

- | | | | | | | |
|------|----|-----------------|-------------------|---------|--------------------|--------------------|
| (21) | a. | /poi.é.-oo/ | <i>poi.óo</i> | ποιῶ | <i>*poi.oo</i> | ‘make’ (1Sg.) |
| | b. | /phi.lé.-e-te/ | <i>phi.léi.te</i> | φιλεῖτε | <i>*phi.lei.te</i> | ‘love’ (2.Pl.) |
| | c. | /ti.the.-ée-te/ | <i>ti.thée.te</i> | τιθητε | <i>*ti.thee.te</i> | ‘put’ (2.Pl.Subj.) |

The starred forms in the fourth column are what would be derived if accent were assigned to output forms. (The forms between slashes represent the stem level forms, as syllabified and accented at that level. The accent is predictably assigned by (15), therefore not necessarily present in underlying representations.)

The examples in (22) illustrate the same point for the morphological intonation rule (19b), according to which a word-final syllable is acute in the nominative and in the accusative and circumflex in the genitive and dative. It is apparent that (22) violate both halves of this rule at the output level. (22a-c) have a circumflex accent in direct cases and (22d) has an acute accent in an oblique case.

⁴Probert 2000 shows how the stock of such inherently accented derivational suffixes was augmented by reanalysis of the output of Wheeler’s Law (the accent retraction mentioned in section 2 above).

- (22) a. /pló.-os/ *plóus* πλοῦς **plóus* ‘sailing’ (Nom.Sg.)
 b. /a.lee.thé.s-a/ *a.lee.thée* ἀληθῆ **a.lee.thée* ‘true’ (Acc.Sg.)
 c. /her.mé.-ee-n/ *herméen* Ἑρμῆν **her.meén* ‘Hermes’ (Acc.Sg.)
 d. /di.-í/ *dít* (∼di.í) Δί (∼ Διί) **díi* ‘Zeus’ (Dat.Sg.)

The correct output in all these forms is derived on the assumption that the accent is assigned to the uncontracted form and stays on the original mora (or as close to it as possible) after contraction, viz. $\acute{V}.V \rightarrow \acute{V}V$, $V.\acute{V} \rightarrow V\acute{V}$.⁵

Another demonstration of the generalization that accent in simple words is assigned on the basis of the pre-contraction syllable structure comes from the process of IAMBIC RETRACTION. This process, first identified in Bartoli 1930, deaccents a final iambic sequence (◌ ◌) in polysyllabic words, resulting in recessive accentuation.⁶ The effect of this retraction appears systematically in the inflection of consonant stems (see (23a)) and with several derivational suffixes, such as *-tees* and *-lee* (see (23b,c)).

- (23) a. /thu.ga.teér/ *thu.gá.ter* θυγάτηρ ‘daughter’ (Acc.Sg. *thu.ga.tér-a*)
 b. /er.ga.-teés/ *er.gá.tees* ἐργάτης ‘worker’ (*a.go.reu.-teés* ‘orator’)
 c. /di.e.-teés/ *di.é.tees* διέτης ‘two-year’ (Koine διετής)
 d. /ne.phe.-leé/ *ne.phé.lee* νεφέλη ‘cloud’ (*ter.poo.-leé* ‘delight’)

That iambic retraction (like recessive accent) applies crucially prior to vowel contraction was shown in Kiparsky 1967. There is a class of underlyingly disyllabic noun stems which contract into monosyllables. These derived monosyllabic stems uniformly undergo iambic retraction — a fact comprehensible only if iambic retraction applies prior to contraction. The examples in (24) illustrate this point.

- (24) a. /go.nu.-oin/ *goú.n-oin* γούνοιον ‘knees’ (G/D.Du.) cf. *gónu* ‘knee’
 b. /o.a.t-oon/ *oót-oon* ὠτων ‘ears’ (G.Pl.) cf. *óus* ‘ear’

The nominative in (24a) shows the disyllabic stem directly, the nominative in (24b) attests to it indirectly through its circumflex accent, which because of (8c) must be inherited from a disyllabic /ó.os/.

The examples of iambic retraction in (25) show that the process also bleeds the stem-level reduction (ablaut) of the final syllable in sonorant stems that is triggered by the accented case endings of the genitive and dative. These examples are important because they confirm the stem-level status of iambic retraction. If iambic retraction operated only on words, it would itself be bled by the stem-level reduction process.

- (25) a. /thu.ga.te.r-oon/ *thu.ga.té.r-oon* θυγατέρων ‘daughter’ (G.Pl.)
 b. /pa.te.r-oin/ *pa.té.r-oin* πατέρων ‘father’ (G/D.Du.)

For comparison with (24) and (25), the data in (26) illustrate the unretracted suffix accentuation that obtains when the conditions of iambic retraction are not met, either

⁵N.A.Dual forms in *-oo* are reportedly exceptions to this generalization (Vendryes 1945:214); accordingly, a N.A.Dual of *plóus* ‘voyage’ would be /pló-oo/ *plóo* (not **plóo*).

⁶In Kiparsky 1967 I propose that it applies more generally to iambic sequences in any polysyllabic word, and relate it to the retraction in words like /egoó-ge/ *égoo-ge* ἔγωγε ‘I (for my part)’ in the Attic dialect.

because the word is not polysyllabic ((26a,b)), or because the accented syllable is short ((26c,d)).

- | | | | | | |
|------|----|------------------|---------------------|----------|--------------------|
| (26) | a. | /po.d-oin/ | <i>po.d-óin</i> | ποδοῖν | ‘feet’ (G./D.Du.) |
| | b. | /po.d-oon/ | <i>po.d-óon</i> | ποδῶν | ‘feet’ (G.Pl.) |
| | c. | /thu.ga.te.r-os/ | <i>thu.gat.r-ós</i> | θυγατρός | ‘daughter’ (G.Sg.) |
| | c. | /pa.te.r-os/ | <i>pat.r-í</i> | πατρί | ‘father’ (D.Sg.) |

Vowel contraction is not the only phonological process that must not “count” in determining the accentuation of underived words. As Steriade 1988b was the first to point out (at least in the generative tradition), the assignment of recessive accent pays heed to underlying word-final consonants even when they are deleted in the output. The neuter participles in (27) furnish a good illustration.

- | | | | | | | |
|------|----|---------------|-------------------|----------|---------------------|-------------|
| (27) | a. | /kha.rí.ent/ | <i>kha.rí.en</i> | χαρίεν | * <i>khá.ri.en</i> | ‘pleasing’ |
| | b. | /pai.deú.ont/ | <i>pai.deú.on</i> | παιδεύον | * <i>paí.deu.on</i> | ‘educating’ |

In consequence of this generalization, underived words ending in consonant clusters never have antepenultimate accent, whether the clusters actually surface or not. (Here too, we shall see that a class of morphologically derived words behave differently; the distribution of opaque and transparent interactions between cluster simplification and accent is quite analogous to that between contraction and accent.)

The failure of parallel OT. Can the data in (21) and (22) be accommodated in parallel OT? Consider (22c) *phi.léi.te* ‘you love’, contracted from /phi.lé.-e.-te/. Finite verbs invariably take recessive accent, and application of recessive accent at face value to the contracted form would give **phí.lei.te* (cf. *é.lei.pe* ‘left’). The antepenultimate accent that the constraints responsible for recessive accent would assign must be defeated by some faithfulness constraint. The question is, by what faithfulness constraint? Under full parallelism, it cannot be I/O faithfulness, for the only inputs in that theory are underlying representations, and predictable accent (such as recessive accent in verbs) may not be counted on to be present in underlying representations, by Freedom of Analysis. Any accentuation may be posited in input representations of finite verbs, and hence there is no particular accentuation to be faithful to. Nor, clearly, can it be O/O faithfulness, or some other type of paradigm uniformity such as Lexical Conservatism (Steriade 1999), because any such constraint would overapply to uncontracted verbs that have their accent on the expected syllable. The special accentuation of contracted verbs has to be related to the fact that they are contracted. This can only be done by sympathetic faithfulness (McCarthy 1999a, 1999b). Let us consider how a sympathy analysis would work.

A sympathy analysis would have to derive the penult circumflex accent of *phi.léi.te* by sympathetic faithfulness to the final accent of the losing uncontracted candidate **phi.lé.-e.-te*. This SYMPATHY CANDIDATE must be identified as the optimal candidate that satisfies some selector constraint, and *CUMUL and *DIFF must then select

the cumulative candidate most similar to the sympathy candidate. The selector constraint must be a constraint that imposes faithfulness to some property of the input representation. Here are some possibilities.

The most obvious possibility is that it is faithfulness to syllable structure. But that runs counter to McCarthy's stricture that there is no faithfulness to syllabicity, firmly motivated by the observation that allowing faithfulness to syllable structure would nullify the effect of cumulativity. If faithfulness to syllabification is prohibited, then obviously sympathy candidates cannot be selected by such a faithfulness constraint. Another possibility is that the selector constraint requires faithfulness to the moraic status of segments. This one is a non-starter because the the uncontracted sequence **-lé.e-* and the output form *-léi-* are identical in moraic terms: both have two moras. A third possibility is to posit a deleted consonant and invoke \star MAX-C as selector constraint. This fails because there is absolutely no synchronic motivation for such a consonant.⁷ Finally, alignment of morphemes with syllables would pick out the desired sympathy candidate, in this case, but alignment constraints are not faithfulness constraints, and McCarthy argues on principled grounds that the selector constraint must be a faithfulness constraint. If I am not mistaken, these considerations eliminate all selector constraints that could pick the required sympathy candidate. So no sympathy analysis is available either.

The upshot is that parallel OT will incorrectly assign recessive accent to the antepenult in *phi.léi.te*.

This is not just an isolated problem involving a few verb forms. For exactly parallel reasons, most inflected forms of the vast class of contracted verbs, as well as numerous types of inflected nominals, will receive their recessive accent on the wrong syllable; (21) and (22) are just a small sample of the massive misgeneration that parallelism will have to contend with.

In 4 below I argue that stratal OT provides a straightforward analysis of these cases. The following core ideas of the theory are relevant:

- Stems, words, and sentences are characterized by distinct constraint systems.
- These constraint systems are parallel, and interface serially.
- I/O constraints are the only type of correspondence constraint.

One consequence of these assumptions is that *opacity arises from inter-level constraint masking*. I will argue that Greek accentuation is opaque because accent is assigned to stems, and contraction applies to words.⁸ As far as I can tell, in Greek all

⁷Historically, there was a *y* between the vowels, but it is long gone by the earliest attested stages of Greek, and no morphophonemics betrays any synchronic residue of it to the learner.

⁸See Hedin 2000 for phonological analysis of Greek contraction, including arguments that contraction is a lexical process. Postlexically, elision is Greek's preferred method for coping with hiatus, and although there is some contraction too as a second-tier strategy (so-called *crasis*) it works somewhat differently than contraction.

word morphology proper is located at the stem level (“level 1”); only clitics are added to words (forming bigger words). At the stem level, /phi.le.-e.-te/ receives regular recessive accent on the antepenult (*phi.lé.e.te*). When this is contracted to *phi.lée.te* at the word level, the accent remains on the original mora, because faithfulness (specifically, (15b) IDENT(Acc)) protects it from being retracted to the antepenult:

(28) /phi.le.-e.-te/ → (Stem Level) *phi(lé.e)te* → (Word Level) [phi(léi)te]

Transparent accent in derived words. In a class of noun compounds, however — and that brings us back to the nub of Noyer’s argument — accentuation is determined on the basis of the *output* vocalism, with all contractions and word-final consonant deletions already in place. The examples in (29) are recessively accented derived compounds which illustrate how the recessive accent rule must be applied at the output level to give the right results.

(29) a. /pe.ri.+plo.-ou/ *pe.rí.plou* **pe.ri.plóu* ‘sailing round’ (G.Sg.)
 b. /phi.l+a.lee.the.s-oon/ *phi.la.léé.thoon* **phi.la.lee.thóon* ‘truth-loving’ (G.Pl.)

The generalization that recessive accent in this class of derived words is assigned to word-level representations can be verified with another phonological process that interacts with accentuation. Recall Steriade’s observation that recessive accent is determined not only prior to vowel contraction, but prior to the deletion of word-final obstruents. Underlying final sonorant-obstruent clusters make the last syllable heavy for purposes of recessive accent, even though the final obstruent is always deleted in the output. The accent for simple words ending in underlying -VCC, such as /khari-ent/ *khárien*, must be computed on the basis of a representation with the deleted final consonants present: otherwise the antepenult will be incorrectly accented. What Noyer points out that the lost consonant is *not* visible in zero derivatives of such forms. The adverb (30b) *khárien*, formed from the same adjective, shows why:

(30) a. /khari-ent/ *khárien* χάρειν ‘graceful’ (Nom.Sg.Neuter)
 b. /khari-ent/ *khárien* χάρειν ‘with pleasure’ (adverb)

Noyer further observes that recessive accent in certain compounds (unlike recessive accent on simple words) also ignores deleted final consonants:⁹

(31) a. /dús+dámart/ *dúsdamar* δύσδαμαρ **dusdámar* ‘ill-wedded’
 b. /oinó+gálakt/ *oinógala* οινόγαλα **oinogála* ‘wine-milk’
 c. /ámphoo+odónt/ *ámphoodon* ἄμφωδον **amphóodon* ‘with teeth on both’

This time, the final syllable counts as *light* for purposes of the accentuation, in spite of the underlying final cluster. If the accent were assigned on the basis of the underlying consonantism, the penult would be accented in all such cases (as in (6a), for example). The correct form is derived on the basis of the output (word-level) consonantism.

⁹Cases like (31c) are predicted by Noyer, but he does not cite any example of them. By a pleasant coincidence, I found (31c) in a passage where Aristotle proposes a kind of proto-OT theory of the form of biological organisms (*De Partibus Animalium* 663 b36).

Noyer’s argument for an intermediate derivational stage. The data in the preceding sections certainly show that recessive accent is opaque in simple words, and transparent in some derived words. Now, what about Noyer’s claim that accentuation is determined at an “arbitrary intermediate derivational stage”?

Building on the assumption that simple words are accented before contraction and derived words after it, Noyer develops a cyclic analysis originated by Sommerstein 1973. The idea is that simple words undergo the accent rules just once, and derived words (including compounds) go through the accent rules a second time, after contraction has applied. If so, then it follows that accentuation, contraction and “stray erasure” (such as the deletion of the unsyllabifiable consonant in (30) and in (31)) are all cyclic, and accentuation must be assigned on a given cycle *before* contraction and stray erasure apply. In other words, on this view accentuation interacts opaquely with the other processes *in each derivational cycle*. And that is indeed tantamount to saying that the syllabification relevant to accentuation is not located at the interface between two levels — it is just an arbitrary stage in the derivation.

If OT is right, then something must be wrong with this argument. In OT, whether stratal or parallel, there is no such thing as extrinsic (opaque) ordering of processes. These theories are flatly incompatible with the proposed cyclic analysis.

A conceptual weakness of Noyer’s argument is that it presupposes a model of phonology in which there is no word level. In terms of LPM, which does countenance a word level, it is simply invalid. If contraction and deletion of final consonants apply to words, then the accent constraints will yield the opaque accent pattern if they apply to stems, and the transparent accent pattern if they apply to words. An associated analytic point is that a rule such as final cluster simplification is certainly not cyclic, because it only applies at word boundaries.

In any case, the argument is based on an incorrect generalization. The division between “early” and “late” accentuation does not run exactly where Noyer put it (and still less where Sommerstein put it). There are two classes of cases that do not fit. On the one hand, many derived words receive recessive accent like simple words on the basis of the underlying vocalism. On the other hand, certain accent constraints treat simple and derived words alike on the basis of the output vocalism.

The alternative formulation that I will defend is very simple: *accent is assigned to stems and retained in words in so far as the accent constraints on words permit*. An unexpected consequence of this generalization is that *unaccented* stems receive their accentuation entirely at the word level, where they must get default recessive accent (since all words, of course, must bear an accent). This the key to understanding why precisely the class of stems which is deaccented in the derivational morphology gets recessive accent on the basis of the *word-level* syllable structure. Based on this idea, we can develop a constraint-based analysis of Greek accentuation which is consistent with stratal OT (though inconsistent with unstratified parallel OT).

4 The stratal OT explanation

Sharpening the generalization. The derived words that are exceptionally accented on the basis of the *input* syllable structure include a class of compounds that retain the inherent accent of the second member.

- (32) a. /eu.+ge.né.s-a/ *eu.ge.née* (-ῆ) **eu.ge.néé* ‘well-born’ (Acc.Sg.)
 b. /dus.+tu.khés-a/ *dus.tu.khée* (-ῆ) **du.stu.kheé* ‘unlucky’ (Acc.Sg.)

The intonation in (32) is determined prior to contraction, just as in analogous simple words, compare in particular (22b). Hence the circumflex, in spite of (1), which requires final acutes in direct case forms. From this we conclude that even some compounds get their surface accent assigned before vowel contraction.

Secondly, *verbs* compounded with prefixes get their place of accent assigned prior to contraction, just like simple verbs.

- (33) a. /pe.ri.+ho.rá.-e-te/ *pe.ri.o.ráa.te* περιόρατε **pe.ri.ó.raa.te* ‘look around’
 b. /ho.rá.-e-te/ *ho.ráa.te* ὁράτε **hó.raa.te* ‘look’

Noyer himself (1997:513) draws attention to this problem and suggests that there is a cycle only on nouns, not on verbs.

Conversely, contraction never interferes with the *phonological* constraint (11). If intonation were wholly determined prior to contraction, we would expect acute penults before final short syllables from contractions of the form CV.́.CV → -CV.́.CV, but no such cases exist.

- (34) a. /hes.ta.-ó.t-os/ *hes.tóo.tos* ἑστῶτος (**hes.toó.tos*) ‘standing’
 b. /nee.ree.-í.d-es/ *Nee.réi.des* Νηρηίδες (Hom. *Nee.ree.í.des*) ‘Nereids’

The conclusion is that contraction disturbs the distribution of acute and circumflex in final syllables governed by the *morphological* constraint (19), but it never causes any violations of the *phonological* constraint (17) (\approx (11)).

Contraction and word-final consonant deletion are clearly word-level processes. (If they were stem-level processes, than they could not be opaque with respect to accentual processes; moreover, any process which is restricted to word edges intrinsically applies only to words.) Given this, the descriptive generalization which covers (32)–(34), as well as the previously discussed data, amounts to the following:

- (35) a. Accent is assigned at the stem level (therefore before contraction); but
 b. a subclass of compounds and derived adverbs get recessive accent at the word level; and
 c. the phonological constraints on intonation (* $[\mu\acute{\iota}.\mu]$, ALIGN) must be satisfied at the word level, modulo faithfulness (IDENT(Acc)).

Thus the two kinds of accentual behavior divide both derived words and phonological constraints into two classes. The characterization of both classes involves the

stratification of the lexicon into stems and words. Morphologically, the division is very simple in Greek. All affixes proper are added to stems, and clitics are added to words. Both levels are, of course, recursive. Phonologically, both levels are domains of accent assignment, but only the word level is a domain of contraction and final consonant cluster simplification. By intra-level parallelism (transparency), the constraints that impose accentuation on stems must be enforced on the basis of stem-level syllabification, which is to say “before” contraction and “before” the deletion of word-final consonants. The compounds and derived adverbs referred to by (35b) undergo morphological deaccentuation *qua* stems, and receive default recessive accent as *words*, hence on the basis of the word-level syllable structure.

The previously formulated constraints cover these additional data as well. The constraint * $\mu\acute{\iota}.\mu$], which we introduced in the first place for the sake of the circumflex in words like *katéelips* (recall (18)), now guarantees that accented long vowels will be circumflex before a short syllable even if they inherit acute accent by contraction. For example, *hes.ta.-ó.t-os* → [hestóotos], not *[hestoótos], where -ot- is an inherently accented suffix.

The constraint IDENT(Acc), which in (16) crucially prevented accenting the final foot, now protects existing accents on that foot from being removed or shifted around. For example, in the derivation of the participle (27a) *kha.rí.en*, the recessive accent is assigned with the final consonant in place, hence on the basis of the footing *kha.rí.(en)t*; by IDENT(Acc) this accent is not retracted to the antepenult when the final consonant is deleted at the word level (*[khá(ri.e)n]).

At this point we must delve a bit deeper into the morphology, to find out why some derived words are accented “before” contraction and others are accented “after” contraction.

Right-headed synthetic compounds. The second member of a compound is accented if it is a deverbal agent noun or action noun. Often it is a bound stem which does not form a word in its own right, at least not in the same meaning. The first member of such a compound is a nominal or adverbial complement of the verb from which the second member is derived. Such compounds are called *synthetic* compounds. Most synthetic compounds are accented on the final syllable, but this tendency is subject to lexical exceptions and can be overridden by other generalizations, including Wheeler’s Law (or more precisely, its synchronic residue; see 2).

- (36)
- | | | | |
|----|-------------------------|---------------|---|
| a. | <i>hip.po.+phor.bós</i> | ‘horsekeeper’ | * <i>phorbos</i> |
| b. | <i>dru.(o.)+tó.mos</i> | ‘woodcutter’ | <i>tómos</i> ‘slice’, <i>tomós</i> ‘sharp’ |
| c. | <i>gu.nai.+ma.neés</i> | ‘woman-crazy’ | * <i>manees</i> |
| d. | <i>po.lu.+ma.theés</i> | ‘polymath’ | * <i>mathees</i> |
| e. | <i>mee.lo.+bo.teér</i> | ‘shepherd’ | <i>boteér</i> ‘herdsman’ |
| f. | <i>pai.d+e.ras.teés</i> | ‘pederast’ | <i>erasteés</i> ‘lover’ |
| g. | <i>oi.no.+khó.os</i> | ‘wine-pourer’ | <i>khó.os</i> ‘a liquid measure’, * <i>kho.ós</i> |

A second class of right-headed synthetic compounds are *bahuvrīhi* (adjectival) compounds in *-eés*, also typically with bound second members.

- (37) a. /eu.+ge.neés/ *eu.ge.neés* ‘well-born’ **geneés*
 b. /dus.+tu.kheés/ *dus.tu.kheés* ‘unlucky’ **tukhees*
 c. /me.ga.+kle.eés/ *me.ga.kle.eés* ‘very famous’ **kle.eés*

The accentuation of compounds like (36) and (37) can be understood on the assumption that the whole compound is governed by the second member (or perhaps more accurately by its final compound-forming suffix), and receives its accent from it. It is these compounds that receive their accent *before* contraction class (see (32)). By locality, such morphologically governed accentuation must be assigned when the morphology is introduced, which as we now know is at the stem level.

With respect to their phonological behavior, stem-level derived accents, including those of such synthetic compounds, are equivalent to underlying accents, as was illustrated in (32).

Compounds with recessive accent. The majority of compounds, including adjectival (*bahuvrihi*) adjectives and most determinative compounds, including left-headed synthetic compounds, receive default recessive accentuation.¹⁰ The inherent accents of the first and second member play no role in the accentuation of such compounds. These are just the types of compounds whose accent, on the above evidence, must be assigned *after* contraction, as in (29).¹¹

- (38) a. *ar.gi.+ké.rau.nos* ‘with brilliant lightning’ *kerounós* ‘lightning’
 b. *kluu.tó.+poo.los* ‘with noble steeds’ *póolos* ‘steed’
 c. *pa.n+á.ga.thos* ‘very good’ *agathós* ‘good’
 d. *sún.+dou.los* ‘fellow slave’ *dóulos* ‘slave’
 e. *pa.rá.+deig.ma* ‘example’ *déigma* ‘sample’
 f. *phe.ré.+oi.kos* ‘house-carrier, snail’ *óikos* ‘house’

Either member of the compound may have an underlying accent of its own, and both usually do. All such accents are suppressed in this type of compound. By locality assumptions (“bracket erasure”), the deletion of the individual constituents’ accents must take place when they are combined into compounds, namely at the stem level. Such compounds receive default accentuation at the word level, which accounts at one stroke both for the uniform recessive accent of these compounds, and for the fact that it is assigned on the basis of the output vocalism.¹²

¹⁰Vendryes 1945 characterizes them as “composés de détermination” (189) and “composés de dépendance . . . dont le second terme existe à l’état isolé et conserve en composition sa forme aussi bien que son sens” (191).

¹¹See Vendryes 1945:189,191,196.

¹²In a group of compounds which morphologically belong in this type, a final two-mora syllable of the second member preserves its inherent accent, e.g. *sum-phoraá* συμφορά ‘misfortune’ (Vendryes 1945:190). For these, our analysis predicts accentuation on the basis of the “early” syllable structure, but I am not aware of any crucial cases to test this prediction.

Why do deaccented stems get recessive accent only at the word level, rather than immediately as stems? The rationale can be found in the parallelism of constraint interaction within a level, as required by stratal OT. First, we know that recessive accent is the *default* accent: it is superseded by underlying marked lexical accent on the final foot (otherwise *all* words would have recessive accent). This establishes the ranking IDENT(Acc) \gg ALIGN. Since Deaccentuation overrides lexical accent (that is the whole point of it), it must dominate IDENT(Acc). Since Deaccentuation forces an unaccented output wherever it applies, it does not “feed” recessive accent at the stem level.¹³ Deaccentuation of *stems*, however, *can* feed default recessive accent assignment to *words*, under stratal OT assumptions. Therefore, default recessive accent must be a word level process; this implies that it interacts transparently with contraction.

Stem-level deaccentuation with default recessive accent at the word level is apparently associated not only with synthetic compounds, but with at least one other type of zero derivation: the formation of adverbs from neuter nominals, as in the adverb *khárien* ‘gracefully’, from the participle *khárien* ‘pleasing’ (see (30)). The transparent interaction of word-level recessive accentuation with word-final consonant deletion follows, as in the preceding cases.

From this perspective, we can also understand the fact that verbs compounded with prefixes get recessive accent on the basis of their stem-level syllabification (see (33)). There is no reason to assume that finite verbs, whether simple or compounded, are subject to any deaccentuation processes at all. Such stems are free to receive recessive accent at the stem level, just as do all other lexical categories with inherent recessive accent, such as neuter nouns.

Compound accentuation in comparative perspective. The distinction between analytic and synthetic compounds (in the above sense) is fundamental in Indo-European languages. In Vedic Sanskrit compounds (Han 1994) the accent of right-headed synthetic compounds is determined *mutatis mutandis* as in Greek. The accentuation of analytic compound differs, though. In Sanskrit, the accent of analytic compounds is normally the first member’s inherent accent,¹⁴ e.g. /sahásra+dákṣiṇa/ → *sahásradakṣiṇa* ‘having a fee of a thousand (cows)’, while in Greek it is recessive accent. Unsurprisingly, it is Greek that has innovated here: the limitation of Greek accent to the last three syllables would have left few opportunities for the learner to detect the operation of the original first-member accentuation rule, whereas it was eminently learnable in Sanskrit, and retained there until distinctive accent itself was lost.

A version of this morphologically based accent distinction remains in force in modern Greek also. According to Nespors and Ralli (1996), compounds whose sec-

¹³However, if recessive accentuation were not a default process, and could override lexical accent, then it would outrank IDENT(Acc), and in that case, if it also dominated deaccentuation, it would supersede it.

¹⁴This follows directly from the Basic Accentuation Principle (Kiparsky and Halle 1977), according to which the first accent of the word wins. After underlyingly unaccented stems, the *second* member is usually accented on *its* inherently accented syllable, e.g. *puru+rūpa* ‘polymorphic’. If neither member of the compound has an inherent accent, the compound gets final accent by default, *dvi+pád* ‘biped’.

ond member is a derived noun (right-headed synthetic compounds, in the terminology used above) receive accent on the second member (e.g. *meliso+kómos* ‘apiarist’, *astro+nómos* ‘astronomer’), whereas compounds whose rightmost member is a basic noun normally receive recessive accent (e.g. *spanakó+píta* ‘spinach pie’, *anthó+kipos* ‘flower garden’).

Summary. We have concluded that stems fall into two accentual classes: lexically unaccented and lexically accented. Unaccented stems receive recessive accent. That includes finite verbs, as well as neuter nouns and vocatives, unless they are lexically accented on the final foot, in which case they receive accent on its leftmost mora. Accented stems have an accent on the rightmost mora. Stem-level accentuation is retained at the word level, modified only by those accentual processes that outrank accentual faithfulness there. Most compounds and certain adverbs are morphologically deaccented at the stem level, by a constraint which dominates both faithfulness to the inherent accents of their members, and the accentual constraints which assign recessive accent. They receive default recessive accent at the word level. Contraction (triggered by high-ranking ONSET) applies only to words, not to stems. Therefore, by transparency, any accent assigned to stems accesses only the uncontracted vocalism, and any accent assigned to words accesses only the contracted vocalism.

Since the intonation of final syllables is not phonologically restricted (but only governed by the morphological constraints in (19)) the intonation inherited from the stem-level (pre-contraction) representation is always maintained in the final syllable. It is this that makes the morphological intonation constraints opaque. The dominant *phonological* constraint that governs intonation in non-final syllables ((17), corresponding to (11)) remains unviolated, and overrides any contrary accent inherited from the stem level.

Recall from (30) that words ending in sonorant+obstruent clusters are accentually treated as ending in heavy syllables. The compounds which do not conform to this generalization are all of the analytic type (*bahuvrihi* compounds, in fact), and thus included among those for which our analysis, correctly, predicts “late” recessive accentuation.

All in all, then, compounds display three basic types of accentual behavior. Compound verbs, like simple verbs, receive inherent recessive accent at the stem level. A minority of nominal compounds, primarily those of the right-headed synthetic type, are accented on the second member. All other nominal compounds lose the inherent accents of both their constituents and form unaccented stems, which receive default accent when they become words.

The constraints. Now let us spell out the stem-level and word-level constraint system of classical Greek that supports this analysis within stratal OT assumptions. The word-level constraint system includes the stem-level constraints formulated in (15) and (17) and repeated below, which must be ranked as listed.

- (39) a. * $\mu\acute{\mu}.\mu$]: No acute before a word-final mora.
 b. IDENT(Acc): Corresponding segments in a foot have the same accentuation. (Where a foot is either an input or an output foot).
 c. ALIGN: The head of the last foot must be accented.

In addition, it includes the undominated syllable-structure constraints in (40).¹⁵

- (40) a. ONSET: Every syllable must have an onset. (Drives contraction.)
 b. *-CC: No word-final complex clusters allowed. (Drives deletion.)

The input to this word-level constraint system are the outputs of the stem level. How the word level constraint system governs word-level retention or modification of stem-level accent is shown for some of the crucial cases in (41).

(41)

Simple words: W.L.	ONS	*-CC	* $\mu\acute{\mu}.\mu$]	IDENT(Acc)	ALIGN
1. Input: [hes.ta(ó.to)s]					
1a. hes(toó)tos			*		*
1b. φ hes(tóo)tos				*	
1c. hés(too)tos				*	*
1d. hes(ta.ó)tos	*				*
2. Input: [ho.raá(e.te)]					
2a. φ ho(ráa)te				*	
2b. hó(raa)te				*	*
2c. ho(raá)te			*		
2d. ho(rá.e)te	*				
3. Input: [(pló.o)s]					
3a. φ (plóo)s					
3b. (ploó)s				*	*
3c. (plo.ó)s	*				*
4. Input: [(dí.i)]					
4a. φ (díi)					*
4b. (díi)				*	
5. Input: [kha.rí(en)t] 'pleasing' (participle)					
5a. kha.rí(en)t		*			*
5b. φ kha(rí.e)n					
5c. khá(ri.e)n				*	*

Candidate set 1 shows how * $\mu\acute{\mu}.\mu$], crucially dominating IDENT(Acc), changes an inherited acute into a circumflex if a final one-mora syllable. The other candidate sets illustrate the main types of “cyclic” accent preservation that we encountered above.

¹⁵These formulations are too crude but they will do for present purposes. Here is some of the fine print: combinations of a high vowel and a nonhigh vowel, such as [i.a], forms a special case and are usually not contracted. I assume without further ado that these do not violate ONSET, perhaps in consequence of an alternative hiatus-resolving strategy of homorganic glide-insertion (which, however, is not marked in the orthography). The consonant phonology is also more complicated. As (9) illustrates, *-ks*, *-ps* are actually licit final clusters. Also, final obstruent stops are disallowed even as single segments.

Now for the compounds and other derived words that are deaccented in the stem phonology and get a default accent in the word phonology on the basis of the contracted vocalism. Items 1, 2, and 3 of (42) show how, being accented entirely afresh, such words come to obey the accent constraints transparently.

(42)

Derived words: W.L.	ONS	*-CC	*[μ̄i.μ]	IDENT(Acc)	ALIGN
1. Input: [pa.ra.deig.ma]					
1a. ☞ pa.rá(deig)ma					*
1b. pa.ra(déig)ma				*	
1c. pa.ra(deíḡ)ma			*	*	*
3. Input: [dus.da.mart]					
2a. dus.dá(mar)t		*			
2b. dus(dá.ma)r				*	*
2c. ☞ dúḡ(da.ma)r					
4. Input: [am.phoo.+o.dont]					
3a. am.phoó(don)t		*			*
3b. am(phoó)don			*	*	*
3c. am(phóo)don				*	
3d. ☞ ám(phoo)don					*
3e. am(phó.o)don	*			*	
2. Input: [hip.po.phor(bós)]					
4a. ☞ hip.po.phor(bós)					
4b. hip.po(phór)bos				*	
4c. hip.pó(phor)bos				*	*
5. Input: [kha.ri.ent] 'gracefully' (adverb)					
5a. kha.rí(en)t		*			*
5b. kha(rí.e)n				*	
5c. ☞ khá(ri.e)n					*

Item 4 in the same tableau illustrates the preservation of lexical (underlying or morphologically assigned) accent by faithfulness. Finally, item 5 shows the contrast with the corresponding form in (41), discussed above in (30). The recessive accent is assigned in participles on the basis of the stem-level representation (with the final cluster intact) and in adverbs derived from them on the basis of the word-level representation (where the final cluster is simplified) can be understood on the basis of the same assumption as was made for the recessive accentuation of compounds. The process of adverb formation involves elimination of the lexical accent of the base adjective by a stem-level constraint, the deaccented stems are recessively reaccented at the word level in deference to the requirement that every word must have some accent.

5 Conclusion

Stratal OT's account of classical Greek accentuation explains the interaction of the accentual constraints with other phonological constraints, and their relation to the morphology. They follow from the theory's basic premise that the stem-level constraint system constitutes the input to the word-level constraint system. The pre-surface syllable structure on which accent is computed is exactly that of the stem level, and the distinction between words whose accent is determined at the stem level and words whose accent is determined at the output (word) level is a consequence of their morphological derivation.

The bottom line is that opaque accentuation in Greek offers no support whatever for stipulative rule ordering: the pre-contraction syllabification that determines accentuation, contra Noyer, is *not* "merely an arbitrary intermediate derivational stage". In the stratal OT analysis we developed, it is exactly *the stem-level output*. Accent is assigned to stems and words, each satisfying the constraints transparently on the basis of their respective syllable structures. Contraction and word-final consonant deletion are driven by syllabic constraints which are undominated at the word-level. Those stems that retain their inherent stem accent form words whose accent reflects the pre-contracted syllable structure, word-level constraints permitting. Those stems that are morphologically deaccented receive recessive accent *qua* words. That is why accent is systematically transparent in morphologically deaccented stems. The transparency of constraint interaction dictates that word-level recessive accent is sensitive to all contraction processes. The puzzling mix of opaque and transparent accentuation in Greek follows entirely from the application of recessive accent at both levels of the lexical phonology.

The second conclusion of theoretical interest is that Greek word accentuation falsifies unstratified OT. The persistence of stem-level accent requires either I/O faithfulness to derived properties which are predictable, and therefore not necessarily present in underlying representations (violating the fundamental principles of Freedom of Analysis and Richness of the Base), and sympathy to a candidate selected by faithfulness to syllable structure (which, as MacCarthy shows, must be excluded in order to preclude unwanted sympathy effects). Together, these properties defeat alternative accounts of the opaque constraint relations of Greek within fully parallel OT.

References

- GOLSTON, C. (1989). Floating H (and *L) Tones in Ancient Greek. *Proceedings of the Arizona Phonology Conference, Vol. 3*. Coyote Papers, U. of Arizona.
- HEDIN, BRUCE (2000). *Phonological and Syntactic Conditions on Elision in Greek*. Ph.D. Dissertation, Dept. Of Classics, Stanford University.
- KIPARSKY, PAUL 1967. A propos de l'histoire de l'accentuation grecque. *Langages* 8.73-93.
- KIPARSKY, PAUL (2000). Opacity and Cyclicity. *The Linguistic Review* 17.351-365.
- KIPARSKY, PAUL (to appear). *Paradigms and Opacity*. CSLI.
- MCCARTHY, JOHN (1999a). Sympathy and Phonological Opacity. *Phonology* 16.331-400.
- MCCARTHY, JOHN (1999b). Serialism, OT, and the Duke-of-York Gambit. Rutgers Optimality Archive.
- NESPOR, MARINA, AND ANGELA RALLI (1996). Morphology-Phonology Interface: Phonological Domains in Greek Compounds. *TLR* 13:357-382.
- NOYER, ROLF (1997). Attic Greek Accentuation and Intermediate Derivational Representations. In I. Roca (ed.), *Derivations and Constraints in Phonology*, 501-528. Oxford University Press.
- ORGUN, ORHAN (1996). *Sign-based Phonology and Morphology, with Special Attention to Optimality*. Ph.D. dissertation. University of California, Berkeley.
- PROBERT, PHILOMEN (2000). *Studies in Ancient Greek Accentuation*. Ph.D. Dissertation, Oxford.
- SAUZET, PATRICK (1989). L'accent du grec ancien et les relations entre structure métrique et représentation autosegmentale. *Langages* 24:81-111.
- SOMMERSTEIN, A. (1973). *The Sound Pattern of Ancient Greek*. Oxford: Blackwell.
- STERIADE, DONCA (1988b). Greek Accent: a Case for Preserving Structure. *Linguistic Inquiry* 19:271-314.
- STERIADE, DONCA 1999. Lexical Conservatism in French Adjectival Liaison. In Marc Authier, B. Bullock, and L. Reed (eds.), *Formal perspectives on Romance linguistics*. Amsterdam: Benjamins.
- VENDRYES, JOSEPH (1945). *Traité d'accentuation grecque*. Paris: Klincksieck.