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Cleo Condoravdi
Yale/Stanford

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1 Prosodic Theory

The theory of prosodic phonology, designed as a theory of phrasal phonology, has contributed insights about the interaction between syntax and phonology and post-lexical rule application.[1] As developed in Selkirk (1980, 1984, 1986), Hayes (1984), Nespor & Vogel (1982, 1986), the theory makes the following basic claims:

1. The domains for post-lexical rule application are provided by the hierarchically organized prosodic structure, the *prosodic hierarchy.*

2. The role syntax plays in sentence phonology is indirect. The extent of the influence of syntactic structure on phonology is in determining prosodic structure.

3. The mapping between syntactic and prosodic structure is highly constrained.[2]

Optimally, then, there should be no phonological rules whose domain of application is provided directly by the syntax. Although some apparent cases of direct syntax–phonology interaction have been successfully reanalyzed either within a prosodic framework (cf. *Phonology Yearbook* 4) or as precompiled lexical rules

[1]Thanks to S. Inkelas, P. Kiparsky and D. Zec for many useful discussions. Thanks also to the NELS audience, especially E. Selkirk and K. Rice, for their comments. This paper is extracted from a larger piece of work to appear in Inkelas & Zec (eds.) under the title "The Phrasal Phonology of Greek."

[2]Though proponents for a direct influence of syntax on phonology might compromise on 1 and 2, they would still adhere to an appropriately formulated version of 3. Phonological rules would be allowed to have only limited access to syntactic structure, preferably one that would be systematic across languages as well.

(Hayes 1988), problematic cases still remain. The external sandhi rules of Modern Greek constitute one such case, resilient as they have been to a prosodic treatment.

Greek has three distinct rules which delete an unstressed non-high word-final vowel if it is followed by a vowel-initial word. In the discussions of Greek sandhi so far, the problem appears particularly intriguing. Which of the three rules applies to a given pair of words depends on the syntactic relation between the two words; this relation, however, appears to be of a rather whimsical nature, hard to express even syntactically in any general and sufficiently abstract terms.

In this paper, I reexamine the Greek sandhi rules and show that they are, in fact, amenable to a prosodic treatment. The mapping between syntax and phonology in Greek turns out to be easily expressible within the edge–based approach of Chen (1987) and Selkirk (1986). Furthermore, as I show, the Greek facts have implications for the organization of post-lexical phonology and for the nature of prosodic subcategorization and phrasal allomorphy. In the course of the analysis, I argue for the introduction of a new prosodic category, which I call the *minimal phrase*, and for a partly bottom-up partly top-down phrasing. The new prosodic constituent is motivated on two independent grounds: (*i*) it constitutes a post-lexical rule domain, (*ii*) it serves as the environment of phrasal allomorphy. That phrasing cannot be strictly bottom–up is shown by the effect of focused elements on phrasing. If phrasing is partly top–down, then the building of prosodic structure cannot be done successively for each prosodic category and cannot be intertwined with the phonology. As a consequence some theories of phrasal phonology are filtered out.

2 External Sandhi Rules

The sandhi phenomena have had a long history in the linguistic literature on Modern Greek starting with Hadzidakis's (1905) original analysis. Yet the realization that the different processes of vowel coalescence are sensitive to the syntactic configuration of the words involved was late to come.

The sandhi phenomena were systematically discussed by Kaisse (1977), where seven rules were shown to be operative, three of them syntactically conditioned deletion rules:[3] First Vowel Deletion (Rule 1), Unrounded First Vowel Deletion (Rule 2) and Less Sonorant First Vowel Deletion (Rule 3).[4]

All three rules have the following in common: they do not delete high vowels, they do not delete stressed vowels, and they are blocked if the deletion of a vowel would cause two stressed syllables to become adjacent.[5] The First Vowel Deletion

[3]One of the remaining four, the rule of contraction, applies between clitics and their host, while the other three are not syntactically conditioned rules. One of them, the rule of degemination, will figure in our discussion later.

[4]I adopt Kaisse's naming for the 3 rules and her analysis of them as deletion rules since the exact phonological process involved is not crucial to the analysis. The dialect described in Kaisse (1977) and in this work is the Athenian dialect.

[5]The relevant pairs consist of a penultimately stressed word followed by an initially stressed word:

Rule, illustrated in (1), deletes the final vowel of the first word regardless of the nature of the initial vowel of the second word.[6]

(1) a. to álo**γo** **é**rxete → to álo**γ'** **é**rxete **o e**
the horse-sg. come-sg.
b. ta álo**γa** **é**rxonde → ta álo**γ'** **é**rxonde **a e**
the horse-pl. come-pl.

Unrounded First Vowel Deletion, illustrated in (2), is similar to First Vowel Deletion except that the vowel **o** is not deleted.

(2) a. to frésk**o** **e**lafró frúto → *to frésk' **e**lafró frúto * **o e**
the fresh-sg. light-sg. fruit-sg
b. ta frésk**a** **e**lafrá frúta → ta frésk' **e**lafrá frúta **a e**
the fresh-sg. light-sg. fruit-sg

Less Sonorant First Vowel Deletion, illustrated in (3), differs from the previous two rules in that the second vowel, as well as the first, must meet certain requirements. Traditional grammarians, as well as Kaisse, have appealed to a so-called "strength" hierarchy of vowels.[7] Less Sonorant First Vowel Deletion, then, deletes the final vowel of the first word if it is "stronger", that is higher on the hierarchy, than the following vowel.

o a u i e
←——→
"strong" "weak"

e may delete before **o, a, u, i**
a may delete before **o, u, i**
o may *not* delete

The different rules apply in different environments. Examples (1) and (2) distiguish rules 1 and 2. The crucial vowel sequences are marked next to each sentence.

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i **γ**áta érxete → *i **γ**át' érxete (Rule 1 blocked)
the cat come-3sg.
fréska órima fruta → *frésk' órima fruta (Rule 2 blocked)
fresh-pl. ripe-pl. fruit-pl.
ta frúta óla → *ta frút' óla (Rule 3 blocked)
the fruit-pl. all-pl.

Interestingly, a sequence of two adjacent stressed syllables is not otherwise blocked in the language; there is no equivalent to the Rhythm Rule in Greek:

*δ*ekatrís án*θ*ropi 'thirteen people'
* *δ*ékatris án*θ*ropi

[6]The site of deletion is marked with an apostrophe.
[7]It is unclear what the phonological justification for this hierarchy is.

In the subject–verb sequence of (1) both **o** and **a** delete before **e**. Therefore, rule 1 applies in this environment. In the adjective–adjective sequence of (2), however, **o** does *not* delete before **e** while **a** does. Rule 2 applies in this environment.

Examples (2) and (3) distinguish rules 2 and 3. In the Noun–post-nominal modifier sequence of (3a) and (3b), or in the Verb–complement sequence of (3c) and (3d) **a** does *not* delete before **e** but it does delete before **o**. Rule 3 applies in these environments.

(3) a. ta kómat**a** **e**kína → *ta kómat' **e**kína * **a** **e**
the parties those
b. ta kómat**a** **ó**la → ta kómat' **ó**la **a** **o**
the parties all
c. kítaks**a** **e**ftá eláfya → *kítaks' **e**ftá eláfya * **a** **e**
looked-at-1sg. seven deer
d. kítaks**a** **o**xtó eláfya → kítaks' **o**xtó eláfya **a** **o**
looked-at-1sg. eight deer

The rules are sensitive to abstract syntactic configurations rather than mere lexical category specification as Kaisse (1977) argues. Both (4a) and (4b) contain the same sequence of adjectives. In (4a) the two adjectives are within the same NP, whereas in (4b) the first belongs to an NP while the second one to an adjunct phrase. In (4a) rule 2 applies, in (4b) rule 1 applies.

(4) a. to frésk**o** **a**kálipto frúto → *to frésk' **a**kálipto frúto
the fresh uncovered fruit
b. to pedi servire to fruto to frésk**o** **a**kálipto → ... frésk' **a**kálipto
the child served the fruit the fresh uncovered
'The child$_i$ served the fresh fruit$_j$ uncovered$_{i/j}$.'

All three rules operate *across* phonological words. Notice that *within* phonological words, as in the post-lexically formed phonological words of (5), traditionally known as clitic groups, hiatus is resolved in rather different ways. For example, a high vowel may delete (5a), **a** does not delete before **o**(5b), the second vowel in a sequence or a stressed vowel may delete (5c).

(5) a. m**u** **a**górase → m **a**górase
to-me bought-3sg.
b. t**a** **o**dígisa → *t **o**dígisa
them led-1sg.
c. t**u** **í**pa → t**ú** pa
to-him said-1sg.

Kaisse (1985) gives the following formulation for the domains of application of the 3 rules:

> *Unconditional First Vowel Deletion* applies between any two words separated by an S bracket; and between a nonverb and any adjacent word not in the same phrase.
>
> *Less Sonorant First Vowel Deletion* applies between a verb and its complements but it is bled by Unrounded First Vowel Deletion.
>
> *Unrounded First Vowel Deletion* applies between a noun and its preceding complements and specifiers, and between a verb or preposition and its (following) complements, including, optionally, adverbs. (p. 124–125)

Given this formulation, the rules seem to require non-overlapping disjunctive domains and an extrinsic ordering stipulation. The theory that Kaisse develops admits a segregation of post-lexical phonology into a P1 and a P2 component. The sandhi rules naturally fall into the P1 component given their dependency on syntactic structure. The prediction of such a model is that no purely phonological rule may interact with the sandhi rules. The prediction is not unique to this particular model. It follows from any model in which phonosyntactic rules (rules sensitive to syntactic structure) form a subcomponent distinct from subcomponents of purely phonological rules, such as, for example, the model outlined in Selkirk (1986).

That prediction, however, is not borne out in Greek. The allophonic rule of palatalization interacts with the sandhi rules in an unexpected fashion (Kaisse 1988). In Greek, the alternation between palatals and velars is not distinctive: velar consonants palatalize when they are followed by a front vowel:

(6) γ^jelyo 'laughter'; γ^jipsos 'plaster' vs. γala 'milk'; γoma 'eraser'; γulya 'sip'.
ceri 'hand'; ciros 'pig'; vs. xari 'favor' xora 'country'; axuri 'barn'.
k^{j}eri 'candle'; k^{j}irios 'gentleman' vs. kapa 'cape'; kora 'crust'; kuvas 'bucket'.

The interaction between palatalization and the sandhi rules has the following two surprising properties: (*i*) a vowel exercises its palatalizing effect *before* it is eliminated by sandhi (ex. 7a), (*ii*) the vowel of the following word has no effect on the consonant left final after sandhi (ex. 7b).

(7) a. to kreas pu etroγ^j**e** itan nostimo → ...etroγ^j itan ...
the meat that ate-3sg. was delicious
'The meat that he was eating was delicious.'
b. to kreas pu etroγ**a** itan nostimo → ...etroγ itan ...
the meat that ate-1sg. was delicious
'The meat that I was eating was delicious.'

The interaction of the sandhi rules with the allophonic rule of palatalization also shows that we cannot "push" the sandhi rules into the lexicon, treating them as precompiled rules, in the sense of Hayes (1988).

So far then, we have seen that the sandhi rules are sensitive to syntactic structure, and yet, given their interaction with an allophonic rule they cannot be phonosyntactic rules if we are to take seriously any reasonably restrictive model of post-lexical phonology, which would place phonosyntactic rules earlier in the derivation than purely phonological rules. Luckily, the paradox we are faced with is only an apparent one. The domains of application of the sandhi rules are, in reality, provided by the prosodic hierarchy, enriched, however, with a new prosodic category, intermediate between the phonological word and the phonological phrase. This new category I call *minimal phrase* and symbolize with *z*.

First Vowel Deletion applies in the following syntactic environments:

First Vowel Deletion
NP – V (Su – V)
NP – Adv (D.O. – Adv)
NP – S (topicalization)
{NP, S} – Conj
NP – PP
NP – NP (I.O. – D.O.)
NP – S′ (S′:complement or adjunct)
NP – AdjP
AdjP – NP

What these environments have in common is that they all involve the edge of a maximal projection: the first word belongs to a maximal projection which does not include the second word. A matching of an X^{max} edge with a prosodic constituent edge has already been demonstrated for several languages. It has been given theoretical justification by Chen (1987) and Selkirk (1986), who argue that the syntactic information available for prosodic phrasing is describable in terms of the different levels of the X-bar hierarchy and the right or left end of the constituents they comprise. For Greek then, X^{max} and right edge are the parameter settings for the delimitation of the prosodic constituent *phonological phrase.* First Vowel Deletion applies across phonological phrases.

Let us now look at the environments of the other two rules:[8]

Unrounded First Vowel Deletion
Between prenominal modifiers in a NP
Between a prenominal modifier and the head N in a NP
Adv – V

[8]Prepositions do not appear in the list since it is impossible to discern which rule they would undergo. Most prepositions are clitics. The remaining ones, with the exception of one, end either in a consonant or a stressed vowel. The only preposition eligible to undergo sandhi, *isame* 'up to', ends in e which is deleted in all three sandhi rules.

Less Sonorant First Vowel Deletion
V – Adv
V – NP (Su, D.O., I.O)
V – AdjP
V – adverbial clause
V – S′
N – postnominal modifier

The environments show a remarkable complementarity. Rule 2 applies across words up to a lexical head, Rule 3 applies between a lexical head and material following it within the same maximal projection. Therefore, heads, as well as X^{max}, are crucial in phrasing. The prosodic category delimited by heads cannot be the phonological word as we have seen in (5),[9] nor can it be a phonological phrase since the parameter setting for the latter is X^{max}. Therefore, a new prosodic category is needed, one higher than the phonological word w in the hierarchy and lower than the phonological phrase ϕ. This category is the minimal phrase and its parameter settings are: X^{head} and right end.[10] The Phrasing Algorithm that I propose for Greek is:

1. From left to right map all material up to and including the lexical head of a maximal projection into a minimal phrase z.
2. From left to right map all material up to the right end of a maximal projection into a phonological phrase ϕ.
3. Map all unassociated material within a ϕ into a z.

Clauses 1 and 2 take priority over clause 3. Essentially, the effect of the phrasing algorithm is the following: strings of w's are grouped into z's and ϕ's and remaining material within a ϕ is then incorporated into prosodic structure by forming its own z. The way the algorithm works is illustrated in (8).

(8) a. [[freska_A fruta_N] elafra_A] 'fresh light fruit'
b. $(\text{freska})_\omega$ $(\text{fruta})_\omega$ $(\text{elafra})_\omega$
c. $[(\text{freska})_\omega$ $(\text{fruta})_\omega$ $_z]$ $(\text{elafra})_\omega$
d. $[[$ $(\text{freska})_\omega$ $(\text{fruta})_\omega$ $_z]$ $(\text{elafra})_\omega$ $_\phi$]
e. $[[(\text{freska})_\omega$ $(\text{fruta})_\omega$ $_z]$ $[(\text{elafra})_\omega$ $_z]$ $_\phi]$

The three sandhi rules are as follows (I have abstracted away from the particular features of the vowels deleted in each case): Unrounded First Vowel Deletion applies

[9]The post-lexically formed phonological word includes clitics and their host.

[10]I am assuming that adjectives and adverbs do not have phrasal projections when used as modifiers, an assumption that is common in discussions of phrasing across languages. I have to remain agnostic as to whether this really reflects something about the syntax of adjectives and adverbs (not projecting to phrasal categories), or whether adjectives and adverbs don't count as heads *for the purposes of phrasing*, that is whether a completely cross-categorial syntax–phonology mapping is tenable.

between w's in the domain of the minimal phrase; Less Sonorant First Vowel Deletion applies between minimal phrases in the domain of the phonological phrase; First Vowel Deletion applies between phonological phrases within a "large" domain (U-domain)

Unrounded First Vowel Deletion:
$V \rightarrow \emptyset$ / $\_\_\ _w\ ]\ [_w\ V$ domain z
Less Sonorant First Vowel Deletion:
$V \rightarrow \emptyset$ / $\_\_\ _z\ ]\ [_z\ V$ domain ϕ
First Vowel Deletion:
$V \rightarrow \emptyset$ / $\_\_\ _\phi\ ]\ [_\phi\ V$ domain U

All three rules are juncture rules but with an interesting property: the type of the juncture depends on the domain of the rule, more specifically, if α is the domain of the rule and β the category of the juncture, then β is immediately dominated by α in the prosodic hierarchy. In other words, all we need to know about a rule is its domain and whether it is a juncture rule. It is important to note that the need for three distinct domains is independent of the analysis of the actual phonological processes involved in the sandhi phenomena. Even if the sandhi rules are the result of resyllabification and degemination, one would still have to contend with three domains. Palatalization, I am assuming, is a word-level allophonic rule.

Although the mapping between syntactic and prosodic structure in Greek turns out to be rather unsurprising, Greek still provides an interesting case for theories of syntax–phonology interaction in the following three ways. (*i*) *Both* X^{head} *and* X^{max} are implicated in phrasing. In exploring the implications of the end-based approach, Selkirk (1986) surmised that X^{head} might play a role in phrasing, in determining, for example, the edge of a *small phonological phrase*. Whether X^{head} is an alternative parameter setting for the delimitation of a phonological phrase, or whether it delimits a new prosodic category was left unclear. What has not been shown up to now is a case where both the maximal and the small phonological phrases are needed and that is precisely what Greek provides. (*ii*) What forms a minimal phrase in Greek is not a compound word but a full-fledged syntactic phrase prosodically composed of full phonological words. That is, a minimal phrase in Greek can contain any number of full phonological words. (*iii*) While the left side of an NP in Greek is a recursive side, all material on that side phrases together with the head; furthermore, if a specifier follows the head, the phrasing breaks it off from the head. In other words, in Greek we have a real case of edge-to-edge mapping, rather than a relational type of mapping.[11]

3 A New View on Phrasing

Clause 3 in the algorithm above guarantees exhaustiveness of parse for the category z, which is not achieved by the end-to-end mapping alone. The exhaustiveness

[11] According to relational theories of mapping heads are phrased together with all elements on their non-recursive side within the same maximal projection (cf. Nespor & Vogel 1986).

of parse requirement demands that a string must be exhaustively parsed for each prosodic category. The algorithm proposed departs from the usual assumptions about phrasing in that it accommodates both the minimal phrase and the phonological phrase and in that it reflects both a bottom-up type of phrasing (clauses 1, 2), and a top-down type of phrasing (clause 3). Given the priority of clause 2 over clause 3, the ϕ domain is already defined when unassociated w's are mapped into z's. In the common view of phrasing, every language has a phrasing algorithm *per* prosodic category[12] and crucially, when category X^n is to be constructed, all categories of lower type, X^{n-m}, $m = 1, 2, ..., n$ have already been constructed. For the construction of X^n only constituents of category X^{n-1} are visible. This latter is a version of a locality condition, achieved either through a convention of Bracket Erasure or some adjacency principle. For some theorists, furthermore, phonological rules having as their domains categories of lower type have already applied when X^n is to be constructed. In other words, the phonology is interspersed with the prosodic structure formation.

Let us compare the "mixed" algorithm proposed above with the pair of algorithms conforming to the common assumptions:

Minimal Phrase
Clause 1: From left to right map all material up to and including the lexical head of a maximal projection into a minimal phrase z.
Clause 2: Map all unassociated material within the same maximal projection into a z.

Phonological Phrase
From left to right map all material up to the right end of a maximal projection into a phonological phrase ϕ.

Clause 2 guarantees the well-formedness of the prosodic tree structure by anticipating the effect of the phonological phrase formation rule. In other words, it is because the string must have already been parsed fully with respect to all lower prosodic categories and because the prosodic structure must form a tree structure that the redundancy between clause 2 of the minimal phrase formation and the phonological phrase formation arises. The "mixed" algorithm avoids this redundancy; the well-formedness of the tree structure is achieved by the ordering of clauses 2 and 3.

There is also empirical evidence showing that phrasing is not strictly bottom-up.[13] The evidence comes from the behavior of focused elements in phrasing. That focus plays a special role in phrasing has already been demonstrated for several languages by Inkelas (1988), Zec & Inkelas (1988), Vogel & Kenesei (1987), Kanerva (1988) among others. As in other languages, focused elements in Greek constitute a special case and their phrasing requirements supersede those of the regular mapping principles in the language. Crucially, however, the focused element does not

[12] At least for those categories that are operative in the language.
[13] Selkirk & Tateishi (1988) have argued for the need of top-down phrasing in Japanese.

constitute a special case in the phrasing of either the minimal phrase or the phonological phrase. As we see in (9a), the focused element does not constitute its own z, since otherwise **a** would not delete before **e**. As we see in (9b), the focused element does not constitute its own ϕ, since otherwise **a** would delete before **e**. Instead, the focused element introduces a U break just before it. The test rule for this is a rule of vowel degemination, which, as argued in Nespor (1987), has U as its domain. Between a focused and a non-focused element the rule applies (9c), both elements, therefore, are within the same U. The rule does not apply between a non-focused and a focused element even when those would ordinarily belong to the same z (9d). Therefore, there must be a U break between those two.[14]

(9) a. γipsin**a** **e**lafya → γipsin' elafya 'plaster deer'
[+Foc]

b. agoras**a** **e**fta elafya → *agoras' efta elafya 'bought-1sg. seven deer'
[+Foc]

c. γipsin**a** **a**galmata → γipsin' agalmata 'plaster statues'
[+Foc]

d. γipsin**a** **a**galmata → * γipsin' agalmata
[+Foc]

The importance of the phrasing of focused elements in Greek lies precisely in showing that phrasing is not strictly bottom-up. The category U can be created *before* other categories lower in the hierarchy are created. Here's a more profitable way of viewing phrasing. Phrasing algorithms consist of 3 types of clauses: overriding structure clauses, regular mapping clauses, and clauses accommodating unassociated material. The overriding structure clauses are the special case, the regular mapping clauses are the elsewhere case, while the unassociated material clauses guarantee exhaustiveness of parse.

Now if the building of prosodic structure is not strictly bottom-up, then the whole of prosodic structure must be present when phonological rules apply. Therefore, phonology is not taking place in tandem with prosodic structure building, either in a strong form (the cyclic application that McHugh (1988) has advocated) or in a weaker form (category to category as, for example, Rice (1988) and Hayes (1988) assume). Consider the category U in Greek and the effect of focus. If U were to be built last, then already built structure would have to be destroyed without any perceptible effect on the phonology since the phonological rules having lower categories as their domains would have already applied. Of course, this is not what we witness (cf. 9). Locality can be achieved only though an adjacency principle since in this view Bracket Erasure makes no sense.[15] The juncture rules of Greek, as we have seen, obey such a locality principle, the category of the juncture being determined by the category of the domain.

[14]There is no perceptible pause.

[15]An adjacency principle would have to be a condition on the prosodic structure rules may refer to. It doesn't necessarily have to govern the formation of prosodic structure, in fact, it must not if there are prosodic categories that are defined prosodically. For example, in Selkirk & Tateishi's (1988) minor phrase formation appeal is made to both prosodic word and major phrase.

4 The Prosodic Category *z*

In this section, I provide independent evidence for the inclusion of the minimal phrase in the inventory of prosodic categories in Greek by arguing that the environment of some phrasal allomorphy requires reference to the minimal phrase.

The distribution of the masc.-acc.-sing. form in *-n* of certain pronominal elements has been a long-standing puzzle for Greek grammarians. These include the following pronouns and pronominal modifiers:[16] *pyos* 'who, which', *aftos* 'he, this', *tutos* 'this', *ekinos* 'he, that', *kapyos* 'someone, some', *olos* 'all, whole', *alos* '(someone) else, other/another', *enas* 'someone, one', *opyos* 'who/whichever', *tosos* 'such, so/as/that much/many', *osos* 'as much/many as'.[17] The final-*n* form is obligatory when the following word begins either with a vowel or a voiceless stop as in (10a,b), (11a,b) and (12a,b). Mysteriously, however, it is also obligatory in some other environments as well. Consider *pyos*. While in (10d) the form without the final *n* is acceptable, final *n* is obligatory in (10c) and (10e). An identical contrast can be observed for *enas* between (11d) and (11c,e), and for *opyos* between (12d) and (12c,e).

(10) a. pyon/*pyo andra? 'which-acc. man-acc.?'
b. pyon/*pyo kafe? 'which-acc. coffee-acc.?'
c. pyon/*pyo voiθises? 'which-acc. did you help?' or
"Which-acc. one did you help?'
d. pyo filo su? 'which-acc. friend-acc. of yours?'
e. filo su pyon/*pyo voiθises? 'which-acc. friend-acc. of yours did you help?'

(11) a. enan/*ena andra 'one-acc. man-acc.'
b. enan/*ena kafe 'one-acc. coffee-acc.'
c. iδa enan/*ena na kapnizi 'I saw someone-acc. smoking' or
"I saw one-acc. (of those) smoking'
d. ena filo su 'one-acc. friend-acc. of yours'
e. δose apo enan/*ena sta peδya 'give the children one-acc. (of those) each'

(12) a. opyon/*opyo andra 'whichever-acc. man-acc.'
b. opyon/*opyo kafe 'whichever-acc. coffee-acc.'
c. opyon/*opyo δyaforetiko vris 'whoever-acc. different you find' or
'whichever-acc. one different you find'[18]
d. opyo δyaforetiko δromo 'whichever-acc. different-acc. road-acc.'
e. δromo opyon/*opyo vris 'whichever-acc. road-acc. you find'

[16]In Greek there is no distinction between free pronouns and pronominal modifiers; *pyos*, for example, means both 'who-masc.' and 'which-masc.'

[17]The pronominal elements are listed in the masc. nom. sing. form.

[18]A proper translation of this in English is: whoever/whichever one you might find that is different.

The generalization is that the final-*n* form is obligatory when the element is (*i*) a pronoun, or (*ii*) a modifier following the nominal head, or (*iii*) a modifier immediately preceding a null head.[19] But why should the generalization require a 3-way disjunctive statement? Syntactically (*i*), (*ii*) and (*iii*) have nothing in common. In prosodic terms, however, they can be unified as follows:

> the final-*n* form is obligatory when the pronominal element is at the right end of a minimal phrase.[20]

This prosodic generalization accounts for (*i*) – (*iii*) as follows. If a pronominal element is a free pronoun, then it constitutes the head of a NP. Since heads induce a minimal phrase break on their right, it follows that, if overt, they end up at the right end of a minimal phrase, and if null, the immediately preceding modifier ends up at the right end of a minimal phrase. This covers (*i*) and (*iii*). Given clause 3 of the phrasing algorithm, material to the right of the head within a maximal projection constitutes its own minimal phrase and, therefore, if a single word, it is at the right end of a minimal phrase. This covers (*ii*).

If the clustering of (*i*), (*ii*) and (*iii*) is not accidental, then we should expect that a description of the distribution of other elements would include either (*i*), (*ii*) and (*iii*) together or their complement but not an arbitrary combination, say (*i*), (*iii*) plus something else. This is precisely what we find. The restricted allomorphs of *ólon* 'all-gen.-pl.' and *ekínon* 'them-gen.-pl., those-gen.-pl.' provide the desired case. *ólon* has an allomorph with a more restricted distribution (*olonón*) and so does *ekínon* (*ekinón*). As can be seen in examples (13) and (14), *olonón* appears in the familiar constellation (*i*), (*ii*) and (*iii*), while *ekinón* appears everywhere else. In other words, *olonón* can appear only *z*-finally, while *ekinón* can appear only in a position that is *not* *z*-final.

(13) a. ton filon olon/olonón 'all-gen.-pl. the-gen.-pl. friends-gen.'
b. dose olon/olonón psomi 'give all-gen.-pl. bread'
c. olon/*olonón ton filon 'all-gen.-pl. the-gen.-pl. friends-gen.'

(14) a. ekinón tun filun 'those friends-gen.'
b. *tun filon ekinón 'those friends-gen.'
c. *dose ekinón psomi 'give those people bread'

[19]The equivalent of the English nominal pro-form *one* is a null pro-form. This null element constitutes a nominal head and, crucially, it must be visible in phrasing.

[20]Of all the attempts to characterize the obligatory occurrence of the final-*n* form, the most insightful is that of Triandaphyllidis (1941): "The final *n* is preserved in the masc.-acc.-sing. of several pronouns and pronominal adjectives when they *are not closely connected with the following word* or when it [the following word] starts with a vowel or stop consonant." (p. 82, my translation and italics). The analysis that I offer can be seen as making the notion of "not closely connected" precise: two words are not closely connected if they are not part of the same *z*. This analysis also accounts for the case when the relevant pronominal element is utterance final.

The formalization of these generalizations raises some interesting theoretical questions. While the alternations discussed implicate a post-lexical prosodic category, they don't arise through any post-lexical rule application. After all, they involve only a class of pronominal elements and some isolated forms like *ólon* and *ekínon*. The proper characterization of these alternations must be as *lexically precompiled phrasal allomorphy*, in the sense of Hayes (1988). Hayes, in an effort to eliminate all syntax–sensitive rules from post-lexical phonology, develops a theory of lexically precompiled rules, that is lexical rules which create allomorphs for insertion in certain phrasal contexts (hence the term 'precompiling'). While the cases of phrasal allomorphy discussed in Hayes (1988) all involve some rather idiosyncratic syntactic environments, the cases of Greek allomorphy are, in a sense, better behaved, in that they exploit a prosodic category, which allows for a simply stated environment.[21] There is nothing surprising about this as long as we assume that lexical insertion is subject both to syntactic and to prosodic well-formedness conditions. In other words, at the point of lexical insertion both syntactic and prosodic structures have been created and lexical insertion must be in accord with well-formedness conditions on both structures.[22] The prosodic requirements of allomorphs can be represented by the familiar subcategorization frames. *Olonón* and *ekinón*, therefore, would be accompanied by the following subcategorization frames in their lexical specification:

olonón __ $z]$
ekinón __ w

If subcategorized information must be local, then the specification __w would exclude anything intervening between the relevant lexical item and the next w. [23]

For the class of pronominal elements showing the $n/\emptyset$ alternation we can utilize Hayes's phonological instantiation frames and assume that the n-final form is inserted in Frame 1.

Frame 1: __ $z]$

We have seen that post-lexical prosodic categories enter the lexicon as phrasal environments. Inkelas (1988, 1989) has argued for the need of prosodic categories in the lexicon, both lexical and post-lexical, but in her view prosodic subcategorization is a property solely of affixes and clitics. In other words, prosodic subcategorization is tied to prosodic dependence. The analysis of the Greek facts forces a different

[21] As Hayes points out, these idiosyncratic environments are the result of a restructuring of the residue of at one point exceptionless post-lexical rules. There is no reason, in principle, why restructuring of an environment should not exploit the prosodic inventory of the language and thus create a more regular pattern.

[22] In a more general vein, Inkelas & Zec (1988) argue for bidirectionality in syntax–phonology interactions, always mediated by prosodic structure.

[23] This case of allomorphy is interesting for another reason. The more restricted allomorph does not induce blocking. The non-restricted forms *ólon* and *ekínon* are not simply the *elsewhere* case but the *anywhere* case.

view: prosodic subcategorization subsumes but is not identical to prosodic dependence. More precisely, prosodic subcategorization is a representation of two things: (*i*) prosodic dependence, in which case it is interpreted as building prosodic constituency, (*ii*) prosodic allomorphy, in which case it serves as a well-formedness condition on lexical insertion.

5 Kimatuumbi

An analysis similar to that proposed here for Greek will dispose also of the other known major counterexample to prosodic theory. I show that Kimatuumbi too can be given a prosodic analysis if we allow its prosodic inventory to include both the phonological and the minimal phrase.

Odden (1987, 1988) has argued extensively that there are phonological rules in Kimatuumbi which make direct reference to syntactic structure. One such rule is the rule of Shortening which shortens long vowels in a stem if the stem is the head of the phrase and is followed by something else in the same maximal projection. Odden states the rule as follows:

$$V \overset{\curvearrowright}{V} \quad / \; [\,[\; \_\_ \;]_X \; Y \;]_{X'}, \text{ where } Y \text{ contains phonetic material}$$

Another rule is that of phrasal tone insertion, which introduces a H tone on the last vowel of a word if the word is last in a phrase and immediately followed by another phrase. Odden formalizes the rule as follows:

$$\emptyset \rightarrow \text{H} \;/\; [\,[\ldots]_{Y''} \;\_\_\; [\ldots]_{Z''} \;]_{X''}$$

If we assume that Kimatuumbi has the same phrasing algorithm as Greek with an X^{head} to z and X^{max} to ϕ right edge mapping, then Shortening can be stated as a z juncture rule and phrasal tone insertion as a ϕ juncture rule.

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