The Greek Phonological Phrase

A. M. Devine and Laurence D. Stephens

RECONSTRUCTING THE PROSODIC 'domains'[1] of ancient Greek continues to play an important rôle in classical philology. The syntactic components of the appositive group,[2] as well as its accentual and rhythmic properties, have been analyzed in fine detail, primarily because of the value of metrical bridges in textual criticism. The major phrase—that is, the phonological counterpart of the syntactic clause or simple sentence—has also been the object of study, especially for its importance in defining the domain of the avoidance of hiatus and in the stylistic evolution of enjambement. But little or no progress has been made in reconstructing the accent and rhythm of the minor phonological phrase (hereafter simply the 'phonological phrase'), nor in analyzing its syntactic composition. Almost nothing has been discovered about how the words of even the simplest sentences were joined together into

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[1] Intuitively, a prosodic domain is the stretch or chunk of language, *e.g.* syllable, word, word plus enclitic, phrase, on up to paragraph, within which or to which a prosodic process such as lengthening, rhythmic grouping, lowering of pitch, *etc.*, applies. For example in Greek, crasis applies in a domain different from and smaller than the domain in which elision applies.

[2] The term appositive group refers to a prosodic structure consisting of a host word, usually lexical, and one or more non-lexicals, and not phonologically identical either to the word or to the minor phrase. The class of non-lexical words comprises not only the clitics (the cover term for enclitics and [the traditionally understood] proclitics), but also the Article, Conjunctions, particles, negatives, pronominals, Prepositions, and other 'little' words; the class shades off into semilexicals such as the lower cardinal numerals, the Adverb εὖ (*e.g.* Aesch. *Choe.* 693), the modal δεῖ (*e.g.* Eur. *Or.* 1035), semantically bleached imperatives such as φέρε (*e.g.* Ar. *Eq.* 145), ἄγε (*e.g.* Ar. *Eq.* 155), *etc.* Many non-lexicals tend to lose the status of autonomous words and to be treated, to varying extents, as part of a contiguous word. Those non-lexicals losing their phonological autonomy are termed 'appositives'. Prepositives are those appositives that cohere with what follows, postpositives those cohering with what precedes. See A. M. Devine and L. D. Stephens, "The Greek Appositives: Toward a Linguistically Adequate Definition of Caesura and Bridge," *CP* 73 (1978) 314–28, and "Semantics Syntax, and Phonological Organization in Greek: Aspects of the Theory of Metrical Bridges," *CP* 78 (1983) 1–25.

prosodic subunits in ordinary Greek speech. How can we demonstrate that there actually were prosodic domains intermediate between the word or appositive group and the utterance? And if we can, how do we know which sequences of words can make up these phonological phrases and which cannot? Under what circumstances, if any, can a subject be phrased with its Verb? Can a direct object modified by an Adjective be phrased with its Verb? What happens if there is also an indirect object? Is a Prepositional Phrase always a phonological phrase by itself or can it be joined with an adjacent constituent? In addition to discovering its syntactic constituency, we should also like to know what the Greek phonological phrase sounded like; specifically whether, in addition to the temporal demarcation (final lengthening) normally found at the end of phonological phrases, the Greek phonological phrase was also characterized by tonal properties such as the scaling of accentual peaks within the phonological phrase.

It is not that anyone doubts that Greek must have had phonological phrases, just that there seemed to be no really tangible metrical evidence for their definition and analysis. A separate study[3] has shown far more metrical evidence than previously understood, and this clearly confirms the importance of syntactic constituency[4] in the phonological phrasing of

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[3] A. M. Devine and L. D. Stephens, "The Syntax and Phonology of Hyperbaton" (forthcoming).

[4] Syntactic constituents are groups of words that go together to make grammatical and semantic units of some kind within a clause, e.g. Prepositional Phrase, Noun Phrase, etc. Syntactic constituency is hierarchical; e.g. a Prepositional Phrase may consist of a Preposition plus a Noun Phrase that in turn may consist of an Article plus an Adjective Phrase plus a Noun, and the Adjective Phrase may consist of an Adverb Phrase plus an Adjective, and so on. Not just any string of contiguous words forms a constitutent: e.g. in a Prepositional Phrase, Preposition plus Article does not form a constituent, since the Article does not belong with the Preposition to the exclusion of the Noun. Conversely, in a language with free word order like Greek, a syntactic constituent, in the sense used here, need not be continuous, i.e., consisting of only contiguous words, but may be discontinuous, interrupted by some other constituent or word belonging to some other constituent. In fact interrupted structures such as Adjective plus Verb plus Noun, where the Adjective and the Noun form a Noun phrase, are common in Greek, e.g. where all three belong to the Verb Phrase, as in καινὸν ἀγγείλεις ἔπος (Eur. *Tro.* 55): [Adj V N]$_{VP}$. For the depth and rich conceptual content of the notion of constituency, see A. Zwicky, "Arguing for Constituents," *Proceedings, 14th Regional Meetings of the Chicago Linguistics Society* (Chicago 1978) 505–12; A. Radford, *Transformational Grammar* (Cambridge 1988) 50ff.

Greek. But the metrical evidence for phrasing remains a veiled and rather imprecise basis for an explicit reconstruction: it establishes principles and tendencies without necessarily leading to an exhaustive phrasing of any particular stretch of text. Fortunately, this lacuna is filled by a substantial body of epigraphical evidence pertaining precisely to the temporal chunking of speech at a level between the appositive group and the major phrase. This evidence consists in the placement of interpuncts in certain punctuating inscriptions.

Whereas one class of these inscriptions, including the well-known *Teiae Dirae* (*SEG* XXXI 985), punctuates exclusively or almost exclusively appositive groups, another class punctuates phrases, often with a sufficient degree of consistency to justify detailed study. This latter class includes the following inscriptions chosen as particularly suitable for analysis:

Acrop. = *IG* I³ 45
Elis = Meiggs/Lewis 17 (*LSAG*² 42.6)
Ephesus = *I.Ephesos* 1 (*LSAG*² pl. 66.53)
Miletus = *LSAM* 41 (*LSAG*² 64.33)
Naup. = *IG* IX.1² 718 (*IGBM* IV p.119)
Oeanth. = *IG* IX ² 717 (*LSAG*² 15.4)
Priene = O. Masson and J. Yoyotte, "Une inscription ionienne
    mentionnant Psammétique Iᵉʳ," *EpigAnat* 11 (1988) 171.

Our object is not the epigraphical-philological one of accounting for all instances of punctuation in all inscriptions of a particular corpus but the linguistic-theoretical one of establishing that phonological phrases existed in the Greek language and analyzing their syntactic composition. Punctuation in metrical inscriptions is a less reliable guide to phrasing, partly because it can also reflect metrical structure. Although inscriptions in which there is a formalized use of punctuation to demarcate the items in a list are excluded from this corpus of texts, *Miletus* has been included since it is phrase-punctuated throughout and shows how list punctuation originates from consistent phrase punctuation: items in a list, even when they comprise only a single word, are separated from each other by phrase boundary and in many languages are also intonationally demarcated.

Phonological phrasing in any language tends to be quite variable, depending on rate of speech and discourse factors as well as semantic, syntactic, and phonological properties. To cite just one instance, in Tokyo Japanese minor phrases may consist of from one to three words, and the same sentence can have

different pronunciations: the syntagm *takonado tabeta* ("ate octopus, *etc.*") can be pronounced as two major phrases in unnaturally slow speech, as a single major phrase containing two minor phrases, or, in more rapid speech, as a single minor phrase.[5] Greek should not be an exception. Although much apparent variation in inscriptional punctuation is motivated by syntactic constituency or by focus, some instances appear to be random:

εχσεναι θοαν (*IG* I³ 4b.7)
εχσεναι : θοαν (*IG* I³ 4b.12)

This variability naturally inherent in phonological phrasing is compounded by epigraphical and editorial 'noise': the evidentiary value of any inscriptional instance of punctuation rests on the assumption that it is neither an inscriber's error nor a false transcription. The latter category of error frequently occurs, partly because interpuncts can be difficult to recognize on damaged stone surfaces, and partly because the importance of punctuation for an understanding of Greek phrasing has been generally underestimated. Editorial error can involve omission (*LSAG*² 3.20, 4.31, 16.4) or addition (*SEG* XXX 1283); but the assumption of widespread inscriber's error is methodologically dangerous. There are apparently absurd word internal punctuations of the type

: οι δικαζον:τες (*LSAM* 30.B.5)
Ταλειδες π:οιες (*JHS* 52 [1932] 171, pl. VII.2),

but not even all these are outright errors. Problems with a nail

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[5] T. J. Vance, *An Introduction to Japanese Phonology* (Albany 1987); E. SELKIRK and K. TATEISHI, "Constraints on Minor Phrase Formation in Japanese," *Papers from the 24ᵗʰ Annual Regional Meeting of the Chicago Linguistics Society* I (1988) 316. Other aspects of the syntax and phonology of the Japanese minor phrase are investigated in E. SELKIRK, "On the Nature of Prosodic Constituency," in J. Kingston and M. E. Beckman, edd., *Papers in Laboratory Phonology* I (Cambridge 1990) 179; E. SELKIRK and K. TATEISHI, "Syntax and Downstep in Japanese," *Interdisciplinary Approaches to Language. Essays in Honor of S.-Y. Kuroda*, edd. C. Georgopoulos and R. Ishihara (Dordrecht 1991) 519–44. The results presented in these three papers are referred to hereafter as 'Selkirk'. There is little crosslinguistic uniformity in the terminology used for the phrasal hierarchy: in some, but not all, respects, what is called the phonological phrase in English and what we call the minor phonological phrase in Greek correspond more closely to what is called the major phrase in Japanese.

hole explain the oddity of : τα: ς :: Αθαναιας. [6] Two other in-
stances seem to involve vacillation between punctuating word
end and syllable end in the presence of elision: καταλειπον:τα
εν ται ιστιαι (*Naup.* 7), where other factors have been sug-
gested[7] (the expected location for the punctuation is after
ιστιαι), and : μ' α:νεθεκε : (*LSAG*[2] 55.3). More troublesome is
the apparent tendency for some inscriptions to vary between
minor phrase punctuation and major phrase punctuation.
Oeanth. B seems to begin with word punctuation, proceed to
minor phrase punctuation, and end with major phrase punctua-
tion; the length of the punctuated segments also tends to in-
crease towards the end in *Ephesus*; other inscriptions just lose
interest in punctuation as the text proceeds (*LSAG*[2] 42.8).
Punctuation is often but not always omitted at the end of the
physical line; this feature of inscriptional orthographic practice
can be a source of additional indeterminacy.

It is intuitively reasonable to assume that the placement of in-
terpuncts in inscriptions is intended to demarcate phonological
domains and not syntactic constituents, an intuition that is
confirmed by instances in word punctuating inscriptions where
punctuation is placed after a phonological composite structure
consisting of two prepositives:[8]

> : και τος : *h*ιεροποιος : (*IG* I[3] 244.C.3)
> : εν τοι : πολεμοι : (*IG* I[2] 929.2)
> επι τες : τριτες (*IG* I[3] 261.1);

This makes good phonological sense—such composites can also
appear before the caesura in the trimeter (Soph. *Aj.* 1228, *OC*
280), where single prepositives are strongly avoided—but no
syntactic sense at all, since in such cases a Determiner (article or
demonstrative) is typically detached from its Noun and at-
tached to a preceding Preposition or Conjunction. Since word
punctuation systematically reflects prosodic structure, it is un-
likely that phrase punctuation should simply be random,
haphazard and linguistically unmotivated. The phrase-punctuat-
ing inscriptions form a substantial body of text, so that it is

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[6] M. H. Jameson, "A Treasury of Athena in the Argolid (*IG* IV.554)," in D.
W. Bradeen and M. F. McGregor, edd., *ΦΟΡΟΣ: Tribute to Benjamin Dean
Meritt* (Locust Valley 1974) 67.

[7] R. G. Kent, *The Textual Criticism of Inscriptions* (=*Language* Mono-
graphs 2 [Philadelphia 1926]) 19.

[8] See *supra* n.2. An appositive group need not contain a lexical host.

possible, with the above qualifications, to reconstruct at least the outline of an algorithm for the formation of the phonological minor phrase in Greek on the basis of the system of punctuation. It should be noted that in some inscriptions punctuation may be omitted at the end of a major phrase (*Naup.* 12, *Oeanth.* 3, *LSAG*² 71.43/4.19); in others, minor phrases are punctuated by a single row of interpuncts and major phrases by multiple rows (*Ephesus*; *IG* I³ 4). Apart from this latter device, the binary nature of inscriptional punctuation precludes representation of any higher level prosodic structure. That the class of phrase-punctuating inscriptions is significantly different from the class of word-punctuating inscriptions is well illustrated by differences in the punctuation of precompiled phraseology:

> : η τεχνηι : η μηχανηι : (*Teiae Dirae* A.8)
> : τεχναι και μαχαναι : (*Naup.* 38)

> : και αυτον : και γενος : (*Teiae Dirae* B.38)
> : αυτον και το γενος : (*Naup.* 4).

On one interpretation, word punctuation is simply phrase punctuation at a rate of speech at which every appositive group is a separate minor phrase, as it might be in slow dictation.

The first step in the phrasing algorithm is to form phrases from phonologically binarily branching constituents,[9] that is, from contiguous appositive groups making a syntactic constituent:

> : ταλαντον κ' αργυρο : (*Elis* 5)
> : τυρον αγνον : (*Miletus* 4)
> : διφασια μελιχματα : (*Miletus* 2)
> : ες βασιλεως διδοται : (*Miletus* 3)
> : εκ πολεως ηνειχτθησαν : (*Ephesus* 2)
> : εν τριαϷοντ' αμαραις : (*Naup.* 42)
> : το 'ν Ναυπακτον Ϝοικεοντος : (*Naup.* 29)
> : τον ξενον με ͱαγεν : (*Oeanth.* 1)
> : αι ψευδεα προξενεοι : (*Oeanth.* 8).

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[9] Constituency, whether phonological or syntactic, is represented by graphs known as trees (see Radford [*supra* n.4]). Each point, or node, on the tree represents a constituent. If a constituent is complex, *i.e.*, has internal structure, then its node branches, each branch connecting it with lower nodes for its subconstituents. Thus a binary branching constituent is one that contains two subconstituents at the next hierarchical level down.

There is no reason to suspect that this premium on binary structures is a mechanical or artificial epigraphical feature: some speakers of Japanese apparently have just such a preference for binary accentual structures, particularly in slower speech (Selkirk). A minor phrase can be formed whether the modifier precedes the head[10] or follows it:

> : ε Ναυπακτο ανχορεοντα : (*Naup.* 19 [PP V])
> : καρυξαι εν τἀγοραι : (*Naup.* 20 [V PP]),

but there may be a preference for phrasing prehead modifiers with the head when both a prehead and a posthead modifier are present: in : αι κα *h*υπ᾽ ανανκας απελαονται : ε Ναυπακτο : (*Naup.* 8) the prehead adjunct is phrased with the head and the posthead complement is orphaned. Proper names having the structure head plus modifier tend to constitute fixed phrases in phrase-punctuating inscriptions:

> : τοι Δι Ολυνπιοι : (*Elis* 6)
> : τοι Ζι τολυνπιοι (*I. Olymp.* 3.4)
>   Αθεναιηι Πατροιηι : (*LSCG* 113 [Guarducci, *EpigrGr* IV 13 fig. 5])
> : Απολλωνος Δελφινιο (*Miletus* 12)
>   Απολλωνι Δελφινιωι : (*LSAG*² 65.50);

sometimes also in word-punctuating inscriptions: : *H*ερμει Εναγονιοι : (*IG* I³ 5.3). Unarticulated forms probably have a stronger tendency to lack internal punctuation.

A nonbranching subject or the head of an interrupted branching subject phrase may be phrased with a verb, at least when the verb is intransitive or when, for whatever reason, its complement is not phrased with the verb:

> : δραπετες με εσιει : (*Acrop.* 4)
> : *h*α δε βολα ποτελατο : (*IG* IV 554.6)
> : και χρεματα παματοφαγεισται : (*Naup.* 40, 44)
> : εορτη κηρυσσεται : (*Miletus* 12).

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[10] Intuitively, the head of a constituent is the part of speech that gives it its basic syntactic and semantic properties. Thus a noun is the head of a Noun Phrase, a verb is the head of a Verb Phrase. In Greek concord and rection are determined by heads. For a recent review of the notion of head, see R. A. Hudson, "Zwicky on Heads," *Journal of Linguistics* 23 (1987) 109–32.

These data suggest that the verb is phrased with the subject only by default, at least in the absence of interfering phonological factors. In one case where a subject seems to be phrased with the indirect object in a dedication, the inscriber left space for the missing punctuation (Raubitschek, *DAA* 220). In Korean sentences with fronted objects, the rule of obstruent devoicing indicates that the subject can be phrased with the Verb, but not if the Verb is followed by an Adverb: for instance "[balls] [Cuni catches]," but "[balls] [Cuni] [catches quickly]," where the brackets indicate how the Korean words corresponding to the glosses would be phrased.[11]

In Cyprian,[12] apart from a few instances with phonologically heavy non-lexicals (see *supra* n.1)

> Ι ϝρετας τασδε Ι (*Id.* 29)
> Ι α(ν)τι το μισθον Ι (*Id.* 5)

and a few fixed phrases with proper names

> Ι τα(ν) πτολιν Εδαλιον Ι (*Id.* 1)
> Ι τον Ονασικυπρον τον γατερανΙ (*Id.* 2)
> Ι ο Παφο βασιλευς Ι (*ICS* 6, *cf.* 15, contrast 7),

most of the clear cases of the divider sign punctuating phrases involve a Verb phrased with its subject or complement:

> Ι κατεϝοργον Μαδοι Ι (*Id.* 1)
> Ι ανογον Ονασιλον Ι (*Id.* 2)
> Ιπεισει Ονασιλοι Ι (*Id.* 12, 25)
> Ι ο Αρμενευς εχε Ι (*Id.* 21)
> Ι ανοσιγα ϝοι γενοιτυ Ι (*Id.* 29)
> Ι οικον ναον Ι (*ICS* 306.4).

The preponderance of verbs in Cyprian punctuated phrases may indicate that in this dialect particularly Verbs lacked prosodic salience. The nonverbal element in the phrase tends to be free of appositives. The high incidence of proper names

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[11] Y. Y. Cho, "Syntax and Phrasing in Korean," in S. Inkelas and D. Zec, edd., *The Phonology-Syntax Connection* (Chicago 1990) 47–62.

[12] O. Masson, *Les inscriptions chypriotes syllabiques*[2] (Paris 1983: hereafter '*ICS*'). '*Id.*' indicates the main Idalion inscription (*ICS* 217).

could be a focus[13] related phenomenon or it could be a reflex of the constraint on appositives. In the latter case, it follows that for the easiest and most restrictive type of phrasing, the simple lexical word phrases more readily than the group consisting of lexical word plus appositive(s).

In general, however, it is clear that the minor phrase is based on phonologically branching structure, not on a syntactically branching structure. The phrasing algorithm is largely blind to appositives. Simple two-word constituents can become a phonological phrase:

> : προσταταν καταστασαι : (*Naup.* 34)
> : διομοσαι *h*ορϙον : (*Naup.* 45),

but so can syntactically much more complex structures, such as branching Prepositional Phrase with articulated Noun and articulated modifier plus any additional appositive material such as a conjunction:

> : εκ τες φυλες τες πρυτανευοσες : (*Acrop.* 16)
> : αι τις *h*υπο τον νομιον τον επιϝοιϙον : (*Naup.* 27).

The importance of syntactic constituency in the phrasing algorithm is illustrated by cases in which a nonbranching constituent is flanked by two branching constituents, for example NP V NP

> : ταλαντον κ' αργυρο : αποτινοιαν : τοι Δι Ολυνπιοι : (*Elis* 5)
> : τοις αυτον νομιοις : χρεσται : κατα πολιν ϝεκαστους :
>   (*Naup.* 28).

If in these instances the phrasing had been completely random, constituency relations would not have been reflected by punctuation at a greater than chance rate. If the phrasing had simply paired appositive groups from left to right, the Verb would have been phrased with the first following appositive group of the right-hand Noun Phrase; if the phrasing had simply paired appositive groups from right to left, the Verb would have been

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[13] Focus is the new information that the sentence is intended to convey. Focus can be seen as typically foreground information, including contrastive and counterassertive information, while (unfocused) topic is typically background information, similar to the old notion of "psychological subject." Both focus and topic may be marked in nonneutral utterances. This may be done by word order, particles, or prosodic prominence. Topicalization is the name for the special marking of the utterance topic.

paired with the second element of the left-hand Noun Phrase, again violating constituency. The Verbs are left unpaired because the algorithm, on its first pass, paired appositive groups according to constituency (αυτον is not appositive: *cf. Teiae Dirae* B.38, *Naup.* 4). Other instances of phonologically non-branching constituents phrased separately from flanking branching constituents are the second Prepositional Phrase in : αι κα hυπ' ανανκας απελαονται : ε Ναυπακτο : ΛοϞροι τοι *H*υποκναμιδιοι : (*Naup.* 8) and the phrasing of the modifiers in : οις λευκη : εγκυαρ : λευκωι αναβεβαμενη : (*Miletus* 6), where εγκυαρ modifies the Noun Phrase οις λευκη to form a constituent that is itself modified by the following Participial Phrase. Contrast : δυο γυλλοι εστεθμενοι : (*Miletus* 2) with prepositive δυο and nonbranching Participial Phrase.

It should be noted that some of the usual approaches[14] to phrasing are too directional in character to handle the Greek data. An approach in which phrases are built from the head and material on the nonrecursive side of the head[15] privileges the nonrecursive side to a degree that appears unwarranted in Greek. An approach that phrases right-branching structures with a left-hand node, or vice versa, but allows a new phrase to start only at the end, or respectively at the beginning, of a constituent, cannot account for data that allow inclusion of non-branching nodes from both the left and the right; for instance, a Verb can be joined to a Prepositional Phrase from either the left or the right.

The limitation of first-pass phrasing to two appositive groups per phrase means that (phonologically) branching constituents can be phrased differently from their nonbranching counterparts:

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[14] M. Nespor and I. Vogel, *Prosodic Phonology* (Dordrecht 1986); E. O. Selkirk, "On derived domains in sentence phonology," *Phonology Yearbook* 3 (1986) 371. For a recent collection of articles on this and related topics, see Inkelas and Zec (*supra* n.11). The book on this topic by A. M. Zwicky and G. K. Pullum had not appeared at the time of writing.

[15] The recursive side of the head is the side on which complements or adjuncts may freely be added, *e.g.* the right side of the Noun Phrase in French and Italian; the nonrecursive side is the side on which only a limited class of items may occur, *e.g.* the left side of the Noun Phrase in French and Italian.

: θυειν και λανχανειν : (*Naup.* 2)
: οσια λανχανειν : και θυειν :(*Naup.* 3)

: το τες Νεμεσεος αργυριο : (*IG* I³ 248.3)
: το δε αλλο αργυριο : το τες Νεμεσιος : (*IG* I³ 248.9)

: Λοϙρον τον *Hυποκναμιδιον* : (*Naup.* 26, 34)
: επιϝοικους Λοϙρον : τον *Hυποκναμιδιον* : (*Naup.* 5)
: ε Ναυπακτο ανχορεοντα :(*Naup.* 19)

: εν Ναυπακτοι : καρυξαι εν τἀγοραι : (*Naup.* 20)
: αι τις *h*υπο τον νομιον τον επιϝοικον : ανχορεει : (*Naup.* 27).

Since the first-pass pairs only contiguous items forming a constituent, some sequences of appositive groups will remain unpaired after the initial pass. These may optionally be paired in a second pass through the unpaired material:

τον *h*ορϙον εξειμεν : (*Naup.* 12)
: τον Λοϙρον τὀπιϝοιϙοι : (*Naup.* 34)
: αι κα με γενος εν ται ιστιαι : (*Naup.* 16)
: ϝεκαστον νομος εστι : (*Naup.* 30).

This phonological pairing in the absence of syntactic motivation is also found in the phrasing of unaccented words in Japanese, where optionally indirect object and direct object may be paired without intervening initial lowering (Selkirk). But there is apparently some resistance to joining either a direct object or an indirect object to its Verb to the exclusion of the other complement:

: τὀνκαλειμενοι : ταν δικαν : δομεν τον αρχον : (*Naup.* 41)
: αι κα με διδοι : τοι ενκαλειμενοι : ταν δικαν :(*Naup.* 43).

The next step is to phrase single appositive groups orphaned by the preceding steps. This may be accomplished by allowing the orphans to stand as autonomous phrases:

: ταλαντον κ' αργυρο : αποτινοιαν : (*Elis* 5)
: τοι Δι Ολυνπιοι : τοι καδαλεμενοι :(*Elis* 6)
: εν υδριαν : ταν ψαφιξιν ειμεν : (*Naup.* 45)
τεκναι και μαχαναι : μεδεμιαι : ϝεϙοντας :(*Naup.* 12)
: τὀνκαλειμενοι : ταν δικαν : (*Naup.* 41, *cf.* 43)

: εν Ναυπακτοι : καρυξαι εν τἀγοραι : (*Naup.* 20)
: με φαρειν : εν Λοϙροις τοις *Η*υποκναμιδιοις : (*Naup.* 5).

Alternatively, the orphan appositive group may be adjoined to a preceding or following phonological phrase according to its syntactic constituency relations: this solution may have been favored when one of the three appositive groups was phonologically light or lacked appositives:

: επαγεν μετα τριακοντα ϝετεα : (*Naup.* 13)
: ενορϙον τοις επιϝοικοις εν Ναυπακτον : (*Naup.* 11)
: *h*οπος αριστα και ευτελεστατα σκευασαι : (*Acrop.* 8)
: ειν τωι πρωτωι χρυσωι ηνειχτθησαν : (*Ephesus* 3)
  τα ξενικα ε θαλασας *h*αγεν : (*Oeanth.* 3)
: ερδεται τὡτερων ετως τελη : (*SLCG* 113)

In the phrasing of Japanese accented words, a ternary branching subject phrase may optionally be treated as a single domain; and in the phrasing of Japanese unaccented words an object Noun following a branching subject phrase is optionally joined to the latter without initial lowering (Selkirk).

In an early fourth-century Boeotian inventory with list punctuation (*SEG* XXIV 361), simplex numerals are adjoined to a preceding branching phrase:

: λανπτερωχοι σιδαριοι τρις : (20)
: χαλκια πλατεα πεντε (7)

but a complex numeral is phrased separately : ϝοινοχοια χαλκια : πεντεκαιδεκα : (13). In particular, a syntactically interrupted structure consisting of three appositive groups can be treated as a single phonological phrase:

Πηδωμ μ' ανεθηκεν ωμφιννεω : (*Priene* 1)
: ϙωι βασιλευς εδωϙ' ωιγυπτιος : (*Priene* 3)
: το παρα τοισι τας διακοσιας δραχμας οφελοσι (*IG* I³ 248.5).

The special status of such YXY syntactic structures is confirmed by metrical evidence: in the iambic trimeter of tragedy positional lengthening (-V#CC-) between X and Y or Y and X is permitted to a significantly greater degree in YXY structures than in their flanking counterparts XYY or YYX.[16]

[16] Devine and Stephens (*supra* n.3).

Scope[17] affects phrasing, since scope affects constituency and constituency affects phrasing:

: οσια λανχανειν : και θυειν (*Naup.* 2);

if the punctuation were after οσια rather than λανχανειν, the phonology would have indicated that οσια was the complement of both verbs. When a phonologically heavy preposition has scope over two conjuncts, there may be some preference for not linking the first conjunct with the preposition to the exclusion of the second conjunct:

: εχθος προξενο και ϝιδιο ξενο : (*Oeanth.* 11: και begins a
     new line)
: ανευς : βολαν : και ζαμον πλαθυοντα (*I.Olymp.* 3.8).

Although articulated modifiers can follow the basic rules of phrase formation as in various examples already cited, in certain contexts they can also show some degree of prosodic autonomy. A probably branching articulated modifier is phrased separately from its Noun in an example involving a head-interrupted Verb Phrase:

εν τέπιαροι κ' ενεχοιτο : τοι 'νταυτ' εγραμενοι (*Elis* 10).[18]

Two cases have an articulated modifier located between two elements of a Noun Phrase; the articulated modifier is not phrased with either element of the Noun Phrase to the exclusion of the other:

: Χαλειεοις : τοις συν Αντιφαται : ϝοικεταις (*Naup.* 47)
  και Ναϝπακτιον : τον επιϝοιϟον : πλεθαι : (*Naup.* 40).

The separate phrasing of articulated modifiers can result in a *prima facie* violation of constituency:

: επιϝοικους Λοϟρον : τον *H*υποκναμιδιον : (*Naup.* 5)
: διομοσαι *h*ορϟον : τον νομιον : (*Naup.* 45).

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[17] Scope is the part of a sentence or stretch of words over which the meaning of a word applies. Varying possibilities for scope are the source of well known ambiguities of the type 'old men and women', in which if the scope of 'old' is wide only old people are included, but if it is narrow, *i.e.*, over 'men' only, then young women would also be possible referents.

[18] A. Johnson reports that the punctuation is partly worn but clearly visible.

The most likely explanation for the separate phrasing of articulated modifiers is that the Noun is treated as predictable information and the following articulated modifier is highlighted in its function of specifying a subset, which results in its prosodic autonomy. This approach is supported by the parallel phrasing of Noun Phrases followed by resumptive deictics:

> : αι δε τιρ τα γραφεα : ται καδαλεοιτο : (*Elis* 7)
> | τον α(ν)δριγα(ν)ταν | το(ν)δε κατεστασε | (*ICS* 220)
>   τον α(ν)δρια(ν)ταν [space] τον(ν)υ | εδωκεν [end line]
>   κασ | ονεθεκεν [space] (*ICS* 215; phrase end is denoted
>   by space, word end by the divider).

A significant body of prose evidence relating to the word order of postpositive particles and vocatives indicates that topicalized and contrastive material in general is phonologically demarcated:[19]

> τοὺς μὲν Λακεδαιμονίους, ὦ ἄνδρες ξύμμαχοι, οὐκ ἂν ἔτι
>   αἰτιασαίμεθα (Thuc. 1.120)
> Κλεοφῶντος τοίνυν, ὦ ἄνδρες δικασταί, ἕτερα μὲν ἄν τις
>   ἔχοι κατηγορῆσαι (Lys. 30.12)

The likelihood that focused constituents will form a separate minor phrase may explain certain apparent anomalies, but this approach is circular to the extent that the discourse structure assumed cannot be independently motivated. Constituents that are contrastive or focused, particularly at the beginning of a paragraph, tend to appear as phrases consisting of one appositive group only:

> : κα τονδε : *h*α 'πιϝοικια : (*Naup.* 1)
> :Λοϙρον τον : *H*υποκναμιδιον : (*Naup.* 1; elsewhere mostly
>   unpunctuated)
> : Περϙοθαριαν : και Μυσαχεον : (*Naup.* 22; unpunctuated in
>   line 27)
> : κεν Λοϙροις : τοι⟨ς⟩ *H*υποκναμιδιοις : (*Naup.* 21; contrastive
>   with εν Ναυπακτοι in line 20).

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[19] E. Fraenkel, "Kolon und Satz," *Kleine Beiträge* (Rome 1964) I 73–92 (= *NGG* [1932] 197–213), "Kolon und Satz, II," I 93–130 (=*NGG* [1933] 319–54), "Nachträge zu 'Kolon und Satz'," I 131–39, and "Noch einmal Kolon und Satz," *SBMünch* (1965) 2.

It is well known that in addition to syntactic constituency, phrasing is also sensitive to the need for phonologically balanced prosodic constituents.[20] This may explain why in a few cases constituency is disregarded in favor of phonologically balanced phrasing:

: αργυραι πεντε : και ειϘοσ⟨ι⟩ μνεαι : (*Ephesus* 2)
: χρεματα τοις *H*υποκναμιδιοις : νομιοις χρεσται : (*Naup.* 24),

or when a numeral is phrased with a Preposition and separated from its Noun:

εντος *h*εχσεκοντα : εμερον : (*Acrop.* 12)
μεχρι τριον : οβελον (*IG* I³ 4.B12).

This restructuring is another indication that inscriptional punctuation is an orthographic representation of phonological and not syntactic structure.

Conjuncts and disjuncts are regularly phrased together:

: αιτε Ϝεπος αιτε Ϝαργον : (*Elis* 3)
: τα τ᾽ αλ⟨α⟩ και παρ πολεμο : (*Elis* 4)
: κὲ δαμο κὲ Ϙοινανον : (*Naup.* 4)
: τεχναι και μαχαναι : (*Naup.* 38, *cf.* 12).

Pairing of conjuncts and disjuncts proceeds left to right, so that a third item is phrased separately:

: αιτε Ϝετας αιτε τελεστα : αιτε δαμος : (*Elis* 8).

A recurrent feature of the phrasing of conjuncts and disjuncts is disregard for constituency:

: τρετο και δαμευεσσθο : ενς Αθεναιαν : (*IG* IV 554.5)
: ε τας Χαλειδος : τον Οιανθεα μεδε τον Χαλειεα : ε τας Οιανθιδος : (*Oeanth.* 2)
: *H*οποντιον : τε χιλιον : πλεθαι και ΝαϜπακτιον : τον επιϜοιϘον : πλεθαι : (*Naup.* 39).

It is not clear whether this violation of constituency is due to restructuring or simply to the mechanical application on the part of inscribers of a rule requiring conjuncts to be phrased together.

[20] J. P. Gee and F. Grosjean, "Performance Structures: A Psycholinguistic and Linguistic Appraisal," *Cognitive Psychology* 15 (1983) 411.

Of the three questions we would like to answer about the phonological phrase in Greek—what are its syntactic components? what are its temporal and rhythmical properties? what, if any, are its accentual properties?—the above analysis has provided a fairly complete answer to the first. The answer to the second question follows automatically, at least in broad outline. The mere fact of inscriptional phrase punctuation implies some form of temporal demarcation, and this in turn implies a more cohesive domain for rhythmic organization as well as for the application of sandhi processes.[21] Between interpuncts, for instance, *Priene* consistently applies the rules of connected speech—elision, crasis, assimilation of final nasals, movable *nu.* It is also reasonable to look for accentual properties specific to the Greek phonological phrase. Recent work on the Japanese pitch accent[22] has revealed that long major phrases can be broken up into more manageable subunits by means of an intermediate raising of the pitch range at the beginning of (often, but not exclusively, syntactically defined) subunits. The result can be interpreted as a hierarchical structuring of phrasal downtrends. Musical records can be used to discover whether something of a similar nature occurred in Greek.

It is necessary to begin with a review of the principal phonological process affecting accentual pitch excursions in the domain of the major phonological phrase, namely catathesis, the name given to the lowering and compression of the intervals of rise to and fall from pitch peaks in alternating High-Tone/Low-Tone structures; catathesis is distinguished from declination, a smaller progressive lowering of pitch from the beginning to the end of the domain.[23] The effects of catathesis are dramatic whether the High-Low structures are tonal, as in Hausa,[24] or

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[21] Sandhi (from Sanskrit *sam + dhā,* 'put together') is a term covering the different phonological modifications that words undergo when they come into contact. Such modifications in Greek are traditionally classified as, *e.g.,* elision, aphaeresis, crasis.

[22] H. Kubozono, *The Organization of Japanese Prosody* (diss.Edinburgh 1987); *cf.* Selkirk.

[23] Full documentation and discussion in A. M. Devine and L. D. Stephens, "Dionysius of Halicarnassus, *de compositione Verborum* XI: Reconstructing the Phonetics of the Greek Accent," *TAPA* 121 (1991, forthcoming).

[24] S. Inkelas and W. R. Leben, "Where Phonology and Phonetics Intersect," in Kingston and Beckman (*supra* n.6) 17.

accentual, as in Japanese.[25] In Greek catathesis applies to sequences of fully accented words, that is words bearing the acute or circumflex, or appositive groups. Catathesis is very strongly respected in the musical settings of the Delphic hymns.[26] Although sometimes the accentual peak of the second of two successive, fully-accented words is set higher than the peak of the first, both the frequency and the magnitude of pitch falling from the first to the second peak are so great that an overall mean fall from one accentual peak to the next of a semitone occurs. Catathesis is blocked by the grave accent. Since the grave does not have the pitch fall after the accentual peak that triggers catathesis, a word bearing the grave may form a single accentual trajectory with a following, fully-accented word. The result is that in strings of full + grave + full accent the peak of the second full accent may be higher than than that of the first. Allowing for the effect of the grave and for local pitch rises due to emphasis, it is typical for a clause or major syntactic phrase to have its highest note on the accentual peak of its first fully accented lexical word, after which the pitches of the peaks and valleys fall all the way to the end. At the beginning of the next clause or major phrase the pitch level is reset upward, but within periodic sentences generally not quite so high as in the preceding clause or major phrase.

Both the relative magnitude of the lowering of accentual peaks and the locations in which the infrequent exceptions to it may occur are regulated by the articulation of the catathesis domain into constituent minor phonological phrases. To avoid circularity in the definition of minor phonological phrases, the analysis will proceed initially in terms of syntactic constituency relations. It will be shown (1) that syntactic constituency imposes very strict constraints on the relative magnitudes of successive peak-to-peak intervals in the musical setting of the Delphic hymns; (2) that the syntactic structures involved in those constraints correspond to minor phonological phrases; and (3) that minor phonological phrase structure not only explains the exception to the syntactically formulated constraints, but also accounts for the variability of the interval

[25] W. J. Poser, *The Phonetics and Phonology of Tone in Japanese* (diss. Massachusetts Institute of Technology 1985).

[26] E. Pöhlmann, *Denkmäler altgriechischer Musik* (Nürnberg 1970: hereafter '*DAM*') nos. 19f.

relations in syntactic configurations not included in the initial syntactic formulation of the rules.

The unit of analysis is a string of three fully-accented lexical words not interrupted by grave accents. Such a string is the minimal sequence in which two successive peak-to-peak intervals can be observed. Proper names constitute a special class and will be treated separately.[27] Description of the interval relations is simplified if falling intervals are defined as positive and rising intervals as negative; in other words the interval from D to C is +1 tone, the interval from C to D −1 tone.[28]

The basic principle is that greater peak-to-peak intervals occur within smaller, more cohesive syntactic constituents, and, conversely, smaller (including rising) intervals occur across such constituents, *i.e.*, within larger, less cohesive stretches of the sentence. This principle can be rendered sufficiently explicit for empirical testing as follows. In any string of three lexical words, $L_1 L_2 L_3$, not interrupted by grave accents or non-clitic non-lexicals, (1.a) if L_1 does not belong to the smallest constituent containing $L_2 L_3$, then the peak-to-peak interval between L_2 and L_3 is not less than the interval between L_1 and L_2. Conversely, (2.a) if L_3 does not belong to the smallest constituent containing $L_1 L_2$, then the interval between L_1 and L_2 is greater than the interval between L_2 and L_3. If the smallest constituent containing $L_1 L_2$ is identical to the smallest constituent containing $L_2 L_3$, then the interval relations are determined by asymmetry in subconstituency between L_1 and L_3. (1.b) If L_1 is not a sister of L_2, but belongs to a branching subconstituent (*i.e.*, has a sister to its left) and L_3 does not, then the interval between L_2 and L_3 is not less than the interval between L_1 and L_2. Conversely, (2.b) if L_3 belongs to a branching subconstituent

[27] The frequency of interruption by grave accents and non-clitic non-lexicals and damage to the inscriptions reduce the number of such lexical triples, but the settings of enough are preserved to permit a definitive statistical test as given below in the text.

[28] The definition has no substantive consequences and in no way prejudices the test results; it merely allows the substitution of 'greater' for the periphrasis 'which falls more / rises less'. If the reverse definition is chosen, then the inequalities in rules 1 and 2 are reversed. Defining falling intervals as positive, however, has the intuitive appeal of according with the progressive lowering of pitch imposed by catathesis. Furthermore, since intervals measured in tones are merely the logarithms of fundamental frequencies ($I_{ij}=\log[f_i/f_j]=\log f_i - \log f_j$), when intervals are calculated in the direction that the notes are sung, if the first is higher than the second the difference $\log f_i - \log f_j$ is positive, and, conversely, if the second is higher than the first, the difference is negative.

(*i.e.*, has a sister to its right) and L_1 does not, then the interval between L_1 and L_2 is greater than the interval between L_2 and L_3.[29] If L_1, L_2, and L_3 are sisters, or if L_1 and L_3 are both immediate constituents of respective branching subconstituents, no prediction is made about the relative magnitudes of the intervals. Rules 1.a–b and 2.a–b can be more readily comprehensible with the help of some shorthand notation. Let I_{12} and I_{23} stand for the magnitudes of the intervals between the peaks of the accents of L_1 and L_2, and, respectively, between the peaks of L_2 and L_3. Let square brackets indicate the constituency relations among L_1, L_2, and L_3. Then

1.a. $L_1 [L_2 L_3]$

1.b. $[[X L_1] L_2 L_3]$ $\Big\}$ $\longrightarrow$ $I_{12} \leq I_{23}$

2.a. $[L_1 L_2] L_3$

2.b. $[L_1 L_2 [L_3 X]]$ $\Big\}$ $\longrightarrow$ $I_{12} > I_{23}$

Rule 1.a applies to a lexical triple such as

 DAM 19.14

since the Adjective and the Noun belong to a Noun Phrase that does not include the Participle on the left. The prediction of the rule is correct, since $I_{12} = -0.5$ but $I_{23} = +0.5$ tones. Rule 1.b applies to a lexical triple formed by the last three words of a Noun Phrase consisting of a branching Genitive Phrase + Noun + Adjective, *e.g.*

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[29] Constituents are sisters if they are at the same hierarchical level; thus a Genitive Phrase consisting of an Adjective and Noun may be the sister of a single Noun that is the head of the Noun Phrase comprising all three words, but the Noun in the Genitive is not itself a sister of the Noun that is the head of the Noun Phrase. The rather involved definition of rules 1.b and 2.b is required because we do not wish to beg the questions of formal syntactic analysis posed by discontinuous constituents in Greek.

Διὸ]ς ἐ[ρι]- βρό-μου-ου θύ-γα-τρες εὐ - ώ - λ[ενοι,]

DAM 19.2

since there are no obvious grounds for grouping θύγατρες with either the Genitive Phrase to the exclusion of the Adjective, or vice versa, but the Genitive Phrase branches, so that ἐριβρόμου has a sister to its left. The prediction of the rule is correct, since I_{12} = +0.5 but I_{23} = +1 tone. Rule 2.a applies to a lexical triple such as

αἴ νι - φο - βό - λους πέ - τρας ναί - εθ'

DAM 20.3

since the Adjective and the Noun belong to a Noun Phrase that does not include the Verb. The prediction of the rule is correct, since I_{12} = +2 but I_{23} = 0 tones.

Excluded from these rules are head interrupted configurations in which neither of the flanking modifier or complement element branches, for example

μαντεῖον ἐφέπων πάγον (*DAM* 19.8)
νέων μῆρα ταύρων (*DAM* 19.12)

and also configurations of two modifiers preceding (or following) their head, for example, οἰνῶπα δάφνας (*DAM* 20.23f). These configurations will be treated separately.

We now provide examples of how rules 1 and 2 regulate the interval relations in different syntactic structures. Rule 1 predicts that in a triple in which the first lexical belongs to a Prepositional Phrase, the second to a Direct Object Phrase, and the third is the Verb, if there is a falling interval and a rising interval, the falling interval will occur between the word of the Direct Object Phrase and the Verb, the rising interval between the word belonging to the Prepositional Phrase and word belonging to the Object Phrase.

Δελ - φὸν ἀ - νὰ [πρ]ω - ῶ - να μα-αν-

DAM 19.7-8

Here the falling interval of 1.5 tones occurs between the peak of
τεῖ and φέ, but the rising interval of 1.5 tones between the peak
of πρῶ and the peak of τεῖ. Rule 1 permits equal intervals in
structures such as verb + branching Noun Phrase

DAM 19.12

with equal intervals of a semitone, and in structures such as the
last word of a Noun Phrase + a branching Adjective Phrase

DAM 20.20-1

with two zero intervals.
    Rule 2 means that in a structure of, for example, branching
Genitive Phrase + verbal form, if there are two unequal falling
intervals between the accentual peaks, the larger interval will
occur within the Genitive Phrase and the smaller between the
last word of the Genitive Phrase and the Verb.

DAM 20.6

Here the larger falling interval of two whole tones occurs be-
tween the peak of ᾶς and λαί within the Genitive Phrase, but
the smaller falling interval of only a semitone between λαί and
the peak of γοῦ. Similarly in a structure of branching Noun
Phrase indirect object + Verb, if there is one falling and one
rising interval, the falling interval will occur within the Noun
Phrase, the rising interval between the last word of the Noun
Phrase and the Verb.

πᾶ - σι θνα - τοι-οῖς προ-φαί - νει - [εις λόγια,]

DAM 19.20

Here the falling interval of 1.5 tones occurs between the peaks of πᾶ and τοῖς, but the rising interval between the peak of τοῖς and φαί. Again, in a structure of branching Noun Phrase direct object + Verb, if there are two unequal rising intervals, the smaller rise will occur within the Noun Phrase, the larger rise between the final word of the Noun Phrase and the Verb.

[τρ][- πο-δα μαν - τει-εῖ - ον ὡς ει- εἰ - [λες,

DAM 19.21

Here the larger rising interval of 1.5 tones occurs from the peak of τεῖ to that of εἰ , but the smaller rising interval of a whole tone between τρί and the peak of τεῖ within the Noun Phrase.

The table below presents the results of a statistical test of rules 1 and 2 in the Delphic hymns.

	$I_{12} > I_{23}$	$I_{12} \leq I_{23}$
L_1 [L_2 L_3], *etc.*	0	6
[L_1 L_2] L_3, *etc.*	6	1

P = .0041

Interval Relations Between Accentual Peaks

The distribution observed is highly significant. Even though there are only thirteen lexical triples that meet the structural descriptions of rules 1 and 2, there is (by the hypergeometric distribution) only a chance of about 1 in 244 that the relations of the interval magnitudes would accord with the syntactic structure as prescribed by the rules purely as a result of chance.

There is only one exception to a perfect, bidirectional implication:

Κα - στα-λί-δος ε - οὐ - ὑ-δρου νά - ματ' ἐ - πι - νί - σε-ται,

DAM 19.6

Here the greater interval of fall occurs between the direct object noun and the verb rather than between the direct object νάματ' and genitive Adjective εὐύδρου of the branching Genitive Phrase that modifies νάματ'. This case, however, is an instructive exception, for it illustrates that pitch relations are regulated directly by minor phonological phrases. Pitch relations can to a high degree of accuracy be expressed in syntactic terms, because the formation of minor phonological phrases is strongly determined by syntactic constituency, but it is not completely so determined. In *DAM* 19.6 νάματ' could not form a minor phonological phrase with εὐύδρου to the exclusion of the head of the Genitive Phrase, Κασταλίδος. As noted above, minor phonological phrases are preferentially formed from two, rather than three, lexical words or appositive groups, unless they are in a head-interrupted structure. There is a further reason why formation of a single minor phonological phrase spanning the entire Noun Phrase Κασταλίδος εὐύδρου νάματ' is unlikely. In the Delphic hymns, proper names such as Κασταλίδος are treated as emphatic, focused constituents, and given a pitch boost. Not only does emphatic material not form minor phonological phrases with contiguous unemphatic material, but, as we have seen, in inscriptions that punctuate minor phonological phrases, the structure proper name + modifier is punctuated separately, not inclosed with other words inside interpuncts. Thus in the present case νάματ' was undoubtedly orphaned from the minor phonological phrase containing the proper name and its epithet and adjoined to its governing Verb ἐπινίσεται. The pitch relations are now predictable from the structure of the minor phonological phrases: the greater fall occurs within, not across the pair of words belonging to the same minor phonological phrase.

We have seen (*supra* n.3) that interrupted structures consisting of three appositive groups may be treated as a single minor phonological phrase in inscriptions and in meter. Certainly in the Delphic hymns head-interrupted configurations behave differently from structures that have more strongly differentiated internal constituency. In these head-interrupted configurations there is no constraint on the location of the greater and the smaller peak-to-peak interval. For example in

DAM 19.8

the greater interval occurs between the second and third words
(probably because of the steep drop in pitch resulting from
terminal fall[30] at the end of a periodic sentence), whereas in

DAM 19.12

just the opposite relation holds, although in each case the inter-
rupted constituent is a Noun Phrase in the order Adjective,
Noun. Since there is no internal differentiation into separate
minor phonological phrases, lexical triples in head-interrupted
configurations trivially conform to the constraint that the
interval within the minor phonological phrase is greater than the
interval across minor phonological phrases, whatever the in-
tervals may be. Accordingly, their peak-to-peak pitch relations
may be determined wholly by other factors, such as terminal
fall or considerations of emphasis that are independent of or not
also signalled by the order of the interrupted structure.

The interval relations in the configuration consisting of
modifier + modifier + head Noun in

DAM 20.23-4

suggest that οἰνῶπα δάφνας at least forms a minor phonological
phrase, probably but not necessarily to the exclusion of κλά-
δον. Unfortunately there is no evidence that could indicate a
difference between complements and adjuncts.

The syntactically formulated rules 1 and 2 may now be re-
stated in terms of minor phonological phrases. Within minor
phonological phrases the pitch of accentual peaks falls more /
rises less, than across minor phonological phrases, where pitch
falls less / rises more. These rules may be formalized as

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[30] See Devine and Stephens (*supra* n.23).

$1'. L_1 {}_{[\varphi}L_2L_3 \rightarrow I_{12} \leq I_{23}$

$2'. L_1L_2{}_{\varphi]} L_3 \rightarrow I_{12} > I_{23},$

where φ indicates that the brackets now refer to the boundaries of minor phonological phrases.

Rules 1′ and 2′ may be tested against all pairs of uninterrupted fully-accented lexical words in the hymns. This prediction is that the mean interval between accentual peaks will be greater in pairs that are within the same minor phonological phrase, smaller in pairs of words belonging to different minor phonological phrases. The size of the data set for the test is therefore greatly increased beyond that available for the lexical triples above. The results are presented in the table below.

| *Within*	*Across*
$P_1P_2{}_{]\varphi} = 1.12$	$P_1{}_{\varphi]}{}_{[\varphi} P_2 = 0.00$
$s = 1.00$	$s = 1.11$

$$t = 3.68, df = 46$$
$$p < .005$$

Mean Interval between Peaks

The parsing into minor phonological phrases was done according to the algorithm deduced from inscription punctuation. The mean fall within minor phonological phrases was found to be just over a whole tone, whereas the mean fall across minor phonological phrases was observed to be zero. The difference between the means is highly significant.[31] The effect of rules 1′ and 2′ on accentual pitch excursions may be illustrated by a schematic diagram of a major phonological phrase articulated into three minor phonological phrases. Each minor phrase is taken to consist of only two medially-accented lexical polysyllables. Such polysyllables have a Mid-High-Low, rather than a Low-High-Low, pitch pattern.[32] The diagram does not attempt

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[31] The parsing into minor phonological phrases employed for the test is not the only one compatible with the algorithm discussed above, but one that minimizes minor phonological phrases of three appositive groups in length. Other parsings will yield somewhat different means, but the mean interval within minor phonological phrases will always be greater than the mean across them.

[32] See Devine and Stephens (*supra* n.23).

to represent to scale the compression effect of catathesis, only the average lowering of about a tone of successive accentual peaks within minor phrases, and the small pitch boost at the beginning of successive minor phrases that blocks the lowering of the first peak vis-à-vis the last peak of the preceding minor phrase.

[Minor Phrase1]   [Minor Phrase 2]   [Minor Phrase 3]
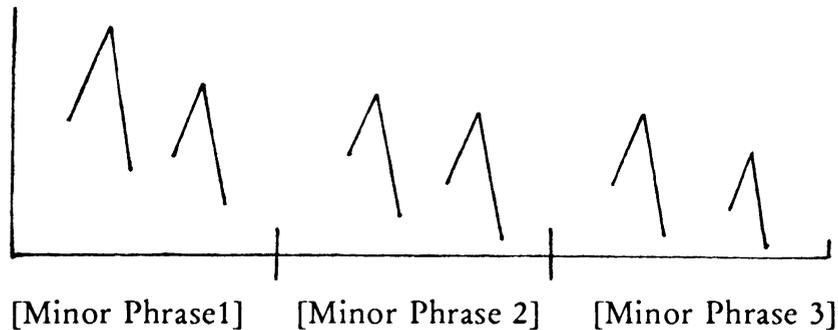
The interval relations described by rules 1′ and 2′ are the result of the processing of pitch excursions in minor phonological phrases. There is a major upward reset at the beginning of primary catathesis domains, which are basically coterminous with major phonological phrases. There is also a minor pitch boost, much smaller than initial reset, at the beginning of minor phonological phrases. As a result, the pitch of the first full accent in a minor phonological phrase is not as much lower than the last peak of the preceding minor phonological phrase as is the following pitch peak within a minor phonological phrase. The initial pitch peak may in fact sometimes be higher than the last peak in the preceding minor phonological phrase, but on the average it is about the same, since the mean interval was observed to be 0. It follows that catathesis works in terms of a self-similar hierarchy: (1) the minor phonological phrase that has a minor pitch boost on its first lexical full accent and strong catathesis lowering of the following full accent; (2) the major phonological phrase, or primary catathesis domain, which has a major pitch reset at its beginning and general fall over the minor phonological phrases within it; (3) the periodic sentence, which has an even greater initial pitch level and long-term pitch fall over the primary catathesis domains within it.

STANFORD UNIVERSITY
UNIVERSITY OF NORTH CAROLINA, CHAPEL HILL
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