Second-position clitics and the syntax-prosody interface: The case of Ancient Greek

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Introduction Recent work on clitics in LFG (e.g. Bögel et al. 2010) has tended to make at least one of two assumptions that are at odds with traditional LFG concepts of grammar, namely 1. that there is a syntactic constituent Clitic Cluster (CCL), and 2. that there can be a (limited) mismatch between the c-string (the terminals of the c-structure) and the p-string (the prosodic structure). Though not impossible, both assumptions seem contrary to the spirit of LFG.

The CCL is problematic because it groups together words with very different functions (at least pronominals, connectives, discourse particles, and tense and modal auxiliaries), so that it is impossible to give a principled structure-function mapping for it; the CCL itself is normally considered a functional co-head of the clause (annotated with $\uparrow=\downarrow$), and most work in this tradition leaves implicit the principles that govern the assignment of functions to the CL daughters of CCL. And even disregarding the structure-function mapping, there is little or no syntactic evidence for a group of clitics forming a syntactic constituent in the first place.

The syntax-prosody mismatch is problematic because it seems to open the door to postsyntactic manipulation of word order *contra* traditional LFG assumptions. The most explicit theory of the syntax-prosody mismatch (Bögel et al. 2010) has the virtue of severely constraining the prosody-syntax interface to regular relations, but it is not even clear that we want the power of regular relations to manipulate this interface. Moreover, the theory requires the use of an empty category LB_S to identify the left bracket of S constituents. Finally, we will see that the complex distributional facts of Ancient Greek (AG) clitics cannot be easily accounted for in a simple transduction theory, although it is likely that more complex theories based on monadic second-order tree transducers (Ashton 2012) could work. This would however introduce even more power in post-syntactic, transformation-like component (although likely without increasing the power of the full LFG formalism).

In this paper we argue for a theory of clitics that interprets clitics in situ while at the same time assigning GFs in the ordinary way, i.e. with no c-structure rule specifically referencing clitics. Sadler (1997) achieved this for Welsh, but relied on configurational properties of Welsh that are simply absent in AG. For AG, we argue, we must dissociate category formation (where GF assignment takes place) from linearization, as is done in multiple context-free grammar (MCFG, Seki et al. 1991).

The distribution AG has two sets of clitics, clausal and sentential ones.[1] The sentential clitics all express discourse relations between the entire sentence and the surrounding discourse; in terms of category, we assume they are non-projecting (sentential) adverbs, $\widehat{\text{Adv}}$. Clausal clitics overtly realize functional properties of the clause and are non-projecting pronominals ($\widehat{\text{D}}$) or auxiliaries ($\widehat{\text{V}}$). Distributionally, the crucial difference between the two classes is that sentence clitics are hosted at the beginning of the sentence, even when that means attaching to preposed material; whereas clausal clitics follow the first prosodic word of the core clause, ignoring preposed material.[2] Whenever there are no preposed elements, sentential and clausal clitics are adjacent (with sentential clitics preceding clausal ones), as in (1), where *gár* is a sentential clitic and *me* a clausal one. If there is a preposed element, they will be separate, as in (2): *mèn* in this example is a phrasal clitic and marks the preposing, *gàr* is sentential and *sphi* clausal.

(1) hoi=gár=me ek tē̃s kṓmēs paĩdes ... paízontes sphéōn autō̃n
the=for=me.ACC from the.GEN village.GEN children.NOM play.PP.NOM they.GEN self.GEN
estḗsanto basiléa
make stand.PFV.MID.3.PL king.ACC
'For the children from the village, while playing, chose me as their king' (Hdt. 1.115.2)

(2) tḕn=mèn=gàr protérēn hēmérēn pánta=sphi kakà ékhein
the.ACC.SG=PTCL=PTCL previous.ACC.SG day.ACC.SG everything.ACC.PL=them.DAT bad.ACC.PL hold.INF
'For on the previous day, everything was bad for them' (Hdt. 1.126.4)

Sentential clitics either attach to the first prosodic word in their domain, or to the first morphosyntactic word, even when it is not a full prosodic word. In either case, the metrical evidence clearly tells us that the host and the clitic form

[1] There are also phrasal clitics, which we mostly ignore here.

[2] Preposed material that is topicalized is independently identifiable by the presence of the phrasal clitics *mén* and *dé*. Preposed material that is under strong focus is not marked by any particle, but the semantic effects are clearly visible. See Goldstein (2015, 121–217) for an analysis of these two positions and their discourse effects in terms of Craige Roberts' Question under Discussion framework.

a single prosodic word (PW).[3] Interestingly, in such cases, the resulting PW can in turn host a clausal clitic as happens in (1). This placement of the clausal clitic requires reference to prosody, contra Lowe (2016, 5). It is not trivial to get this distribution through prosodic inversion without assuming a clitic cluster.

Sentence structure, functional and prosodic domains We assume the sentence structure in Figure 1 for Herodotean Greek. This is argued for in Goldstein (2015). We assume that sentential adverbs must scope as high as possible, i.e. adjoin to the highest CP.[4] Topics are adjoined to CP and marked with the phrasal clitics *mén* or *dé*.[5] Foci are adjoined to S. Notice that topic and focus as marked by adjunction to S/CP and phrasal clitics are pure i-structure concepts which we ignore for simplicity in our rules. Such topics and foci do not license long distance dependencies. By contrast, specCP does license long distance dependencies and is annotated with $(\uparrow \text{UDF}) = \downarrow$.

This sentence structure gives us functional domains for the clitics which intuitively correspond to their semantics. Sentential clitics scope over the whole sentence and so are realized in the highest CP, whereas clausal clitics realize functional properties of the clause and are realized in S. The prosodic domains are the same as the functional ones, with the exception that COMP incorporates with S whenever there is no focus, as noted above.

Analysis We capture the special kind of discontinuities that clitics give rise to by using a Multiple Context Free Grammar (MCFG[6]) instead of an ordinary CFG to constrain admissible c-structures. Although MCFGs are strictly more expressive than CFGs, we show that this move does not increase the expressivity of the combined LFG formalism, but only affects the division of labour between c- and f-structure: what the MCFG c-structure does for us could in principle be handled in the f-structure, though not without introducing a lot of linguistically unmotivated bookkeeping.

Despite there being no increase in formal expressivity, our framework can give a very natural account of clitic discontinuities which have otherwise been dealt with using an OT component that effects cross-derivational comparisons, introducing introduces a significant and not well understood expansion of the expressive power of grammatical description (Potts, 2002; Dalrymple et al., 2015).

A CFG rule $\alpha \to \beta\gamma$ conflates a category-forming operation and a concatenation operation: β and γ together form a category α and at the same time the concatenation of their yields is the yield of α. MCFGs separate the two operations by combining productions with explicit yield functions that describe how to compute the yield of the right hand side from the yields of the left hand-side categories.

If the yield function simply concatenates the yields, we get the MCFG that is equivalent to a CFG. To achieve greater expressivity than a CFG, we allow yields to be n-tuples of strings. In our notation of yield functions, we use $\langle 1, 1\rangle, \langle 1, 2\rangle, \ldots \langle 1, n\rangle$ for the n components of the yield of the first category on the right hand side of a production rule, $\langle 2, 1\rangle, \langle 2, 2\rangle, \ldots \langle 2, n\rangle$ for the components of the second category's yield etc. Semicolon (;) denotes concatenation and each component in the output yield is marked off with square brackets. For example $f = [\langle 2, 1\rangle; \langle 1, 1\rangle; \langle 2, 2\rangle]$ defines a yield function that "wraps" the first and second components of the second argument ($\langle 2, 1\rangle$ and $\langle 2, 2\rangle$) around the (single component of) the first argument ($\langle 1, 1\rangle$) and concatenates the parts. This corresponds to what happens when the second argument is a clitic that gets hosted inside the first argument: we call this function **resolve** because it resolves the latent discontinuity in the second argument. A second, minimally different yield function is defined by $f = [\langle 2, 1\rangle][\langle 1, 1\rangle; \langle 2, 2\rangle]$. This performs the same wrapping operation, hosting a potentially clitic first argument, but leaves the gap in the second argument open for more elements to be hosted. We call this function **host**.

The families of yield functions we need in our grammar are shown in Table 4; these are parametrised by the superscript number n of arguments on the right hand side production that they combine with (to avoid notational clutter we often leave out this parameter as it corresponds directly to the number of daughter nodes); and subscript i, which is the number of the distinguished argument that gets/remains split in **split** and **propagate** or that acts as a host in **host** and **resolve**. The idea behind our analysis is that the yield functions from Table 4 combine freely with the productions in Table 3 subject only to the constraint that the $i - 1$ first arguments of **host** and **resolve** must be non-projecting. Put another way: projective and non-projective syntax happens in different layers that are superposed for linearization, giving rise to discontinuities.

There are various ways we can define tree languages for MCFGs; here we follow (Kallmeyer, 2010, 116-7) who uses trees with crossing branches. Figure (1) shows the c-structure we get for 2. Nonterminals are subscripted with

[3] Given the nature of the data, we may never know the internal structure of this PW. For concreteness we will assume (in Table 1) that it is formed through stray adjunction of syllables.

[4] The relationship between c-structure position and semantic scope is a well-known problem in LFG which we do not go further into here

[5] Though note that topicalization can be recursive and in that case, only the first constituent is marked with a phrasal clitic.

[6] See `http://www.cs.rhul.ac.uk/home/alexc/lot2012/mcfgsforlinguists.pdf` for an accessible introduction to MCFG for linguists.

PW	$\rightarrow$	PW	σ
		$(\uparrow_\chi \text{L}) \sqsubseteq (\downarrow_\chi \text{L})$	$(\uparrow_\chi \text{R}) \sqsubseteq (\downarrow_\chi \text{R})$
		$\text{PW} \in (\downarrow_\chi \text{L})$	$\text{PW} \in (\downarrow_\chi \text{R})$
		$\text{IntP} \in_c (\downarrow_\chi \text{L})$	$(\downarrow_\chi \text{HOST}) = \text{PW}$
PW	$\rightarrow$	σ^+	σ
		$(\uparrow_\chi \text{L}) \sqsubseteq (\downarrow_\chi \text{L})$	$(\uparrow_\chi \text{R}) \sqsubseteq (\downarrow_\chi \text{R})$
		$\text{PW} \in (\downarrow_\chi \text{L})$	$\text{PW} \in (\downarrow_\chi \text{R})$
		$\text{IntP} \in_c (\downarrow_\chi \text{L})$	$(\downarrow_\chi \text{HOST}) = \sigma$

Table 1: Prosodic structure-building rules

gár	$\widehat{\text{Adv}}$	$(\uparrow_\chi \text{HOST})$
		$\vdots$
me	$\widehat{\text{D}}$	$(\uparrow_\chi \text{HOST}) =_c \text{PW}$
		PRED = 'PRO'
		CASE = ACC
		$\vdots$

Table 2: Sample lexical entries for clitics

the yield function that has been applied (with the trivial c-function suppressed). Thus, DP_{s_1} means that the DP is split after the first daughter. S_{h_2} means that the second daughter of S acts as a host.[7] C'_{p_1} and CP_{p_1} mean a discontinuity in the first (and only) daughter node is propagated. Finally, CP_{r_2} means that the second daughter node acts as host and that the discontinuity is resolved so that the CP is continuous.

The free application of yield functions obviously overgenerate on the syntactic side. And indeed we claim that prosody is crucial to clitic placement. To capture this we follow the approach of Dalrymple and Mycock (2011) and build a prosodic tree in tandem with the prosodic one. To achieve this we enrich their prosodic structure building-rules with the following rules for clitics, as shown in Table 1. In essence, these rules allow clitics, which only project syllables (σ) rather than PWs, to form complex PWs with preceding elements at the edge of an intonation phrase. The use of the rules is governed by the HOST feature which is specified in the lexical entry of clitics as shown in Table 2. Sentential clitics like *gár* simply require that *some* host is available: this captures their ability to attach both to the first morphosyntactic word and to the first prosodic word. On the other hand, clausal clitics like *me* require a full prosodic word as their host.

The prosodic structure of (1) is shown in Figure 3. For concreteness, we give a complete and necessarily speculative prosodic tree, but only two things are crucial to our analysis: First, that (the left part of) the sentence is a single IntP so that material in the CP and S layer can be hosted at the edge of a single IntP; and second, that *hoi gár me* forms a single prosodic word, as metrical evidence suggests.

Consider now (2). The c- and p-structures are given in Figures 4 and 5. The prosodic domains of the clausal and sentential clitics differ and so they are realized in different locations. A salient feature of our analysis is that whenever the clitic follows a non-branching constituent such as the first NP under S in Figure 4, *nothing* happens in the syntax, as the clitic can get a licit prosodic host in situ. By contrast, variants of prosodic inversion analyses must assume that the clitic has a fixed position at the left edge of S and then "moves" for prosodic reasons. There is, however, no evidence for such a fixed position for the clitics.

Conclusion Second-position phenomena in AG have important consequences for the long-standing theoretical debate concerning the division of labor between syntax and phonology in the distribution of clitics (Bošković 2001, Lowe 2016). AG clausal clitics show that Zwickian "special" clitics (Zwicky 1977) do exist, contra the recent denial of this class by Bermúdez-Otero and Payne (2011). Specifically, our accounts locates clitic idiosyncrasy in the prosody, as clitics are special in being morphosyntactic words that do not project a PW but must enter into a complex PW via prosodic rules licensed by the lexically determined HOST feature.

Second, our account captures the complex data without introducing either cross-derivational comparisons (as in OT-based accounts) or a pipeline architecture that makes the LFG framework procedural (even if the syntactic component remains declarative). The move to an MCFG-based c-structure may seem radical, but is in fact very well understood mathematically. Our yield functions only license one discontinuity in a given category and only one discontinuous daughter in each category. This means that c-structure parsing can be done in quintic time in the worst case; moreover, worst case complexity is unlikely to arise in practice because the elements that introduce discontinuities all belong to the closed, unambiguous group of clitics.

[7] For graphical reasons, the DP host is nevertheless shown as the first argument in Figure (1).

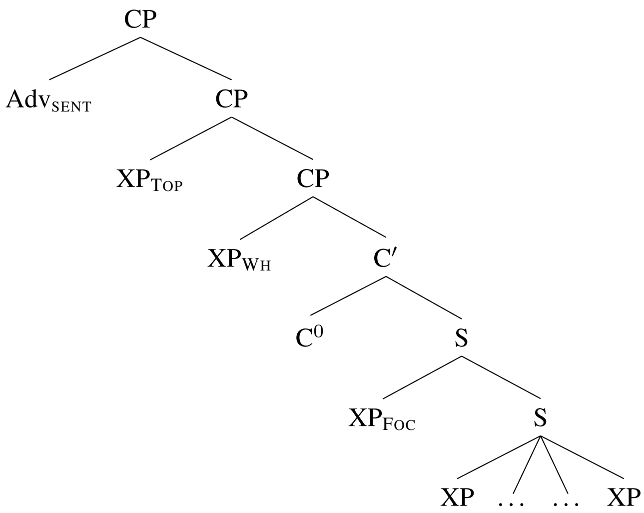

Figure 1: Herodotean sentence structure

Clause-level rules				
CP	$\rightarrow$	XP $(\uparrow \text{UDF}){=}\downarrow$		C′ $\uparrow{=}\downarrow$
C′	$\rightarrow$	C^0 $\uparrow{=}\downarrow$		S $\uparrow{=}\downarrow$
S	$\rightarrow$	XP* $(\uparrow\text{GF}){=}\downarrow$	,	V* $\uparrow{=}\downarrow$
Adjunction to clausal categories				
CP	$\rightarrow$	AdvP $\uparrow{=}\downarrow$		CP $\uparrow{=}\downarrow$
CP	$\rightarrow$	XP $(\uparrow\text{GF}){=}\downarrow$		CP $\uparrow{=}\downarrow$
S	$\rightarrow$	XP $(\uparrow\text{GF}){=}\downarrow$		S $\uparrow{=}\downarrow$
Lexical phrases				
PP	$\rightarrow$	P $\uparrow{=}\downarrow$		DP $(\uparrow \text{OBJ}) {=}\downarrow$
DP	$\rightarrow$	$\begin{pmatrix}\text{D}\\ \uparrow{=}\downarrow\end{pmatrix}$		NP $\uparrow{=}\downarrow$
NP	$\rightarrow$	A* $(\uparrow\text{ADJ}) \in \downarrow$	,	$\begin{pmatrix}\text{N}\\ \uparrow{=}\downarrow\end{pmatrix}$

Table 3: Basic c-structure rules

concatenate	$c^n =$	$[\langle 1,1\rangle; \langle 2,1\rangle; \ldots; \langle n,1\rangle]$
split	$s_i^n =$	$[\langle 1,1\rangle; \ldots; \langle i,1\rangle][\langle i+1,1\rangle; \ldots; \langle n,1\rangle]$
propagate	$p_i^n =$	$[\langle 1,1\rangle; \langle 2,1\rangle; \ldots \langle i,1\rangle][\langle i,2\rangle; \langle i+1,1\rangle; \ldots; \langle n,1\rangle]$
host	$h_i^n =$	$[\langle i,1\rangle][\langle 1,1\rangle; \ldots; \langle i-1,1\rangle; \langle i,2\rangle; \langle i+1,1\rangle; \ldots; \langle n,1\rangle]$
resolve	$r_i^n =$	$[\langle i,1\rangle; \langle 1,1\rangle; \ldots; \langle i-1,1\rangle; \langle i,2\rangle; \langle i+1,1\rangle; \ldots; \langle n,1\rangle]$

Table 4: Yield function families

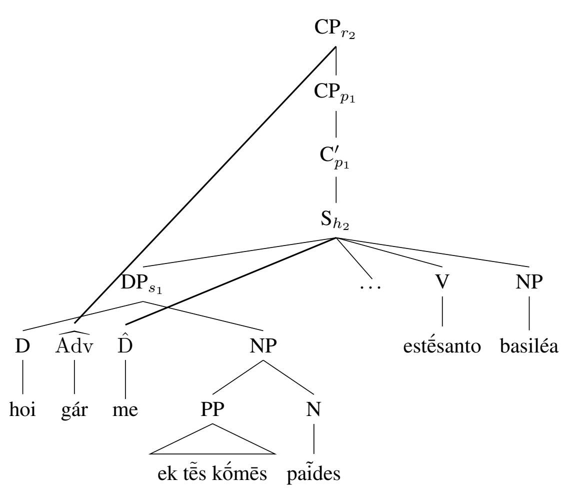

Figure 2: C-structure of (1)

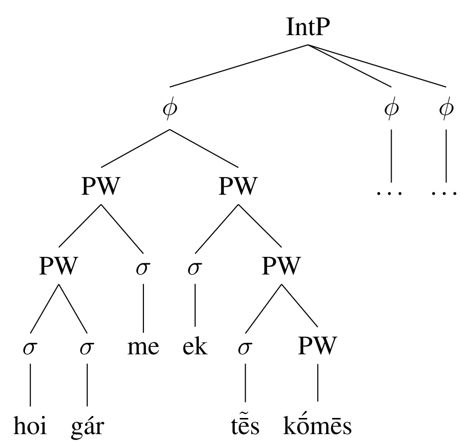

Figure 3: Prosodic structure of (1)

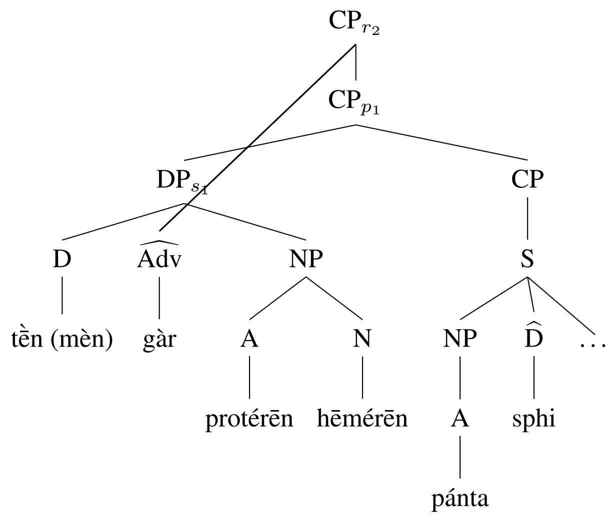

Figure 4: C-structure of (2)

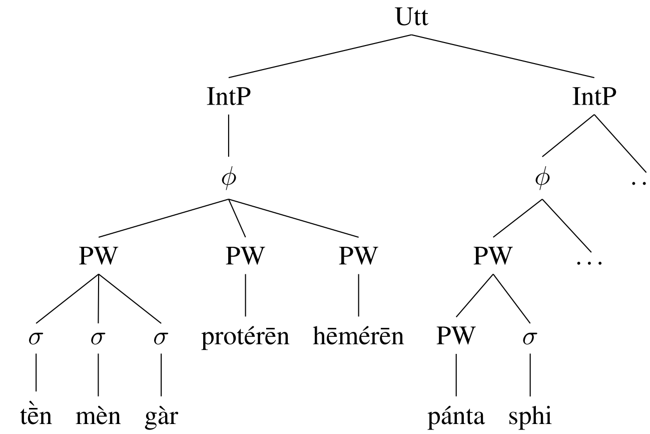

Figure 5: Prosodic structure of (2)

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