Modularity, Phase-Phase Faithfulness and Prosodification of Function Words in English

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Abstract

This paper investigates the interface of syntax and phonology in a fully modular view of language, deriving the effects of (morpho)syntactic structure on prosodification without referring to that structure in the phonological computation, *contra* the use of constraints that map (morpho)syntactic edges or constituents to prosodic ones. The data focus is on function words in English, which receive different prosodic treatment from lexical words. The approach presented here adopts the view of the 'syntax-all-the-way-down' approaches, specifically Nanosyntax, which erase the traditional distinction between lexical and functional categories. The paper argues that phonological computation needs to proceed in phases in order to achieve domain mapping while maintaining an input consisting of purely phonological information, and offers a formalization within the Optimality Theory framework by introducing Phase-Phase Faithfulness constraints. Spell-out is attempted at each merge, and is successful when lexical matching is successful. The paper argues that spell-out cannot proceed in chunks but in concentric circles, producing cumulative cyclic input to phonology. An analysis is provided deriving prosodic domains from phases by phonological computation being faithful to the prosodification output of the previous phase. The prosodic word status of lexical words is derived from their status as phase 1 in the derivation.

1. Introduction

This paper provides an account of the prosodic properties of function words in a fully modular model of the syntax-phonology interface. 'Modularity' refers to the model of language presented in Chomsky (1965), which is still the basis for generative theories of grammar. According to this model, language consists of three independent modules, (morpho)syntax, phonology and semantics. They are independent from one another and operate on domain-specific primitives, which is why there is a need for the interface between them. In this paper, language computation is seen as derivational and uni-directional. Phonology follows syntax, and the output of the syntactic computation serves as input to the phonological computation. The point at which information is translated from one module to another is called the 'interface'. In the syntax-phonology interface, 'spell-out' is the process of linearising the syntactic tree structure and performing lexical insertion. Syntactic spell-out provides phonology with a linear input consisting of underlying forms of the lexical items. The phonological representation assumed in this paper for suprasegmental structure is that of the Prosodic Hierarchy of domains (PH), consisting of syllable (σ), foot (Σ), prosodic word (ω), prosodic phrase (φ), intonation phrase (Int) and utterance (Utt) levels (e.g. Selkirk 1980 *et seq*., Nespor and Vogel 1986, Hayes 1989). The computational model adopted is that of Optimality Theory (Prince and Smolensky 1993, McCarthy and Prince 1993, 1995).

The data this paper focuses on is function words in English. The prosodification of function words in English has been one of the central issues for the syntax-phonology interface theories, especially Prosodic Phonology (e.g. Selkirk 1981, 1986, 1995; Nespor and Vogel 1986; Hayes 1989; Truckenbrodt 1999 *inter alia*). As elaborated in section 1.1 below, the different prosodic treatment of function and lexical words suggests that there is actually some interaction between the syntactic and phonological module of language. This is a challenge for the interface theories that advocate a modular approach to language. The way that Prosodic Phonology, for example, accounts for the interaction, by the Indirect Reference Hypothesis, violates modularity. As a result, these theories do not achieve full modularity in their accounts of the data. This paper argues that full modularity can be achieved by applying the

© 2013 Dragana Šurkalović. *Nordlyd* 40.1: 301-322, special issue 'A Festschrift on the Occasion of X Years of CASTL Phonology and Curt Rice's Lth Birthday' ed. by Sylvia Blaho, Martin Krämer and Bruce Morén-Duolljá. University of Tromsø. http://www.ub.uit.no/baser/nordlyd/

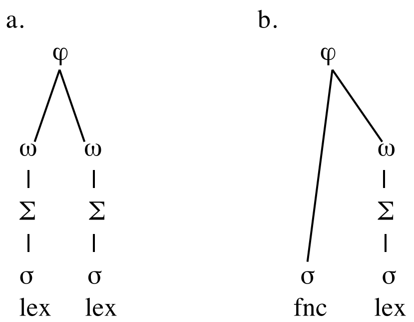
alternative No Reference Hypothesis approach presented in Šurkalović (2011a), and outlined in section 1.2 below, to this aspect of the syntax-phonology interaction in English. The goal of the work presented here is to account for the interaction of syntax and phonology in a fully modular view of language, and, in the process, answer questions about the nature of the input to phonology and the nature of derivation and its phases.

In section 2 I present an OT account of the prosodification of function words which relies not on the distinction between lexical and function words, but on the differences in the derivational status of different lexical items. Section 2.1 looks briefly at function words in isolation and introduces some of the constraints used throughout the paper. Sections 2.2 and 2.4 focus on determiners and prepositions respectively, and provide an account of the difference in behavior between monosyllabic and polysyllabic function words. Section 2.3 provides a brief account of suffixes as functional elements in the system presented in the paper. Section 2.5 unifies the data analysis by providing a clausal derivation which exemplifies the interaction between lexical and functional elements, and at the same time provides an account of the non-isomorphism of syntactic and phonological domains. Section 3 concludes the paper and provides direction for future research.

1.1 Function Words in English

This paper uses as its starting point the data on the prosodification of function words in English discussed initially in Selkirk (1995). This data played a crucial role in establishing the importance of the difference between lexical and functional elements for prosodification, which has been used to argue for the Indirect Reference Hypothesis, *contra* the premise of modularity. In English, function words are most commonly phonologically unstressed and their vowels reduce, i.e. they appear in their ‘weak’ form (when they are non-focused, non-final or final but in object position) whereas lexical words always carry word stress. For example, the phrase ‘for Timothy’, /fə’tɪməθɪ/, has the same stress pattern as the word ‘fertility’, /fə’tɪlətɪ/. Selkirk (1995) provides an analysis where lexical words are always associated with prosodic word status, whereas function words by default are not, and thus are prosodically less prominent. Function words have the prosodic status of a free clitic, adjoined outside the prosodic word at the prosodic phrase level. The difference is illustrated in (1) below (assuming monosyllabic words for ease of representation). (1a) represents a sequence of two lexical words prosodified as two prosodic words, whereas (1b) represents a sequence of a function word followed by a lexical word, prosodified as a free clitic and a prosodic word.

(1)



The exception are the cases when function words are pronounced in isolation, phrase-finally or focused, in which case they appear in their full, ‘strong’ form. This difference in prosodification possibilities for function words is addressed in the analysis in section 2 and in Šurkalović (2011b). Section 2.5 also addresses cases of non-isomorphism, and cases when the function word is found between two lexical words.

The difference in status of function and lexical words results in the fact that, while there is at most one unstressed syllable at the left edge of a PWd in English (Selkirk 1995, citing McCarthy and Prince 1993), a lexical word can be preceded by multiple function words which all remain unstressed and unfooted, as shown in (2) below:

(2)	te (le pa $)_{Ft}$ thy	vs.	(te $le)_{Ft}$ (pa $thic)_{Ft}$ vs.	*te le (pa $thic)_{Ft}$
	a mas $(sage)_{Ft}$	vs.	for a mas $(sage)_{Ft}$ vs.	*for (a $mas)_{Ft}$ $(sage)_{Ft}$

Based on the difference in prosodification of function and lexical words, Selkirk (1995) has argued that the mapping (interface) constraints relating syntactic and prosodic structure apply to lexical elements and their projections, but not to functional elements and their projections:

(3) Selkirk (1995:445):

The Word Alignment Constraints (WDCON)

ALIGN (Lex, L/R; PWd, L/R)

Left/right edge of a lexical word coincides with the Left/right edge of a prosodic word

The Prosodic Word Alignment Constraints (PWDCON)

ALIGN (PWd, L/R; Lex, L/R)

Left/right edge of a prosodic word coincides with the Left/right edge of a lexical word

Phrasal Alignment Constraints

ALIGN (Lex^{max}, R; PPh, R)

The right edge of a maximal phrase projected from a lexical head coincides with the right edge of a prosodic phrase.

This restriction is later explicitly formulated by Truckenbrodt (1999: 226) in his Lexical Category Condition:

(4) *Lexical Category Condition* (LCC)

Constraints relating syntactic and prosodic categories apply to lexical syntactic elements and their projections, but not to functional elements and their projections, or to empty syntactic elements and their projections.

1.2 No Reference Hypothesis

As mentioned in section 1.1 above, one of the crucial problems for modularity is that phonology seems to be able to recognize whether it is receiving a function or lexical word in its input. This results in the different prosodic treatment of the two. This assumption about phonology violates modularity, since lexical and functional features are primitives that the syntactic module operates on and are not phonological primitives. Phonology should not ne able to recognize them. As a consequence, constraints used to account for this data are non-modular. The mapping constraints given in (3) above align Lexical and Prosodic words, thus containing reference to syntactic primitives. [1]

This paper, however, accounts for the difference in prosodic behavior by deriving it from the difference in derivational status of lexical and function words. In a nutshell, lexical words are those that the syntactic derivation starts with, and they are thus spelled-out first and parsed as prosodic words first. Subsequently added material, in form of functional material, is added onto that prosodic word. The

[1] More recently, the Match Theory of Selkirk (2009, 2011) provides an analysis of the syntax-phonology interface that does not use the alignment constraints. However, the Match constraints are also non-modular, since they directly refer to syntactic constituents, much like the alignment constraints above.

difference in prosodification is not an effect of phonology recognizing syntactic structure and operating on its primitives. It is an effect of the stages in syntactic derivation, and how that derivation is spelled-out to create an input to phonology.

The No Reference Hypothesis (NRH) approach, outlined in this section and used throughout the paper, is originally presented in Šurkalović (2011a) The approach adopts the 'decomposed' view of syntactic representation, present in a number of 'syntax-all-the-way-down' approaches, e.g. Distributed Morphology (DM; Halle and Marantz 1993, Harley and Noyer 1999 *inter alia*), Nanosyntax (NS; Starke 2009, Caha 2009, Ramchand 2008, Lundquist 2008 *inter alia*) or Borer's (2005) system. What is common to these approaches is that the traditional distinction between lexical and functional categories is erased and many formerly lexical elements in the syntactic tree are reanalyzed as part of the functional sequence (f-seq).

The lexical information, i.e. the encyclopedic meaning of lexical items, is encoded in some form of an acategorial root, devoid of any syntactic information. What makes that root a category such as Noun, Verb or Adjective, is a functional feature it merges with, making the whole nominal or verbal constituent functional in nature. The input to syntax is not lexical items, but feature bundles (DM) or individual features (NS) that encode information at the level of the morpheme. This deconstruction down to features, which become the basic building blocks of (morpho)syntax, has resulted in both the loss of lexical categories and the loss of the notion of 'word' as a (morpho)syntactic primitive. Syntax combines features, the lexicon is post-syntactic, and it is not possible to define a 'word' in any morpho-syntactic sense anymore. Recent syntactic work (Borer 2005, Newell 2008) assumes that word is a purely phonological notion, defined as the domain of main prominence, e.g. of stress assignment. This development, crucially, renders the alignment constraints in (3), referring to 'lexical words', inapplicable.

In addition to this 'decomposed' view of syntax, the NRH approach adopts the Multiple Spell-Out Hypothesis (MSOH) (Uriagereka 1999, Chomsky 2000, 2001, 2004), also known as Phase Theory, and explores the effects of phases in spell-out on the syntax-phonology interface. According to Phase Theory, spell-out proceeds in phases. Syntactic structure is spelled out to phonology in phases, chunks, without waiting for the whole syntactic structure to be created. Complex constituents are derived individually before being merged into the main derivation (Cinque's 1993 'minor' vs. 'major' path of embedding, Uriagereka's 1999 'command units'). The traditional view is that the internal structure of these chunks becomes inaccessible to the rest of the computation, resulting in syntactic islands. Also, traditionally there are certain points in the structure that are designated as phases, and partial spell-out can happen only when these points are reached. For example, creating the vP node causes the VP to be spelled out, and the CP triggers the spell-out of the TP.

However, the NRH approach advocated here adopts the less traditional view, argued for by Epstein and Seely (2002, 2006), Marvin (2002), Newell (2008), that spell-out is not reserved for specific nodes in the tree, but happens whenever all the features in a constituent are valued/checked, making that constituent 'complete' and interpretable at the interface. Thus, each application of Merge and Move creates a phase which will attempt to spell out the created structure. This view is adopted for two reasons. The first is that it is compatible with the Nanosyntax approach to syntactic representation and computation. In Nanosyntax there are no phases, spell-out is attempted at each merge, and is successful when lexical matching is successful. The second reason for adopting the spell-out-at-each-merge view, and not the spell-out-at-designated-nodes view, is that the former is the null hypothesis, with minimal stipulations about the system, and as such more in the spirit of the Minimalist Program (Chomsky 1995).

Šurkalović (2011a) explores what kind of effects a spell-out that proceeds in phases has on the nature of the input to phonology. It shows how current linearization algorithms (e.g. Kayne 1994, Fox and Pesetsky 2005, Richards 2010) cannot derive the correct linear order of the chunks that were spelled-out separately[2], and presents an alternative account that solves the linearization problem while at the same

[2] For the detailed argumentation behind this aspect of the NRH approach the reader is referred to Šurkalović (2011a).

time resolving the modularity issues. The problem for the current views of multiple spell-out is that they assume that outputs of different phases become separate chunks of input to phonology and enter its computation separately. The approach presented here argues that the input to phonology at each spell-out is cumulative, i.e. a unified input comprising all of the previous phases including the latest one. Thus, as the syntactic derivation grows, the input to phonology grows as well. Phonology parses each input as it reaches it, and has the ability to refer to the output of the computation of the previous phase while processing the current phase. This results in an illusion of mapping syntactic domains onto phonological ones, but this is actually the effect of the phases in derivation.

Thus, in the system presented here, modularity is maintained while still accounting for the prosodification of function words. The derivation is the interface tool used in the domain mapping, and phonology does not need to operate on syntactic primitives. The prosodic difference between lexical and function words is the result of the difference in their derivational status. 'Lexical' words are those the derivation starts with. They are the result of the first Merge, and are thus spelled-out to phonology first. There they are parsed as prosodic words. We call this Phase1. In a language such as English, as we will see in more detail in section 2, the computation remains faithful to this parsing. Thus the prosodic word status of lexical words is derived from their derivational status as Phase1. For an example of how other languages, e.g. Kayardild and Ojibwa, reconcile different phases in the computation, the reader is referred to Šurkalović (2011a).

As mentioned earlier, this analysis is couched in Optimality Theory and the approach is formalized in terms of constraints and their interaction. The basic premises will be outlined here, while the in-depth OT analysis will be provided in the rest of the paper. As stated above, in Phase1 a prosodic word is created by parsing the input to phonology without knowing what syntactic string that input corresponds to. The input is a linear string of phonological primitives that corresponds to the underlying representations of lexical items inserted in the spell-out process. Phonology parses this input in the optimal way. In the next phase, Phase2, the input phonology receives is the cumulative input containing both what was already spelled out and any additional material occurring in the new phase. The initial prosodic word phrasing is maintained in Phase2 through the computation being faithful to the phonological output of Phase1. This paper contributes to the OT constraint system by introducing Phase-Phase Faithfulness constraints. The degree to which a language maintains the domains created in Phase-n while computing Phase-n+1 depends on the interaction of Phase-Phase constraints with other constraints in the system, most significantly prosodic well-formedness constraints, in the spirit of OT constraint interaction.

2. Function words and Phase-Phase Faithfulness

As mentioned in the introduction, one of the greatest issues for modularity is the distinction between lexical and functional categories in their prosodic behavior. Based on this difference in behavior it appears as though phonology recognizes whether a string it receives in the input is a spell-out of lexical or functional syntactic features. However, if modularity is to be maintained, we need to restate this difference so that phonology does not need to make reference to syntactic (lexical) features. In the system presented here, the derivation itself is used as the interface tool, and the difference between lexical and function words is reduced to the fact that 'lexical' words are those that the derivation starts with. They are thus sent to PF first and parsed as prosodic words at the start of the derivation, at Phase1. The phonological computation in languages such as English remains faithful to this phrasing later on.

A simple example tableau of the Selkirk (1995) analysis, presented in Šurkalović (2011a), is given in (5). It illustrates how the non-modular constraints on the mapping between lexical words and prosodic words, which are the first two constraints listed below, derive the prosodic phrasing of e.g. 'a book', 'in town' etc. They interact with the prosodic well-formedness constraints EXHAUSTIVITY and NONRECURSIVITY, which sanction skipping of prosodic levels and recursivity of levels respectively. As we can see, the optimal outcome is the one where the function word is a free clitic.

(5)

WDCON L/R, i.e. ALIGN (Lex, L/R; PWd, L/R)

Left/right edge of a lexical word coincides with the Left/right edge of a prosodic word

PWDCON L/R, i.e. ALIGN (PWd, L/R; Lex, L/R)

Left/right edge of a prosodic word coincides with the Left/right edge of a lexical word

EXHAUSTIVITY

No C^i immediately dominates a constituent C^j, $j < i-1$ (No PWd immediately dominates a σ)

NONRECURSIVITY

No C^i dominates C^j, $j = i$ (No Ft dominates a Ft)

[fnc lex]	WD CON L/R	NON REC	PWD CON L/R	EXH
a. ({fnc}$_\omega$ {lex}$_\omega$)$_\varphi$			*!*	
b. ☞(fnc { lex }$_\omega$)$_\varphi$				*
c. ({ fnc lex }$_\omega$)$_\varphi$	*!		*	
d. ({fnc {lex}$_\omega$}$_\omega$)$_\varphi$		*!	*	

In contrast to this approach, (6) and (7) below (see also Šurkalović 2011a) are an example of how (5) can be restated in the modular approach advocated in this paper, capturing the difference in prosodic behavior by using the difference in derivational status. The output of the preceding phase will be shown in each tableau above the input string, and indicated by vertical lines, e.g. | (book)$_\omega$ |.

Tableau (6) shows how the PARSEFT constraint creates a prosodic word (PWd) in Phase1, which dominates the input string /book/. Since this is only the first phase, the Phase-Phase Faithfulness constraint PHASE-ANCHOR-L(PWd), aligning the left edge of a PWd in one phase with the left edge in the other phase, does not apply. The anchoring constraint has its roots in the alignment constraints, and is derived from the template for anchoring constraints given in McCarthy and Prince (1999: 56), where (S_1, S_2) are pairs of representations, e.g. Input-Output, Base-Reduplicant, or, in this case, Phase *n*-Phase *n+1*:

(6) {Right, Left}-ANCHOR(S_1, S_2)

Any element at the designated periphery of S_1 has a correspondent at the designated periphery of S_2

Let *Edge*(X, {L, R}) = the element standing at the *Edge* = L, R of X

RIGHT-ANCHOR – If x = Edge(S_1, R) and y = Edge(S_2, R) then x$\mathfrak{R}$y

LEFT-ANCHOR. likewise, *mutatis mutandis*.

PHASE-ANCHOR-L(PWd) – PAL PWD

Assign a violation mark if a Prosodic Constituent which is at the Left edge of a prosodic word in Phase *n* is not at the Left edge of that Prosodic word in Phase *n+1*

PARSEFT

Assign a violation for each foot not immediately dominated by a PWord

/book/	PARSE FT	PAL PWD
a. ☞ {book}$_\omega$		
b. book	*!	

In tableau (7) below we see the relevance of PHASEANCHORL(PWD) in preventing function words linearized to the left of the material from the previous phase, such as determiners, from incorporating into the PWd created in the first phase. We also see, in candidate (c), how PHASEDEP(PWD) prevents the formation of recursive structure.

(7)

PHASEDEP(PWd) - PDEPPWD

A prosodic word constituent in phase *n* must have a correspondent in phase *n-1*

I $(\text{book})_\omega$ I /a book/	PARSE FT	PAL PWD	P-DEP PWD
a. ☞(a $\{\text{book}\}_\omega)_\varphi$			
b. ({ a book$\}_\omega)_\varphi$		*!	
c. ({a $\{\text{book}\}_\omega\}_\omega)_\varphi$			*!

The tableaux above are simplified for illustrative purpose. A more detailed account of the prosodification of various combinations of function and lexical words is presented in the following sections.

2.1 Function words in isolation

Before we move on to cases when function words appear in reduced form cliticised to a PWd, we will briefly address the fact that function words in isolation appear in their full (strong) form and behave prosodically like monosyllabic lexical words (Selkirk 1995:447):

(8)	can	[kæn]	(tin) can
	at	[æt]	hat
	would	[wʊd]	wood
	is	[ɪz]	fizz

Selkirk (1995) accounts for this by means of a top-down argument, relying on the group of constraints that governs the hierarchical organization of the PH, called Constraints on Prosodic Domination. These constraints, given in (9) below, capture the essence of the Strict Layer Hypothesis (Selkirk 1984). The first two are considered inviolable.

(9)

a. LAYEREDNESS

No C^i dominates C^j, $j > i$, (where C^n = some prosodic category)

e.g. “No σ dominates a Ft.”

b. HEADEDNESS

Any C^i must dominate a C^{i-1} (except if $C^i = \sigma$),

e.g. “A PWd must dominate a Ft.”

c. EXHAUSTIVITY

No C^i immediately dominates a constituent C^j, $j < i-1$,

e.g. “No PWd immediately dominates a σ.”

d. NONRECURSIVITY

No C^i dominates C^j, $j = i$,

e.g. “No Ft dominates a Ft.”

Any utterance in isolation is analyzed as the prosodic category of utterance (Utt). Following the principle of HEADEDNESS, which is one of the principles defining the structure of the Prosodic Hierarchy, an utterance must be headed by an intonation phrase (IntP), which must be headed by a prosodic phrase (PPh), which must have a prosodic word (PWd) as its head, which gives us the PWd status of the function word in isolation. As a result of this PWd status, the function word must be parsed as a foot (Ft) which heads the PWd, and must bear Ft and PWd stress, as well as prosodic marking of higher categories, and cannot be reduced like unstressed function words.

(10) $\S \ \backslash \ \{ \ (\ \text{can}_{\text{Ft}}\ )_{\text{PWd}}\ \}_{\text{PPh}}\ \backslash_{\text{IntP}}\ \S_{\text{Utt}}$

In the system presented here, HEADEDNESS and LAYEREDNESS as inviolable constraints can be replaced by PARSE constraints:

(11)

PARSE

Assign a violation for each Prosodic Constituent not dominated by a higher one

PARSESEGMENT

Assign a violation for each segment not immediately dominated by a syllable

PARSESYLLABLE

Assign a violation for each syllable not dominated by a foot

PARSEFT

Assign a violation for each foot not immediately dominated by a PWd

PARSEPWD

Assign a violation for each PWd not immediately dominated by a PPhrase

PARSE constraints give us the effects of inviolable LAYERDNESS, because the structure projects only in the direction specified by the constraints. They also have the same effect as inviolable HEADEDNESS, because the only way to create a higher-level constituent is by parsing a lower level one, so as an effect of that the higher-level one will always contain at least one instance of the lower one.

Thus, that function words appear in their full form in isolation is the result of the fact that in this case they are the sole content of the utterance, and thus the sole element in the syntactic tree and processed in the one and only phase. Since prosodic parsing is exhaustive in each phase, including the first, due to the PARSE family of constraints, the output is a function word parsed as a syllable which forms a foot upon which a prosodic word is built which projects a prosodic phrase which heads an intonation phrase dominated by an utterance, as presented in example (12) below. This is the case with all words used in isolation, as well as all lexical items which spell out the first phase of a derivation (discussed in the following subsections). In most tableaux I will leave out phrasing above PPh, for the sake of simplicity, but I am assuming that higher levels are parsed in all cases.

(12)[3] input: / can /

output: a) ☞ § \ { ([can$_{\sigma}$]$_{Ft}$)$_{PWd}$ }$_{PPh}$ \$_{IntP}$ §$_{Utt}$
b) \ { ([can $_{\sigma}$]$_{Ft}$)$_{PWd}$ }$_{PPh}$ \$_{IntP}$
c) { ([can $_{\sigma}$]$_{Ft}$)$_{PWd}$ }$_{PPh}$
d) ([can $_{\sigma}$]$_{Ft}$)$_{PWd}$
e) [can $_{\sigma}$]$_{Ft}$
f) can $_{\sigma}$
g) can

The tableau in (12.1) illustrates the bottom-down reasoning behind the exhaustive parsing of function words in isolation, which applies also to lexical words uttered in isolation or having the status of phase1 in the derivation. PARSESEGMENT outranks other constraints in the tableau, forcing the prosodic parsing of segmental material in the input, and causing the 'snowball effect' of exhaustive parsing. Following the hierarchy in bottom-up fashion, PARSESYLLABLE eliminates the candidate which has no foot dominating the syllable, and so on.

(12.1)

	PARSESEG	PARSESYLL	PARSEFT	PARSEPWD	PARSEPPH	PARSEINTP
a ☞						
b						*!
c					*!	
d				*!		
e			*!			
f		*!				
g	*!**					

However, as we see in tableau (12.2), the ranking can be reversed with the same outcome, producing candidate (a) as the optimal one. I shall use the ranking given in tableau (12.1), following the bottom-up reasoning, until such a time that it proves necessary to rerank the constraints.

(12.2)

	PARSEINTP	PARSEPPH	PARSEPWD	PARSEFT	PARSESYLL	PARSESEG
a ☞						
b	*!					
c		*!				
d			*!			
e				*!		
f					*!	
g						*!**

[3] For reasons of space and for a better overview of different candidate structure in some tableaux I will be separating the part of the tableau which lists the candidates from the part of the tableau which presents the constraint evaluation of those candidates – as exemplified by (12) and (12.1).

In addition to cases when they are used in isolation, function words also appear in their strong form when they are clause-final, which will be a topic of future research, and when they are focused, which is addressed in Šurkalović (2011b).

2.2 *Determiners*

In the introduction we were introduced to the peculiar prosodic properties of function words. They can appear in their strong (stressed, unreduced) form or their weak (unstressed, reduced) form depending on whether they are pronounced in isolation, focused or clause-final as opposed to when they are non-focused, non-final or final but in object position. Prosodically, strong forms are head syllables of a foot, whereas weak forms are unfooted syllables in a prosodic clitic configuration, dominated by a PPh node and sister to the PWd built around the lexical word which is adjacent to the function word.

The first example of a fnc-lex combination we will discuss is that of a Determiner preceding a Noun. The category of Determiner includes articles, demonstratives, possessives and quantifiers. As discussed in the introduction, I assume that the Noun is a lexical item spelling out the first phase of the DP constituent (I will limit the examples to non-derived nouns at this point, and will address phases in the derivation of nouns in section 3). The Determiner is the lexical item that spells out in the second phase the functional material merged on top of the node spelled out by the Noun in the first phase. It does not have its own derivational path (or its own first Merge), like Nouns, Verbs and Adjectives, and thus it does not have its own Phase1, which results in it not receiving PWd status.

Evidence for function words being outside of PWd and not forming a PWd on their own comes from lack of PWd-initial aspiration, and from the stress pattern, showing more unfooted and unstressed syllables at the left edge than are allowed in English words.

English allows at most one unstressed syllable at the left edge of a PWd (Selkirk 1995:450):

(13)	a.	masságe	Màssachúsetts	*Massachúsetts
		telépathy	tèlepáthic	*telepáthic
			Tàtamagóuchee	*Tatamagóuchee
		but:		
	b.	masságe	*à masságe	a masságe
		masságe	*fòr a masságe	for a masságe
		telépathy	*hèr telépathy	her telépathy

McCarthy and Prince (1993) argue that the data in (13a) are the effect of the Align (PWd, L; Ft, L) constraint, which requires that the left edge of a PWd corresponds to a left edge of a foot. The fact that the data in (13b) is the opposite, allowing for several unstressed syllables at the left edge, is an argument for analyzing the function words as clitics outside the PWd formed around the lexical word. The tableaux below show how this pattern can be derived without referring to the lexical-functional distinction, but by separating the derivation and phonological computation into phases.

To establish a baseline for the behavior of unstressed syllables in a PWd, we will look at a bisyllabic word with final stress, *massage*, a trisyllabic word with two light and one heavy syllable, *celebrate*, and a quadrisyllabic word with the LLHL pattern, *Massachusetts*. These words have either one or two light syllables at the left edge. At this stage I will use as a starting point the constraint ranking for English argued for in Pater (2000), given in (14) below.

(14) FTBIN, NONFIN >> ALIGNHEADR >> PARSE-σ >>WSP

Words like *massage*, as presented in (15) below, are the type of words that allow a single unstressed syllable at the left edge of a PWd. Candidate (15c) violates the requirement that feet be minimally bimoraic by projecting a monomoraic foot on the first syllable. Candidate (15d) has an unfooted syllable at the left edge, which violates the PARSESYLLABLE constraint. Candidate (15a) wins over candidate (15b) due to the stress being on the heavy syllable and satisfying the WEIGHT-TO-STRESS constraint.

(15)

FOOTBINARITY

Feet are minimally bimoraic.

PARSE-σ

Every syllable belongs to a foot.

WEIGHT-TO-STRESS

Bimoraic syllables are foot-heads.

/ma$_{\mu}$ssa$_{\mu\mu}$ge/	FTBIN	PARSE SYLL	WSP
a☞ { ([ma.sságe]$_{Ft}$)$_{PWd}$ }$_{PPh}$			
b { ([má.ssage]$_{\mathbf{Ft}}$)$_{PWd}$ }$_{PPh}$			*!
c { ([má]$_{Ft}$ ssage$_{\sigma}$)$_{PWd}$ }$_{PPh}$	*!	*	*
d { (ma$_{\sigma}$ [sságe]$_{Ft}$)$_{PWd}$ }$_{PPh}$		*!	

When a word has two light syllables followed by a heavy one (LLH), as in (16) below, all three syllables are footed due to PARSESYLLABLE. Candidates (16b, c) below violate NONFIN by carrying main stress on the last syllable of the PWd. Candidate (16d) violates PARSESYLLABLE and is thus not optimal, which leaves (16a) as the optimal one.

(16)

NONFINALITY

The head of the prosodic word must not be final.

/ce$_{\mu}$le$_{\mu}$bra$_{\mu}$te/	NONFIN	PARSE SYLL	WSP
a☞{ ([céle]$_{Ft}$ [bràte]$_{Ft}$)$_{PWd}$ }$_{PPh}$			
b { ([cèle]$_{Ft}$ [bráte]$_{Ft}$)$_{PWd}$ }$_{PPh}$	*!		
c { (ce$_{\sigma}$ le$_{\sigma}$ [bráte]$_{Ft}$)$_{PWd}$ }$_{PPh}$	*!	**	
d { ([céle]$_{Ft}$ brate$_{\sigma}$)$_{PWd}$ }$_{PPh}$		*!	*

This ranking is applied to *Massachusetts* in (17) below. This is an example of a quadrisyllabic word with two light syllables at the left edge (LLHL). As we can see, in order to derive the actual stress pattern with the word containing two feet, we need to re-rank the constraints and rank NONFIN and ALIGNHDR below PARSESYLL and WSP, as presented in (18). It is important to note that this does not affect the outcome of previous tableaux. The optimal parsing results in two feet, with the light syllables necessarily footed due to PARSE-σ, unlike in (17h). Candidate (17d) is suboptimal due to lack of stress on the heavy syllable, while (17c) violates the requirement that the head of the PWd be aligned with the right edge of that PWd.

(17)

ALIGNHEADR (ALIGN (PrWd-R, Head(PrWd)-R)

Align the right edge of the prosodic word With the right edge of the head of the prosodic word

/ma$_{\mu}$ssa$_{\mu}$chu$_{\mu\mu}$se$_{\mu}$tts/	PARSESYLL	WSP	NONFIN	ALIGNHDR
a☞{ ([Màssa]$_{\mathbf{Ft}}$ [chúsetts]$_{\mathbf{Ft}}$)$_{PWd}$ }$_{PPh}$			*	
b { ([Màssa]$_{\mathbf{Ft}}$ [chú]$_{\mathbf{Ft}}$ setts$_{\sigma}$)$_{PWd}$ }$_{PPh}$	*!			*
c { ([Mássa]$_{\mathbf{Ft}}$ [chùsetts]$_{\mathbf{Ft}}$)$_{PWd}$ }$_{PPh}$			*	**!
d { ([Màssa]$_{\mathbf{Ft}}$ [chusétts]$_{\mathbf{Ft}}$)$_{PWd}$ }$_{PPh}$		*!	*	
e { ([Màssa]$_{\mathbf{Ft}}$ [chú]$_{\mathbf{Ft}}$ setts$_{\sigma}$)$_{PWd}$ }$_{PPh}$	*!			*
f { (Ma$_{\sigma}$ssa$_{\sigma}$ [chúsetts]$_{\mathbf{Ft}}$)$_{PWd}$ }$_{PPh}$	*!*		*	
g { ([Mássa]$_{\mathbf{Ft}}$ chu$_{\sigma}$setts$_{\sigma}$)$_{PWd}$ }$_{PPh}$	*!*	*		**
h { (Ma$_{\sigma}$ [ssáchu]$_{\mathbf{Ft}}$ setts$_{\sigma}$)$_{PWd}$ }$_{PPh}$	*!*	*		*

(18) FTBIN >> PARSE-σ >> WSP >> NONFIN >> ALIGNHEADR

Now that we have established that there is at most one unstressed syllable at the left edge of a PWd, we will start computing the derivation of *a massage*. The first point in the syntactic derivation at which spell out is possible is when the syntactic constituent corresponding to the lexical entry < massage > is built. Thus, /massage/ is the first input that reaches phonology, and the output is as computed in (16) above.

In the second phase the article is spelled out together with the noun, since, as discussed in the introduction, I adopt the 'spell-out-at-each-merge' approach. The input is the string of segments /amassage/, with no information about the syntactic structure of the string. All we have to refer to is the output of the previous phase, stored in the working memory. The computation of /amassage/ (LLH) parallels that of /celebrate/ (LLH), and if it were not for the high-ranked PHASEANCHORLEFT(PWD) and PARSESEGMENT constraints, the winning candidate would be (19b) with the same stress pattern as ǀ(céle$_{Ft}$ bràte$_{Ft}$)ǀ . However, PAL(PWD) excludes the candidate (19b), among others, because the prosodic constituent which is at the left edge of the PWd in the previous phase is the syllable 'ma', whereas in the current phase in these candidates the constituent at the left edge is the foot 'a.ma'. This shows us how the cliticisation of the function word, in this case the indefinite article, is not the result of its function word properties but of its derivational status. We also see how the optimal prosodification of the article is as a monosyllabic clitic to the PWd, since it cannot form a foot on its own due to the violation of the FOOTBINARITY requirement.

(19)

PHASE-ANCHOR-L(PWD) – PAL PWD

Assign a violation mark if a Prosodic Constituent which is at the Left edge of a prosodic word in Phase *n* is not at the Left edge of that Prosodic word in Phase *n+1*

phase: ǀ {([ma.sságe]$_{Ft}$)$_{PWd}$}$_{PPh}$ ǀ
input: /a$_{\mu}$ma$_{\mu}$ssa$_{\mu\mu}$ge/

output: a)	{		(	[àma]$_{Ft}$ [sságe]$_{Ft}$	)$_{PWd}$	}$_{PPh}$
b)	{		(	[áma]$_{Ft}$ [sságe]$_{Ft}$	)$_{PWd}$	}$_{PPh}$
c) ☞	{	a$_{\sigma}$	(	[ma.sságe]$_{Ft}$	)$_{PWd}$	}$_{PPh}$
d)	{	a	(	[ma.sságe]$_{Ft}$	)$_{PWd}$	}$_{PPh}$
e)	{	[áma]$_{Ft}$	(	[sságe]$_{Ft}$	)$_{PWd}$	}$_{PPh}$
f)	{		(	a$_{\sigma}$ [ma.sságe]$_{Ft}$	)$_{PWd}$	}$_{PPh}$
g)	{	[a]$_{FT}$	(	[ma.sságe]$_{Ft}$	)$_{PWd}$	}$_{PPh}$

	PALPWD	PARSESEG	FTBIN	PARSESYLL	WSP
a	*!				
b	*!				
c ☞				*	
d		*!			
e	*!				
f	*!			*	
g			*!		

The next example we will look at is deriving the prosodification of *some cake* in (20) below. As we can see from (19g), the indefinite article cannot form a foot on its own since it does not satisfy the requirement that a foot be minimally bimoraic[4]. Another example of a monosyllabic monomoraic function word is *some,* which occurs in a reduced form. As we can see from the table below, the optimal parsing of *some* is into a syllable, but not a foot due to the FTBIN violations, which also prevents *some* from parsing into a PWd and carrying stress. We are left with two optimal candidates, (20b), where the syllable *some* is incorporated into the PPh (as Selkirk's free clitic), which violates EXHAUSTIVITY, and (20g), where the syllable is outside the prosodic structure (unattached to either PPh, IntP or Utt). I introduce the general PARSE constraint here, which states that each prosodic constituent must be dominated by a higher Prosodic Constituent, ensuring that the whole input be parsed into one umbrella prosodic category, since the EXHAUSTIVITY constraint favors candidate (20g).

(20) phase: | { ([ca$_{\mu\mu}$ke]$_{Ft}$)$_{PWd}$ }$_{PPh}$ |
input: /so$_{\mu}$meca$_{\mu\mu}$ke /

output: a)	{	so$_{\mu}$me	([ca$_{\mu\mu}$ke]$_{Ft}$	)$_{PWd}$	}$_{PPh}$
b) ☞	{	so$_{\mu}$me$_{\sigma}$	([ca$_{\mu\mu}$ke]$_{Ft}$	)$_{PWd}$	}$_{PPh}$
c)	{	[sò$_{\mu}$me]$_{Ft}$	([ca$_{\mu\mu}$ke]$_{Ft}$	)$_{PWd}$	}$_{PPh}$
d)	{	([só$_{\mu}$me]$_{Ft}$)$_{PWd}$	([ca$_{\mu\mu}$ke]$_{Ft}$	)$_{PWd}$	}$_{PPh}$
e)			(so$_{\mu}$m$_{\mu}$e$_{\sigma}$ [ca$_{\mu\mu}$ke]$_{Ft}$	)$_{PWd}$	
f)	{		(so$_{\mu}$m$_{\mu}$e$_{\sigma}$ [ca$_{\mu\mu}$ke]$_{Ft}$	)$_{PWd}$	}$_{PPh}$
g)		so$_{\mu}$me$_{\sigma}$	{ ([ca$_{\mu\mu}$ke]$_{Ft}$	)$_{PWd}$	}$_{PPh}$
h)	{		([so$_{\mu}$m$_{\mu}$e. ca$_{\mu\mu}$ke]$_{Ft}$	)$_{PWd}$	}$_{PPh}$
i)	{		([só$_{\mu}$m$_{\mu}$e. ca$_{\mu\mu}$ke]$_{Ft}$	)$_{PWd}$	}$_{PPh}$
j)	{		([sò$_{\mu}$m$_{\mu}$e]$_{Ft}$ [ca$_{\mu\mu}$ke]$_{Ft}$	)$_{PWd}$	}$_{PPh}$
k)	{		([só$_{\mu}$m$_{\mu}$e]$_{Ft.}$ [ca$_{\mu\mu}$ke]$_{Ft}$	)$_{PWd}$	}$_{PPh}$

[4] For cases when the indefinite (and definite) article are bimoraic and do form a foot due to focus, see the related discussion in Šurkalović (2011b) on Information Structure marking.

	PALPWD	PARSESEG	FTBIN	PARSESYLL	WSP	NONFIN	PARSE	EXHAUSTIVITY
a		*!***			*	*		*
b ☞				*	*	*		*
c			*!			*		*
d			*!			**		
e	*!			*	*	*		*
f	*!			*	*	*		*
g				*	*	*	*!	
h	*!				*	*		
i	*!				*	*		
j	*!				*	*		
k	*!				*	*		

A distinction needs to be drawn between monosyllabic determiners and polysyllabic ones, which extends to other function words as well. While e.g. *a, the, some, her* have reduced forms, e.g. *many, several, any* do not. We will look at the derivation of *any table* in (22), with Phase1 given in (21), to see how bisyllabic determiners are prosodified.

(21)

/ta$_{\mu\mu}$bl$_\mu$e/	PAL PWD	PARSE SEG	FT BIN	PARSE SYLL
a ☞{ ([tá$_{\mu\mu}$.bl$_\mu$e]$_{Ft}$)$_{PWd}$ }$_{PPh}$				
b { ([tá$_{\mu\mu}$]$_{Ft}$ bl$_\mu$e$_\sigma$)$_{PWd}$ }$_{PPh}$				*!

Selkirk (1995) states that the difference between strong and weak forms of function words is in that the former are parsed as a foot while the latter are not, adding that this foot status is the result of function words receiving PWd status, which then entails a foot through headedness. As we can see from the table (22) below, this is confirmed, and it is indeed the case that the function words that do not reduce have PWd status due to their ability to form a minimally bimoraic foot.

Candidates (22e, f, g) attempt to incorporate the Phase2 material, *any*, into the existing PWd, which violates Phase-Phase Faithfulness. Since *any* is bisyllabic, forming a foot does not violate FTBIN, which makes it possible for that foot to project a PWd, resulting in the stressed, strong, form of the function word.

(22) phase: | { ([tá$_{\mu\mu}$.bl$_\mu$e]$_{Ft}$)$_{PWd}$ }$_{PPh}$ |
input: /a$_\mu$ny$_\mu$ta$_{\mu\mu}$bl$_\mu$e/

output:
a) { a$_\mu$ny$_\mu$ ([tá$_{\mu\mu}$.bl$_\mu$e]$_{Ft}$)$_{PWd}$ }$_{PPh}$
b) { a$_{\mu\ \sigma}$ny$_{\mu\ \sigma}$ ([tá$_{\mu\mu}$.bl$_\mu$e]$_{Ft}$)$_{PWd}$ }$_{PPh}$
c) { [à$_\mu$ny$_\mu$]$_{Ft}$ ([tá$_{\mu\mu}$.bl$_\mu$e]$_{Ft}$)$_{PWd}$ }$_{PPh}$
d) ☞ { ([á$_\mu$ny$_\mu$]$_{Ft}$)$_{PWd}$ ([tá$_{\mu\mu}$.bl$_\mu$e]$_{Ft}$)$_{PWd}$ }$_{PPh}$
e) { ([à$_\mu$ny$_\mu$]$_{Ft}$ [tá$_{\mu\mu}$.bl$_\mu$e]$_{Ft}$)$_{PWd}$ }$_{PPh}$
f) { ([á$_\mu$ny$_\mu$]$_{Ft}$ [tá$_{\mu\mu}$.bl$_\mu$e]$_{Ft}$)$_{PWd}$ }$_{PPh}$
g) { (a$_{\mu\ \sigma}$ ny$_{\mu\ \sigma}$ [tá$_{\mu\mu}$.bl$_\mu$e]$_{Ft}$)$_{PWd}$ }$_{PPh}$

	PALPWD	PARSESEG	FTBIN	PARSESYLL	PARSEFT
a		*!**			
b				**!	
c					*!
d☞					
e	*!				
f	*!				
g	*!			**	

As we have seen in section 2.2, defining the prosodification of function words in terms of the functional vs. lexical features categorizes function words as a unified group and fails to account for the difference in behavior between monosyllabic and bisyllabic function words. In the account presented here, the mapping from syntax to phonology is fully modular, and as a result it leaves room for a purely phonological account of the effect of syllable count on prosodification.

2.3 *Inflectional suffixes*

The next category of functional items we will be discussing briefly are inflectional suffixes, such as the plural –s, past tense –t/d, present tense –s. These are functional morphemes that spell out certain syntactic categories, and as such parallel to traditional function words in this system, and are phonological suffixes to the lexical item they modify, usually mono-consonantal or monosyllabic.

We will start with the derivation of the plural *books*. In the first phase the lexical item <book> is spelled out, and the phonological computation takes the input /boo$_{\mu}$k/ and chooses the optimal output candidate [{ ([boo$_{\mu}$k$_{\mu}$]$_{Ft}$)$_{PWd}$ }$_{PPh}$]. This is then stored in the active memory and accessed at the next phase, when the input is /boo$_{\mu}$ks/. As we can see in (23), incorporating functional material of this type is not a problem in this account, for two reasons. First, so far we have only seen evidence that PHASEANCHORING of PWd in English is active on the Left edge, so incorporating material at the right edge is not problematic for now. Secondly, even if PHASEANCHORRIGHT(PWD) were active, [books] would not violate it if the *-s* is incorporated into the foot or its rightmost syllable, since it would still be the same foot at the edge of the PWd as in the previous phase.

This approach also captures the fact that inflectional suffixes are exceptions to the phonotactic constraints on syllable codas. It is simply the case that the ban on consonantal nuclei (presented here with the shorthand constraint prohibiting /s/ from being a nucleus) interacts with the constraint requiring all segments be parsed. Since /s/ needs to be parsed as part of a syllable but it cannot be a syllable on its own, it incorporates to the adjoining syllable. The same happens with the third person suffix –s on verbs, in (24) below.

(23)

phase: | { ([boo$_{\mu}$k$_{\mu}$]$_{Ft}$)$_{PWd}$ }$_{PPh}$ | input: /boo$_{\mu}$ks/	*NUCL-S	PALPWD	PARSESEG
a { ([boo$_{\mu}$k$_{\mu}$]$_{Ft}$)$_{PWd}$ s }$_{PPh}$			*!
b { ([boo$_{\mu}$k$_{\mu}$]$_{Ft}$)$_{PWd}$ s$_{\sigma}$ }$_{PPh}$	*!		
c ☞{ ([boo$_{\mu}$k$_{\mu}$s]$_{Ft}$)$_{PWd}$ }$_{PPh}$			

(24)

phase: $\vert\{(\,[\text{rea}_{\mu\mu}\text{d}]_{\text{Ft}})_{\text{PWd}}\}_{\text{PPh}}\vert$ input: /rea$_{\mu\mu}$ds/	*NUCL-S	PALPWD	PARSESEG
a $\{(\,[\text{rea}_{\mu\mu}\text{d}]_{\text{Ft}})_{\text{PWd}}\ \text{s}\}_{\text{PPh}}$			*!
b $\{(\,[\text{rea}_{\mu\mu}\text{d}]_{\text{Ft}})_{\text{PWd}}\ \text{s}_{\sigma}\}_{\text{PPh}}$	*!		
c ☞ $\{(\,[\text{rea}_{\mu\mu}\text{ds}]_{\text{Ft}})_{\text{PWd}}\}_{\text{PPh}}$			

To account for the choice between [s] and [z] in the suffix, as presented in (25) below, I use the shorthand constraint 'voice' which requires that adjoining consonants have the same voicing specification, and the constraint PHASEID(voice) stating that 'the specification of a segment for feature [voice] in phase *n* is identical to its specification in phase *n-1*. This gives us the directionality of voicing without having to distinguish between roots and affixes in faithfulness to their featural specification. In (26) we see how PHASEID(voi) prevents the voicing to apply to words that have already been processed in the previous phase, i.e. traditionally 'lexical' words.

(25)

phase: $\vert\{(\,[\text{read}]_{\text{Ft}})_{\text{PWd}}\}_{\text{PPh}}\vert$ input: /reads/	PhaseID(Voi)	voice
a ☞ $\{(\,[\text{read}]_{\text{Ft}})_{\text{PWd}}\ \text{z}\}_{\text{PPh}}$		
b $\{(\,[\text{read}]_{\text{Ft}})_{\text{PWd}}\ \text{s}\}_{\text{PPh}}$		*!

(26)

phase: $\vert\{(\,[\text{read}]_{\text{Ft}})_{\text{PWd}}\}_{\text{PPh}}\vert\ \vert\{(\text{something})_{\text{PWd}}\}_{\text{PPh}}\vert$ input: /readsomething/	PhaseID(Voi)	voice
a $\{(\,[\text{read}]_{\text{Ft}})_{\text{PWd}}(\text{zomething})_{\text{PWd}}\}_{\text{PPh}}$	*!	
b $\{(\,[\text{read}]_{\text{Ft}})_{\text{PWd}}(\text{something})_{\text{PWd}}\}_{\text{PPh}}$		*
c $\{(\,[\text{reat}]_{\text{Ft}})_{\text{PWd}}(\text{something})_{\text{PWd}}\}_{\text{PPh}}$	*!	*

2.4 *Prepositions*

Monosyllabic prepositions, such as *for, to, at*, behave differently from bisyllabic ones, such as *over, under, behind*, just like the determiners we discussed above. Monosyllabic ones reduce whereas bisyllabic ones appear in their full form. An example of a phrase with a monosyllabic preposition we will look at is *for a massage*. Monosyllabic prepositions add another syllable to the combination of determiner and noun, which parallels the cases with bisyllabic determiners presented in subsection 2.2 above. *For a massage* has the same amount of syllables as *any massage*. However, both the preposition and determiner appear in their reduced form, suggesting that they do not form a foot and PWd together. Our current constraint ranking cannot account for this. The winning candidate would be (c), which is the optimal output of *any massage*, similar to (22) above.

(27)

phase: $\vert\{\text{a}_{\mu\ \sigma}(\,[\text{ma.sságe}]_{\text{Ft}})_{\text{PWd}}\}_{\text{PPh}}\vert$ input: /fo$_{\mu}$ra$_{\mu}$ma$_{\mu}$ssa$_{\mu\mu}$ge/	PAL PWD	PARSE SEG	FT BIN	PARSE SYLL	PARSE FT
a ☹ $\{\ \text{fo}_{\mu}\text{r}_{\ \sigma}\ \text{a}_{\mu\ \sigma}\ (\,[\text{ma.sságe}]_{\text{Ft}})_{\text{PWd}}\}_{\text{PPh}}$				**!	
b $\{\ [\text{fo}_{\mu}\text{r.a}_{\mu}]_{\text{Ft}}\ (\,[\text{ma.sságe}]_{\text{Ft}})_{\text{PWd}}\}_{\text{PPh}}$					*!
c 💣 $\{(\,[\text{fo}_{\mu}\text{r.a}_{\mu}]_{\text{Ft}})_{\text{PWd}}(\,[\text{ma.sságe}]_{\text{Ft}})_{\text{PWd}}\}_{\text{PPh}}$					
d $\{(\,[\text{fo}_{\mu}\text{r.a}_{\mu}]_{\text{Ft}}\ [\text{ma.sságe}]_{\text{Ft}})_{\text{PWd}}\}_{\text{PPh}}$	*!				

The difference between *for a* and *any* is that the latter enters the computation in only one phase, while the former is cumulative input from two phases. This difference can be incorporated into our analysis through the Phase-Phase Faithfulness constraints. At this point we will be introducing a PHASEDEP constraint that bans the insertion of association lines in material that was already processed by the previous phase.

(28)

PHASEDEP

if a prosodic constituent is part of another prosodic constituent in phase *n*, it must be part of the same constituent in phase *n-1*

As we can se in (29) below, this constraint helps us differentiate between *any massage* and *for a massage*. In *any massage* it will not apply, since *any* was not present in the computation in Phase n-1. On the other hand, in the case of *for a massage*, the article 'a' was present in the previous phase, and since it was not associated with a foot there, it cannot be associated with a foot in this phase either (of course, the system with its constraint interaction leaves open the possibility of some constraints outranking this one and thus allowing for re-prosodification). As we see in (29), any attempt at combining these syllables results in a suboptimal candidate, and the candidate with two syllables that do not form a unit, (29a), wins.

(29)

phase: |{a$_{\mu\ \sigma}$ ([ma sságe]$_{Ft}$)$_{PWd}$}$_{PPh}$| input: /fo$_\mu$ra$_\mu$ma$_\mu$ssa$_{\mu\mu}$ge/	PAL PWD	PDEP	PARSE SEG	FT BIN	PARSE SYLL	PARSE FT
a ☞{ fo$_\mu$r$_\sigma$ a$_{\mu\ \sigma}$ ([ma sságe]$_{Ft}$)$_{PWd}$ }$_{PPh}$					**	
b { [fo$_\mu$r.a$_\mu$]$_{Ft}$ ([ma sságe]$_{Ft}$)$_{PWd}$ }$_{PPh}$		*!				*
c { ([fo$_\mu$ r.a$_\mu$]$_{Ft}$)$_{PWd}$ ([ma sságe]$_{Ft}$)$_{PWd}$ }$_{PPh}$		*!				
d { ([fo$_\mu$ r.a$_\mu$] $_{Ft}$ [ma sságe]$_{Ft}$)$_{PWd}$ }$_{PPh}$	*!	*				

However, as with the determiners, there are many cases where a preposition of more than one syllable forms a PWd on its own. In tableau (29) we saw an example of a monosyllabic preposition, whereas in (30) below we take a look at a bisyllabic preposition.

Candidates (30b, d, f, g, h) fail because *the* is associated with prosodic constituents it was not associated with in the previous phase. In (30a) there are too few unparsed syllables. While this was not a problem in the previous tableau since all the other candidates were excluded by higher-ranking constraints, in this case there are candidates that fare better. Candidate (30c, e) both have one foot and one unparsed syllable, but candidate (30e) is at an advantage since the foot projects a PWd. This tableau gives an account of why polysyllabic prepositions, and function words in general, can form a PWd on their own, unlike the monosyllabic ones.

(30) phase: \| { the$_{\mu\ \sigma}$ ([tá$_{\mu\mu}$.bl$_\mu$e]$_{Ft}$)$_{PWd}$ }$_{PPh}$ \|
input: /u$_\mu$nde$_\mu$rthe$_\mu$ta$_{\mu\mu}$bl$_\mu$e/

output:
a) { u$_\mu$n $_\sigma$ de$_\mu$r $_\sigma$ the$_{\mu\ \sigma}$ ([tá$_{\mu\mu}$.bl$_\mu$e]$_{Ft}$)$_{PWd}$ }$_{PPh}$
b) { [u$_\mu$nde$_\mu$r]$_{Ft}$ [the$_\mu$] $_{Ft}$ ([tá$_{\mu\mu}$.bl$_\mu$e]$_{Ft}$)$_{PWd}$ }$_{PPh}$
c) { [u$_\mu$nde$_\mu$r]$_{Ft}$ the$_{\mu\ \sigma}$ ([tá$_{\mu\mu}$.bl$_\mu$e]$_{Ft}$)$_{PWd}$ }$_{PPh}$
d) { u$_\mu$n $_\sigma$ [de$_\mu$rthe$_\mu$]$_{Ft}$ ([tá$_{\mu\mu}$.bl$_\mu$e]$_{Ft}$)$_{PWd}$ }$_{PPh}$
e) ☞ { ([u$_\mu$nde$_\mu$r]$_{Ft}$)$_{PWd}$ the$_{\mu\ \sigma}$ ([tá$_{\mu\mu}$.bl$_\mu$e]$_{Ft}$)$_{PWd}$ }$_{PPh}$
f) { u$_\mu$n$_\sigma$ ([de$_\mu$rthe$_\mu$]$_{Ft}$)$_{PWd}$ ([tá$_{\mu\mu}$.bl$_\mu$e]$_{Ft}$)$_{PWd}$ }$_{PPh}$
g) { ([u$_\mu$n]$_{Ft}$)$_{PWd}$ ([de$_\mu$rthe$_\mu$]$_{Ft}$)$_{PWd}$ ([tá$_{\mu\mu}$.bl$_\mu$e]$_{Ft}$)$_{PWd}$ }$_{PPh}$
h) { ([u$_\mu$nde$_\mu$r]$_{Ft}$ the$_{\mu\ \sigma}$)$_{PWd}$ ([tá$_{\mu\mu}$.bl$_\mu$e]$_{Ft}$)$_{PWd}$ }$_{PPh}$

	PALPWD	PDEP	PARSESEG	FTBIN	PARSESYLL	PARSEFT
a					**!*	
b		*!		*		**
c					*	*!
d		*!			*	*
e ☞					*	
f		*!			*	
g		*!		*		
h		*!			*	

2.5 *Functional structure and Non-Isomorphism*

This section builds on the model as presented in the previous sections. It is meant to illustrate the interaction of lexical and functional material at sentence level, and also illustrate how larger scale derivation takes place in the computational model presented here. The data analysed in this section is the most famous example of syntax-phonology non-isomorphism. It comes from Chomsky and Halle (1968:372), where (a) is the syntactic structure, while (b) is the prosodic phrasing:

(31) a. This is [$_{NP}$ the cat that caught [$_{NP}$ the rat that stole [$_{NP}$ the cheese]]]

b. (This is the cat)$_{\varphi}$ (that caught the rat)$_{\varphi}$ (that stole the cheese)$_{\varphi}$

The derivation of Phase1 of each 'lexical' word will be omitted for conciseness. In tableau (32) we see again an example of a function word cliticising to a PWd created in the previous phase. Since it is a monosyllabic function word, it is parsed as a syllable but it cannot form a foot or PWd.

(32)

phase: $\vert$ { ([chee$_{\mu\mu}$se]$_{Ft}$)$_{PWd}$ }$_{PPh}$ $\vert$ input: /the$_{\mu}$ chee$_{\mu\mu}$se /	PALPWD	PDEP	PARSESEG	FTBIN	PARSESYLL
a ☞{ the$_{\mu\ \sigma}$ ([chee$_{\mu\mu}$se]$_{Ft}$)$_{PWd}$ }$_{PPh}$					*
b { [the$_{\mu}$]$_{Ft}$ ([chee$_{\mu\mu}$se]$_{Ft}$)$_{PWd}$ }$_{PPh}$				*!	
c { (the$_{\mu\ \sigma}$ [chee$_{\mu\mu}$se]$_{Ft}$)$_{PWd}$ }$_{PPh}$	*!				*
d { ([the$_{\mu}$]$_{Ft}$)$_{PWd}$ ([chee$_{\mu\mu}$se]$_{Ft}$)$_{PWd}$ }$_{PPh}$				*!	

In tableau (33) below we have the first example of joining two paths of the derivation, and two outputs of a previous phase. Candidate (33a) is the fully faithful one, but as a result it keeps the non-binary prosodic phrases and is not the optimal candidate. Candidate (33b) incorporates the extra syllable into the preceding PWd, since the right edge is not anchored like the left one. However, this violates the PHASEDEP constraint against assigning new structure to prosodic constituents that have already been processed in the previous phase. The winner is, therefore, candidate (33c), with a well-formed binary prosodic phrase.

(33) phase: | { ([stole$_{\mu\mu}$]$_{Ft}$)$_{PWd}$}$_{PPh}$ | | { the$_{\mu\ \sigma}$ ([chee$_{\mu\mu}$se]$_{Ft}$)$_{PWd}$ }$_{PPh}$ |
input: /stole$_{\mu\mu}$the$_{\mu}$chee$_{\mu\mu}$se /

output: a) { ([stole$_{\mu\mu}$]$_{Ft}$)$_{PWd}$ }$_{PPh}$ { the$_{\mu\ \sigma}$ ([chee$_{\mu\mu}$se]$_{Ft}$)$_{PWd}$ }$_{PPh}$
b) { ([stole$_{\mu\mu}$]$_{Ft}$ the$_{\mu\ \sigma}$)$_{PWd}$ ([chee$_{\mu\mu}$se]$_{Ft}$)$_{PWd}$ }$_{PPh}$
c) ☞ { ([stole$_{\mu\mu}$]$_{Ft}$)$_{PWd}$ the$_{\mu\ \sigma}$ ([chee$_{\mu\mu}$se]$_{Ft}$)$_{PWd}$ }$_{PPh}$

	PALPWD	PDEP	PARSESYLL	NONFIN	PPHBIN
a			*	**	*!*
b		*!	*	*	
c ☞			*	**	

In the next phase the function word *that* is added to the cumulative input. Since it is a monosyllabic function word, it cannot form a foot on its own, and it gets cliticised to the following PWd as part of the binary PPh created in the previous phase.

(34) phase: | { ([stole$_{\mu\mu}$]$_{Ft}$)$_{PWd}$ the$_{\mu\,\sigma}$ ([chee$_{\mu\mu}$se]$_{Ft}$)$_{PWd}$ }$_{PPh}$ |
input: /that$_{\mu}$stole$_{\mu\mu}$the$_{\mu}$chee$_{\mu\mu}$se /

output: a) ☞ { that$_{\mu\,\sigma}$ ([stole$_{\mu\mu}$]$_{Ft}$)$_{PWd}$ the$_{\mu\,\sigma}$ ([chee$_{\mu\mu}$se]$_{Ft}$)$_{PWd}$ }$_{PPh}$
b) { [that$_{\mu}$]$_{Ft}$ ([stole$_{\mu\mu}$]$_{Ft}$)$_{PWd}$ the$_{\mu\,\sigma}$ ([chee$_{\mu\mu}$se]$_{Ft}$)$_{PWd}$ }$_{PPh}$
c) { ([that$_{\mu}$]$_{Ft}$)$_{PWd}$ ([stole$_{\mu\mu}$]$_{Ft}$)$_{PWd}$ the$_{\mu\,\sigma}$ ([chee$_{\mu\mu}$se]$_{Ft}$)$_{PWd}$ }$_{PPh}$
d) { (that$_{\mu\,\sigma}$ [stole$_{\mu\mu}$]$_{Ft}$)$_{PWd}$ the$_{\mu\,\sigma}$ ([chee$_{\mu\mu}$se]$_{Ft}$)$_{PWd}$ }$_{PPh}$

	PALPWD	PDEP	PARSESEG	FTBIN
a ☞				
b				*!
c				*!
d	*!			

Tableau (35) shows how PHASEDEP and PROSODICPHRASEBINARITY result in the non-isomorphic phrasing that we observed in (31). Namely, at this point a new 'lexical' word is added to the cumulative input. However, since the output of the previous phase is a well-formed binary prosodic phrase, incorporating the added PWd into this phrase would result in a suboptimal output, as we see in (35a). The optimal output is that in (35c) where there is a prosodic phrase boundary between *rat* and *that*, resulting in a prosodic structure that is non-isomorphic with the syntactic structure.

(35) phase: | { that$_{\mu\,\sigma}$ ([stole$_{\mu\mu}$]$_{Ft}$)$_{PWd}$ the$_{\mu\,\sigma}$ ([chee$_{\mu\mu}$se]$_{Ft}$)$_{PWd}$ }$_{PPh}$ |
input: /ra$_{\mu}$tthat$_{\mu}$stole$_{\mu\mu}$the$_{\mu}$chee$_{\mu\mu}$se$_{\mu}$/

output:
a) { ([ra$_{\mu\mu}$t$_{\mu}$]$_{Ft}$)$_{PWd}$ that$_{\mu\mu\,\sigma}$ ([stole$_{\mu\mu}$]$_{Ft}$)$_{PWd}$ the$_{\mu\,\sigma}$ ([chee$_{\mu\mu}$se$_{\mu}$]$_{Ft}$)$_{PWd}$ }$_{PPh}$
b) { ([ra$_{\mu\mu}$t$_{\mu}$]$_{Ft}$ that$_{\mu\mu\,\sigma}$)$_{PWd}$ ([stole$_{\mu\mu}$]$_{Ft}$)$_{PWd}$ the$_{\mu\,\sigma}$ ([chee$_{\mu\mu}$se$_{\mu}$]$_{Ft}$)$_{PWd}$ }$_{PPh}$
c) ☞ { ([ra$_{\mu\mu}$t$_{\mu}$]$_{Ft}$)$_{PWd}$ }$_{PPh}$ { that$_{\mu\mu\,\sigma}$ ([stole$_{\mu\mu}$]$_{Ft}$)$_{PWd}$ the$_{\mu\,\sigma}$ ([chee$_{\mu\mu}$se$_{\mu}$]$_{Ft}$)$_{PWd}$ }$_{PPh}$

	PALPWD	PDEP	FTBIN	PARSESYLL	PPHBIN
a				**	*!
b		*!		**	*
c ☞				**	

3. Conclusion

This paper has provided an account of the prosodification of function words in English in a modular approach to the syntax-phonology interface. It advocates the No Reference Hypothesis approach introduced in Šurkalović (2011a). It has as its goal to combine the current syntactic theories with the tradition of Prosodic Phonology to arrive at a fully modular theory of the interface. It shows that modularity can be achieved through utilizing current Phase Theory in syntax and the 'decomposed' views of syntactic representation.

The premise is that the derivation through spell-out is the only communication channel between syntax and phonology. The derivation proceeds in phases both in syntax and, as a result, in phonology. What is traditionally thought of reflections of syntactic structure in phonology is merely an effect of the course of the derivation. The input to phonology consists only of phonological information retrieved from the lexical entries in the spell-out process. Syntax affects phonology indirectly through the size of the chunks it spells-out in phases, which then become processed by phonology. This input to phonology is not the output of each phase separately, but a cumulative output including all previous phases. Phonology stores the output of the phonological computation of each phase in working memory and refers to it when computing the next phase. As a result, the seeming effects of the (morpho)syntactic structure on phonology are derived without phonology needing to refer to that structure.

This approach is formalized through Optimality Theory constraint interaction. A new type of constraints is introduced – the Phase-Phase Faithfulness constraints, relating the output of one phase with the computation of the following phase. In this paper the focus is on the aspect of the interface dealing with the lexical-functional distinction and its relevance for prosodic phrasing. An analysis of the prosody of function words is provided that relies not on (morpho)syntactic features to explain the difference, but on their difference in derivational status. 'Lexical' words start the derivation and are as such prosodified first in Phase1. Prosody is subsequently faithful to this prosodification, which is why 'lexical' words always appear in their full form, as opposed to function words which reduce phonologically. This paper focused in particular on determiners and prepositions, and specifically on the fact that polysyllabic function words behave prosodically like lexical words, not like monosyllabic function words. Future research is expanding to include derivational morphology, as well as the interaction of multiple spell-out, syntactic movement operations and clause-level prosody, and in particular the prosody of clause-final function words.

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