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The No-Reference Hypothesis

A Modular Approach to the Syntax-Phonology Interface

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Dragana Šurkalović

A dissertation for the degree of Philosophiae Doctor – June 2015

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mami i tati s ljubavlju

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Abstract

This dissertation investigates the interface of syntax and phonology in a fully modular view of language, deriving the effects of syntactic structure on prosodification without referring to that structure in the phonological computation. It explores the effects of the Multiple Spell-Out Hypothesis and 'syntax-all-the-way-down approaches', specifically Nanosyntax, on the phonological computation. The dissertation addresses three issues for modularity: (i) phonology can see edges of syntactic constituents, (ii) phonology distinguishes between lexical and functional elements in syntax, and (iii) phonology recognizes Information Structure marking features. The No-Reference Hypothesis is presented as the solution. It states that phonological computation needs to proceed in phases in order to achieve domain mapping while maintaining an input to phonology consisting of purely phonological information. The dissertation provides an explicit account of how the outputs of different phases get linearized wrt each other, providing arguments that spell-out does not proceed in chunks but produces cumulative cyclic input to phonology. An analysis is provided, using data from English, Kayardild and Ojibwa, showing how prosodic domains can be derived from phases by phonological computation being faithful to the prosodification output of the previous phase. The analysis is formalized by introducing Phase-Phase Faithfulness constraints to Optimality Theory.

Keywords: syntax-phonology interface, prosody, Optimality Theory, phases, modularity, linearization, spell-out, Nanosyntax, English, Kayardild, Ojibwa

List of the papers

Paper 1

Šurkalović, D. (2011a). Lexical and Functional Decomposition in Syntax: A view from Phonology. *Poznan Studies in Contemporary Linguistics (PSiCL)* 47(2). pp. 399–425.

Paper 2

Šurkalović, D. (2011b). Modularity, Linearization and Phase-Phase Faithfulness in Kayardild. *Iberia: An International Journal of Theoretical Linguistics* 3(1). pp. 81-118

Paper 3

Šurkalović, D. (2013). Modularity, Phase-Phase Faithfulness and Prosodification of Function Words in English. *Nordlyd* 40(1). pp. 301-322

Please note that Šurkalović (2013) refers to the first two papers in the opposite order. What is 2011a here is 2011b there, and the other way around. The reason for this at the time was the order in which the papers came out in print. However, they were written in the order used in this thesis, which also presents the work in the three papers as a more coherent whole. I apologize for any inconvenience this might cause the reader while reading Šurkalović (2013).

Part I: Extended Introduction

1. Aim and Scope of the Dissertation

The central premise of this article-based dissertation is that language is modular. Modularity is the notion that language is divided into discrete modules: syntax, phonology and semantics. These modules are seen as independent of one another and unable to see into each other. They operate on distinct sets of primitives, much like the human senses operate on visual, auditory or olfactory information, and cannot process information that they are not designed for. As a result, for example, phonology cannot operate on syntactic primitives, such as syntactic features. The modular model of language originates in Chomsky (1965). It has been the basis for generative theories of grammar ever since (cf. Scheer 2011 for a detailed overview), although there are approaches that argue for phonology having direct access to Syntax (e.g. the Direct Syntax approach of e.g. Kaisse 1985, Odden 1987). In this dissertation, the term Direct Reference is used for such approaches. Indirect Reference is used in its intended meaning within the theory of Prosodic Phonology, for the view that phonology has access to some, but not all, syntactic information. The term No-Reference is introduced to refer to the fully modular approach developed in this dissertation.

The computational system of language assumed by this dissertation is derivational and unidirectional. This means that phonology follows syntax in the derivation, and the output of syntax is the input to phonology. The output of syntax is a hierarchical organization of syntactic features, commonly represented as a syntactic tree structure. However, phonological representations consist of a linear string of phonological forms. What translates the output of the syntactic computation into something that phonology can interpret and that consists of phonological primitives is referred to as the syntax-phonology interface, or the process of spell-out. This process consists of linearizing the syntactic hierarchical structure and performing the operation of lexical insertion, which retrieves from the Lexicon the phonological representation that matches a certain piece of the syntactic structure. Crucially, no syntactic features reach phonology, and phonology cannot perform operations that would need to recognize syntactic features or configurations.

However, there is crosslinguistic evidence of phonological processes that suggest that phonology does recognize some aspects of syntax, and that these syntactic properties affect the phonological computation. Three of the main arguments for the view that phonology does see parts of syntax, which are addressed in this dissertation, are that:

- phonology can see edges of syntactic constituents (Selkirk 1986 *et seq*, McCarthy and Prince 1993, Truckenbrodt 1995 *et seq*, *inter alia*),
- phonology distinguishes between lexical and functional elements in syntax (Inkelas and Zec 1993; Selkirk 1995; Chen 1987 *inter alia*).
- phonology recognizes Information Structure marking features, such as Focus and Topic (Truckenbrodt 1999, Samek-Lodovici 2005, Féry & Samek-Lodovici 2006 *inter alia*)

All three of these aspects of syntactic structure affect the prosodic phrasing and marking of utterances. This has been a problem for the most successful theories of the syntax-phonology mapping. As a result, they have been unable to maintain full modularity in their accounts of these phenomena.

Assuming modularity of language, the questions that this dissertation strives towards answering are the following:

- How can we derive the effects of syntactic structure on phonology listed above?
- How is mapping from syntax to phonology carried out?
- What is the nature of input to phonology?
- What is the nature of the phonological computation?

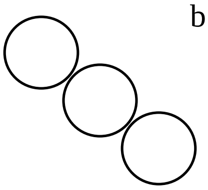
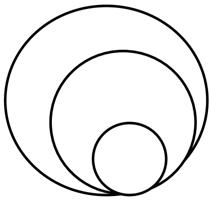
Being primarily a dissertation in phonology, but dealing with issues of its interface with syntax, this dissertation is also built on certain assumptions regarding the nature of the syntactic computation and representation. It adopts the following views of syntax:

- the ‘decomposed’, or ‘syntax-all-the-way-down’ view of syntactic representation, present in a number of approaches, e.g. Distributed Morphology (Halle and Marantz

1993, Harley and Noyer 1999 *inter alia*), Nanosyntax (Starke 2009, Caha 2009, Ramchand 2008, Lundquist 2008 *inter alia*) or Borer's (2005) system. The particular approach adopted in this dissertation is that of Nanosyntax.

- the less traditional spell-out-at-each-merge view (Epstein and Seely 2002, 2006, Marvin 2002, Newell 2008) of the Multiple Spell-Out Hypothesis (MSOH) (Uriagereka 1999, Chomsky 2000, 2001, 2004, 2008) as the approach to syntactic computation.

Additionally, this dissertation argues for a modification of the multiple spell-out approaches, which is necessary to account for the process of linearization. The suggested modification is that spell-out does not proceed in separate chunks (1a) but in concentric circles (1b), where each spell-out domain includes the previous one:

(1) a.  b. 

Nanosyntax presents an approach to lexical look-up that corresponds with (1b), thus giving us the first step in the spell-out to phonology by specifying how syntactic form is translated into phonological form. However, being a syntactic model, it does not address the issue of when and how this phonological form reaches the phonological computation. This dissertation expands this into the phonological domain, by arguing that material reaches phonology every time lexical matching is successful.

The dissertation is a collection of three papers:

- Paper 1 (Šurkalović 2011a) presents the challenges that the decomposition of traditional lexical categories in syntax into functional categories brings for the views on phonology and the syntax-phonology mapping that have relied on this distinction to account for some phonological phenomena. It also addresses the challenge of mapping syntactic constituents and Information Structure marking from syntax to phonology in a fully modular view of language. It analyzes data from English, focusing on the prosodification of function words and affixes, and prosodic marking of Focus and Contrastive Topic.

- Paper 2 (Šurkalović 2011b) further addresses the challenges of mapping syntactic domains to prosodic ones and distinguishing between lexical and functional categories. It also introduces the challenge of how outputs of different phases are linearized once they reach phonology, and proposes the solution represented in (1b) above. It analyzes data from Kayardild, focusing on the Prosodic Word domain and suffixation. It introduces a new category of constraints, Phase-Phase Faithfulness constraints[1]. It also compares Kayardild to Ojibwa and English, and shows how these constraints interact with other phonological constraints to produce language variety.
- Paper 3 (Šurkalović 2013) elaborates on the proposal and the English data presented in Papers 1 and 2. It takes a closer look at function words in English, and argues that the phonological distinction between function and lexical words is not as clear cut as the literature would suggest, since polysyllabic function words behave phonologically like lexical words. It provides an account that derives this difference in prosody from the difference in the derivational status of the words.

The answers to the questions posed above that are given in this dissertation are:

Q: How can we derive the effects of syntactic structure on phonology listed above?

A: What seem to be examples of phonology recognizing syntactic structure are actually the effects of the process of derivation itself. Phonology is not parsing syntactic elements. It is parsing the chunks it receives from spell-out. The reason it seems that it processes syntactic chunks is that these spell-out chunks correspond to syntactic units.

Q: How is mapping from syntax to phonology carried out?

A: Syntactic computation proceeds in phases. These phases are not separate chunks, as in

[1] The computational model adopted in this dissertation is that of Optimality Theory (OT; Prince and Smolensky 1993, McCarthy and Prince 1993, 1995).

(1a), but cumulative phases, which include the previous phase, as in (1b). Thus, Phase 1 does not need to be linearized with respect to Phase 2 after it is spelled out to phonology. It is, in fact, linearized with the new material as part of Phase 2, before it reaches the phonological computation.

Q: What is the nature of input to phonology?

A: The input to phonology is a linearized string of phonological underlying forms of lexical items. It is created as the output of spell-out, and it is a cumulative input including the previous phase. Crucially, it does not contain information about syntactic domains, categories or features.

Q: What is the nature of the phonological computation?

A: The phonological computation proceeds in phases, which parallel those in syntax. Whenever the output of a syntactic phase is spelled-out, the phonological input thus created is fully processed by the phonology. The phonological computation creates prosodic structure at each phase, which reflects the syntactic organization of the utterance. This prosodic structure is stored in working memory and referred to in the processing of the next phase. This reference to the previous phase is achieved by Phase-Phase Faithfulness constraints. What has been parsed a certain way in the first phase can remain identically parsed throughout the derivation, or its parsing can change, depending on the constraint interaction.

This extended introduction is organized into five sections. Having outlined the aim and the scope of the dissertation in Section 1, we will now move on to Section 2, which gives an overview of the theoretical framework the dissertation is built on, when it comes to both the phonological and the syntactic side of the interface. Section 3 presents the basic principles of the No-Reference Hypothesis, which this dissertation argues for, whereas Section 4 summarizes the three papers and their contribution to the dissertation. Section 5 discusses the No-Reference Hypothesis by answering some questions from audiences and reviewers of the papers, and by comparing it with other interface and phonological computation theories, before ending with a few concluding remarks.

2. The Theoretical Framework

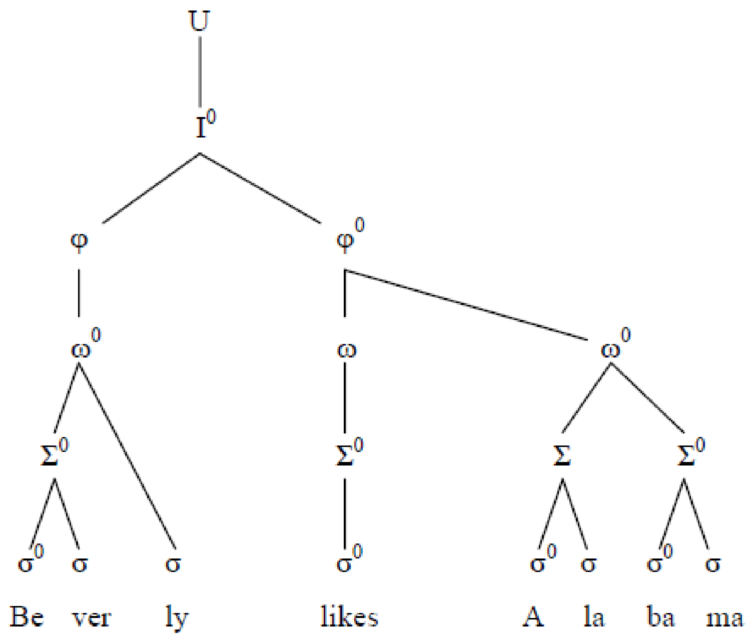
This section presents the theoretical background referred to in all three papers. Subsection 2.1 gives an outline of Prosodic Phonology, which is the phonological theory this dissertation uses as a starting point. Subsection 2.2 presents the theories of syntactic representation and computation that this dissertation assumes and builds on.

2.1 Prosodic Phonology

The work that has been done in this dissertation has taken as its starting point the theory of Prosodic Phonology (e.g. Selkirk 1981 *et seq*; Nespor and Vogel 1986; Hayes 1989; Truckenbrodt 1999 *inter alia*) as the most widely used approach to prosody and the syntax-phonology mapping in generative grammar. Prosodic Phonology is based on the notion that prosodic structure is organized as the Prosodic Hierarchy of domains (PH), consisting of Syllable (σ), Foot (Σ or Ft), Prosodic Word (ω or PWd), Prosodic Phrase (φ or PPh), Intonation Phrase (I), and Utterance levels (U)[2], origins of which are going back to Liberman (1975) and Liberman and Prince (1977). Below, in (2), is an example of the prosodic organisation of an English sentence (Šurkalovic 2007:16, adapted from Truckenbrodt 2007:2).

[2] The list of different levels in the Prosodic Hierarchy varies in the literature, and other levels have been proposed, both as universals and as language-specific levels. Going into details of the levels of the hierarchy is orthogonal to and beyond the scope of this dissertation, and the levels listed here are the most commonly used ones.

(2[3])



The crosslinguistic evidence for the various prosodic domains comes from a number of segmental processes that are sensitive to them. Although the Prosodic Hierarchy was originally created to account for different domains of phonological rule application, its use has since been extended to accounting for the cases of syntax-phonology mapping. The central idea of Prosodic Phonology is the Indirect Reference Hypothesis, which assumes that prosodic constituents are what bridges syntactic and phonological representation. Since the modular view of language assumes that phonology cannot directly access syntax, it accesses it indirectly through the prosodic structure, which serves as the interface.

The following subsections present the account of syntax-phonology domain mapping, lexical and function word distinction processing and Information Structure marking within the theory of Prosodic Phonology. They also point out the modularity violations present in this theory.

3 Superscript ^{0} marks the head of the higher level element.

2.1.1 Constraints for domain mapping

Work in Prosodic Phonology uses OT constraints and constraint interaction to model the phonological computation. The central constraints belong to the category of Alignment Constraints. They have their origins in the end-based theory of syntax-prosody mapping proposed by Selkirk (1986). They were developed into the Generalised Alignment theory by McCarthy and Prince (1993).

(3) Generalized Alignment (McCarthy and Prince 1993:2)

Align(Cat1, Edge1, Cat2, Edge2) $=_{def}$

$\forall$ Cat1 $\exists$ Cat2 such that Edge1 of Cat1 and Edge2 of Cat2 coincide.

Where

Cat1, Cat2 $\in$ PCat $\cup$ GCat

Edge1, Edge2 $\in$ {Right, Left}

These constraints are used to align edges of different domains, as well as to align the head of a domain with an edge of its respective domain. Selkirk (1995) uses the alignment constraints in (4) in her account of the prosodification of function words (the analysis is presented in more detail in the Papers 1, 2, and 3):

(4)

The Word Alignment Constraints (WdCon)

ALIGN (LEX, L/R; PWD, L/R)

The 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)

The 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.

An example tableau from Paper 2 (Šurkalović 2011b) of Selkirk's (1995) analysis using the prosodic alignment constraints is given in (5) below, where we see the derivation of the prosodic phrasing of a function word to form a clitic to the lexical word, in a phrase such as "a table".

(5)

EXHAUSTIVITY

No Ci immediately dominates a constituent Cj, j < i-1 (No PWd immediately dominates a σ)

NONRECURSIVITY

No Ci dominates Cj, 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 $\{lex\}_\omega$ $\}_\omega$ $)_\varphi$		*!	*	

Selkirk (2005) uses similar alignment constraints, given in (6), to analyse Intonational Phrases in English, and their mapping from syntactic Comma phrases, exemplified in (7), taken from Selkirk (2005:7)

(6)

Align R (XP, MaP)

Align the right edge of a maximal projection in the interface syntactic representation with the right edge of a Major Phrase (aka Intermediate Phrase) in phonological representation.

Align R (CommaP, IP)

Align the R edge of a constituent of type Comma Phrase in syntactic (PF) representation with the R edge of a corresponding constituent of type $\boldsymbol{\pi}_{\text{CommaP}}$ (=Intonational Phrase, IP) in phonological (PR) representation.

(7)

[$_{\text{DP}}$[$_{\text{DP}}$[The Romans]$_{\text{DP}}$ [who arrived early]$_{\text{Comma}}$]$_{\text{DP}}$ [found [a land [of wooded hills]]]]

$_{\text{IP}}$((The Ro$^{\text{H*}}$mans$^{\text{L-}}$)$_{\text{MaP}}$ (who arri$^{\text{!H*}}$ved ea$^{\text{!H*}}$rly$^{\text{L-H\%}}$)$_{\text{MaP}}$)$_{\text{IP}}$// $_{\text{IP}}$(($^{\text{\^{}\^{}!}}$fou$^{\text{H*}}$nd a la$^{\text{!H*}}$nd…)$_{\text{MaP}}$)$_{\text{IP}}$

Truckenbrodt (1995, 1999, 2006, 2007, 2012) also proposes an elaborate account of the syntax-phonology interface. His system uses Selkirk's edge alignment and introduces the WRAP constraint and constraints on stress placement:

(8)

ALIGN-XP,R/L: ALIGN(XP, R/L; P-PHRASE, R/L)

The right/left edge of each syntactic XP is aligned with the right/left edge of a p-phrase

WRAP-XP

For each XP there must be a p-phrase that contains the XP

STRESS-XP

Each XP must contain a beat of stress on the level of the p-phrase

Furthermore, Truckenbrodt (1999: 226) also argues that the distinction between lexical and function words is relevant in the phonological computation, and, building on Selkirk (1995), formalizes this in his Lexical Category Condition:

(9) 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.

More recently, Selkirk (2009, 2011), building on Selkirk (2005), puts forth a Match theory of the interface between the constituents of syntactic and prosodic structure.

(10) A Match theory of the syntax-prosodic structure interface (Selkirk 2009:40)

(i) Match Clause

A clause in syntactic constituent structure must be matched by a constituent of a corresponding prosodic type in phonological representation, call it ι[4].

(ii) Match Phrase

A phrase in syntactic constituent structure must be matched by a constituent of a corresponding prosodic type, in phonological representation, call it ϕ.

(iii) Match Word

A word in syntactic constituent structure must be matched by a constituent of a corresponding prosodic type in phonological representation, call it ω.

An example of the Match constraints, from Selkirk (2011), is given below. The examples show how Match constraints interact with the prosodic well-formedness constraints to give the output parsing of Prosodic Phrases in Xitsonga:

---

[4] ι stands for Intonation Phrase, ϕ stands for Prosodic Phrase, ω stands for prosodic word

(11)

Match (Phrase, ϕ)

A syntactic phrase corresponds to a prosodic phrase ϕ in phonological representation

BinMin(ϕ, ω)

A ϕ is minimally binary and thus consist of at least two prosodic words

a.

$_{clause}$[[verb [noun]$_{NP}$]$_{VP}$]$_{clause}$	BinMin(ϕ, ω)	Match (Phrase, ϕ)
a. $_ι$($_ϕ$(verb $_ϕ$(noun)$_ϕ$)$_ϕ$)$_ι$	*	
☞ b. $_ι$($_ϕ$(verb noun)$_ϕ$)$_ι$		*

b.

$_{clause}$[[verb [noun adj] [noun adj]]]$_{clause}$	BinMin(ϕ, ω)	Match (Phrase, ϕ)
☞ a. $_ι$($_ϕ$(verb $_ϕ$(noun adj)$_ϕ$ $_ϕ$(noun adj)$_ϕ$)$_ϕ$)$_ι$	*	
b. $_ι$($_ϕ$($_ϕ$(verb noun adj)$_ϕ$ $_ϕ$(noun adj)$_ϕ$)$_ϕ$)$_ι$		*
c. $_ι$($_ϕ$(verb $_ϕ$(noun adj noun adj)$_ϕ$)$_ϕ$)$_ι$		**

As we can see in (4), (6), (8) and (10), the constraints make reference both to syntactic constituents (Lex^{MAX}, XP, Comma Phrase, clause, phrase) and to the distinction between lexical and functional elements (Lexical Word). This means that, although there is no reference to syntactic features, phonology still makes direct reference to elements of the syntactic structure. Although prosody is seen as the channel of communication between syntax and phonology, it is nevertheless part of the phonological module. Due to that, constraints like these are a clear violation of modularity. Indirect Reference still assumes reference, which is why the model argued for in this dissertation is called the No-Reference Hypothesis.

It is interesting to point out that the notion of a lexical projection is problematically defined. The Prosodic Phonology literature assumes that all lexical projections share the common 'lexical' feature under their V, N or A head. This feature marks both the word inserted into that head and its projection as lexical. Truckenbrodt (1999: 227) states that in cases of complex VPs, where the verb moves from VP to vP, it is the vP that is "a lexically headed projection in the relevant sense". Once the verb moves and becomes head of vP, it is the vP that becomes a lexically-headed projection. However, as an anonymous reviewer of Paper 2 points out, in languages with overt V-to-T movement this would mean that the whole TP would need to be wrapped in one Prosodic Phrase. However, since the WRAP constraint was motivated largely to account for the (S)(VO) prosodic phrasing, if the subject is in the SpecTP and the verb is in T, then the whole TP is lexical and thus it should be wrapped, resulting in (SVO), and defeating the purpose of WRAP.

2.1.2 Information Structure marking

As mentioned in the introduction, another violation of modularity in Prosodic Phonology occurs in the domain of Information Structure marking. Information Structure features such as Focus, Topic or Contrastive Topic are assumed to be privative features in syntax (Jackendoff 1972), and they are taken to project their own phrasal nodes (Rizzi 1997). These features are realized in different ways in different languages: by syntactic movement (e.g. Polish: Szczegielniak 2005; Hungarian: Kiss 1998; Serbian: Migdalski 2006), by morpheme markers (e.g. Japanese: Yamato 2007; Kĩĩtharaka: Abels and Muriungi 2006), by prosodic phrasing (Chichewa: Truckenbrodt 1999) and by pitch accent and intonational contour (English: Ladd 1996, Büring 2007).

Analyses cast within Prosodic Phonology use constraints that make direct reference to these syntactic features, thus assuming that phonology has access to and can operate on syntactic primitives. Examples of these constraints are the following:

(12)

ALIGNF (Truckenbrodt 1999)

Align the right edge of an F constituent with a prosodic phrase

STRESSFOCUS **(**Samek-Lodovici 2005, Féry & Samek-Lodovici 2006)

The focused phrase has the highest prosodic prominence in its focus domain.

STRESSTOPIC **(**Samek-Lodovici 2005, Féry & Samek-Lodovici 2006)

The topic phrase has the highest prosodic prominence in its domain.

An example of how these constraints are used in the computation are given below. (13) is an example of contrastive focus from Féry & Samek-Lodovici (2006:138). Here, the words "American" and "Canadian" are contrastively focused, which results in the StressFocus constraint overriding the HP constraint which drives regular stress assignment.

(13)

HP: Align the right boundary of every P-phrase with its head(s).

[An American$_f$ farmer was talking to a Canadian$_f$ farmer]$_f$	SF	HP
a. (x) P An American$_f$ farmer	*!	
b. ☞ (x) P An American$_f$ farmer		*

Example in (14), from Samek-Lodovici (2005), shows how languages such as Italian satisfy StressFocus by moving the focused constituent instead of moving the prosodic marking for focus. Samek-Lodovici (2005) provides an OT analysis that integrates syntax and phonology in one tableau, making not only the constraints but the computation itself not modular. The StressFocus constraint in English is ranked lower than the constraints governing word order and movement in syntax, whereas it is ranked higher in Italian, making syntactic movement preferable to satisfy higher ranked prosodic constraints. Unfortunately, addressing cases of phonology-driven movement, such as these examples of focus in Italian, heavy NP shift, or prosodic scrambling of phonological phrases in Japanese (Agbayani, Golston and Ishii 2015) are beyond the scope of this dissertation. Accounting for these cases in a strictly modular framework would be an important next step in developing the No-Reference Hypothesis argued for here.

(14)

a. English

[John has LAUGHED]$_f$ vs. JOHN$_f$ has laughed.

b. Italian

[Gianni ha RISO]$_f$ vs. Ha riso GIANNI$_f$

In addition to not being modular, none of the constraints or accounts above addresses the issue of how the specific tones and intonational contours get associated with the specific features. For example, how the H* Pitch Accent, and not L*, marks Focus in English whereas the tonal contour L+H*L-H%, and not some other, marks Contrastive Topic. This issue is addressed in this dissertation, most specifically in Paper 1.

2.2 Syntactic representation and computation

2.2.1 Decomposition of lexical categories

Traditionally, the syntactic representation in generative grammar has consisted of heads as terminals and their projections as phrasal nodes. These heads could be lexical, like Noun, Verb, Adjective, or functional, like Case or Tense, and they would be hosting a bundle of features associated with that category. However, in the last few decades these heads have been decomposed into individual features. Initially it was the functional heads that were decomposed into multiple functional projections (e.g. Rizzi 1997, 2004; Svenonius 2010). More recently, there has been a lot of work on decomposing the lexical categories as well. This 'syntax-all-the-way-down' view of syntactic representation is present in e.g. Distributed Morphology (Halle and Marantz 1993, Harley and Noyer 1999 *inter alia*), Nanosyntax (Starke 2009, Caha 2009, Ramchand 2008, Lundquist 2008 *inter alia*) or Borer's (2005) system. The particular approach adopted in this dissertation is that of Nanosyntax.

In Nanosyntax, the elements syntax operates on are not words or bundles of features, but individual features. Each feature is a terminal in a syntactic tree. Thus, what was traditionally thought of as lexical words or the N or V heads is in fact a sequence of functional features in a hierarchical structure. The distinction between words and morphemes is erased, and all that exists is lexical items that spell out certain parts of the syntactic tree. Both the notion of "lexical" and "word" are thus nonexistent in syntax. This poses a problem for the theories of syntax-phonology interface which rely on these notions to account for the mapping patterns, such as, for example, Selkirk (2009:40) which states that "The Match constraints … pare syntactic constituent types to the minimum, exploiting the notions clause, phrase and word, which presumably play a role in any theory of morphosyntax."

For example, Ramchand (2008) decomposes the category of V and VP into three separate functional projections: Initiator Phrase, Process Phrase and Result Phrase. This system encodes verbal roots in the f-seq in a way that captures the relations between argument structure and event structure. In this approach phrases in the syntactic tree are necessarily functional. i.e.

there is no V or VP, only InitP, ProcP or ResP. Furthermore, neither of these is a necessary ingredient of what is traditionally thought of as a verb, so recasting the analysis by using a different primitive is not possible. Recognizing that a piece of syntactic structure corresponds to a lexical item that is a verb would require phonology to have Direct Reference to all aspects of the syntactic representation. When it comes to Nouns and Adjectives, Lundquist (2008) looks at structures where the distinction between categories of Verb, Noun and Adjective are blurred, such as participles and nominalizations. He adopts Borer's (2005) system of acategorial roots. In this view, roots are stored in the lexicon as bare roots, without categorical information about them being N, V or A. What determines their word class, i.e. what category they behave as in syntax, is the functional feature they merge with. Whatever defines N, V or A as such is not of lexical but of functional nature.

This view of syntactic structure and lexical matching poses a challenge not only for the mapping of prosodic domains, but also for other phonological theories that rely on the difference between lexical and functional categories, and among different lexical categories. One example is the relativized faithfulness of McCarthy and Prince's (1995) Correspondence Theory. They analyse cases of reduplication and posit "a universal metacondition on ranking, …, which ensures that faithfulness constraints on the stem domain always dominate those on the affixal domains." (McCarthy and Prince 1995:4). However, in the Nanosyntax model, there is no distinction between stem and affixes in their encoding in the lexicon. They are both simply lexical entries spelling out single features or feature combinations. While addressing the implications of Nanosyntax for McCarthy and Prince (1995) is beyond the scope of this dissertation, a similar challenge is addressed on a smaller scale in the discussion of Paper 1 in section 4.1. Another example is that of lexical category-specific effects, such as the stress distinction between nouns and verbs in English (e.g. cónvict.N vs convíct.V), addressed in e.g. Smith (2011). Although this dissertation does not address these, a possible way of analyzing them could be similar to the account of information structure marking by suprasegmental affixes presented in Paper 1. It is possible that the lexical entry for a functional feature in the N or V domain contains a suprasegmental phonological representation that results in a specific stress pattern.

2.2.2 Multiple Spell-Out and Phases

Another challenge in describing the process of transforming syntactic structure into phonological structure is accommodating for phases in spell-out. Phases originate in the Multiple Spell-Out Hypothesis (MSOH) (Uriagereka 1999, Chomsky 2000, 2001, 2004, 2008) approach to syntactic computation, also known as Phase Theory. According to MSOH, parts of the syntactic structure get spelled-out to PF and LF (Phonological Form, and Logical Form) before the full structure is computed. This partial spell-out happens at certain points in the structure that are designated as phases (literature varies on which nodes are considered phases). Once they are spelled out, these parts of structure become inaccessible to the rest of the computation.

However, this dissertation subscribes, more specifically, to the spell-out-at-each-merge view of MSOH, which is the less traditional view (Epstein and Seely 2002, 2006, Marvin 2002, Newell 2008). According to this view, spell-out does not happen only at specific points in the structure that are designated as phases. Spell-out happens as soon as all the features in a piece of structure are checked, making that piece of structure interpretable at the interface. This is compatible with Nanosyntax, where spell-out for the purpose of lexical matching is carried out at each merge. Once a lexical item is found that matches the syntactic structure that was built in syntax, that piece of structure can be spelled out. For example, in the case of irregular verbs in English there is a lexical item that corresponds to the piece of structure in syntax that includes both the features comprising the verb itself and the features that mark the past tense. On the other hand, in the case of regular verbs in English there is no such item. There is a lexical item that corresponds to the piece of structure representing the verb itself in its bare form, and the part of the structure marking past tense needs to be spelled out by a different lexical item, the suffix “ed”.

3. The No-Reference Hypothesis (NRH)

The following section outlines the No-Reference Hypothesis view of the syntax-phonology interface argued for in this dissertation as a whole and in the papers it consists of.

3.1 Syntactic computation: cumulative spell-out at each merge

As stated above, the NRH assumes that syntactic computation proceeds in phases. Furthermore, it adopts the view that phases are not reserved for designate nodes in the syntactic structure, but that spell-out is attempted at each merge. The reason for this is twofold. First of all, if we are to derive prosodic phrasing of what is traditionally thought of as words from the course of the derivation, that derivation needs to provide us with domains smaller than phrasal ones. This is achieved by having smaller spell-out domains (cf. Newell 2008). Second of all, the theory which argues for specific points of spell-out is less minimal (Chomsky 1995) in that it needs to make more assumptions about the system in order to account for the distinction between the points of merger that do and do not trigger spell-out. A more minimal theory is the one that assumes that all points of merger trigger spell-out. Whether that spell-out is successful or not, in this case, depends on whether lexical matching can be achieved.

What the NRH introduces, however, is the claim that spell-out is cumulative. This dissertation argues that phases are not separate chunks (cf. 1a), but cumulative phases, which include the previous phase (cf. 1b). The reason for this is again twofold. Primarily, it is a way of solving the linearization challenge. Namely, if spell-out proceeds in discrete chunks, these chunks will reach phonology separately, unlinearized wrt each other. However, phonology has no preferences or mechanisms for linearizing these chunks. If it did, linearization would be based on phonological properties, since those are the primitives phonology operates on. Thus, these chunks might be ordered so that consonant clusters are avoided. For example, the two chunks “Anne loves” and “John” would be linearized as “John Anne loves” to avoid the “sj” sequence of “Anne loves John”. However, since we know that the linear order of elements depends on their place in the hierarchical structure in syntax, and assuming a modular system, it cannot be the case that phonology is responsible for the linearization. If we assume a cumulative spell-out, Phase 1 does not need to be linearized with respect to Phase 2 after it is spelled out to phonology, since it is actually part of Phase 2. It is, in fact, linearized with the new material as part of the overarching Phase 2. This does not mean that the NRH excludes the possibility of phonology playing a part in linearization, e.g. in cases of heavy NP shift. What it does exclude is that all linearization happens in phonology. A more detailed discussion of linearization can be found in Section 4 of Paper 2.

An anonymous reviewer of Paper 2 points out that “the fact that phase material is accessible to probes in the next phase up is also recognized by Chomsky (2008), where it is assumed that by the completion of a phase the complement domain of the phase head is not Spelled-Out until the next phase up is completed”. The reviewer suggests that this mechanism may also provide a solution to the linearization problem. However, in the system the reviewer refers to, once any material is spelled out, it does become inaccessible. To put it simply, even if “John” is not spelled out until “loves” or “Anne” is completed, “John” is still spelled out before the phases above it in the hierarchy are, and separately from them. Once it is spelled out it is no longer accessible and thus cannot be spelled-out again. I argue that it is spelled out separately (which gives us domain mapping) but is crucially still accessible and spelled out again (which gives us linearization and accommodates for reordering due to movement which happens after spell-out of lower merges in this system).

Furthermore, any view that does not allow for previously spelled-out material to be accessible in the next spell-out has a difficulty accounting for cases such as the spell-out of regular and irregular past tense in English (and suppletive morphology in general). If what was once lexically matched and spelled out could not be spelled out again, all verbs would be regular. This is the secondary reason why cumulative spell-out is argued for in the NRH.

3.2 Modularity: the nature of input to phonology

Once a piece of syntactic structure is successfully spelled-out, the input that reaches phonology consists of a linearized string of phonological underlying forms of lexical items. It is a cumulative input that includes a spell-out of the syntactic structure that was spelled out in the previous phase. Sometimes the result of spelling out the same chunk will be the same input to phonology (as in the example of regular verbs). Sometimes it will be different because there exists in the lexicon an entry which matches the whole of the newly created structure (as in the example of irregular verbs). Crucially, this input does not contain information about syntactic domains, categories or features. Anything that might seem on the surface as mapping of syntactic categories or domains onto phonological ones is actually the effect of parsing chunks of syntax that were successfully spelled out and thus reached phonology.

Furthermore, the approach presented in this dissertation shows how it is not necessary to assume that phonology sees Information Structure features in order to account for their prosodic marking. In the system assumed here any feature can be spelled out by an individual lexical item. This makes suprasegmental markers of Information Structure features just like any other lexical entry, consisting of a piece of syntactic structure (the feature) and the corresponding phonological representation (the tone or tonal contour). Although it is not a widespread approach in generative literature, treating tones as lexical entries spelling out syntactic features is standard in literature on Bantu (e.g. Kula 2007).

3.3 Phonological computation: phonological phases

The NRH approach argued for in this dissertation claims that examples of phonology recognizing syntactic structure that are discussed in literature are actually examples of the effects of the process of derivation itself on the prosodic structure. Phonology is not recognizing and mapping syntactic elements. It is parsing the chunks it receives from spell-out. The only reason it looks as if it processes syntactic chunks is that these spell-out chunks correspond to syntactic units of various sizes.

The NRH approach assumes that phonological computation proceeds in phases, which parallel those in syntax. When a piece of the syntactic structure is successfully spelled out, it reaches phonology in form of a phonological input. This means, crucially, that not every Merge creates a structure that can be successfully lexically matched with phonological material. The reason phases will look different on the phonological side of the interface is that, although syntax sends structures off to spell out every time, there is no successful lexical match every time. This results in fewer phases in phonology, because they only happen when phonological material actually reaches phonology. The input that does reach phonology is then fully parsed in an OT computational system. In that way, prosodic structure is created at each phase, and these prosodic constituents correspond to the spell-out chunks in size. Since spell-out can happen at each merge, these prosodic constituents can be of any size and phonological content: a single phoneme, tone, morpheme, word, phrase, utterance. In this way not only prosodic phrasing is accounted for, but also the prosodic organization below PPh level (in cooperation, of course, with prosodic well-formedness constraints). This prosodic structure is stored in working memory and referred to in the processing of the next phase. What has been parsed a certain way in the first phase can remain identically parsed throughout the derivation, or its parsing can change, depending on the constraint interaction.

The approach presented in this dissertation also claims that the difference in the prosodic behavior of function words and lexical words comes from the fact that what is thought of as lexical words actually spells out parts of the syntactic structure that are merged first into the syntactic tree. These parts are then fully prosodified and parsed as Prosodic Words (and all the levels above). This PWd status is then kept throughout the derivation. This approach also captures the fact that polysyllabic function words behave prosodically like lexical words, in that they can be parsed as PWd and carry word stress. This is the result of the fact that the requirements of prosodic well-formedness constraints in this case do not clash with those of Phase-Phase Faithfulness constraints that outrank them. Furthermore, since in this system any functional material added to the initial “lexical” phase gets treated equally, regardless of whether it is a function word or an affix, this dissertation provides an account of the difference in prosodification of the two.

This reference to the previous phase is achieved by Phase-Phase Faithfulness constraints. The constraints proposed in this dissertation are the following:

(15)

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*

PHASEMAX - PMAX

Every prosodic constituent in phase *n* must have a correspondent in phase *n+1*, for example:

PHASEMAX(FT)

Every Foot in phase *n* must have a correspondent in phase *n+1*

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*

The anchoring constraint stems from the alignment constraints, and is derived from the template for anchoring constraints given in McCarthy and Prince (1995: 123), where (S_1, S_2) are pairs of representations, e.g. Input-Output, Base-Reduplicant, or, in this case, Phase n-Phase n+1:

(16) {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 $\mathscr{R}$ y

LEFT-ANCHOR. likewise, mutatis mutandis.

Sections 2 and 3 have provided an overview of the theoretical framework this dissertation assumes, and of the No-Reference Hypothesis it puts forth. The following section, Section 4, summarizes the contributions of each of the three papers to the theory of syntax-phonology interface argued for here. Subsequently, Section 5 presents a discussion of the theory and some concluding remarks.

4. Summaries of the Papers

4.1 Paper 1: Šurkalović, D. (2011a). Lexical and Functional Decomposition in Syntax: A view from Phonology. *Poznan Studies in Contemporary Linguistics (PSiCL)* 47(2). pp. 399–425.

Paper 1 was the first of the three to be written, and as such it sets the stage for the work presented in the two papers that followed. Its importance lies in that it was the first to present the need for revising our view of the interface based on changes in our understanding of syntax. It was also the first to utilize the decomposed view of syntax argued for by the Nanosyntax theory in addressing the syntax-phonology interface.

The paper presents the challenges that featural decomposition in syntax brings for the theories of phonological computation and of the syntax-phonology interface that are based on Prosodic Phonology. It discusses two particular issues. The first issue is that prosody, and by that phonology, recognizes edges of syntactic constituents, and lexical elements and projections but not functional ones (cf. Selkirk 1995; Truckenbrodt 1999, 2007 *inter alia*). The second issue is that, for Information Structure to be prosodically marked, prosodic constraints (Align-F, Stress-Focus) need to 'see' these syntactic features, which is undesirable if modularity is to be maintained.

The proposal presented in Paper 1 is that the Lexicon is the locus of communication between the two modules, since that is where syntactic and phonological information co-occur within a single lexical entry. Lexicon subcategorisation (cf. Paster 2005; Bye 2006) and/or Extended Exponence (Bye and Svenonius 2012 [to appear]) are offered as modular solutions to the challenge of recognizing the difference between lexical and function words. These two categories of words are seen as two distinct subsets in the lexicon. The phonological part of the lexical entry that reaches the phonological module after spell-out has the lexicon subset information encoded in it. This is then recognized in the phonological computation, which results in the different treatment of lexical and function words. Paper 1 also uses the Nanosyntactic view that features are merged into the tree individually, and suggests that Lexical entries for e.g. F and CT features in English are suprasegmental affixes, and that the phonological information in their lexical entry is only suprasegmental, namely a H* tone for the F feature and a L+H*L-H% contour for the CT feature.

As we can see, the solution to the challenges Paper 1 presents is different from what Papers 2 and 3, and indeed this dissertation as a whole, argue for. Paper 1 argues for the Lexicon as the solution to the modularity issues presented in the paper, whereas the proposal argued for in this dissertation is that the computation itself is the source of and the solution to what seem to be modularity violations. Footnote 1 in Paper 1 (Šurkalović 2011a:400) anticipates the competition between these two approaches, and promises a comparison of the two in Šurkalović (in prep.), which is the current dissertation. This comparison is addressed below in subsection 4.1.1, and the analysis of Information Structure marking is updated in subsection 4.1.2, to reflect the later findings and the proposed No-Reference Hypothesis theory.

4.1.1 Interface through the Lexicon vs. No-Reference Hypothesis

As mentioned above, Paper 1 presents a solution to the modularity issues that differs from that of the No-Reference Hypothesis. It argues for the use of the lexicon as the interface, through Lexicon Subcategorisation (cf. Paster 2005; Bye 2006) and/or Extended Exponence (Bye and Svenonius 2012 [to appear]). The question that needs to be addressed is why the subsequent work departs from this analysis.

The reason for departing from this analysis is that using the lexicon as the interface tool does not give us the solution to the problem of multiple spell-out and linearization discussed in section 3.1 of this introduction. One of the challenges that the views on syntactic computation assumed by this dissertation bring for the interface and the phonological computation is that of how the outputs of different phases of syntactic spell-out get linearized with respect to one another once they reach the phonological module. The lexicon cannot be used to solve this problem because the linear ordering of elements is based on their syntactic configuration in the tree, which changes from one structure to another and is not permanent information about any lexical entry that can be encoded in the lexicon.

Using the computation and the phases as the interface tool, however, does account both for the linearization of spell-out chunks and for the issues addressed by this paper. Furthermore, one could also argue that introducing indices to mark membership to what is traditionally defined as the lexical or functional category does not account for the source of the difference, but merely encodes it in a different way. In effect, it still represents (morpho)syntactic features in a phonological input. The No-Reference Hypothesis approach of using the computation itself to account for the difference between lexical and functional items is superior in that it demonstrates the underlying source of that difference.

The linearization issue and the issue of how phonology recognizes syntactic units and the difference between lexical and functional elements are addressed in Papers 2 and 3. In particular, Paper 3 (Šurkalović 2013) addresses in more detail the similarities and differences in the prosodification of affixes and function words, which are mentioned in Footnote 8 and briefly addressed in sections 4.1.1. and 4.1.2 in Paper 1 (Šurkalović 2011a). Since the issue of Information Structure marking is not analyzed within the current framework in any existing work, it is addressed in the following subsection.

4.1.2 Updated analysis of Information Structure marking

As we have seen in section 2.1.2, the analysis of prosodic marking of Information Structure in Paper 1 relies on the Nanosyntax view that all features, including Focus and Topic ones, are merged into the syntactic tree as individual terminals. These features have lexical items associated with them that pair the feature with its phonological realization. Thus, prosodic markers of Focus and Contrastive Topic in English are lexical items (morphemes) that spell out certain syntactic material (the feature) as certain phonological material (the suprasegmental information about tone).

The analysis presented in Paper 1 states that “The Lexicon provides the tonal contour, the spell-out (linearization) provides the domain of realization, and phonology places the tones within that domain with Prosodic Well-formedness Constraints, which make sure that the suprasegmental affix is properly placed on an appropriate Tone Bearing Unit (TBU) within its domain, e.g. that the H* tone marking Focus in English is realized on the main stress unit of the focused constituent.” (Šurkalović 2011a:416) As we can see, Paper 1 takes linearization for granted, and assumes a single input to phonology, without multiple phases.

In tableaux (20) and (21) in Paper 1 (Šurkalović 2011a: 419), cited below as (17) and (18) respectively, the lexical indexation and extended exponence approaches are applied respectively. We see that the suprasegmental affix H* is either indexed as a part of the lexical subset of suffixes in (17), or it includes place information about being located on the inside of a PWd in (18). The optimal candidate in (17a) satisfies the high-ranking constraint AlignR(suff, PWd), which requires phonological material indexed as a suffix to be aligned with the right edge of a PWd. This constraint, along with AssocPA, result in the focused preposition being realized as a PWd. In (18a) the outcome is the same, but this time due to IO-Faithfulness which forces the right edge of a PWd onto the focused preposition.

(17)

ASSOCPA

A Pitch Accent associates to (aligns with) a stressed syllable (head of a Ft) (Selkirk 1995)

ALIGN (SUFFIX, R; PWD, R)

The right edge of a suffix coincides with the right edge of a Prosodic Word

ALIGN (FNC, R; PWD, L)

The right edge of a fnc coincides with the left edge of a Prosodic Word

ALIGNL/R (ROOT; PWD)

The left/right edge of a Root coincides with the Left/right edge of a Prosodic Word

ALIGNL/R (PWD; ROOT)

The left/right edge of a Prosodic Word coincides with the Left/right edge of a Root

HP

Align the right boundary of every P-phrase with its head(s). (Féry and Samek-Lodovici 2006)

Throw it to$_{fnc}$-H*$_{Suff}$ the$_{fnc}$ dog$_R$ (not at it)	AssocPA	AlignR (suffix, PWd)	AlignR (Fnc, R; PWd, L)	AlignL/R (Root, PWd)	AlignL/R (PWd, Root)	HP
a. H* ☞((**tʊ**)$_\omega$ (ðə (dɔg)$_\omega$)$_\varphi$)$_\varphi$					**	*
b. H* (tə (ðə (**dɔg**)$_\omega$)$_\varphi$)$_\varphi$	*!	*				

(18)

Throw it to-H*)$_\omega$ the dog$_R$ (not at it)	AssocPA	I-O Faith	AlignL/R (Root, PWd)	AlignL/R (PWd, Root)	HP
a. H* ☞((**tʊ**)$_\omega$ (ðə (dɔg)$_\omega$)$_\varphi$)$_\varphi$				**	*
b. H* (tə (ðə (**dɔg**)$_\omega$)$_\varphi$)$_\varphi$	*!	*			

However, as stated above, this analysis needs to be updated within the current approach, which utilizes phases in spell-out to achieve domain mapping. Coupled with the notion of individual features as terminals, this means that, in order for the preposition to be focused and marked with the appropriate tonal affix, the two need to be spelled out in the same phase. One of the questions for further research posed in the conclusion to Paper 1 is "if all features are terminals and information structure markers are encoded as lexical items/prosodic affixes, and we know that e.g. in English any word can be focused, what is the position of the information structure features in the f-seq? Do they freely adjoin at any point or is there a fixed functional hierarchy?" (Šurkalović 2011a: 421). In the system presented in this dissertation the answer would be that there is no one fixed position. The Focus feature, in this case, needs to be able to adjoin to any part of the structure and be spelled out in a phase with it in order to mark it as focused. This also accounts for why focused function words are parsed as Prosodic Words. They are spelled out in a phase of their own, with the Focus feature, and not just added to a PWd in Phase 2.

In tableau (19) below we see the derivation of "to the dog" without focus, which is parallel to the derivation of "for a massage" given in tableau (29) in Šurkalović (2013: 317). We see that the optimal parsing in (19a) is that of two separate function words adjoined to the lexical word at the phrasal level, without having PWd status themselves. This PWd status in candidate (19c) is prevented by the violation of the PHASEDEP constraint. Namely, since "the" was not part of a Foot in the previous phase, it cannot become part of one in this phase, and thus it cannot be part of a PWd either.

(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*

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*

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

phase: |{ðə$_{\mu\ \sigma}$ ([dɔg]$_{Ft}$)$_{PWd}$}$_{PPh}$ | input: /tə$_\mu$ðə$_\mu$dɔg$_\mu$/	PALPWD	PDEP	PARSESYL	PARSEFT
a ☞ {tə$_{\mu\ \sigma}$ ðə$_{\mu\ \sigma}$ ([dɔg]$_{Ft}$)$_{PWd}$}$_{PPh}$			**	
b { [tə$_\mu$ ðə$_\mu$]$_{Ft}$ ([dɔg]$_{Ft}$)$_{PWd}$}$_{PPh}$		*!		*
c {([tə$_\mu$ ðə$_\mu$]$_{Ft}$)$_{PWd}$ ([dɔg]$_{Ft}$)$_{PWd}$ }$_{PPh}$		*!		
d {([tə$_\mu$ ðə$_\mu$] $_{Ft}$ [dɔg]$_{Ft}$)$_{PWd}$ }$_{PPh}$	*!	*		

In tableau (20) below we see the derivation of "TO the dog" with focus. We see that "to" is spelled out with the suprasegmental affix in a phase of its own before joining "the dog". There are two ways Phase 1 in focused function words can occur. The first is that these are separate lexical items, "to" and Focus marking, and they get merged and spelled out together as a PWd. In this case there are two options, either the underlying form is /tə/, and prosodic well-formedness forces the vowel to lengthen so that it can form a PWd and carry word stress and with that the suprasegmental marking, or the underlying form is /tʊ/ and reduction to schwa occurs when the vowel is not carrying stress. The other option for Phase 1 is that there are two lexical entries for function words, one that spells out the functional element alone, and one that spells out the functional element with the Focus feature. For the purpose of the argument presented here, it is irrelevant in what way Phase 1 occurs. What is important is that the function word forms a phase with the Focus marking which defines the domain of that marking, and which results in that function word forming a PWd on its own. As we can see, the constraint PHASEMAX, introduced in Paper 2, prevents the parsing identical to that of the unfocused preposition.

(20)

PHASEMAX - PMAX

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

phase: $\|\{ð ə_{\mu\ \sigma}([dɔg]_{Ft})_{PWd}\}_{PPh}\|$ phase: $\|\{([tʊ*H]_{Ft})_{PWd}\}_{PPh}\|$ input: /$tə_{\mu}$*H$ðə_{\mu}dɔg_{\mu}$/	PMAX	PARSESYLL	PARSEFT
a $\{tə_{\mu\ \sigma}$ *H $ðə_{\mu\ \sigma}$ $([dɔg]_{Ft})_{PWd}\}_{PPh}$	*!	**	
c ☞ $\{([tʊ*H]_{Ft})_{PWd}$ $ðə_{\mu\ \sigma}$ $([dɔg]_{Ft})_{PWd}\}_{PPh}$			

The same spell-out sequence would apply to lexical words as well, such as the example (22) in Paper 1 (Šurkalović 2011a: 420), cited below as (21), which illustrates CT marking and is taken from Büring (2007:16).

(21) (What did the pop stars wear?)

L+H* **L- H%** **H*** L- L%

The $FEMALE_{CT}$ pop stars wore $CAFTANS_{F}$.

The input to phonology in Phase 1 is /fi:meil L+H* L-H%/, and the prosodic well-formedness constraints ensure that the suprasegmental affix is associated with the appropriate nuclei. The output of Phase 1 is thus a CT marked “female”, which continues as such throughout the phases of the computation.

4.2 Paper 2: Šurkalović, D. (2011b). Modularity, Linearization and Phase-Phase Faithfulness in Kayardild. *Iberia: An International Journal of Theoretical Linguistics* 3(1). pp. 81-118

Paper 2 was the second of the three to be written. It builds on the issues discussed in Paper 1, and it is the first paper to present the No-Reference Hypothesis approach argued for in this dissertation. As in Paper 1, its primary concern is achieving a modular mapping of syntax to phonology, and it relies on the decomposed view of syntax argued for in the Nanosyntax approach. However, it departs from Paper 1 in that it assumes multiple spell-out and phases in syntax.

Paper 2 explores the effects of the multiple spell-out view of syntactic computation on phonology. It argues that what seem to be syntactic domains mapping onto phonological ones is, in fact, syntactic phases being mapped to phonological domains. It shows how we can achieve a modular mapping of syntactic domains to phonological ones by using the process of derivation itself, and not the Lexicon, as the tool of syntax-phonology mapping. Paper 2 argues that phonological computation also proceeds in phases, matching those in syntax. The additional challenge this poses on the interface is that of linearization of the outputs of different phases when they reach the phonological module. This is resolved in the NRH model by assuming a cumulative cyclic spell-out, and an explicit account of linearization is provided. Paper 2 also provides a formalization of this approach within Optimality Theory, and introduces Phase-Phase Faithfulness constraints.

This paper focuses on data from Kayardild, and takes a brief look at Ojibwa and English. Kayardild is chosen because of its interesting case-stacking properties and the interaction of syntax and phonology. In Kayardild, each root and its suffixes form a Prosodic Word domain (Evans 1995, Round 2009). In traditional terms, this would mean that the left edge of a PWd aligns with the left edge of a lexical word. This is illustrated in example (22) below, taken from Evans (1995: 115) and cited in Šurkalović (2011b: 84):

(22)

maku yalawu-jarra yakuri-na dangka-karra-nguni-na mijil-nguni-na

[(maku)$_\omega$ (jalawucara)$_\omega$ (jakuɻina)$_\omega$ (t̪aŋkakaraɲŋunina)$_\omega$ (micilŋunina)$_\omega$]

woman *catch*-PST *fish*-MABL *man*-GEN-INSTR-MABL *net*-INSTR-MABL[5]

'The woman caught the fish with the man's net.'

(Evans 1995: 115, transcription following Round 2009)

The category of CASE illustrated by the suffixes in (22) above encodes various syntactic and semantic relations among the elements of a clause, such as tense, mood or aspect, on the nouns participating in the event expressed by the verb. Due to the fact that spell-out of these features is delayed until the verbal domain features are merged into the tree, the order in which the elements of the clause reach spell-out, and thus phonology, does not correspond with the final linear order of the utterance. This creates a challenge for the linearization of spell-out chunks, if we assume, as is common, that linearization happens in discrete chunks which do not overlap. To solve this linearization problem the NRH model argues that spell-out proceeds in cumulative cycles, and each phase includes the material that was already spelled-out and the newly merged material. This way, the material that would otherwise have needed to be infixed into the material from the previous phase gets linearized by the regular algorithms.

In phonology, each phase is parsed as a prosodic domain. Lexical words reach phonology as the first phase, and are fully parsed, which accounts for them having PWd status. Function words, such as suffixes in Kayardild, are merged in later phases, and adjoin the PWd formed around the lexical word. Phase-Phase Faithfulness constraints recognize the previously parsed material and force faithfulness to the parsing that has already been carried out. The extent to which a language is faithful to a parsing in the previous phase depends on the interaction between these constraints and prosodic well-formedness constraints. Kayardild is an example of a language which maintains the left edge of the PWd throughout the phases, whereas the right edge is extendable and it freely incorporates new material, making Kayardild prone to

[5] PST = Past, MABL = Modal Ablative (Case that is assigned by the Tense of the Verb), GEN = Genitive, INSTR = Instrumental)

extensive suffixation.

Kayardild is contrasted with Ojibwa, where faithfulness to Feet that were parsed in the initial phase outranks many prosodic well-formedness constraints, which results in suboptimal parsing of the final string. Paper 2 also addresses the prosodification of function words in English, and derives the difference in prosodic marking of function and lexical words from their derivational status. This is explored in more detail in Paper 3.

4.3 Paper 3: Šurkalović, D. (2013). Modularity, Phase-Phase Faithfulness and Prosodification of Function Words in English. *Nordlyd* 40(1). pp. 301-322

Paper 3 extends the argument for the No-Reference Hypothesis model introduced in Paper 2 by focusing on the prosodification of function words in English. As stated in sections 4.1 and 4.2 above, some of the challenges involved in capturing the difference between the prosodification of function and lexical words that have been mentioned in Paper 1 and 2 are explored in more detail in Paper 3, such as the differences in the prosodic behavior of affixes and function words. Furthermore, Paper 3 addresses the fact that not all function words behave prosodically the same. While monosyllabic function words behave the way function words are commonly described, polysyllabic function words side prosodically with lexical words. The paper additionally shows how the effects of LAYERDNESS and HEADEDNESS, the inviolable half of the Constraints on Prosodic Domination (Selkirk 1995, capturing the Strict Layer Hypothesis of Selkirk 1984), can be captured by use of the PARSE family of constraints, thus removing the need for two inviolable constraints being postulated.

Function words in English are a recurring theme in all three papers because of their relevance for the argument that phonology sees the difference between lexical and functional categories in syntax (cf. Selkirk 1981, 1995, 2011 inter alia). This paper applies the NRH model to this data and shows how the difference in prosodic behavior can be derived from the difference in derivational status. Section 2.2 of Paper 3 looks at determiners, and addresses the fact that monosyllabic determiners are unstressed and do not form a PWd (unless focused), while polysyllabic ones do carry stress and form a PWd on their own. It contrasts the prosodic behavior of “a” and “some” with that of “any”. Section 2.4 addresses the same difference in behavior in prepositions, contrasting “for” with “under”. Finally, section 2.5 illustrates the interaction of functional and lexical material in a longer stretch of a derivation.

5. Discussion and Concluding Remarks

5.1 Answers to questions from audiences and reviewers

The three papers that comprise this thesis have benefited greatly from comments and suggestions given by conference abstract reviewers, presentation audiences and by the anonymous reviewers of the papers themselves. As it is usually the case, some of these questions and comments went unaddressed for reasons of space. Since space is not an issue in a dissertation, I will address some of them here.

5.1.1 The Prosodic Hierarchy

An anonymous reviewer of Paper 1 states:

> "reference to prosodic words, prosodic phrases etc. supposes that prosodic structure exists independently: only then can the lexical specifications be compared via IO-Faith. But how do prosodic words and prosodic phrases come into being? The way they are created in OT is precisely what the author shows to be incompatible with modularity. So an alternative way to create prosodic structure is needed, and the author needs to be explicit about its genesis."

The second reviewer of the same paper also wonders:

> "there is a critical ingredient of the approach that is not made explicit (but is implicit from the practice of the author): the prosodic hierarchy as such is not called into question… However, the PH has been called into question in recent literature by Scheer precisely because it violates modularity".

The account argued for in this dissertation does assume the existence of the Prosodic Hierarchy. However, it is seen merely as a model of phonological representation of suprasegmental structure, and as such it does not violate modularity. What does violate modularity is the computation assumed by the Prosodic Phonology, which makes reference to both syntactic elements and the elements in the Prosodic Hierarchy. This computation is used to create the prosodic structure, and its non-modular reputation has been unfairly transferred to the representation itself. Scheer (pc) also does not deny the existence of prosodic organization of utterances, but he objects to deriving it by mapping it from syntactic categories, which is what the PH has become identified with.

The alternative way of creating the prosodic domains, that the first reviewer is asking to be made explicit, is through the use of PARSE constraints introduced in Paper 2. As the paper shows, they replace the non-violable constraints on prosodic representation that form the Strict Layer Hypothesis of Selkirk (1984), and create the prosodic structure. In a way, they can be thought of as similar to the Merge operation in syntax, which creates syntactic structure.

5.1.2 Prosodic Phrase level computation in Kayardild

An anonymous reviewer of Paper 2 states:

> "The proposed analysis deals with the prosodification at the lower levels of the prosodic hierarchy (i.e. foot, PrW). There is no reference to the higher levels of the prosodic hierarchy such as PPhs. … It is not clear whether the analysis proposed can account for the prosodification at this level and in what ways. The author is advised to address this issue, especially since almost all the previous Multiple Spell-Out approaches to the syntax-phonology interface are concerned with the prosodification at this level."

While Paper 3 does address prosodification above PWd level using English as the example, there are two reasons why the analysis of Kayardild prosodification above PWd is not included in Paper 2. First was, of course, space. The scope of the paper needed to be limited, and it was so, to the levels below PWd. Partly precisely because there have been few accounts that refer to the effects of MSOH on levels below PPh.

The second reason is that Kayardild is a difficult language to analyse at levels above PWd, for the following reason. Neither Evans (1995) nor Round (2009) give any prosodic structure above PWd. Namely, Round (2009) states that the levels above PWd are Breath group and Utterance, and states that:

> "for the purposes of cross-linguistic comparison, the breath group can be considered on par with many other languages' utterance domains. An alternative to the analysis presented in this chapter would be to label the breath group as a subordinate utterance constituent, in a system which permits recursive embedding of the utterance domain" (Round 2009: 313, fn1)

Breath Groups are defined as "a stretch of speech bounded by planned pauses… and are characterised at their right edge by truncation processes … and by distinct intonation" (Round 2009: 315). Round leaves the details of BG in Kayardild for future research, and provides very few examples of BG-parsed utterances, but from what can be seen there seems to be no binarity requirement and they seem to be dependent more on the information structure of the utterance than its prosodic structure at lower levels. Thus, for lack of sufficient data and understanding of the data provided I do not address this issue in this paper.

5.2 Comparison with other interface theories

This dissertation focuses on issues related to Prosodic Phonology as the most influential theory of the Syntax-Phonology interface. However, since I began work on this dissertation several different works that address this interface and connect multiple spell-out and phases in syntax with phonological computation and structure have appeared and become notable. This section compares the current proposal with these theories. I will limit this comparison to theories that adopt the Optimality Theory view of phonological computation, to the exclusion of Scheer (2012), whose work, although seminal in nature, is set within the CVCV theory of phonology.

5.2.1 Non-modular interface theories

Non-modular interface theories are clearly distinct from the No-Reference Hypothesis presented in this dissertation in that they do not assume a modular view of the language system. One set of non-modular theories has been discussed in detail in the previous sections and in the papers that comprise this dissertation. Those are the theories belonging to the Prosodic Phonology tradition (e.g. Selkirk 2005, 2009, 2011). Prosodic Phonology assumes the existence of prosodic structure that mediates between syntax and phonology. However, the constraints mapping that structure, such as Align and Match constraints in (4), (6), (8) and (10) make reference syntactic elements, which violates modularity. As previously discussed, the NRH argued for in this dissertation assumes that input to phonology consists only of phonological primitives, and no syntactic information survives, so no reference is made to it in the phonological computation.

The other category of non-modular interface theories assumes no prosodic structure exists. Phonological computation has direct access to syntactic structure and operates on syntactic domains and primitives. Ishihara (2003, 2007) analyzes the focus intonation pattern (FIP) by using the phase spell-out domains as domains of prosodic prominence assignment. However, unlike this dissertation, his work assumes there are no prosodic domains, and that prosodic prominence is assigned within syntactic spell-out domains. Phonological rules have direct access to syntactic features, such as the FOCUS feature, and can manipulate them by e.g. deleting them. For example, "the FIP Rules do not apply at any early Spell-Out cycles until the FOCUS phrase/wh-phrase is assigned a FOCUS feature… after the FIP Rules applied to a FOCUS feature at one Spell-Out cycle, the feature is deleted. Consequently, they become invisible to operations at later Spell-Out cycles." (Ishihara 2003:95). Seidl (2001) and Pak (2008) also argue that there is no prosodic hierarchy, but that phonological rules refer directly to syntax, as does Samuels (2009). Their arguments are based on the related phenomena of domain paradoxes (Seidl) and multiple-domain and variable-domain effects (Pak), where phonological rules seem to make reference to different but overlapping domains, and there is no one to one correspondence between syntactic and prosodic domains.

5.2.2 Phase-based interface theories

A category that intersects the previous one to a great extent is the phase-based interface theories. In Ishihara (2003, 2007) and Pak (2008) the spell-out is assumed to happen at specific points in the syntactic derivation, vPs, and CPs, not at each merge, like in the NRH. Kratzer and Selkirk (2007), Revithiadou and Spyropoulos (2009), and to some extent the Match theory of Selkirk (2009, 2011) are also based on the notions of specific points at which spell-out happens, but differ from Ishihara (2003, 2007), Seidl (2001) and Pak (2008) in that they assume the existence of a prosodic hierarchy of domains. Adger (2007) also assumes specific spell-out points, and refers to prosodic structure in the form of prominence and bracketed domains, but does not incorporate the Prosodic Hierarchy in the analysis. Revithiadou and Spyropoulos (2009) further differ from the proposal presented in this dissertation in that they argue that the derivational domains, products of each spell-out cycle, "are mapped onto separate prosodic constituents. More specifically, [they] argue that, since these derivational cascades reach PF as individual units, they are independently processed and thus, are mapped onto separate p-phrases" (Revithiadou and Spyropoulos 2009:206). This means that in their view spell-out proceeds in individual chunks, such as in (1a), and not in cumulative phases, such as in (1b), as is argued for in the NRH.

Unlike the works listed above, the No-Reference Hypothesis argued for here is based on the idea of spell-out happening at each merge. What the theories adopting the spell-out-at-specific points have in common is that they analyze higher-level prosodic domains, from Prosodic Phrase and upwards. However, if we want to map all prosodic domains, including lower level ones, such as Prosodic Words, by using phases in syntactic spell-out, and if we want to capture what is traditionally called word-level phenomena, we need to assume smaller spell-out domains. This is discussed in more detail in the three papers that comprise this dissertation, as well as in the previous sections of this extended introduction.

An approach that has more aspects in common with the approach presented in this dissertation is that of Bye and Svenonius (2012), who look at non-concatenative effects in productive inflectional morphology and work towards eliminating mechanisms such as morphological subcategorization and morpheme-specific alignment constraints from the phonological computation. Like the NRH, their approach is based on the syntax-all-the-way-down view present in Distributed Morphology and Nanosyntax, and they adopt a modular view of language in that they "uphold the view that lexical, morphological and syntactic information is unavailable to the phonological component" (Bye and Svenonius 2012:2). They also assume spell-out is cyclic. However, they also state that only certain syntactic heads are designated as phase heads.

A phase-based approach that does assume spell-out at each point where spell-out is possible is that of Newell (2008). She looks at languages such as Ojibwa, where we see cyclic effects within words, suggesting that there are phases below phrase level. The difference between Newell (2008) and the approach presented in this dissertation is the treatment of linearization and the formalization of the phonological computation in phases within the OT constraint-based system. While Newell (2008: 32) states that "at PF and LF, the output of each phase is stored and integrated according to the principles that are operative in each branch of the computation", the NRH presented in this dissertation recognizes that phonology has no principles for integrating two phonological strings that arrive from syntax. NRH presents an explicit account of the nature of the input to phonology after cyclic, phase-based, spell-out, and of the OT constraints used in mapping prosodic domains in this system.

Another phase-based syntax-phonology interface approach that shares certain traits with the NRH argued for in this dissertation is that of Cheng and Downing (2012**,** *to appear*). They look at data from Bantu and argue for a non-cyclic model, against the idea that the output of each spell-out reaches phonology, which is an important part of NRH. Due to the fact that phonology has access to syntax only at the end of the derivation, the mapping constraints in Cheng and Downing (*to appear*) such as the one in (23) below still violate modularity in that they refer to syntactic objects such as phase edges[6].

[6] Since the input to phonology arrives as a single spell-out at the end of the derivation, phase edges need to be encoded in that input. In a modular system, the only source of phonological information in the input is the phonological information stored in lexical items. Unless phase edges are spelled out by specific phonological material, those edges are syntactic in nature, which means that syntactic information reaches phonology.

(23)

a. ALIGNR[PHASE, INTPH] (ALIGNR-PHASE): Align the right edge of every phase (*v*P/CP) with the right edge of an Intonation Phrase (IntPh).

b. ALIGNR[INTPH, PHASE] (ALIGNR-INTPH): Align the right edge of every Intonation Phrase (IntPh) with the right edge of a phase (*v*P/CP).

Cheng and Downing (*to appear*) do, however, show that phase edges need to be recognized by phonology, which parallels the findings of this dissertation. It would be an important step in developing the NRH to account for the Bantu data using the Phase-Phase Faithfulness constraints, e.g. a PHASEANCHOR, in conjunction with prosodic well-formedness constraints.

5.3 Comparison with Stratal OT

This dissertation argues that phonological computation proceeds in phases that are caused by phases in the syntactic computation. Although the idea of basing phonological cycles on syntactic phases is relatively new, the idea of the phonological computation happening in cycles is well established within OT in form of Stratal OT. This section compares the current proposal with this theory.

Stratal OT (Bermúdez-Otero 2011, 2012, 2014, Kiparsky 2000) is a theory of phonological computation combining the classical OT parallel constraint-based computation with the idea of the phonological cycle and phonological stratification, originating in the theory of Lexical Phonology (LP). Phonological computation is assumed to operate on phonological domains, starting with the smallest domains created early on in the (morpho)syntactic concatenation of an utterance, and recursively applying to all subsequent larger domains created at later stages of (morpho)syntactic concatenation. Thus, although Stratal OT follows the classical OT in achieving the mapping of input to output by a parallel constraint-based computation, there is no one parallel computation of a single input string, but multiple parallel computations of different input strings provided by the different cycles.

The stratal architecture of phonology in this theory assumes that (morpho)syntactic constituents exist in three types: stem-level, word-level and phrase-level. Each level (stratum) is associated with its own constraint ranking, which is where this theory departs from the classical OT notion of a unique ranking for a given language. Thus, the stem-level constituent triggers a cycle which creates a domain for stem-level phonology, the inflectionally complete grammatical word triggers a cycle creating a domain for word-level phonology, and the cycle triggered by the highest node of the utterance creates the domain of phrase-level phonology. There are no restrictions on the amount of divergence between rankings at different levels within the phonology of one language.

In addition to the cyclic approach, giving multiple input-output computations, and the different rankings for different levels, Stratal OT differs from mainstream OT in its repertoire of constraints used in the computation. It rejects the Output-Output constraints as a means to capture (morpho)syntactic and lexical effects on phonological computation, and due to its modular approach to the (morpho)syntax-phonology interface it rejects constraint indexation as a way of referring to non-phonological information in a phonological computation. Access to syntactic information is indirect and local, via morphological levels (stem, word, phrase). Thus, the grammar has the classical modular unidirectional architecture, with syntax preceding morphology, morphology preceding phonology and phonology preceding phonetics

Beyond the obvious difference of multiple vs. one constraint rankings, Stratal OT is similar to the No-Reference Hypothesis argued for here in that it strives towards a modular account of the syntax-phonology interactions. However, the two approaches differ greatly in their assumptions about the nature of (morpho)syntax. While a separate morphological module is necessary for Stratal OT, the NRH adopts the decomposed view of syntax where there is no separate morphological module, and thus no morphological categories, especially that of “word”. Furthermore, the cycles in Stratal OT are related to these morphological categories/levels, whereas the NRH derives them from independently motivated syntactic cycles. This results in prosodic domains corresponding with cyclic domains in the phase-based NRH, but not in Stratal OT.

Stratal OT has had great success in accounting for many language phenomena, especially at word level, such as stress and affixation, and a true comparison of the two approaches is not possible within the boundaries of this dissertation. A brief analysis of Belfast English dentalization will be presented for illustrative purpose, to compare the two theories and show how NRH could potentially account for the types of cases Stratal OT has accounted for.

Belfast English dentalization (Bermúdez-Otero 2011) is the process of dentalizing /t, d, n, l/ in front of /(ə)r/, for example in "train", "drain", "Peter", "ladder" etc. However, dentalization underapplies when the environment is created by agentive –er and comparative –er, for example in "waiter", "loader", "runner" etc. This gives us the difference between the dentalized 'better' (comparative of "good") and non-dentalized 'better' ("one who bets"). Within Stratal OT, "In the case of Belfast English, one must assume that dentalization applies only within stem-level domains, and that agentive -er and comparative -er are word-level suffixes unless attached to bound roots. This yields the appropriate counterfeeding relationship between stem level dentalization and word-level suffixation" (Bermúdez-Otero 2011:6).

Within the framework of the No-Reference Hypothesis argued for in this dissertation, the distinction between the two cases is made by appealing to the difference in the derivation. The dentalization process applies at all cycles, but Phase Faithfulness constraints would block the application in the second cycle. We see in tableau in (24) below, how in the derivation of "train" the dentalization trigger is present in Phase 1, whereas it is not in "wait". The Phase faithfulness constraint, PhaseID Dental, demanding that the dental features of segments remain identical to the previous phase, is not activated in Phase 1, since there is no previous phase. The constraint that favours dentalization (a placeholder constraint is used here for simplicity) outranks Input-Output Identity constraint for the dental feature, which means that in the case of "train" the dentalized candidate is optimal, as opposed to "wait". In Phase 2 of "waiter", in tableau (25), the trigger is there, but faithfulness to the output of the previous phase is outranking the constraint that favours dentalization, whuch results in underapplication.

(24) Phase 1

/train/	PhaseID Dental	Dentalize before /(ə)r/	IO-ID Dental
a. ☞ train.Dental			*
b. train		*!	
/wait/			
a. wait.Dental			*!
b. ☞ wait			

(25) Phase 2

Phase1 Output: | wait |			
/waiter/	PhaseID Dental	Dentalize before /(ə)r/	IO-ID Dental
a. waiter.Dental	*!		*
b. ☞ waiter		*	

5.4 Conclusion

This extended introduction had the purpose of presenting the three articles that comprise this thesis as a coherent whole. Section 1 outlined the aims and scope of the dissertation. Section 2 placed the papers in a theoretical context, before Section 3 presented the No-Reference Hypothesis the dissertation argues for. Section 4 summarized the contributions of each of the papers, and section 5 took the discussion further by answering some questions that were left unaddressed in the papers for reasons of space, and by comparing the theory presented here with some other theories within the similar frameworks for syntax, phonology and the syntax-phonology interface.

The dissertation addresses the questions of how we can derive the effects of syntactic structure on phonology, how mapping from syntax to phonology is carried out, of the nature of input to phonology and of the phonological computation. It argues that syntactic computation proceeds in phases, producing cumulative cyclic input to phonology consisting solely of phonological primitives. The No-Reference Hypothesis manages to formalize a fully modular approach to the syntax-phonology interface within the Optimality Theoretical computation, by introducing PhasePhase Faithfulness constraints. Furthermore, it provides an explicit account of how the outputs of the different phases are linearized on their way to the phonological module.

The clear limitations of this dissertation lie in its narrow empirical coverage. Directions for future research include looking into cyclic effects at word level (such as those Stratal OT successfully accounts for), cases where prosody seems to drive syntactic movement (such as Focus movement in Italian, heavy NP shift or prosodic scrambling of phonological phrases in Japanese touched on in section 2.1.2.), and lexical category-specific effects, mentioned in section 2.2.1.

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Part II

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LEXICAL AND FUNCTIONAL DECOMPOSITION IN SYNTAX: A VIEW FROM PHONOLOGY

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ABSTRACT

In recent years many lexical elements in the syntactic tree have been decomposed into formal features forming part of the functional sequence. This paper explores the effects of this change on the syntax–phonology interface, addressing two problems for language modularity and proposing that the Lexicon be the locus of communication between the two modules. The first issue is the sensitivity of prosody to edges of syntactic constituents and to lexical elements and projections but not to functional ones (cf. Selkirk 1995; Truckenbrodt 1999, 2007 inter alia). Lexicon subcategorisation is offered as the solution (cf. Bye 2006; Paster 2005). The second issue is the prosodic marking of Information Structure. In Prosodic Phonology, constraints (Align-F, Stress-Focus) "see" these syntactic features, which is undesirable if modularity is to be maintained. This paper uses the Nanosyntactic view that features are merged into the tree individually, and suggests that Lexical entries for e.g. F and CT features in English are suprasegmental affixes pairing a H* tone with F feature or a L+H*L-H% contour with a CT feature.

KEYWORDS: Modularity; syntax–phonology interface; prosody; information structure; lexicon.

1. Introduction

The term "modularity" as it is used in this paper refers to the notion that the language computation system consists of three independent modules, syntax, phonology and semantics. This model originated in Chomsky (1965) and has been the basis for generative theories of grammar ever since (cf. Scheer 2010 for a detailed overview). Furthermore, the view here is derivational, in the sense that phonology follows syntax, and output of the syntactic computation serves as input to the phonological computation. These modules are considered to be independent of one another, operating on domain-specific primitives and not understanding the "vocabulary" of the other modules, much like hearing is distinct from seeing. We cannot "see sounds", and in the same way phonology cannot understand or operate on syntactic primitives. The term "interface" refers to the translation of information from one module to another. In the case of the syntax–phonology interface, "spell-out" is used to refer to the process of linearization of syntactic tree structure and lexical insertion, providing phonology with a linear input consisting of underlying forms of lexical items.

However, as we will see in the following sections, certain interaction between the modules does seem to exist, and current theories addressing them have been unable to maintain full modularity. The goal of the work presented here is to account for the interaction of syntax and phonology in a modular view of language, focusing on the "word" level.[1] The questions I will be answering are: How can we derive the effects of (morpho)syntax and information structure on prosodification without referring to that structure in the phonological computation? How do we restate the lexical/functional distinction in a completely functional syntax? What is the nature of the input to phonology?

Section 2 presents an overview of current theories of syntax–phonology mapping and shows how they violate modularity. Section 3 gives a brief introduction to lexical and functional decomposition in syntax, focusing on aspects relevant to phonology. Section 4 addresses the issues arising from combining our views on phonology and its interface with syntax with the current advances in syntactic research. Section 5 gives some concluding remarks and offers directions for future research.

2. Prosody and modularity

Modeling the mapping from syntax to phonology in phonological theory has been the task of Prosodic Phonology (e.g. Selkirk 1981, 1986, 1995; Nespor and Vogel 1986; Hayes 1989; Truckenbrodt 1999, inter alia). Since, in the modular view of grammar, phonology cannot access syntax due to the fact that syntactic representations are not phonological objects, it does so indirectly via prosodic structure. Prosodic constituents mediate between syntactic structure and phonological rules/constraints. In Prosodic Phonology this is known as The Indirect

[1] For a modular account of PPh parsing based on Phases in syntax, and a comparison of the account presented here with accounts of mapping at word level based on Phases, e.g. Marvin (2002), Newell (2008), see Šurkalović (in prep.). Unfortunately, I will not be addressing them here for lack of space.

Reference Hypothesis. Suprasegmental representations are assumed to be organized into a Prosodic Hierarchy of domains (PH), consisting of Syllable, Foot, Prosodic Word, Prosodic Phrase, Intonation Phrase, and Utterance levels.[2] The motivation for proposing it and evidence for the various prosodic domains comes from a number of segmental processes that seem to be sensitive to them. The PH plays the main role in the interface.

Computationally, when accounting for the mapping from the output of the syntactic component to a phonological representation, current work in Prosodic Phonology uses constraints and constraint interaction as defined in Optimality Theory (Prince and Smolensky 1993; McCarthy and Prince 1993, 1995).

The most active group of constraints are the Alignment constraints, originally stemming from the end-based theory of syntax-prosody mapping proposed by Selkirk (1986), and later developed into the Generalised Alignment theory of McCarthy and Prince (1993). They are used to align edges of different domains, as well as to align the head of a domain with an edge of the domain it is the head of. The most developed and currently most influential account of the interface between syntax and prosody has been proposed by Truckenbrodt (1995, 1999, 2006, 2007). His system uses Selkirk's edge alignment and introduces constraints on stress placement:

(1) **Align-XP,R/L**: ALIGN(XP, R/L; p-phrase, R/L)
The right/left edge of each syntactic XP is aligned with the right/left edge of a p-phrase.

(1b) **Wrap-XP**
For each XP there must be a p-phrase that contains the XP.

(1c) **Stress-XP**
Each XP must contain a beat of stress on the level of the p-phrase.

Note however that, even without referring to specific syntactic categories, labels, syntactic relations or the rest of the syntactic information present in the tree, prosody still sees certain syntactic information, such as the edges of syntactic constituents. Also, prosody is not a separate module, but is for all intents and purposes part of the phonological computation, which means that the separation of the syntactic and phonological module is not achieved. For full modu-

[2] More detailed versions of PH exist in various works, I list here the most general view, as it will suffice for the discussion at hand.

larity to exist we would need a "No Reference Hypothesis"[3] (cf. also Scheer 2010), which is what this paper is arguing for.[4]

2.1. Lexical/functional distinction

In addition to the edges of syntactic constituents, it is the distinction between lexical words (nouns, verbs, adjectives) and function words (determiners, prepositions, auxiliaries, complementizers etc.) that seems to be relevant not only in the morpho-syntactic module of language, but also in the phonology (Inkelas and Zec 1993; Selkirk 1995; Chen 1987, inter alia). The idea that lexical government plays a role in the syntax-prosody mapping dates back to Hale and Selkirk (1987).

In prosodic phonology it has been assumed that all lexical projections share the common "lexical" feature under their V, N or A head, which percolates to the phrasal projection they are the head of. This feature marks both the morphological word inserted into that head and its projection as lexical. This is made clear in Truckenbrodt (1999: 227), where he states that in cases of complex VPs, containing more than one object, and where the verb moves from VP to vP, it is the vP that is "a lexically headed projection in the relevant sense". The verb moves and becomes head of vP, which in turn becomes a lexically-headed projection.

Selkirk (1995) has argued that the mapping constraints relating syntactic and prosodic structure apply to lexical elements and their projections, but not to functional elements and their projections:

(2a) 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.

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[3] I use the term Direct Reference to signal phonology having direct access to syntax (e.g. the Direct Syntax approach of e.g. Kaisse 1985; Odden 1987), and the term No Reference to refer to phonology only processing phonological information and not referring to syntactic notions. The term Direct Reference is not to be confused with the term Direct Interface, which Scheer (2010) introduces and uses in the sense No Reference is used here.

[4] It is important to point out that this paper is not arguing against the existence of prosodic structure, but only against the current non-modular accounts of accounting for the particular prosodic phrasings of various utterances.

(2b) 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.

(2c) 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.

The example used to argue for this is the fact that in English monosyllabic function words can occur both in their full, "strong", form and in the reduced, "weak" form, depending on their position in an utterance (e.g. *I want [tʊ], but I don't think I [kæn]* vs. *I want [tə] see if I [kən] do it*), whereas lexical words always appear in their full form (that is, even though some reduction may appear in lexical words, e.g. *telepathy* [təlepəθi], but *telepathic* [teləpæθɪk], they can never be fully reduced, i.e. *[tələpəθi], unlike function words, since the stressed syllable of the lexical word remains in its full form). If we look at lexical words, a sequence of two lexical words in a phrase will be prosodified as a sequence of Prosodic Words. On the other hand, in a sequence of a function word and a lexical word, the function word can be mapped onto a PWd, or onto a prosodic clitic, i.e. a (morpho)syntactic word which is not a PWd, but a syllable or Foot adjoined to the PWd. Thus, the special prosodic status of function words is simply a reflection of the Prosodic Word organization of an utterance.

Truckenbrodt (1999: 226) formalizes this restriction in his Lexical Category Condition.

(3) **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.

He shows that the LCC is relevant not only for alignment constraints but for Wrap-XP as well. In (4) and (5) below, the lexical NP projections in Chichewa are contained within a lexical VP projection, and thus wrapping the VP satisfies Wrap-XP for the NPs as well. However, when two lexical XPs are contained in a higher functional projection, like in (6), the resulting prosodic structure wraps the NP and the VP in individual prosodic phrases.[5] Because of the LCC, IP or CP, functional projections, do not invoke Wrap-XP.

(4)	[X$_1$ XP$_2$]$_{XP1}$	[V	NP]$_{VP}$	
	( )$_P$	(tinabá	káluúlu)$_P$	
		we-stole	hare	
		‘We stole the hare.’		
(5a)	[X$_1$ XP$_2$ XP$_3$]$_{XP1}$	[V	NP	[P NP]$_{PP}$]$_{VP}$
	( )$_P$	(anaményá	nyu^{m}bá	^{n}dí mwáála)$_P$
		he-hit	house	with rock
		‘He hit the house with a rock.’		
(5b)		[V	NP	NP]$_{VP}$
		(tinapátsá	mwaná	^{n}jíí^{n}ga)$_P$
		we-gave	child	bicycle
		‘We gave the child a bicycle.’		
(6)	[XP$_1$ XP$_2$]$_{IP/CP}$	[NP	VP]$_{IP}$	
	( )$_P$ ( )$_P$	(kagaálu)$_P$	(kanáafa)$_P$	
		(small) dog	died	
		‘The (small) dog died.’		

(Truckenbrodt 1999: 245)

2.2. Information structure features

In addition to edges of syntactic constituents and lexical elements, prosody, and thus phonology, also makes reference to information structure (IS) features, such as Focus and Topic. Following Jackendoff (1972), most literature on focus and topic marking assumes that they are represented as privative features (F, T) on syntactic nodes. Since Rizzi (1997) both are considered to project their own phrases, FocP and TopP, in the left periphery of a clause. A third category of

[5] Evidence for the phrasing comes from processes of penultimate vowel lengthening, tone retraction and tone doubling. Furthermore, this account of Chichewa assumes that V stays within the VP and does not raise to higher functional projections. The reader is referred to Truckenbrodt (1999) for details.

Contrastive Topic (CT) has been argued for by Büring (2007) for English and Yamato (2007) for Japanese. In addition to syntactic movement (e.g. Polish: Szczegielniak 2005; Hungarian: Kiss 1998; Serbian: Migdalski 2006) and morpheme markers (e.g. Japanese: Yamato 2007; Kîîtharaka: Abels and Muriungi 2006), F, T and CT are marked by prosodic phrasing (Chichewa: Truckenbrodt 1999) and pitch accent and intonational contour (English: Ladd 1996 and Büring 2007 in (7) below).[6]

(7a) A: Well, what about FRED? What did HE eat?

L+H*L-H% **H*** L-L%
B: $\text{FRED}_{\mathbf{CT}}$ ate the $\text{BEANS}_{\mathbf{F}}$.

(7b) A: Well, what about the BEANS? Who ate THEM?

H* **L+H*L-H%**
B: $\text{FRED}_{\mathbf{F}}$ ate the $\text{BEANS}_{\mathbf{CT}}$.

In OT Prosodic Phonology it is assumed that phonology sees these syntactic features. Truckenbrodt (1999) introduces the constraint Align-F, aligning the right edge of a focused constituent with a prosodic phrase to capture the effects of focus in Chichewa, Samek-Lodovici (2005) and Fery and Samek-Lodovici (2006) use Stress-Focus and Stress-Topic to assign highest prominence to the focused/topicalised constituent, as in (8).

(8a) **AlignF**
Align the right edge of an F constituent with a prosodic phrase.

(8b) **StressFocus**
Focused phrase has the highest prosodic prominence in its focus domain.

(8c) **StressTopic**
Topic phrase has the highest prosodic prominence in its domain.

However, these constraints are undesirable if modularity is to be maintained, and, by focusing only on prosodic prominence, none of them make a connection

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[6] In the representation of tones and tonal contours, "L" and "H" mark a low and a high tone respectively, "*" marks a pitch accent, and "%" a boundary tone. Tones are marked above the word they are pronounced on.

between specific tones or tone contours and different information structure being marked, i.e. the fact that e.g. in English H* Pitch Accent, and not L*, marks Focus whereas the tonal contour L+H*L-H%, and not some other, marks Contrastive Topic. Although the association between sound (a tone or tonal contour) and meaning (a particular information structure) is arbitrary in origin, it is nevertheless fixed for an individual language and varies across languages. Therefore, this arbitrary connection, once established, needs to be encoded, and this paper argues, in Section 4.2, that it is encoded in the lexicon, along with other sound-meaning pairs.

As we have seen in Section 2, phonological theories accounting for the syntax–phonology interface are not modular, since phonology "sees" syntactic edges, the distinction between lexical and functional elements and IS features (see also Scheer 2010 for similar argument). Mapping constraints contain reference to both syntactic and phonological entities and are actually part of the phonological computation, and not some separate "prosody" module. Section 3 below gives an overview of current syntactic theories, and shows how they both complicate and simplify the modular mapping issue.

3. Decomposed syntax

In recent years a number of "syntax-all-the-way-down" approaches have appeared, arguing for a proliferation of functional elements in syntactic structure. They have erased the traditional distinction between lexical and functional categories and many traditionally lexical elements in the syntactic tree have been reanalyzed as being part of the functional sequence (f-seq). This approach results in the disappearance of the notion of "word" from syntax, but also provides us with a solution for some mapping issues.

3.1. No lexical categories

Just as functional categories of C, I or P have been decomposed into several functional projections (e.g. Rizzi 1997, 2004; Svenonius 2010), in recent years much work has been done on decomposing lexical categories of V, N or A. Ramchand (2008) develops a system of encoding verbal roots in the f-seq that captures the relations between argument structure and event structure. The category of Verb and VP is decomposed into three parts: Initiator Phrase, Process Phrase and Result Phrase. Phrases in the syntactic tree are necessarily functional. i.e. there is no V or VP, only InitP, ProcP or ResP.

Lundquist (2008) looks at structures where the distinction between categories of Verb, Noun and Adjective are blurred, such as verbs with adjectival properties, i.e. participles, and verbs with noun properties, i.e. nominalizations (or verbal nouns). In his system, he adopts Borer's (2005) system in which roots are crucially acategorial, i.e. not tagged in the Lexicon as Noun, Adjective or Verb. The category is determined by the syntactic configuration that the root appears in, or more specifically, which functional morpheme the root appears in the complement of. Whatever defines N, V or A as such is not of lexical but of functional nature.

If we look at the category of "verb" in Ramchand's system, there is not one feature/projection common to all verbs. While all dynamic verbs contain the "proc" head in their syntactic specification, stative verbs spell out only the "init" projection. If we look for it higher in the tree, the projection above verb is Tense, and it is not always there in the structure (cf. infinitives and participles). Thus, we see that there is no common syntactic feature or label to replace the reference to the lexical feature traditionally present on V. Phonological mapping constraints would have to refer individually to all the syntactic features and projections that could be part of the verbal f-seq. This would require phonology to see the full syntactic tree, all the features and labels, suggesting Direct Reference and no modularity.

In Lundquist's work on the nominal system, following Harley and Noyer (1999) and the Distributed Morphology (DM) framework, a distinction is drawn between f-morphemes (functional) and l-morphemes (lexical), l-morphemes being acategorial roots. This is akin to the system of Borer (2005), where listemes (DM roots) are devoid of any grammatical information, including that of syntactic category. Thus, functional heads that have a root as their complement could be thought of as projecting a lexical phrase, whereas phrases consisting solely of f-morphemes would be functional. Phonology would not only have to see the boundaries of phrases as it does currently, but also the structure of the phrase and whether there is a root as a complement to the functional node. This would again suggest that the interface is Direct, that phonology needs to "see" the whole syntactic tree and recognize relations between nodes, and that modularity is non-existent.

3.2. No (morpho)syntactic words

The notion of words combining into sentences has been widely accepted among linguists from all fields of linguistic research, from Saussure through the Structuralists, Sociolinguists, Cognitive and Generative linguists alike.

However, several frameworks have emerged in the past two decades which part from this traditional notion of syntax combining words, and claim that words are created in the syntax and that lexical insertion is post-syntactic. This "syntax-all-the-way-down" approach is advocated by Distributed Morphology (DM; Halle and Marantz 1993; Harley and Noyer 1999, inter alia) and Nanosyntax (NS; Starke 2009; Caha 2009; Ramchand 2008, inter alia). What is traditionally considered two modules, morphology (word-syntax) and (phrasal) syntax, is actually one computational module governed by syntactic rules and operations. There are no words in the syntax. The input to syntax consists of feature bundles (DM) or individual features (NS; cf. Section 3.3 below) that encode information at the level of the morpheme. Taking it even a step further, while DM allows spell-out of only terminal nodes, Nanosyntax departs even further from the traditional view in that lexical insertion can target any node in the tree, including phrasal nodes.

A crucial consequence of this approach is that there is no entity that can be described as a 'word' within syntax. Borer (2009) clearly states that "[w]ords are not syntactic primitives or atomic in any meaningful sense". There are features and phrases and terminals, but words exist only in lexical entries, and there they are equal to entities traditionally thought of as affixes and thus not full-fledged words. Thus, defining a "word" in any morpho-syntactic sense is not possible anymore, and recent syntactic work (Borer 2005; Newell 2008) assumes a purely phonological definition of the word as the domain of main prominence, i.e. stress assignment.

Sections 3.1 and 3.2 have illustrated some aspects of the lexical decomposition in syntax which create complications for the theory of syntax–phonology mapping: if phonology creates prosodic words by mapping them from lexical words, what do we do when there is no such a thing as "lexical" or "word"? Section 3.3 below shows how functional decomposition in syntax provides a tool for a solution to one of the mapping problems.

3.3. Features as terminals

In Nanosyntax, all features are merged into the syntactic tree as individual terminals, and lexical entries can spell out both terminal and phrasal nodes.

The building blocks of syntax are features, not lexical items or feature bundles. Each terminal is a single feature. Thus, for example, the 3rd Person Singular Present Tense *-s* in English lexicalizes the stretch of three terminal nodes, [3rd [Sing [Pres]]]. In some cases a single lexical item can spell out a stretch of f-seq, as in English *went*, which in one "word" spells out a whole stretch of the syntactic tree including the verbal and tense projections, as opposed to *walk-ed*. As far as spell-out is concerned, all nodes are equal, be they terminals or phrasal nodes. Thus, syntax builds lexical items, and does not merely use them to build bigger structures.

Lexical items, schematized in (9), consist of three pieces of information: phonological form (the underlying form, input into the phonological module), syntactic configuration (the piece of syntactic tree that a particular item can spell out) and conceptual information (encyclopedic knowledge). The conceptual information is limited to the kind that distinguishes *cat* from *dog*, whereas the formal semantic interpretation is computed from the syntactic features (e.g. number, gender, tense etc.). As such, the Lexicon only stores those structures that syntax has built, i.e. any chunk of structure the syntactic computation creates can be lexicalized in a language and spelled out by a single lexical item, and there is no syntactic computation done in the Lexicon.

(9) <gesture,  , concept>

Section 4.3 will show how this view of syntactic features and lexical items solves the modularity problem of prosodically marking information structure by allowing us to formalize prosodic markers of Focus and Topic as lexical items (morphemes; affixes) that spell out syntactic features and have no segmental but only suprasegmental phonological content.

4. Lexicon as the interface

If we are to argue for the idea of modularity, the only place in the system where syntactic and phonological information are in contact is the **Lexicon**. A natural avenue to pursue is to attempt to use the lexical entries as translators of syntactic information into phonological information which serves as input to phonological computation. This has also been suggested by Scheer (2010) within the framework of Government Phonology, as well as Bye and Svenonius (to appear) for some non-concatenative morphological phenomena.

4.1 lexical/functional distinction between words

In the current theories of the syntax–phonology interface presented in Section 2, the distinction between lexical and functional projections is crucial for accounting for prosodic phrasing patterns. However, as we saw in Sections 3.1 and 3.2, such distinction is lost in syntax. The way of encoding the morpho-syntactic information in the phonological part of the lexical item that is explored here is subcategorisation and indexing within the Lexicon.

Lexicon subcategorisation has already been introduced into the Lexicon e.g. to account for allomorphy that is not optimizing, be it phonologically conditioned or not. The subcategorisation approach outlined in Paster (2005), and more specifically its formalization in the form of Morpholexical Control Theory, defined by Bye (2006), states that the Lexicon is not just an unstructured list of entries, but a hierarchical inheritance network of cross-cutting categories. Lexical entries can be grouped into classes with common properties. Thus encoding categorical information and lexical vs. functional distinction could be achieved by creating subsets in the Lexicon.

The way of accounting for the particular division of the Lexicon, and counteracting the potential randomness of subcategorisation which evidently is not present, applied in this paper, is referring to the fact that what are traditionally thought of as lexical items contain conceptual information in their vocabulary entry, whereas functional items derive their semantics solely from the f-seq in the syntactic part of the entry (c.f. Section 3.3 on the structure of lexical items in Nanosyntax). Lundquist (2008), following the DM framework, draws a distinction between f-morphemes (functional) and l-morphemes (lexical), l-morphemes being acategorial roots. Also, in the system of Borer (2005) "roots" or "listemes" are lexical items devoid of any grammatical information, including that of syntactic category, containing only conceptual and phonological information, whereas other lexemes spell out functional features in the syntactic tree. Thus, what phonology traditionally recognizes as lexical words, is actually the subset of the Lexicon that contains bare roots that carry the conceptual information, and function words are the lexical items, including affixes, whose meaning rests on the f-seq features they spell out.

Mapping subsets to different phonological behavior, in this case different prosodic phrasing and prominence of lexical and functional words, is already present in phonological theory. One way to analyze morpheme-specific behavior in OT[7] is by use of lexically indexed markedness and faithfulness constraints (Urbanczyk 1995; Fukazawa 1999; Ito and Mester 1999; Pater 2009). Similarly,

[7] I am assuming a parallel OT view of computation, in that there is only one level of phonological computation and only one constraint ranking, *contra* e.g. Stratal OT (Kiparsky 2000; Bermúdez-Otero 1999, 2007) and the cophonologies approach (e.g. Anttila 2002; Inkelas and Zoll 2007).

McCarthy and Prince (1995, 1999) suggest relativization of faithfulness constraints to roots and affixes.[8]

In the tableau in (11) below is an example of how Selkirk (1995) accounts for the prosodification of function words onto a prosodic clitic, i.e. a (morpho-) syntactic word which is not a Prosodic Word, by use of prosodic domination and syntax–phonology mapping constraints given in (10; cf. Section 2.1).

(10a) Constraints on Prosodic Domination (Selkirk 1995) (C^n = a prosodic category)

Layeredness	No C^i dominates C^j, $j > i$, e.g. *No σ dominates a Ft.*
Headedness	Any C^i must dominate a C^{i-1} (except if $C^i = \sigma$), e.g. *A PWd must dominate a Ft.*
Exhaustivity	No C^i immediately dominates a constituent C^j, $j < i\text{-}1$, e.g. *No PWd immediately dominates a σ.*
Nonrecursivity	No C^i dominates C^j, $j = i$, e.g. *No Ft dominates a Ft.*

(10b) Syntax–Phonology mapping constraints

AlignL/R (Lex; PWd)
Left/right edge of a Lexical Word coincides with the Left/right edge of a Prosodic Word.

AlignL/R (PWd; Lex)
Left/right edge of a Prosodic Word coincides with the Left/right edge of a Lexical Word.

[8] An extensive empirical investigation of whether the distinction between roots and affixes fully parallels the distinction between lexical and function words is beyond the scope and volume of this paper, and is being carried out in my current research. The basis for assuming the parallel in this paper is drawn from the theoretical background in works cited above.

(11)

[a book]	AlignL/R (Lex; PWd)	Non Rec	AlignL/R (PWd; Lex)	Exh
a. $((a)_\omega (book)_\omega)_\varphi$			*!*	
b. ☞$(a\ (book)_\omega)_\varphi$				*
c. $((a\ book)_\omega)_\varphi$	*!		*	
d. $((a\ (book)_\omega)_\omega)_\varphi$		*!	*	

In an approach assuming lexicon subcategorisation, input information would contain indices indicating lexicon subset membership. In (12) below I give a tableau parallel to that in (11) above, but crucially not containing any reference to (morpho)syntactic categories. Thus, "Root" is used as shorthand for a phonological input consisting of a string of segments with a specific index indicating its membership in a Lexicon subset, not indicating a (morpho)syntactic category.

(12) **AlignL/R (Root; PWd)**
Left/right edge of a Root coincides with the Left/right edge of a Prosodic Word.

AlignL/R (PWd; Root)
Left/right edge of a Prosodic Word coincides with the Left/right edge of a Root.

[a $book_R$]	AlignRoot L/R	Non Rec	AlignPWd L/R	Exh
a. $((a)_\omega (book_R)_\omega)_\varphi$			*!*	
b. ☞$(a\ (book_R)_\omega)_\varphi$				*
c. $((a\ book_R)_\omega)_\varphi$	*!		*	
d. $((a\ (book_R)_\omega)_\omega)_\varphi$		*!	*	

However, it is not as simple as just replacing reference to words with reference to roots. What is traditionally thought of as 'words' consist of roots and affixes, and as we see in tableau (13), under the present ranking the wrong candidate is chosen as optimal.

(13)

/book$_R$-s/	AlignRoot L/R	Non Rec	AlignPWd L/R	Exh
a. ((book$_R$)$_\omega$ (s)$_\omega$)$_\varphi$			*!*	
b. 💣 ((book$_R$)$_\omega$s)$_\varphi$				*
c. ☹ ((book$_R$s)$_\omega$)$_\varphi$	*!		*	
d. (((book$_R$)$_\omega$s)$_\omega$)$_\varphi$		*!	*	

We need to capture the difference in prosodification of affixes and function words, since e.g. in English affixes form a Prosodic Word with the root, whereas function words adjoin to the Prosodic Word to form a Prosodic Phrase. As far as syntax is concerned, affixes and function words have the same status in that they all spell out functional features in the f-seq. There are two ways present in the literature that can be used for encoding the fact that affixes prosodify on the inside of an edge of a Prosodic Word whereas function words on the outside. One is lexicon subcategorisation (4.1.1), the other Extended Exponence (4.1.2).

4.1.1. Function words and lexicon subcategorisation

Taking the subcategorisation approach further, we can state that different affixes and function words form lexicon subsets as well. "Prefix", "suffix" and "fnc" (function word) are shorthand for a phonological input consisting of a string of segments with a specific index indicating its membership in a Lexicon subset, while alignment constraints listed below specify their position. The analysis is illustrated in the tableau in (14) below, where we see that a re-ranking of AlignPWd and AlignRoot is required, which does not affect the outcome of the previous tableaux.

(14a) **Align (prefix, L; PWd, L)**
Left edge of a prefix coincides with the left edge of a Prosodic Word.

(14b) **Align (suffix, R; PWd, R)**
Right edge of a suffix coincides with the right edge of a Prosodic Word.

(14c) **Align (fnc, R; PWd, L)**
Right edge of a fnc coincides with the left edge of a Prosodic Word.

/book$_R$ -s$_{Suff}$/	AlignR (Suff, PWd)	Non Rec	Align PWd L/R	Align Rt L/R	Exh
a. ((book$_R$)$_\omega$ (s)$_\omega$)$_\varphi$			**!		
b. ((book$_R$)$_\omega$s)$_\varphi$	*!				*
c. ☞ ((book$_R$s)$_\omega$)$_\varphi$			*	*	
d. (((book$_R$)$_\omega$s)$_\omega$)$_\varphi$		*!	*		

In addition to providing a modular mapping from syntax to phonology, this approach potentially helps us avoid "affix lowering" in syntax as an account of why e.g. English Past Tense *-ed* is realized as a suffix even though it linearizes as a functional head to the left of the verb.

4.1.2. Function words and Extended Exponence

Bye and Svenonius (to appear) introduce the notion of Extended Exponence to account for non-concatenative morphology. The idea is that phonological information in the lexical entry of an affix includes information both on phonological (segmental) shape and on its place in structure. Thus, a lexical entry of a suffix would include $< \_)_{\omega} >$ as place information, i.e. that it is located on the inside of a PWd adjacent to its right boundary, an entry for a prefix would include $< {}_{\omega}(\_ >$ place, and an entry for a function word would not include place information. AlignRoot and AlignPWd constraints would prevent fnc from interfering and would prosodify them on the outside of a PWd, as in (11) above, Input-Output Faithfulness constraints would prosodify prefixes and suffixes within the PWd as in (15) below.

(15)

/book$_R$ -s)$_\omega$ /	IO-Faith	Non Rec	AlignPWd L/R	AlignRoot L/R	Exh
a. ((book$_R$)$_\omega$ (s)$_\omega$)$_\varphi$			**!		
b. ((book$_R$)$_\omega$s)$_\varphi$	*!				*
c. ☞ ((book$_R$s)$_\omega$)$_\varphi$			*	*	
d. (((book$_R$)$_\omega$s)$_\omega$)$_\varphi$		*!	*		

We see that candidate (15c) wins over candidate (15b) even though it violates both AlignPWd and AlignRoot because it preserves the place information of the suffix present in the input.

I will not discuss in detail the different implications of the two approaches, both for reasons of space and due to the fact that the choice between the two depends on our view of the Lexicon and of underlying prosodification, which is a somewhat controversial issue in phonology. Both these issues are orthogonal to the issue of a modular syntax–phonology mapping which this paper explores, and for which it is only relevant that both approaches are equally modular in that they encode the lexical/functional distinction in the lexicon by means already present in phonological theory for unrelated reasons. Needless to say, the necessity for further research into the nature of the Lexicon and lexical entries falls naturally as a consequence of this paper.

4.2. Information structure marking

As we have seen in Section 3.3, in Nanosyntax all features are merged into the syntactic tree as individual terminals. By default, then, information structure features are also individual terminals in a nanosyntactic tree, and those features drive movement in some languages while they correspond to lexical items in others. These lexical items pair a feature with its phonological realization, which is in some languages a segmental morpheme (e.g. Japanese Topic marker -*wa*) and in some a prosodic morpheme. Thus, prosodic markers of Focus and Contrastive Topic in English are lexical items (morphemes) with no segmental but only suprasegmental phonological content that spells out certain syntactic material, much as e.g. the English -*ed* suffix spells out Tense/Past.

This view of prosodic markers of information structure fits well with what we currently know about the system. Lexical entries consisting of only *segmental* phonological information as well as those consisting of *segmental and suprasegmental* information (in lexical tone languages) exist, so the existence of lexical entries consisting of solely *suprasegmental* information is not unexpected. Furthermore, lexical entries consisting of suprasegmental information that spell out *morpho-syntactic* categories such as number or gender are already attested in many African languages, so it is possible for suprasegmental affixes to spell out *IS-related* parts of the functional sequence. Finally, if discourse-related parts of the f-seq can be marked by *segmental affixes*, why could those features not be marked by *suprasegmental affixes* as well?

Lexical entries for F and CT features in English in (16) would be as in (17), just as the lexical entry for the past suffix would be </id/, Past>.

(16a) A: Well, what about FRED? What did HE eat?

L+H* L-H% **H*** L-L%
B: FRED$_{\mathrm{CT}}$ ate the BEANS$_{\mathrm{F}}$.

(16b) A: Well, what about the BEANS? Who ate THEM?

H* **L+H*L-H%**
B: FRED$_{\mathrm{F}}$ ate the BEANS$_{\mathrm{CT}}$.

(17) </H*/, F>,
</L+H*L-H%/, CT>

Encoding tones and tunes in the Lexicon and not in the phonology also allows for capturing the arbitrariness and cross-linguistic variation in their association to different meanings. Furthermore, this approach is also applicable to cases of purely intonational marking of questions (e.g. English Y/N Questions), assuming that the intonational contour is a spell-out of a Q/Interrog feature in syntax, and tonal marking of various grammatical features such as is found in Bantu languages.

The merit of this approach in view of modularity is that, after lexical insertion is done, what reaches phonology is pure phonological information, and the same type of constraints in charge of placing segmental affixes in their rightful place are used to place suprasegmental affixes in theirs. The segmental and prosodic affixes are treated equally by phonology. The Lexicon provides the tonal contour, the spell-out (linearization) provides the domain of realization, and phonology places the tones within that domain with Prosodic Well-formedness Constraints, which make sure that the suprasegmental affix is properly placed on an appropriate Tone Bearing Unit (TBU) within its domain, e.g. that the H* tone marking Focus in English is realized on the main stress unit of the focused constituent.

The constraints currently used in OT Prosodic Phonology are given in (18).

(18a) **AlignF**
Align the right edge of an F constituent with a prosodic phrase.
(Truckenbrodt 1999)

(18b) **StressFocus**
Focused phrase has the highest prosodic prominence in its focus domain.

(18c) **StressTopic**
Topic phrase has the highest prosodic prominence in its domain.
(Fery and Samek-Lodovici 2006: 9)

(18d) **AssocPA**
A Pitch Accent associates to (aligns with) a stressed syllable (head of a Ft).
(Selkirk 1995)

The StressFocus constraint suggests that Focus requires highest stress prominence, which attracts the H* tone. The focus marker, i.e. the pitch accent, is assigned to the most prominent segment. Taking it one step further, Fery and Samek-Lodovici (2006) argue against the relation between pitch accents and F-marking. They claim that the distribution of pitch accents follows from the interaction between the constraints governing the prosodic organization of the clause, like AssocPA, on the one side, and the constraints like Stress-Focus and StressTopic governing the prosodic expression of discourse status on the other. In her recent work, Selkirk (Kratzer and Selkirk 2007) also adopts this view and uses these constraints.

An example tableau of the current approach is given in (19) below, using function words as an example of a clear distinction in prosodification dependent on IS status, and the constraint ranking from Selkirk (1995). We see from the tableau how requirements of Focus force function words to assume PWd status in order to be able to bear PA, and the otherwise optimal candidate (b) yields to (a).

(19a) **AlignL/R (Lex; PWd)**
Left/right edge of a Lexical Word coincides with the Left/right edge of a Prosodic Word.

(19b) **AlignL/R (PWd; Lex)**
Left/right edge of a Prosodic Word coincides with the Left/right edge of a Lexical Word.

(19c) **AlignR (Lexmax; PPh)**
The right edge of a maximal phrase projected from a lexical head coincides with the right edge of a PPh.

(19d) **AlignR (PPh; PWd)**
The right edge of a PPh coincides with the right edge of a PWd.

(19e) **HP**
Align the right boundary of every P-phrase with its head(s).
(Fery and Samek-Lodovici 2006)

Throw it $[\text{to}]_F$ the dog (not at it)	Stress Focus	AlignR (LexP;PPh)	AlignR (PPh;PWd)	AlignL/R(Lex;PWd)	AlignL/R(PWd;Lex)	HP
a. ☞$((\textbf{tʊ})_\omega$ $(\text{ðə}$ $(\text{dɔg}$ $)_\omega)_\varphi)_\varphi$					**	*
b. $(\text{tə}$ $(\text{ðə}$ $(\textbf{dɔg})_\omega)_\varphi$ $)_\varphi$	*!					

In the account presented here, it is argued that it is not the prominence that drives tone placement, but the other way around. Focus is spelled out by an H* tone,[9] which then attracts the main prominence of the sentence due to prosodic well-formedness constraints requiring pitch accents to be realized on the head of the intonational domain. More precisely, it is not the presence of an F feature that requires stress prominence, which then attracts the suprasegmental marking, but it is the presence of the suprasegmental affixal marker that attracts the high stress prominence.

In (20) and (21) below (applying the lexical indexation and extended exponence approaches respectively), we see tableaux parallel to (19) where it is shown that, if we assume that the H* is present in the input as a suprasegmental affix, and specified as e.g. a suffix, the presence of this Focus-marking Pitch Accent requires the presence of prosodic structure that satisfies AssocPA, and the optimal candidate in (20a) and (21a) has the stressed/strong form of the pitch-accented function word (boldface indicates location of main stress). The linearity is achieved in the same way as with segmental suffixes, and it is assumed that constraints that prevent the relocation of segmental affixes, such as Realize Morpheme or Contiguity, apply equally to suprasegmental affixes, and thus prevent the relocation of the H* affix onto *dog*.[10]

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[9] Or L+H*, if we follow Selkirk (2002), distinguishing it from the default clausal prominence marker H*.

[10] I leave out constraints referring to Prosodic Phrases in tableaux (20) and (21). For a modular account of PPh parsing, see Šurkalović (in prep.).

(20)

Throw it to$_{fnc}$-H*$_{Suff}$ the$_{fnc}$ dog$_R$ (not at it)	AssocPA	AlignR (suffix;PWd)	Align (fnc, R; PWd, L)	AlignL/R (Root;PWd)	AlignL/R (PWd;Root)	HP
a. H* ☞((**tʊ**)$_\omega$ (ðə (dɔg)$_\omega$)$_\varphi$)$_\varphi$					**	*
b. H* (tə(ðə(**dɔg**)$_\omega$)$_\varphi$)$_\varphi$	*!	*				

(21)

Throw it to-H*)$_\omega$ the dog$_R$ (not at it)	AssocPA	IO-Faith	AlignL/R (Root;PWd)	AlignL/R (PWd;Root)	HP
a. H* ☞((**tʊ**)$_\omega$ (ðə (dɔg)$_\omega$)$_\varphi$)$_\varphi$				**	*
b. H* (tə(ðə(**dɔg**)$_\omega$)$_\varphi$)$_\varphi$	*!	*			

Büring (2007) argues that, in English, CTs are characteristically marked by a fall-rise contour, what Jackendoff (1972) calls the B-accent (whereas focus is A-accent), and what has been described as an H* or L+H* followed by a L-H% boundary sequence.

A further example from Büring (2007: 16) illustrates the non-exhaustive meaning of CT:

(22) (What did the pop stars wear?)

L+H* L-H% **H*** L-L%
The FEMALE$_{CT}$ pop stars wore CAFTANS$_{F}$.

In the account presented here, the input to phonology is /fiːmeil L+H* L-H%/. The prosodic well-formedness constraints that I propose are the AssocPA and the AssocBT constraint. They appear under (23).

(23a) **AssocBT-R/L**
A right/left Boundary Tone associates to (aligns with) a right/left edge of a constituent it associates to.

(23b) **FtForm(Trochaic)** [11]
The head of a Ft is aligned with the Left edge of a Ft.

	/fiːmeil L+H* L-H%/	AssocPA	AssocBT	FtForm
☞a	L+H* L-H% [**fiː** meil]			
b	L+H* L-H% [**fiː** meil]		*!	
c	L+H*L-H% [**fiː** meil]	*!		
d	L+H* L-H% [fiː **meil**]	*!		*
e	L+H* L-H% [fiː **meil**]			*!

In candidate (a), the PA from the suprasegmental affix is associated with the initial syllable and the BT is associated with the right boundary, resulting in a well-formed structure. Candidates (b, c, d) are not optimal due to the misalignment of the two components of the contour, whereas candidate (e), in an attempt to not split up the contour, violates FtForm-Trochaic.

[11] This constraint is used as shorthand for whatever formal way of achieving trochaic feet is in English, abstracting away from different stress-assignment theories.

As we see from the examples above, if we assume that there are no IS features present in phonology, but that IS marking is present in the input in the form of suprasegmental affixes, there is no need for modularity-violating constraints, and with slight modifications in form of introducing the AssocBT constraint, the current system of prosodic well-formedness constraints is equipped to account for the realization of those prosodic markers.

5. Conclusion

This paper has argued that changes in syntactic theory can be reconciled with prosodic theory and that modularity can be maintained to a greater extent than in current theories of the syntax–phonology interface if we assume the Lexicon to be the only means of communication between syntax and phonology and the only source of information used in phonological computation.

We can derive the effects of (morpho)syntactic and information structure on prosody without referring to that structure in the phonological computation by using the lexical entries to translate syntactic structure into phonological material. We can restate the lexical/functional distinction in a completely functional syntax by using Lexicon subsets. Input to phonology is purely phonological information, with no reference to syntactic or information structure categories or features. It is a linearized string of phonological underlying forms of lexical items, with lexical subcategorisation information. Phonology operates only on phonological primitives, not syntactic F, T, CT features in the constraints.

However, this approach presents certain challenges to the decomposition program as well as to phonological theory. If lexical categories are decomposed into a part of the f-seq, and e.g. in Ramchand's (2008) system there is no feature/projection that is common to all verbs, how do we unite the category of verb into one subset of the Lexicon? More generally, is the Lexicon structured, and, in case it is, how exactly does this structure look like? Also, if all features are terminals and information structure markers are encoded as lexical items/prosodic affixes, and we know that e.g. in English any word can be focused, what is the position of the information structure features in the f-seq? Do they freely adjoin at any point or is there a fixed functional hierarchy? Furthermore, the exact correlations between prosody and the various meanings has not been fully explored, and there is much variation present in the prosody. On the phonological side, thus, the challenge is to strive for a better understanding of the correlation between prosody and the variation in IS meanings that is encoded, as well as to explore the extent to which prosodic information is encoded in the lexicon.

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Modularity, Linearization and Phase-Phase Faithfulness in Kayardild[1]

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Abstract: This paper investigates the effects of the Multiple Spell-Out Hypothesis (MSOH) (Uriagereka 1999, Chomsky 2000, 2001, 2004) on the phonology-syntax interface in a modular view of language. It derives the effects of (morpho)syntactic structure on prosody without referring to that structure in the phonological computation, contra the alignment constraints that map (morpho)syntactic edges to prosodic ones in Prosodic Phonology (Selkirk 1986, 1995, Truckenbrodt 1999 inter alia). It provides an explicit account of how the outputs of different phases get linearized wrt each other, providing arguments that spell-out does not proceed in chunks but produces cumulative cyclic input to phonology. It argues that phonological computation needs to proceed in phases in order to achieve domain mapping while maintaining an input to phonology consisting of purely phonological information. An analysis is provided deriving prosodic domains from phases by phonological computation being faithful to the prosodification output of the previous phase, introducing Phase-Phase Faithfulness to Optimality Theory. Languages with cyclic effects at Prosodic Word level (exemplified by Kayardild and English) differ from languages with cyclic effects at Foot level (exemplified by Ojibwa) by ranking Phase-Phase faithfulness constraints differently wrt prosodic well-formedness constraints regulating, for example, the binarity of prosodic constituents or their alignment to one another.

Keywords: phases, modularity, linearization, syntax-phonology interface, prosody, OT.

Resumen: Este artículo investiga los efectos de la Hipótesis de la Transferencia Múltiple (Multiple Spell-Out Hypothesis (MSOH), Uriagereka 1999, Chomsky 2000, 2001, 2004) en la interfaz fonológico-sintáctica, bajo una perspectiva modular del lenguaje. Se derivan los efectos de la estructura

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morfosintáctica en la prosodia sin apelar a dicha estructura en la computación fonológica, contra las restricciones de alineamiento que proyectan extremos (morfo)sintácticos a extremos prosódicos, propuestas por la Fonología Prosódica (Selkirk 1986, 1995, Truckenbrodt 1999 entre otros). Se ofrece una explicación explícita de cómo los productos de diferentes fases quedan alineados, argumentando que la transferencia no ocurre en partes, sino que proporciona a la fonología entradas cíclicas y acumulativas. Se propone que la computación fonológica necesita proceder en fases para conseguir la proyección de un ámbito/dominio y al mismo tiempo mantener una entrada (input) a la fonología consistente en información fonológica pura. Se ofrece un análisis en el que se derivan ámbitos/dominios prosódicos a partir de las fases, en el cual la computación fonológica es fiel al producto (output) de la prosodificación de la fase previa. Se introduce, así, el concepto de la Fidelidad de Fases en la Teoría de la Optimidad. Las lenguas que presentan efectos cíclicos a nivel de la Palabra Prosódica (ejemplificados por el kayardild y el inglés) difieren de las lenguas que presentan efectos cíclicos a nivel del Pié Prosódico (ejemplificado por el ojibwa). Esto ocurre debido a la diferente ordenación de las restricciones de fidelidad de fases con respecto a las restricciones de buena formación prosódica que regulan, por ejemplo, la binaridad de los constituyentes prosódicos o su respectivo alineamiento.

Palabras clave: fases, modularidad, linearización, interfaz sintactico-fonológica, Teoría de la Optimidad.

Resumo*:* Este artigo investiga os efeitos da Hipótese de Múltiplos Spell-Out (MSOH) (Uriagereka 1999, Chomsky 2000, 2001, 2004) na interface fonologia-sintaxe numa perspectiva modular da linguagem. Deriva os efeitos da estrutura (morfo)sintáctica na prosódia sem referência a essa estrutura na computação fonológica, contra as restrições de alinhamento que projectam as fronteiras (morfo)sintácticas para fronteiras prosódicas na Fonologia Prosódica (Selkirk 1986, 1995, Truckenbrodt 1999 inter alia). Fornece uma explicação explícita de como os outputs de diferentes fases são linearizados relativamente uns aos outros, fornecendo argumentos de que o spell-out não procede em unidades (chunks) mas produz input cíclico cumulativo para a fonologia. Defende que a computação fonológica necessita de proceder em fases para atingir a projecção de domínio enquanto mantém um input para a fonologia consistindo de informação puramente fonológica. É apresentada uma análise que deriva os domínios prosódicos de fases através de uma computação fonológica fiel ao ouput de prosodificação da fase anterior, introduzindo a Fidelidade Fase-Fase à Teoria da Optimalidade. Línguas com efeitos cíclicos ao nível da Palavra Prosódica (por exemplo, o Kayardild e o Inglês) diferem de línguas com efeitos cíclicos ao nível do Pé (por exemplo, o Ojibwa) na medida em que organizam as restrições de Fidelidade Fase-Fase de modo diferente no que diz respeito às restrições de boa formação prosódica que regulam, por exemplo, a binariedade dos constituintes prosódicos ou o seu alinhamento relativamente um ao outro.

Palavras-chave: fases, modularidade, linearização, interface sintaxe-fonologia, prosódia, Teoria da Optimalidade (OT).

1. Introduction

The term 'modularity' as it is used in this paper refers to the notion that language consists of three independent modules, (morpho)syntax, phonology and semantics. This model originated in Chomsky (1965) and has been the basis for generative theories of grammar ever since. These modules are considered to be independent from one another, operating on domain-specific primitives and not understanding the 'vocabulary' of the other modules. We cannot 'see sounds', and in the same way phonology cannot understand or operate on syntactic primitives. Furthermore, the view here is derivational and uni-directional, in the sense that phonology follows syntax, and output of the syntactic computation serves as input for the phonological computation. The term 'interface' refers to the translation of information from one module to another. In the case of the syntax-phonology interface, 'spell-out' is used to refer to the process of linearising the syntactic tree structure and performing lexical insertion, which provides phonology with a linear input consisting of underlying forms of the lexical items.

However, certain interactions between the modules do seem to exist, as we will see in section 2, and this has been a problem for current theories of the syntax-phonology mapping. As a result, they have been unable to maintain full modularity. The goal of the work presented here is to account for the interaction of syntax and phonology in a modular view of language. The questions I will be answering are: i) How can we derive the effects of (morpho)syntactic structure on prosody without referring to that structure in the phonological computation?, ii) If syntactic computation proceeds in phases, does phonology proceed in phases, too?; iii) If so, what is the nature of input to phonology?

This paper focuses on data from Kayardild, a Southern Tangkic language, due to its peculiar case-stacking properties and syntax-phonology interaction. The category of CASE encodes a number of syntactic and semantic relations between elements of the clause, including tense, aspect and mood information, in the form of suffixes on nouns. Phonologically/prosodically, each root and its suffixes form a single Prosodic Word domain (Evans 1995, Round 2009), illustrated in (1) below (Prosodic Word boundaries will be indicated by {}, while () will mark Foot boundaries):

(1) maku	yalawu-jarra	yakuri-na	dangka-karra-nguni-na	mijil-nguni-na
[{maku}$_\omega$	{jalawu-cara}$_\omega$	{jakuɻi-na}$_\omega$	{ʈaŋka-karaɲ-ŋuni-na}$_\omega$	{micil-ŋuni-na}$_\omega$]
woman	catch-PST	fish-MABL	man-GEN-INSTR-MABL	net-INSTR-MABL[2]

‘The woman caught the fish with the man’s net.’

(Evans 1995: 115, transcription following Round 2009)

Thus, the left edge of each Prosodic Word corresponds to and is defined by the left edge of a root, i.e. of what is referred to in Prosodic theory as ‘lexical word’. It is this correspondence that is being restated in modular terms in this paper by making reference to phases of spell-out. However, in Kayardild, due to the fact that spell-out of case features is delayed until the verbal domain features are merged into the tree, the order in which parts of the tree are spelled out, i.e. lexicalized and sent to phonology, does not match with the ultimate linear order of those elements in an utterance. This paper shows how current linearization algorithms are unable to derive the correct linear order, and provides an alternate account that solves both the linearization problem, and the issues related to modularity and nature of phonological input. It is not the case that outputs of different phases reach phonology as separate chunks, as is assumed in current phase theory, but that the input to phonology at each phase is cumulative, consisting of the spell-out of the current phase together with the spell-out of the previous phases. Thus, as the syntactic derivation of the sentence unfolds, the input to phonology gets bigger with each step. However, phonology does fully parse each phase, starting from the first or ‘smallest’ one, and has the ability to refer to the output of the phonological computation of the phase that precedes the currently parsed one. This allows us to achieve what seems to be syntax-phonology domain mapping, but is actually an effect of the course of the derivation.

Phonological systems of different languages vary in the level of faithfulness to the parsing of the previous phase. Kayardild is an example of a language where parsing of the left edge of a Prosodic Word is maintained throughout the derivation, whereas the right boundary expands to incorporate suffixes (cf. section 5.1). Ojibwa, an Algonquian language, is briefly presented for comparison purposes (section 5.2), as a language which values faithfulness

[2] PST = Past, MABL = Modal Ablative (Case that is assigned by the Tense of the Verb), GEN = Genitive, INSTR = Instrumental)

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to Foot structure parsed in the initial phase more than prosodic well-formedness, resulting in ill-formed Feet consisting of a single light syllable, as in (2b) below, opposed to the optimal parsing of (2c):

(2) (a)	[ni	[[bi:mi-Ø]	[gi:we:-Ø]]]
	[1P	[[ALONG-FIN $_{AP}$]	[GO HOME-FIN $_{vP}$]$_{vP}$]…$_{CP}$]
	'I walk on home'		
(b)	(nibì:)(mí)(gì:)(wè:)		
(c)	*(nibì:)(migì:)(wè:)		(Newell 2008: 34)

In section 5.3, I address the data on the prosodification of function words in English discussed in Selkirk (1995) inter alia, due to the role this data played in establishing the relevance of (morpho)syntactic structure for prosodic parsing. Namely, in English, like in many other languages, function words (determiners, prepositions etc.) are not associated with Prosodic Word status, whereas lexical words always are. In English, function words do not incorporate into the Prosodic Word in the way that suffixes in Kayardild do, but they have the status of a free clitic, adjoined outside the Prosodic Word at the Prosodic Phrase level. This is evident from the fact that, while there is at most one unstressed syllable at the left edge of a PWd in English (McCarthy & Prince 1993), a lexical word can be preceded by a number of function words which all remain unstressed and unfooted, shown in (3) below:

(3)	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)$_{Ft}$

This paper accounts for this difference in behaviour by deriving it from the difference in derivational status between lexical and function words, in that the lexical words are those that the derivation starts with, and are thus parsed as Prosodic Words first. On one hand, in English, like in Kayardild, this initial Prosodic Word is faithfully mapped throughout the derivation. On the other hand, unlike Kayardild, English does not incorporate subsequently added material into that Prosodic Word.

Section 2 presents an overview of current theories of syntax-phonology mapping and shows how they violate modularity. Section 3 gives a brief overview of recent advances in syntax, focusing on aspects relevant to phonology. Section 4 offers a solution to the modularity issues by combining our views on phonology and its interface with syntax with Phase theory, while section 5 offers a way of formally capturing the proposed solution in Optimality Theory, and applies it to data from Kayardild, Ojibwa and English. Section 6 gives some concluding remarks and offers directions for future research.

2. Prosody and Modularity

Prosodic Phonology is the part of phonological theory dedicated to modelling the mapping from syntax to phonology (e.g. Selkirk 1981, 1986, 1995, Nespor & Vogel 1986, Hayes 1989, Truckenbrodt 1995 et seq). Since in the modular view of grammar syntactic representations are not phonological objects and phonology cannot access syntax directly, it does so indirectly via prosodic structure. Prosodic constituents mediate between syntactic structure and phonological rules/constraints. In Prosodic Phonology this is known as The Indirect Reference Hypothesis. Suprasegmental representations are organized into a Prosodic Hierarchy of domains (PH), consisting of Syllable, Foot, Prosodic Word, Prosodic Phrase, Intonation Phrase and Utterance levels[3]. The original motivation for proposing PH and evidence for the various prosodic domains comes from a number of segmental processes that seem to be sensitive to them. Since then, PH has assumed an increasingly important role in the syntax-phonology interface.

Computationally, when accounting for the mapping from the output of the syntactic component to a phonological representation, current work in Prosodic Phonology uses constraints and constraint interaction as defined within Optimality Theory (Prince & Smolensky 1993, McCarthy & Prince 1993, 1995). The most active group of constraints are the Alignment constraints, originally stemming from the end-based theory of the syntax-prosody mapping proposed by Selkirk (1986), and later developed into the Generalized Alignment theory of McCarthy & Prince (1993). They are used to align edges of different prosodic domains, the head of a domain with an edge of its respective domain, as well as to align edges of syntactic domains with edges of prosodic domains. The most developed and currently most influential account of the interface

[3] More detailed versions of PH exist in various works (e.g. Selkirk 1980 [1978] et seq., Nespor & Vogel 1986, Hayes 1989). I list here the most general view, as it will suffice for the discussion at hand.

between syntax and prosody has been proposed by Truckenbrodt (1995, 1999, 2006, 2007). His system uses Selkirk's edge alignment and introduces the WRAPXP and STRESSXP constraints:

(4) ALIGN-XP,R/L: ALIGN(XP, R/L; P-PHRASE, R/L)
The right/left edge of each syntactic XP is aligned with the right/left edge of a p-phrase
WRAP-XP
For each XP there must be a p-phrase that contains the XP
STRESS-XP
Each XP must contain a beat of stress on the level of the p-phrase

In addition to edges of syntactic constituents, it is the distinction between lexical words (nouns, verbs, adjectives) and function words (determiners, prepositions, auxiliaries, complementizers etc.) that seems to be relevant not only in the morpho-syntactic module of language, but also in the phonological one (Chen 1987, Inkelas & Zec 1993, Selkirk 1995 inter alia). This idea that lexical government plays a role in syntax-prosody mapping dates back to Hale & Selkirk (1987). In prosodic phonology, it has been assumed that all lexical projections share the common 'lexical' feature under their V, N or A head, which percolates to the phrasal projection of which they are the head. This feature marks both the morphological word inserted into that head and its projection as lexical. This is made clear in Truckenbrodt (1999: 227) where he states that in cases of complex VPs, those containing more than one object, where the verb moves from VP to vP, it is the vP that is "a lexically headed projection in the relevant sense". In other words, the verb moves and becomes head of vP, which in turn becomes a lexically-headed projection.

Selkirk (1995) has argued that the mapping constraints relating syntactic and prosodic structure apply to lexical elements and their projections, but not to functional elements and their projections:

(5) 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.

The example used to argue for this comes from the fact that in English monosyllabic function words can occur both in their full, 'strong', form and in their reduced, 'weak' form, depending on their position in an utterance. In contrast, lexical words always appear in their full form (that is, even though some reduction may appear in lexical words, they can never be fully reduced, unlike function words, since the stressed syllable of the lexical word remains in its full form). On one hand, if we look at lexical words, a sequence of two lexical words in a phrase will be prosodified as a sequence of Prosodic Words. On the other hand, in a sequence of a function word and a lexical word, the function word can be mapped onto a Prosodic Word, or onto a prosodic clitic, i.e. a (morpho)syntactic word which is not a Prosodic Word. Thus, the special prosodic status of function words is simply a reflection of the Prosodic Word organization of an utterance.

Truckenbrodt (1999: 226) formalizes this restriction in his Lexical Category Condition

(6) 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.

He shows that the LCC is relevant not only for alignment constraints but for WRAP-XP as well. In (7) and (8) below in Chichewa, the lexical NP projections are contained within a lexical VP projection, and thus wrapping the VP satisfies WRAP-XP for the NPs as well. However, when two lexical XPs are contained in a higher functional projection, as in (9), the resulting prosodic structure wraps the NP and the VP in individual prosodic phrases[4]. Because of the LCC, IP or CP, functional projections, do not invoke WRAP-XP.

[4] Evidence for the phrasing comes from processes of penultimate vowel lengthening, tone retraction and tone doubling. The reader is referred to Truckenbrodt (1999) for details.

(7) $[X_1\ XP_2]_{XP1}$ [V NP $]_{VP}$
($)_P$ (tinabá káluúlu$)_P$
we-stole hare
'We stole the hare.'

(8) $[X_1\ XP_2\ XP_3]_{XP1}$ (a) [V NP [P NP $]_{PP}]_{VP}$
($)_P$ (anaményá nyu^{m}bá ^{n}dí mwaála$)_P$
he-hit house with rock
'He hit the house with a rock.'
(b) [V NP NP $]_{VP}$
(tinapátsá mwaná ^{n}jíí^{n}ga$)_P$
we-gave child bicycle
'We gave the child a bicycle.'

(9) $[XP_1\ XP_2]_{IP/CP}$ [NP VP $]_{IP}$
($)_P$ ($)_P$ (kagaálu$)_P$ (kanáafa$)_P$
(small) dog died
'The (small) dog died.'

(Truckenbrodt 1999: 245)

As we can see from the constraints presented above and the LCC, even without referring to specific syntactic categories, labels, syntactic relations or the rest of the syntactic information present in the tree, constraints do refer to edges of syntactic constituents and the distinction between lexical and function words (cf. Selkirk 1995, Truckenbrodt 1999 inter alia). Despite the modular underpinnings of the Indirect Reference Hypothesis, in order to account for the prosodic phrasing patterns current theory assumes that prosody still sees certain syntactic information. Also, prosody is not a separate module, but part of the phonological computation, which means that the separation of the syntactic and phonological module is not achieved. For full modularity to exist we would need a 'No Reference Hypothesis'[5] (cf. also Scheer 2011), which is what this paper is arguing for.

Section 3 below gives an overview of the aspects of current syntactic theories that are relevant to phonology and shows how some of them force us to change the current views of syntax-phonology mapping presented in section

[5] I use the term Direct Reference to signal phonology having direct access to syntax, and the term No Reference to refer to phonology only processing phonological information and not referring to syntactic notions. Scheer (2011) uses the term Direct Reference for what I call No Reference.

2, while others present a solution to the modularity issues.

3. Decomposition and Phases in Syntax

In recent years syntactic theory has been experiencing a proliferation of functional elements in syntactic structure. The traditional distinction between lexical and functional categories is being erased and many traditionally lexical elements in the syntactic tree have been reanalyzed as being part of the functional sequence (f-seq). Furthermore, a number of 'syntax-all-the-way-down' approaches have appeared (e.g. Distributed Morphology, Nanosyntax), thus removing the notion of 'word' from syntax. Additionally, the idea of 'multiple spell-out' has been introduced, affecting the way in which information travels from syntax to phonology. This section addresses the relevance of these changes for the syntax-phonology interface.

3.1. No lexical categories

Just as functional categories of C, I or P have been decomposed into several functional projections (e.g. Rizzi 2004, Svenonius 2010a), in recent years, much work has been done on decomposing lexical categories of V, N or A. Ramchand (2008) develops a system of encoding verbal roots in the f-seq that captures the relations between argument structure and event structure. The category of Verb and VP is decomposed into three parts: Initiator Phrase, Process Phrase and Result Phrase. Phrases in the syntactic tree are necessarily functional. i.e. there is no V or VP, only InitP, ProcP or ResP.

Lundquist (2008, 2009) looks at structures where the distinction between categories of Verb, Noun and Adjective are blurred, such as verbs with adjectival properties, i.e. participles, and verbs with noun properties, i.e. nominalizations (or verbal nouns). In his system, he adopts Borer's (2005) system in which roots are crucially acategorial, i.e., not tagged in the Lexicon as Noun, Adjective or Verb. The category is determined by the syntactic configuration in which the root appears, or more specifically, by the functional morpheme of which the root is the complement. Whatever defines N, V or A as such is not of lexical but of functional nature.

If we look at the category of 'verb' in Ramchand's system, there is no one feature/projection common to all verbs. While all dynamic verbs contain the 'proc' head in their syntactic specification, stative verbs spell out only the 'init' projection. If we look for it higher in the tree, the projection above verb is Tense, and it is not always there in the structure (cf. infinitives and participles). Thus, we see that there is no common syntactic feature or label to replace the reference to the lexical feature traditionally present on V, and there is no phrasal projection in syntax that could replace the reference to Lex^{Max} in the constraints. Phonological mapping constraints would have to refer to all the syntactic features, and thus, projections, that could be part of the verbal f-seq individually. This would require phonology to see the full syntactic tree, all the features and labels, resulting in Direct Reference and not modularity.

In Lundquist's work on the nominal system, following Harley & Noyer (1999) and the Distributed Morphology (DM) framework, a distinction is drawn between f-morphemes (functional) and l-morphemes (lexical), l-morphemes being acategorial roots. This is akin to the system of Borer (2005), where listemes (DM roots) are devoid of any grammatical information, including that of syntactic category. Thus, functional heads that have a root as their complement could be thought of as projecting a lexical phrase, whereas phrases consisting solely of f-morphemes would be functional. Phonology would not only have to see the boundaries of phrases as it does currently, but also the structure of the phrase and whether there is a root as a complement to the functional node. This would again suggest that the interface is direct, that phonology needs to 'see' the whole syntactic tree and recognize relations between nodes, and that modularity is non-existent.

3.2. No (morpho)syntactic words

The notion of words combining into sentences has been widely accepted among linguists from all fields of linguistic research, from Saussure through the Structuralists, Sociolinguists, Cognitive and Generative linguists alike. However, several frameworks have emerged in the past two decades which part from this traditional notion of syntax combining words, and claim that words are created in the syntax and that lexical insertion is post-syntactic. This 'syntax-all-the-way-down' approach is advocated by Distributed Morphology (DM; Halle & Marantz 1993, Harley & Noyer 1999 inter alia) and Nanosyntax (NS; Starke 2009, Caha 2009, Ramchand 2008 inter alia). What is traditionally considered two modules, morphology (word-syntax) and syntax (phrasal), is actually one computational module governed by syntactic rules and operations. According to this model, there are no words in the syntax. The input to syntax consists of feature bundles (DM) or individual features (NS) that encode information at the level of the morpheme. Taking this even a step further, while DM allows spell-out of only terminal nodes, Nanosyntax departs even further from the traditional view in that lexical insertion can target any node in the tree, including phrasal nodes.

A crucial consequence of this approach is that there is no entity that can be described as a 'word' within syntax. Borer (2009) clearly states that 'Words are not syntactic primitives or atomic in any meaningful sense.' There are features, phrases and terminals, but words only exist in lexical entries, and there, they are equal to entities traditionally thought of as affixes and thus, not full-fledged words. Therefore, defining a 'word' in any morpho-syntactic sense is not possible anymore, and recent syntactic work (Borer 2005, Newell 2008) assumes a purely phonological definition of word as the domain of main prominence, for example, stress assignment.

Sections 3.1 and 3.2 illustrated some aspects of decomposition in syntax which create complications for the theory of syntax-phonology mapping: if phonology creates prosodic words and phrases by mapping them from lexical words and phrases, what do we do when there is no such thing as 'lexical' or 'word'? Section 3.3 below puts forth another aspect of recent syntactic theory which, as we will see in sections 4 and 5, provides a tool for a solution to the problems of modular mapping.

3.3. Phases

Another influential advancement in syntax in the past decade is The Multiple Spell-Out Hypothesis (MSOH) (Uriagereka 1999, Chomsky 2000, 2001, 2004), also known as Phase Theory. It assumes that spell-out proceeds in phases, i.e. parts of the syntactic structure get spelled out to the PF and LF component before the whole structure is computed[6]. The internal structure of

[6] In this paper, 'PF' refers to the part of the derivation following Syntax, encompassing linearization of syntactic nodes, lexical insertion and phonological

such chunks becomes inaccessible to the rest of the computation, giving rise to syntactic islands. Furthermore, it is assumed that complex constituents are derived individually before they are merged together in the main derivation (Cinque's 1993 'minor' vs. 'major' path of embedding, Uriagereka's 1999 'command units').

There are various views on the exact points in the syntactic tree that are designated as phases. The mainstream view is that CP and vP are phases causing the spell-out of TP and VP, respectively, while CP and vP themselves are at 'phase edge' and thus remain accessible to the structure higher up in the tree. DP and KP are also claimed to be a phase.

On the other hand, Newell (2008), working on domains below phrasal level, argues that spell-out is not reserved for specific nodes in the tree, but happens as soon as all the features in a constituent are valued/checked, which makes that constituent interpretable at the interfaces. This is compatible with the Nanosyntax approach, in which there are no phases but spell-out is attempted at each merge and successfully occurs when lexical matching is achieved. Also, Epstein & Seely (2002, 2006) argue that each application of Merge and Move (i.e. Re-Merge) creates a phase that spells out the created tree structure to PF and LF. This paper advocates this hypothesis, and not the phase theory which stipulates that only specific nodes in the tree are phases. This is the null hypothesis, with minimal stipulative assumptions about the system, and as such the only one that remains in the spirit of the Minimalist Program (Chomsky 1995).

Some recent work on Prosody has attempted to incorporate the notion of Phases into Phonology (see Kratzer & Selkirk 2007, Revithiadou & Spyropoulos 2009 for phrase-level, Marvin 2002, Newell 2008 for word-level). The PF interface is claimed to also process spell-out chunks separately, deriving prosodic domains without referring to syntactic structure. Section 4 below addresses a problem for linearization that this view creates, and offers a

computation. Thus, the traditional term 'Phonological Form' should not be confused with 'Phonology', since the former includes the interface between Syntax and Phonology.

solution in the form of a modified theory of multiple spell-out, while section 5 offers a formalization within Optimality Theory.

4. Linearization and the nature of Input to Phonology

If we assume that spell-out proceeds in phases, and phonology receives input in chunks, this causes a problem for linearization. Imagine a simple derivation of the sentence John reads books in (10) below:

(10) phase1 input: /bʊks/
phase2 input: / dʒɔn ɹi:dz/

In a modular view of language, current linearization algorithms (e.g. Kayne 1994, Fox & Pesetsky 2005, Richards 2010) cannot produce the final utterance John reads books. from the chunks in (10), since they are based on linearising syntactic nodes and constituents with respect to each other, and they operate before Phonology. They can linearise constituents within a phase, and linearise that phase with respect to other syntactic constituents. However, and crucially, they cannot instruct phonology on how to linearise a phonological input coming as spell-out of a phase with respect to the phonological string which is already processed by phonology as the output of the previous phase. Phonology has no preference for the ordering of /bʊks/, / dʒɔn ɹi:dz/. Newell (2008: 32) states that 'at PF and LF, the output of each phase is stored and integrated according to the principles that are operative in each branch of the computation.' However, phonology has no principles for integrating two phonological strings, especially when their linear order wrt each other is dependent on their syntactic position in the tree. Even if it did order them, it would do so according to phonological principles; for example, by creating a perfect CVCV string and avoiding onset-less syllables.

There are several plausible options that deal with this linearization problem. It could perhaps be argued that linearization follows by default from the direction of merger within the separate phonological computations; and spell-out could, perhaps, (somehow) direct PF to place new material before or after the material already processed by phonology, depending on the direction of branching. However, this is problematic for all mixed-branching languages, including Kayardild which is discussed in section 5 below.

A more explicit way of dealing with linearization would be tracking by indexation, i.e. if the linearization algorithm had a way of indexing each node in syntax with a corresponding phonological constituent created by the phonological computation of each phase (i.e. creating pairs of type {N1, ω1}, {V1, ω2}). However, simply adding the output of syntactic spell-out to the output of phonological computation of the previous phase would create the wrong structure.

If new material linearizes wrt the output of the phonological computation of the previous phase, the underlying form for the first phase would be lost in the second phase. Hence, we would always see evidence of word-edge phenomena and recursive structure. An example of this is Polish word-final devoicing in (11) below. By looking at examples (11a-d), one might argue that the final consonant is underlyingly voiceless and becomes voiced intervocalically in the plural form. However, examples (11e-f) show that this is not the case, since the final consonant remains voiceless intervocalically in plural. Thus, the correct analysis is that the voice quality intervocalically remains faithful to the underlying form, and it is the voicing of the word-final consonant in the singular that actually changes; for example, word-final consonants get devoiced:

(11)

	Sg.	Pl		
(a)	klup	klubɨ	'club'	
(b)	trut	trudɨ	'labour'	
(c)	vos	vozɨ	'cart'	
(d)	nuš	nože	'knife'	
(e)	trup	trupɨ	'corpse'	
(f)	kot	kotɨ	'cat'	
(g)	nos	nosɨ	'nose'	
(h)	koš	kože	'basket'	(Kenstowicz 1994: 75)

If we accept the premise that each application of Merge introduces a new phase, the plural marker is added to the singular form in the second phase. If it were added to the phonological output of the first phase it would never surface as voiced since there is no intervocalic voicing in the language. This suggests that phonological computation needs access to the underlying input form of the first phase, not only in computing the first phase but the second one as well.

Further examples of this are seen in Dutch and German syllable-final obstruent devoicing, where vowel-initial suffixes induce re-syllabification which bleeds the devoicing rule (Kenstowicz 1994).

In Kayardild, one of the languages discussed in this paper, suffixes have 'word final' and 'protected' (i.e., word-internal) allomorphs (Evans 1995, Round 2009) as well as word-final reduction that changes vowel length and quality. If the second phase were built on an output of the first phase, the word-internal form would never surface.

(12)	(a)	thawurr-karran-ji	(b)	kamarr-karra	
		[taur-karaɲ-ci]		[kamar-kara]	
		stream-GEN-LOC		stone-GEN	(Round 2009)

In addition to GENitive, illustrated in (12) above, suffixes that also show this alternation are ABLative (word-internal [-naa]/[-naba] vs. word-final [-na]), PROPrietive ([-kuu]/[-kuru] vs. word-final [-ku]), ALLative ([-ɻiŋ] vs. [-ɻi]), NEGative ([-naŋ] vs. [-na]), etc. [7]

Thus, an adequate modular account of the syntax-phonology interface utilizing Phase theory would need to account for (i) proper linearization of outputs of different phases once they reach phonology, (ii) phonological access to the input underlying form of one phase while processing the input from subsequent phases (capturing the insights of a non-phase-based account) and (iii) phonological access to the output form of processing each phase separately in order to capture prosodic domain mapping modularly (capturing the insights of a phase-based account).

In this paper I argue that, if modularity is the basic organizational principle of the computational system of human language, our theory of language must satisfy the three conditions outlined above, which is possible

[7] It is not clear from Evans (1995) and Round (2009) whether there is only one underlying form and the alternation is the result of word-final truncation in Kayardild, or if there are two allomorphs, one of which is specified for word-final position. The analysis here does not depend on which account we choose (cf. tableaux (22) and (23)).

only if spell-out does not proceed in chunks but in concentric circles, producing cumulative cyclic input to phonology:

(13) phase1 input: /bʊks/
phase2 input: /ɹi:dz bʊks /
phase3 input: /dʒɔn ɹi:dz bʊks /

This goes against the traditional view of phases creating inaccessible domains in syntax, since syntactic structure does not get 'flattened' but stays fully accessible to lexical matching. Nevertheless, the idea that the part of the tree already sent off to be interpreted at the interfaces is still visible in syntax and, thus, accessible for later rounds of spell-out is not new. Nissenbaum (2000) and Newell (2008) argue that upon spell-out information is read off of the syntactic structure for the sake of lexical access and phonological interpretation, but it is not altered nor removed from syntax, since syntactic nodes of already spelled-out domains can be targets for Late Adjunction. The idea that domains are inaccessible comes from a ban on movement out of them. In the system used here this follows from the fact that all features in that domain are interpreted, leaving nothing to drive movement. This is also compatible with the Nanosyntax view of spell-out, where the whole tree needs to be accessible for lexical matching throughout the derivation.

By applying this view to the syntax-phonology interface, we account for (i) proper linearization by only linearising the syntactic elements wrt each other and by keeping linearization outside Phonology, (ii) continuous phonological access to the input underlying form by receiving that form in each phase due to lexical insertion and linearization occurring every time we spell out, and (iii) phonological access to the output form of processing each phase separately by being faithful to the phonological output of the previous phase, as presented in section 5 below.

5. Derivation as the Interface: Phase-Phase Faithfulness

This section offers an Optimality Theoretical account of how prosodic domains are modularly derived from Phases. A Prosodic Word is created not by phonological constraints referring to (morpho)syntactic words, but by parsing the input from the first phase as a string of phonological segments with no (morpho) syntactic information. Phonology simply receives a phonological string in the input and parses it in the most optimal way it can. This is done without knowing or caring what piece of the syntactic tree that string represents. This domain is further maintained in the computation of subsequent phases by the phonological computation being faithful to the prosodification output of the previous phase. The degree of faithfulness to the prosodification from the previous phase depends on the interaction of Phase-Phase Faithfulness constraints (introduced here into the OT computation) and general prosodic well-formedness constraints. As we will see from the example derivations below, the fact that lexical words are parsed as Prosodic Words, while functional material attaches to them, is simply an effect of the way syntactic derivation proceeds, starting from lexical material (roots) and building functional structure on top. In addition to this, when it comes to the Prosodic Phrase level, Cinque's (1993) idea that the most embedded element receives highest stress prominence can be derived from the fact that the most embedded element will be processed by phonology first, and the prominence assigned to it there will be maintained faithfully throughout the computation of subsequent phases of the derivation. Prosodic Phrases will be built starting from the most embedded elements. This derives the tendency of the Verb and the Object to form a PPh to the exclusion of the Subject from the fact that they are prosodified together before the Subject reaches the phonological computation. Prosodification changes at PPh level later in the derivation of an utterance will again depend on the interaction of Phase-Phase Faithfulness constraints and prosodic well-formedness constraints; for example, those requiring PPh to be binary. For reasons of space, the scope of this paper is limited to the PWd level and lower. For an account of the prosodification of these and higher levels within the system presented in this paper, the reader is referred to Šurkalović (in preparation). Below are examples of how phases of spell-out and phonological derivation proceed in the system outlined above, focusing on the Prosodic Word, using Kayardild, Ojibwa and English.

5.1. Kayardild

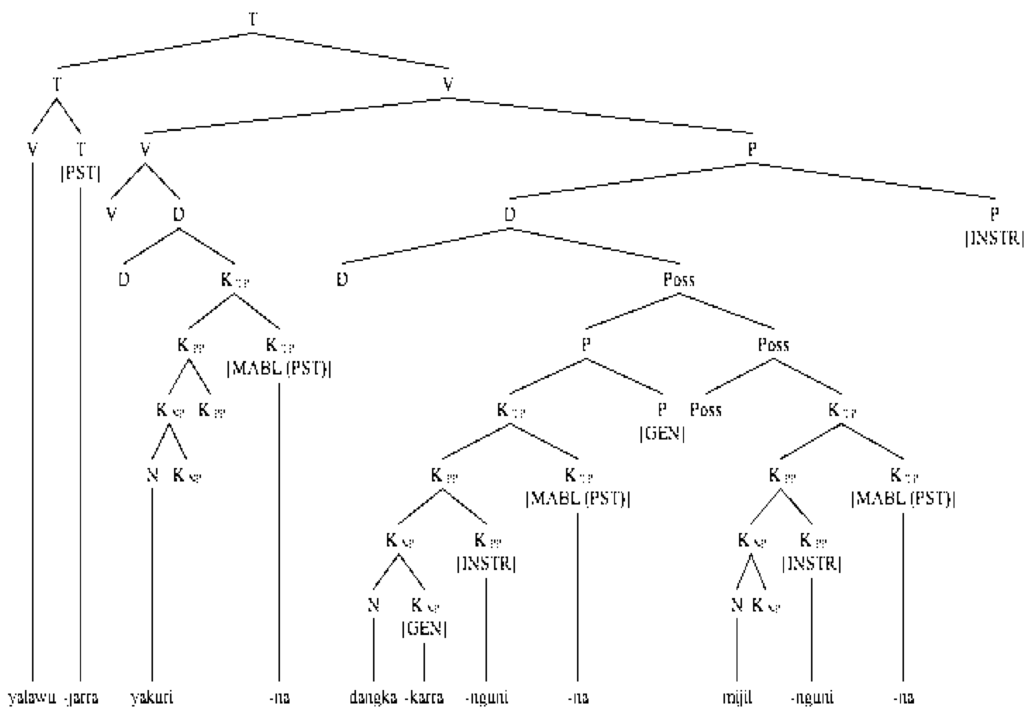
Kayardild is a moribund Southern Tangkic language, traditionally spoken by the Kaiadilt people of the Southern Wellesley Islands off the north coast of Australia. The main sources on the language are Evans' (1995) Grammar of Kayardild and Round's (2009) PhD dissertation on Kayardild syntax, morphology and phonology.

The most peculiar linguistic property of Kayardild is that it is a case-stacking language. The category of CASE encodes a number of syntactic and semantic relations between elements of the clause (such as relations among NPs, tense, aspect and mood information), as well as performs a complementizing function. Thus, some CASE features on NPs do not get valued until projections as high as T or C are merged into the tree. Phonologically/prosodically each root and its suffixes form a single Prosodic Word domain (Evans 1995, Round 2009), as illustrated in (1), repeated here:

(1) maku yalawu-jarra yakuri-na dangka-karra-nguni-na mijil-nguni-na
[{maku}$_\omega$ {jalawu-cara}$_\omega$ {jakuɹi-na}$_\omega$ {ʈaŋka-karaɲ-ŋuni-na}$_\omega$ {micil-ŋuni-na}$_\omega$]
woman catch-PST fish-MABL man-GEN-INSTR-MABL net-INSTR-MABL
'The woman caught the fish with the man's net.'
(Evans 1995: 115, transcription following Round 2009)

The syntactic tree representation of the sentence in (1) is given in (14) below, following Svenonius' (2010b) work on the Kayardild case system. I will not address the full tree, for the sake of simplicity, since a subpart is enough to carry out the discussion

(14)



catch-PST fish-MABL man-GEN-INSTR-MABL net-INSTR-MABL
(following Svenonius 2010b)

In the system outlined above the derivation proceeds as follows. The 'lexical' words 'man' and 'net' each start their own derivation before merging together into the main derivation ('fish'). They get spelled out since all the features are interpretable (Newell 2008) or because lexical matching is possible (Nanosyntax)[8]. (In theories that do not subscribe to this view, spell-out starts from the second step, at KP level.) Input to phonology is as in (15):

(15) /jaku i/ 'fish'; /ʈaŋka/ 'man'; /micil/ 'net'

In the second step, 'man' merges with CASE features, none of them interpretable until P is merged, at which point K_{NP} is interpretable, and input to phonology is /karaɲ/, which needs to be linearized wrt. /ʈaŋka/ 'man'. Next, 'net' merges with CASE features (none of them interpretable yet) and Poss merges the two derivations together. K_{PP} and K_{TP} are still uninterpretable on both constituents, so PossP is uninterpretable and cannot be spelled-out yet. Instrumental P is merged on top of the created DP and K_{PP} is now interpretable, but the two constituents are still part of separate derivations since PossP is still not interpretable and are, thus, not linearized wrt each other. The input to phonology is /-ŋuni/, which needs to be linearized wrt /ʈaŋka-karaɲ/ 'man.GEN' in the one path of embedding , and /-ŋuni/ which needs to be linearized wrt /micil/'net' in the other path of embedding. At this point the Instrumental PP is adjoined to the VP in the main derivation, but none of the CASE features on the object DP are interpretable yet, nor is the V (see fn.8). The verb and the two DPs are still separate constituents as far as PF is concerned. When T is merged, V, T and K_{TP} are interpretable at the interface, which makes all constituents interpretable and spell-out needs to linearise the parallel constituent derivations wrt each other and wrt new material. Thus, by joining the minor paths of embedding into the major one, 'catch-PST' and 'fish-MABL' and 'man-GEN-INSTR-MABL' and 'net-INSTR-MABL' all need to be linearized in the right order wrt each other. Furthermore, the input /na/ needs to be linearised wrt /jaku i/'fish',

[8] To keep things slightly simpler, I assume the traditional view where V has an uninterpretable T feature and is not spelled-out until it moves to T. Nanosyntax has a very different account of V-T dynamics. An alternative closer to Newell (2008) would be to say that V can spell-out on its own, in which case it needs to be linearized wrt. the object before the Instrumental PP and the T are merged.

another /na/ wrt. /ʈaŋkakaraɲŋuni/'man-GEN-INSTR', and another /na/ wrt /micilŋuni/'net-INSTR'.

Thus, in the traditional view of spell-out, phonology needs to linearise the following individual chunks of segments wrt one another when they reach the phonological computation in separate phases:

(16) (a)	/ʈaŋka/	wrt.	/karaɲ/
(b)	/-ŋuni/	wrt.	/ʈaŋkakaraɲ/
	/-ŋuni/	wrt	/micil/
(c)	/ʈaŋkakaraɲŋuni/	wrt.	/micilŋuni/
	/jakuɻi/	wrt	/ʈaŋkakaraɲŋuni micilŋuni/
	/jalawucara/	wrt	/jakuɻi ʈaŋkakaraɲŋuni micilŋuni/
	/na/	wrt.	/jakuɻi/
	/na/	wrt.	/ʈaŋkakaraɲŋuni/
	/na/	wrt .	/micilŋuni/

As we have seen in section 4 above, phonology has no principled way of linearising these chunks. Alternatively, it is argued here that spell-out cannot proceed in chunks but in concentric circles, producing cumulative cyclic input to phonology:

(17)

Phase 1: /jaku i/ 'fish'; /ʈaŋka/ 'man; /micil/ 'net' .

Phase 2: /ʈaŋka-karaɲ/ .

Phase 3: /ʈaŋka-karaɲ-ŋuni/

/micil-ŋuni/ .

Phase 4: /jalawu-cara/

/ʈaŋka-karaɲ-ŋuni micil-ŋuni/

/jaku i-ʈaŋka-karaɲ-ŋuni micil-ŋuni/

/jalawu-cara jakuɻi ʈaŋka-karaɲ-ŋuni-micil-ŋuni/

/jalawu-carajakuɻi-naʈaŋka-karaɲ-ŋuni-namicil-ŋuni-na/ .

Thus, for the path of embedding starting with /ʈaŋka/'man', input to phonology in each phase would be as in (18), with that path of embedding merging with others in Phase 3-4 :

(18) Phase 1: / ʈaŋka /

Phase 2 : / ʈaŋka-karaɲ /

Phase 3: / ʈaŋka-karaɲ-ŋuni micil-ŋuni /

Phase 4: / jakuɻi-na ʈaŋka-karaɲ-ŋuni-na micil-ŋuni-na /

Languages such as Kayardild differ from languages where phases induce cyclic effects within words (e.g. Ojibwa, in Newell 2008) by ranking Phase-Phase faithfulness constraints differently wrt. prosodic well-formedness constraints regulating, for example, the binarity of prosodic constituents or their alignment to one another. The constraints I use, adapted from Round (2009), are given in (19) below:

(19) NONRECURSIVITY
No prosodic constituent dominates another constituent of the same type.

*LAPSE
The output does not contain adjacent, unfooted syllables.

PARSE Ft
Assign a violation for each Foot not dominated by a word

WDBINMIN
Prosodic words are minimally binary

FTBIN
Feet are minimally and maximally binary

ALIGNL (FT, WD)
Align the left edge of each Foot with a left edge of a Prosodic Word

The Phase-Phase Faithfulness constraints I introduce into the OT constraint system are given in (20) below. PHASE-ANCHOR-L(PWD) replaces Round's (2009: 331) L-ANCHOR(GRWD,PWD) constraint which maps morpho-syntactic structure to prosodic structure by stating that 'The leftmost syllable of any grammatical word is the leftmost syllable of a prosodic word'. It restates the non-modular reference to grammatical words with reference to the phonological output of the previous phase. The PHASEMAX constraint requires that the prosodic structure created in one phase be maintained throughout the subsequent phases. Data from Kayardild shows the importance of PHASE-ANCHOR-L(PWD), as does the data from English in section 5.3, whereas Ojibwa is used in section 5.2 to exemplify the importance of PHASEMAX at the Foot level. The output of the previous phase will be shown in each tableau above the input string, and indicated by vertical lines, e.g. | $\{(\text{mi.cil})_{Ft}\ (\text{ŋu.ni})_{Ft}\text{na}\}_{\omega}$ |.

(20) PHASE-ANCHOR-L(PWD) - PALPWD
The left edge of a PWd constituent in phase n must correspond to its left edge in phase n-1

PHASEMAX[9] - PMAX
A prosodic constituent in phase n must have a correspondent in phase n+1

The derivation of a part of the Kayardild sentence in (1), repeated below for convenience, following the course of the derivation in the four Phases given in (17), is presented in tableaux (21) through (25).

(1) maku	yalawu-jarra	yakuri-na	dangka-karra-nguni-na	mijil-nguni-na
[{maku}$_\omega$	{jalawu-cara}$_\omega$	{jakuɻi-na}$_\omega$	{ʈaŋka-karaɲ-ŋuni-na}$_\omega$	{micil-ŋuni-na}$_\omega$]
woman	catch-PST	fish-MABL	man-GEN-INSTR-MABL	net-INSTR-MABL

‘The woman caught the fish with the man’s net.’

(Evans 1995: 115, transcription following Round 2009)

The tableaux (21a) and (21b) show the computation of the output of Phase1 for the two different paths of embedding. We see how the initial Prosodic word is parsed from the input string that Phonology receives from spell-out without knowing or needing to know what (morpho)syntactic structure that string spells out. On the one hand, the requirement that Prosodic words be minimally binary (WDBIN) is outranked by the requirement that the utterance is parsed into Words (PARSE-Ft), which is why Prosodic Words are created in computing the very first phase. On the other hand, presumably, the requirement that Prosodic Phrases be minimally binary outranks the requirement that the utterance be parsed into Prosodic Phrases, which is why Phrases are only created when two paths of embedding merge and two Prosodic Words are joined. Moreover, PHASE-ANCHOR-LEFT(PWD) is not violated since it does not apply due to the fact that there is no previous phase and thus no phase computation output to be faithful to.

(21a)

/ʈaŋka/	PAL PWD	NON REC	*LAPSE	PARSE-Ft	FT BIN	WD BIN	ALIGNL
a. ☞ {(ʈaŋ.ka)$_{Ft}$}$_\omega$						*	
b. (ʈaŋ.ka)$_{Ft}$				*!			

[9] Although a PHASEDEP constraint, stating that a prosodic constituent in phase *n* must have a correspondent in phase *n-1*, is assumed to exist, it will not be discussed in the paper, as it is not active in the data presented.

(21b)

/micil/	PAL PWD	NON REC	*LAPSE	PARSE-Ft	FT BIN	WD BIN	ALIGNL
a. ☞ {(mi.cil)Ft }ω						*	
b. (mi.cil)Ft				*!			

The tableaux (22a) and (22b) show the computation of Phase2 when the GEN suffix is added to 'man'. As mentioned in section 4, Kayardild suffixes have 'word final' and 'protected' (i.e., word-internal) forms, GEN being one of those suffixes. It is not clear from Evans (1995) or Round (2009) whether there is only one underlying form of this suffix and the alternation is the result of word-final truncation (for example, Kayardild banning consonants in word-final position (22a)) or if there are two allomorphs, one of which is specified for word-final position (22b)[10]. The analysis here does not depend on which account we choose, since they both provide us with the right allomorph in the right location, and both accounts are presented in the tableaux below. This lack of relevance will be evident in the next phase, tableau (23).

In both tableaux (22a – 22b) below, candidate (a) faithfully maps both PWd edges parsed in the computation of Phase1 in (21a) and parses the suffix as a separate PWd, which violates the requirement that PWd be minimally binary. The candidates in (b) also map faithfully the initial PWd, but have recursive structure, and violate NONRECURSIVITY. The optimal candidate in (d) satisfies *LAPSE by parsing the suffix as a Foot, but satisfies WORDBINMIN by incorporating that foot into the PWd parsed in Phase1. As we can see, the winning candidate can be chosen without appealing to the Phase Faithfulness constraint. It is tableau that (25) provides us with the crucial example, where two lexical words with their suffixes are joined, producing dangka-karra-nguni-na mijil-nguni-na. This is where the constraint L-ANCHOR(GRWD,PWD) had to be invoked to account for the location of the left edge of the prosodic word. It is also crucial for the theory presented here, as it illustrates how Phase Faithfulness constraints can outrank the prosodic well-formedness constraints and provide us with a winning candidate that is not prosodically optimal but

[10] I will not go into details of allomorph selection, as it is orthogonal to the issues addressed in this paper.

does reflect the course of the derivation. However, since this is a derivational account, presenting the steps leading up to (25) will nevertheless be necessary.

(22a)

| {(ʈaŋ.ka)$_{Ft}$ }$_{\omega}$ | /ʈaŋkakaraɲ/	*C]$_{\omega}$	PAL PWD	NON REC	*LAPSE	PARS Ft	FT BIN	WD BIN	ALIGN L
a. {(ʈaŋ.ka)$_{Ft}$}$_{\omega}${(ka.ra)$_{Ft}$}$_{\omega}$							*!*	
b. {{(ʈaŋ.ka)$_{Ft}$}$_{\omega}$(ka.ra)$_{Ft}$}$_{\omega}$			*!				*	**
c. {(ʈaŋ.ka)$_{Ft}$ ka.ra} $_{\omega}$				*!			*	
d. ☞ {(ʈaŋ.ka)$_{Ft}$(ka.ra)$_{Ft}$} $_{\omega}$								**
e. { ʈaŋ (ka.ka)$_{Ft}$ ra} $_{\omega}$							*!	*
f. {(ʈaŋ.ka)$_{Ft}$ (ka.raɲ)$_{Ft}$} $_{\omega}$	*!							**

(22b)

| {(ʈaŋ.ka)$_{Ft}$ }$_{\omega}$ | /ʈaŋkakara/	PAL PWD	NON REC	*LAPS	PARSE Ft	FT BIN	WD BIN	ALIGN L
a. {(ʈaŋ.ka) $_{Ft}$}$_{\omega}${(ka.ra)$_{Ft}$} $_{\omega}$						*!*	
b. {{(ʈaŋ.ka)$_{Ft}$}$_{\omega}$(ka.ra)$_{Ft}$}$_{\omega}$		*!				*	**
c. {(ʈaŋ.ka)$_{Ft}$ ka.ra} $_{\omega}$			*!			*	
d. ☞ {(ʈaŋ.ka)$_{Ft}$ (ka.ra)$_{Ft}$} $_{\omega}$							**
e. {ʈaŋ (ka.ka)$_{Ft}$ ra} $_{\omega}$						*!	*

In (23a) and (23b) we see the computation of Phase3, when the INSTR suffix *ŋuni* becomes available for spell-out. Here we see an example of a crucial part of the 'spell out at each merge' approach argued for in this paper. Lexical lookup, as part of the process of spelling out the syntactic structure, applies to the whole tree every time, including the already spelled out part. Thus, the input to phonology will be /ʈaŋkakaraɲŋuni/, and not just /ŋuni/. Namely, as we saw in section 4, we need to maintain the full underlying form of each lexical item in each phase, since, in Kayardild, word-edge phenomena apply only to the word edge in the final phase, and there are no effects on the word edges created by intermediate phases. We cannot simply use the output of (22), [ʈaŋkakara], and build on it in (23a). This would give us the unattested output *[ʈaŋkakaraŋuni]. We need to process the whole string independently, and only selectively refer to the output of Phase2; as in the Phase faithfulness constraints. It is also evident that only Phase Faithfulness to prosodification is relevant in Kayardild, and not faithfulness to segmental material.

(23a) processes the different parsing options of the input string regardless of the options already explored and rejected in (22). The truncation account is presented in the tableau for ease of exposition (cf. fn10). Candidates (a, b) are not optimal because they violate the WDBINMIN constraint. As in (22), the optimal candidate satisfies *LAPSE by parsing the suffix as a Foot, and NONRECURSIVITY by incorporating that foot into the PWd parsed in Phase2. Again, as above, the winning candidate can be chosen without appeal to Phase Faithfulness.

(23a)

| {(ʈaŋ.ka)$_{Ft}$ (ka.ra)$_{Ft}$} $_{\omega}$ | / ʈaŋkakaraɲŋuni/	PAL PWD	NON REC	*LAPS	PARSE Ft	FT BIN	WD BIN	ALIGN L
a. {(ʈaŋ.ka)$_{Ft}$}$_{\omega}$ {(ka.raɲ)$_{Ft}$}$_{\omega}$ {(ŋu.ni)$_{Ft}$} $_{\omega}$						*!**	
b. {(ʈaŋ.ka)$_{Ft}$(ka.raɲ)$_{Ft}$}$_{\omega}$ {(ŋu.ni)$_{Ft}$}$_{\omega}$						*!	**
c. {(ʈaŋ.ka)$_{Ft}$ {(ka.raɲ)$_{Ft}$(ŋu.ni)$_{Ft}$}$_{\omega}$}$_{\omega}$		*!					**
d. {{ (ʈaŋ.ka)$_{Ft}$(ka.raɲ)$_{Ft}$}$_{\omega}$ (ŋu.ni)$_{Ft}$}$_{\omega}$		*!					****
e. {(ʈaŋ.ka)$_{Ft}$(ka.raɲ)$_{Ft}$ ŋu.ni}$_{\omega}$			*!				**
f.☞ {(ʈaŋ.ka)$_{Ft}$ (ka.raɲ)$_{Ft}$ (ŋu.ni)$_{Ft}$}$_{\omega}$							****

The second tableau, (23b), which computes a different path of embedding, parallels (22b) in that the optimal candidate maintains the PWd parsed in the previous phase without creating additional PWd, and while incorporating the suffix into the PWd, which results in a binary PWd. As in (22), the winning candidate can still be chosen by appealing to the requirement that PWd be minimally binary.

(23b)

| {(mi.cil)$_{Ft}$ }$_{\omega}$ | /micilŋuni/	PAL PWD	NON REC	*LAPS	PARSE Ft	FT BIN	WD BIN	ALIGN L
a. {(mi.cil) $_{Ft}$}$_{\omega}$ {(ŋu.ni)$_{Ft}$}$_{\omega}$						*!*	
b. {{(mi.cil)$_{Ft}$}$_{\omega}$(ŋu.ni)$_{Ft}$}$_{\omega}$						*!	**
c. {(mi.cil)$_{Ft}$ ŋu.ni} $_{\omega}$			*!			*	
d.☞ {(mi.cil)$_{Ft}$ (ŋu.ni)$_{Ft}$}$_{\omega}$							**
e. {mi (cil. ŋu)$_{Ft}$ ni} $_{\omega}$						*!	*

The following tableaux show the computation of a part of Phase4, when the whole tree becomes available for spell-out. In (24) we see that, once the Modal Ablative suffix -na is added, we again have the option of parsing the input string into more Prosodic Words. However, candidates (a-c) fail due to binarity violations, and the optimal candidate in both tableaux once again incorporates all the suffixes into one PWd together with the base, leaving na unfooted. The winning candidate is chosen by appealing to the binarity and alignment requirements coupled with a ban on recursive structure (thus excluding candidate (d) in (24a)), without making reference to phases in the derivation.

(24a)

|{(ʈaŋ.ka)$_{Ft}$(ka.raɲ)$_{Ft}$ (ŋu.ni)$_{Ft}$}$_{\omega}$| /ʈaŋkakaraɲŋunina/	PAL PWD	NON REC	*LAPS	FT BIN	WD BIN	ALIGN L
a. {(ʈaŋ.ka) $_{Ft}$}$_{\omega}$ {(ka.raɲ)$_{Ft}$}$_{\omega}$ {(ŋu.ni)$_{Ft}$}$_{\omega}$ {(na)$_{Ft}$}$_{\omega}$				*!	****	
b. {(ʈaŋ.ka)$_{Ft}$ (ka.raɲ)$_{Ft}$}$_{\omega}$ {(ŋu.ni)$_{Ft}$ (na)$_{Ft}$}$_{\omega}$				*!		****
c. {(ʈaŋ.ka) $_{Ft}$ (ka.raɲ)$_{Ft}$}$_{\omega}$ {(ŋu.ni)$_{Ft}$ na}$_{\omega}$					*!	****
d. {{(ʈaŋ.ka)$_{Ft}$ (ka.raɲ)$_{Ft}$}$_{\omega}$ (ŋu.ni)$_{Ft}$ na}$_{\omega}$		*!				******
e.☞ {(ʈaŋ.ka)$_{Ft}$ (ka.raɲ)$_{Ft}$ (ŋu.ni)$_{Ft}$ na}$_{\omega}$						******
f. {(ʈaŋ.ka)$_{Ft}$ (ka.raɲ)$_{Ft}$ ŋu (ni.na)$_{Ft}$}$_{\omega}$						****** *!

(24b)

| {(mi.cil)$_{Ft}$ (ŋu.ni)$_{Ft}$}$_{\omega}$ | /micilŋunina/	PAL PWD	NON REC	*LAPS	PARSE Ft	FT BIN	WD BIN	ALIGN L
a. {(mi.cil)$_{Ft}$}$_{\omega}${(ŋu.ni)$_{Ft}$}$_{\omega}$ {(na)$_{Ft}$}$_{\omega}$					*!	**	
b. {(mi.cil)$_{Ft}$ (ŋu.ni)$_{Ft}$}$_{\omega}$ {(na)$_{Ft}$}$_{\omega}$					*!	*	**
c. {(mi.cil)$_{Ft}$}$_{\omega}$ {(ŋu.ni)$_{Ft}$ (na)$_{Ft}$}$_{\omega}$					*!	*	**
d.☞ {(mi.cil)$_{Ft}$ (ŋu.ni)$_{Ft}$na}$_{\omega}$							**
e. {(mi.cil)$_{Ft}$ ŋu (ni.na)$_{Ft}$}$_{\omega}$							***!

The crucial example for illustrating the importance of Phase-Phase Faithfulness constraints is given in tableau (25) below, which shows the computation of the input formed by joining the two paths of embedding in tableaux (24a-b) and spelling them out together. As we can see, the optimal candidate in (25a) is fully faithful to the PWd parsing of the previous phases. It contains, however, two unparsed syllables. Candidates (25b, c, e) have exhaustively parsed syllables into feet, but this results in the relocation of the left edge of the second PWd, violating PHASE-ANCHOR-L. Candidate (25d) follows the trend in the language of creating single PWD, but crucially violates ALIGNL(FT, WD) more than the winning candidate (25a). Candidate (25e) parses the string into three binary PWd. Thus, it incurs the least violations of ALIGNL(FT, PWD) and would actually be the optimal parsing of the input string if it were not for the violation of PHASE-ANCHOR-L(PWD) by the change in location of the left edge of the second PWd.[11] Therefore, Phase Faithfulness is crucial when it comes to Prosodic Words in Kayardild, and the less optimally aligned candidate wins.

(25)

| {(ʈaŋ.ka)$_{Ft}$ (ka.raɲ)$_{Ft}$ (ŋu.ni)$_{Ft}$ na} $_{\omega}$ | | {(mi.cil)$_{Ft}$ (ŋu.ni)$_{Ft}$na} $_{\omega}$ | /ʈaŋkakaraɲŋuninamicilŋunina/	PAL PWD	NON REC	*LAPS	FT BIN	WD BIN	ALIGN L
a. ☞ {(ʈaŋ.ka)$_{Ft}$(ka.raɲ)$_{Ft}$(ŋu.ni)$_{Ft}$na}$_{\omega}$ {(mi.cil)$_{Ft}$ (ŋu.ni)$_{Ft}$ na} $_{\omega}$						********
b. {(ʈaŋ.ka)$_{Ft}$ (ka.raɲ)$_{Ft}$(ŋu.ni)$_{Ft}$(na.mi)$_{Ft}$}$_{\omega}$ {(cil. ŋu)$_{Ft}$ (ni. na)$_{Ft}$ } $_{\omega}$	*!					******* *******
c. {(ʈaŋ.ka)$_{Ft}$ (ka.raɲ)$_{Ft}$ (ŋu.ni)$_{Ft}$ }$_{\omega}$ {(na.mi)$_{Ft}$ (cil. ŋu)$_{Ft}$ (ni. na)$_{Ft}$ } $_{\omega}$	*!					******* *****
d. {(ʈaŋ.ka)$_{Ft}$ (ka.raɲ)$_{Ft}$ (ŋu.ni)$_{Ft}$ (na.mi)$_{Ft}$ (cil.ŋu)$_{Ft}$ (ni.na)$_{Ft}$ } $_{\omega}$						******** *!****** ******** *******
e. {(ʈaŋ.ka)$_{Ft}$ (ka.raɲ)$_{Ft}$}$_{\omega}$ {(ŋu.ni)$_{Ft}$ (na.mi)$_{Ft}$}$_{\omega}$ {(cil.ŋu)$_{Ft}$ (ni.na)$_{Ft}$ } $_{\omega}$	*!					******

[11] Also, candidate (25d) violates PHASEMAX(PWD) by failing to keep the second PWd parsed in the previous phase, and candidate (25e) violates PHASEDEP(PWD) by introducing a third PWd, not created in the previous phase. However, the correct output choice does not depend on these constrains and they are thus excluded. Whether there are cases in Kayardild where these constraints are crucial in choosing the right output remains for further research.

As phonological evidence for the prosodic structure in (25), Round (2009) provides the stress pattern in Kayardild. Based on the prominence facts, Feet in Kayardild are trochaic and bisyllabic. The head of each Foot receives level 1 prominence, whereas the leftmost Foot head in a word receives higher prominence, level 2, as the head of the PWd. This head of PWd serves as an anchor for pitch realisation in focus marking, for example. No two adjacent syllables are unfooted. There is no interaction between segmental phonology and stress, but there is phonetic neutralisation of the length contrast in unstressed syllables. While higher stress prominence signals the beginning of the PWd, word-final allomorphs of some suffixes (Evans 1995, Round 2009) as well as word-final reduction that changes vowel length and quality (as mentioned in section 4 above), signal the end of a PWd. For reasons of space, I have not provided a detailed discussion of the data supporting the prosodification in (25) and the reader is referred to the extensive work and argumentation in Round (2009), to which I adhere.

5.2. Ojibwa

Ojibwa (also Ojibwe, Chippewa or Anishinaabe) is a language belonging to the Algonquian family, spoken in Canada and the United States. It is an example of a language where phases induce cyclic effects within words, at the Foot level. Namely, as illustrated in (26) below, in Ojibwa a single word can express what in other languages, a whole sentence is used (Newell 2008: 7), for example, as in English:

(26) $[_{CP}$ ni $[_{TP}$ gi: $[_{vP}$ $[_{AP}$ ini] $[_{VP}$ a:gam-ose:]]]]
[nigi:inia:gamose:]
1SG-PAST-away-snowshoe-walk
'I walked there in snowshoes'

Ojibwa feet are iambic and syllables are exhaustively parsed from left to right. Degenerate feet (single light syllable) are only permitted at the right edge of a domain. In (27) below (Newell 2008: 34), the antepenultimate light syllable mi should optimally be footed together with the penultimate syllable gi:, as in (27c). However, this is not the attested output, and the actual parsing is as in (27b):

(27) (a) [ni [[bi:mi-Ø] [gi:we:-Ø]]]
[1P [[ALONG-FIN $_{AP}$] [GO HOME-FIN $_{VP}$]$_{vP}$]...$_{CP}$]
'I walk on home'
(b) (nibì:)(mí)(gì:)(wè:)
(c)* (nibì:)(migì:)(wè:)

This parsing is due to the fact that feet are parsed at the computation of each phase and they do not cross a phase boundary. In the system presented in this paper, the derivation through phases proceeds as in (28) with the OT computation of the final phase given in (29). We see in (29a) that the prosodic well-formedness constraints do not account for the actual output given in (28d), since the optimally footed candidate (b) in (29a) is not the actual output candidate. (29b) shows how the correct output candidate can be chosen by introducing the PHASEMAX(FT) constraint into the computation, which forces the feet created in the previous phases of the computation to be maintained at the cost of prosodic well-formedness.

(28) (a) phase1: {(gi:)$_{Ft}$ (we:)$_{Ft}$}$_{\omega}$
(b) phase2: {(bi:mi)$_{Ft}$}$_{\omega}$
(c) phase3: {(nibi:)$_{Ft}$ (mi)$_{Ft}$}$_{\omega}$ [12]
(d) phase4: {(nibi:)$_{Ft}$ (mi)$_{Ft}$ (gi:)$_{Ft}$ (we:)$_{Ft}$}$_{\omega}$ *{(nibi:)$_{Ft}$(migi:)$_{Ft}$(we:)$_{Ft}$}$_{\omega}$

(29)

PHASEMAX(FT)
A Foot in phase n must have a correspondent in phase n+1
PARSE Ft
Assign a violation for each Foot not dominated by a word
*STRUC ω
Assign a violation for each Prosodic Word
ALIGNL (FT, WD)
Align the left edge of each Foot with a left edge of a Prosodic Word

[12] 1pSg marker *ni-* is prosodically cliticised, cf. Newell (2008)

(a)

| {(nibi:)$_{Ft}$ (mi)$_{Ft}$}$_{\omega}$ | | {(gi:)$_{Ft}$ (we:)$_{Ft}$}$_{\omega}$ | /nibi:migi:we:/	PARSE Ft	*STRUC ω	ALIGN L
a. ☹ {(nibi:)$_{Ft}$ (mi)$_{Ft}$ (gi:)$_{Ft}$ (we:)$_{Ft}$}$_{\omega}$		*	*******!**
b. 💣 {(nibi:)$_{Ft}$(migi:)$_{Ft}$(we:)$_{Ft}$}$_{\omega}$		*	******
c. {(nibi:)$_{Ft}$ (mi)$_{Ft}$}$_{\omega}$ {(gi:)$_{Ft}$ (we:)$_{Ft}$}$_{\omega}$		**!	

(b)

| {(nibi:)$_{Ft}$ (mi)$_{Ft}$}$_{\omega}$ | | {(gi:)$_{Ft}$ (we:)$_{Ft}$}$_{\omega}$ | /nibi:migi:we:/	P-MAX FT	PARSE Ft	*STRUC ω	ALIGN L
a. ☞ {(nibi:)$_{Ft}$ (mi)$_{Ft}$ (gi:)$_{Ft}$ (we:)$_{Ft}$}$_{\omega}$			*	*********
b. {(nibi:)$_{Ft}$(migi:)$_{Ft}$(we:)$_{Ft}$}$_{\omega}$	*!		*	******
c. {(nibi:)$_{Ft}$ (mi)$_{Ft}$}$_{\omega}$ {(gi:)$_{Ft}$ (we:)$_{Ft}$}$_{\omega}$			**!	

5.3. English function words

As mentioned in sections 2 and 3 above, in addition to the alignment of prosodic and syntactic constituents, another issue for modularity is the distinction between lexical and functional categories in their prosodic behaviour. Phonology seems to be able to recognize whether a word or a phrase it receives in the input is a spell-out of lexical or functional syntactic features. This is evident from the different phonological behaviour of lexical and function words. Seminal work on the importance of this distinction in phonology is found in the Selkirk (1995) paper on the prosody of function words in English. Namely, a sequence of two lexical words in a phrase will be prosodified as a sequence of Prosodic Words; whereas, in a sequence of a function word and a lexical word, the function word can be mapped onto a Prosodic Word, or onto a prosodic clitic, for example a (morpho)syntactic word which is not a Prosodic Word, but is adjoined to a PWd at the Prosodic Phrase level. An example tableau of Selkirk's (1995) analysis is given in (30), where we see how the non-modular constraints on the mapping between Lexical Words and Prosodic Words derive the prosodic phrasing of a book. in town, for example.

(30)

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. ($\{\text{fnc}\}_\omega$ $\{\text{lex}\}_\omega)_\varphi$			**!	
b. ☞(fnc { lex $\}_\omega)_\varphi$				*
c. ({ fnc lex $\}_\omega)_\varphi$	*!		*	
d. ({fnc $\{\text{lex}\}_\omega$ $\}_\omega)_\varphi$		*!	*	

Nevertheless, if modularity is to be maintained, we need to restate the difference in such a way that phonology need not refer to syntactic (lexical) features. In the system presented here, using the derivation itself as the interface tool, the key difference between lexical and function words is that 'lexical' words are those with which the derivation starts, and thus are sent to PF first. They are phrased as Prosodic Words at the start of the derivation, at phase1, and the phonological computation in languages such as English remains faithful to this phrasing later on. We already saw how lexical words start the derivation by being parsed as Prosodic Words in the Kayardild analysis in section 5.1, more specifically in (21a,b). In (31) below an example is given of how (30) can be restated in a modular approach, deriving the Prosodic Word status of lexical words from their status as phase1 in the derivation and capturing the difference in prosodic behaviour by using the difference in derivational status.

Tableau (31b) shows how the output parsing is achieved by incorporating the suffix into the already existing PWd, without creating recursive structure and, thus, violating PHASEDEP(PWD). In tableau (31c) we see the relevance of PHASEANCHORL(PWD). In candidate (b) it prevents 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) again prevents the formation of recursive structure. The constraints are unranked since there is no evidence for their ranking based on the data sample discussed here. For a more in-depth discussion of English in the theory presented here, the reader is referred to Šurkalović (in preparation).

(31)

PHASE-ANCHOR-L(PWD) – PAL PWD

The left edge of a PWd constituent in one phase corresponds to its left edge in the other phase

PHASEDEP(PWD) - PDEPPWD

A Prosodic Word constituent in phase n must have a correspondent in phase n-1

PARSE Ft

Assign a violation for each Foot not dominated by a word

EXHAUSTIVITY

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

(a)

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

(b)

| $(book)_\omega$ | /book-s/	PARSE Ft	PAL PWD	P-DEP PWD	EXH
a. ($\{book\}_\omega$ s $)_\varphi$				*!
b. ☞($\{books\}_\omega)_\varphi$				
c. (($\{book\}_\omega$ s $\}_\omega)_\varphi$			*!	

(c)

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

6. Conclusion

This paper has attempted to reconcile current syntactic theories with what we know about prosody, in order to arrive at a fully modular theory of the syntax-phonology interface. It has argued that modularity can be maintained, unlike in the current theories of the syntax-phonology interface, if we assume that spell-out is the only means of communication between syntax and phonology, and that the only source of information used in phonological computation is the phonological information in the Lexical entry.

If we utilize the current Phase theory in syntax and assume that, as an effect of syntactic phases, phonology proceeds in phases as well, we can achieve domain mapping while maintaining an input to phonology consisting of purely phonological information. Input to phonology is, thus, a linearized string of phonological underlying forms of lexical items, created as output of syntactic spell-out. It is not an output of each syntactic phase separately, but necessarily a cumulative output including the material spelled-out in previous phases. Linearization of one phase with respect to another thus, requires no special mechanism, and linearization algorithms still operate only on syntactic elements.

We can derive the effects of (morpho)syntactic and information structure on prosody without referring to that structure in the phonological computation by creating prosodic structure at each phase, thus reflecting the syntactic derivation and structure, and by referring to the prosodic structure created in previous phases when computing the output of the current phase.

This is formalized within the Optimality Theory framework by introducing Phase-Phase Faithfulness constraints. The lexical/functional distinction can be captured in a completely functional syntax by deriving the difference in prosodic behaviour from the difference in derivational status. If we assume that spell-out happens not at designated nodes in the tree, but at any point when all the features are valued and lexical matching can occur, 'lexical' words are those with which the derivation starts, and thus are sent to PF first. As a result they are phrased as Prosodic Words at the start, with phonological computation being faithful to this phrasing later on. The Prosodic Word status of lexical words is derived from their status as Phase1 in the derivation.

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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

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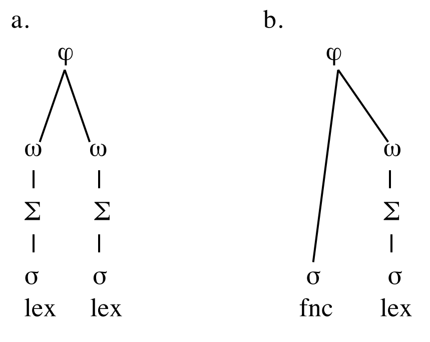
alternative No Reference Hypothesis approach presented in Šurkalović (2011a), and outlined in section 1.2 below, to this aspect of the syntax-phonology interaction in English. The goal of the work presented here is to account for the interaction of syntax and phonology in a fully modular view of language, 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, $j < i\text{-}1$ (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}$_ω$ {lex}$_ω$)$_φ$			*!*	
b. ☞(fnc { lex }$_ω$)$_φ$				*
c. ({ fnc lex }$_ω$)$_φ$	*!		*	
d. ({fnc {lex}$_ω$}$_ω$)$_φ$		*!	*	

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)$_ω$ |.

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$\Re$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}$_ω$		
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, $j < i\text{-}1$,

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

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 |(céle$_{Ft}$ bràte$_{Ft}$)| . 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: | {([ma.sságe]$_{Ft}$)$_{PWd}$}$_{PPh}$ |
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]$_{\text{Ft}}$)$_{\text{PWd}}$ }$_{\text{PPh}}$ |
input: /so$_{\mu}$meca$_{\mu\mu}$ke /

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

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

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

(26)

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

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

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: $\vert${a$_{\mu\ \sigma}$ ([ma.sságe]$_{\text{Ft}}$)$_{\text{PWd}}$}$_{\text{PPh}}$$\vert$ 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]$_{\text{Ft}}$)$_{\text{PWd}}$ }$_{\text{PPh}}$					**	
b { [fo$_{\mu}$r.a$_{\mu}$]$_{\text{Ft}}$ ([ma.sságe]$_{\text{Ft}}$)$_{\text{PWd}}$ }$_{\text{PPh}}$		*!				*
c { ([fo$_{\mu}$ r.a$_{\mu}$]$_{\text{Ft}}$)$_{\text{PWd}}$ ([ma.sságe]$_{\text{Ft}}$)$_{\text{PWd}}$ }$_{\text{PPh}}$		*!				
d { ([fo$_{\mu}$ r.a$_{\mu}$] $_{\text{Ft}}$ [ma.sságe]$_{\text{Ft}}$)$_{\text{PWd}}$ }$_{\text{PPh}}$	*!	*				

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

	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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