

# Modularity, Linearization and Phase-Phase Faithfulness in Kayardild<sup>1</sup>

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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 Optimalidad. 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 Optimalidad.

**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 output 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 unidirectional, 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}<sub>ω</sub>]    {jalawu-cara}<sub>ω</sub>    {jaku*ɹ*-i-na}<sub>ω</sub>    {taŋka-karaŋ-ŋuni-na}<sub>ω</sub>    {micil-ŋuni-na}<sub>ω</sub>]  
 woman    catch-PST      fish-MABL      man-GEN-INSTR-MABL      net-INSTR-MABL<sup>2</sup>  
 ‘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

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<sup>2</sup> PST = Past, MABL = Modal Ablative (Case that is assigned by the Tense of the Verb), GEN = Genitive, INSTR = Instrumental)



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<sub>AP</sub>] [GO HOME-FIN<sub>VP</sub>]<sub>VP</sub>...CP]  
 'I walk on home'  
 (b) (nibì:)(mí)(gì:)(wè:)  
 (c) \*(nibi:)(migi:)(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)<sub>Ft</sub> thy vs. (te le)<sub>Ft</sub> (pa thic)<sub>Ft</sub> vs. \*te le (pa thic)<sub>Ft</sub>  
 a mas (sage)<sub>Ft</sub> vs. for a mas (sage)<sub>Ft</sub> vs. \*for (a mas)<sub>Ft</sub> (sage)<sub>Ft</sub>

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<sup>3</sup>. 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

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<sup>3</sup> 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<sup>MAX</sup>, 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<sup>4</sup>. Because of the LCC, IP or CP, functional projections, do not invoke WRAP-XP.

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<sup>4</sup> 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<sub>1</sub> XP<sub>2</sub>]<sub>XP<sub>1</sub></sub> [ V NP ]<sub>VP</sub>  
 ( )<sub>P</sub> (tinabá káluúlu)<sub>P</sub>  
 we-stole hare  
 'We stole the hare.'
- (8) [X<sub>1</sub> XP<sub>2</sub> XP<sub>3</sub>]<sub>XP<sub>1</sub></sub> (a) [ V NP [ P NP ]<sub>PP</sub> ]<sub>VP</sub>  
 ( )<sub>P</sub> (anaményá nyumbá <sup>n</sup>dí mwáála)<sub>P</sub>  
 he-hit house with rock  
 'He hit the house with a rock.'
- (b) [ V NP NP ]<sub>VP</sub>  
 (tinapátsá mwaná <sup>n</sup>jínga)<sub>P</sub>  
 we-gave child bicycle  
 'We gave the child a bicycle.'
- (9) [XP<sub>1</sub> XP<sub>2</sub>]<sub>IP/CP</sub> [ NP VP ]<sub>IP</sub>  
 ( )<sub>P</sub> ( )<sub>P</sub> (kagaálu)<sub>P</sub> (kanáafa)<sub>P</sub>  
 (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'<sup>5</sup> (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

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<sup>5</sup> 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 acategorical, 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<sup>Max</sup> 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 acategorical 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<sup>6</sup>. The internal structure of

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<sup>6</sup> 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

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

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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 ʝi: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 ʝi: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,  $\omega$ 1}, {V1,  $\omega$ 2}). 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	koɨ	'cat'
(g)	nos	nosi	'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<br>[taur-karaŋ-ci]<br>stream-GEN-LOC | (b) | kamarr-karra<br>[kamar-kara]<br>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]), PROPrietary ([-kuu]/[-kuru] vs. word-final [-ku]), ALLative ([-ɽiŋ] vs. [-ɽi]), NEGative ([-nan] vs. [-na]), etc.<sup>7</sup>

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

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<sup>7</sup> 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.

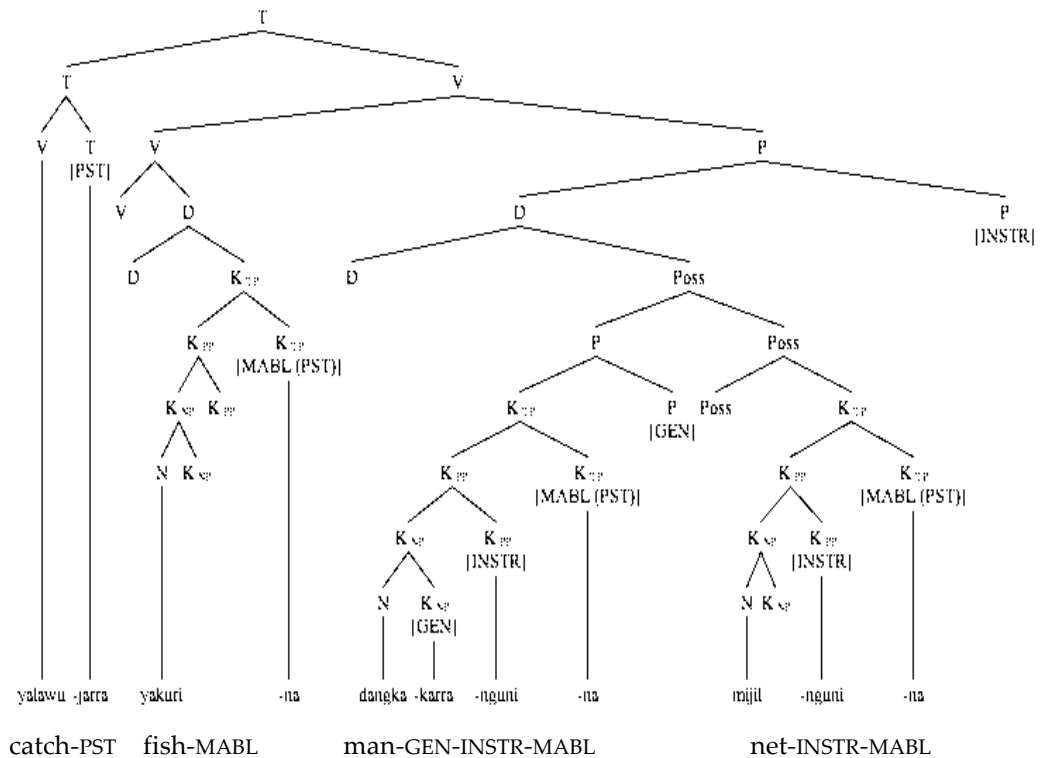
The most peculiar linguistic property of Kayardild is that it is a case-stacking language. The category of CASE encodes a number of syntactic and semantic relations between elements of the clause (such as relations among NPs, tense, aspect and mood information), as well as performs a complementizing 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}<sub>ω</sub> {jalawu-cara}<sub>ω</sub> {jakuɿi-na}<sub>ω</sub> {taŋka-karaŋ-ŋuni-na}<sub>ω</sub> {micil-ŋuni-na}<sub>ω</sub>]  
 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)



(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)<sup>8</sup>. (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’;            /taŋka/ ‘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 /karaŋ/, which needs to be linearized wrt. /taŋka/ ‘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 /taŋka-karaŋ/ ‘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’,

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<sup>8</sup> 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. /tʰəkakaraŋuni/ 'man-GEN-INSTR', and another /na/ wrt /micilʰuni/ '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) /tʰəkka/	wrt.	/karaŋ/
(b) /-ŋuni/	wrt.	/tʰəkakaraŋ/
/-ŋuni/	wrt	/micil/
(c) /tʰəkakaraŋuni/	wrt.	/micilʰuni/
/ʝakuɿi/	wrt	/tʰəkakaraŋuni micilʰuni/
/ʝalawucara/	wrt	/ʝakuɿi tʰəkakaraŋuni micilʰuni/
/na/	wrt.	/ʝakuɿi/
/na/	wrt.	/tʰəkakaraŋuni/
/na/	wrt .	/micilʰuni/

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:	_____/ʝaku i/ 'fish';      /tʰəkka/ 'man;      /micil/ 'net' _____.
Phase 2:	_____/tʰəkka-karaŋ/ _____.
Phase 3:	_____/tʰəkka-karaŋ-ŋuni/ _____.
	_____/micil-ŋuni/ _____.
Phase 4:	/ʝalawu-cara/
	_____/tʰəkka-karaŋ-ŋuni micil-ŋuni/ _____.
	_____/ʝaku i-tʰəkka-karaŋ-ŋuni micil-ŋuni/ _____.
	_____/ʝalawu-cara ʝakuɿi tʰəkka-karaŋ-ŋuni-micil-ŋuni/ _____.
	_____/ʝalawu-carajakuɿi-na tʰəkka-karaŋ-ŋuni-namicil-ŋuni-na/ _____.

Thus, for the path of embedding starting with /tʰəkka/ '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: / tʰəkka /
	Phase 2 : / tʰəkka-karaŋ /
	Phase 3: / tʰəkka-karaŋ-ŋuni micil-ŋuni /
	Phase 4: / ʝakuɿi-na tʰəkka-karaŋ-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. | {(mi.cil)<sub>Ft</sub> (ŋu.ni)<sub>Ft</sub>na}<sub>ω</sub> |.

- (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<sup>9</sup> - P<sub>MAX</sub>

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]<sub>ω</sub>    [jalawu-cara]<sub>ω</sub>    [jaku.i-na]<sub>ω</sub>    {taŋka-karaŋ-ŋuni-na}<sub>ω</sub>    {micil-ŋuni-na}<sub>ω</sub>]  
 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)

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

<sup>9</sup> 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. $\varnothing$ $\{(mi.cil)_{Ft}\}_{\omega}$						*	
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)<sup>10</sup>. 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

<sup>10</sup> 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)

$  \{(\text{ta}\eta.\text{ka})_{\text{Ft}}\}_{\omega}  $ /taŋkakarəŋ/	*C] <sub>ω</sub>	PAL PWD	NON REC	*LAPSE	PARS Ft	FT BIN	WD BIN	ALIGN L
a. $\{(\text{ta}\eta.\text{ka})_{\text{Ft}}\}_{\omega} \{(\text{ka.ra})_{\text{Ft}}\}_{\omega}$							*!*	
b. $\{ \{(\text{ta}\eta.\text{ka})_{\text{Ft}}\}_{\omega} (\text{ka.ra})_{\text{Ft}} \}_{\omega}$			*!				*	**
c. $\{(\text{ta}\eta.\text{ka})_{\text{Ft}} \text{ka.ra}\}_{\omega}$				*!			*	
d. $\text{☞} \{(\text{ta}\eta.\text{ka})_{\text{Ft}} (\text{ka.ra})_{\text{Ft}}\}_{\omega}$								**
e. $\{ \text{ta}\eta (\text{ka.ka})_{\text{Ft}} \text{ra} \}_{\omega}$							*!	*
f. $\{(\text{ta}\eta.\text{ka})_{\text{Ft}} (\text{ka.ra}\eta)_{\text{Ft}}\}_{\omega}$	*!							**

(22b)

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

In (23a) and (23b) we see the computation of Phase3, when the INSTR suffix *ηuni* 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 /taŋkakarəŋηuni/, and not just /ηuni/. 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), [taŋkakarə], and build on it in (23a). This would give us the unattested output \*[taŋkakarəŋuni]. 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)

{(təŋ.ka) <sub>Ft</sub> (ka.ra) <sub>Ft</sub> } <sub>ω</sub>   / təŋkakarəŋjuni/	PAL PWD	NON REC	*LAPS	PARSE Ft	FT BIN	WD BIN	ALIGN L
a. {(təŋ.ka) <sub>Ft</sub> } <sub>ω</sub> {(ka.raŋ) <sub>Ft</sub> } <sub>ω</sub> {(ŋu.ni) <sub>Ft</sub> } <sub>ω</sub>						*!***	
b. {(təŋ.ka) <sub>Ft</sub> (ka.raŋ) <sub>Ft</sub> } <sub>ω</sub> {(ŋu.ni) <sub>Ft</sub> } <sub>ω</sub>						*!	**
c. {(təŋ.ka) <sub>Ft</sub> {(ka.raŋ) <sub>Ft</sub> (ŋu.ni) <sub>Ft</sub> } <sub>ω</sub> } <sub>ω</sub>		*!					**
d. {{(təŋ.ka) <sub>Ft</sub> (ka.raŋ) <sub>Ft</sub> } <sub>ω</sub> (ŋu.ni) <sub>Ft</sub> } <sub>ω</sub>		*!					****
e. {(təŋ.ka) <sub>Ft</sub> (ka.raŋ) <sub>Ft</sub> ŋu.ni} <sub>ω</sub>			*!				**
f. ☞ {(təŋ.ka) <sub>Ft</sub> (ka.raŋ) <sub>Ft</sub> (ŋu.ni) <sub>Ft</sub> } <sub>ω</sub>							****

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) <sub>Ft</sub> } <sub>ω</sub>   /miciljuni/	PAL PWD	NON REC	*LAPS	PARSE Ft	FT BIN	WD BIN	ALIGN L
a. {(mi.cil) <sub>Ft</sub> } <sub>ω</sub> {(ŋu.ni) <sub>Ft</sub> } <sub>ω</sub>						*!*	
b. {{(mi.cil) <sub>Ft</sub> } <sub>ω</sub> (ŋu.ni) <sub>Ft</sub> } <sub>ω</sub>						*!	**
c. {(mi.cil) <sub>Ft</sub> ŋu.ni} <sub>ω</sub>			*!			*	
d. ☞ {(mi.cil) <sub>Ft</sub> (ŋu.ni) <sub>Ft</sub> } <sub>ω</sub>							**
e. {mi (cil. ŋu) <sub>Ft</sub> ni} <sub>ω</sub>						*!	*

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)

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

(24b)

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

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.<sup>11</sup> Therefore, Phase Faithfulness is crucial when it comes to Prosodic Words in Kayardild, and the less optimally aligned candidate wins.

(25)

$\{ \{ (\text{ʈaj.ka})_{\text{Ft}} (\text{ka.raŋ})_{\text{Ft}} (\text{ŋu.ni})_{\text{Ft}} \text{na} \}_{\omega} \mid$ $\{ \{ (\text{mi.cil})_{\text{Ft}} (\text{ŋu.ni})_{\text{Ft}} \text{na} \}_{\omega} \mid$ $/\text{ʈaŋkakarajŋuninamicilŋunina}/$	PAL PWD	NON REC	*LAPS	FT BIN	WD BIN	ALIGN L
a. $\{ \{ (\text{ʈaj.ka})_{\text{Ft}} (\text{ka.raŋ})_{\text{Ft}} (\text{ŋu.ni})_{\text{Ft}} \text{na} \}_{\omega}$ $\{ \{ (\text{mi.cil})_{\text{Ft}} (\text{ŋu.ni})_{\text{Ft}} \text{na} \}_{\omega}$						*****
b. $\{ \{ (\text{ʈaj.ka})_{\text{Ft}}$ $(\text{ka.raŋ})_{\text{Ft}} (\text{ŋu.ni})_{\text{Ft}} (\text{na.mi})_{\text{Ft}} \}_{\omega}$ $\{ \{ (\text{cil.ŋu})_{\text{Ft}} (\text{ni.na})_{\text{Ft}} \}_{\omega}$	*!					***** *****
c. $\{ \{ (\text{ʈaj.ka})_{\text{Ft}} (\text{ka.raŋ})_{\text{Ft}} (\text{ŋu.ni})_{\text{Ft}} \}_{\omega}$ $\{ \{ (\text{na.mi})_{\text{Ft}} (\text{cil.ŋu})_{\text{Ft}} (\text{ni.na})_{\text{Ft}} \}_{\omega}$	*!					***** *****
d. $\{ \{ (\text{ʈaj.ka})_{\text{Ft}} (\text{ka.raŋ})_{\text{Ft}} (\text{ŋu.ni})_{\text{Ft}}$ $(\text{na.mi})_{\text{Ft}} (\text{cil.ŋu})_{\text{Ft}} (\text{ni.na})_{\text{Ft}} \}_{\omega}$						***** *!***** ***** *****
e. $\{ \{ (\text{ʈaj.ka})_{\text{Ft}} (\text{ka.raŋ})_{\text{Ft}} \}_{\omega}$ $\{ \{ (\text{ŋu.ni})_{\text{Ft}} (\text{na.mi})_{\text{Ft}} \}_{\omega}$ $\{ \{ (\text{cil.ŋu})_{\text{Ft}} (\text{ni.na})_{\text{Ft}} \}_{\omega}$	*!					*****

<sup>11</sup> 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 constraints 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<sub>AP</sub>] [GO HOME-FIN<sub>VP</sub>]<sub>vP</sub>]<sub>vP</sub>]...<sub>CP</sub>]  
 'I walk on home'  
 (b) (nibi:)(mi)(gi:)(wè:)  
 (c)\* (nibi:)(migi:)(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:)<sub>Ft</sub> (we:)<sub>Ft</sub>}<sub>ω</sub>  
 (b) phase2: {(bi:mi)<sub>Ft</sub>}<sub>ω</sub>  
 (c) phase3: {(nibi:)<sub>Ft</sub> (mi)<sub>Ft</sub>}<sub>ω</sub><sup>12</sup>  
 (d) phase4: {(nibi:)<sub>Ft</sub> (mi)<sub>Ft</sub> (gi:)<sub>Ft</sub> (we:)<sub>Ft</sub>}<sub>ω</sub>      \*{(nibi:)<sub>Ft</sub>(migi:)<sub>Ft</sub>(we:)<sub>Ft</sub>}<sub>ω</sub>

(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<sub>ω</sub>

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

---

<sup>12</sup> 1pSg marker *ni-* is prosodically cliticised, cf. Newell (2008)

(a)

{(nibi:) <sub>Ft</sub> (mi) <sub>Ft</sub> } <sub>ω</sub>     {(gi:) <sub>Ft</sub> (we:) <sub>Ft</sub> } <sub>ω</sub>   /nibi:migi:we:/	PARSE Ft	*STRUC ω	ALIGN L
a. ⊗ {(nibi:) <sub>Ft</sub> (mi) <sub>Ft</sub> (gi:) <sub>Ft</sub> (we:) <sub>Ft</sub> } <sub>ω</sub>		*	*****!*
b. ● {(nibi:) <sub>Ft</sub> (migi:) <sub>Ft</sub> (we:) <sub>Ft</sub> } <sub>ω</sub>		*	*****
c. {(nibi:) <sub>Ft</sub> (mi) <sub>Ft</sub> } <sub>ω</sub> {(gi:) <sub>Ft</sub> (we:) <sub>Ft</sub> } <sub>ω</sub>		**!	

(b)

{(nibi:) <sub>Ft</sub> (mi) <sub>Ft</sub> } <sub>ω</sub>     {(gi:) <sub>Ft</sub> (we:) <sub>Ft</sub> } <sub>ω</sub>   /nibi:migi:we:/	P-MAX Ft	PARSE Ft	*STRUC ω	ALIGN L
a. ⚡ {(nibi:) <sub>Ft</sub> (mi) <sub>Ft</sub> (gi:) <sub>Ft</sub> (we:) <sub>Ft</sub> } <sub>ω</sub>			*	*****!*
b. {(nibi:) <sub>Ft</sub> (migi:) <sub>Ft</sub> (we:) <sub>Ft</sub> } <sub>ω</sub>	*!		*	*****
c. {(nibi:) <sub>Ft</sub> (mi) <sub>Ft</sub> } <sub>ω</sub> {(gi:) <sub>Ft</sub> (we:) <sub>Ft</sub> } <sub>ω</sub>			**!	

### 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  $\sigma$ )

## 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} <sub>ω</sub> {lex} <sub>ω</sub> ) <sub>φ</sub>			**!	
b. $\sigma$ -( fnc { lex } <sub>ω</sub> ) <sub>φ</sub>				*
c. ( { fnc lex } <sub>ω</sub> ) <sub>φ</sub>	*!		*	
d. ( {fnc {lex} <sub>ω</sub> } <sub>ω</sub> ) <sub>φ</sub>		*!	*	

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  $\sigma$ )

(a)

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

(b)

(book) <sub>ω</sub>	PARSE Ft	PAL PWD	P-DEP PWD	EXH
/book-s/				
a. ( {book} <sub>ω</sub> s ) <sub>φ</sub>				*!
b. $\{books\}_\omega$				
c. ( ( {book} <sub>ω</sub> s ) <sub>ω</sub> ) <sub>φ</sub>			*!	

(c)

(book) <sub>ω</sub>	PARSE Ft	PAL PWD	P-DEP PWD	Exh
/a book/				
a. ( a {book} <sub>ω</sub> ) <sub>φ</sub>				*
b. ( { a book } <sub>ω</sub> ) <sub>φ</sub>		*!		
c. ( { a {book} <sub>ω</sub> } <sub>ω</sub> ) <sub>φ</sub>			*!	

## 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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