



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.

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 [tu]*, but *I don't think I [kæn]* vs. *I want [tə] see if I [kæn] 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* [tələpəθi], but *telepathic* [teləpəθɪk], 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) | $[X_1 \text{ XP}_2]_{\text{XP}_1}$
$(\quad)_{\text{P}}$ | $[V \quad \text{NP}]_{\text{VP}}$
(tinabá káluúlu) _P
we-stole hare
‘We stole the hare.’ |
| (5a) | $[X_1 \text{ XP}_2 \text{ XP}_3]_{\text{XP}_1}$
$(\quad)_{\text{P}}$ | $[V \quad \text{NP} \quad [\text{P NP}]_{\text{PP}}]_{\text{VP}}$
(anaményá nyu ^m bá ⁿ dí mwáála) _P
he-hit house with rock
‘He hit the house with a rock.’ |
| (5b) | | $[V \quad \text{NP} \quad \text{NP}]_{\text{VP}}$
(tinapátsá mwaná ⁿ jí ⁿ ga) _P
we-gave child bicycle
‘We gave the child a bicycle.’ |
| (6) | $[\text{XP}_1 \quad \text{XP}_2]_{\text{IP/CP}}$
$(\quad)_{\text{P}} (\quad)_{\text{P}}$ | $[\text{NP} \quad \text{VP}]_{\text{IP}}$
(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; Kĩĩtharaka: 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: FRED_{CT} ate the BEANS_F.

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

H* L+H*L-H%
B: FRED_F ate the BEANS_{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

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 acategorical, 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 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 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 account-

ing 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 acategorical 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 OT⁷ 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 , $j < i-1$,
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) _ω (book) _ω) _φ			*!*	
b. ☞ (a (book) _ω) _φ				*
c. ((a book) _ω) _φ	*!		*	
d. ((a (book) _ω) _ω) _φ		*!	*	

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) _ω (book _R) _ω) _φ			*!*	
b. ☞ (a (book _R) _ω) _φ				*
c. ((a book _R) _ω) _φ	*!		*	
d. ((a (book _R) _ω) _ω) _φ		*!	*	

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) _ω (s) _ω) _φ			*!*	
b. ● [*] ((book _R) _ω s) _φ				*
c. ⊕((book _R s) _ω) _φ	*!		*	
d. (((book _R) _ω s) _ω) _φ		*!	*	

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) _ω (s) _ω) _φ			**!		
b. ((book _R) _ω s) _φ	*!				*
c. $\overline{\mathcal{F}}$ ((book _R s) _ω) _φ			*	*	
d. (((book _R) _ω s) _ω) _φ		*!	*		

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 $\langle _ \rangle_{\omega}$ 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 $\langle _ \rangle_{\omega}$ 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) _ω /	IO-Faith	Non Rec	AlignPWd L/R	AlignRoot L/R	Exh
a. ((book _R) _ω (s) _ω) _φ			**!		
b. ((book _R) _ω s) _φ	*!				*
c. $\overline{\mathcal{F}}$ ((book _R s) _ω) _φ			*	*	
d. (((book _R) _ω s) _ω) _φ		*!	*		

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 $\langle /id/, Past \rangle$.

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

$L+H^* L-H\%$ $H^* L-L\%$
B: FRED_{CT} ate the BEANS_F.

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

H^* $L+H^* L-H\%$
B: FRED_F ate the BEANS_{CT}.

(17) $\langle /H^*/, F \rangle$,
 $\langle /L+H^* L-H\%/, CT \rangle$

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 [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. $\mathcal{F}((\mathbf{t\ddot{u}})_{\omega}(\delta\partial(\mathbf{d\ddot{o}g})_{\omega})_{\phi})_{\phi}$					**	*
b. $(t\partial(\delta\partial(\mathbf{d\ddot{o}g})_{\omega})_{\phi})_{\phi}$	*!					

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

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 _{fin} -H* _{Suff} the _{fin} 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* ☞ ((tu) _ω (ðə (dɔg) _ω) _φ) _φ					**	*
b. H* (tə(ðə(dɔg) _ω) _φ) _φ	*!	*				

(21)

Throw it to-H* _ω the dog _R (not at it)	AssocPA	IO-Faith	AlignL/R (Root;PWd)	AlignL/R (PWd;Root)	HP
a. H* ☞ ((tu) _ω (ðə (dɔg) _ω) _φ) _φ				**	*
b. H* (tə(ðə(dɔg) _ω) _φ) _φ	*!	*			

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:

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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