sThe Syntax-Phonology Interface*

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1.0 Introduction

The topic of the syntax-phonology interface is broad, encompassing different submodules of grammar and interactions of these. This chapter addresses one fundamental aspect of the syntax-phonology interface in detail: the relation between syntactic constituency and the prosodic constituent domains for sentence-level phonological and phonetic phenomena. Two further core aspects, which rely on an understanding of the first, are not examined here-- the phonological realization (spell-out) of the morphosyntactic feature bundles of morphemes and lexical items that form part of syntactic representation[1] and the linearization of syntactic representation which produces the surface word order of the sentence as actually pronounced[2].

Early observations in the context of generative grammar of the apparent effects of syntactic constituency on phonology indicate already that the presence or absence of various types of phonological phenomena at different locations within a sentence correlates with differences in syntactic structure. Chomsky and Halle 1968 observed the tendency for local maxima of prosodic stress prominence to fall on the rightmost constituent within a phrase: [[A sènator [from Chicágo]] [wòn [the làst eléction]]]. McCawley 1968 recognized that in Tokyo Japanese "initial lowering"—a LH tone sequence-- appeared at the left edge of groupings that correlate (in part) with syntactic constituency. Selkirk 1974 reported that in French the absence of word-final consonant deletion before a following vowel, referred to as *liaison,* also correlates with syntactic structure, as seen in the pronunciation of the adjective *petit* with final *–t* or without it: [[Le petit_âne] [le suivait]] the little donkey him-followed "The little donkey followed him" *vs.* [[Le peti~~t~~] [[aime] [le Guignol]], the little one loves the Guignol*,* "The little one loves the marionette theater". Subsequent research has expanded our understanding of the types of phonological phenomena that may be domain-sensitive in this very general sense: the full set includes a broad range of markedness-driven tonal phenomena of the sort that are independently attested in studies of word-level tonology and a broad range of markedness-driven segmental phenomena. There has also has been considerable phonetic research testifying to domain-sensitivity in the phonetic interpretation of the sentence.

In the last thirty years or so, debate has persisted around a central basic question: What is the nature of the linguistic representation in terms of which domain-sensitive phenomena of sentence phonology and phonetics are defined? Does the syntactic representation alone itself provide the structure in terms of which these domain-sensitive phenomena are defined (Cooper and Paccia-Cooper 1980, Kaisse 1985, Odden 1987, 1994, 1996, 2000; Tokizaki 2008, Wagner 2005, 2007; Pak 2008, among others)? Or are there domains for phonology and phonetics that are defined in terms of a distinct prosodic structure that forms part of the properly phonological representation of the sentence (Selkirk 1978 et seq, Nespor and Vogel 1986, Beckman and Pierrehumbert 1986, Pierrehumbert and

Beckman 1988, Hayes 1989, Inkelas 1990, Truckenbrodt 1995, 1999, Ladd 1996, 2008, Shattuck-Hufnagel and Turk 1996, Elordieta 1998, 2007, Frota 2000, Seidl 2001, Dobashi 2003, Kahnemuyipour 2003, Gussenhoven 2004, Prieto 2005, Jun 2005, Revithiadou and Spyropoulos 2005, 2008, Ishihara 2007, among others)? Is a mixed picture of domain-sensitivity required, in which some phenomena are defined in terms of syntax directly and some in terms of a syntax-influenced phonological representation (Kaisse 1985, Seidl 2001, Pak 2008), and, if there is a mixed theory, which sorts of phenomena are sensitive to which sorts of constituency[3]? There is no easy answer to these questions. In this chapter, I will review and revise arguments for a prosodic structure representation of phonological domains, a representation that is independent of syntactic constituency but related to it by a module of syntactic-prosodic constituency correspondence constraints. The arguments to be presented in favor of a place in the theory of grammar for a prosodic constituent representation of phonological domains are based on recent rethinking of the nature of prosodic structure and the nature of syntactic structure-prosodic structure correspondence.

It does seems likely that the vast majority of domain-sensitive phenomena of sentence phonology as well as all of domain-sensitive phonetic phenomena are defined in terms of a properly phonological prosodic structure representation of domain. For example, depending on the language, the right or left edge of specific prosodic domains (whether prosodic word, phonological phrase, or intonational phrase) may identify the locus of local prosodic stress prominence, or the locus of tonal epenthesis, or the locus of consonant epenthesis or deletion, or the locus of segmental neutralization, etc. These phenomena are arguably driven by a pressure for surface phonological representations to respect general constraints on phonological markedness, as construed, for example, within optimality theory (Prince and Smolensky 1993, McCarthy and Prince 1993 et seq). At the same time, it does also seem likely that certain phonological phenomena, like that of French *liaison* (in particular as it involves inflectional endings), are best analyzed as being directly sensitive to morpho-syntactic structure[4].

In what one might refer to as the 'standard theory' of prosodic structure, prosodic constituent representation is defined as a well-formed labeled tree or bracketing, but one which has two fundamental properties that distinguish it from syntactic constituent structure representations—the prosodic hierarchy and strict layering (Selkirk 1978/1981a, 1981b, 1986: Nespor and Vogel 1986; Beckman and Pierrehumbert 1986, Pierrehumbert and Beckman 1988; and others). The *prosodic hierarchy* is the name for an ordered set of prosodic category types. These prosodic category types constitute possible node labels for prosodic structures and in the standard view are stipulated by phonological theory.

(1) Prosodic category types of a commonly posited prosodic hierarchy

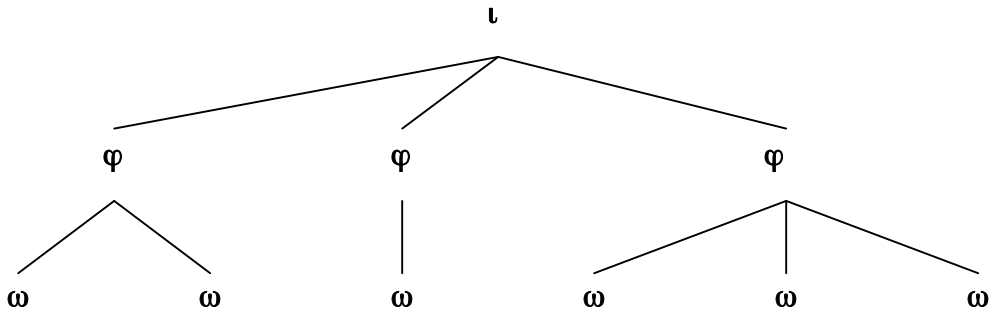
Intonational Phrase (ι)
Phonological Phrase (φ)
Prosodic Word (ω)
Foot
Syllable

In the standard theory no inherent relation is assumed to exist between the prosodic category types found in phonological representations and the category types of syntactic representation.

In this standard theory the nature of domination relations within a prosodic constituent structure is also stipulated by phonological theory. The *strict layer hypothesis* is the name given to the idea that a prosodic structure representation is strictly arranged according to the ordered set of categories in the prosodic hierarchy, as in (2). The strict layer hypothesis constitutes a purely phonological theory of the formal relations holding between constituents of the different prosodic category types in a prosodic structure.

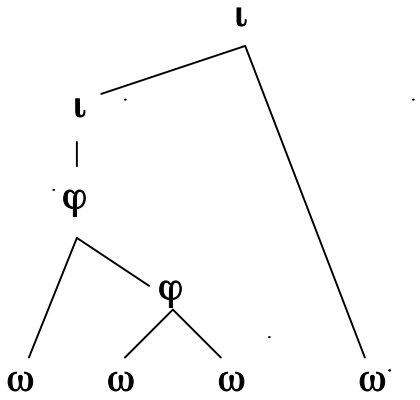
(2) The strict layer hypothesis

> A constituent of category-level *n* in the prosodic hierarchy immediately dominates only a (sequence of) constituents at category-level *n-1* in the hierarchy:



(Selkirk 1981, 1995, Nespor and Vogel 1982, 1986, Pierrehumbert and Beckman 1988, Hayes 1989, Inkelas 1990)

(3) A representation that violates the strict layer hypothesis:



In (3) are instances of configurations in which a constituent of a particular prosodic category type dominates another of the same category type (ι/ι and φ/φ); these are

instances of *recursivity*. There is also an instance of a configuration in which a constituent of category level *n* in the prosodic hierarchy immediately dominates a constituent of category level n-2 (ι/ω); call this *level-skipping*[5]. These configurations both represent violations of the strict layer hypothesis. Strict layering predicts, among other things, that the edge of a higher-level prosodic category will always coincide with the edge of a category at the next level down in the prosodic hierarchy, with the consequence that the right edge of the sentence should always show the phonological properties of the right edge of phonological phrase and right edge of prosodic word, in addition to the properties of right edge of intonational phrase. If representations like (2) that do obey the strict layer hypothesis were the rule in phonology, as much earlier work contended, then phonological representations would indeed differ fundamentally from syntactic representations, which show configurations of the same general character as those found in (3). One first type of argument, then, for a nonsyntactic, prosodic, representation of phonological domain structure was based on evidence that was taken to show that the domain structure for phonological and phonetic phenomena was indeed strictly layered, namely that it had formal properties distinct from that of syntactic constituent structure, as specified in (2) (see e.g. Selkirk 1978/1981a, 1980b; Nespor and Vogel 1986).

A second, related, argument for an independent prosodic constituency is based on the (putative) empirical generalization, found in this earlier literature, that phonological domain constituents may be systematically nonisomorphic to syntactic constituents. Early accounts attributed this putative nonisomorphism, or some of it, to the nature of the constraints relating syntactic structure and prosodic structure, which, in given syntactic configurations, were thought to result in mismatches between syntactic and prosodic constituency (see Nespor & Vogel 1986, Selkirk 1986, and discussion in Section 2.3).

A third type of argument for the distinctness of prosodic and syntactic structures is due originally to Nespor and Vogel 1986, who pointed out that nonsyntactic factors like speech rate may have an influence on phonological domain structure. Subsequent findings that phonological domain structure is also affected by phonological constraints on the weight or size of constituents or on their tonal properties (Selkirk and Tateishi 1988, Ghini 1993, Inkelas and Zec 1995, among others) provided further evidence for the nonsyntactic character of phonological domains.

But evidence has been emerging that undermines the earlier claim made by the standard theory that representations of phonological domain structure systematically respect the strict layer hypothesis[6], and the claim that constraints on syntax-phonology constituent correspondence produce a systematic nonisomorphism with syntactic and phonological constituents[7]. It turns out that the only argument for prosodic constituent structure that stands the test of time comes from nonsyntactic influences on phonological domain structure. Section 3 of this chapter is devoted to elaborating this latter argument; it includes a review of phonological constraints on phonological domain structure, as well as a case study of prosodic phrasing in Lekeitio Basque (section 3.2), which provides telling evidence for the role of properly phonological markedness-based factors in determining surface prosodic structure.

Section 2 addresses the nature of syntactic-prosodic constituency correspondence per se. Section 2.1 includes evidence from a case study of the Bantu language Xitsonga, which displays properties of prosodic constituent representation like those in (3) that go contrary to the strict layer hypothesis-- namely recursivity and level-skipping. These properties are arguably the consequence of a new theory of the syntactic-prosodic constituency relation, one which calls for a match between syntactic and prosodic constituents (Selkirk 2006, 2009b). An initial, pre-theoretic, version of a Match theory of syntactic-prosodic constituency correspondence is given in (4):

(4) Match theory of syntactic-prosodic constituency correspondence [to be refined[8]]

i. Match Clause

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

ii. Match Phrase

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

iii. Match Word

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

This set of universal Match constraints calls for the constituent structures of syntax and phonology to correspond; it predicts a strong tendency for phonological domains to mirror syntactic constituents. The view to be argued for below is that the actual phonological domain structure produced for individual sentences in individual languages, which includes a strong tendency to recursivity, is the result of syntactic constituency-respecting Match constraints like those in (4). Moreover, in identifying distinct prosodic constituent types (ι, φ, ω) to correspond to the designated syntactic constituent types, Match theory embodies the claim that, in the ideal case, the grammar allows the fundamental syntactic distinctions between clause, phrase and word to be reflected in, and retrieved from, the phonological representation. At the same time, though, we will see that phonological markedness constraints on prosodic structure, if high-ranked, may lead to violations of Match constraints and produce instances of nonisomorphism between syntactic constituency and phonological domain structure. This independence of phonological domain structure from what is predicted by syntactic constituency provides the essential argument for the prosodic structure theory of this domain structure.

A general Match theory of syntactic-prosodic structure correspondence that encompasses ι-domains, φ-domains and ω-domains has not before been proposed. But it has precursors in Ladd 1986 and Nespor and Vogel 1986 on intonational phrasing, and has re-emerged in more recent proposals within minimalist phase theory (Chomsky 2001) which hold that the Spell-Out domains of phases correspond to phonological phrases and/or that certain

phrase types identifiable in terms of phase theory are spelled out as phonological phrases[9]. Further articulation of the Match theory of correspondence is found in section 2.2, which also examines the implications of Match theory for the theory of prosodic structure itself. Match theory complements recent thinking by Ito and Mester (2007, 2009) on the nature of prosodic constituency representations in that it predicts that prosodic structure should display formal properties that bring it much closer to syntactic structure, including recursivity in constituency and a limited universal theory of prosodic category types. Section 2.3 is devoted to showing that Match theory is a better theory of syntactic-prosodic constituency correspondence than its predecessors, most notably the demarcative Alignment theory of Selkirk 1986, 1996 and the cohesional Wrap theory of Truckenbrodt 1995, 1999.

2. Syntactic constituency and phonological domain structure

2.1 A case study from Xitsonga

In Xitsonga, a Bantu language of northeast South Africa and Mozambique described and analyzed by Kisseberth 1994 and Cassimjee & Kisseberth 1998, the domain structure motivated by both tonal and segmental phenomena of sentence-level phonology shows a clear effect of syntactic constituency, but this domain structure also exhibits divergences from syntactic structure which are arguably the effect of prosodic structure markedness constraints. Kisseberth 1994 provides all the empirical insights concerning the distribution of high tone spread and penultimate lengthening in Xitsonga sentences that are the basis for the analysis of phonological domain structure and domain-sensitivity offered here[10]. The data from Xitsonga is particularly valuable in that it provides evidence for the two distinct above-word levels of prosodic constituency that are grounded in the Match theory in (4), namely, the **ι**-domain and the **φ**-domain.

2.1.1 Penultimate lengthening

In Xitsonga, all and only vowels that are penultimate in the clause are long (V:). There is no lexical vowel length contrast; this penultimate lengthening is introduced by the phonology[11]. According to a purely syntactic approach, the clause would constitute the phonological domain for penultimate lengthening. But according to the prosodic structure hypothesis, and specifically Match theory, (4), the clause would correspond to an intonational phrase, or ι-domain, which itself would be the domain for penultimate lengthening:

(5)[12] a. [[ndzi-xav-el-a$_{Verb}$ [xi-phukuphuku] [fo:le]]]$_{clause}$ [K148]

1st.sg.Subj-buy-appl-FV fool tobacco

'I am buying tobacco for a fool'

b. (ndzi-xavela xi-phukuphuku fo:le)ι

[Prosodic constituents internal to the ι will be shown when they are under discussion.]

Sentences like those below in (6) which contain a postposed subject show penultimate lengthening on the final word of the entire sentence as well as penultimate lengthening on the word preceding the postposed subject. According to Kisseberth 1994, the morphosyntax of such sentences argues that what precedes the subject is a clause itself[13].

(6) a. $_{clause}$[$_{clause}$[[y-â:-j!á$_{Verb}$]]$_{clause}$ [n-gúlú:ve]]$_{clause}$ [K150-151]

Class9.subj-tense-eat-FV Class9-pig

'it's eating, the pig'

b-i. ((yâ:j!á) n-gúlú:ve) b-ii. * (yâ:j!á) (n-gúlú:ve)

c. $_{clause}$[$_{clause}$[[vá-xáv-á$_{Verb}$ [tí-ho:m!ú]]]$_{clause}$ [vá:-nhu]]$_{clause}$

'they are buying cattle, the people are'

d-i. ((vá-xává tí-ho:m!ú) vá:-nhu) d-ii. *(vá-xává tí-ho:m!ú) (vá:-nhu)

The nested prosodic ι-domain structure seen at the left in (6b-i, 6d-i) mirrors the embedded syntactic clause structure. That this recursive ι-domain structure would have to be posited in a prosodic account, rather than the alternative, sequential, ι-domain structure at the right in (6b-ii, 6e-ii), is shown by the ability of a lexical H tone that's final in the preceding clause to spread onto the postposed subject. As we will see below, such tone spreading is blocked at the left edge of both phonological phrases (φ) and intonational phrases (ι), so the postposed subjects in (6) cannot be parsed as a φ or an ι. Assuming a prosodic structure account, the level-skipping recursive ι-domain structure here would be a first indication from Xitsonga that faithfulness to syntactic constituency leads to a violation of the strict layering that is assumed by the standard theory of prosodic structure.

Penultimate lengthening also appears at the right edge of syntactic phrases that are preposed in Xitsonga; it is found on any preverbal object, as in (7a, c, e). Any subject that immediately precedes the verb, like *hi-hontlovila* in (7c), does not show penultimate lengthening, but a subject preceding a preposed object does show it, as in (7e).

(7) a. $_{clause}$[[ti-ho:mú] $_{clause}$[[ndz-a-xa:v-a$_{Verb}$]]$_{clause}$]$_{clause}$ [K154-155]

‘as for the cattle, I am buying’

b-i. * (ti-homú (ndz-a-xa:va)) b-ii. (ti-ho:mú) (ndz-axa:va)

c. $_{clause}$[[ti-ho:mú] $_{clause}$[[hi-hontlovila] [x-!á-xá:v-a]]$_{clause}$]$_{clause}$

‘as for the cattle, the giant is buying’

d-i. *(ti-homú (hi-hontlovila x!áxá:va)

d-ii. (ti-ho:mú) (hi-hontlovila x!á-xá:va)

e. $_{clause}$[[n-sá:tí] $_{clause}$[[ti-n-gu:vu] $_{clause}$[[w-!á-xá:v-a]]$_{clause}$]$_{clause}$]$_{clause}$

‘the wife, as for the clothes, she is buying’

f-i. * (n-sátí (t-n-guvu (w!á-xá:va)

f-ii. (n-sá:tí) (t-n-gu:vu) (w!á-xá:va)

Kisseberth proposes that the preposed objects and subjects in (7) lie outside the clause, in the nested syntactic clause structure seen in (7a, c, e). However, the ι-domain structures that are motivated by the distribution of penultimate lengthening must be sequential, as in (7b-ii, 7d-ii, 7f-ii); they do not display the simple recursive embedding predicted by the syntax. If there were no right ι-domain edge at the edge of the preposed phrases, as in the ungrammatical prosodic structure parses in the recursive (7b-i, 7d-i, 7f-i), there would be no penultimate lengthening.

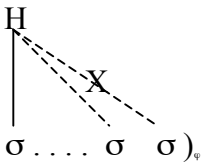
These Xitsonga data on penultimate lengthening in preposing structures show a certain divergence between syntactic structure and the phonological domain structure, given that the preposed phrases constitute ι-domains which do not correspond to syntactic clauses. That this divergence may have a source in some prosodic markedness constraint(s) is suggested by a comparison with the distribution of penultimate lengthening in the Bantu language Northern Sotho, a neighbor of Xitsonga in northeastern South Africa. Zerbian 2006, 2007 points out that penultimate lengthening appears sentence-finally in Northern Sotho, and also at the right end of the internal clauses in subject postposing cases, analogous to the Xitsonga cases in (5) and (6). But penultimate lengthening does not occur at the right edge of preposed phrases in Northern Sotho; the preposed phrases don’t have the status of ι-domains, unlike in Xitsonga. Supposing that Northern Sotho and Xitsonga have the same clause-adjoining syntax for left-dislocations, as Zerbian argues, a nonsyntactic explanation for the difference in the domain structure for penultimate lengthening in the two languages would be required. The ι-domain structure of the Northern Sotho preposing construction is faithful to the syntactic clause constituency, unaffected by phonological constraints; it is predicted by the constraint Match Clause alone. But the Xitsonga preposing cases violate Match Clause in that they contain instances of prosodic ι-domains which do not correspond to syntactic clauses. Section

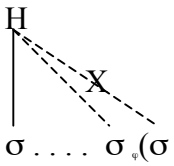
3.1.2 posits a markedness constraint Strong Start which would motivate the promotion of preposed phrases in Xitsonga to ι-domain status. In the grammar of Xitsonga, Strong Start would outrank Match Clause; the grammar of Northern Sotho, by contrast, would rank Strong Start lower than Match Clause[14].

2.1.2 High tone spread

Xitsonga is a tone language, and like many Bantu languages, has lexical H tone but no lexical L tone. High tone in Xitsonga may spread long-distance-fashion to the right onto toneless syllables. Limits on the extent of high tone spread in Xitsonga provide evidence for two clause-internal levels of phonological domain, one at the phrase level, referred to here as the φ-domain, and one at the word level, the ω-domain. Xitsonga high tone spread makes a very special contribution to the understanding of the relation between syntactic constituency and φ-domain structure in that the limits on the spread of high tone that are observed in Xitsonga allow both the left and the right edges of φ-domains to be diagnosed. In what follows we will see that the following generalization holds: a lexical high tone spreads rightward from its underlying position, but it is (i) blocked from spreading onto the final, rightmost, syllable of a φ-domain and (ii) blocked from spreading across the left edge of a φ-domain. This generalization is graphically depicted in (8).

(8) The limits on Xitsonga High Tone Spread diagnose right and left edges of φ

(i) 

(ii) 

(9) shows the tonal patterns of verbs which constitute sentences on their own. The cases in (9a) consist of lexically toneless verb roots and lexically toneless prefixes, while those in (9b) contain the same toneless verb with a H tone prefix *vá,* 3rd person plural subject*:*

(9) a. [[ndz-a-tlomute:la$_{verb}$]]$_{clause}$ [[ndz-a-ti:rha$_{verb}$]]$_{clause}$ [K139]

I-pres-fish I-pres-work

b. [[v-á-tlómúté:la$_{verb}$]]$_{clause}$ [[v-á-tí:rha$_{verb}$]]$_{clause}$ (< vá-a-tirha)

they-pres-fish they-pres-work

c. ι(φ(ω(v-á-tlómúté:la)ω)φ)ι ι(φ(ω(v-á-tírha)ω)φ)ι

In (9bc) the high tone of the subject prefix *vá-* spreads rightward through the verb but is blocked from spreading onto the final syllable of the sentence. Cassimjee and Kisseberth 1998 propose that a phonological constraint Nonfinality bans tone on a domain-final syllable: Nonfinality(D, H). The data from isolation forms in (9bc) does not indicate whether the domain D for Nonfinality is ι, φ, or ω, since the final syllable of this one-word sentence appears at the right domain edge at all these levels, as in (9c). But (10bc)

shows that ω (prosodic word) is not the domain for Nonfinality: when the verb is not final in a phrase, as is the case in (10), the high tone spreads from the tone-bearing prefix throughout the verb and continues through a following toneless noun object up to the pre-final syllable of that noun.

(10) a. [[hi-tisa [xi-hontlovi:la]]] [[ndzi-xava [nya:ma]]] [K142]

'We are bringing a giant' 'I am buying meat'

b. [[vá-tísá [xí-hóntlóví:la]]] [[vá-xává [nyá:ma]]]

'They are bringing a giant' 'They are buying meat'

c. $_{\iota}(_{\varphi}(_{\omega}$(vá-tísá)$_{\omega}$ $_{\omega}$(xí-hóntlóví:la)$_{\omega}$ $)_{\varphi})_{\iota}$ $_{\iota}(_{\varphi}(_{\omega}$(vá-xává)$_{\omega}$ $_{\omega}$(nyá:ma)$_{\omega}$$)_{\varphi})_{\iota}$

The important fact is that H tone spreads onto and beyond the ω-final syllable of the verb. The data from (11) [K148] show, more specifically, that a higher-than-word and lower-than-clause-sized domain, namely φ, is a/the domain for Nonfinality.

(11) a. [[ndzi-xavela [xi-phukuphuku] [fo:le]]] [[ndzi-xavela [mu-nhu] [ti-n-gu:vu]]]
'I am buying tobacco for a fool' 'I am buying clothes for s.o.'

b. [[vá-xávélá [xí-phúkúphúku] [fo:le]]] [[vá-xávélá [mú-nhu] [ti-n-gu:vu]]]

'they are buying tobacco for a fool' 'they are buying clothes for s.o.'

c. $_{\iota}(_{\varphi}$(vá-xávélá xí-phúkúphúku)$_{\varphi}$ fo:le)$_{\iota}$ $_{\iota}(_{\varphi}$(vá-xávélá mú-nhu)$_{\varphi}$ ti-n-gu:vu)$_{\iota}$

High tone spread stops before the final syllable of the first object in (11b/c). This fact will be taken to indicate that the final syllable of the first object is at the right edge of a phrasal φ-domain and that Nonfinality holds of that φ-domain: Nonfinality(φ, H). The φ-final status of the last syllable of the indirect object in these examples is indicated by the right φ bracket in (11c).

The constraint Nonfinality(φ, H), formulated as in (12a), rules out the appearance of a high tone on the final syllable of φ[15]. If we make the assumption that high tone spread is not itself domain-sensitive but has the completely general formulation in (12b), then it is the optimality theoretic ranking of H-Spread below Nonfinality(φ, H), as in (12c), that would serve to block the spread of high tone onto a φ-final syllable.

(12) a. Nonfinality(φ, H) b. High Tone Spread (H-Spread)[16]

c. Nonfinality(φ, H) >> H-Spread

It is important to note in this connection that when a lexical tone originates on a word-final syllable in lexical representation and as a result of prosodic domain formation ends up in a φ-final position within the sentence, that φ-final H tone is indeed realized in surface representation, in violation of the Nonfinality constraint[17]. This is observed in the nouns *ti-homú* 'cattle' and *n-sátí* 'wife' in examples in (7) above; the first has lexical tone on its final syllable, the second has lexical tone on both final and pre-final syllables. In the examples in (7), where these nouns are final in preposed phrases, there is no rightward spread of that final lexical H tone. But in the example in (6), the final tone of the direct object *ti-homú* spreads onto the postposed subject. This example shows that high tone spread can take place from a word-final lexical tone across the right edge of a φ-domain and even across the right edge of a ι-domain, namely the instances of these that are found at the right of the embedded clause in (6). Given this, the preposing examples in (7) provide evidence that it is the left edge of the following ι-domain (or the left edge of any φ-domain that might appear at the beginning of that following clause) that is responsible for the blocking of high tone spread there (see 2.1.3). Additional examples support the hypothesis that the left edge of the φ-domain does block high tone spread.

Kisseberth observes that high tone spread may never penetrate the left edge of a noun phrase that contains a noun plus a modifier, while, as we saw above in (6), (10) and (11), it can spread into a noun phrase consisting of a single noun. This effect of noun phrase size or branchingness can be seen in the contrast in the distribution of high tone spread in the verb plus direct object constructions in (13i) and (13ii):

(13) (i) a. vá-súsá [n-gúlú:ve] (ii) a. vá-súsá [n-guluve y!á vo:n!á] [K157]

'they are removing a pig' 'they are removing their pig'

b. (φ(vá-súsá n-gúlú:ve)φ) b. (vá-súsá φ(n-guluve t!á vo:n!á)φ)

Note that the H tone, which originates in a verbal prefix, extends only through the final syllable of the verb in (13ii)[18], and stops there. The H tone does not spread into even the first syllable of the two-word noun phrase[19]. In (13i), by contrast, the H tone extends two syllables into the verb. If we assume the distinct prosodic φ-domain structures for (13i-b) and (13ii-b), we can attribute the blocking of high tone spread in the latter case to the presence of the left φ-domain edge coinciding with the left edge of the multi-word direct object.

Further evidence of a difference in phonological domain structure for single-word and multiword phrases in Xitsonga is found in cases of the blocking of rightward spread from a φ-final lexical high tone. Kisseberth reports that in configurations with a postposed subject or with the second object noun phrase of a ditransitive verb, if that noun phrase consists of a noun plus a modifier, a final lexical H tone can't spread from a preceding word into the noun phrase [K159]. The hypothesis here is that failure of high tone spread onto a multiword second object or postposed subject diagnoses the presence of a left edge of φ, while presence of high tone spread into a following single-word noun phrase tells us that in such a case the noun phrase is not itself parsed as a φ-domain. The postposing examples above in (6) show spreading of a final lexical H tone from a clause-final word

onto a following single-word postposed subject. The example in (14) shows high tone spread of the final lexical H tone in a direct object noun phrase into the following single-word second object phrase *ti-n-gu:vu*.

(14) a. ndzi-nyíká [mu-nw!í] [tí-n-gú:vu] [K149]

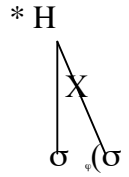
b. 'I am giving the drinker clothes'

c. $_{\iota}($ $_{\varphi}($ ndzi-nyíká mu-nw!í $)_{\varphi}$ $_{\omega}$(tí-n-gú:vu)$_{\omega}$ $)_{\iota}$

In such cases, it is assumed that the single-noun phrase is not preceded by a left edge of φ, and the generalization holds that the left edge of a φ-domain blocks the spread of high tone, as stated in (8ii)[20].

In addressing the general question of domain-sensitivity in phonology, Ito and Mester 1999 propose a family of CrispEdge constraints which have the general property of blocking multiple linking of features across the edges of constituent domains. In this spirit, a constraint CrispEdgeLeft (φ, H) will be posited here; it rules out non-crisp-edge multiple linking of H tone across a left edge of φ-domain[21]:

(15) a. CrispEdgeLeft (φ, H)



b. CrispEdgeL (φ, H) >> H-Spread

The ranking of the domain-sensitive CrispEdgeLeft (φ, H) above H-Spread in the grammar of Xitsonga, as in (15b), will guarantee that high tone spreading into a φ-domain is not allowed.

It is necessary now to provide an analysis of the domain structure contained in the phonological representations that are evaluated by domain-sensitive constraints like Nonfinality and CrispEdgeLeft. A prosodic account of the φ-domain formation seen in cases like those just discussed consists of two parts: (i) a syntactic-prosodic constituency correspondence constraint Match (Phrase, φ)[22] that calls for a syntactic phrase to correspond to a prosodic phrase φ in phonological representation and (ii) a prosodic markedness constraint—call it BinMin(φ, ω) -- that calls for a φ to be minimally binary and thus consist of at least two prosodic words (Inkelas and Zec 1990, 1995)[23]. The size-dependent effects on domain structure would be the effect of BinMin(φ, ω). (Prosodic minimality constraints are also common at lower levels of the prosodic hierarchy, cf. Section 3.1.1). In Xitsonga a language-particular ranking of BinMin(φ, ω) above the

phrase-matching correspondence constraint achieves the desired result, as shown in the optimality theoretic tableaux in (16):

(16) (i)

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

(ii)

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

In the optimal, grammatical, candidate (b) in (16-i), a single-noun direct object is not parsed as a φ, in violation of Match Phrase; the Match-Phrase-respecting nonoptimal candidate (16-i-a) violates the higher-ranked BinMin(φ, ω). But as the optimal candidate (a) in (16-ii) shows, a direct object can stand on its own as a φ if it contains more than one word, satisfying BinMin(φ, ω). In (16ii) both candidates satisfy BinMin(φ, ω); the optimality of (16-ii-a) is the effect of Match (Phrase, φ). The prosodic constituent structure of (16-ii-a) perfectly mirrors the syntactic structure, while that in (16-ii-b) does not. Note that (16-ii-a) shows a violation of strict layering, in that the verb stands external to the φ of its direct object, but does not itself have the status of a φ (as shown by the fact that tone may spread onto the final syllable of the verb in such cases).

It should be noted here that a Xitsonga sentence consisting of a verb plus two-word object and in addition a single-word postposed subject noun phrase provides an instance of the structure in (3), which served to illustrate configurations in violation of the strict layer hypothesis, namely instances of recursivity and level-skipping. The general point, then, is that syntactic constituency has a central role in determining the phonological domain structure of a sentence, through the agency of Match correspondence constraints, but that the effect of syntactic constituency on that domain structure may, depending on the constraint ranking of the language, be mitigated by prosodic markedness constraints, a point that will be elaborated in section 3.

Consider next the prosodic parsing of a construction with verb followed by two single-word objects. The information available on Xitsonga syntax does not permit any decision on the details of the syntactic parsing of such ditransitive constructions, for which there are various possibilities, depending, for example, on whether the verb might have been raised to an inflectional head position, on whether the direct object might have been raised to some higher specifier position, and so on. For this reason, it is impossible to be sure about the nature of the hypothetical Constraint X in tableau (17-i) which selects (b) as optimal from among the BinMin-respecting candidates (b) and (c); this remains a matter for future research[24]. What's important for the argument here is the significant difference in the φ-domain structure of the optimal (b) in (17i), with its two single-word objects, as compared to the optimal φ-domain structure (a) in (17-ii), with its two multi-word object noun phrases[25].

(17) (i)

$_{clause}$[[verb [noun] [noun]]]$_{clause}$	BinMin (φ, ω)	Match (Phrase, φ)	Constraint X
a. ι(φ(verb φ(noun) φ φ(noun)) φ) ι	**		
☞ b. ι(φ(verb noun) φ noun) φ) ι		**	
c. ι(φ(verb φ(noun noun) φ) φ) ι		**	*

(ii)

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

The fact that two ditransitive structures like these that are identical in all but the word count of their object noun phrases should be spelled out with such different prosodic phrase structures is claimed here to be due to the subordination of Match (Phrase, φ) to BinMin(φ, ω) in the language-particular constraint ranking in Xitsonga[26].

2.1.3 Typological variation in phonological domain structure and domain-sensitivity

The optimality theoretic proposal being made here is that language-particular differences in prosodic structure that may be assigned to a sentence with a particular syntactic structure are a consequence of language-particular rankings of universal constraints on syntactic-prosodic constituency correspondence with respect to universal prosodic structure markedness constraints. Let's call this the interface theory of prosodic structure formation. But this interface theory does not provide the whole story on cross-linguistic variation in domain structure and domain-sensitivity. Another source of cross-linguistic variation lies, of course, in language-particular differences in syntactic structure itself. For example, differences in the surface position of preposed constituents from one language to another—e.g. whether they are located inside or outside the basic clause—can have consequences for the prosodic structure of the sentence[27]. And a third source of variation lies in the phonology proper, more specifically in the theory of domain-sensitivity, which was illustrated in the treatment of high tone spread in Xitsonga.

To further illustrate this latter point, we will complete the account of high tone spread in Xitsonga. It is necessary to tend to cases of the blocking of high tone spread which are not the consequence of the φ-domain structure of the language, but rather of its ι-domain structure. Consider the example of (6), where high tone spreads from the final syllable of the embedded clause through the postposed subject, but not onto the final syllable of the matrix clause. As argued above, the very possibility of tone spread onto the postposed single-noun phrase indicates that this phrase does not constitute a φ-domain. But if the postposed noun does not have the prosodic analysis of a φ, then the domain-sensitive constraint Nonfinality (φ, H) can't be responsible for blocking the spread onto the final syllable. It must be an additional constraint Nonfinality (ι, H) that is responsible.

Given the general theory of the prosodic constituency hierarchy embodied in the Match correspondence constraints in (4), and given the idea that constraints like Nonfinality are defined with respect to prosodic constituents, it is of course to be expected that the universal repertoire of phonological markedness constraints should include in addition a constraint Nonfinality (ι, H), as well as a constraint Nonfinality (ω, H), and that their effects should be attested in some language, as Cassimjee and Kisseberth 1998 propose. The fact that Nonfinality (ω, H) is not active in Xitsonga and that Nonfinality (φ, H) and Nonfinality (ι, H) are active can be ascribed to the optimality theoretic constraint ranking in (18).

(18) Nonfinality constraints and high tone spread in Xitsonga

Nonfinality (ι, H), Nonfinality (φ, H) >> H-Spread >> Nonfinality (ω)

It's to be expected that different rankings of H-Spread with respect to the various Nonfinality constraints would be found in other languages. For example, in a language where Nonfinality (ω) dominates H-Spread, no H tone could spread to a word-final syllable (and beyond). On the other hand, in a language in which H-spread was dominated only by Nonfinality (ι, H), H-spread would not be blocked at the right edge of ω or φ, but rather would have the capacity to spread across the span of the intonational phrase (if it weren't blocked by CrispEdgeLeft at the φ and ω levels.)

The prosodic structure theory of domain-sensitive constraints also makes available a family of CrispEdgeLeft constraints. The facts of Xitsonga are consistent with the ranking in (19), since high tone spread never penetrates the edge left of φ or of ι, but it passes through the left edge of ω[28]:

(19) CrispEdgeLeft and high tone spread in Xitsonga

CrispEdgeL (ι, H), CrispEdgeL (φ, H) >> H-Spread >> CrispEdgeL (ω)

By contrast, a language with a grammar where the constraint H-Spread was ranked below all three CrispEdgeLeft constraints would never permit spreading from one word to the following word. On the other hand, a language in whose grammar only CrispEdgeL (ι, H) dominates H-Spread would allow any left edge of φ or ω to be passed through by high tone spreading, up till the next left edge of ι (unless blocked by Nonfinality at the φ or ω levels). A theory of domain sensitivity along the lines sketched here is a crucial component of a theory of cross-linguistic variation in the distribution of domain-sensitive phenomena within sentences[29].

2.2. The nature of the syntactic constituency-prosodic constituency relation

In what follows, sections 2.2.1 and 2.2.2 provide some needed elaborations of the Match theory of syntactic-prosodic constituency correspondence that was sketched in preceding sections. Section 2.2.3 reviews implications of Match theory for the theory of prosodic structure representation itself. In section 2.3 Match theory is compared to other extant theories of the syntactic-prosodic constituency correspondence from both a theoretical and empirical point of view. Section 3 puts the focus on the prosodic markedness constraints that interact with Match constraints in prosodic structure formation.

2.2.1 Match theory and syntactic-prosodic constituent edge correspondence

A highly restrictive general theory of the effects of syntactic constituency on phonological domains is presented in Selkirk 1986. Drawing on earlier proposals of Clements 1978 for Ewe and Chen 1987 for Xiamen which posited a relation between the edge of a syntactic constituent and the edge of a tone group in phonological representation, Selkirk 1986 proposes that only information about the *edges* of syntactic constituents of designated types is appealed to in constituency correspondence constraints. In its optimality theoretic instantiation in Selkirk 1996, this edge-based theory is referred to as the Alignment theory of the syntax-phonological phrasing interface, in the spirit of the generalized alignment theory of McCarthy and Prince 1993. In this theory two distinct phrase-level constraints Align-R (XP, φ) and Align-L (XP, φ) are posited as part of the universal syntax-phonology interface constraint repertoire; the first calls for the right edge of a syntactic phrase XP to align with/correspond to the edge of a phonological phrase, the second calls for correspondence/alignment between left edges. The hypothesis was that languages could differ in which version of Align XP is responsible for prosodic phrasing patterns. Match theory shares with the edge-based theory of Selkirk 1986, 1996 this very limited appeal to the formal properties of syntactic phrase structure: Match (α, π) can be construed as a constraint requiring simply that *both* the right and left edges of a syntactic constituent of a designated type α correspond, respectively, to the right and left edges of a prosodic constituent π. This dual-edge-matching entails a matching up of the constituents themselves. (These two theories receive a comparative evaluation in section 2.3.2.)

Match theory, like Alignment theory, is a theory of universal constraints on the correspondence between syntactic and prosodic constituency in grammar. As the McCarthy and Prince 1995 theory of correspondence between distinct linguistic representations makes clear, correspondence is a two way street. In the case of correspondence between underlying (lexical) and surface phonological representation, an input-output correspondence constraint may require, for example, that a segment of the input has a corresponding segment in the output, thus disfavoring segmental deletion, while an analogous output-input correspondence constraint may require that a segment of the output correspond to a segment of the input, thus disfavoring segmental epenthesis. In the case of correspondence between syntactic and prosodic constituency, one set of correspondence constraints expresses the requirement that the edges of a syntactic constituent of type α must correspond to the edges of a phonological constituent of type

π, while another set of correspondence constraints requires that the edges of a phonological constituent π correspond to the edges of a syntactic constituent α, as in (20). The first type—call them S-P faithfulness constraints-- require that syntactic constituency be faithfully reflected in prosodic constituency, and the second—call them P-S faithfulness constraints-- require that prosodic constituency be a faithful reflection of syntactic constituency. In the constraint schemata in (20), α is a variable over syntactic constituent types and π is a variable over their corresponding prosodic constituent types, as posited in (4):

(20) a. Match (α, π) [= S-P faithfulness]

The left and right edges of a constituent of type α in the input syntactic representation must correspond to the left and right edges of a constituent of type π in the output phonological representation.

b. Match (π, α) [= P-S faithfulness]

The left and right edges of a constituent of type π in the output phonological representation must correspond to the left and right edges of a constituent of type α in the input syntactic representation.

It does seem that both types of faithfulness are required in a theory of syntactic-prosodic constituency correspondence (see Selkirk 1996, Werle 2009).

Given the understanding of constraints on syntactic-prosodic constituency correspondence as faithfulness constraints, the proposal presented in the current chapter that these constraints interact, in language-particular fashion, with markedness constraints on prosodic representation is an entirely familiar one. In an optimality theoretic phonological component, a language-particular ranking of universal faithfulness and markedness constraints provides the basis for the phonological analysis of individual languages, while possible differences in language-particular rankings constitute a theory of cross-linguistic typology.

2.2.2 Constituency correspondence theory and syntactic category types

A central question for the Match theory of syntactic-prosodic structure faithfulness, as for any theory of the syntactic-prosodic constituency relation, concerns the choice of the syntactic constituents that figure in the correspondence constraints. What are possible α in the correspondence constraints schematized in (20)? The set of Match constraints proposed in (4) pare syntactic constituent types to the minimum, exploiting the notions clause, phrase and word, which presumably play a role in any theory of morphosyntax. Assuming the general correctness of the claim embodied in (4) that a fundamental distinction between syntactic constituents of type clause, phrase and word is made in constituency correspondence constraints, it remains to be determined just how to characterize in terms of current syntactic theory the notions ‘clause’, ‘phrase’ and ‘word’ that are relevant to prosodic domain formation.

Consider first the clause-sensitive correspondence constraints Match (Clause, ι) and Match (ι, Clause). There are at least two notions of 'clause' that come into play in syntax-prosodic structure correspondence, call them the 'standard clause' and the 'illocutionary clause'. The standard clause is the constituent that is the complement of the functional head $Comp^0$. In modern syntactic theory, $Comp^0$, or simply C, is commonly assumed to introduce the canonical sentence, which consists of an explicit or implied subject, a predicate, and a locus for Tense[30]: $_{CP}$[$Comp^0$ [standard clause]]$_{CP}$. CP, and hence the standard clause, may be syntactically embedded, whether as a complement to a verbal or nominal head, or as a restrictive relative clause within determiner phrase, or in other positions. What's being called here the illocutionary clause is the highest syntactic projection of the sentence and carries its illocutionary force, which determines its appropriateness in a discourse context. Emonds 1976 termed this the root clause; Rizzi 1997 refers to this as the Force Phrase; it can be seen as an instance of the Potts 2005 comma phrase. The syntactic structure for this clause type will be assumed to be: $_{ForceP}$[$Force^0$ [illocutionary clause]]$_{ForceP}$. Parentheticals, nonrestrictive relative clauses and other expressions of the type that Potts calls 'supplements' may be embedded within the larger sentence, but they have the property that their meaning does not contribute to the 'at issue' meaning of the surrounding sentence (Potts 2005). It seems reasonable to understand these as instances of embedded ForceP (see Kan 2009, Selkirk 2009).

What are being called here illocutionary clauses are commonly observed to correspond to intonational phrases in phonological representation (see, e.g. Downing 1970, Nespor and Vogel 1986, Ladd 1986, Selkirk 2005, Dehé 2009 on English). It is less commonly observed, though apparently necessary, for standard clauses to correspond to intonational phrases. The Xitsonga cases of clauses embedded in dislocation structures would be instances of this sort, as would the cases where embedded standard clauses are reported to serve as a domain for phonological phenomena in German (Truckenbrodt 2005), Huave and Luganda (Pak 2008), and Japanese (Selkirk 2009). Yet embedded illocutionary clauses appear to have a stronger tendency than standard clauses to be prosodically parsed as ι-domains. In English, for example, the syntactic/semantic distinction between restrictive and nonrestrictive relative clauses, or between parentheticals and basic clausal complements, is reflected in a difference in ι-domain structure (Ladd 1986, Selkirk 2005, Dehé 2009), with the former set off as ι-domains and the latter not. It is proposed in Selkirk 2009 that the theory of grammar distinguishes two instances of the Match Clause constraint, the more specific Match (illocutionary clause, ι) and the more general Match (clause, ι). If $Force^0$ and $Complementizer^0$ do indeed form a natural class of functional heads, as is implied by the Rizzi 1997 proposal, then the general notion 'clause' can be taken to designate the constituent that is complement to functional heads of this general complementizer class.

Turning next to Match Phrase, the simple appeal to "phrase" in this constraint embodies the assumption made in previous theories of the syntactic-prosodic structure relation that distinctions between lexical projections NP vs. VP vs. AP are not relevant to this correspondence (Nespor & Vogel 1986; Selkirk 1986, 1995; Truckenbrodt 1999 and others). Selkirk 1986, 1995, 2005 and Truckenbrodt 1999 propose that the notion 'maximal projection' (XP) from X-bar theory (Jackendoff 1977) is crucial to defining the notion 'phonological phrase'. This cross-categorial appeal to maximal projection predicts

the sort of φ-domain organization that is arguably typical in languages: SVO sentences like NP $_{VP}$[Verb NP]$_{VP}$ are parsed into φ-domains as (NP)$_{φ}$ (Verb (NP)$_{φ}$)$_{φ}$; double object structures like $_{VP}$[Verb NP NP]$_{VP}$ are parsed as (Verb (NP)$_{φ}$ (NP)$_{φ}$)$_{φ}$.

But the notion XP needs to be further refined, since it's likely that lexical and functional phrasal projections—LexP and FncP-- have to be distinguished (see discussion in Selkirk and Shen 1990, Truckenbrodt 1999). The functional vs. lexical distinction is important for syntactic-prosodic correspondence at the word level (Fnc^0 vs. Lex^0): lexical category words are standardly parsed as prosodic words (ω), while functional category words like determiners, complementizers, prepositions, auxiliary verbs, etc.--in particular the monosyllabic versions of these-- are not (see e.g. Selkirk 1996, Werle 2009). Of relevance to the phrasing issue is the fact that a function head may in some languages become prosodically enclitic to a preceding constituent that is not contained in the FncP that the Fnc word heads; this may be explained by assuming that a FncP is not delimited by φ-boundaries. Examples are the inclusion of a preposition from a following prepositional phrase into a prosodic word that includes the preceding verb in Shanghai Chinese (Selkirk and Shen 1990) and the inclusion of the determiner from a following determiner phrase into the prosodic word of the preceding verb in Kwakwala (Boas 1947, Anderson 1984, 2005) and Chamicuro (Parker 1999), or of a syllabic noun-class prefix from a following noun phrase, as in Xitsonga (Kisseberth 1994). The English forms *wanna* (< *want to* or *want a*), *gotta* (< *got to* or *got a*), *kinda* (< *kind of*), *shoulda* (< *should have*) are likely historical, or even synchronic, instances of this sort of thing. If instead of a general Match XP this correspondence constraint were limited to lexical categories[31], then, on the basis of the syntactic structure $_{VP}$[Verb $_{FncP}$[Fnc NP]$_{FncP}$]$_{VP}$, the φ-domain structure $_{φ}$(Verb Fnc $_{φ}$(NP)$_{φ}$)$_{φ}$ would be predicted, namely a structure that would pose no obstacle to the prosodic encliticization of the Fnc from the verbal complement onto the verb. Whether or not a language would as a result exhibit prosodic enclitization of the Fnc onto the verb-- as in the prosodic structure $_{ω}$($_{ω}$(Verb)$_{ω}$ Fnc)$_{ω}$-- would be driven by the ranking of relevant prosodic markedness constraints (see e.g. Werle 2009).

Proposals concerning the syntactic constituents relevant to prosodic constituency have been made within minimalist phase theory (Chomsky 2001). In that theory phases constitute stages in the derivation of syntactic structure and its interpretation; Spell-Out (phonological and semantic interpretation) completes each phase. The complement of any phasal head constitutes the domain of Spell-Out. It has been proposed that a Spell-Out domain itself corresponds to a prosodic constituent (see Adger 2006, Dobashi 2003, Ishihara 2007, for example). Two constituent types typically singled out for phasehood are νP and CP. The complement of phase head ν is the VP, or some functional projection containing the VP; it contains all the internal arguments of the verb[32]. The complement of the phase head C (complementizer) is an inflectional projection, typically the Tense Phrase; it contains all the material of the standard clause, namely subject, predicate and tense-marking. It was proposed above that "complement of complementizer" does indeed identify the notion "clause" for the Match Clause constraint(s) under consideration here. But "complement of ν" does not on its own denote the full set of syntactic phrase types that are relevant to the correspondence with prosodic phrases,

since these also include instances of lexical maximal projections like NP and AP. Moreover, Kahnemuyipour 2004, 2009 and Kratzer and Selkirk 2007 point out that in German all-new sentences, for example, not all lexical maximal projections have the stress and accent properties associated with φ-domains and they propose that those that do have the properties of φ-domains occupy the position of the highest phrase in the Spell-Out domain of a phase. The question of just how to syntactically define the set of syntactic phrases that may figure in the Match Phrase correspondence constraint(s) remains a question for further research. In what follows, for expository purposes, it will simply be assumed that Match Phrase stands for Match XP.

2.2.3 Implications of Match correspondence theory for prosodic structure theory

A new generalization about the nature of prosodic structure above the foot emerges from the review of Xitsonga sentence tonology in Section 2.1, namely that the prosodic constituent structure of a sentence is grounded in large part in the syntactic constituency of the sentence. It displays properties that are predicted by the Match theory of syntactic-prosodic constituency correspondence: (1) presence of systematic recursivity and level-skipping, in violation of strict layering, and (2) the presence of distinct prosodic domain types corresponding to clause, phrase and word.

Note that the systematic recursivity of φ or ι domains that is predicted by the Match theory of the syntax-prosodic constituency correspondence provides the basis for accounts of known patterns in the phonetic realization of syntactically recursive structures such as have been studied by Lehiste 1973, Ladd 1986, 1988, Truckenbrodt and Féry 2005, and Wagner 2005, 2007, Féry and Schobö 2008, among others. Wagner (2005), for example, has shown that variant syntactic parsings of conjoined noun phrases such as (21ac), and their associated differences in semantic interpretation, are correlated with different patterns of final lengthening, with the greater lengthening occurring at the end of a more deeply embedded phrase:

(21) a. [Lysander and [Demetrius and Hermia]]

b. $_{\varphi}$(Lysander and $_{\varphi}$(Demetrius and Hermia)$_{\varphi}$)$_{\varphi}$

c. [Lysander and Demetrius] and Hermia]

d. $_{\varphi}$($_{\varphi}$(Lysander and Demetrius)$_{\varphi}$ and Hermia)$_{\varphi}$

The correspondence constraint Match Phrase converts syntactic representations like (21ac) into recursive φ-domain representations, which would minimally show the bracketing in (21bd). The phonetics would recognize this depth of φ-embedding in phonological representation and would assign the different values for final lengthening. Thus Match theory provides the basis for a prosodic structure-based account of the effects of syntactic structure recursivity on the phonological and phonetic interpretation of the sentence.

At this point, it is an open question whether prosodic markedness constraints that would enforce a flattening of phonological domain structure into a strictly layered representation

are at play in grammar. Selkirk 1996 posits the existence of violable Nonrecursivity and Exhaustivity constraints whose purpose is, respectively, to exclude instances of recursive and level-skipping prosodic structure. Markedness constraints like these which enforce strict layering (call them SLH constraints) will not be reviewed in section 3. It remains a question for future research whether they are in fact needed in the theory of grammar. (Section 2.3.3 treats apparent counterexamples to a strong theory of prosodic structure formation which includes Match theory and excludes SLH markedness constraints.)

As for the repertoire of prosodic category types that figure in prosodic representations of sentences, the need for restricting this repertoire has been underlined in Ito and Mester (2007, 2009). In the proposal here, the small repertoire of distinct types ι, φ, and ω posited by Ito and Mester (and many others) derives from the theory of syntactic-prosodic constituency correspondence constraints. In the Match theory posited in (4), the fundamental types of syntactic constituent—clause, phrase and word—are each identified with a distinct corresponding type of prosodic constituent in phonological representation: (clause, ι), (phrase, φ), (word, ω). What names are given to these distinct prosodic constituent types is immaterial. What's crucial is that there's a distinct prosodic constituent type that clauses are required to correspond to, referred to here as ι, or intonational phrase (following standard usage); there's the distinct prosodic constituent type that syntactic phrases are called on to correspond to, referred to here as φ, or phonological phrase; and there's the distinct type that words are required to correspond to, namely ω, or prosodic word.

Stated explicitly, this *syntactically grounded prosodic hierarchy hypothesis* holds that all and only the suprafoot prosodic category types that figure in syntactic-prosodic constituency correspondence constraints are defined as primitive prosodic category types in linguistic theory (see Selkirk 2005). There are two essential predictions of this hypothesis. One is that the syntactically grounded prosodic category types ι, φ, and ω are universal. This prediction follows from the hypothesized universality of Match correspondence constraints in the grammar. Unless some higher ranked prosodic markedness constraint(s) were to prevent the realization of constituents of one or more of these types in some language, they all should appear in every sentence of every language. The second prediction is that, where further types of prosodic category above the foot appear to be warranted in the phonology or the phonetics, they are in fact subtypes of the primitive, syntactically grounded category types ι, φ, and ω, as Ito and Mester 2007, 2009 propose. They point out that, given recursivity in φ-structure, for example, distinctions can be made between *maximal* φ-- a φ not dominated by any other φ, *minimal* φ-- a φ not dominating any other φ, and simple φ-- the general case. They argue that phonological constraints may make appeal to these various subtypes.

The notion that prosodic category types above the foot are universally instantiated in the phonological representations of any language is not shared by all phonologists and phoneticians working within a prosodic structure framework. In a summary chapter in the volume *Prosodic Typology*, Jun 2005 writes "Languages seem to differ in how an utterance is rhythmically and prosodically organized. Based on the [autosegmental-metrical] model of various languages, some languages have only one prosodic unit above the word (e.g. Serbo-Croatian), while others have three (e.g. Bininj Gun-wok, Farsi)

(443)". In the same volume Venditti 2005 posits two levels of prosodic organization for Japanese above the word, which she refers to as the accentual phrase and the intonational phrase. The former, smaller, phrasal unit has also been referred to as the minor phrase in work on Japanese; the latter is what has been referred to as the major phrase or intermediate phrase in other work on Japanese. What's explicitly claimed not to exist in the prosodic structure of Japanese sentences, in this and earlier presentations of Japanese sentence prosody in Venditti 1995 and Pierrehumbert and Beckman 1988, is a larger unit of prosodic structure of the sort typically referred to as intonational phrase. But Kawahara and Shinya's (2008) investigation of the prosody of Japanese sentences based on standard coordinate sentences and coordinate sentences with gapping has since shown the necessity of positing a prosodic category above the major/intermediate phrase whose edges coincide with clause boundaries, namely a prosodic category of the clause-grounded ι-domain level. They found that the ι-domain/clause edge exhibits final lowering, creaky voice and pause not seen at a mere phonological phrase edge. (See Selkirk 2009 for a fuller discussion of clause and intonational phrase in Japanese.) Clearly, the hypothesis that prosodic category types are syntactically grounded and universal suggests an interesting program for further crosslinguistic research.

Paying systematic heed to syntactic structure is arguably a necessary component of crosslinguistic investigation of potential universals in the phonological and/or phonetic interpretation of different levels of prosodic structure, given that it is not possible to establish what the prosodic levels of organization in a language are based only on the nature of the phonological or phonetic phenomena that are typically reported. Languages may differ in whether it is a phonological phrase or an intonational phrase that is the locus of a particular phonological or phonetic phenomenon (cf. 2.1.3). The important question whether there is in fact any crosslinguistic commonality on some phonological or phonetic dimension in the properties of intonational phrases or phonological phrases can be asked only if there is a theory that identifies independently of phonological or phonetic criteria which domain is an intonational phrase and which is a phonological phrase. An explicit theory of syntactic structure-prosodic structure correspondence like Match theory is just such a theory.

2.3 Other treatments of syntactic-prosodic constituency correspondence

The year 1986 saw the publication of four influential works on the prosodic structure of sentences. Nespor and Vogel 1986 put forth a "relation-based" theory for defining phonological phrases as well as a Match theory of intonational phrases. Ladd 1986 presupposed a Match based account of intonational phrasing . Selkirk 1986 argued for an single-edge-based theory of phonological phrasing. Beckman and Pierrehumbert 1986 assumed no particular relation between syntax and prosodic structure; their intention was to argue for general commonalities in prosodic structure organization and domain-sensitive phonetic interpretation in English and Japanese. Common to all but Ladd 1986 was the assumption that the prosodic structure of sentences conforms to the strict layer hypothesis (Selkirk 1981b). Ladd's contention in the 1986 paper and in more recent work has been, by contrast, that intonational phrases may be nested, in what has been termed here a recursive ι-domain structure. We saw above that a Match theory of the interface leads to potentially recursive ι-domain and φ-domain structure, with good results. The

evaluation below of alternative theories of the syntax-phonological domain structure correspondence and of the data that motivated them will show that the typological predictions of Match theory are confirmed.

2.3.1 Nespor and Vogel 1986 on phonological phrasing

Nespor and Vogel 1986 report that in Tuscan Italian gemination of a word-initial consonant following a stress-final word (*raddoppiamento sintattico (RS))* is optionally possible between the head of a syntactic phrase and the first word of a following complement to that head if that complement phrase is nonbranching: *Venderà questo leopardo* [will-sell [this leopard]] but *Prenderà qqualcosa* [will-take [something]]. Assuming that RS in confined to a φ-domain, they propose an interface prosodic phrase formation rule that that would restructure the Verb plus nonbranching direct object in the second case into a single φ, but in the first case would leave the head and the following phrase separated into two φ: "A nonbranching φ which is the first complement of X on its recursive side is joined into the φ that contains X (173)." The actual domain-sensitive account of the phonology of RS that would be proposed with the current theory wouldn't necessarily be different, but the phrasing would be arrived at differently, with a simple Match Phrase constraint interacting with the prosodic constraint BinMin(φ,ω). (The Italian case is quite parallel to the one in Xitsonga that was illustrated above.) But Match Phrase is a double-edge-matching constraint; its language is minimalist; it avoids reference to a richer set of notions like linear order, adjacency, and relational notions like head-of or first-complement-of that appear in statements in the relation-based theory. For this reason, all else being equal, the Match theory is to be preferred. The current theory of prosodic structure formation retains, though, the role for phrase-size or branchingness in determining prosodic structure that was first recognized by Nespor and Vogel 1986; since then Ghini 1993, Inkelas and Zec 1995 and others have made the case that such branching effects in Italian should be understood as prosodic in character (see also section 3.1.1).

2.3.2 Selkirk 1986, 1995: Align R/L (XP, φ)

Like Match theory the single-edge-based theory of Selkirk 1986 hypothesizes a restricted appeal to syntactic structure constituency, except that it calls for the R or L edges of designated syntactic constituents to match up with edges of prosodic constituents, rather than for the entire constituent (the "node") to match up (via matching of both edges), as in Match theory. Selkirk 1986 makes a general proposal concerning syntactic-prosodic constituent correspondence according to which (i) depending on the language, either the R or the L edge of a designated constituent type in the syntax, e.g. $]_{Xmax}$, must coincide with the edge of a corresponding prosodic constituent in phonological representation and (ii) the resulting constituency is governed by strict layering: "With the setting $]_{Xmax}$, an X^{max}-derived domain simply extends from one instance of $]_{Xmax}$ to another (or to the end of the sentence, if there is no further $]_{Xmax}$ [and similarly for the opposite setting-eos] (392)." From the outset, the edge-based theory presupposed the strict layer hypothesis, and, as a result, satisfaction of the edge correspondence constraint led to the formation of prosodic constituents that were nonisomorphic with the syntax. After the articulation of a

generalized theory of alignment in McCarthy and Prince 1993, the single-edge-based theory was dubbed the Align XP theory of phrasing.

It is important to observe that the single-edge-based Align XP theory is in fact underdetermined by the data from the languages which were originally taken to motivate it, since a Match XP analysis is equally consistent with the data. This is true of the cases of ChiMwiini, Xiamen Chinese and Tokyo Japanese, for example. Data from the extensive investigation of the distribution of vowel length in sentences of the Bantu language ChiMwiini reported in Kisseberth and Abasheikh 1974 is consistent with the Selkirk 1986 proposal that a right-end-of- X^{max} setting for the interface phrasing parameter derives the phonological phrasing manifested in the distribution of ChiMwiini vowel length. Kisseberth 2005 reports on further investigations of the distribution of vowel length as well as of the distribution of a right-edge phrasal tone in ChiMwiini (an otherwise nontonal language), showing that the distribution of both these phonological phenomena converge on the φ-domain structure that is predicted by the Align-R(XP, φ) analysis. The forward slashes provided in the (a) lines in (22) and (23) by Kisseberth 2005 informally represent the medial φ boundaries predicted by the single-XP-edge-based theory, while the (b) lines give the syntactic structure that Kisseberth assumes. The (c) lines give a representation of the φ-domain structure produced in satisfaction of Align-R(XP, φ) theory and assuming strict layering, while the (d) lines give a phrasing produced in satisfaction of Match(XP,φ).

(22) a. u-zile chi-búuku / na méeza '(s)he bought a book/ and a table'

b. $_{VP}$[u-zile$_{V}$ $_{NP}$[[chi-búuku]$_{NP}$ [na meezá]$_{NP}$]$_{NP}$]$_{VP}$

c. $_{\varphi}$(u-zile chi-búuku)$_{\varphi}$ $_{\varphi}$(na meezá)$_{\varphi}$ *Align-R(XP,φ)*[33]

d. $_{\varphi}$(u-zile $_{\varphi}$($_{\varphi}$(chi-búuku)$_{\varphi}$ $_{\varphi}$(na meezá)$_{\varphi}$)$_{\varphi}$)$_{\varphi}$ *Match(XP,φ)*[34]

(23) a. mw-ana w-a Núuru / m-someleeló / laazíle

'the child who Nuuru / read to (him)/ fell asleep'

b. [$_{NP}$[mw-ana [w-a $_{clause}$[[Núuru]$_{NP}$ [m-someléelo]$_{VP}$]$_{clause}$]$_{DP}$ [laazíle]$_{VP}$]

c. $_{\varphi}$(mw-ana w-a Núuru)$_{\varphi}$ $_{\varphi}$(m-someléelo)$_{\varphi}$ $_{\varphi}$(laazíle)$_{\varphi}$ *Align-R(XP, φ)*

d. $_{\varphi}$(mw-ana w-a $_{\varphi}$(Núuru)$_{\varphi}$ $_{\varphi}$(m-someléelo)$_{\varphi}$)$_{\varphi}$ $_{\varphi}$(laazíle)$_{\varphi}$ *Match(XP,φ)*

In ChiMwiini vowel length (whether lexical or derived) will surface only in a position at the right edge of a φ, namely in penultimate position, or in antepenultimate position if the penultimate is light, a pattern familiar from the Latin stress rule. The noun for 'child' in (23) has an underlying long vowel, *mw-aana*; its shortening to *mw-ana* in (23) indicates that it is *not* in the R-phrase-edge position for licensing length. As for the phrasal H tone (marked with acute accent here), its default position is on the penultimate syllable in a φ (though certain verb forms and lexical items require H tone on the final syllable of φ). The appearance of phrasal tone and vowel length in a word therefore diagnoses a word's location at the right edge of φ.

Note that in (22c) the R-edge-based parsing proposed by Selkirk 1986 produces a φ-domain structure that is radically nonisomorphic to the syntactic structure: the first conjunct of the conjoined direct object NP is grouped with the preceding verb in a φ. The Match-based parsing, on the other hand, produces the isomorphic φ-domain structure in (22d). Similarly, in (23c), *Nuuru*, the subject of the relative clause is nonisomorphically grouped with the preceding head noun of the NP by Align-R (XP, φ). But the nonisomorphic phrasings are not necessary to the account of vowel length alternations, contra Selkirk 1986. *Mw-aana* loses its underlying vowel length in (23) because it is not in the antepenultimate or penultimate position of a φ, where its length could be licensed by phrasal stress. The vowel shortens in the absence of this positional licensing of vowel length, simply because it is stressless, not because it is located in the same φ-domain as a following stressed syllable. As (22cd) and (23cd) show, both the Align-R-XP theory and the Match XP theory predict the same locations of right edge of φ, and so both correctly predict the position of phrasal stress and the licensing of vowel length. They also both predict the distribution of the penultimate H tone accent. It is in fact is not possible to decide between these two analyses on empirical grounds, since there is in point of fact no phonological phenomenon that diagnoses the left edge of φ in Chi Mwiini. What drove Selkirk 1986 to adopt nonisomorphic phrasing analyses like those in the (c) lines was the presupposition that the strict layer hypothesis held of any prosodic structure representation, not any evidence that showed that all material between successive right edges was contained in the same φ.

The conclusion that the single-edge-theory-driven φ-domain structure is underdetermined by the facts in ChiMwiini is also true of the facts of Xiamen Chinese reported by Chen 1987. In Xiamen the phenomenon at issue is the distribution of the two possible tonal realizations that any lexical morpheme of Xiamen may display—the phrase-final form and the non-phrase-final form. (There is no known phonological rule that relates the final forms to the nonfinal forms). Let's assume with Chen that the appearance of the phrase-final form diagnoses the right edge of a phonological phrase (his 'tone group'). Chen shows that the right edge of a phonological phrase diagnosed in this way coincides with the right edge of a syntactic XP. But there is no empirical reason to assume with Chen that the φ extends from the right edge of one syntactic XP to the right edge of another. Just as there was no reason to make that assumption in ChiMwiini. The nonfinal form in Xiamen will appear just as long as the word is not in phrase-final position.

A left-edge version of Align XP was taken by Selkirk and Tateishi 1991 to derive the distribution of major phonological phrases (aka intermediate phrases aka maximal φ) that provide the phonological domains for the phonetic implementation of sentence tone in Japanese, as proposed for example in the account of Pierrehumbert and Beckman 1988. The left edge of major phrase/intermediate phrase/maximal φ is the locus of a significant upward pitch reset, which largely undoes the various pitch downtrends that result in a lower pitch range at the end of a preceding phrase. This is illustrated in sentence (24).

(24) a. [$_{NP}$[[Na^{H*}gano$_{N}$-no] ani^{H*}yome-ga]$_{NP}$ $_{VP}$[$_{NP}$[[Ao^{H*}yama-no] yama^{H*}mori-o] yonda]$_{VP}$]$_{S}$
Nagano-GEN sister-in-law-NOM Aoyama-GEN mountain guard-ACC called

'A sister-in-law from Nagano called a mountain guard who is in Aoyama.'

b. $_{\varphi}$(^{LH}Na^{H*}↓gano$_{N}$-no ^{LH}ani^{H*}↓yome-ga)$_{\varphi}$ $_{\varphi}$(^{L}↑^{H}Ao^{H*}↓yama-no ^{LH}yama^{H*}↓ mori-o yonda)$_{\varphi}$

c. $_{\varphi}$(^{LH}Na^{H*}↓gano$_{N}$-no ^{LH}ani^{H*}↓yome-ga)$_{\varphi}$ $_{\varphi}$($_{\varphi}$(^{L}↑^{H}Ao^{H*}↓yama-no ^{LH}yama^{H*}↓ mori-o)$_{\varphi}$ yonda)$_{\varphi}$

The down arrows in (24bc) indicate the phonetic downstep that is produced in Japanese following a lexically accented syllable, marked with H*, and the up arrow indicates the presence of the significant upward reset attested at the left edge of a major phrase/intermediate phrase/maximal φ. The Align-L XP constraint argued for by Selkirk and Tateishi assigns the prosodic structure in (24b) to sentences like these: the left edge of each XP (the subject and the object and VP edges) coincides with a φ-edge; the verb is included in the same φ with the preceding direct object. This inclusion of the verb within the same φ as what precedes is consistent with the phonetic facts, given that there is no major upward reset of pitch before the verb. But the Match Phrase analysis which is given in (24c) is also consistent with the known facts. In (24c) the verb *yonda* is external to the φ which parses the object phrase, but is not a φ itself and so would not trigger upward reset. (Note that any φ-structure internal to NP has not been included here.)

In the three cases just reviewed the facts do not decide between a single-edge-based theory and a Match-based theory of syntactic-prosodic constituency, precisely because the reported phonological and phonetic phenomena in these languages diagnose only one edge of φ. The syntactic single-edge that was aligned with the phonological domain in the minimal strictly layered Align XP analysis was precisely the sole edge at which some phonological or phonetic phenomenon was attested. But in a language like Xitsonga, where both edges of φ are diagnosable, it's Match(XP, φ) and Match(φ, XP), which together require a perfect correspondence of left and right edges of XP in syntactic representation with right and left edges of φ in phonological representation, whose predictions hold (cf. footnote 32). This can be seen in (25), where the prediction of the Match (XP, φ) and Match(φ, XP) combination is compared with the predictions of Align-R (XP, φ) and of Align-L (XP, φ):

(25) φ-domains predicted by Match vs. Align correspondence for Xitsonga XPs

a. [$_{NP}$[noun adjective]$_{NP}$ $_{VP}$[verb $_{NP}$[noun adjective]$_{NP}$]$_{VP}$]

b. Match (XP, φ)/Match(φ, XP): $_{\varphi}$(noun adj)$_{\varphi}$ $_{\varphi}$(verb $_{\varphi}$(noun adj)$_{\varphi}$)$_{\varphi}$

c. Align-R (XP, φ): *$_{\varphi}$(noun adj)$_{\varphi}$ $_{\varphi}$(verb noun adj)$_{\varphi}$

d. Align-L (XP, φ): (i) *$_{\varphi}$(noun adj)$_{\varphi}$ $_{\varphi}$(verb)$_{\varphi}$ $_{\varphi}$(noun adj)$_{\varphi}$
OR: (ii) $_{\varphi}$(noun adj)$_{\varphi}$ $_{\varphi}$(verb $_{\varphi}$(noun adj)$_{\varphi}$)$_{\varphi}$

The Match(XP, φ)/Match(φ, XP) combination straightforwardly predicts the attested recursive, level-skipping domain structure in (25b) with its nested XP corresponding to recursive φ and no φ structure assigned to the verb. Align-R(XP, φ) wrongly predicts that the entire VP should constitute a single φ as in (25c). The prediction of Align-L(XP, φ) is more complicated. If strict layering is assumed, as in the original Selkirk 1986 proposal, the verb and its following multiword object would each be parsed as a φ, as in the ungrammatical (25d-i). Yet the attested recursive φ-structure in (25d-ii) is also consistent with Align-L(XP, φ)—even if this correspondence constraint does not force the recursivity. Some other constraint would have to be responsible for the presence of the recursive structure. But, since recursivity as a property of prosodic structure is presumably phonologically marked, no phonological constraint could be given responsibility for producing the prosodic structure in (25d-ii). Moreover, even allowing the option for *both* Align-R(XP, φ) and Align-L(XP, φ) to come into play simultaneously, as proposed by de Lacy 2003, would produce the same pair of possible φ-domain structures, without favoring the recursive one. In other words, a theory of prosodic structure formation consisting of just the set of single-edge Align-R/L XP constraints on syntactic-prosodic constituency correspondence and a set of phonological markedness constraints cannot derive the pattern of phonological phrasing observed in Xitsonga. In 2.3.3 we review the proposal by Truckenbrodt 1999 that adding an additional constraint type—Wrap XP—to the theory of the syntax-prosodic structure relation allows for this recursivity to be produced.

2.3.3 Truckenbrodt 1999: Wrap (XP, φ) and Align R/L (XP, φ)

Truckenbrodt 1999 proposes that a theory of syntactic-prosodic constituency correspondence must include, in addition to the constraints Align-R (XP, φ) and Align-L (XP, φ), a constraint Wrap (XP, φ). Wrap XP demands that each syntactic XP be contained in a phonological phrase (φ). Given a VP containing one or more arguments, a single φ corresponding to just the VP will satisfy Wrap XP with respect to that VP as well as to all the component NPs: e.g. $_{VP}$[XP XP…verb]$_{VP}$ ➔ $_{\varphi}$(XP XP …verb)$_{\varphi}$. In this φ-domain structure all XP are *contained within a φ,* as required by Wrap XP. The addition of Wrap XP to a repertoire of constraints on the syntactic-prosodic constituency correspondence that includes Align-R (XP, φ) and Align-L (XP, φ) is designed to provide the foundation for a richer cross-linguistic typology of possible syntactic structure-φ structure correspondences than is available with Align XP theory itself.

Importantly, the Wrap XP-plus-Align XP theory permits the generation of recursive φ-structures on the basis of nested XPs in the syntax. This can be illustrated with data from German where a recursive φ-structure is necessary for an adequate account of phrase stress. In German main phrase stress and the pitch accent that necessarily accompanies main phrase stress, falls on the rightmost element within a φ. In the SOV structure found in embedded clauses, discourse-new subject and object phrases each necessarily receive a pitch accent, while the verb does not:

(26) a. …weil María die neuen Gesétze studiert

because M. art new law-s study-pres:3s

'because Maria is studying the new laws'

b. …weil [[María]$_{DP}$ $_{VP}$[[die neuen Gesétze]$_{DP}$ studiert]$_{VP}$]

c. Match (XP,φ)/
Match(φ, XP): …weil $_{\varphi}$(María)$_{\varphi}$ $_{\varphi}$($_{\varphi}$(die neuen Gesétze)$_{\varphi}$ studiert)$_{\varphi}$

d. Wrap XP *and*
Align-R XP: …weil $_{\varphi}$(María)$_{\varphi}$ $_{\varphi}$($_{\varphi}$(die neuen Gesétze)$_{\varphi}$ studiert)$_{\varphi}$

e. Wrap XP *and*
Align-L XP: *…weil $_{\varphi}$(María)$_{\varphi}$ $_{\varphi}$(die neuen Gesetze studíert)$_{\varphi}$

The Match(XP, φ)/Match(φ, XP) account, coupled with a theory of the prosodic phonology of φ, correctly derives the absence of necessary pitch accent on the verb in all new sentences. These phonological assumptions are (i) that main phrase stress in φ is assigned to the rightmost ω in φ in German, (ii) that a pitch accent is necessarily assigned to the syllable carrying main stress of φ and (iii) that a φ contains just one main stress. (See Kratzer and Selkirk 2007). By these assumptions, the main phrase stress of the recursive φ structure corresponding to the VP at the right in (26c) is correctly located within the lower φ (on the direct object), where it is marked by a pitch accent[35]. A Wrap XP-plus-Align-R XP can produce the same recursive φ-structure as Match XP and so can also derive the same phrase stress and pitch accenting, seen in (26d): Align-R XP ensures the presence of the right φ edge following the direct object and Wrap XP is responsible for the left and right φ-edges flanking the entire VP, ensuring that the entire VP, including its component constituents, is contained within a same φ[36]. Yet the Wrap XP-plus-Align XP theory of syntactic-prosodic constituency correspondence differs from Match theory in predicting, cross-linguistically, a greater range of possible φ-structures for a given syntactic structure. For example, the combination of Wrap XP and Align-L XP would predict the nonrecursive φ-structure in (26e) for a verb phrase with verb and direct object. This structure is inappropriate for German, since it would predict that in all-new sentences like these the verb should necessarily bear main phrase stress and pitch accent and the direct object no phrase stress or pitch accent at all. But Wrap XP-plus-Align XP theory is committed to the existence of this particular VP-φ structure relation in some language.

Crosslinguistic investigation is required in order to ascertain which theory of syntactic-prosodic constituency correspondence provides a better foundation for a typology of φ-domain formation in grammar. The Wrap XP-plus-Align XP theory predicts, of course, that the broader range of φ-domain structures it defines should be attested in some language. Kahnemuyipour 2004, 2009 reports on a highly relevant cross-linguistic investigation of patterns of phrasal stress and pitch accenting according to which a phrase

stress pattern like (26e) for a VP consisting of XP plus verb in an all-new sentence is not attested in any of the languages investigated. Match XP predicts this crosslinguistic limitation in distribution of phrase stress prominence, but Wrap XP-plus-Align XP does not. If further research does indeed substantiate Kahnemuyipour's claim that, in systems where the assignment of phrase stress is discernable, phrase stress never falls on the verb instead of the direct object in neutral all-new sentences, then Wrap XP-plus-Align XP theory must be rejected as a theory of syntactic-prosodic constituency correspondence.

According to Truckenbrodt 1999, the full typology of possible XP-φ structure relations that are predicted by the Wrap XP-plus-Align XP theory relies on a role for the prosodic markedness constraint Nonrecursivity (Selkirk 1996). If Nonrecursivity is higher ranked than Wrap XP and Align-R/L XP, then recursive φ-structures are excluded. In this case, Truckenbrodt 1999 proposes, the respective ranking of Wrap XP and Align XP in the grammar of a language produces a range of nonrecursive φ-domain organizations, and these should all be attested in some language(s) of the world. This can be illustrated with the case of a verb phrase containing multiple internal arguments:

(27) φ-domain structures generable from syntactic input [NP NP V]$_{VP}$ by Wrap XP-plus-Align XP theory supplemented by high-ranked Nonrecursivity constraint[37]:

a. (NP NP verb)$_{\varphi}$ by Wrap XP >> Align-R/L XP

b. (NP)$_{\varphi}$ (NP)$_{\varphi}$ verb by Align-R XP >> Wrap XP:

c. (NP)$_{\varphi}$ (NP verb)$_{\varphi}$ by Align-L XP >> Wrap XP:

In the case of (27a), where Wrap XP dominates Align XP, the VP itself will correspond to a φ and internal to the VP there will be no further φ-structure. In the case where Align-R XP or Align-L XP dominates Wrap XP, there will be no φ-domain corresponding to the VP itself, but there will be φ-domains marking off the syntactic phrase break between the arguments, as in (27b) and (27c). By contrast, a theory including the correspondence constraints Match(XP,φ)/Match(φ, XP) but lacking any SLH-enforcing markedness constraints like Nonrecursivity only allows for the recursive structure in (28):

(28) φ-domain structure generable by Match theory from syntactic input [NP NP V]$_{VP}$:

((NP)$_{\varphi}$ (NP)$_{\varphi}$ verb)$_{\varphi}$

The research question that is now open is whether or not crosslinguistic investigation of φ-domain-sensitive phenomena provides support for the systematic appearance of recursivity envisaged by the Match theory of syntactic-prosodic constituency correspondence articulated above, or whether instead all or some of the richer array of φ-structure possibilities envisaged by the Truckenbrodt 1999 articulation of Wrap XP-plus-Align XP theory are attested.

It must be kept in mind that proposals concerning theories of the syntax-phonological domain structure relation have to be evaluated in the context of a full theory of grammar. As discussed in section 2.1, the phonological component of a grammar includes a theory

of language-particular variation in domain-sensitivity as well as a theory of phonological markedness constraints on prosodic structure wellformedness. So explanations for patterns of distribution of domain-sensitive phenomena in the sentences of a language do not rely just on the theory of the syntactic-prosodic constituency relation alone. It is with this general point in mind that we turn to a case which Truckenbrodt 1999 takes to display the nonrecursive phrasing of VP illustrated in (27a), that of Tohono 'O'odham, whose sentence phonology was first described and analyzed in Hale and Selkirk 1987.

In Tohono 'O'odham, evidence from the distribution of a basic default (L)HL tonal pattern in the sentence supports the positing of φ-domains over which that (L)HL pattern is defined. Note first that a single (L)HL patterns extends over the clause-final verb and all the XP arguments which precede the verb and lie to the right of the tense-bearing auxiliary on the left, as in (29).

(29) i. L HHH HHH H L
Na-t [[g wákial]$_{XP}$ [g wísilo]$_{XP}$ cépos]$_{VP}$
Inter-Aux:3:perf art cowboy art calf brand:perf

'Did the cowboy brand the calf?'

ii. L H*-------- H*------ H* L%
Na-t $_{\varphi}$(g wákial g wísilo cépos)$_{\varphi}$

(Orthographic acute accents mark the positions of word stress; the (i) lines contain the tonal transcription given in Hale and Selkirk 1987; the (ii) lines contain the phonological phrasing representations they propose, and a phonological analysis of the tonal patterns to be explained below.) An XP that precedes the auxiliary shows its own (L)HL pattern, as in (30). And any verbal argument that is dislocated to the right shows the (L)HL pattern: compare (31ab).

(30) i. H LL L HHH H L
[g wákial]$_{XP}$ 'at $_{VP}$[[g wísilo]$_{XP}$ cépos]$_{VP}$
art cowboy Aux art calf brand:perf

'The cowboy branded the calf.'

H*LL% L H*------- H*L%
ii. $_{\varphi}$(wákial)$_{\varphi}$ 'at $_{\varphi}$(g wísilo cépos)$_{\varphi}$

(31) a-i. L HHH HHH HHH H H L
No [[g wákial]$_{XP}$ [g wísilo]$_{XP}$ [g wíjina-kaj]$_{\varphi}$ wúpda]$_{VP}$
Inter-Aux art cowboy art calf art rope-with rope:imperf

'Did the cowboy rope the calf with the rope?'

L H*-------- H*------- H*---------- H*L%
a-ii. No $_{\varphi}$(g wákial g wísilo g wíjina-kay cépos)$_{\varphi}$

b-i. L H L H LL HLL HL L
No [wúpda]$_{VP}$ [g wákial]$_{XP}$ [g wísilo]$_{XP}$ [g-wíjin-kay]$_{XP}$

'Did the cowboy rope the calf with the rope?'

b-ii. L H* L% H*LL% H*LL% H*L L%
No $_{\varphi}$(wúpda)$_{\varphi}$ $_{\varphi}$(g wákial)$_{\varphi}$ $_{\varphi}$(g wísilo)$_{\varphi}$ $_{\varphi}$(g-wíjin-kay)$_{\varphi}$

Moreover, right dislocation of an XP within a nominal or locative XP results in a sequence (L)HL, as comparison of the patterns in (32ab) and (33ab) shows:

(32) a-i. HH HL
[[g Húsi]$_{YP}$ kíi]$_{XP}$
art Joe house

'Joe's house'

a-ii. H* H*L%
$_{\varphi}$(g Húsi kíi)$_{\varphi}$

b-i. HL HL
[[g kíi]$_{XP}$ [g Húsi]$_{YP}$]$_{XP}$
art house art Joe

'Joe's house'

b-ii. H*L% H*L%
$_{\varphi}$(g kíi)$_{\varphi}$ $_{\varphi}$(g Húsi)$_{\varphi}$

(33) a-i. L HHH HL
[am [míisa]$_{YP}$ wéco]$_{XP}$
loc table under

'under the table'

a-ii. L H*---- H*L%
$_{\varphi}$(am míisa wéco)$_{\varphi}$

b-i. L HL HLL
[[am wéco]$_{XP}$ [g míisa]$_{YP}$]$_{XP}$
loc under art table

'under the table'

b-ii. L H*L% H*L%
$_{\varphi}$(am wéco)$_{\varphi}$ $_{\varphi}$(g míisa)$_{\varphi}$

The sequence of (L)HL patterns in cases like (32) and (33), which involve XP-internal differences in syntactic phrase structure, shows that the phonological domain for the (L)HL pattern observed here is indeed the φ-domain, which appears in correspondence with syntactic phrases, rather than the ι-domain, which corresponds to syntactic clauses.

The (L)HL pattern associated to each φ-domain may analyzed as follows: a H tone appears on each word stress; a high plateau extends from one word-stressed syllable to another in the φ (perhaps due to fusion). The syllables following the φ-final word stress bear a L tone. There is also L tone on any syllable(s) preceding the H tone on the first word-stress of the φ-domain. It will be assumed that any stressless syllable that does not come to bear a H tone through spreading is realized with a default L tone. This analysis of default L tone for stressless syllables is supported by the fact that when the leftmost word of a φ has initial stress the tonal pattern of the φ begins with just a H. By contrast,

the fact that a φ-final word-stressed syllable shows a fall from H to L indicates that the final contour must result from the association of the word-stress H tone and a right-phrase-edge L% boundary tone to the same φ-final stressed syllable. The right-edge L% boundary tone is therefore a reliable indicator of right edge of φ. This tonal analysis is reflected in the phonological representations in the (ii) lines above.

Two earlier analyses of the distribution of this (L)HL pattern, and in particular of the absence of the right-edge L% on pre-head XPs, sought to enrich the theory of constraints on the relation between syntactic structure and phonological phrasing in order to accommodate it. Hale & Selkirk 1987 took the distribution of this canonical (L)HL pattern to indicate that-- in the grammar of Tohono 'O'odham-- the relevant Align-R phrasing constraint for Tohono 'O'odham was parameterized to appeal only to maximal projections that were not "lexically governed". XPs preceding the verb within the VP were lexically governed, as were prehead XP within nominal and locative phrases. But the pre-Aux XP, lying outside the VP, was not lexically governed; nor was the VP itself. Nor was any XP that was dislocated. This parameterized Align-R ($XP^{\text{not-lex-gov'd}}$, φ) constraint correctly locates the right-φ-edges indicated in (ii) in each of the examples above. Truckenbrodt 1999, on the other hand, opted to restrict the theory of phrasal edge-alignment constraints to just the general type Align XP, and instead offered an account of the Tohono 'O'odham phrasing pattern that relies on two distinct types of universal constraint on the relation between syntactic and prosodic constituency: Align XP and Wrap XP. As discussed above, Truckenbrodt proposes that the ranking of Wrap XP above Align XP in the grammar of a language in the grammar of a language in which Nonrecursivity prevails is the source of the VP-size φ-domain that is observed in Tohono 'O'odham in (29), (30) and (31)[38].

But there is a third possible approach to this data from Tohono 'O'odham within the more restrictive Match theory of syntax-prosodic structure correspondence. Match(XP,φ)/Match(φ,XP) will assign the sentences in (29) and (30) the recursive φ-domain structure corresponding to the VP and its daughter XPs that is seen in (34ii) and (35ii). The pre-Aux XP of (30/35) will be assigned a separate φ.

(34) i. L HHH HHH H L
Na-t [[g wákial]$_{XP}$ [g wísilo]$_{XP}$ cépos]$_{VP}$
Inter-Aux:3:perf art cowboy art calf brand:perf

'Did the cowboy brand the calf?'

L H*---------- H*-------- H* L%
ii. Na-t $_{\varphi}$($_{\varphi}$(g wákial)$_{\varphi}$ $_{\varphi}$(g wísilo)$_{\varphi}$ cépos)$_{\varphi}$

(35) i. H LL L HHH H L
[g wákial]$_{XP}$ ‘at $_{VP}$[[g wísilo]$_{XP}$ cépos]$_{VP}$
art cowboy Aux art calf brand:perf

‘The cowboy branded the calf.’

H*LL% L H*---------- H*L%
ii. $_{\varphi}$(wákial)$_{\varphi}$ ‘at $_{\varphi}$($_{\varphi}$(g wísilo)$_{\varphi}$ cépos)$_{\varphi}$

Note that the (L)HL contours found in these sentences are defined over just those φ which are not dominated by any other φ. These are precisely instances of maximal φ, a subtype of φ defined by Ito and Mester 2007, 2009. The L% boundary tone can be analyzed as being restricted to the right edge of a maximal φ. This alternative within a Match theory framework to the Hale & Selkirk 1987 and Truckenbrodt 1995, 1999 accounts of the distribution of the LHL phrasal tone pattern in Tohono ‘O’odham relies on the theory of domain-sensitivity. We know on the basis of independent evidence that phonological theory must allow for this general sort of language-particular variation in domain-sensitivity when it comes to the distribution of boundary tones at prosodic constituent edges. Japanese shows a L% at the right edge of *any* φ, not just maximal φ; Bengali (Hayes and Lahiri 1991) shows a H% at the edge of any φ. Importantly, a reanalysis of the distribution of phrasal H tone insertion in Kimatuumbi (Odden 1987, 1996) along the lines proposed here for Tohono ‘O’odham would locate this H% tone epenthesis at the right edge of a maximal φ[39].

The hypothesis favored here, then, is that the theory of prosodic domain formation and prosodic domain-sensitivity includes (i) the highly restrictive universal Match theory of syntactic-prosodic constituency correspondence, (ii) a theory of domain-sensitivity in phonology which allows for domain-sensitive phenomena to be sensitive to any of the prosodic category types defined in the theory, in the general manner sketched in 2.1.3 and 2.2.3, and (iii) a phonological theory of markedness constraints on prosodic structure (to be discussed immediately below). Further crosslinguistic research is required, of course, to determine if this theory does indeed allow for an insightful characterization of typological variation in the distribution of domain-sensitive phenomena in the sentence phonology or phonetics of any language investigated.

3.0 Phonological influences on prosodic constituent structure

The existence of nonsyntactic influences on phonological domain structure provides the fundamental argument in favor of a prosodic structure theory of phonological domains. In what follows a brief review will be made of the sorts of prosodic markedness constraints that can result in the formation of surface phonological constituents that do not correspond to syntactic constituents, in violation of Match constraints on the syntactic-prosodic structure correspondence. The case study from Lekeitio Basque in section 3.2 illustrates a range of prosodic markedness effects leading to such instances of nonisomorphism between φ-domains and syntactic phrases.

3.1 Prosodic markedness constraints interacting with Match constraints

The theory of prosodic structure markedness constraints, which plausibly has its foundations in the purely phonological rhythm-grounded foot, extends its reach to ι, φ, and ω, which, according to the theory of supra-foot prosodic category types put forward above, are grounded in syntactic-prosodic structure correspondence. The vocabulary of phonological constraints includes all prosodic categories, regardless of provenance. We have seen that domain-sensitive phonological markedness constraints—like Nonfinality--mention the syntactically grounded category types ι, φ, and ω. The review below shows that markedness constraints on prosodic structure itself—like BinMin-- do so as well.

3.1.1 Size constraints

Constraints requiring that a prosodic constituent be structurally binary at some lower level of prosodic analysis are well motivated at the foot level, where languages divide up according to whether they require feet to be minimally bimoraic or bisyllabic (Hayes 1995 among others). At the ω level prosodic minimality is often a consequence of the fact that a ω consists of at least one foot (which must itself be binary), though Ito and Mester 1992 [2003] have shown that certain Japanese loanword adaptations require ω binarity at a higher level, so that the derived ω in such cases must consist of either two feet or a foot plus a syllable. It is to be expected, then, that prosodic minimality effects will be common across languages both at the φ-level and at the ι-level, where, as Ghini 1993 and Inkelas and Zec 1995 suggest, they might override the effects of syntax-prosodic structure interface constraints (see also Selkirk 2000). At higher levels of phonological domain, it has been proposed that syntactic branchingness affects prosodic domain structure (Nespor and Vogel 1986, Bickmore 1990, among others), though Inkelas and Zec 1995 have argued that such restrictions are not based on syntactic branchingness, but rather on prosodic word (ω) count. In this spirit, Selkirk 2000 proposes the prosodic markedness constraint formulated here as BinMin (φ,ω), requiring that a φ minimally consist of two ω, and the constraint BinMax (φ,ω), requiring that there be no more than two ω in a φ. The ranking of BinMin (φ,ω) with respect to the interface constraint Match (Phrase, φ), discussed above, makes for a clear typological difference between languages. Xitsonga, for example, does not allow single-word noun phrases and ChiMwiini, for example, does:

(36) Typological differences in φ domain structure due to ranking of BinMin (φ,ω):

a. BinMin (φ,ω) >> Match (Phrase, φ) [Xitsonga, Italian, …]

b. Match (Phrase, φ) >> BinMin (φ,ω) [ChiMwiini, German, …]

As we saw in Xitsonga, the effect of the ranking of BinMin (φ,ω) over Match (Phrase, φ) is to disallow phonological phrases that would correspond to syntactic phrases that are sub-binary. The effect of the excess-size-penalizing BinMax (φ,ω) constraint would be the opposite, if it outranked the input-output correspondence constraint Match (φ, Phrase), which rules against instances of φ in the output representation which don't correspond to some syntactic phrase in the input. Japanese is reported to show a case of this sort: a noun phrase consisting of four lexical words in a recursive left-branching genitive structure has a surface prosodic structure containing a sequence of two binary φ (cf. Selkirk and Tateishi 1988, Kubozono 1993; Shinya, Selkirk and Kawahara 2004):

(37) Effects of BinMax (φ,ω) on prosodic φ structure in Tokyo Japanese

$[[[\text{N-no N-no}]\ \text{N-no}]\ \text{N-ga}]_{NP} \rightarrow {}_{\varphi}(\ {}_{\varphi}(\text{N-no N-no})_{\varphi}\ {}_{\varphi}(\text{N-no N-ga})_{\varphi}\ )_{\varphi}$

Note that the effect of high-ranked BinMax (φ,ω) is the appearance of a φ-- the one embedded on the right—that is not identical to any constituent of the syntactic representation, in violation of Match (φ, Phrase). This optimal prosodic structure departs from the left-branching φ-binarity predicted by Match Phrase, so as to produce an improvement in the binarity of φ-structure.

It is also reported in the literature that there are prosodic size effects on prosodic phrase organization that appear to depend on brute syllable count and are not reducible to prosodic binarity (Delais-Roussarie 1995, Prieto 1997, 2005, Elordieta et al 2003, 2005, D'Imperio et al 2005). The question arises whether such effects give rise to categorical, typological, distinctions between languages, or whether they may reflect more universalist tendencies of performance organization. This is clearly a question for future research.

3.1.2 Left edge strengthening

Examination of foot distribution within words testifies to constraints that are specific to prosodic left edge organization. A class of languages including English and Garawa, which place main word stress on the rightmost foot, take the option of organizing the left edge of the word into feet, when presented with the choice (Hayes 1995). This so-called 'initial dactyl effect' (McCarthy and Prince 1993) can be seen in five-syllable monomorphemic English words like *Tàtamagóuchi*. If foot organization were organized entirely from right to left, the pattern should be *Tatàmagóuchi,* which contains a 'stray' syllable at the left edge of ω. The necessity, instead, of a left-edge foot could seen as an instance of what will be called a Strong Start effect[40]:

(38) Strong Start

A prosodic constituent optimally begins with a leftmost daughter constituent which is not lower in the prosodic hierarchy than the constituent that immediately follows:

$* (\pi_n \pi_{n+1} \ldots$

A Strong Start effect at levels of prosodic organization above the word can plausibly be found in avoidance of 'stray' syllables or feet at the left edge of phonological phrases, an avoidance seen for example in the promotion of initial weak pronouns to ω status or in their obligatory rightward displacement (Werle 2009, Elfner to appear)). A Strong Start effect is also possibly the source of a bias to place a pitch accent on the first prosodic word of an ι-domain in English: avoiding a 'stray' ω at the left edge of an ι-domain would involved promoting it to φ status, with consequent φ-stress prominence assignment and the resulting insertion of epenthetic H* pitch accent. In Xitsonga, the parsing of preposed syntactic phrases as ι-domains rather than the expected φ, discussed above in section 2.1.1, is plausibly another instance of a Strong Start effect. The ι-domain status of preposed noun phrases in Xitsonga constitute a violation of the output-input interface faithfulness constraint Match (ι, Clause); this violation would be produced if the prosodic markedness constraint Strong Start were to outrank Match (ι, Clause) in the grammar of Xitsonga. The grammar of Northern Sotho, which does not show this promotion to ι of preposed XPs, would by contrast rank Match (ι, Clause) above Strong Start.

3.1.3 Prosodic stress prominence assignment

Another robust prosodic markedness effect at foot level and above concerns the presence and placement of stress prominence (for which see the classic Hayes 1995 review). A class of constraints calls for a prosodic constituent π to be headed, namely to contain a most prominent, main stressed, constituent (see Selkirk 1980a, 2009a among many others). Call this the constraint family ProsProm(π). Another class of prosodic constraints locates that prominence at the left or right edge of the prosodic constituent π (Prince 1983, McCarthy and Prince 1993). Call this the constraint family Edgemost-L/R (Prom-π, Edge-π) (Prince and Smolensky 1993, McCarthy 2003). So feet are either trochaic or iambic, with prominence either on the lefthand or righthand syllable, depending on the language. And main word stress falls either on the leftmost or rightmost foot of the word. The expectation, then, is that at the φ-level, the location of main stress within φ would be edgemost, on a language particular basis— falling in the rightmost ω in some languages, the leftmost ω in others. This prediction does appear to be borne out in precisely those cases where it can be put to the test, namely in cases of minimal φ that consist of two ω, as in syntactic phrases consisting of Adjective plus Noun. φ-stress is rightmost in [Adj N] phrases in German, English, Italian and leftmost in Turkish and Persian.

The theory of prosodic stress prominence in the φ-domain is a theory of the default assignment of phrasal stress in sentences which are 'neutral'--all new in the discourse. These default stress patterns are claimed to reflect the prosodic constituency of the sentence (see e.g. Nespor and Vogel 1986, Kratzer and Selkirk 2007). Other approaches to describing default phrase stress patterns have characterized them as depending directly on syntactic constituency (Chomsky and Halle 1968, Selkirk 1984, Cinque 93, Kahnemuyipour 2004, 2009; Wagner 2005, Truckenbrodt 2006[41]), though these couldn't account for any phrase stresses appearing in constituents that are nonisomorphic with the syntax.

Relevant to the point at hand, the markedness constraints ProsProm(φ) and Edgemost-R/L (Prom-φ, Edge-φ) may have an effect on the very prosodic constituency of the sentence, precisely in cases where the distribution of phrasal stress prominence is not determined by default, and specifically in cases where syntactic constituents are marked for contrastive Focus or discourse-Givenness. It has been proposed that Given-marked constituents in English are submitted to an interface constraint, call it Destress Given, that prohibits them from carrying phrasal stress prominence (see, e.g. Ladd 1980, Reinhart 1995, Féry and Samek-Lodivici 2006, Selkirk 2008 and Kratzer and Selkirk 2007, 2009). The ranking Destress Given >> ProsProm(φ) would lead to an absence of φ-level stress on a Given constituent. This required absence in φ-level prominence for Given-marked constituents would lead to an absence of φ-domain status for a Given-marked phrase, in violation of Match (Phrase, φ), when ProsProm(φ) is higher ranked than Match (Phrase, φ) in the grammar of the language. As for the case of contrastive Focus, it has been proposed by many authors (Jackendoff 1972, Truckenbrodt 1995, Reinhart 1995, Zubizarreta 1998, Szendroi 2001 that a Focus-marked constituent is required to contain the greatest stress prominence within some relevant domain; call this interface constraint Stress Focus. As Truckenbrodt 1995 suggests, the appearance of a φ-domain edge at the right or left edge of a Focus constituent, observed in a variety of languages, could be understood as an effect of the prosodic markedness constraint Edgemost (Prom-φ; R/L; Edge-φ). The phrasal stress that is produced in order to satisfy Stress Focus would induce the presence of a φ-edge adjacent to that stress, through the effect of Edgemost Prom, and could thereby introduce a φ-domain structure that does not correspond to a syntactic phrase (see, e.g. Selkirk 2002, 2009a). In cases of this sort, then, there is potential for violation of Match correspondence constraints.

3.1.4 Constraints on the relation between tone and prosodic prominence

Another particularly relevant sort of prosodic markedness constraint regulates the relation between tone and prosodic prominence (stress), and by extension the relation between tone and prosodic constituency. There are languages in which predictable (epenthetic) tone appears on the main stress of the foot (Singapore English, Siraj 2008), on the main stress of a ω (Tohono 'O'dham, see above; Serbo-Croatian, Zec 1999, Werle 2009; Cairene Arabic, Hellmuth 2007; see also Hyman 2006), or on the main stress of a φ (Bengali, Hayes and Lahiri 1991; English, Ladd 1996, 2008, Selkirk 2000, Féry and Samek-Lodovici 2006, Calhoun 2006; German, Kratzer and Selkirk 2007)[42]. (Cases of tone that is restricted in distribution to a local prosodic prominence have standardly been referred to as pitch accents.) It has also been observed that in some languages a lexical tone may migrate to a position of stress prominence, whether in the word or in the phrase, see e.g. Kisseberth 1984 on Digo. Yip 2002 hypothesizes that these sorts of phenomena testify to the existence of phonological markedness constraints on the tone-stress relation. Such constraints could be formulated schematically as below[43]:

(39) a. No Toneless π-Stress
The prosodically prominent (stressed) syllable of a prosodic constituent of level π must be associated to some tone T.

b. No π-Stress-less Tone
A tone T must be associated to a prosodically prominent (stressed) syllable of a prosodic constituent of level π.

(In the constraint schemata given here, π is a variable over the set of prosodic category types {foot, ω, φ, ι}.) Markedness constraints on tone-prosodic stress prominence association like those in (39) may—if high enough ranked-- contribute to determining the prosodic constituent structure of a sentence, and, in particular, may be responsible for violations of the correspondence constraints that govern the φ-domain/syntactic phrase relations in the sentence. Consider, for example, the well-known fact of Japanese that a syntactic NP with embedded genitive *–no* NP that consists of two accented words [[A-no] A-case] will be prosodically parsed as $_{\varphi}(_{\varphi}$(A-no)$_{\varphi}$ $_{\varphi}$(A-case)$_{\varphi}$)$_{\varphi}$, that is, into two minimal φ (also referred to as minor phrase or accentual phrases), whereas the same syntactic phrase type with a sequence of two unaccented words will be tend to be parsed as one minimal φ, namely as $_{\varphi}$(U-no U-case)$_{\varphi}$ (see Poser 1984, Kubozono 1988, 1993, Selkirk and Tateishi 1988)[44]. In the first case, a lexically accented head noun (the one on the right) acquires φ-phrase status in the phonology. In the second case, an unaccented genitive noun phrase lacks φ-phrase status in the phonology. The hypothesis here is that the two-φ sequence for the two accented nouns, for example, comes about due to a tone-stress markedness constraint which requires that each tonal pitch accent be associated with a distinct φ-prominence; this has as a consequence the parsing of the sequence of accented words into two distinct φ[45]. In the following section we will see further examples from Lekeitio Basque of the effect of tone-prosodic prominence markedness constraints on the surface prosodic constituent structure of the sentence.

3.2 A case study from Lekeitio Basque

This section reports on the findings of Elordieta 1997, 1998, 2006, 2007abc and Jun & Elordieta 1997 concerning the φ-domain structure of Lekeitio Basque, a variety of Northern Bizkaian Basque spoken in Spain. These works establish the basic generalizations concerning the patterning of phonological phrase organization in the language, and argue that various prosodic markedness constraints on the composition of phonological phrases outrank syntax-phonology correspondence constraints, producing important cases of nonisomorphism between syntactic and prosodic constituents. The generalizations that Elordieta lays out make a distinction between two distinct types of phonological phrase—the accentual/minor phrase and the intermediate/major phrase. It will be assumed here, with Ito and Mester 2007, 2009, that these are both instances of the prosodic category φ. The facts below are consistent with the proposal in section 2.2.3 that interface Match Phrase constraints appeal only to a single prosodic category φ. At the same time, it will seen that phonological markedness constraints and rules of phonetic interpretation may recognize distinctions between sub-types of φ that depend on the position of a φ in a recursive φ-domain structure, as the Ito and Mester propose. Recall that a minimal φ is a φ which dominates no other φ, while a maximal φ is a φ that is dominated by no other φ.

Lekeitio Basque is a lexical pitch accent language and its phrasal phonology displays many typological similarities with Tokyo Japanese. There is a contrast between lexically accented and unaccented words[46]:

(40) Lexical contrasts in pitch accenting in Lekeitio Basque:

a.	ama	'mother'		itturri	'fountain'	lagun	'friend'
b.	égi	'truth'		mái	'table'	áurre	'front'

The lexical pitch accent is H*L. At most one pitch accent can appear in a minimal φ, and when it does it must be on the final ω in the φ[47]. These restrictions have the consequence that a minimal φ can consist of a single accented word, one or more unaccented words, or a sequence of an unaccented word followed by an accented word. Two-word noun phrases of these types are given in (41); these are shown with isolation pronunciations, such as might also appear in topic position, for example[48].

(41) Two-word noun phrase types in Lekeitio Basque:

(i) [[A-gen] A-case] ➔ $_{\varphi}(_{\varphi}(\ A\ )_{\varphi}\ _{\varphi}(\ A\ )_{\varphi})_{\varphi}$

a. [[lagún-en] liburú-ak]
friend-pl-gen book-pl abs "the friends' books"
b. LH H*+L !LH H*+L
$_{\varphi}(_{\varphi}$(lagún-en)$_{\varphi}$ $_{\varphi}$(liburú-ak)$_{\varphi})_{\varphi}$

(ii) [[U-gen] A-case] ➔ $_{\varphi}(\ U\ A\ )_{\varphi}$

a. [[lagun-en] liburú-ak]
friend-sg gen book-pl abs "the friend's books"
b. LH H*+L
$_{\varphi}(_{\varphi}$(lagun-en liburú-ak)$_{\varphi}$

(iii) [[U-gen] U-case] ➔ $_{\varphi}(\ U\ U\ )_{\varphi}$

a. [[lagunen] dirua]
friend-sg gen money abs "the friend's money"
b. LH
$_{\varphi}(_{\varphi}$(lagun-en dirua)$_{\varphi}$

As in Japanese, a nonlexical epenthetic LH boundary tone sequence marks the left edge of any φ in Lekeitio Basque, and provides a crucial source of evidence for the φ-domain structures posited. The presence of a LH rise at the left edge of both accented nouns in the (i) case is evidence for its sequential φ-domain structure, in which each accented noun occupies its own minimal φ. That these two accented minimal φ are also grouped together within a superordinate maximal φ is indicated by substantial downstepping of the tone of the second word (marked with '!'); in Lekeitio Basque, as in Japanese, such downstepping would not appear if the second noun were initial in a maximal φ (see below). Of course the presence of the superordinate φ in (41-i) is predicted by the Match (Phrase, φ) interface constraint, and the lower φ corresponding to the genitive NP on the left is too. But, as in the Japanese case discussed just above, the presence of the minimal φ on the head noun on the right must be attributed to a phonological markedness constraint, one whose effect is to allow just one accented noun within a minimal φ. It was suggested above for Japanese that this is a constraint of type (39b): No φ-Stress-less Tone. The imposition of φ-stress by the presence of lexical accent has as a consequence the imposition of the φ constituency implied by the presence of φ-level main stress, and this has as a consequence the epenthesis of the initial left-φ-edge LH tone sequence.

In the (41-ii) case, the absence of a LH rise immediately preceding the accented noun in second position shows that the accented word is not itself a φ, but rather that the UA sequence together forms a single minimal φ (one that is at the same time maximal). The UU case in (iii) also constitutes a minimal φ (that is also maximal). The effect of absence of lexical accent on φ-domain structure in Basque will be discussed below.

In Tokyo Japanese, an accented word triggers a downstepping of the pitch range in which the subsequent word is realized (Poser 1984, Pierrehumbert and Beckman 1988, Kubozono 2007). Elordieta shows that this phonetic effect is found in Lekeitio Basque as well. It is illustrated in the three-accent noun phrase in the sentence in (42), for example (cf. Elordieta 2007c):

(42) a. $_{clause}[_{NP}[\ _{NP}[\ _{NP}$[Maialénen]$_{NP}$ lagúnen]$_{NP}$ liburúak]$_{NP}$ gustaten dxákes]$_{clause}$

Maialen-gen friends-gen books-abs like aux

'They like Maialen's friends' books.'

b. $_{\iota}(_{\varphi}(_{\varphi}($ Maialénen ↓lagúnen$)_{\varphi}$ ↓liburúak $)_{\varphi}$ ⇓$_{\varphi}$(gustaten dxákes $)_{\varphi})_{\iota}$

(42) shows downstep after every accented word preceding the verb. (For typographical ease and visual clarity, in (42) and other examples that follow, a simple down arrow '↓' indicates the presence of downstep, with the complex down arrow '⇓' indicating the larger-than-normal downstep or pitch compression that is found on the sentence-final verbal complex. An orthographic acute accent replaces the tonal representation of the pitch accent H*L, and the left edge tonal rise LH will not be represented at all, but should be assumed to be present at the left edge of any φ. Finally, a φ consisting of just a single accented ω will not be written.) A further aspect of the phonetic interpretation of Lekeitio Basque that mirrors that of Tokyo Japanese is the upwards pitch reset that is found at the left edge of a maximal φ. (A maximal φ is dominated by no other φ. 'Maximal φ' corresponds roughly to the 'major phrase' or 'intermediate phrase' in earlier accounts.) This upward reset is indicated with an up arrow '↑', as in (43).

(43) a. $_{clause}[_{NP}[\ _{NP}$[Maialénen]$_{NP}$ lagunári]$_{NP}$ $_{NP}[$ liburúak]$_{NP}$ gustaten dxákes]$_{clause}$

Maialen-gen friends-dat books-abs like aux

'Maialen's friends like the books.'

b. $_{\iota}(_{\varphi}($ Maialénen ↓lagunári $)_{\varphi}$ ↑$_{\varphi}$(liburúak $)_{\varphi}$ ⇓$_{\varphi}$(gustaten dxákes $)_{\varphi})_{\iota}$

The preverbal three-noun sequence in (42) constitutes the object noun phrase of the sentence. The three-noun sequence in (43) consists of a two-noun dative object noun phrase followed by a single-word direct object noun phrase. The different patterns of downstep/reset in the two sentence types are a function of differences in maximal φ-domain structure, which in turn mirror the differences in syntactic constituency. Elordieta 2006, 2007c reports on experimental results showing show that the F0 relation between the peaks of the second and third nouns is significantly different in the two cases, with

the greater difference in F0 in the case of sentences like (42) attributable to downstep (and lack of upward pitch reset). These same sorts of results have been found for Tokyo Japanese (Selkirk and Tateishi 1990, Ishihara 2008).

Two important ways in which the pitch patterning of Lekeitio Basque sentences differs from that of Tokyo Japanese will be discussed below. Both of these involve cases where the φ-domain constituency of the sentence diverges from that which is predicted by simply matching up φ-domains with syntactic phrases. First of all, as Elordieta 1997, 1998 points out, syntactic constituents consisting of unaccented nouns may fail to correspond to the φ-domain structure that syntactic-prosodic structure correspondence constraints would predict. For example, pronunciations of the sentence in (44), which contains three wholly unaccented noun phrases preceding the final verb sequence, include a rendition with tonal properties justifying the prosodic structure representation in (44b) as well as the rendition in (44c)[49].

(44) a. [$_{NP}$[[nire lagunen] alabia]$_{NP}$ [$_{NP}$[umiari]$_{NP}$ $_{NP}$[biberoya]$_{DP}$ emóten] jun da]

my friend-gen. daughter-abs child-dat baby-bottle-abs give-imperf go aux

'My friend's daughter has gone to feed the bottle to the baby'

LH H*+L

b. $_{ι}$($_{φ}$(nire lagunen alabia umiari biberoya emóten)$_{φ}$ jun da)$_{ι}$

LH H LH H*+L

c. $_{ι}$($_{φ}$(nire lagunen alabia)$_{φ}$ $_{φ}$(umiari biberoya emóten)$_{φ}$ jun da)$_{ι}$

(44b) contains an initial LH rise at the left edge of the sentence, a lexical H*L accent on the verb, and a high plateau extending between them. The absence of any instances of LH rise at the left edge of the noun phrases that intervene indicates that all this material is contained within a single minimal φ. For some speakers, though, the presence of two or more words in the subject noun phrase favors the appearance of a corresponding φ, as seen in (44c), while the remaining single-noun arguments of the verb are grouped with it into a second φ[50]. Such cases show that a purely phonological property like the absence of a lexical pitch accent can have an effect on the establishment of φ-domains and can lead to cases of substantial divergence from the phonological domain structure predicted by interface Match Phrase constraints.

A possible explanation for the violation of Match(Phrase, φ) and Match(φ, Phrase) seen in representations like (44bc), where syntactic phrases lacking lexical pitch accents may fail to get prosodically parsed as φ-domains, would make crucial appeal to a prosodic markedness constraint, as suggested by Elordieta 2007a[51]. The assumption here is that this constraint is No Toneless φ-Stress (cf. (39a)). Lekeitio Basque does not allow pitch accent epenthesis onto the main stress of any φ; Elordieta suggests this follows from a high ranked constraint requiring faithfulness to lexical pitch accent representations,. Given this lack of tonal epenthesis, any lexically unaccented word which bears main stress of φ would incur a violation of No Toneless φ-Stress at the surface. The pressure to introduce φ-level stress comes from the combination of Match(Phrase, φ), which calls

for the presence of φ, and ProsProm(φ), which calls for the φ to contain a stress prominence. But if No Toneless φ-Stress were ranked higher than Match (Phrase, φ) and ProsProm(φ), a syntactic phrase consisting of unaccented words would not be allowed to correspond to a φ in surface representation and would not contain any φ-level stress that would fall on a syllable that does not bear a tonal accent. This ranking would produce the representation in (44b). Of course, the existence of variation in the prosodic structure of sentences like those in (44a), shows that this particular constraint ranking is not the whole story. Elordieta 1998 observes that, as seen in (44c), when an all-unaccented syntactic phrase contains two or more words, some speakers prefer to render the phrase as a φ. A full analysis of the prosodic structure of unaccented phrases is beyond the scope of this chapter and will have to await further research. But these facts do nonetheless testify to the role for nonsyntactic factors in the determining the phonological domain structure of the sentence in Lekeitio Basque, as Elordieta points out.

A second case which Elordieta offers of phonology-induced nonisomorphism between syntactic constituents and phonological domains in Lekeitio Basque involves sentences in which an initial syntactic constituent is not "heavy" enough, and as a consequence forms part of a φ that includes the following syntactic phrase of the sentence, thereby creating a violation of Match (φ, Phrase). In sentence (45a), for example, Match (Phrase, φ) would predict that each of the single-word noun phrases found there should have the status of a φ, as in (45b). All these φ would be maximal, i.e. dominated directly by an ι. Upwards pitch reset is therefore expected at the left edge of each medial noun phrase. But the facts turn out to be different. (45a) is pronounced with a pattern of downstep and upward pitch reset that would be derived on the basis of the prosodic structure in (45c), but not on the basis of the predicted φ-domain structure in (45b)[52].

(45) a. $_{clause}$[$_{DP}$[Amáiak]$_{DP}$ $_{DP}$[amumári]$_{DP}$ $_{DP}$[liburúa]$_{DP}$ emon dotzo]$_{clause}$
Amaya-erg grandmother-dat book-abs give aux

'Amaya has given the book to the grandmother.'

b. *$_{\iota}$($_{\varphi}$(Amáiak)$_{\varphi}$ $_{\varphi}$(↑amumári)$_{\varphi}$ $_{\varphi}$(↑liburúa)$_{\varphi}$ ⇓ emon dotzo)$_{\iota}$
subject dative object direct object

c. $_{\iota}$($_{\varphi}$(Amáiak ↓amumári)$_{\varphi}$ $_{\varphi}$(↑liburúa)$_{\varphi}$ ⇓ emon dotzo)$_{\iota}$
subject dative object direct object

In the hypothesized prosodic structure in (45c), a maximal φ groups together the subject and dative object; this deprives the dative object of maximal φ status and the upward pitch reset that appears at the left edge of a maximal φ. Instead, the φ-structure in (45c) subjects the dative object to the downstepping found after an accent within a φ. Note that the downstepping pattern seen in (45c) is identical to that which is found with the syntactic structure in (43b), in which the φ that groups together the first two nouns of the sentence does correspond to a syntactic constituent. Clearly, Match Phrase is not responsible for generating the superordinate maximal φ in the case of (45c). This is a case of nonisomorphism between syntactic and prosodic constituency which must have its source in phonological constraints.

A further example where the first syntactic phrase of the sentence is not "heavy" enough is provided by sentences like (46), in which an initial one-word syntactic phrase is followed by a two-word phrase:

(46) a. $_{DP}$[Amumári] $_{DP}$[Amáyen liburúa] emon dotzat

grandmother-dat Amaya-gen book-abs give aux

'I have given Amaya's book to the grandmother.'

b. *$_{\iota}$($_{\varphi}$(Amumári)$_{\varphi}$ $_{\varphi}$(↑Amáyen ↓liburúa)$_{\varphi}$ ⇓ emon dotzat)$_{\iota}$

c. $_{\iota}$($_{\varphi}$(Amumári $_{\varphi}$(↓Amáyen ↓liburúa)$_{\varphi}$)$_{\varphi}$ ⇓ emon dotzat)$_{\iota}$

The expected φ-domain structure and consequent pattern of downstep and upward reset is as in (46b). But (46c) shows the actual downstepping pattern attested. Indeed, the experiment results of Elordieta 2006/2007c show that the downstepping pattern exhibited for (46) is not different from the pattern exhibited for the three-word subject in (42).

In sum, the facts discussed thus far seem to suggest that a prosodic markedness constraint requires that the initial maximal φ within an ι-domain be binary, namely that this φ branch into two ω; this analysis is proposed in Elordieta 1998 and Gussenhoven 2004. Respect for this constraint produces prosodic structures like those in (45c) and (46c) in which the initial maximal φ corresponds to no syntactic constituent in the input. Yet the experimental investigation reported in Elordieta 2006/2007c shows that mere prosodic word binarity is still not enough: initial syntactic phrases consisting of unaccented noun plus accented noun-- namely $_{\varphi}$(U$_{\omega}$ A$_{\omega}$)$_{\varphi}$-- are not heavy enough to stand on their own as an ι-domain-initial maximal φ either. Reworded in terms of the Ito and Mester theory of prosodic category types, Elordieta's proposal is that there is a prosodic markedness constraint which requires that an ι-initial maximal φ must branch into two φ[53], not simply into two ω.

Summing up, Lekeitio Basque illustrates a role for a broad range of phonological constraints which, together in a constraint ranking with syntactic-prosodic constituency correspondence constraints, define the phonological domain structure of a sentence. An ideal of prosodic binarity comes into play in accounting for the last array of facts discussed. The restriction of this binarity constraint to initial position of the ι-domain is in some way reminiscent of the left-edge-specific Strong Start constraints alluded to above. As for the tone-stress markedness constraints that are hypothesized to account for the effects of presence or absence of lexical accent on phonological phrasing patterns, in the analysis suggested, they crucially join with ProsProm markedness constraints that call for any prosodic constituent to carry a main stress or head prominence and faithfulness constraints on the tonal representation. Thus in Lekeitio Basque, markedness constraints on tone, binarity and stress in prosodic structure all contribute to defining a φ-domain structure that may be at odds with the syntactic structure of the sentence.

3.3 Summary

Evidence has been reviewed here that shows a role for properly phonological constraints as part of a theory of the phonological domain structure of the sentence. It supports the conclusion that influences on the phonological domain structure of a sentence are highly modular; it cannot be accounted for by the theory of syntax alone. Rather, a simple theory of the correspondence between syntactic constituency and prosodic constituency posits a set of universal Match correspondence constraints. These interact in language-particular rankings with phonological constraints of the sort reviewed above to produce a prosodic constituent structure for a sentence which matches up, to greater or lesser degree according to that constraint ranking, with the syntactic constituent structure of the sentence. The defining of the phonological domain structure of a sentence is in this sense a true syntax-phonology interface phenomenon, with contributions from the theory of syntactic representation, the theory of phonological representation, and the theory of the correspondence relation between the two.

***Acknowledgments**

Research for this article was provided in part by NSF grant #BCS-0004038 to Elisabeth Selkirk. I have benefitted from input from innumerable colleagues and students over the years, and only most recently and directly by interaction with Laura Downing and Annie Rialland in the context of their grant BANTUPSYN (funded through the CNRS-ARN/DFG French/German collaboration), as well as with Gorka Elordieta. I regret that the full list is too long to include; the already exceeds reasonable space limits.

[Manuscript completed Fall 2009, to appear in John Goldsmith, Jason Riggle and Alan Yu, eds. *The Handbook of Phonological Theory*, 2nd edition. Blackwell][54]

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[1] For useful reviews on issues related to the spellout of morphosyntactic features, see Embick and Noyer 2007, Elordieta 2007d and Wolf 2008. Phonological properties associated with the information structure features marking focus, givenness, topic and the like are considered here to be cases of morphosyntactic feature spellout and are not examined in this chapter, except in passing (see section 3.3).

[2] Much of this latter area is the traditional domain of the field of syntax. A role for phonological factors in determining some aspects of word order, including those that involve the distribution of focus, has been advocated by Inkelas and Zec 1990, Reinhart 1995, Zubizarreta 1998, Szendroi 2001, Arregi 2002, Samek-Lodovici 2005, Richards 2009, among others.

[3] The theory of the syntax-phonology interface reviewed in Truckenbrodt 2006 forms part of the set of "mixed theories", in the sense that it countenances both an independent prosodic structure over which phonological and phonetic phenomena

are defined, and a direct appeal to syntactic constituency representation on the part of the phrase-stress-assigning principle Stress XP. An alternative view, of course, is that phrase stress is assigned only indirectly on the basis of syntax, on the prosodic phrasal constituent domains that are themselves defined with respect to syntax.

[4] Selkirk 1974 reports that only consonants forming part of an inflectional ending make liaison between a word that is head of a phrase and a vowel-initial word at the beginning of the phrasal complement that follows. In pre-head contexts, liaison is not so restricted. Pak 2006 presents data showing that the surface prosodic constituents revealed by intonational patterns in French cannot provide the context for liaison and argues instead that liaison is introduced in the process of morphosyntactic spellout, independent of prosodic domain (see also Pak 2008).

[5] This useful term is due to Ito and Mester 2009. A level skipping configuration constitutes a violation of the phonological constraint Exhaustivity in the Selkirk 1996 proposal decomposing the stricter layer hypothesis into a number of distinct constraints on prosodic domination. Of these, Exhaustivity and Nonrecursivity are violable.

[6] For example, the notion that recursivity is a systematic property of prosodic domain structures--contra the strict layer hypothesis—has been emerging with particular force in recent years (see Ladd 1986 et seq, Selkirk 1996, Frota 2000, Dobashi 2003, Féry and Truckenbrodt 2005, Wagner 2005, 2007, Ito and Mester 2007, 2009). Section 2.4 addresses the significance of these findings for current theories of the interface.

[7] Section 2.3 provides a reanalysis of certain cases that have been assumed to show nonisomorphism that is brought on by satisfying syntactic-prosodic constituency correspondence constraints.

[8] Section 2.2.2 presents Match theory as a type of correspondence theory in the sense of McCarthy and Prince 1995, and distinguishes two versions of correspondence constraint, one requiring that a designated syntactic constituent have a corresponding prosodic constituent in phonological representation and another requiring that a surface prosodic constituent correspond to a constituent in syntactic representation.

[9] Proposals in the context of minimalist phase theory include Dobashi 2003, Revithiadou and Spyropoulos 2005, 2008, Adger 2006, Selkirk 2006, Ishihara 2007, Kratzer and Selkirk 2007, among others)

[10] The term domain that is used in this chapter refers to an abstract constituent structure that controls the phonological and phonetic interpretation of the sentence. It is not identified with any particular aspect of tonal or segmental representation. The notion of domain introduced in Kisseberth 1994 and developed in Cassimjee and Kisseberth 1998 concerns the representation of tone, and is designed, in part, to supplant the autosegmental representation of tone and tonal spreading. This chapter draws on the generalizations about the relation between tonal domains (= tonal spreading) and constituency-related domains that have been brought to light in Kisseberth 1994.

[11] It's plausible that penult lengthening is in fact a reflex of penultimate stress prominence assigned on the ι-domain, in which case the phenomenon that is ι-domain-sensitive would be stress assignment, not lengthening. This issue can't be decided here.

[12] The transcription of Xitsonga examples is from Kisseberth 1994, as are the translations. The illustrative glosses which accompany certain of the examples have been supplied by one of the editors of this volume.

[13] The exclamation point in the examples in (6) and below indicates that the high tone on the following syllable is downstepped. Downstep appears when a high tone is preceded by another, distinct, high tone in the same domain. In (6ab), the H of the HL sequence on *â* triggers downstep of what follows; in (6cd) the downstepping in *tí-ho:m!ú* is due to the H tone that spread onto the first syllable of the word from the preceding verb.

[14] See Downing (to appear) on an alternative approach to explaining the asymmetry between right and left dislocation structures in Bantu.

[15] Kisseberth [K153] reports that high tone spread from the first word to the second within a noun phrase is also blocked from spreading onto the final syllable of the noun phrase, e.g. [xoná xi-ambalo]$_{NP}$ > (xoná xí-ámbálo)$_{\varphi}$. This is expected, since a multi-word noun phrase will always correspond to a φ, and so Nonfinality (φ, H) will do the blocking at the right edge.

[16] The formulation of H-Spread here expresses the marked status of a configuration in which a H tone associated to a syllable to the left fails to spread onto a toneless syllable on the right.

[17] This maintenance of final lexical H is predicted if Nonfinality(φ, H) is ranked lower than the anti-deletion faithfulness constraint MaxTone (cf. McCarthy and Prince 1995). As for the permissibility of high tone spread onto lexically toneless syllables, it implies the ranking of H-Spread above whatever faithfulness constraint that disallows tone-syllable associations that are not part of underlying representation.

[18] Note that this shows that H-Spread must dominate the constraint Nonfinality(ω, H), which holds at the level of prosodic word. See section 2.1.3.

[19] It is not the presence of other, lexical, tones in the object noun phrase in (13ii) that explains the lack of high tone spread. The OCP does block high tone from spreading to a syllable that is adjacent to a lexical high tone but the (c) example shows that H tone can in principle spread from the verb into a following single-noun object that has lexical tone, as long as one syllable intervenes between the two H.

a.	ndzi-vóná xí-xlámbétwá:na	'I see a cooking pot.'
b.	ndzi-vóná ma-k!ó:ti	'I see vultures.'
c.	ndzi-vóná vá-la:l!á	'I see enemies.'

[20] There is evidence that high tone does not spread from a subject into a following verb phrase, even when the verb phrase consists of just a single verb. The examples all involve 1st or 2nd person subject pronouns, since only these can be followed by a subject agreement prefix on the verb that is toneless, and thus capable in principle of showing the effects of high tone spread from the subject, e.g. *hiná h-a-hle:ka* 'as for us, we are laughing' [K153]. The fact is that the final H tone on the pronoun *hiná* does not spread onto the verb; this shows that the verb phrase must be preceded by a left φ-edge. And this also shows that in the case of verb phrase the binarity constraints no φ-domain seen with noun phrase are not observed: a VP will correspond to a φ regardless of whether it contains more than word or not. No attempt is made here to account for lack of binarity effect.

[21] Other formal characterizations of this type of edge-sensitivee constraint would be required if a Kisseberth-inspired tonal-domain-based representation of H tone spreading span were assumed. In any case, what's to be ruled out is a configuration where a H tone feature spreads across, or a H tone domain includes, the edge of a constituent domain (cf. footnote 9).

[22] Section 2.2.1 articulates a Match theory as a theory of constituent faithfulness and expresses the Match constraints as correspondence constraints (McCarthy and Prince 1995). The formulation Match (Phrase, φ) given here is a syntactic-prosodic structure correspondence constraint calling for any phrase in syntactic representation (the input) to have a corresponding φ in phonological representation (the output). It is not violated by an output φ which does not have an correspondent in the input syntactic representation.

[23] This theory of phonological phrasing makes the typological prediction the ranking of Match (Phrase, φ) and BinMin(φ, ω) might be reversed in the grammar of some other language, in which case, all phrases would be parsed as φ, regardless of their internal word count. Among the Bantu languages, ChiMwi:ni, to be discussed below in section 2.3, is a language of this sort.

[24] It's conceivable that Constraint X here is the prosodic markedness constraint Strong Start, cf. section 3.1.2.

[25] These tableaux only indicate input-output violations of Match correspondence constraints, though output-input violations are in general relevant too. See 2.2.1.

[26] We still have to contend with the fact mentioned in footnote 18 that a single-word VP will be parsed as a φ, in violation of BinMin(φ,ω). A possible solution would lie in distinguishing more than one type of Match Phrase constraint, with the one relevant to VP ranked above BinMin(φ,ω). See relevant discussion in section 2.2.2.

[27] In addition, the marking of syntactic constituents for information structure properties like contrastive focus, discourse-givenness and topic-hood may also, whether directly or indirectly, have an influence on the prosodic phrasing structure of a language. See section 3.3 for a brief treatment of this question, and Gordon et al 2007 for a collection of papers documenting such effects.

[28] Evidence that CrispEdgeL(ι,H) is active in Xitsonga comes from the set of left dislocation examples in (7). A lexical final H tone does not spread from a preposed NP onto a toneless subject or other preposed NP that follows. Since these following phrases contain just a single word, they do not count as φ, and so it can't be CrispEdgeL(φ,H) that's blocking H-Spread here. Rather, the blocking is due to the left edge of the ι-domain that follows the lexical final H, more specifically to the ranking of CrispEdgeL(ι,H) over H-Spread.

[29] The OCP is another family of constraints that should be expected to show language-particular ranking with respect to H-Spread. As Myers 1997 has shown with evidence from Bantu, two H tones in sequence constitute an OCP violation only when they are associated to adjacent syllables. Data from Xitsonga shows that the notion 'adjacent syllable' must be relativized to prosodic domains. Kisseberth shows that H-Spread may spread to the final syllable of a verb even if the following single-word direct object noun begins with a lexical H tone. According to the present analysis, these H tones belong to different ω. So ω-internal syllable adjacency is permitted. But as we saw in footnote 17,

H-Spread does not allow spreading from a verb into a following noun and onto a syllable adjacent to lexical tone further to the right in the noun. This would create a ω-internal configuration consisting of two adjacent H-toned syllables. Defining a set of OCP constraints specific to the distinct prosodic category types and allowing various rankings of H-Spread amongst them predicts a typology of OCP adjacency effects across languages. Xitsonga must have the ranking OCP(ω, H) >> H-Spread >> OCP(φ, H).

[30] In phase theory (Chomsky 2001), the TnsP that is complement to Comp constitutes the Spell-Out domain of the CP phase.

[31] A recent formulation of a Lexical Category Constraint that accomplishes this is in Truckenbrodt 1999, 2006

[32] (The ν head introduces the subject argument in its Specifier position.)

[33] The representation of φ-domain structure in (22c) is the *minimal* strictly layered φ-domain analysis that is consistent with Align-R(XP, φ), not the only one. Also consistent with Align-R(XP,φ) would be φ-domain structure in which the verb stands on its own as a φ, as in the ungrammatical (22e), which would wrongly predict presence of a pitch accent and possibility of realization of underlying vowel length in the verb.

(22e) $*_{\varphi}(\text{ verb })_{\varphi}\,{}_{\varphi}(\text{ NP })_{\varphi}\,{}_{\varphi}(\text{ conj NP })_{\varphi}$

In an optimality theoretic account, some additional constraint- yet to be determined-- would be required to rule out this non-optimal non-minimal candidate.

[34] It is in fact the combination of the S-P correspondence constraint Match(XP, φ) and the P-S correspondence constraint Match(φ, XP) which predicts the φ-domain structure in (22d). Match(XP, φ) alone would allow for the parsing of the verb as a φ, as in (22f):

(22f) $*_{\varphi}(\,{}_{\varphi}(\text{ verb })_{\varphi}\,{}_{\varphi}(\text{ NP })_{\varphi}\,{}_{\varphi}(\text{ conj NP })_{\varphi}\,)_{\varphi}$

But assignment of φ-domain status to the verb, which lacks XP status here, is ruled out by Match(φ, XP), which requires that any φ in the surface phonological representation correspond to an XP in syntactic constituent structure.

[35] Féry (to appear) proposes a Match XP account of these same cases in German, with the same assumptions about the prosodic phonology of stress and pitch accenting. Kratzer and Selkirk 2007, building on the Kahnemuyipour 2004 phase-based theory of German stress, propose a version of Match theory which derives the desired prosodic phonology (φ-domains, main φ-stress and pitch accenting) in (28c), as well as that on intransitive verbs in all-new sentences in German in function of their position in the Spell-Out domain of a phasal head.

There is a certain variability in the accenting of the verb in all-new sentences in German. A slightly less common verb, e.g. *untersucht* 'investigates' in the same context might show an accent. In such a case, like the preceding XP arguments, the verb would carry the φ-level stress that gets a pitch accent and would have the status of a φ. A violation of Match(φ, XP) is brought about in such cases. For this violation to come about, whatever constraint it is that calls for this optional prominence on the verb would have to be higher ranked than Match(φ,XP). An interesting question for future research is just what the nature of that constraint would be.

[36] Note that the Wrap XP/Align-R XP combination is satisfied by either the level-skipping recursive φ-structure of (26d), where the verb is not a φ itself, or by a sequential φ-structure within the higher φ that contains the VP in which the verb and object XP are also both parsed as a φ. The latter, non-minimal, recursive structure would have to be ruled out by some additional constraint. Cf. footnote 31.

[37] In all cases, these are the *minimal* φ-domain structures that satisfy the constraints at issue, namely Wrap XP, Align XP and Nonrecursivity. Cf. footnote 31.

[38] Truckenbrodt proposes that, in general, the higher node produced as a consequence of an adjunction operation, e.g. by right dislocation of YP, as in $[\ XP\ YP]_{XP}$, is not visible to syntactic-prosodic correspondence constraints like Wrap XP. This assumption explains why the internal φ-domains appear the prosodic structure of the dislocated examples in (32b) and (33b), for example. The same assumption will be made for Match Phrase.

[39]Clearly, some phonological markedness constraint calling for the presence of a tone at a prosodic constituent edge of the appropriate level must be responsible for the epenthesis of phrasal edge tones in cases like these. See (39) for analogous markedness constraints governing the relation between tone and prosodic stress prominence.

[40] McCarthy and Prince 1993 propose an alignment of PWd and Ft to account for the initial dactyl effect, but this doesn't generalize to the cases below.

[41] Truckenbrodt (2006) proposes a constraint Stress XP whose role is to account for the presence of main phrase stress within syntactic phrases. But Stress XP is redundant in a theory of grammar that also posits a syntactic-prosodic constituency correspondence constraint like Match (XP, φ) and a set of prosodic structure markedness constraints like ProsProm(π) that call for prosodic constituents in general, and in particular φ, to contain a prosodic stress prominence.

[42] This epenthesis can be seen as a phonological enhancement of abstract prosodic stress prominence (see Smith 2005 on positional markedness).

[43]These constraints can be seen as a generalization of the original autosegmental wellformedness constraints (i) "A tone-bearing unit must be associated with some tone" and (ii) "A tone must be associated to some tone-bearing unit" (Goldsmith 1976), on the assumption that tone-bearing units correspond to the class of prosodically defined prominences, ranging from mora *tout court* to mora that is the head prominence of a prosodic phrase.

[44] The maintenance in surface forms of the distinction between lexically accented and unaccented words implies, of course, that a faithfulness constraint against epenthesis of tone must outrank the markedness constraint No Toneless π-stress, which would call for the epenthesis of tonal accent in the lexically unaccented case.

[45] Alternatively, the limitation of one pitch accent per phrase could be the result of a constraint simply stipulating that a minimal φ (= minor phrase or accentual phrase) contain at most one pitch accent (cf. Selkirk 2000, Gussenhoven 2004). But it is more interesting, theoretically, to attempt to explain such facts in the context of a general autosegmental theory of the relation between tones and tone-bearing units. The notion tone-bearing-unit (cf. Goldsmith 1976) is generalized here in being based on local prosodic prominence, whether the tone-bearing-unit is defined (within the syllable) as a

moraic segment, or on higher domains as a moraic segment which bears in addition some higher level of prosodic prominence. See Hellmuth 2007 for a development of this idea.

[46] In contrast to Tokyo Japanese, in Lekeitio Basque this contrast appears only in singular forms; plural nouns are always accented. Also, in Lekeitio Basque the lexical pitch accent always appears on the penultimate syllable in the word, regardless of the morpheme of origin in the word. Tokyo Japanese verbs and adjectives whose roots are lexically accented show this penultimate positioning of accent, but nouns do not.

[47] These generalizations are expressed by Elordieta 1997 et seq using the term 'accentual phrase' to identify the relevant prosodic constituent type. The term 'minimal φ' used here refers to the same prosodic constituent.

[48] All examples here are either from the cited Elordieta 1997 et seq, or from Elordieta directly (personal communication).

[49] Experimental studies of comparable Japanese sentences which contain a sequence of wholly unaccented noun phrases have not shown a tendency for unaccented arguments of the verb to join into a same φ (Selkirk, Shinya and Sugahara 2003, Selkirk, Shinya and Kawahara 2004).

[50] Examples like (44c) reveal the presence of a H boundary tone appearing at the right edge of a φ. This predictable boundary H is not observed when a word carrying H*L pitch accent ends the φ, in which case the L is associated to the φ-final syllable. Epenthesis of a boundary H is avoided in that case, presumably to avoid the creation of a contour tone and still maintain the L.

[51] Elordieta 2007a suggests a role for a constraint with the effect of No Toneless φ-stress in his optimality theoretic account of the resistance of unaccented words to the bearing of the prosodic prominence associated with contrastive Focus.

[52] Comparable facts are not reported for Tokyo Japanese, see e.g. Pierrehumbert and Beckman 1988, Selkirk and Tateishi 1991, Kubozono 1993, Ishihara 2008.

[53] Elordieta sees this as a type of positional markedness constraint, see Smith 2002, 2005. (His own formulation is an intonational-phrase-initial intermediate phrase must dominate two distinct accentual phrases.)

REFERENCES

Adger, David. 2007. Stress and phasal syntax. *Linguistic Analysis* 33:238-266.

Anderson, Stephen. 1984. Kwakw'ala Syntax and the Government/Binding Theory. In *The Syntax of Native American Languages*, eds. E.-D. Cook and Donna Gerdts, 21-75. New York: Academic Press.

Arregi, Karlos. 2002. *Focus on Basque Movements,* Ph.D dissertation, Linguistics and Philosophy, MIT.

Beckman, Mary, and Pierrehumbert, Janet. 1986. Intonational structure in English and Japanese. *Phonology Yearbook* 3:255-310.

Boas, Franz. 1947. Grammar of Kwakiutl (With a Glossary of the Suffixes). *Transactions of the American Philosophical Society* 37:201–377.

Calhoun, Sasha. 2006. *Information structure and the prosodic structure of English: a probabilistic relationship*, Ph.D. dissertation, Linguistics, University of Edinburgh.

Cassimjee, Farida, and Kisseberth, Charles. 1998. Optimal Domains Theory and Bantu Tonology: A Case Study from Isixhosa and Shingasidja. In *Theoretical Aspects of Bantu Tone*, eds. Larry Hyman and Charles Kisseberth, 33–132. Stanford, California: CSLI.

Chen, Matthew. 1987. The syntax of Xiamen tone sandhi. *Phonology Yearbook* 4:109-150.

Chomsky, Noam, and Halle, Morris. 1968. *The Sound Pattern of English*. New York: Harper and Row.

Chomsky, Noam. 2001. Derivation by phase. In *Ken Hale: A Life in Language*, ed. Michael Kenstowicz, 1-52. Cambridge, MA: The MIT Press.

Cinque, Gugliemo. 1993. A null theory of phrase and compound stress. *Linguistic Inquiry* 24:239-297.

Clements, George N. 1978. Tone and Syntax in Ewe. In *Elements of Tone, Stress, and Intonation*, ed. D.J. Napoli, 21-99. Washington, D.C: Georgetown University Press.

Cooper, William E., and Paccia-Cooper, Jeanne. 1980. *Syntax and Speech*. Cambridge MA: Harvard University Press.

D'Imperio, Mariapaola, Elordieta, Gorka, Frota, Sonia, Prieto, Pilar, and Vigário, Marina. 2005. Intonational Phrasing in Romance: The role of prosodic and syntactic structure. In *Prosodies*, eds. Sonia Frota, Marina Vigário and M.J. Freitas, 59-97.

Berlin: Mouton de Gruyter.

de Lacy, Paul. 2003. Constraint universality and prosodic phrasing in Māori. In *Papers in Optimality II*, eds. Angela Carpenter, Andries Coetzee and Paul de Lacy, 59-79. Amherst MA: GLSA Publications.

Dehé, Nicole. 2009. Clausal parentheticals, intonational phrasing, and prosodic theory. *Journal of Linguistics* 45:569-615.

Delais-Roussarie, Elisabeth. 1995. *Pour une approche parallèle de la structure prosodique: Etude de l'organisation prosodique et rythmique de la phrase française,* Thèse de Doctorat, Université de Toulouse - Le Mirail.

Dobashi, Yoshihito. 2003. *Phonological phrasing and syntactic derivation.* Ph.D. dissertation., Linguistics, Cornell University.

Downing, Bruce. 1970. *Syntactic structure and phonological phrasing in English*. Ph.D. dissertation, Linguistics, University of Texas at Austin.

Downing, Bruce. 1973. Parenthetical rules and obligatory phrasing. *Papers in Linguistics* 6:108-128.

Downing, Laura. to appear. The Prosody of 'Dislocation' in Selected Bantu Languages *Manuscript submitted and under review, Zentrum für Allgemeine Sprachwissenschaft, Berlin*.

Elfner, Emily. To appear. The interaction of linearization and prosody: Evidence from pronoun postposing in Irish. In *Formal Approaches to Celtic Linguistics*, ed. Andrew Carnie. Cambridge: Cambridge Scholars Publishing.

Elordieta, Gorka. 1997. Accent, tone and intonation in Lekeitio Basque
. In *Issues in the Phonology and Morphology of the Major Iberian Languages*, eds. F. Martínez-Giland and A. Morales-Front, 4-78. Washington, DC: Georgetown University Press.

Elordieta, Gorka. 1998. Intonation in a pitch-accent dialect of Basque. *International Journal of Basque Linguistics and Philology* 32:511-569.

Elordieta, Gorka, Frota, Sónia, Prieto, Pilar, and Vigário, Marina. 2003. Effects of constituent length and syntactic branching on intonational phrasing in Ibero-Romance. In *Proceedings of the 15th International Congress of Phonetic Sciences*, eds. M.J. Solé, D. Recasens and I. Romero, 487-490. Barcelona: Universitata Autònoma de Barcelona.

Elordieta, Gorka, Frota, Sonia, and Vigário, Marina. 2005. Subjects, objects and intonational phrasing in Spanish and Portuguese. *Studia Linguistica* 59:110-143.

Elordieta, Gorka. 2006. Binarity at the left edge of Intonational Phrases. Paper presented

at *GLOW Workshop on Prosodic Phrasing, April 2006*, Universitat Autònoma de Barcelona.

Elordieta, Gorka. 2007a. A Constraint-based Analysis of restrictions on intonational realization of focus in Northern Bizkaian Basque. In *Tones and Tunes I: Typological Studies in Word and Sentence Prosody*, eds. Tomas Riad and Carlos Gussenhoven, 199-232. Berlin: Mouton de Gruyter.

Elordieta, Gorka. 2007b. Constraints on intonational prominence of focalized constituents. In *Topic and Focus: Cross-Linguistic Perspectives on Meaning and Intonation*, eds. Chungmin Lee, Matthew Gordon and Daniel Büring. Dordrecht: Springer.

Elordieta, Gorka. 2007d. Segmental Phonology and Syntactic Structure. In *The Oxford Handbook of Linguistic Interfaces*, eds. Gillian Ramchand and Charles Reiss, 125-178. Oxford: Oxford University Press.

Elordieta, Gorka. 2007c. Minimum size constraints on intermediate phrases. *Proceedings of the 16th International Congress of Phonetic Sciences (Saarbrucken)*:1021-1024.

Embick, David, and Noyer, Rolf. 2007. Distributed Morphology and the Syntax-Morphology Interface. In *The Oxford Handbook of Linguistic Interfaces*, eds. Gillian Ramchand and Charles Reiss, 289-324. Oxford: Oxford University Press.

Emonds, Joseph. 1976. *A transformational approach to English syntax*. New York: Academic Press.

Fougeron, Cécile, and Keating, Pat. 1997. Articulatory strengthening at edges of prosodic domains. *Journal of the Acoustical Society of America* 106:3728-3740.

Frota, Sonia. 2000. *Prosody and focus in European Portuguese: Phonological phrasing and intonation*: Outstanding dissertations in linguistics. New York, London: Garland Publishing Co.

Féry, Caroline, and Truckenbrodt, Hubert. 2005. Sisterhood and tonal scaling. *Studia Linguistica. Special issue: Boundaries in intonational phonology* 59:223-243.

Féry, Caroline, and Samek-Lodovici, Vieri. 2006. Focus projection and prosodic prominence in nested foci. *Language* 82:131-150.

Féry, Caroline, and Schubö, Fabian. 2008. Hierarchical prosodic structures in the intonation of syntactically recursive sentences. Ms. University of Potsdam.

Féry, Caroline. to appear. German sentence accents and embedded prosodic phrases. *Lingua*.

Ghini, Mirco. 1993. Φ-formation in Italian: A new proposal. *Toronto Working Papers in Linguistics* 12:41-78.

Goldsmith, John A. 1976. *Autosegmental Phonology.* Ph.D. dissertation, Linguistics, MIT.

Gussenhoven, Carlos. 2004. *The phonology of tone and intonation*. Cambridge: Cambridge University Press.

Hale, Kenneth, and Selkirk, Elisabeth. 1987. Government and Tonal Phrasing in Papago. *Phonology Yearbook* 4:151-183.

Harford, Carolyn, and Demuth, Katherine. 1999. Prosody outranks syntax: An Optimality approach to subject inversion in Bantu relatives. *Linguistic Analysis* 29:47-68.

Hayes, Bruce. 1989. The prosodic hierarchy in meter. In *Rhythm and Meter*, eds. Paul Kiparsky and Gilbert Youmans, 201-260. Orlando, FL: Academic Press.

Hayes, Bruce, and Lahiri, Aditi. 1991. Bengali intonational phonology. *Natural Language and Linguistic Theory* 9:47-96.

Hayes, Bruce. 1995. *Metrical stress theory: Principles and case studies*. Chicago: Chicago University Press.

Hellmuth, Sam. 2007. The relation between prosodic structure and pitch accent distribution: Evidence from Egyptian Arabic. *The Linguistic Review* 24:291-316.

Hyman, Larry. 2006. Word-prosodic typology. *Phonology* 23:225-258.

Inkelas, Sharon. 1988. Prosodic constraints on syntax: Hausa fa. In *Proceedings of the Seventh West Coast Conference on Formal Linguistics*, ed. Hagit Borer. Palo Alto CA: Stanford Linguistics Association.

Inkelas, Sharon. 1990. *Prosodic Constituency in the Lexicon.*: Outstanding Dissertations in Linguistics Series. New York: Garland Publishing Co.

Inkelas, Sharon, and Zec, Draga. 1990a. Prosodically constrained syntax. In *The phonology-syntax connection*, eds. Sharon Inkelas and Draga Zec. Chicago: University of Chicago Press.

Inkelas, Sharon, and Zec, Draga. 1995. The Phonology/Syntax Interface. In *Handbook of Phonological Theory*, ed. John A. Goldsmith. Oxford: Blackwell Publishing.

Inkelas, Sharon, and Zec, Draga eds. 1990b. *The phonology-syntax connection*. Chicago: University of Chicago Press.

Ishihara, Shin. 2007. Major Phrase, Focus Intonation, Multiple Spell-Out. *The Linguistic Review* 24:137-167.

Ishihara, Shin. 2008. Japanese downstep revisited. Manuscript, University of Potsdam.

Ito, Junko, and Mester, Armin. 1992/2003. Weak Layering and word binarity. In *A new*

century of phonology and phonological theory: A festschrift for Professor Shosuke Haraguchi on the occasion of his 60th birthday, eds. Takeru Honma, Masao Okasaki, Toshiyuki Tabata and Shin-ichi Tanaka, 26-65. Tokyo: Kaitakusha.

Ito, Junko, and Mester, Armin. 1999. Realignment. In *The Prosody-Morphology Interface*, eds. René Kager, Harry van der Hulst and Wim Zonnefeld. Cambridge: Cambridge University Press.

Ito, Junko, and Mester, Armin. 2006. Prosodic Adjunction in Japanese Compounds. Paper presented at *Formal Approaches to Japanese Linguistics 4*, Osaka.

Ito, Junko, and Mester, Armin. 2007. Categories and projections in prosodic structure. In *OCP4 [Old World Conference in Phonology]*. Rhodes, Greece.

Ito, Junko, and Mester, Armin. 2009. Trimming the prosodic hierarchy. In *Prosody matters: Essays in honor of Elisabeth Selkirk*, eds. Toni Borowsky, Shigeto Kawahara, Takahito Shinya and Mariko Sugahara. London: Equinox Publishers.

Jun, Sun-Ah, and Elordieta, Gorka. 1997. Intonational structure of Lekeitio Basque. In *Intonation: Theory, Model and Applications*, eds. Atonis Botinis, Giorgios Kouroupetroglou and George Carayiannis, 193-196. Athens.

Jun, Sun-Ah. 2005. Prosodic typology. In *Prosodic typology: The phonology of intonation and phrasing*, ed. Sun-Ah Jun, 430-458. Oxford, New York: Oxford University Press.

Kahnemuyipour, Arsalan. 2003. Syntactic Categories and Persian Stress. *Natural Language and Linguistic Theory* 21:333-379.

Kahnemuyipour, Arsalan. 2004. *The syntax of sentential stress,* Ph.D. dissertation, Linguistics, University of Toronto.

Kahnemuyipour, Arsalan. 2009. *The Syntax of Sentential Stress*. Oxford: Oxford University Press.

Kaisse, Ellen. 1985. *Connected speech: the interaction of syntax and phonology*. New York: Academic Press.

Kan, Seda. 2009. Prosodic domains and the syntax-phonology interface in Turkish, M.A. thesis, Linguistics, Bogazici University.

Kawahara, Shigeto, and Shinya, Takahito. 2008. The intonation of gapping and coordination in Japanese; Evidence for Intonational Phrase and Utterance. *Phonetica* 65:62-105.

Kawahara, Shigeto. to appear. The intonation of parentheticals in Japanese. In *Prosody matters: Essays in honor of Elisabeth Selkirk*, eds. Toni Borowsky, Shigeto

Kawahara, Takahito Shinya and Mariko Sugahara. London: Equinox.

Kisseberth, Charles, and Abasheikh, Mohammed. 1974. Vowel length in Chi-Mwi:ni:—a case study of the role of grammar in phonology. In *Papers from the parasession on Natural Phonology*, eds. R. IM. W. la Galy, A. Fox and A. Bruck: Chicago Lingustics Society.

Kisseberth, Charles. 1994. On domains. In *Perspectives in Phonology*, eds. Jennifer Cole and Charles Kisseberth, 133-166. Stanford, CA: CSLI Publications.

Kisseberth, Charles. 2005. Accent and phrasing in Chimwiini. In *Proceedings of the Symposium Cross-Linguistic Studies of Tonal Phenomena: Historical Development, Phonetics of Tone abd Descriptive Studies*, ed. Shigeki Kaji, 129-145. Tokyo: Tokyo University of Foreign Studies. Research ILCAA.

Kratzer, Angelika, and Selkirk, Elisabeth. 2007. Phase theory and prosodic spellout: The case of verbs. *The Linguistic Review* 24.

Kubozono, Haruo. 1988. *The organisation of Japanese prosody*, Ph.D. dissertation, Linguistics, University of Edinburgh.

Kubozono, Haruo. 1989. Syntactic and rhythmic effects on downstep in Japanese. *Phonology* 6:39-67.

Kubozono, Haruo. 1993. *The organization of Japanese prosody*. Tokyo: Kurosio.

Kubozono, Haruo. 2007. Focus and intonation in Japanese. In *Interdisciplinary Studies on Information Structure 9: Proceedings of the 2nd Workshop on Prosody, Syntax and Information Structure*, ed. Shin Ishihara. Potsdam: University of Potsdam.

Ladd, D. Robert. 1980. *The structure on intonational meaning: evidence from English*. Bloomington IN: Indiana University Press.

Ladd, D. Robert. 1988. Declination 'Reset' and the hierarchical organization of utterances. *Journal of the Acoustical Society of America* 84:538-544.

Ladd, D. Robert. 1996. *Intonational Phonology*. Cambridge: Cambridge University Press.

Ladd, D. Robert. 2008. *Intonational phonology*. Cambridge: Cambridge University Press.

Ladd, D. Robert. 1986. Intonational phrasing: the case for recursive prosodic structure. *Phonology Yearbook* 3:311-340.

Lee, Chung-min, Gordon, Matthew, and Büring, Daniel eds. 2007. *Topic and Focus: Crosslinguistic Perspectives on Intonation and Meaning*. *Studies in Linguistics and Philosophy*. Dordrecht: Springer.

Lehiste, Ilse. 1973. Rhythmic units and syntactic units in production and perception. *Journal of the Acoustical Society of America* 54:1228-1234.

Liberman, Mark, and Prince, Alan. 1977. On stress and linguistic rhythm. *Linguistic Inquiry* 8:249-336.

McCarthy, John, and Prince, Alan. 1993. Prosodic morphology: Constraint interaction and satisfaction, 48-1201: Rutgers Optimality Archive.

McCarthy, John, and Prince, Alan. 1995. Faithfulness and reduplicative identity. In *Papers in Optimality Theory*, eds. Jill Beckman, Laura Walsh Dickey and Suzanne Urbanczyk: University of Massachusetts Working Papers in Linguistics (UMOP) 18.

McCarthy, John. 2003. OT constraints are categorical. *Phonology* 20:75-138.

McCawley, James. 1968. *The Phonological Component of a Grammar of Japanese*. The Hague: Mouton.

Myers, Scott. 1997. OCP effects in Optimality Theory. *Natural Language and Linguistic Theory* 15:847-892.

Nagahara, Hiroyuki. 1994. *Phonological phrasing in Japanese*. Ph.D. dissertation, Linguistics, UCLA.

Nespor, Marina, and Vogel, Irene. 1982. Prosodic domains of external sandhi rules. In *The Structure of Phonological Representations.*, eds. Harry v.d. Hulst and Neil Smith, 224-255. Dordrecht: Foris.

Nespor, Marina, and Vogel, Irene. 1986. *Prosodic phonology*. Dordrecht: Foris Publications.

Odden, David. 1987. Kimatuumbi phrasal phonology. *Phonology yearbook* 4:13-36.

Odden, David. 1990. Syntax, lexical rules and postlexical rules in Kimatuumbi. In *The Phonology-Syntax Connection*, eds. Sharon Inkelas and Draga Zec, 259-277. Chicago: The University of Chicago Press.

Odden, David. 1994. Syntactic and semantic conditions in Kikongo phrasal phonology. In *Perspectives in Phonology*, eds. Jennifer Cole and Charles Kisseberth, 167-202. Stanford CA: CSLI.

Odden, David. 1996. *The Phonology and Morphology of Kimatuumbi*: The Phonology of the World's Languages. Oxford: Clarendon Press.

Odden, David. 2000. The Phrasal Tonology of Zinza. *Journal of African Languages and Linguistics* 21:45-75.

Pak, Marjorie, and Friesner, Michael. 2006. French phrasal phonology in a derivational model of PF. In *Proceedings of NELS 36*, ed. Christopher Davis et al, 430-449. Amherst MA: GLSA Publications.

Pak, Marjorie. 2008. *The postsyntactic derivation and its phonological reflexes*, Ph.D. dissertation, Linguistics, University of Pennsylvania.

Parker, Steve. 1999. On the behavior of definite articles in Chamicuro. *Language* 75:552-562.

Peperkamp, Sharon. 1997. *Prosodic Words*: HIL dissertation series 34. The Hague: Holland Academic Graphics.

Pierrehumbert, Janet. 1980. The phonology and phonetics of English intonation, Linguistics, MIT.

Pierrehumbert, Janet, and Beckman, Mary. 1988. *Japanese Tone Structure*. Cambridge MA: The MIT Press.

Poser, William. 1984. *The Phonetics and Phonology of Tone and Intonation in Japanese*, Ph.D. dissertation, Linguistics, MIT.

Potts, Christopher. 2005. *The logic of conventional implicatures*. Oxford, New York: Oxford University Press.

Prieto, Pilar. 1997. Prosodic Manifestation of Syntactic Structure in Catalan. In *Issues in the Phonology of the Iberian Languages*, eds. Fernando Martínez-Gil and Alfonso Morales-Front, 179-199. Washigton D.C.
: Georgetown University Press.

Prieto, Pilar. 2005. Syntactic and eurhythmic constraints on phrasing decisions. *Studia Linguistica (Special issue: Boundaries in Intonational Phonology, ed. by Merle Horne and Marc van Oostendorp)* 59:194-222.

Prince, Alan. 1983. Relating to the grid. *Linguistic Inquiry* 14:19-100.

Reinhart, Tanya. 1995. Interface strategies. *OTS Working Papers in Theoretical Linguistics*:55-109.

Reinhart, Tanya. 2006. *Interface Strategies: Optimal and Costly Computations*. Cambrige MA: MIT Press.

Revithiadou, Anthi, and Spyropoulos, Vassili. 2005. The Multiple Spell-Out Hypothesis and the phonological component: Evidence from Greek. Paper presented at *NELS 35*, University of Connecticut.

Revithiadou, Anthi, and Spyropoulos, Vassili. in press?2008. A dynamic approach to the syntax-phonology interface: A case study from Greek. In *InterPhases: Phase-*

theoretic investigations of linguistic interfaces, ed. Kleanthes Grohmann. Oxford: Oxford University Press.

Richards, Norvin. 2009. *Uttering Trees*. Cambridge MA: MIT Press.

Rizzi, Luigi. 1997. The fine structure of the left periphery. In *Elements of grammar: Handbook in generative syntax*, ed. Liliane Haegeman, 75-116. Dordrecht: Kluwer Publishing.

Rochemont, Michael. 1986. *Focus in generative grammar*. Amsterdam and Philadelphia: J. Benjamins Publishing Co.

Rooth, Mats. 1992. A theory of focus interpretation. *Natural Language Semantics* 1:75-116.

Rooth, Mats. 1996. Focus. In *The handbook of contremporary semantic theory*, ed. Shalom Lappin, 271-297. London: Blackwell.

Rotenberg, Joel. 1978. The Syntax of Phonology, Linguistics, MIT.

Samek-Lodovici, Vieri. 2005. Prosody Syntax Interaction in the Expression of Focus. *Natural Language and Linguistic Theory* 23:687-755.

Seidl, Amanda. 2001. *Minimal indirect reference: A theory of the syntax-phonology interface*: Outstanding dissertations in Linguistics. London, New York: Routledge.

Selkirk, Elisabeth. 1972. *The phrase phonology of English and French*. Outstanding dissertations in Linguistics. New York: Garland Publishin Co.

Selkirk, Elisabeth. 1974. French liaison and the X-bar convention. *Linguistic Inquiry* 5:573–590.

Selkirk, Elisabeth. 1978/1981a. On prosodic structure and its relation to syntactic structure. In *Nordic Prosody II: Papers from a symposium*, ed. Thorstein Fretheim, 111-140. Trondheim: TAPIR.

Selkirk, Elisabeth. 1980a. The role of prosodic categories in English word stress. *Linguistic Inquiry* 11:563-605.

Selkirk, Elisabeth. 1980c. Prosodic domains in phonology: Sanskrit revisited. In *Juncture*, eds. Mark Aronoff and Mary-Louise Kean. Saratoga: Anma Libri.

Selkirk, Elisabeth. 1981a. On prosodic structure and its relation to syntactic structure. In *Nordic Prosody II: Papers from a Symposium*, ed. Thorstein Fretheim, 111-140. Trondheim: TAPIR.

Selkirk, Elisabeth. 1981b. The nature of phonological representation. In *The cognitive*

representation of speech, eds. John Anderson, John Laver and Terry Myers, 379-388. Dordrecht: North Holland Publishing Company.

Selkirk, Elisabeth. 1984. *Phonology and syntax: the relation between sound and structure*. Cambridge MA: MIT Press.

Selkirk, Elisabeth. 1986. On derived domains in sentence phonology. *Phonology Yearbook* 3:371-405.

Selkirk, Elisabeth, and Tateishi, Koichi. 1988. Constraints on minor phrase formation in Japanese. In *Proceedings of the 24th annual meeting of the Chicago Lingusitics Society*, eds. M.G. Larson and Diane Brentari, 316-336. Chicago IL: Chicago Linguistics Society.

Selkirk, Elisabeth, and Tateishi, Koichi. 1991. Syntax and downstep in Japanese. In *Interdisciplinary approaches to langauge: Essays in honor of S.-Y. Kuroda*, eds. Carol Georgopoulos and Roberta Ishihara, 519-543. Dordrecht: Kluwer.

Selkirk, Elisabeth. 1995. Sentence prosody: Intonation, stress and phrasing. In *The handbook of phonological theory*, ed. John A. Goldsmith, 550-569. Cambridge MA and Oxford UK: Blackwell.

Selkirk, Elisabeth. 1996. The prosodic structure of function words. In *Signal to syntax: Prosodic bootstrapping from speech to grammar in early acquisition*, eds. James L. Morgan and Katherine Demuth, 187-214. Mahwah, NJ: Lawrence Erlbaum Associates.

Selkirk, Elisabeth. 2000. The interaction of constraints on prosodic phrasing. In *Prosody: Theory and experiments*, ed. Merle Horne, 231-262. Dordrecht: Kluwer.

Selkirk, Elisabeth. 2002. Contrastive focus vs. presentational focus: Prosodic evidence from right node raising in English. In *Speech Prosody 2002: Proceeding sof the 1st International Conference on Speech Prosody*, ed. Bernard Bel and Isabelle Marlien, 643-646. Aix-en-Provence, France.

Selkirk, Elisabeth, Shinya, Takahito, and Sugahara, Mariko. 2003. Degree of lowering in Japanese as a reflex of prosodic structure organization. In *Proceedings of the 15th International Congress of Phonetic Sciences*, 491-494. Barcelona.

Selkirk, Elisabeth, Shinya, Takahito, and Kawahara, Shigeto. 2004. Phonological and phonetic effects of phrase length on F0 in Japanese. In *Proceedings of the second international conference on speech prosody 2004*, eds. Bernard Bel and Isabelle Marlien, 183-186. Nara, Japan.

Selkirk, Elisabeth. 2005. Comments on intonational phrasing. In *Prosodies*, eds. Sonia Frota, Marina Vigario and Maria Joao Freitas, 11-58. Berlin: Mouton de Gruyter.

Selkirk, Elisabeth. 2006. Strong minimalist Spell-Out of prosodic phrases. In *GLOW*

Workshop on Prosodic Phrasing. Universitat Auònoma Barcelona.

Selkirk, Elisabeth. 2007. Focus prominence drives focus phrasing: Bengali intonation revisited. In *Topic and focus: Cross-linguistic perspectives on Intonation and Meaning*, eds. Chung-min Lee, Matthew Gordon and Daniel Büring, 217-246. Dordrecht: Spinger.

Selkirk, Elisabeth. 2008. Contrastive focus, givenness and the unmarked status of "discourse-new". *Acta Linguistica Hungarica* 55:331-346.

Selkirk, Elisabeth. 2009a. On clause and intonational phrase in Japanese: the syntactic grounding of prosodic constituent structure. *Gengo Kenkyu*.

Selkirk, Elisabeth. 2009b. The syntax-phonology interface. In *The Handbook of Phonological Theory*, eds. John Goldsmith, Jason Riggle and Alan Yu. Oxford: Blackwell.

Shattuck-Hufnagel, Stephanie, and Turk, Alice. 1996. A prosody tutorial for investigators of auditory sentence processing. *Journal of Psycholinguistic Research* 25:193-247.

Shinya, Takahito, Selkirk, Elisabeth, and Kawahara, Shigeto. 2004. Rhythmic boost and recursive minor phrase in Japanese. In *Proceedings of the second international conference on speech prosody*, 183-186. Nara, Japan.

Siraj, Pasha. 2008. Intonation in Singaporean English is Stress-Dependent. Paper presented at *Poster presented at Tone and Intonation in Europe 3 (Lisbon)*, Manuscript, UMass Amherst.

Smith, Jennifer. 2002. *Phonological Augmentation in Prominent Positions.* Ph.D. dissertation, Linguistics, University of Massachusetts Amherst.

Szendroi, Kriszta. 2001. *Focus and the syntax-phonology interface.* Ph.D. dissertation, Linguistics, University College London.

Tokizaki, Hisao. 2008. *Syntactic structure and silence: A minimalist theory of syntax-phonology interface*. Tokyo: Hituzi Syobo Publishing.

Truckenbrodt, Hubert. 1995. *Phonological phrases: Their relation to syntax, focus and prominence.* Ph.D. dissertation, Linguistics, MIT.

Truckenbrodt, Hubert. 1999. On the relation between syntactic phrases and phonological phrases. *Linguistic Inquiry* 30:219-256.

Truckenbrodt, Hubert. 2005. A short report on intonation phrase boundaries in German. *Linguistische Berichte* 203:273-296.

Truckenbrodt, Hubert. 2006. The syntx-phonology interface. In *The Cambridge*

Handbook of Phonology, ed. Paul de Lacy, 435-456. Cambridge: Cambridge University Press.

Venditti, Jennifer. 1997? 1995. Japanese ToBI labelling guidelines. *Ohio State Working Papers in Linguistics* 50:127-162.

Venditti, Jennifer. 2005. The J_ToBI model of Japanese intonation. In *Prosodic typology: The phonology of intonation and phrasing*, ed. Sun-Ah Jun, 172-200. Oxford, New York: Oxford University Press.

Venditti, Jennifer, Maekawa, Kikuo, and Beckman, Mary. 2008. Prominence Marking in the Japanese intonation system. In *The Oxford handbook of Japanese linguistics*, eds. Shigeru Miyagawa and Mamoru Saito, 456-512. Oxford, New York: Oxford University Press.

Wagner, Michael. 2005. *Prosody and recursion.* Ph.D. dissertation., Linguistics, MIT.

Wagner, Michael. 2007/to appear. Prosody and recursion in coordinate structures and beyond. *Natural Language and Linguistic Theory*.

Werle, Adam. 2009. *Word, phrase and clitic prosody in Bosnian, Serbian and Croatian*. Ph.D. dissertation., Linguistics, University of Massachusetts Amherst.

Wolf, Matt. 2008. *Optimal Interleaving: Serial Phonology-Morphology Interaction in a Constraint-based Model.* Ph.D. dissertation, Linguistics, University of Massachusetts Amherst.

Yip, Moira. 2002. *Tone*: Cambridge Textbooks in Linguistics. Cambridge: Cambridge University Press.

Zec, Draga. 1999. Footed tones and tonal feet: rhythmic constituency in a pitch accent language. *Phonology* 16:225-264.

Zerbian, Sabine. 2006. *Expression of Information Structure in the Bantu Language Northern Sotho*. Ph.D. dissertation, Humboldt University.

Zerbian, Sabine. 2007. Phonological Phrasing in Northern Sotho 2007 24. *The Linguistic Review* 24.

Zubizarrreta, Maria-Luisa. 1998. *Prosody, focus and word order*. Cambridge MA: MIT Press.