

# 18

## The syntax–phonology interface

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### 18.1 Introduction

Phonological structure is sensitive to syntactic phrase structure. This chapter discusses central aspects of this relation: What elements of the phonological representation are influenced by phrase structure? How are they influenced? How does focus affect prosody? What role does the distinction between lexical and functional elements play? A recurring theme will be the role of syntactic XPs in shaping the important layer of p-phrases in different ways.

Section 18.2 identifies prosodic structure above the word level, including the p-phrase. Section 18.3 reviews evidence for edge-alignment of the p-phrase with syntactic XPs. Section 18.4 discusses the further requirement that XPs be fully contained inside p-phrases. Sections 18.5 and 18.6 seek to connect the literature on prosodic phonology of the preceding sections with the literature on phrasal stress: Section 18.5 identifies the main influence of focus on stress, and Section 18.6 tries to show that the additional influence of syntax on stress is also defined in terms of XPs. Section 18.7 addresses the distinction between lexical and functional projections in the syntax–phonology interface. Section 18.8 discusses eurhythmic influences on prosodic structure. Section 18.9 addresses the dependency of intonation phrases on root clauses. Section 18.10 sums up the results.

### 18.2 The prosodic representation

Syntactic structure influences prosodic structure above the word level. This section identifies the most relevant prosodic constituents involved and introduces important assumptions about their representation.

Since Selkirk's (1980b) modifications of Liberman and Prince (1977) there is a broad consensus that syllables are grouped into *feet* (see Kager Ch.9),

which are in turn grouped into *prosodic words* (or *p-words*). Feet and p-words serve as metrical domains in which stress is assigned at or near an edge. In English, feet are left-prominent ('moraic trochees') and prosodic words are right-prominent, as shown for the words 'Beverly' and 'Alabama' in the boxed parts of the representation in (1). In the bracketed grid representation in (1), the strongest element in each prosodic constituent is marked by an *x* on the same line as that constituent (Hayes 1995; see Halle & Vergnaud 1987 for the original and minimally different suggestion for a bracketed grid representation).

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Of interest in this chapter is the prosodic organization above the p-word. There is a greater diversity of views as to the extension of this representation upward.<sup>1</sup> The synthesis of ideas discussed in this article adopts the view that higher prosodic structure is organized by the same principles as lower prosodic structure: there is a small number of higher prosodic levels, and their prosodic constituents are also metrical constituents in which stress is assigned at or near an edge (Nespor and Vogel 1986, 1989, Hayes and Lahiri 1991). Relevant here are the most well-established of these levels. *Phonological phrases* (or *p-phrases*) relate to syntactic phrases (XPs) such as Noun Phrases (NPs), Verb Phrases (VPs), and Adjective Phrases (AP) (see Truckenbrodt 1999 on this terminology). *Intonation phrase* (or *i-phrase*) refers to prosodic constituents related to syntactic clauses. The hierarchy of levels is often called the *prosodic hierarchy*.

The organization of the prosodic constituents is taken to obey a number of restrictions (Selkirk 1984b, Nespor and Vogel 1986). In Optimality Theory (Prince and Smolensky 2004), some of these have been argued to be violable (Selkirk 1995a). Two important ones are given in (2):

- (2) EXHAUST(IVITY)      Every constituent of level *l* is contained in a constituent of level *l*+1. (Example: every syllable is contained in a foot.)
- NONREC(URSIVITY)      No constituent of level *l* is contained in another constituent of level *l*. (Example: no foot is contained in another foot.)

Thus, an ideal of the organization is that all syllables be parsed into feet, but this constraint is violated by the syllable *ly* and by the syllable *ma* in (1). Across levels, this violable condition is called EXHAUST(IVITY). Another restriction relates to recursive structure. In syntax, a DP may contain another



Tohono O'odham (with modifications noted below – Hale and Selkirk 1987). The left edge of XP aligns with prosodic domains in Shanghai Chinese (Selkirk and Shen 1990), Japanese (Selkirk and Tateishi 1991) and Northern Kyungsang Korean (Kenstowicz and Sohn 1997). The constraints are here called ALIGN-XP,R and ALIGN-XP,L.

- (6) (a) ALIGN-XP,R = ALIGN(XP, R; p-phrase, R)  
“The right edge of each syntactic XP is aligned with the right edge of a p-phrase.”
- (b) ALIGN-XP,L = ALIGN(XP, L; p-phrase, L)  
“The left edge of each syntactic XP is aligned with the left edge of a p-phrase.”

Selkirk's theory of edge alignment was later generalized to the influential format of Generalized Alignment in McCarthy and Prince (1993a) in Optimality Theory (Prince and Smolensky 2004). Selkirk (1995a) formulated the syntax-prosody alignment constraints as ranked and violable constraints in this format. Both left-alignment and right-alignment are universal in this theory. They are active if they are ranked above the constraint \*P-PHRASE, which in effect minimizes the number of p-phrases (Truckenbrodt 1999); they are inactive if ranked below \*P-PHRASE. An argument for this conception of the alignment requirements is provided by de Lacy (2003a): in parametric accounts a choice has to be made between left- or right-alignment. Māori, however, shows simultaneous alignment of left and right edges of XPs. This can be accounted for by ranking both left- and right-alignment above \*P-PHRASE, but it could not be accounted for by parametric theories of alignment.

## 18.4 Wrapping of XPs

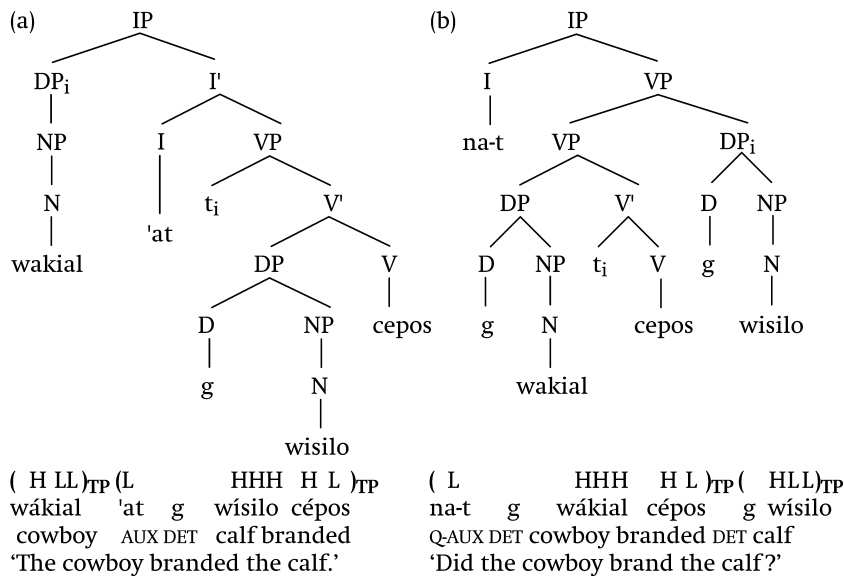
Although Alignment is necessary to account for the interaction of syntax and prosodic structure, it is not enough. This section reviews evidence for a further constraint that seeks to prevent XPs from being split up into multiple p-phrases.

In the Native-American language Tohono O'odham (Hale and Selkirk 1987), *tonal phrases* (here: p-phrases) are bounded on the right by a L(ow) tone. H(igh) tones are found on vowels with word stress and between the first and the last of these word-stresses in the tonal phrase. Remaining vowels at the edges of the tonal phrase carry L tone.

A clause-initial XP such as *wakial* in (7a) is followed by a finite auxiliary. If the initial XP contains lexical material, its right edge regularly coincides with a tonal phrase boundary as in (7a). The language also has a productive process of extraposition. The right edges of XPs are regularly separated from

the extraposed constituent by a tonal phrase boundary. In (7b), such a tonal phrase boundary coincides with the right edge of the lower VP node, preceding the extraposed object.

(7)



However, right-alignment of XPs with p-phrases is not found with arguments of lexical categories in situ. In (7a), there is no tonal phrase boundary following the object, and in (7b), there is no tonal phrase boundary following the subject. Structures like  $\dots ([Subject \ Object \ V]_{VP})_{TP}$  and  $([Possessor \ N]_{NP})_{TP}$  also form a single tonal phrase. Hale and Selkirk (1987) suggest a parameter: in some languages such as Tohono O'odham, lexically governed elements like the object in (7a) and the subject in (7b) are systematically exempt from triggering prosodic boundaries at their right edges.

Building on Hale & Selkirk's proposal, Truckenbrodt (1999) argues that right-alignment of the verb's arguments in (7a,b) is suppressed by another constraint relating to the syntax-phonology mapping, WRAP-XP.

(8) WRAP-XP

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

In (7a,b), the effect of WRAP-XP on the VP is decisive: if the object in (7a) or the subject in (7b) were right-aligned with a p-phrase boundary, the VP would not be contained in a single p-phrase. Following Selkirk (1995a), the constraints mapping between syntax and phonology are taken to be universal constraints of Optimality Theory. In Tohono O'odham, WRAP-XP suppresses ALIGN-XP,R within lexical projections, as shown in (9) for example (7a). Here candidate (9c), with a boundary after the direct object,

is crucially ruled out by WRAP-XP. ALIGN-XP,R still chooses between candidates (9a) and (9b), deriving the boundary after the initial XP. (On the application of WRAP-XP to lexical projections such as VP, but not functional projections such as IP in (7a,b), see Section 18.7.)

(9) *Tohono O'odham*: WRAP-XP » ALIGN-XP,R

	[wakial] <sub>NP1</sub> 'at [g [wisilo] <sub>NP2</sub> cepos] <sub>VP</sub> cowboy AUX DET calf branded	WRAP-XP	ALIGN-XP, R
(a)	( HHH H HHH H L ) <sub>p</sub> wákial 'at g wísilo cépos		*NP2, *NP1!
☞ (b)	( HHL) <sub>p</sub> (L HHH H L ) <sub>p</sub> wákial 'at g wísilo cépos		*NP2
(c)	( HHL) <sub>p</sub> (L HLL) <sub>p</sub> ( H L ) <sub>p</sub> wákial 'at g wísilo cépos	*VP!	

Not all languages show the suppression of boundaries internal to lexical projections. Languages in which Hale and Selkirk's parameter would be set the other way around are analyzed by the opposite ranking of ALIGN-XP and WRAP-XP. Example (5) shows that Xiamen Chinese is such a language. (10) shows how this is derived by ALIGN-XP,R, unimpeded here by the lower-ranked WRAP-XP.

(10) *Xiamen Chinese*: ALIGN-XP,R » WRAP-XP

	[hoo [yin sio-ti] <sub>XP1</sub> [tsit pun ts'eq] <sub>XP</sub> ] <sub>VP</sub> give his brother one CL book	ALIGN-XP,R	WRAP-XP
(a)	(hoo yin sio-ti tsit pun ts'eq) <sub>p</sub>	*XP <sub>1</sub> !	
☞ (b)	(hoo yin sio-ti) <sub>p</sub> (tsit pun ts'eq) <sub>p</sub>		*VP

Two arguments for the constraint WRAP-XP are given in Truckenbrodt (1999). One of them is outlined here.

In the Bantu language Chicheŵa (Kanerva 1989, 1990), the penultimate vowel of a p-phrase is lengthened (vowels are otherwise short) and a number of tonal rules are sensitive to the end of a p-phrase (not detailed here for reasons of space). Constituents preceding the VP such as the subject (and initial topics) are bounded at their right edge by a p-phrase boundary as in (11). The VP is also separated by a following p-phrase boundary from constituents moved to the right. A head and its complement are in the same p-phrase as in (12). As in Tohono O'odham, the right edge of a VP-internal object XP does not trigger a p-phrase-boundary, as shown in (13). This is derived by ranking WRAP-XP above ALIGN-XP, as in Tohono O'odham. ALIGN-XP,R thus inserts a boundary after the initial subject in (11) (and after initial topics, and after the VP before constituents moved to the right). Yet its effect is blocked within VP by WRAP-XP in (13).

- (11) [XP<sub>1</sub> XP<sub>2</sub>]IP/CP [ NP VP ]IP  
 ( )P( )P (kagaálu)<sub>P</sub> (kanáafa)<sub>P</sub>  
 (small) dog died  
 'The (small) dog died.'
- (12) [X<sub>1</sub> XP<sub>2</sub>]XP<sub>1</sub> [ V NP ]VP  
 ( )P (tinabá káluúlu)<sub>P</sub>  
 we-stole hare  
 'We stole the hare.'
- (13) [X<sub>1</sub> XP<sub>2</sub> XP<sub>3</sub>]XP<sub>1</sub> [ V NP [P NP]PP ]VP  
 ( )P (anaményá nyu<sup>m</sup>bá <sup>n</sup>dí mwáála)<sub>P</sub>  
 he-hit house with rock  
 'He hit the house with a rock.'

In Chicheŵa, the interaction with an effect of focus on phrasing leads to additional evidence for this analysis. Focused constituents are followed by a p-phrase boundary, as shown in (14) and (15). As these examples show, the effect of focus overrides WRAP-XP as the effect of focus forces a p-phrase boundary to the right of the focus even within a VP. The effect of focus is captured in a constraint ALIGN-F,R, ranked above WRAP-XP.

- (14) [V<sub>F</sub> NP]VP [What did they do in Mavuto's house?]  
 ( )P( )P (anagóona)<sub>P</sub> (mnyu<sup>m</sup>bá yá mávúuto)<sub>P</sub>  
 'They slept in Mavuto's house.'
- (15) [V NP<sub>F</sub> PP]VP [What did he hit with the rock?]  
 ( )P( )P (anaményá nyuú<sup>m</sup>ba)<sub>P</sub> (<sup>n</sup>dí mwáála)<sub>P</sub>  
 'He hit the house with a rock.'

The crucial case, then, involves focus on a verb that has two objects, as in (16). With the parametric account of Hale and Selkirk, the unfocused case in (13) requires setting the parameter in such a way that lexically governed XPs (such as the first object) do not trigger p-phrase boundaries at their right edges. Consequently, one does not expect a p-phrase boundary at the right edge of the first object when focus is on the verb. Unexpectedly, however, such a p-phrase boundary occurs in this case.

- (16) [V<sub>F</sub> NP PP]VP [What did he do to the house with the rock?]  
 ( )P( )P (anaménya)<sub>P</sub> (nyuú<sup>m</sup>ba)<sub>P</sub> (<sup>n</sup>dí mwáála)<sub>P</sub>  
 'He hit the house with a rock.'
- ↑  
 due to ALIGN-F,R
- ↙ unexpected additional p-phrase boundary

The constraint-based account predicts the presence of this additional boundary as shown in (17). The p-phrase around the VP in (a), preferred by WRAP-XP, is ruled out by ALIGN-F,R which insists on a p-phrase boundary

after the focused verb, as in (b) and (c). Both (b) and (c) violate WRAP-XP. With the possibility of wrapping the VP thus eliminated by the focus effect, the subordinated ALIGN-XP,R makes its effect felt even within the VP. It eliminates (b) and enforces the additional p-phrase boundary after the first object in (c).

(17) *Chichewa*: subordinate ALIGN-XP,R shows an effect where WRAP-XP is ineffective

	[anaményá <sub>F</sub> nyu <sup>m</sup> bá] <sub>XP</sub> [ndí mwáála] <sub>XP</sub> ] <sub>VP</sub>	ALIGN-F,R	WRAP-XP	ALIGN-XP,R
(a)	(anaményá <sub>F</sub> nyu <sup>m</sup> bá ndí mwáála) <sub>P</sub>	*!		*NP
(b)	(anaménya <sub>F</sub> ) <sub>P</sub> (nyu <sup>m</sup> bá ndí mwáála) <sub>P</sub>		*VP	*NP!
☞ (c)	(anaménya <sub>F</sub> ) <sub>P</sub> (nyu <sup>u</sup> m <sub>a</sub> ) <sub>P</sub> (ndí mwáála) <sub>P</sub>		*VP	

This case supports the analysis in which the effect of ALIGN-XP,R is suppressed within lexical projections, but not turned off once and for all in a given language. Where its suppression by WRAP-XP is ineffective, as in the case at hand, the subordinate effect of ALIGN-XP,R can still be seen inside of VP. The reader is referred to Truckenbrodt (1999) for further details of the analysis, and for a further argument for WRAP-XP, in which ALIGN-XP,R and WRAP-XP jointly force recursive p-phrasing in the Bantu language Kimatuumbi.

## 18.5 Stress and focus

In English, Dutch, and German, prosodic structure above the word also shows relations to focus and to syntactic structure. This prosodic structure is manifested in (a) intuitions about stress, be it the strongest stress of a sentence or phrasal stress; (b) providing the anchors for the assignment of tones in intonational analyses in the framework of Pierrehumbert (1980), Beckman and Pierrehumbert (1986) (see Ladd 1996, Gussenhoven 2004, Ch.11); (c) judgments about stress shift which seems to be conditioned by prosodic domains (Hayes 1989b; see also Nespor and Vogel 1989 for Italian); and (d) articulatory phonetic consequences of stressed positions and peripheral positions of prosodic domains (see Fougeron and Keating 1997, Cho 2004 and references there for English, see Cho 2003 for Dutch). I here concentrate on (a), on the assumption that the same prosodic system, or an extension of it, will be able to account for the prosodic structure observed in connection with criteria (b) – (d). This section introduces the main effect of focus on stress; the following section turns to the effect of syntax on stress.

The same sentence can be stressed as [<sub>F</sub> John] likes blueberries or John likes [<sub>F</sub> blueberries]. The former may be an answer to the question *Who likes blueberries?*, the latter an answer to the question *What does John like?*. Since



Jackendoff (1972), the meaning difference between such cases is connected to their stress difference by a feature F, assigned to syntactic constituents. Due to its meaning<sup>5</sup>, F is here assigned to the part of an answer that gives the requested information: the subject [<sub>F</sub> *John*] in the first case, the object [<sub>F</sub> *blueberries*] in the second. If F is a syntactic feature, then its consequences for stress are part of the syntax-phonology mapping. Jackendoff (1972) made a suggestion that is here formulated in two parts. The first part is the mapping constraint (18).

- (18) The strongest stress of the sentence falls inside of the constituent marked F.

Thus the strongest stress of the sentence will correctly fall on [<sub>F</sub> *John*] in the first example used here, and on [<sub>F</sub> *blueberries*] in the second example.

In Truckenbrodt (1995) the perspective is developed that (18) (or a refinement of it) may be the only constraint relating focus to prosodic structure. That perspective excludes the existence of constraints like ALIGN-F,R, employed in connection with Chicheŵa above. Truckenbrodt (1995) shows how this effect can be indirectly derived from (18). (The argument made in connection with (17) is not affected by the difference.) This perspective is explored in Kenstowicz and Sohn (1997), Buring (2001), Selkirk (2002, 2004), and Sugahara (2005).

## 18.6 Stress and XPs

In the examples in (19) F-marking of the information sought for by the question applies to a larger constituent. (18) correctly requires the strongest stress to be within this larger constituent F. Where is stress assigned within this larger constituent? The second part of the suggestion of Jackendoff (1972) is that within the focus, ‘the regular stress rules’ determine the position of the strongest stress of the sentence.

- (19) (a) Who likes blueberries? [<sub>F</sub> *Mary’s brother*] likes blueberries.  
# [<sub>F</sub> *Mary’s* brother] likes blueberries  
(b) Who likes blueberries? [<sub>F</sub> *The brother of Mary*] likes blueberries.  
# [<sub>F</sub> *The brother* of Mary] likes blueberries.  
(c) What did you learn? [<sub>F</sub> *Everyone* likes *blueberries*]

A famous proposal that works well for English is the *Nuclear Stress Rule* (NSR) of Chomsky and Halle (1968). This rule assigns phrasal stress to the rightmost word in a syntactic constituent, and thus correctly to the rightmost words inside of the focus in the examples in (19).

Comparison with German and Dutch showed that the NSR does not work for all languages, and suggested that rules of assigning phrasal stress are

sensitive to the syntactic head–argument relation. It is not easy to distinguish this sensitivity from rightmost stress in English because the complement is regularly the rightmost element in the XP: in (19b) [*brother of Mary*] and (19c) [*. . . likes blueberries*] phrasal stress is in each case rightmost, but it is also on the *complement* of the preceding (nominal or verbal) head. In contrast, in Dutch and German VPs the object precedes the verb and systematically receives the phrasal stress in a larger focus, as in the German examples in (20a). A few postpositions exist in German, and show the same stress-pattern, as in (20b). In NPs (21a) and with prepositions (21b) the head precedes the complement, and stress is again on the complement.

(20)

- |   |   |
|---|---|
| (a) [What does Hans want to do?]        | [What did you do?]  |
| [ <u>Bücher</u> ausleihen] <sub>F</sub> | [Ich habe einen <u>Mechaniker</u> angerufen] <sub>F</sub> |
| books borrow                            | I have a mechanic called                                  |
| ‘to borrow <u>books</u> ’               | ‘I have called a <u>mechanic</u> .’                       |
|   |   |
| (b) [Where did you walk?]               | [Why did you do it?]                                      |
| [den <u>Fluss</u> entlang] <sub>F</sub> | [ <u>Anna-s</u> wegen] <sub>F</sub>                       |
| the river along                         | Anna-GEN because-of                                       |
| ‘along the <u>river</u> ’               | ‘because of <u>Anna</u> ’                                 |

(21)

- |   |  |
|---|--|
| (a) [What did they mourn?]                            | [Who did you meet?]                            |
| [die Zerstörung (von) der <u>Stadt</u> ] <sub>F</sub> | [die Schwester von <u>Peter</u> ] <sub>F</sub> |
| the destruction of the city                           | the sister of Peter                            |
| ‘the destruction of the <u>city</u> ’                 | ‘the sister of <u>Peter</u> ’                  |
|   |  |
| (b) [Where did you walk?]                             | [Why did you do it?]                           |
| [neben dem <u>Fluss</u> ] <sub>F</sub>                | [wegen <u>Anna</u> ] <sub>F</sub>              |
| next-to the river                                     | because-of Anna                                |
| ‘next to the <u>river</u> ’                           | ‘because of <u>Anna</u> ’                      |

This led to new proposals by Gussenhoven (1983a, 1992) and Selkirk (1984b, 1995b), in which reference was made to argument structure in the account of stress. Both Gussenhoven and Selkirk cast their suggestions in terms of the assignment of accents (tones on stressed syllables), rather than in terms of the assignment of stress. Sentences can, and often will, have multiple accents, and so these suggestions introduced a perspective that moved away from the concentration on the strongest stress to an account of all positions of prominence. Consider the German example in (22) from an experiment reported in Truckenbrodt (2002, 2004, to appear). Seven speakers regularly assigned measurable pitch accents in the underlined words in this example and in many other examples like it.

- (22) [Die Nonne] will [der Lola] [in Murnau] [[eine Warnung] geben]  
subject verb indir.obj. adjunct direct object verb  
the nun wants the Lola in Murnau a warning give  
'The nun wants to give Lola a warning in Murnau.'

Here the subject, the indirect and the direct object, as well as the adjunct each carry accent. The element that is shared with (20) and (21), as well as with (19b,c) is that a head (*geben* in (22)) that stands next to an accented argument (*eine Warnung* in (22)) does not carry accent. All this is correctly predicted by the accounts of Selkirk and of Gussenhoven.

The proposal of Selkirk (1984b, 1995b) departs from Jackendoff's perspective, in which the effect of focus and the effect of syntax can be stated independently. Selkirk suggests a mechanism of focus feature percolation that connects the position of accent to the assignment of F. The head–argument structure is given a privileged status in the percolation mechanism, in such a way that a head next to an accented argument need not be accented itself. Other elements, such as heads without accented arguments, adjuncts, and specifiers are not attributed the same percolation privileges and, in all-new sentences, end up having to carry accent. The suggestion of Gussenhoven (1983a, 1992), on the other hand, is in keeping with Jackendoff's perspective, and states the special status of heads next to accented (stressed) arguments directly:

- (23) *Sentence Accent Assignment Rule (SAAR; Gussenhoven 1992)*  
If focused, every predicate, argument, and modifier must be accented, with the exception of a predicate that, discounting unfocused constituents, is adjacent to an argument.

I believe these accounts successfully showed that a complete explanation of stress-assignment (strongest stress and other positions of stress/accents) is most straightforward if two levels are separated: first, the level at which accents are assigned, and at which the SAAR (or the focus percolation mechanism) require accent. Second, the strongest stress of the sentence is simply the last one of these, strengthened by an additional provision as suggested by Uhmann (1991) for German, Hayes and Lahiri (1991) for Bengali, and Selkirk (1995b) for English.<sup>6</sup>

An important prediction of these accounts concerns the difference between arguments and adjuncts, and is illustrated in the English and German examples in (24) and (25) (see also Jacobs 1993, 1999). In all four examples, the object or the adjunct next to the verb is accented by the SAAR. The verb (predicate), however, does not receive phrasal stress next to the accented *arguments* in (24), but does receive accent next to the accented *adjunct* in (25). The resulting argument/adjunct distinction in German is dramatic: while the verb without accent after the argument in (24b) does not qualify for strengthening on the level of the intonation phrase, the verb

with accent after the adjunct in (25b) constitutes the last accent of the intonation phrase, and thus attracts the overall strongest stress. The consequence for English is more subtle, but has been shown to be real in a perception experiment (Gussenhoven 1983b): while there is no obligatory accent on the verb in (24a), there is accent on the verb in (25a), in addition to the accent on the adjunct.

- (24) (a) [What does he do?] He [teaches linguistics]<sub>F</sub>  
(b) [What does he do?] Er soll [Linguistik unterrichten]<sub>F</sub>  
he MODAL linguistics teach  
'He is said to teach linguistics.'
- (25) (a) [What does he do?] He [teaches in Ghana]<sub>F</sub>  
(b) [What does he do?] Er soll [in Ghana unterrichten]<sub>F</sub>  
he MODAL in Ghana teach  
'He is said to teach in Ghana.'

The core cases of Gussenhoven's SAAR and Selkirk's sensitivity of focus percolation to the head-argument relation can be subsumed under a much simpler formulation. I offer the constraint in (26).<sup>7</sup>

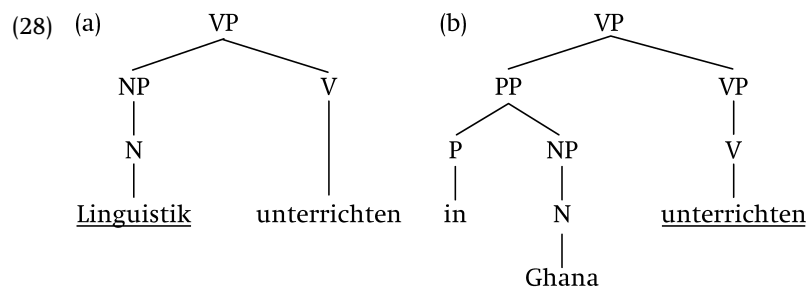
- (26) STRESS-XP  
Each XP must contain a beat of stress on the level of the p-phrase.

In (22), for example, the arguments and the adjunct are each XPs, and thus receive a beat of phrasal stress to satisfy STRESS-XP. (26) works in conjunction with the suggestion of Pierrehumbert 1980 that pitch accents (tones on stressed syllables) in English are assigned to a representation of stress that is independently determined. The strongest stress is then assigned as in (27), similar to the suggestions of Uhmman (1991), Hayes and Lahiri (1991), and Selkirk (1995b).

- (27) On the level of the intonation phrase, the rightmost stress of the level of the p-phrase is strengthened.

Like the account of Xiamen Chinese in terms of ALIGN-XP,R, (26) makes use of syntactic XPs and does not make reference to the relation among nodes (such as whether they are arguments, adjuncts or predicates). Rather, the effect of these relations on the assignment of phrasal stress falls out from the standard syntactic representation of these syntactic relations. To see how, consider the two structures in (28). Arguments of V as in (28a) are standardly represented as syntactic sisters to the V head and daughter to the verb phrase. They are genuinely inside of VP. STRESS-XP requires that the argument contains phrasal stress, since it is an XP (NP in (28a)). STRESS-XP makes no demands on V, which is not an XP. STRESS-XP does require that VP contains phrasal stress. If VP contains a stressed argument, as in (28a), this requirement on VP is fulfilled: the VP contains phrasal stress, located in the argument. There is therefore no need for stressing the verb. On the

other hand, if there is no stressed argument inside of VP, then the requirement of phrasal stress within VP must be satisfied by stressing the verb. Such cases include VPs with no object, such as *Maria* hat [geniest]<sub>VP</sub>, *Mary* has [sneezed]<sub>VP</sub>, or with an unstressable object (see also below), as in *Maria* hat [etwas gesehen]<sub>VP</sub>, *Mary* has [seen something]<sub>VP</sub>. A further case of this kind is (28b). In this standard syntactic representation of adjuncts, the adjunct is not inside of the VP in the same way as the argument. The adjunct is outside of the lower VP node. STRESS-XP requires stress on the adjunct XP, which is assigned. However, this cannot now serve to also satisfy STRESS-XP for the VP, since the adjunct (unlike the argument) is outside of VP, i.e. outside of the lower VP-node in (28b). STRESS-XP requires independent stress in this VP, which can only be assigned on the verb. In other words, the verb needs to be stressed in (28b) because it is itself a syntactic phrase there (i.e. a VP), but it need not be stressed in (28a), because it is not itself a syntactic phrase there.<sup>8</sup>



We have, then, STRESS-XP in (26) and rightmost strengthening in (27) as a good approximation to the English, Dutch and German facts on the location of phrasal stress.

STRESS-XP and ALIGN-XP show considerable overlap in the results they derive. For example, stress on the arguments and adjuncts XPs in (22) could also be derived by (a) right-aligning these XPs with p-phrase boundaries and (b) assigning rightmost stress within the domains thus derived. However, distinctions also exist. ALIGN-XP,R would (on its own) derive identical prosodic structures for (28a) and (28b) (wrongly: (Linguistik)(unterrichten) and correctly: (in Ghana)(unterrichten)). Inversely, STRESS-XP could predict the p-phrase final position of non-sandhi tone in Xiamen Chinese in a variety of cases, including (3), (4) and (5). In Xiamen Chinese, however, a complement that precedes a head is phrased separately from the head (*complement-XP*)(*head*) (see Chen 1987:131). Here ALIGN-XP,R makes the correct prediction, while STRESS-XP would not work without further ado. Other cases in which a replacement of ALIGN-XP with STRESS-XP raises serious questions can be found in the detailed discussion of Shanghai Chinese in Selkirk and Shen (1990). It is still possible that one of ALIGN-XP and STRESS-XP can take on the work of both when interactions with other constraints (such as WRAP-XP or p-phrase-final stress-assignment) are taken into account. The issue is left

open here. What seems to be plausible, however, is that across languages, there is a level of prosodic structure (p-phrases) that is related to syntactic XPs, as captured by the constraints ALIGN-XP, WRAP-XP and STRESS-XP.

## 18.7 The distinction between lexical and functional projections

There is strong evidence that the syntax-phonology interface distinguishes lexical words/lexical projections from function words/functional projections. An important proposal for this difference is due to Selkirk (1995a): it is a general fact, or principle, about the syntax-phonology mapping that the constraints of the mapping, such as ALIGN-XP,R, only apply to lexical categories (here: lexical XPs such as NP and VP) but not to functional categories (here: functionally headed XPs such as DP and CP). The proposal also predicts that STRESS-XP and WRAP-XP apply to lexical XPs but not to functional XPs. The proposal is adopted in Truckenbrodt (1999), where the name *Lexical Category Condition* (LCC) is suggested for a particular formulation of it.

For example, Chen (1987) notes that functional elements such as pronouns do not trigger right-alignment. While a full subject is followed by a tone group boundary (p-phrase boundary) in (3), the pronominal subject is not in (29). Similarly, the first object triggers such a boundary at its right edge in (5), but a pronominal first object does not, as in (30).

(29) [                    ]<sub>DP</sub>  
 yi/lang            sia    k'a    kin  
 (he/someone    write more fast)<sub>TG</sub>    (no internal tone-group boundary)  
 'He/someone writes faster.'

(30) [        [            ]<sub>DP</sub>                    ]<sub>VP</sub>  
 (sang gua/lang    nng opun ts'eq)<sub>TG</sub> (no internal tone-group boundary)  
 give I/someone two CL    book  
 'give me/someone two books'

In the syntactic analysis that has become standard since Abney (1987), pronouns and determiners are both of category D, heading a DP. Pronouns (like intransitive verbs) do not normally have a complement, thus [ *she*<sub>D</sub> ]<sub>DP</sub>. Determiners (like transitive verbs) normally have a complement, an NP, thus [ *the*<sub>D</sub> [ *student*<sub>N</sub> ]<sub>NP</sub> ]<sub>DP</sub>. In this analysis, pronouns like the ones in (29) and (30) are DPs, and thus functionally headed projections. The fact that they do not invoke ALIGN-XP follows from the LCC: Functional projections (such as DP) do not invoke mapping constraints (such as ALIGN-XP).

Selkirk and Shen (1990) argue that prosodic words in Shanghai Chinese are derived by left-alignment with lexical words ( $X^0$ s) while functional words do not trigger prosodic word boundaries. They further argue that

p-phrases are derived by left-alignment with lexically-headed syntactic phrases (XPs), while functional XP projections do not trigger p-phrase boundaries. The phenomenon is found in many other languages as well, and I am not aware of systematic counterexamples.

Pronouns are similarly unstressed by default in English, Dutch, and German. (31) contrasts with (32) and (33): the pronominal subject and object do not receive phrasal stress by default.

(31) [the mayor<sub>NP</sub>]<sub>DP</sub> won their support.

(32) [he]<sub>DP</sub> won their support

(33) [the mayor<sub>NP</sub>]<sub>DP</sub> won [something]<sub>DP</sub>

The LCC correctly predicts that functional XPs do not receive phrasal stress: functional XPs (here: DP) do not invoke the mapping constraints (here: STRESS-XP).

Functional XPs also do not need wrapping (Truckenbrodt 1999). If IP/CP would need wrapping in (7a,b) and (11), this demand would wrongly suppress the p-phrase boundary after the initial XP in these examples, due to the high ranking of WRAP-XP over ALIGN-XP,R in Tohono O’odham and Chicheŵa. Here the LCC correctly predicts that Wrap-XP does not apply to the functional projections IP and CP.

On the account that makes use of the LCC, we have to refine what constituents exactly trigger alignment and stressing in the earlier examples. In (31), for example, the DP constituent that is the subject argument does not literally invoke STRESS-XP: like the subject DP in (32), it is exempt in principle from invoking STRESS-XP. In (31), it is then the lexical NP inside of DP that correctly invokes STRESS-XP. Similar refinements apply to most earlier examples: arguments and adjuncts in these examples attract stress by STRESS-XP and trigger alignment by ALIGN-XP not at the DP-level, but because the NP inside of DP invokes these constraints. Where the DP is present without the NP inside, as with pronouns, STRESS-XP and ALIGN-XP are correctly not applied.

The LCC is not the only approach to the difference between lexical and functional projections. A different proposal comes from the literature on focus. Ladd (1980, 1983a) made the argument that final constituents are *deaccented* if contextually given. Ladd argues that deaccenting does not require the contrastive effect of focus on the element that receives the main stress. This is the ‘givenness effect’: being contextually given alone is enough for deaccenting. In (34), for example, there is no contextual contrast on *like*, yet stress retracts to *like* (relative to the predictions of the NSR or, in the perspective developed here, STRESS-XP) since the final element *Fred* is contextually given.

(34) A: What about Fred?

B: I don’t like Fred.

Interesting examples for deaccenting in non-final positions are discussed in Deemter (1994). Observations like those of Ladd and Deemter have led to refined theories of focus in Selkirk (1995b) and Schwarzschild (1999). In Selkirk (1995b) the focus percolation mechanism mentioned above is integrated with an account of both the givenness effect and the attraction of stress by focus in the more traditional sense of Rooth (1992). (In an account using STRESS-XP in (26), this would have to be replaced by an overriding constraint that prevents the stressing of contextually given elements, in addition to (18).) For discussion of different kinds of givenness, see Baumann and Grice (to appear).

The consequences of the givenness effect for the stressing and phrasing of functional elements have not yet been systematically explored, to the best of the author's knowledge, but they turn out to be remarkable. The cases that are often taken for granted involve definite pronouns as in (32), which have an independent lexical requirement of being contextually given. Satisfaction of this requirement will, in normal cases, lead to their destressing. Indefinite pronouns, as in (33), do not carry such a lexical requirement, yet they can be construed as trivially given in a different sense: *something* can be construed as given in any context that contains anything at all (see the discussion in Schwarzschild 1999:154).

The two accounts, Lexical Category Condition (LCC) and the givenness effect, have a good deal of overlap. For example, both account for the initial intuition that the subject is unaccented in (32). Yet it seems that neither of the two proposals can cover all the territory on its own. An obvious shortcoming of the LCC is that it does not extend to contextually given lexical categories, such as the destressed NP inside of the object in (34) (or, avoiding a proper name, in the similar example *What about the mayor?* I don't like the [*mayor*]<sub>NP</sub>). The LCC alone will also not suffice for pronouns in English. Consider (35). The LCC may explain why the functional DP subject does not require accent here but it cannot account for the stresslessness of the objects on its own: the LCC has only the weak consequence that the functional objects do not require phrasal stress. STRESS-XP still requires stress in the VP, but it is now left open whether this falls on the verb or on the functional object. Since, empirically, stress must fall on the verb (unless the object is narrowly focused), a stronger requirement than the LCC seems to be at work, forcing stress away from the object. Here we must invoke the givenness effect.

- (35) (    x    )                    (                    x                    )  
         He [likes her]<sub>VP</sub>                    Someone [likes someone]<sub>VP</sub>

However, it seems that givenness cannot replace the LCC in all cases. There is a robust generalization in many languages that lexical words form prosodic words while function words do not (Selkirk 1995a). This plays out in an interesting way in interaction with focus in the phrasal



phonology of Xiamen Chinese/Taiwanese as shown in Hsiao (2002). Further, it seems that the application of WRAP-XP to lexical projections like VP in (7a,b) but not functional projections like IP in (7a,b) cannot be reduced to a givenness effect. A further interesting case has been suggested to me by Lisa Selkirk in a review of the present chapter: in the sequence *V NP PP* in English, where NP is given but V and PP are not, a likely phrasing seems to be  $(\underline{V} \text{ NP})(\underline{PP})$ .<sup>9</sup> It seems that the phrase-boundary after the NP must here come from right-alignment with a given constituent, suggesting that givenness does not exempt one from invoking the mapping constraints.

In conclusion, there seems to be evidence for two overlapping but independent factors that may affect functional and lexical elements differently. As proposed by Selkirk, mapping constraints are invoked by lexical syntactic constituents but not by functional syntactic constituents (LCC). Further, as argued by Ladd and others, contextually given elements show an effect of rejecting accent. The latter is not inherently tied to the lexical/functional distinction. However, the anaphoric nature and/or the small content of functional elements will often allow them to be taken as given, in which case deaccenting results.

Interesting issues in connection with the correct account of the behavior of function words and their projection in the mapping are also raised by the detailed studies by Soh (2001) of Shanghai Chinese and Hokkien/Taiwanese and by Zec (2005) of Standard Serbian.

## 18.8 Eurythmic effects on phrasing

The constraints that relate phonological phrases to syntax are not the only ones that influence the shape of p-phrases. They can interact with constraints on preferred size of prosodic constituents and constraints against stress-clash that give rise to eurhythmic preferences. Similar constraints on binarity of feet and even spacing of stress play a crucial role in shaping the stress patterns within words in many languages (see Kager Ch.9).

At the level of the p-phrase they have been found and studied in Romance languages. An early important step in this was the phrasing algorithm of Nespor & Vogel (1986) for Italian. (In Italian, p-phrases and the rightmost stress assigned in them are diagnosed by a number of phonological and phonetic rules sensitive to them.) I begin by relating Nespor and Vogel's algorithm to the discussion in this chapter, since Nespor and Vogel's suggestions approach the issue from a different angle, and have also formed a basis of further insightful work on phrasing in Romance languages (see for example Frascarelli 2000 and Frota 2000). Applied to Italian, the algorithm works as follows. First, general statements of  $\Phi$  domain/ $\Phi$  construction build small p-phrases by grouping a noun together with preceding numerals, determiners and prepositions, an adjective with preceding degree

expressions, and a verb with preceding negation and auxiliaries. A phrasing as resulting from this first step is shown in (36). Second, a rule of  $\Phi$  restructuring allows two small p-phrases to merge into a larger one if the second is the syntactic complement of the first and is not branching. Restructuring of the AP in (36) (taken as a complement of the noun) with the noun *cittá* is blocked, since the AP is branching. In the otherwise similar structure in (37), however, the separate phrasing of the first step (*le cittá*)<sub>P</sub>(*nordiche*)<sub>P</sub> allows restructuring into a larger p-phrase in the second step. The result is as shown in (37). (The accent on *cittá* is orthographic.)

(36) [ [ [ ]<sub>AP</sub>]<sub>NP</sub> ...  
 (Le cittá)<sub>P</sub> (molto nordiche)<sub>P</sub> (non mi piacciono)<sub>P</sub>  
 the cities very Nordic not me please  
 ‘I don't like very Nordic cities.’

(37) [ [ [ ]<sub>AP</sub>]<sub>NP</sub> ...  
 (Le cittá nordiche)<sub>P</sub> (non mi piacciono)<sub>P</sub>  
 the cities Nordic not me please  
 ‘I don't like Nordic cities.’

Ghini (1993) developed a reanalysis of Italian phrasing in terms of ALIGN-XP,R and additional eurhythmic conditions. As his work brings out, the boundaries that would be assigned by ALIGN-XP,R are always also predicted by Nespor and Vogel's algorithm. An example is the p-phrase boundary following the subject in (36) and (37). However, Nespor and Vogel's algorithm assigns additional boundaries between heads and complements, such as the subject-internal boundary in (36), which would not be assigned by ALIGN-XP,R. Ghini (1993) argues that eurhythmic constraints are responsible for these additional divisions. In his account, the branchingness condition of Nespor and Vogel's  $\Phi$  restructuring goes back to a binarity requirement ‘Uniformity and Average Weight’. In Optimality Theory, the idea that the prosodic representation is simultaneously subject to constraints of the interface and to eurhythmic constraints has been developed by Selkirk (2000). Selkirk suggests that in English, ALIGN-XP,R and WRAP-XP are tied in a particular way, and that they interact with a subordinate constraint BINMIN, which requires a minimally binary prosodic length of the Major phrase (here: p-phrase). Selkirk also formulates a constraint BINMAX, which may be employed to capture the main effects of Ghini's ‘Increasing Units’. I use the formulation in (38) in terms of prosodic words, in parallel to Ghini's formulation. For the simple case in (36) the interaction of the constraints may be as shown in (39), following the analysis of a similar case in Brazilian Portuguese in Sandalo and Truckenbrodt (2002). Here the constraint WRAP-XP in subordinate ranking can be seen as an implementation of Ghini's factor ‘Increasing Units’.

- (38) *BINMAX*  
 P-phrases consist of maximally two prosodic words.

(39)

	Le [cittá [molto nordiche] <sub>AP</sub> ] <sub>NP</sub>	ALIGN- XP,R	BIN- MAX	WRAP- XP
(a)	(Le cittá molto nordiche) <sub>P</sub>		*!	
☞ (b)	(Le cittá) <sub>P</sub> (molto nordiche) <sub>P</sub>			* <sub>NP</sub>
(c)	(Le cittá molto) <sub>P</sub> (nordiche) <sub>P</sub>			* <sub>NP</sub> , * <sub>AP</sub> !

Notice that *BINMAX* does not lead to the insertion of a similar p-phrase boundary in the subject in (37), since the subject here is no longer than two prosodic words.

Ghini's perspective, thus implemented in Optimality Theory, has recently been pursued for other Romance languages. Prieto (2005) shows that an impressive range of Catalan patterns of phrasing can be accounted for by an interleaving of *ALIGN-XP,R* and *WRAP-XP* with four eurhythmic constraints. While in Italian *ALIGN-XP,R* seems to be undominated, in Catalan eurhythmic constraints also dominate and override the syntax–phonology mapping constraints. In the interaction of all constraints, *ALIGN-XP,R* and *WRAP-XP* still play a crucial role.

Elordieta, Frota and Vigário (2005) investigate differences in the formation of intonation phrases between Spanish and European Portuguese (also see the following section). They argue that syntax–phonology mapping constraints of alignment and wrapping interact with eurhythmic constraints, with interesting differences between Spanish (preference for *(S)(VO)*) and European Portuguese (preference for *(SVO)*).

An issue that remains in a reanalysis of Nespor and Vogel's algorithm as discussed here is that, in terms of their algorithm,  $\Phi$  restructuring is never obligatory. In other words, a lexical head and its lexical complement, even if they can be, or are preferred to be, phrased together, can also be phrased separately in many languages. In English, for example, though we can have (*He teaches linguistics*), we can also have (*He teaches*) (*linguistics*). It is not clear that mapping constraints are responsible for such optionality. Selkirk (2005) suggests to account for some variability on the level of the intonation phrase (see following section) by allowing the promotion of a lower prosodic constituent (her major phrase) to an intonation phrase. It seems similarly possible that we are here dealing with optional gratuitous promotion of a postlexical prosodic word, such as *he teaches*, to a phonological phrase. Note that such gratuitous promotion is empirically not possible in head-final structures like (20) or (24b), where it would wrongly lead to a shift in the strongest stress to the final head. Thus, gratuitous promotion would be limited either to prenuclear position, or to cases in which it does not reverse relative prominence relations.

## 18.9 Intonation phrases

The position of intonation phrase boundaries shows a good amount of variability. These have been studied in English on the basis of positions of possible pauses within clauses (Selkirk 1984b, Taglicht 1998 and references there) and positions of obligatory pauses (Downing 1970). The detailed and extensive study of Downing (1970) is still relevant today. The core result is that *root clauses, and only these, are bounded by obligatory intonation phrase breaks*. (Root clauses are clauses (CPs) not embedded inside of a higher clause that has a subject and a predicate.) Downing 1970 argues that obligatory pauses separate coordinate root clauses as in (40). Where the coordinate clauses are together embedded as in (41), there is an optional pause as indicated, but not the obligatory pause of interest for the generalization at issue. He also makes this point in regard to (42): in a coherent reading, coordination is at the root level, entailing obligatory pause. If the pause is instead omitted, embedded coordination, and hence a contradictory reading results.

(40) Mary will sing / and Bob will play his banjo.

(41) I hope that Mary will sing (/) and Bob will play his banjo.

(42) Bill believes his father was older than his mother, / and his mother was older than his father.

Downing also argues that certain left-peripheral constituents as in (43) as well as certain right-peripheral elements are separated by obligatory pause (see also Bing 1979). In Downing's analysis, these elements are moved to, or generated in, a position external to the root clause.

(43) John, / he never does anything right.

In the afternoon / everyone went swimming.

In fact / you seem to have put on some weight.

The formation of separate intonation phrases for left- and right-peripheral topics has been established in Italian by Frascarelli (2000). In Italian dialects, the intonation phrase can be diagnosed separately from the p-phrase by different phonological rules.

Downing also analyzes different classes of parentheticals (44), as well as appositive relative clauses and other appositive elements (45), and argues that they are separated by obligatory pauses. In Downing's analysis, they are elements outside of the root clause at an abstract relevant stage of the derivation. Nespor and Vogel (1986) have shown that the intonation phrase boundaries around parentheticals can be demonstrated with the help of the phonological diagnostics for intonation phrase boundaries in Italian.

(44) The operation, / I'm sure, / won't take very long.

(45) The library, / which is a large stone and glass building, / is on the east side of the campus.

The library, / a large stone and glass building, / is on the east side of the campus.

Ladd (1986) has suggested that structures of this kind involve recursive intonation phrases. Frota (2000) has been able to establish this for a case of appositive relative clauses in European Portuguese on the basis of phonological diagnostics.

A recent suggestion for a comprehensive treatment of the interacting factors that govern intonation phrasing can be found in Selkirk (2005). Downing's root clauses are there reanalyzed in terms of the feature [+comma] by Potts (2005), for which Potts provides a semantic/pragmatic interpretation. A different approach to intonation phrases is pursued in Gussenhoven (2004:287ff.) in terms of output-to-output faithfulness. Recent psycholinguistic literature – often working experimentally with intonational cues of intonation phrase boundaries – has investigated the linguistic and contextual conditions under which intonation phrase boundaries are employed and useful for syntactic disambiguation; see Clifton, Carlson and Frazier (2002), Fodor (2002), Kraljic and Brennan (2005), Watson and Gibson (in press) and references therein.

## 18.10 Summary

This chapter has reviewed and presented arguments that (i) prosodic structure – particularly at the p-phrase level – is influenced by syntactic structure; (ii) syntactic XPs play a crucial role in shaping p-phrases; (iii) the forming of p-phrases can be forced by the constraints ALIGN-XP,L/R; (iv) the forming of p-phrases can be blocked by the constraint WRAP-XP; (v) an additional constraint STRESS-XP allows us to understand the assignment of phrasal stress in related terms; (vi) focus affects prosodic structure by attracting stress and in other ways; (vii) the mapping constraints are invoked by lexical XPs but not by functional XPs; (viii) they may interact with eurhythmic constraints; and (ix) root clauses determine positions of obligatory intonation phrase boundaries.

## Notes

Many thanks to Paul de Lacy, Jessica Rett, and Lisa Selkirk for lots of useful comments that helped improve this chapter.

1 Some prominent examples of the diversity of views in this area: Halle and Vergnaud (1987) and Cinque (1993) assume an arbitrary number of levels in the metrical representation; syntax-oriented accounts of

metrical structure like Cinque (1993) and Zubizarreta (1998) are interested in syntax-related stress-generalizations rather than edgemoat placement of stress; Odden (1987b) develops accounts of phrase-level phonology that refer to syntactic structure, without invoking phrasal prosodic constituents; Beckman and Pierrehumbert (1986) name constituents across languages with reference to the phenomena sensitive to them (rather than, as done here, with reference to the syntactic elements that they derive from); many authors who postulate higher prosodic constituents are uncommitted as to whether these also serve as metrical domains.

- 2 See Peperkamp (1997) and Vigário (2003) for prosodic words, Truckenbrodt (1999) and Gussenhoven (2004) for phonological phrases, and Ladd (1986) and Frota (2000) for intonation phrases.
- 3 See Chen (2000) for discussion of the system of tone sandhi that affects the five long tones and the two short tones of this language. Hsiao (2002) has convincingly argued that the Xiamen tone domains are domains of abstract prominence.
- 4 An exception is a class of adjuncts that do not show p-phrase boundaries. Soh (2001) has later argued convincingly for a syntactic analysis of these adjuncts in which they are not exceptions to the general mechanism of right-alignment. Soh however adds a class of exceptions of her own, certain indefinite elements.
- 5 See Rooth (1992) and Schwarzschild (1999) for influential theories of the meaning of focus.
- 6 Some later proposals about sentence stress such as Cinque (1993) and Zubizarreta (1998) do not employ this separation of two levels and concentrate on the position of main stress. See Truckenbrodt (2006) for some more discussion.
- 7 This constraint was originally proposed in Truckenbrodt (1995). In Truckenbrodt (2006), an introduction to phrasal stress, this analysis is motivated in some more detail.
- 8 For a more refined development of the application of mapping-constraints to adjunction structures, see Truckenbrodt (1999); the effect is the same for the case at hand.
- 9 This can be diagnosed in the presence of a H\* pitch accent on V, which is followed by a fall and low valley to the end of the NP, characteristic of the L-phrase accent/edge tone of Beckman and Pierrehumbert (1986).