Second, examples problematic to the strict layer hypothesis are reported by Chen (1987) and Hyman *et al.* (1987). Consider the data in Xiamen, for example:

(57) a. ( ) ( )Intonational Phrase

( ) ( ) ( )Tone Group

lao tsim-a-po m siong-sin ying-ko e kong-we

old lady Neg believe parrot can talk

'The old lady doesn't believe parrots can talk.'

b. ( ) ( ) IP

( ) ( ) ( ) TG

Lim kao-siu si tsit e gian-giu pe-hu gam e tsuan-ka

Lim professor be a Cl investigate skin cancer E specialist

'Professor Lim is a skin cancer specialist.'

Chen argues that in Xiamen intonational phrases and tone groups are not strictly layered in the sense of (49). (57a) and (57b) are cases of multiple domination (50a) which is prohibited by the strict layer hypothesis. In (57a) and (57b) the second tone group is dominated by both the first and the second intonational phrase, which is a violation of (49b).

Third, Ladd (1996:237-240) argues that we should allow the recursion of prosodic categories which is prohibited by the strict layer hypothesis as shown in (50e). He shows the following sentence with prosodic boundaries (|).

(58) | This is the dog | that chased the cat | that killed the rat | that ate the malt | that lay in the house that Jack built |

He observes a weaker boundary between *house* and *that* in (58). He argues that there is no good way to indicate this percept of a weaker boundary under the usual assumptions about prosodic phrasing.

In sum, the prosodic hierarchy theory with the strict layer hypothesis has a number of problems both conceptual and empirical. I will explore an explanation without prosodic categories in the next section, and show how to solve these problems.

3.2.2 Explanation Based on Prosodic Boundaries

We can explain the examples we have looked at in Section 3.2.1 with the bare mapping theory which does not rely on prosodic categories. First, let us reconsider the examples in (51). Assuming that functional categories with no phonetic features and their projections are invisible to the bare mapping rule, the completely bare phrase structures of (51a) and (51b) are (59a) and (59b).

(59) a. [[[Why] [[don't] [[you] [[sell] [Janet]]]]], [[your] [Honour]]]

b. [[Why] [[don't] [[you] [[sell] [[Janet] [[your] [honour]]]]]]]

If we apply the bare mapping rule to (59a) and (59b), the results are (60a) and (60b), respectively.

(60) a. /// why /// don't /// you /// sell // Janet /////// your // Honour ///

b. // why /// don't /// you /// sell /// Janet /// your // honour ///////

If we apply the boundary deletion rule with *n*=3 to (60a) and (60b), then we get (61a) and (61b).

(61) a. why don't you sell Janet //// your Honour (*n*=3) [t j] * [tʃ]

b. why don't you sell Janet your honour //// (*n*=3) [t j] *or* [tʃ]

If we assume that assimilation applies to the representation (61a) and (61b), we can argue that the boundaries between *Janet* and *your* block assimilation in (61a). On the other hand, we can get one intonational contour over the entire sentence as in (51a) and (51b) if we delete seven boundaries between words in (60a) and (60b).

(62) a. why don't you sell Janet your Honour (*n*=7)

b. why don't you sell Janet your honour (*n*=7)

Now in (62a) and (62b) there is no boundary in the sentence to divide the intonational contour into two. Thus we can predict that the whole sentences can be pronounced with one intonational contour L_I H*L H_I as shown in (51a) and (51b).

Next, let us consider (54a) and (54b) above. Their phrase structures are shown in (63a) and (63b).[6]

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[6] I assume that the phrase structure of (54b) is (63b) in which the VP is tertiary branching, and not (i) in which the VP is binary branching (cf. Kayne 1994).

(i) [[Write] [[[your] [name]] [[on] [[this] [envelope]]]]]

If we assume (i) instead of (63b), we get (ii) as the result of mapping.

(63) a. [[Tonight] [[[your] [name]] [[will] [[be] [[on] [[everybody's] [lips]]]]]]]

b. [[Write] [[your] [name]] [[on] [[this] [envelope]]]]

(63a) and (63b) are mapped onto the prosodic structures (64a) and (64b) by the bare mapping rule.

(64) a. // Tonight //// your // name //// will /// be /// on /// everybody's // lips ///////

b. // Write /// your // name //// on /// this // envelope ////

If we apply the boundary deletion rule with *n*=3 to (64a) and (64b), we get (65a) and (65b), respectively.

(65) a. Tonight / your name / will be on everybody's lips //// (*n*=3) [t j] * [tʃ]

b. Write your name / on this envelope / (*n*=3) [t j] *or* [tʃ]

(ii) // Write //// your // name //// on /// this // envelope /////

Then we cannot make difference between (63a) and (i) in the number of brackets and boundaries immediately before *your*. Compare (64b) and (ii). Alternatively we could assume another binary branching structure for (54b) as shown in (iii).

(iii) [[[Write] [[your] [name]]] [[on] [[this] [envelope]]]]

Then the phonological representation would be (iv) where there are fewer boundaries before *your*.

(iv) /// Write /// your // name ///// on /// this // envelope /////

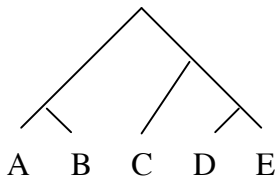
However, the phrase structure of the sentences such as (54b) is still in question. I will leave the matter open here.

In (65a) *your* is separated from *tonight* by a boundary, and in (65b) *your* is adjacent to *write* without no intervening boundary. Thus we correctly predict that assimilation occurs in (65b) but not in (65a).

3.2.3 Deriving the Effects of the Strict Layer Hypothesis

Another advantage of the boundary theory is that we can derive the effects of the strict layer hypothesis from the boundary deletion rule. Let us consider a schematic example (66a) and its prosodic structure (66b).

(66) a. [[[A] [B]] [[C] [[D] [E]]]]



b. /// A // B //// C /// D // E ////

Let us suppose that the boundary deletion rule applies to (66b) with a varying value of *n*. The case of *n*=1 is (67a), *n*=2 (67b), *n*=3 (67c), and *n*=4 (67d).

(67)	a.	// A / B /// C // D / E ///	(*n*=1)	prosodic word
	b.	/ A B // C / D E //	(*n*=2)	phonological phrase
	c.	A B / C D E /	(*n*=3)	intonational phrase
	d.	A B C D E	(*n*=4)	utterance

Then we can think of (67a-d) as the unmarked cases of prosodic categories, ranging from phonological word to utterance, as shown in the right column of (67). For illustration, consider the example (48) above. The phrase structure of (48) is (68a), which is mapped onto the prosodic structure (68b) by the bare mapping rule.

(68) a. [[[In] [Pakistan]] [[Tuesday] [[is] [[a] [holiday]]]]]

b. /// In // Pakistan //// Tuesday /// is /// a // holiday /////

The boundary deletion rule applies to (68b) and deletes *n* boundaries between words. The results are shown in (69a-d).

(69)	a.	In Pakistan Tuesday is a holiday /	(*n*=4) utterance
	b.	In Pakistan / Tuesday is a holiday //	(*n*=3) intonational phrase
	c.	/ In Pakistan // Tuesday / is / a holiday ///	(*n*=2) phonological phrase
	d.	// In / Pakistan /// Tuesday // is // a / holiday ////	(*n*=1) prosodic word

The phrasing patterns Selkirk (1984) shows are (70a-d) (=48).

(70)	a.	(In Pakistan Tuesday is a holiday)	utterance
	b.	(In Pakistan) (Tuesday is a holiday)	intonational phrase
	c.	(In Pakistan) (Tuesday) (is a holiday)	phonological phrase
	d.	(In) (Pakistan) (Tuesday) (is) (a) (holiday)	prosodic word

The phrasing patterns in (69a), (69b), and (69d) correspond to those in (70a), (70b), and (70d), respectively. One might argue that our (69c) is different from Selkirk's (70c) in

that there is a boundary between *is* and *a* in (69c). However, *is* is a function word and is not likely to make an independent phonological phrase. Thus *is* is incorporated into the following phonological phrase together with *a holiday* as in (70c) despite the boundary between *is* and *a* shown in (69c). One might also wonder why *is* is not likely to be incorporated into the preceding phonological phrase together with *Tuesday*, as shown in (71).

(71) ?? (In Pakistan) (Tuesday is) (a holiday).

One possible answer to the question is that the phrasing in (70c) is better than that in (71) because (70c) conforms to the principle of increasing unit proposed by Ghini (1993). In (70c) the third phonological phrase *is a holiday* is longer than the second phonological phrase *Tuesday*. In (71) the second and the third phonological phrases are about the same in length. Thus the theory presented here correctly predicts the phrasing patterns in (70).[7]

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[7] Selkirk (1986:388-389) suggests that prosodic structure could be constructed from silent demibeat structure (cf. Selkirk 1984, Tokizaki 1988).

(i) a. $[_S\ [_{NP}$ fw N $[_{PP}$ fw $[_{NP}$ N]]] $[_{VP}\ [_?$ V $[_{NP}$ N]] $[_{NP}$ N]]]

b. …… **…… *****….. ** *** . *****

c. ( ) ( ) ( ) ( ) ( ) PWd

d. ( ) ( ) ( ) PPh

She suggests that this could be done by making the ends of a particular prosodic constituent coincide with two successive sequences of silent demibeats with matching cardinality of a particular magnitude. However, 'with the hunch in mind', she instead adopts the end-based theory that takes prosodic categories as basic units.

Alternatively, as I mentioned in section 3.1.4, we could argue that the indefinite article *a* is a proclitic which has a boundary only on its left side. Then the phrase structure of (48) is (72a), and the phonological representation is (72b).

(72) a. [[[In] [Pakistan]] [[Tuesday] [[is] [a [holiday]]]]]

b. /// In // Pakistan //// Tuesday /// is // a / holiday /////

The boundary deletion rule with *n*=2 applies to (72b) and gives (73).

(73) / In // Pakistan // Tuesday / is a holiday ///

Thus we can correctly predict the phrasing (70c) by Selkirk.

More problematic is the case of Xiamen mentioned in Section 3.2.1. We have seen that (57) is a counterexample to the strict layer hypothesis. If we are on the right track in

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The bare mapping theory allows us to take the other way. The bare phrase structure of (ia) is (iia) which is mapped onto the prosodic representation (iib). Applying the phrasing rule with *n*=1, 2, and 3, we get (iic, d, e), respectively.

(ii) a. [[[[fw] [N]] [[fw] [N]]] [[[V] [N]] [N]]]

b. //// fw // N //// fw // N ////// V // N /// N ///

c. // fw / N /// fw / N ///// V / N // N // (*n*=1)

d. / fw N // fw N //// V N / N / (*n*=2)

e. fw N / fw N /// V N N (*n*=3)

The predictions in (iic, d, e) are not the same as Selkirk's (ic, d). However, it is still possible to predict the boundaries which block the application of phonological rules.

deriving the hypothesis from the boundary-based theory, how can we explain the reported facts in the language?

Following the idea of derivation by phase with cyclic Spell-Out investigated by Chomsky (1998, 1999), let us assume that the bare mapping rule applies cyclically at each phase level, CP or *v*P. The sentence (57a) has four phase levels and (57b) has only one, as shown in (74a) and (74b).

(74) a. [$_{CP}$ [[lao] [tsim-a-po]] [$_{vP}$ [m [siong-sin]] [$_{CP}$ [ying-ko] [$_{vP}$ [e [kong-we]]]]]
old lady Neg believe parrot can talk
'The old lady doesn't believe parrots can talk.'

b. [$_{CP}$ [[Lim] [kao-siu]] [[si] [[tsit] [e] [[[[gian-giu] [[pe-hu] [gam]]] [e]] [tsuan-ka]]]]]
Lim professor be a Cl investigate skin cancer E specialist
'Professor Lim is a skin cancer specialist.'

Then each phase unit in (74a) is sent to PF in turn as shown in (75).

(75) a. [$_{vP}$ [e [kong-we]]]

b. [ying-ko]

c. [$_{vP}$ [m [siong-sin]]

d. [[lao] [tsim-a-po]]

The brackets are interpreted as phonological boundaries as follows:

(76) a. // e / kong-we ///

b. / ying-ko /

c. // m / siong-sin //

d. // lao // tsim-a-po //

The final result of Spell-Out is the following:

(77) // lao // tsim-a-po // // m / siong-sin // / ying-ko / // e / kong-we ///

Mapping of (74b) is straightforward.

(78) /// Lim // kao-siu //// si /// tsit // e ///// gian-giu /// pe-hu // gam //// e /// tsuan-ka ////

If we apply the boundary deletion rule with n=2 to (77) and (78), we get (79a) and (79b), respectively.

(79) a. / lao tsim-a-po // m siong-sin // ying-ko / e kong-we /// (n=2)

b. / Lim kao-siu // si / tsit e /// gian-giu / pe-hu gam // e / tsuan-ka //// (n=2)

As (79b) has still too many phrases, we should apply the rule with n=3 to (78).

(80) Lim kao-siu / si tsit e // gian-giu pe-hu gam / e tsuan-ka /// (n=3)

Notice that the boundaries between intonational phrases and the boundaries between tone groups in (57) occur complementarily in the positions where prosodic boundaries occur in

(79a) and (79b). In other words, Xiamen expresses syntactic phrase structure through prosodic structure with two types of prosodic phenomena. Prosodic boundaries are reflected either in intonation (lengthening and pause) or in rhythm (tone sandhi).

As for Ladd's (1996) observation on the sentence (58), the boundary-based theory proposed here gives a fresh insight into the problem. The sentence has six phases as shown below:

(81) [$_{CP}$ This is the dog [$_{CP}$ that chased the cat [$_{CP}$ that killed the rat [$_{CP}$ that ate the malt [$_{CP}$ that lay in the house [$_{CP}$ that Jack built]

Merge builds parts of the phrase structure, which is in turn sent to PF in the theory of multiple Spell-Out.

(82) a. [[This] [[is] [[the] [dog]]]]

b. [[that] [[chased] [[the] [cat]]]]

c. [[that] [[killed] [[the] [rat]]]]

d. [[that] [[ate] [[the] [malt]]]]

e. [[that] [[lay] [[in] [[the] [house]]]]]

f. [[that] [[Jack] [built]]]

The mapping rule applies to each of (82a-f) to give the following representations.

(83) a. // This /// is /// the //dog ////

b. // that /// chased /// the // cat ////

c. // that /// killed /// the // rat ////

d. // that /// ate /// the // malt ////

e. // that /// lay /// in /// the // house /////

f. // that /// Jack // built ///

The final representation at PF is (84) when the last phase Spell Out is finished.

(84) // This /// is /// the //dog //// // that /// chased /// the // cat //// // that /// killed /// the // rat //// // that /// ate /// the // malt //// // that /// lay /// in /// the // house ///// // that /// Jack // built ///

In (84) there are no less boundaries between *house* and *that* than the other positions before *that*. Our theory in itself does not predict a weaker boundary between *house* and *that*. If we delete three boundaries between words by the rule (8) (n=3), we get (85).

(85) This is the dog / that chased the cat / that killed the rat / that ate the malt / that lay in the house // that Jack built

However, we may ascribe the observed weakness of the last boundary to Ghini's (1993) principle of increasing unit. The last relative clause *that Jack built* is shorter than the other relative clauses in that it does not contain a direct object or a prepositional phrase. If we separated the last relative clause as an independent prosodic phrase, the short clause would follow the longer ones as shown in (86).

(86) (This is the dog) (that chased the cat) (that killed the rat) (that ate the malt) (that lay in the house) (that Jack built)

This is not a welcomed result. If we make the boundary after *house* weaker, the last (strong) prosodic phrase becomes long enough as shown in (87), where the weak boundaries are shown with italicized brackets.

(87) (This is the dog) (that chased the cat) (that killed the rat) (that ate the malt) (that lay in the house*) (*that Jack built)

Thus, to make the last boundary weaker helps to make well balanced sentence prosody for (87).

3.3 Summary

We have pointed out problems with the prosodic hierarchy theory and have proposed an alternative theory based on prosodic boundaries. An advantage of the theory is that we can avoid the problem of how many prosodic categories are needed. We have seen that we can derive the effects of the strict layer hypothesis from the simple rules of syntax-phonology mapping and prosodic phrasing. I have to admit that the data discussed here are limited and the analysis is not without problems. However, this line of research is fruitful and promising in that the analysis presented here restricts the theory of grammar, especially the syntax-phonology interface.

Chapter 4

Speech Rate and Optional Phrasing

It has been pointed out that some phrasing rules are optional in a number of languages, such as Italian raddoppiamento sintattico, French liaison, and English rhythmic inversion, intonational phrasing, and Mandarin Chinese third tone sandhi. One of the advantages of the bare mapping theory is that it naturally captures the relation between speech rate and optionality of phrasing. In this chapter, I will show that we can explain optional phrasing by changing the value *n* in the boundary deletion rule. I will focus on raddoppiamento sintattico in Italian in Section 4.1 and tone sandhi in Mandarin Chinese in 4.2. In Section 4.3, I will discuss intonational phrasing in English in detail. [1]

4.1 Raddoppiamento Sintattico in Italian

First, let us consider Raddoppiamento Sintattico (RS) in Italian. RS is a rule of central and southern dialects of Italian that lengthens the initial consonant of the second word in a sequence of two words (cf. Nespor and Vogel 1986:38, 166).

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[1] I argued in Tokizaki (1988) that we can explain variable intonational phrasing in English with the rules similar to (3) and (5) in Chapter 2. I assumed there the Invisible Bracket convention, which states that if the node Y exclusively dominates X, X is invisible to the PF mapping rule like (3). The convention is no more necessary if we assume bare phrase structure.

(1) *Perché Carlo* non é venuto? -> Perché [k:]arlo ...
why Carlo NEG is come
'Why didn't Carlo come?'

Nespor and Vogel (1986) argue that phonological phrase is the domain within which RS applies. For example, RS does not apply in the following sentence:

(2) Che c'é un *perché Carlo* lo sa. --- ... perché [k]arlo ...
COMP there-is a reason Carlo it knows
'Carlo knows that there is a reason.'

Then we can represent the prosodic structure of (1) and (2) as follows:

(3) a. [*Perché [k:]arlo*]$_{\phi}$ [non é venuto]$_{\phi}$
b. [Che c'é un *perché*]$_{\phi}$ [*[k]arlo* lo sa]$_{\phi}$

Importantly, the phonological phrasing in (4-6a) can be changed into (4-6b) optionally (Nespor and Vogel 1986:172, cf. Ghini 1993:43), where an underline between words show that RS occurs in that position.

(4) a. [I caribú]$_{\phi}$ [nani]$_{\phi}$ [sono estinti]$_{\phi}$
the caribous dwarf are extinct
'Dwarf caribous are extinct.'
b. [I caribú_nani]$_{\phi}$ [sono estinti]$_{\phi}$

(5) a. [Se prenderá]$_\phi$ [qualcosa]$_\phi$ [prenderá]$_\phi$ [tordi]$_\phi$

if catch(fut) something catch(fut) thrushes

'If he catches something, he will catch thrushes.'

b. [Se prenderá_qualcosa]$_\phi$ [prenderá_tordi]$_\phi$

(6) a. [Ho visto]$_\phi$ [qualche fagiano]$_\phi$ [blu]$_\phi$ [chiaro]$_\phi$

have seen a-few pheasants blue light

'I have seen a few light-blue pheasants.'

b. [Ho visto]$_\phi$ [qualche fagiano]$_\phi$ [blu_chiaro]$_\phi$

Nespor and Vogel argue that the optionality is due to the restructuring of the phonological constituent. They propose the following optional rule for ϕ restructuring (p. 173):

(7) A nonbranching ϕ which is the first complement of X on its recursive side is joined into the ϕ that contains X.

The effect of (7) on phrasing is illustrated in (8).

(8) [... C_W C_S]$_\phi$ [C]$_\phi$ --> [... C_W C_W C_S]$_\phi$

Although Nespor and Vogel explain the optional phrasing in terms of prosodic restructuring, they also note that there are additional factors that play a role in determining whether or not restructuring applies. Among them are speech rate and length. Nespor and Vogel point out that restructuring might turn out to be more frequent in fast speech than in slow speech. Note that the restructuring (7) refers to the nonbranching nature of a phonological constituent. This shows that length also plays a crucial role in determining

the application of RS. However, why can restructuring be applied only to a nonbranching ϕ? Nespor and Vogel's analysis does not give a principled answer to the question. Moreover, there is no way of formalizing the relation between restructuring and speech rate in their analysis.

Let us look at how the bare mapping theory explains the data and the factors affecting prosodic phrasing. Consider the examples in (5). The bare mapping rule we proposed in Chapter 2 maps the bare phrase structure (9a) onto the phonological representation in (9b).

(9) a. $[_{CONJP}\ [_{CONJ'}\ [_{CONJ}$ Se $[_{IP}\ [_{V}$ prenderá$]\ [_{N}$ qualcosa$]]]\ [_{IP}\ [_{V}$ prenderá$]\ [_{N}$ tordi$]]]$

if catch(fut) something catch(fut) thrushes

b. /// Se // prenderá // qualcosa ///// prenderá // tordi ///

Note that Infl and I' are not represented in (9a) on the assumption that phonologically null elements and the constituents made by merging them with other syntactic objects are invisible to the mapping rule (cf. 2.1). It is also assumed that *se* is a proclitic that has a boundary only on its left. If we apply the boundary deletion rule with n=1, we get the following representation:

(10) // Se / prenderá / qualcosa //// prenderá / tordi // (n=1)

Let us assume that the conjunction *se* cannot make a prosodic phrase by itself because it is a monosyllabic clitic. If it is grouped into the next word *prenderá*, then the final result is (11), which gives the right phrasing in (5a).

(11) // Se prenderá / qualcosa //// prenderá / tordi //

If we increase the number of boundaries the deletion rule deletes between words, for example *n*=2, the output of applying the rule to (9b) is (12).

(12) / Se prenderá qualcosa /// prenderá tordi / (*n*=2)

The representation in (12) correctly corresponds to the phrasing in (5b). Remember that in our theory, increasing the number *n* means increasing the speech rate. The representation (12) shows the phrasing pattern when the speaker utters the sentence faster. Thus, we can explain the relation between speech rate and optional phrasing straightforwardly. Similarly, the phrase structure and the mapped representation of (6) is (13a) and (13b), respectively.

(13) a. $[_{IP}\ [_{I}$ Ho $[_{VP}\ [_{V}$ visto$]\ [_{NP}\ [_{N'}\ [_{Q}$ qualche$]\ [_{N}$ fagiano$]]\ [_{AP}\ [_{A}$ blu$]\ [_{Adv}$ chiaro$]]]]]$

b. // Ho // visto //// qualche // fagiano //// blu // chiaro /////

A number of boundaries in (13b) are deleted by the deletion rule. The output is (14a) in the case of *n*=1 and (14b) in the case of *n*=2.

(14) a. / Ho / visto /// qualche / fagiano /// blu / chiaro //// (*n*=1)

b. Ho visto // qualche fagiano // blu chiaro //// (*n*=2)

The boundary between *blu* and *chiaro* in slow speech (14a) is deleted in faster speech (14b). Thus, we can explain the possible RS in the position in (6).[2] The optional phrasing in (4a) and (4b) is explained in the same way.

(15) a. $[_{IP}\ [_{DP}\ [_{D}\ I\ [_{N}$ caribú$]]\ [_{A}$ nani$]]\ [_{VP}\ [_{V}$ sono$]\ [_{A}$ estinti$]]]$

b. /// I / caribú /// nani //// sono // estinti ///

(16) a. / I caribú / nani // sono estinti / (n=2)

b. I caribú nani / sono estinti (n=3)

(16a) and (16b) correctly correspond to (4a) and (4b), respectively. The boundary between *caribú* and *nani* in (16a) is deleted in the faster speech (16b).

4.2 Third Tone Sandhi in Mandarin Chinese

Another example that shows the relation between speech rate and optional phrasing is third tone sandhi in Mandarin Chinese (cf. Cheng 1966: 150). In Mandarin Chinese, if a third tone (ˇ) immediately precedes another third tone, it can be changed into the second tone (ˊ) or flat tone (¯). Robert Cheng (1966:150) argues that third tone sandhi varies

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[2] (14a) is not the same as (6a) in that there is a boundary after *ho* and *qualche*. Perhaps the boundary is ignored in actual speech because of the clitic nature of *ho* and *qualche*. In fact, we cannot exactly tell whether *qualche* and *fagiano* are contained in the same phonological phrase or not because Nespor and Vogel do not mention the possibility of RS on the first consonant of *fagiano*. Since the possibility is not relevant to the discussion here, I will leave the matter open.

according to the speech rate in Mandarin Chinese (cf. 1.3.1). (17b) is slow, (17c) is mid, and (17d) is fast.

(17) a. [$_S$ [$_{NP}$ [$_A$ lǎo] [$_N$ lǐ]] [$_{VP}$ [$_V$ mǎi] [$_{NP}$ [$_A$ měi] [$_N$ jǐu]]]]
old Lee buys good wine

b. [láo lǐ] [mǎi] [méi jǐu]

c. [láo lǐ] [mái mēi jǐu]

d. [láo lǐ māi mēi jǐu]

Cheng cites W. S-Y. Wang's analysis which assumes syntactic closeness. According to Cheng, Wang gives the following phrase structure with the rules and explanations: the numerals 1, 2, and 3 indicate approximately closeness of syntactic relationships from close to remote, which he calls depths of syntactic boundaries.

(18) [$_S$ [$_{NP}$ [$_A$ lǎo] 1 [$_N$ lǐ]] 3 [$_{VP}$ [$_V$ mǎi] 2 [$_{NP}$ [$_A$ měi] 1 [$_N$ jǐu]]]]

a. ˇ --> ˊ / __ ˇ

b. ˊ --> ¯ / [ˊ]__[ ]
[¯]__[ ]

Rule (18a) states that a third tone changes into a second tone when it is followed by a third tone. Rule (18b) states that a second tone changes into a flat tone when it is not final and preceded by a second or flat tone. The observations are the following:

(19) a. In slow speech, Rule (18a) operates only across boundaries of depth 1 to produce the tone sequence ˊˇˇˊˇ.

b. In faster speech, boundaries of depth 2 also cease to block the rules. The result is ˊ ˇ ˊ - ˇ.

c. In rapid speech, all boundaries lose their effect, and the result is ˊ - - - ˇ.

Thus (19) captures the optional phrasing in (17) with the notion of syntactic depth. However, the observations in (19) are nothing but descriptions about the limited data. Also, the definition of syntactic depths is not shown in Cheng (1966). We cannot tell how this analysis explains the other sentences and other degrees of syntactic depths.

This phenomenon of optional tone sandhi is explained naturally in the bare mapping theory by changing the value of variable *n* in the boundary deletion rule. The bare mapping rule spells out (20a) as the phonological representation of (17a). Boundaries in (17a) are deleted by the boundary deletion rule with *n*=2, *n*=3, and *n*=4 to give (20a), (20b), and (20d), respectively.

(20) a. /// lao // li //// mai /// mei // jiu ////

b. / lao li // mai / mei jiu // (*n*=2)

c. lao li / mai mei jiu / (*n*=3)

d. lao li mai mei jiu (*n*=4)

Let us assume that the value *n* is related to the speech rate as well as the level of prosodic categories as we argued in Chapter 3. As the speech becomes faster, the value *n* increases. Thus, we can explain the relation between speech rate and optional phrasing straightforwardly.

Note that if we apply the boundary deletion rule with *n*=1 to (20a), we get a similar representation to Wang's syntactic depths shown in (18).

(21) // lao / li /// mai // mei / jiu ///

The number of boundaries between words in (21) corresponds to the degree of depths in (18). If we show the number instead of boundary sumbol (/), (21) would be (22).

(22) 2 lao 1 li 3 mai 2 mei 1 jiu 3

Then we could think of our theory as a more formal approach to syntactic closeness than Wang's analysis. Our analysis should be preferred because it can give us a better characterization of the relation between speech rate and optional phrasing. Moreover, our analysis of (21) and (22) is different from Wang's (18) in that (21) and (22) have boundaries before and after the sentence. This is an important point when we deal with phonological rules operating across sentences. I will discuss the topic in Chapter 6.

4.3 Variable intonational phrasing in English

This section is concerned with determining the principles and rules by which sentences are divided into intonational phrases (IntP) in English.[3] Downing (1970) argues for the necessity of distinguishing between obligatory and variable intonational phrases. The sentences of (23) (obligatory intonational phrasing) contain two separate constructions, the vocative and the question tag, which, obligatorily, are set off by a pause, as shown in (23).

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[3] I adopt Selkirk's (1984) term 'intonational phrase'. There are many other terms for this phenomenon. such as breath-group, tone-unit, and phonological phrase. See Cruttenden (1986: 35).

(23) a. ($_{IntP}$ John), ($_{IntP}$ you've met Marie), ($_{IntP}$ haven't you)?

b. *($_{IntP}$ John, you've met Marie), ($_{IntP}$ haven't you)?

c. *($_{IntP}$ John), ($_{IntP}$ you've met Marie, haven't you)?

d. *($_{IntP}$ John you've met Marie haven't you)?

On the other hand, the sentences of (24) (variable intonational phrasing) are equally acceptable regardless of which of the three phrasings is chosen:

(24) a. ($_{IntP}$ The boys you met) ($_{IntP}$ are all members) ($_{IntP}$ of the same fraternity).

b. ($_{IntP}$ The boys you met) ($_{IntP}$ are all members of the same fraternity).

c. *($_{IntP}$ The boys you met are all members) ($_{IntP}$ of the same fraternity).

d. ($_{IntP}$ The boys you met are all members of the same fraternity).

(Downing 1970: 14)

The unacceptability of (24c), however, shows that there are rules governing even variable phrasing. In this section, I will concentrate on the latter type, variable intonational phrasing, and investigate the principles and constraints that govern the phenomena.

In section 4.3.1, I will briefly review the previous studies, and show that both syntactic and semantic factors are involved in variable intonational phrasing. In section 4.3.2, I will present an analysis in terms of the bare mapping and boundary deletion.

4.3.1 Previous Studies on Variable Intonational Phrasing

There have been two types of approach in studies of variable intonational phrasing; the syntactic approach (Downing 1970, Selkirk 1978) and the semantic approach (Halliday

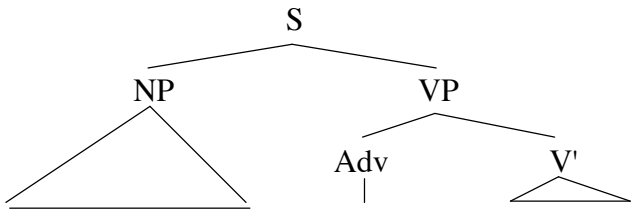
1967, Bing 1979, Selkirk 1984). In this section, I will review Downing (1970) and Bing (1979) and indicate some of the problems they fail to resolve.

First, let us look at Downing's (1970: 14) observation about variable intonational phrasing:

(25) One of these is the principle that in general variable pause occurs at minor constituent breaks only if pause is also present at all major constituent breaks (cf. Bierwisch 1966).

This principle explains the unacceptable phrasing (24c) above, because in (24c) there is a pause within the predicate, but not between the subject and the predicate. This principle also explains the following phrasings (taken from Imai and Nakajima (1978: 469)):

(26)



a. ($_{IntP}$ Two of our horses) ($_{IntP}$ suddenly got restive).

b. *($_{IntP}$ Two of our horses suddenly) ($_{IntP}$ got restive).

The phrasing in (26b) is correctly ruled out by the principle (25). A pause occurs at a minor constituent break, between the adverb and the verb, but there is no pause at the major constituent break, between the subject NP and the VP. These examples show that variable intonational phrasing involves a syntactic factor.

Variable intonational phrasing also involves a semantic factor. Bing (1979: 126) investigates variable intonational phrasing in terms of her Noun Phrase Prominence Principle:[4]

(27) *Noun Phrase Prominence*: A node in metrical structure which corresponds to a node in syntactic structure which is a noun phrase cannot be dominated by any node labeled WEAK except when that node has been destressed because of reference to previous discourse.

Let us compare the following examples:

(28) A: What's happening?
B: ($_{IntP}$ Tom Roeper) ($_{IntP}$ is going to Germany).

(29) A: What's Tom Roeper doing this summer?
B: ($_{IntP}$ As far as I know), ($_{IntP}$ Tom's going to Germany).

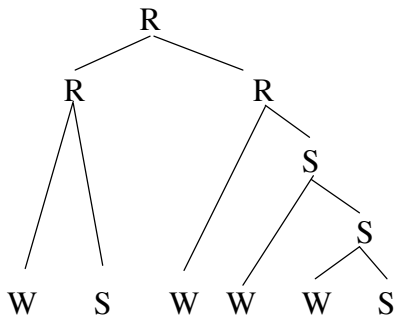
Note that the clause *Tom (Roeper) is going to Germany* is divided into two intonational phrases in (28B), but not in (29B). The NP *Tom Roeper* in (28B) is new information while *Tom* in (29B) is old information. Thus, the Noun Phrase Prominence Principle (27) predicts that the metrical structures of the sentences (28B) and (29B) are (30) and (31), respectively.[5]

---

[4] The page numbers of Bing (1979) indicated here are those of Bing (1985).

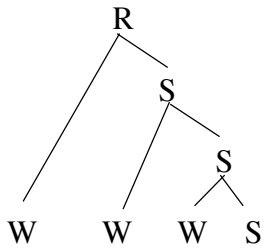
[5] In metrical structures, the node R represents Root, S Strong, and W Weak. See Bing (1979) and Cruttenden (1986: 30).

(30)



Tom Roeper is going to Germany

(31)



Tom's going to Germany (Bing 1979: 129f)

We can regard an R node as an intonational phrase. The whole NP *Tom Roeper* in (30) cannot be dominated by any W and is dominated by another R, because it does not refer to previous discourse. *Tom* in (31), however, has been destressed because of the reference to Tom Roeper in (29A) and is dominated by W. In this way, Bing explains the difference of phrasing between (28B) and (29B).

4.3.2 Problems in the Accounts of Downing (1970) and Bing (1979)

The above review shows that the variable intonational phrasing involves both syntactic and semantic (functional) factors. A syntactic constraint such as Downing's (25) can not therefore explain the phrasing in (30) and (31), because the syntactic structures of these sentences are almost the same. Further, this constraint (25) makes a wrong prediction about the following sentence:

(32) $[_{IP}\ [_{NP}$ Mary$]\ [_{VP}$ took $[_{NP}$ her handkerchief$]\ [_{PP}$ out of her pocket$]]]$

If we apply Downing' s syntactic principle (25) to (32), we will predict a phrasing pause between the subject NP *Mary* and the first word of the predicate VP *took*, as shown in (33a). However, the phrasing in (33a) is far less natural than that in (33b).

(33) a. ?? ($_{IntP}$ Mary) ($_{IntP}$ took her handkerchief out of her pocket).

b. ($_{IntP}$ Mary took her handkerchief) ($_{IntP}$ out of her pocket).

Moreover, (33b) is wrongly ruled out by (25). There is a pause at minor constituent break, between *handkerchief* and *out* even if pause is not present at the major constituent breaks, between *Mary* and *took*. The syntactic constraint cannot capture the fact that the subject NP is short in (32).

On the other hand, a semantic explanation such as Bing's Noun phrase Prominence Principle (27) is not able to predict the unacceptability of (24c) and (26b). This approach, moreover, crucially depends on the somewhat vague notion of New or Old information, and has the weakness that we can not formulate the principle in definite terms.

It is also worth mentioning that neither the syntactic nor the semantic analysis takes the factor of speech rate into account. Consider again the examples in (24), repeated here as (34).

(34) a. ($_{IntP}$ The boys you met) ($_{IntP}$ are all members) ($_{IntP}$ of the same fraternity).

b. ($_{IntP}$ The boys you met) ($_{IntP}$ are all members of the same fraternity).

c. * ($_{IntP}$ The boys you met are all members) ($_{IntP}$ of the same fraternity).

d. ($_{IntP}$ The boys you met are all members of the same fraternity).

(34a) consists of three intonational phrases, (34b) two, and (34d) one. The speech rate is slow in (34a), medium in (34b), and fast in (34d). The relation between phrasing and speech rate seems clear and should be dealt with in any theory of syntax-phonology interface.

I will, in contrast, argue below that variable intonational phrasing can be explained in terms of the bare mapping and boundary deletion, and I will propose a constraint to deal with unacceptable phrasings.

4.3.3 Sense Unit Condition: Selkirk (1984)

Before we move on to the analysis in terms of the bare mapping theory, let us look at another approach to variable intonational phrasing. Selkirk (1984: 286) proposes Sense Unit Condition, shown in (35).[6]

(35) *The Sense Unit Condition on Intonational Phrasing*

The immediate constituents of an intonational phrase must together form a sense unit.

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[6] While Selkirk (1984) says that the number of silent demibeats represent the syntactic timing of the sentence, she does not analyze the intonational phrasing by the Silent Demibeat Addition (see section 1.3), but by her semantic condition, the Sense Unit Condition.

The cases where constituents form a sense unit are defined as follows:

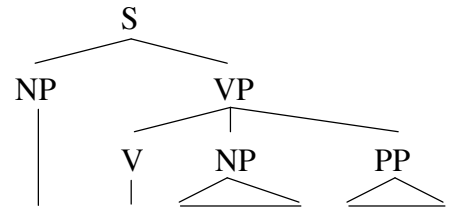
(36) Two constituents C_i, C_j form a sense unit if (a) or (b) is true of the semantic interpretation of the sentence:

a. C_i modifies C_j (a head)

b. C_i is an argument of C_j (a head). (Selkirk 1984: 291)

For illustration, consider the example sentence in (37) and its phrasings in (38), where parentheses represent intonational phrases.

(37)



(Selkirk 1984:292)

(38) a. (Jane gave the book to Mary)

b. (Jane) (gave the book to Mary)

c. (Jane gave the book) (to Mary)

d. (Jane gave) (the book) (to Mary)

e. *(Jane) (gave) (the book to Mary)

f. *(Jane gave) (the book to Mary)

g. (Jane) (gave the book) (to Mary)

h. (Jane) (gave) (the book) (to Mary) (Selkirk 1984:293)

According to Selkirk (1984: 293), (38e) and (38f) are ruled out by the Sense Unit Condition, because *the book* and *to Mary* are not in the relation of head-modifier nor head-argument.

However, her analysis has some weakness. Are the acceptable phrasing patterns in (38) equally natural? The Sense Unit Condition alone predicts that they are, but this does not seem to be the case. For example, (38h) is less natural than (38a) in that each intonational phrase is too short in normal speech rate. Similarly, Selkirk argues that the three phrasings in (39) are all possible.

(39) a. / The mayor of Chicago won their support. /

b. / The mayor of Chicago / won their support. /

c. / The mayor of Chicago won / their support. / (Selkirk 1984:161)

However, (39c) is much less likely than the other two. In other words, (39c) needs some particular context in order to be acceptable. Therefore, Selkirk's analysis is not adequate enough to explain the naturalness of phrasing. Moreover, the Sense Unit Condition cannot deal with the factors of speech rate and constituent length, and cannot explain acceptability difference in various phrasings.

4.3.4 A Constraint on Phrasing

Consider again the following example, which we discussed in section 2.1:

(40) [[Alice] [[loves] [hamsters]]]

The bare mapping rule interprets the brackets in (40) and changes them into prosodic boundaries as in (41).

(41) // Alice /// loves // hamsters ///

Then the boundary deletion applies to (41) and deletes a number of boundaries between words. We can make three types of intonational phrasing out of (41) by changing the value of *n* in the rule, as shown in (42).

(42) a. / Alice // loves / hamsters // (*n*=1)
b. Alice / loves hamsters / (*n*=2)
c. Alice loves hamsters (*n*=3)

As I argued above, the number of boundaries to be deleted (*n*) corresponds to the speed of utterance. If the speaker slowly utters the sentence, it is divided into three intonational phrases as in (42a). In the medium speed, the verb and its object together makes an intonational phrase as in (42b). In the fastest case, the whole sentence is contained in an intonational phrase as in (42c). The results are shown in (43).

(43) a. (Alice) (loves) (hamsters)
b. (Alice) (loves hamsters)
c. (Alice loves hamsters)

Thus, we can explain acceptable phrasings and the factor of speech rate straightforwardly.

Let us consider next how we can account for phrasings such as (44).

(44) ? (Alice loves) (hamsters)

This phrasing is not unacceptable, but still is unnatural, compared to (43a), (43b), and (43c). In other words, this phrasing needs some particular context in order to be acceptable. We can explain the unnaturalness of (44) in the following way. In order to get the phrasing shown in (44), we have to change the value *n* to delete boundaries in (41). That is, all the three boundaries must be deleted between *Alice* and *loves*, but only one silent demibeat can be deleted between *loves* and *hamsters*. The value of *n* must be three (or more) in the former position and one (or zero) in the latter position, as shown in (45).

(45) ? Alice loves / hamsters //

<- *n*=3 -><- *n*=1 ------->

Then we can ascribe the unnaturalness of (44) to the inconsistency of the value *n* in the sentence. I therefore propose the following constraint on boundary deletion:[7]

(46) In a sentence (or paragraph), the number of boundaries to be deleted (*n*) should be as constant as possible.

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[7] I believe that the theory proposed here, including the bare mapping rule, the boundary deletion rule, and the constraint (46), can be extended to apply to units larger than a sentence, such as a paragraph or even a complete discourse. I will argue prosody in discourse in chapter 6.

I will call (46) the constancy constraint on boundary deletion. Then the deletion in (45) is a violation of the constancy constraint (46).

Similarly, the constraint (46), together with the bare mapping and the boundary deletion, also explains examples for syntactic constraint such as (26) above, repeated with its bare phrase structure as (47).

(47) $[_{IP}\ [_{NP}\ [_{N}$ Two$]\ [_{PP}\ [_{P}$ of$]\ [_{DP}\ [_{D}$ our$]\ [_{N}$ horses$]]]]\ [_{VP}\ [_{Adv}$ suddenly$]\ [_{V'}\ [_{V}$ got$]$
$[_{A}$ restive$]]]]$

I have assumed in section 2.1 that phonologically null elements and the constituents made by merging them with other syntactic objects are invisible to phonological rules. Then the mapping rule applies to (47) and gives (48) as the phonological representation.

(48) /// Two /// of /// our // horses ////// suddenly /// got // restive ////

If we specify the number of silent demibeats to be deleted (n) as three, we get a natural phrasing (26a), as shown in (49a). To get (26b), however, we must delete six boundaries between *horses* and *suddenly*, and only two between *suddenly* and *got*, as shown in (49b).

(49) a. Two of our horses /// suddenly got restive / (n=3)

b. *Two of our horses suddenly / got restive /

<---------- n=6 ---------><------ n=2 ------>

In (49b), the value of n decreases by four after *suddenly*. The decrease violates the consistency constraint (46) and makes the phrasing unacceptable. This is also the case

with the example (24) above. The bare phrase structure of (24) and its phonological representation is shown in (50) and (51), respectively.

(50) $[_{IP}\ [_{DP}\ [_{D}$ The$]\ [_{N'}\ [_{N}$ boys$]\ [_{IP}\ [_{D}$ you$]\ [_{V}$ met$]]]]\ [_{VP}\ [_{V}$ are$]\ [_{NP}\ [_{Adv}$ all$]\ [_{N'}\ [_{N}$ members$]$ $[_{PP}\ [_{P}$ of$]\ [_{DP}\ [_{D}$ the$]\ [_{NP}\ [_{A}$ same$]\ [_{N}$ fraternity$]]]]]]]]$

(51) /// The /// boys /// you // met ////// are /// all /// members /// of /// the /// same // fraternity ////////

The results of applying the boundary deletion rule are shown in (52).

(52) a. The boys you met /// are all members of the same fraternity ///// (*n*=3)

b. The boys you met are all members of the same fraternity // (*n*=6)

(52a) and (52b) correspond to the phrasings (12b) and (12d), respectively. The phrasings in (12) are repeated here as (53).

(53) a. $(_{IntP}$ The boys you met$)\ (_{IntP}$ are all members$)\ (_{IntP}$ of the same fraternity$)$.

b. $(_{IntP}$ The boys you met$)\ (_{IntP}$ are all members of the same fraternity$)$.

c. * $(_{IntP}$ The boys you met are all members$)\ (_{IntP}$ of the same fraternity$)$.

d. $(_{IntP}$ The boys you met are all members of the same fraternity$)$.

To derive the other two phrasings (53a) and (53c), we must change the value of *n* in the deletion rule in the sentence. (54a) and (54b) correspond to (53a) and (53c), respectively.

(54) a. The boys you met /// are all members / of the same fraternity /////

<---------- *n*=3 ----------><- *n*=2 -><---------- *n*=3 ---------->

b. *The boys you met are all members / of the same fraternity /////

<---------- *n*=6 ----------><- *n*=2 -><---------- *n*=3 ---------->

The maximum value of *n* is 3 in (54a), and 6 in (54b). Then (54b) is a clear violation of the constancy constraint (46) while (54a) is a minor violation. Thus (53c) is judged as unacceptable, but (53a) is acceptable even if it is not perfect.

Similarly, Selkirk's (l984) example (39c) can be explained in terms of the number of boundaries to be deleted, as shown in (55).

(55) a. [[[The] [[mayor] [[of] [Chicago]]]] [[won] [[their] [support]]]]

b. xxx The xxx mayor xxx of xx Chicago xxxxxx won xxx their xx support xxxx

c. ?? The mayor of Chicago won / their support. /

x xx

<---------- n=6----------><------- n=2 ------->

To get the phrasing in (39c), the variable *n* has to be changed from six to two in a sentence as shown in (55c). This is a violation of (50) and makes the phrasing in (39c) unnatural.

Now it is to be noted again that the constancy constraint (46) allows degrees of (un)acceptability. The bigger the difference between the maximum *n* and the minimum *n* is, the less acceptable the phrasing is. Thus (49b) and (54b) are unacceptable, shown with an asterisk, (45) marginal, shown with a question mark, and (54a) acceptable, shown without any mark. Our analysis explains the degree of acceptability straightforwardly.

4.3.5 Comparison with Other Constraints

There are other constraints and rules that have been proposed to explain intonational phrasing in English. I will briefly review Jackedoff (1987) and Taglicht (1998), and show that their analyses cannot explain the data we have seen above.

Jackendoff (1987:329) proposes a correspondence rule, a partial mapping between syntactic and phonological structure as shown in (56).

(56) A phrasal constituent (NP, S, VP, PP) at the *end* of a sentence *may* be treated as an Intonational Phrase.

This rule nicely explains variable phrasing such as (57a) and (57b).

(57) a. (*Sesame Street* is a production of) (the Children's Television Workshop)

b. (*Sesame Street* is a production) (of the Children's Television Workshop)

The last Intonational Phrase corresponds to NP (or DP) in (57a) and PP in (57b). Our analysis also explains the fact that both (57a) and (57b) are possible phrasing. The syntactic structure of the sentence is shown in (58).

(58) a. [[*Sesame Street*] [is [a [production [of [the [[Children's Television] Workshop]]]]]]]

b. // *Sesame Street* // is / a / production / of / the // Children's Television / Workshop ///////

The maximum number of boundary sequence is two within the sentence. *Of* is separated by one boundary from the preceding word *production* and the following *the*. We can explain why phrasing (57a) and (57b) are equally possible. Without committing a serious violation of the constancy principle, we can phrase the sentence in two ways by deleting boundaries, as shown in (59a) and (59b).

(59) a. *Sesame Street* is a production of / the Children's Television / Workshop /////

<---------- *n*=2 ----------><*n*=0><---------- *n*=2 ---------->

b. *Sesame Street* is a production / of the Children's Television / Workshop /////

<---------- *n*=2 ----------><*n*=0><---------- *n*=2 ---------->

On the other hand, Jackendonff's rule (56) is two weak to rule out the example (53c) we have seen above, repeated here as (60a).

(60) a. *(The boys you met are all members) (of the same fraternity)

b. The boys you met are all members [$_{PP}$ of the same fraternity]

As shown in (60b), the string *of the same fraternity* is PP at the *end* of a sentence. The rule (56) predicts that the string may be treated as an Intonational Phrase, but this is not the case as shown in (60a).

Taglicht (1998:185) also proposes a constraint on intonational phrasing in English.

(61) A headed node is ill-formed if it has a daughter ending in an IP boundary followed by a daughter not ending in an IP boundary.

This constraint explains unacceptable phrasing such as (62).

(62) a. *(On Monday) (morning they left)

* On [Monday % morning] they left %

b. * (Danish) (beer is better)

* [Danish % beer] is better %

Our analysis also explains the data straightforwardly. Daughters of a constituent are always demarcated by two boundaries, the least number of boundaries between two adjacent words. According to our analysis, putting an IP boundary between daughters of a constituent means that we delete no more than one boundary with at least one boundary left there. At the other positions in the same sentence, we have to delete more than one boundaries to get the unacceptable phrasings as shown in (63c) and (64c).

(63) a [[[On] [[Monday] [morning]]] [[they] [left]]]

b. /// On /// Monday // morning ///// they // left ///

c. * On Monday / morning they left /

<- *n*=3 -><- *n*=1 ->< *n*=5 >< *n*=2 >

(64) a. [[[Danish] [beer]] [[is] [better]]]

b. /// Danish // beer //// is // better ///

c. * // Danish / beer is better /

<-- *n*=1 --><*n*=4>< *n*=2 >

Here, the value of *n* is inconsistent ranging from four or five to one. Thus we can naturally explain the unacceptability of these phrasings.

On the other hand, the constraint (61) is too weak to rule out the unacceptable phrasing (60a), repeated here as (65a).

(65) a. * (The boys you met are all members) (of the same fraternity)

b. * The boys you met are all [members % of the same fraternity] %

In (65b) the brackets show a constituent whose first daughter *members* ends in an IP boundary followed by a daughter *of the same fraternity* ending in an IP boundary. Thus the constraint does not apply to (65).

Thus, both Jackendoff's (1987) correspondence rule and Taglicht's (1998) constraint are too weak to explain the unacceptable phrasing (65), and our analysis explains their data straightforwardly.

4.3.6 Length of Constituents

So far, I have shown that the rules and the constraint proposed here naturally explain the examples for such a syntactic analysis as Downing's (1970). Further. I have argued that they can also explain the phenomena concerned with the speed of utterance such as (12). Let us next consider examples of semantic principle such as (28B) and (29B), repeated here as (66B) and (67B), respectively.

(66) A: What's happening?

B: ($_{\text{IntP}}$ Tom Roeper) ($_{\text{IntP}}$ is going to Germany).

(67) A: What's Tom Roeper doing this summer?

B: ($_{IntP}$ As far as I know), ($_{IntP}$ Tom's going to Germany).

The subject NP *Tom (Roeper)* makes an intonational phrase of its own in (66B), but not in (67B). This is, as Bing (1979) argues, because the information of the NP is new in (66B), but old in (67B). Note, however, the fact that the new NP *Tom Roeper* in (66B) consists of two words, but the old NP *Tom* in (67B) one word. Therefore, the newness of information might be judged by the length of the constituents.[8] The notion of length can be captured by the bare mapping rule. Let us consider the bare phrase structure of the examples in (66B) and (67B).

(68) a. $[_{IP}\ [_{NP}\ [_{N}$ Tom] $[_{N}$ Roeper]] $[_{I'}\ [_{I}$ is] $[_{VP}\ [_{V}$ going] $[_{PP}\ [_{P}$ to] $[_{N}$ Germany]]]]]

b. $[_{IP}\ [_{N}$ Tom] $[_{I'}\ [_{I}$ is] $[_{VP}\ [_{V}$ going] $[_{PP}\ [_{P}$ to] $[_{N}$ Germany]]]]]

The word *Roeper* is dominated by N and NP in (68a), but *Tom* is dominated only by N in (68b). The mapping rule applies to (68a) and (68b) to give (69a) and (69b), respectively.

(69) a. /// Tom // Roeper //// is /// going /// to // Germany /////

b. // Tom /// is /// going /// to // Germany /////

---

[8] Bolinger (1972: 640) says "... we rarely use just a given name unless the referent is conceptually close by . . . ." I will discuss the relation between old/new information and the length of constituents in Section 4.3.6.

Note that the boundaries between the subject and *is* are four in (69a) but three in (69b). The boundary deletion rule applies to (69) to give the right phrasings (70a) and (70b) if the value of *n* is specified as 3.

(70) a. Tom Roeper / is going to Germany // (*n*=3)

b. Tom's going to Germany // (*n*=3)

Thus the proposed analysis can explain a semantic factor such as the newness of information in a formal way.

Let us consider more example sentences. The example (32) above is repeated here as (71a).

(71) a. ($_{IntP}$ Mary took her handkerchief) ($_{IntP}$ out of her pocket).

b. ($_{IntP}$ Those who were present) ($_{IntP}$ laughed at him).

These are shown with the most likely phrasing patterns. As I noted above, if we apply Downing' s syntactic constraint (25) to (71a), we will wrongly predict a phrasing pause between the subject NP *Mary* and *took*. The syntactic constraint cannot capture the fact that the subject NP is short in (71a), but long in (71b). The proposed analysis, however, captures the notion of length, and correctly predicts the right phrasings in (71). The bare phrase structures of (71) are (72), and (73) are the results of the application of the mapping rule.

(72) a. [$_{IP}$ [$_{NP}$ Mary] [$_{VP}$ [$_{V}$ took] [$_{NP}$ [$_{D}$ her] [$_{N}$ handkerchief]] [$_{PP}$ [$_{P}$ out] [$_{PP}$ [$_{P}$ of] [$_{NP}$ [$_{D}$ her] [$_{N}$ pocket]]]]

b. $[_{IP}\ [_{NP}\ [_{N}$ Those$]\ [_{CP}\ [_{D}$ who$]\ [_{IP}\ [_{VP}\ [_{V}$ were$]\ [_{A}$ present$]]]]\ [_{VP}\ [_{V}$ laughed$]$
$[_{PP}\ [_{P}$ at$]\ [_{NP}$ him$]]]]$

(73) a. // Mary /// took /// her // handkerchief //// out /// of /// her // pocket ////

b. /// Those /// who /// were // present ////// laughed /// at // him ////

In (73a), the maximum sequence of boundaries is the one between *handkerchief* and *out*, but not between *Mary* and *took*. If we apply the boundary deletion rule with *n*=3 to (73a), we get the right phrasing as shown in (74a). In a similar way, (73b) is phrased into (74b), and this case shows that the phrasing follows the long subject NP.

(74) a. Mary took her handkerchief / out of her pocket / (*n*=3)

b. Those who were present /// laughed at him / (*n*=3)

Note that the examples in (71a) and (71b) cannot be easily explained by Bing's semantic principle in terms of reference to previous discourse, because no previous discourse has been indicated. To summarize, I have shown that the proposed analysis explains both syntactic and semantic factors in variable intonational phrasing in a formal way. Furthermore, it has been shown that this analysis is superior to previous ones in that it also explains a performance factor, the speed of utterance.

4.3.7 Old/New Information, Length, and Boundaries

In this section, I will investigate more closely the relation between old/new information and the length of constituent, and argue that these two are reflected in the number of syntactic and prosodic boundaries. The intuitive idea is that a constituent is long and has more boundaries when it represents new information. When a constituent

represents old information, it becomes short and has fewer boundaries. This is so because shorter forms are more economical and should be preferred as long as they can transfer the intended meaning.

The origin of the idea that information status relates to constituent length dates back to Lakoff (1976: 295). Lakoff explains the coreference data in terms of the following hierarchy of NPs:

(75) 1. proper names (e.g., *Dirksen*)
2. definite descriptions (e.g., *the man in the blue shirt*)
3. epithets (e.g., *the bastard*)
4. pronouns (e.g., *he*)

For example,

(76) a. ? The emperor$_i$ entered the room and Napoleon$_i$ announced that Jean-Luc would hang.
b. * The bastard$_i$ entered the room and Napoleon$_i$ announced that Jean-Luc would hang.
c. ** He$_i$ entered the room and Napoleon$_i$ announced that Jean-Luc would hang.

Lakoff observes that the greater the difference in numbers with respect to the hierarchy in (75), the less acceptable the sentence. Givón (1983) also shows (77) as the hierarchy of topic continuity/predictability.

(77) zero > unstressed/clitic pronoun > stressed/independent pronoun > full DEF-NP > modified DEF-NP

To Lakoff's hierarchy in (75) are added zero and modified DEF-NP in Givón's (77). The relation between information status of NP (or DP) and its length is much clearer in Ariel's (1988) accessibility hierarchy shown in (78).

(78) Joan Smith, the president > Joan Smith > The president > Smith > Joan >That/this hat we bought > That hat > This hat > That > This > SHE > she > herself > ϕ

Let us now consider how the bare mapping succeeds in representing information status and length of NPs (or DPs). Example words and phrases are shown in (79).

(79) a. ϕ (zero)
b. 'em] (unstressed/clitic pronoun)
c. [them] (stressed/independent pronoun)
d. [[the] [book]] (full DEF-NP)
e. [[the] [[interesting] [book]]] (modified DEF-NP)
f. [[the] [[book] [[on] [it]]]] (modified DEF-NP)
g. [[the] [[book] [[on] [[the] [desk]]]]] (modified DEF-NP)

The examples in (79) are basically ordered according to the hierarchy of information status in (77). Each of these syntactic boundaries are interpreted as prosodic boundaries as shown in (80).

(80) a. (ϕ)

b. 'em /

c. / them /

d. // a // book //

e. // an /// interesting // book ///

f. // a /// book /// on // it ////

g. // a /// book /// on /// the // desk /////

(80a) shows that a zero pronoun makes no boundary around it. A clitic pronoun makes a boundary on its right as in (80b). A pronoun makes one on its left and another on its right as in (80c). A DP that consists of a determiner and a noun has two boundaries on its left and two on its right as in (80d). A DP may have three boundaries on its right if it contains an adjective as in (80e). The number of boundaries increases in the right of a DP if it contains a postnominal prepositional phrase as in (80f) and (80g). Then we can conclude that the number of boundaries on the sides of a DP generally increases as the number of words in it increases.[9]

Notice that our analysis formalizes not only the length and information status of NP/DP but also VP, AP, PP, and any other categories. Consider the following paradigm:

---

[9] An exceptional case is when prenominal adjectives are conjoined as in (i).

(i) This is [[a] [[[long] [[but] [uninteresting]]] [book]]]

The DP consists of five words but has two boundaries on its left and just three on its right. It might be the case that the phrase structure of the DP is not that shown in (i). I will leave the matter open, however. I would like to thank a participant in the 24th Penn Linguistic Colloquium who made me aware of the example.

(81) a. [did] (e.g. Jane did.)

b. [sing]

c. [[sing] [beautifully]]

d. [[sing] [[a] [song]]]

e. [[sing] [[with] [[a] [smile]]]]

(82) a. [beautiful]

b. [[very] [beautiful]]

(83) a. [in] [it]

b. [[in] [[the] [park]]]

c. [[right] [[through] [[the] [week]]]]

The examples in (81) show that a VP gets more boundaries on its left and right as it contains more words and becomes longer. (82) and (83) show that this is also the case with AP and PP. The bare mapping rule changes (81)-(83) into (84)-(86), respectively.

(84) a. / did /

b. / sing /

c. // sing // beautifully //

d. // sing /// a // song ///

e. // sing /// with /// a // smile ////

(85) a. / beautiful /

b. // very // beautiful //

(86) a. / in // it /

b. // in /// the // park ///

c. // right /// through /// the // week ////

It is clear that longer phrases have more prosodic boundaries on its left and right.

4.3.8 Boundary and Cognition

Finally, let us consider the cognitive support for the proposed analysis. Consider the following configurations:

(87) a. O O O O O

b. O O O O O O

(87a) is most naturally seen as three circles to the left of two other circles; (87b) as two circles to the left of three. Jackendoff (1983: 128) argues that this fact is due to the perceptual principle of proximity. That is, the things that are close together tend to form a visual group. This principle seems to hold for the function of prosodic boundaries as well. We may regard circles in (87) as words, and space between circles as the time between words. Then a space in (87) can be said to correspond to a prosodic boundary in our analysis. Thus if we replace a word by a circle and a prosodic boundary by a space in (73a) and (73b), we get the configurations in (88a) and (88b), respectively.

(88) a. O O O O O O O O O

b. O O O O O O O O

Where we broke each sentence in (71) into two intonational phrases with a slant line, we may, similarly, indicate the phrasing by the placing of two groups of circles in (88). This process is that of variable intonational phrasing, and the most natural way of phrasing is to pause between the circles which are most distant from each other. This fact is formulated in terms of the bare mapping rule and the boundary deletion rule in our analysis. Note that the speaker seems to utter the sentence according to its internal structure by taking pauses of different lengths, not of the same length. The hearer also seems to restructure the sentence by judging the length of pauses. The example (89) is the result of an experiment made by Grosjean et al. (1979). The numbers under the sentence show the rate of pause duration in each position, with a maximum total of 100:

(89) Closing his client's book, the young expert wondered about this extraordinary story

6 5 6 26 2 4 15 8 9 11 8

(Grosjean et al. 1979: 71)

From this example, we can say that the length of pauses between words is not the same, and reflects the internal structure of the sentence. The bare structure of (89) is the following:

(90) [[[Closing] [[[his] [client's]] [book]]], [[[the] [[young] [expert]]] [[wondered] [[about] [[this] [[extraordinary] [story]]]]]]]

The prosodic structure of (90) is (91).

(91) /// Closing //// his // client's /// book ////// the /// young // expert ///// wondered ///
about /// this /// extraordinary // story ///////

If we represent the number of boundaries between words, (91) would look like (92).

(92) Closing his client's book, the young expert wondered about this extraordinary story

3	*4*	*2*	*3*	*6*	*3*	*2*	*5*	*3*	*3*	*3*	*2*	*7*	
	6	5	6	26	2	4	15	8	9	11	8		

In the third line, I show the rate of pause duration in (89) for ease of comparison. The pause duration generally corresponds to the number of boundaries. The longest pause after *book* [26] corresponds to the largest number [*6*] in the sentence. The second longest pause after *expert* [15] corresponds to the second largest number [*5*].

However, the third longest pause after *this* [11] corresponds to just [*3*]. This long pause seems due to emphatic nature of the word *extraordinary* and partly due to the compound nature of the word. If we assume that *extraordinary* consists of two words, *extra* and *ordinary*, the number of boundaries on its left and right increases as shown in (93).[10]

(93) a. ... this] [[[extra] [ordinary]] [story ...

b. ... this //// extra // ordinary /// story ...

4	*2*	*3*
11		8

[10] The compound nature of *extraordinary* is clear from its Latin origin, *extra ordinem*.

Moreover, *extraordinary* may well be emphasized and be focus in the sentence. Then as I will argue in Chapter 7, it may have another pair of boundaries around it (shown with bold face).

(94) a. ... this] [**[**[[extra] [ordinary]]**]** [story ...

b. ... this ///// extra // ordinary //// story ...

5 *2* *4*

11 8

Thus the revised representation of (92) will be (95).

(95) Closing his client's book, the young expert wondered about this extraordinary story

3 *4* *2* *3* *6* *3* *2* *5* *3* *3* *5* *(2)* *4* *7*

6 5 6 26 2 4 15 8 9 11 8

The correspondence between the number of boundaries and the pause rate in (95) is stricter than in (92).

4.3.9 Summary

In section 4.3, we have considered the phenomena of variable intonational phrasing. First, I have shown that the syntactic constraint (25) proposed by Downing (1970) is not able to explain the difference between (30) and (31), and makes a wrong prediction in (32). Moreover, it has been shown that the semantic principle (27) proposed by Bing (1979) is not definite enough to rule out the unacceptable (24c) and (26b).

As an alternative analysis, I have proposed a constraint on boundary deletion (46). It has been shown that these formulations enable us to explain the factor of speed of such utterances as (43) and (44), and to deal with the examples of syntactic analysis such as (24) and (26). Moreover, it has been argued that our analysis can also explain examples of semantic analysis such as (28B) and (29B); further examples in (71) have been given. Finally, I have argued that our analysis is supported by the cognitive study made by Jackendoff (1983) and Grosjean et al. (1979).

To summarize, variable intonational phrasing can be said to be the means by which the speaker informs the hearer of the proper internal structure, both syntactic and semantic, of a sentence. The bare mapping theory proposed here states this fact in a formal way.

Chapter 5

Mapping and the Length of Constituents

In this chapter, I examine the effect of the length of constituents on phonology and syntax. In particular, I discuss how the theory explains the phenomena of secondary phrasal stress and Heavy NP Shift in English. In addition, I argue that the theory can be an alternative to Hawkins's (1994) analysis of word order in terms of Early Immediate Constituents.

5.1 Secondary Phrasal Stress in English

Let us look at the data in (1) from Selkirk (1995: 565) and Zubizarreta (1998: 166). The sentence (1a) has secondary phrasal stress on the first word and primary phrasal stress on the last word. If we make the VP longer as in (1b), the secondary stress moves from *nineteen* to *linguists*.[1]

(1) a. Nìneteen thousand linguists síng.

b. Nineteen thousand lìnguists sing the Marseilláise.

c. Linguists from Grèece síng.

The bare phrase structure of these sentences is shown in (2).

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[1] In fact, Selkirk's representation of (1a) is (i) (IP=intonational phrase; MaP=major phrase).

(i)

```
                                    x
          x                         x
          x              x          x
          x     x        x          x
IP(MaP((Nineteen thousand)(linguists))MaPMaP((sing))MaP)IP
```

(2) a. [[[[Nineteen] [thousand]] [linguists]] [sing]]

b. [[[[Nineteen] [thousand]] [linguists]] [[sing] [[the] [Marseillaise]]]]

c. [[[Linguists] [[from] [Greece]]] [sing]]

(1a) and (1b) show that the length of VP has an effect on the placement of secondary stress in the subject NP. Notice that the direction of branching also has an effect on the placement of secondary stress. Compare (1a) with (1c). The subject is left-branching in (1a) and right-branching in (1c) as shown in (2a) and (2c). In (1a) secondary stress is on the leftmost element in the subject, *nineteen,* while in (1c) it is on the rightmost element, *Greece*. However, the effects of length and branching direction are not explained in Zubizarreta (1998).

Now I will show that the bare theory of mapping and phrasing gives an explanation for the data in (1). First, the syntax-phonology mapping rule applies to (2a-c) and gives (3a-c) as their phonological representations.

(3) a. //// Nineteen // thousand /// linguists /// sing //

b. //// Nineteen // thousand /// linguists //// sing /// the // Marseillaise ////

c. /// Linguists /// from // Greece //// sing //

Notice that in (3a) there is only three boundaries between the subject and the verb, that is, between *linguist* and *sing*. On the other hand, in (3b) and (3c), there are four boundaries between the subject NP and the verb *sing*. If we delete three boundaries between words by the boundary deletion rule with n=3, we get the representations in (4).

(4) a. / Nineteen thousand linguists sing

b. / Nineteen thousand linguists / sing the Marseillaise /

c. Linguists from Greece / sing

From (4), we expect that the phrasing patterns of these sentences are as in (5).

(5) a. (Nineteen thousand linguists sing)

b. (Nineteen thousand linguists) (sing the Marseillaise)

c. (Linguists from Greece) (sing)

In (4a), all the brackets in the sentence are deleted, and the whole sentence is in a prosodic phrase as shown in (5a). In (4b) and (4c), there is one boundary left between the subject NP and the verb *sing*. This boundary divides the sentence into two prosodic phrases as shown in (5b) and (5c). Now let us assume the primary and secondary phrasal stress assignment rules in (6a) and (6b).

(6) a. Assign primary stress to the rightmost lexical element in a prosodic phrase.

b. Assign secondary stress to the leftmost lexical element in a prosodic phrase.

Then we can give an explanation for the data in (1). In (5a), which consists of only one prosodic phrase, the rule (6a) assigns primary stress to the rightmost lexical element, *sing,* and (6b) assigns secondary stress to the leftmost lexical element, *nineteen*. In (5b), which consists of two prosodic phrases, the rule (6a) assigns primary stress to *linguists* and *Marseillaise* because they are the rightmost elements in their prosodic phrases. (6b) assigns secondary stress to the leftmost element in each prosodic phrase, namely, *nineteen*

and *sing*. (5c) also consists of two prosodic phrases. *Greece* and *sing* are the rightmost lexical elements in their prosodic phrases and are assigned primary stress by (6a). *Linguists*, which is the leftmost element in the first prosodic phrase, is assigned secondary stress by (6b).[2] The results are shown in (7).

(7) a. (Nìneteen thousand linguists síng)

b. (Nìneteen thousand línguists) (sìng the Marseilláise)

c. (Lìnguists from Gréece) (síng)

In (7), I underline two of the most prominent words in each sentence. (7a) is straightforward; it is the same as the observed prominence in (1a). In (7b) *linguists* is assigned primary stress in the first prosodic phrase. However, this stress is heard as secondary stress in the domain of the whole sentence, because *Marseillaise* is also assigned primary stress in the second prosodic phrase. *Marseillaise* is more prominent than *linguists* because it is uttered with sentence-final falling intonation (See Bing 1979:140). Similarly in (7c) *Greece* is assigned primary stress in the first prosodic phrase, but it is heard as secondary stress in the whole sentence. Thus we can explain the prominence in (1a-c) with the bare theory of phrasing. The point is that long constituents have a number of brackets at their ends if it has right branching structure. These brackets are interpreted as prosodic boundaries which separate the constituent from the rest of the sentence.

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[2] In fact, *sing* in (5c) is both leftmost and rightmost in the one-membered prosodic phrase. I assume here that (6b) applies to an element vacuously if (6a) also applies to it.

5.2 Phonological Phrasing in Korean and Japanese

Next, let us consider phonological phrasing phenomena in Korean and Japanese. In section 5.2.1, I will briefly review Selkirk's (1986) end-based theory and Cho's (1990) argument of the phrasing in Korean. In section 5.2.2, I will show the phrasing of the parallel structures in Japanese. Section 5.2.3 is the discussion of the nature of phrasing in Korean and Japanese. The conclusion I will present is that Cho's argument against the end-based theory is not compelling for the left-branching languages such as Korean and Japanese.

5.2.1 The End-Based Theory and Korean Phrasing

As I mentioned in 1.2.2, Selkirk (1986) argues that phonological phrasing can be predicted by the end-based theory, which can be summarized as in the following algorithm:[3]

(8) a. $_{\text{Xmax}}$ [...

b. ...] $_{\text{Xmax}}$

As (8a) and (8b) show, the phrasing position is parameterized so that a language chooses the left end (8a) or the right end (8b) of a maximal projection as a phrasing boundary. Selkirk (1986: 382) gives an example from Chi Mwi:ni, which chooses the right end setting (8b). If we apply (8b) to the sentence (9a), we get the correct phrasing (9c).

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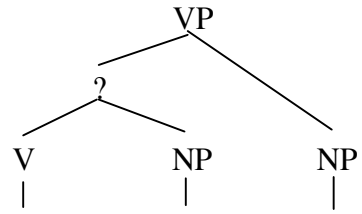
[3] I will use Xmax, X", and XP interchangeably for the maximal projection of X.

(9)



a. pa(:)nzize cho:mbo mwa:mba

'he ran the vessel on to the rock'

b. .....]$_{Xmax}$ .....]$_{Xmax}$

c. ( ) ( )

PPh PPh

Cho (1990: 53) considers sentences involving complex NPs and argues that the assumptions of end-based theory should be modified:[4]

(10) a. [[John][saw [the cat [that [caught [the rat [that [stole [the cheese]]]]]]]]]

(John saw the cat) (that caught the rat) (that stole the cheese)

.....]$_{X''}$ .....]$_{X''}$

[4] Cho (1990) also discuss the relation-based theory (Nespor and Vogel 1986, among others) and the direct syntax approach (Kaisse 1985), which I will not discuss here.

b. [[na-nin][[[[[[[koyani-lil] c*oc-nin] kanaci-lil] t*æli-n] salam-il]
I-Top cat-Acc chase-Rel puppy-Acc beat-Rel man-Acc
poassta]]]
saw
(na-nin)(koyniril c*onnin) (kanajiril t*ærin) (salamil boatt*a)
X''[.....…X''[.....
'I saw a man who beat the puppy that was chasing the cat.'

Since the end-based theory wrongly predicts only two phrases for both English and Korean, Cho proposes the condition that S' obligatorily starts a new phrase. This condition, however, is too strong for the following Korean sentence, as Cho points out:

(11) a. [[John][saw [a cat [that [was smiling.]]]]]
(John) (saw a cat) (that was smiling)
.....]$_{X''}$ .....…. $_{S'}$[.....]$_{X''}$
b. [[Suni-nin][[[[us-nin]] koyani-lil] poass-ta.]]]]
Suni-Top smile-Rel cat-Acc saw
* (Suninin)(unnin) (koyaniril boat*ta) (not acceptable)
(Suninin) (unnin goyaniril) (poat*ta) (actual phrasing)
X''[..... .. X''[.....]$_{S'}$ .....

Thus, Cho concludes that an immediate solution is not available within the end-based theory.

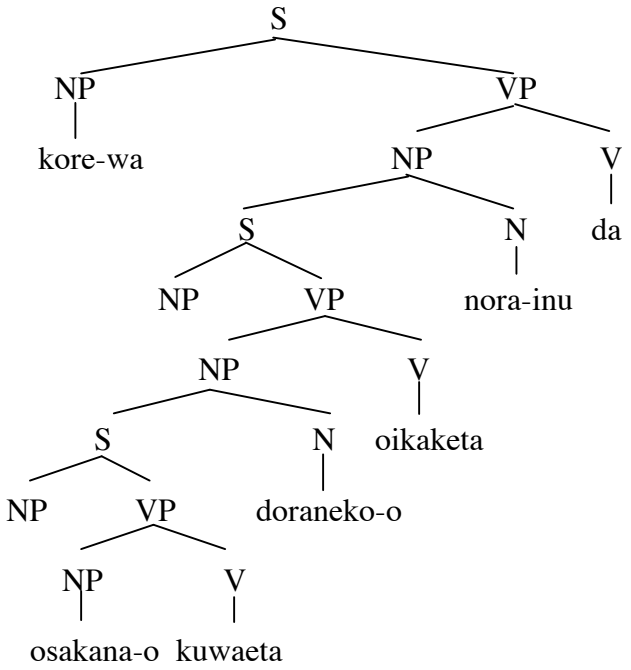
5.2.2 Japanese Phrasing

First, let us consider the parallel sentence to (10) in Japanese:

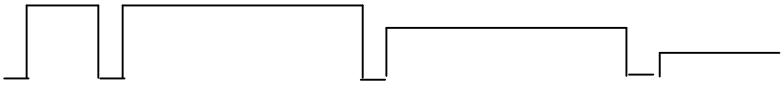
(12) [[kore-wa][[[[[osakana-o kuwaeta] doraneko-o] oikaketa] nora-inu] da]]
this-Top fish-Acc mouthed-Rel stray cat-Acc chased-Rel stray dog is
'This is the stray dog that chased the stray cat that held a fish in its mouth.'

The syntactic structure of (12) is roughly shown in (13).

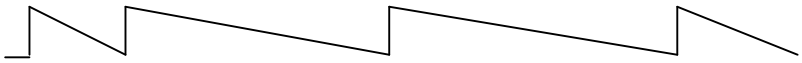
(13)



Selkirk and Tateishi (1991) show that Japanese has two leves of phrasing, i.e. Major Phrase and Minor Phrase, and that the former is characterized by Downstep and the latter by Initial Lowering. The tonal patterns of Downstep and Initial Loweing are shown in (14a) and (14b), respectively:

(14) a. 

Kore-wa osakana-o kuwaeta doraneko-o oikaketa nora-inu da

b. 

Kore-wa osakana-o kuwaeta doraneko-o oikaketa nora-inu da

According to these patterns, the Major Phrasing and the Minor Phrasing of the sentence are (15a) and (15b), respectively:

(15) a. [kore-wa] [osakana-o kuwaeta doraneko-o oikaketa nora-inu da]

X''[..... X''[.....

b. (kore-wa)(osakana-o kuwaeta)(doraneko-o oikaketa)(nora-inu da)

Selkirk and Tateishi (1991) propose (16) as the parameterized rule of the syntax-prosodic structure mapping for Japanese:

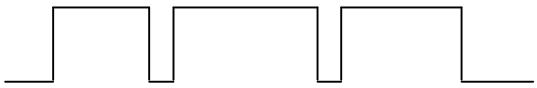
(16) Major Phrase: {Left, XP}

The rule (16) correctly predicts the Major Phrases in (15a). Note also that the Minor Phrasing in (15b) does not violate any constraints which are proposed by Selkirk and Tateishi (1988), such as the Peripherality Constraint, the Accent Condition, and the Ternary Branching Condition.

Now let us turn to the parallel Japanese sentence to (11):

(17) [Masao-wa] [[warat-teiru noraneko-o] mita.]
Masao-Nom smile-PROG stray cat-Acc saw
'Masao saw a stray cat that was smiling.'

The tonal pattern of Downstep and Initial Lowering is shown in (18).

(18) 

In (18), there can be seen no Downstep effect on the second and the third word, which keeps the highest pitch. The first mora of the second and the third word retains its low tone. Thus the Major Phrasing and the Minor Phrasing of (18) are the same, as shown in (19a) and (19b), respectively:

(19) a. $_{MajP}$(Masao-wa) $_{MajP}$(waratteiru) $_{MajP}$(noraneko-o mita)
$_{X''}$[..... $_{X''}$[..... .....]$_{S'}$ .....
b. $_{MinP}$(Masao-wa) $_{MinP}$(waratteiru) $_{MinP}$(noraneko-o mita)

Together with the condition that S' obligatorily starts a new phrase, the end-based theory correctly predicts the phrasing in sentences involving complex NPs in Japanese.

5.2.3 Discussion

Since both Korean and Japanese are left-branching languages, we expect they are similar in phonological phrasing as well. The data (10b) vs. (15a) and (11b) vs. (19a), however, show that Korean phrasing is different from Japanese Major Phrasing:

(20) a. (na-nɨn) (koynirɨl c*onnɨn)(kanajirɨl t*ærin) (salamɨl boatt*a) (=10b)
b. (kore-wa)(osakana-o kuwaeta doraneko-o oikaketa nora-inu da) (=15a)

(21) a. (Sunɨnin)(unnɨn goyanirɨl) (poat*ta) (=11b)
b. (Masao-wa)(waratteiru)(noraneko-o mita) (=19a)

A solution to this problem is to consider Korean phrasing as Minor Phrasing, a level of phrasing that is purely phonological and not syntactic. Korean phrasing (10b) is in fact similar to Japanese Minor Phrasing (22b).

(22) a. (na-nɨn) (koynirɨl c*onnɨn)(kanajirɨl t*ærin) (salamɨl boatt*a)(=10b)
b. (kore-wa)(osakana-o kuwaeta)(doraneko-o oikaketa)(nora-inu da) (=15b)

One might argue that Korean (11b) does not show the similar phrasing to Japanese (10b).

(23) a. (Sunɨnin) (unnɨn goyanirɨl) (poat*ta) (=11b)
b. (Masao-wa) (waratteiru) (noraneko-o mita) (=19b)

Japanese Minor Phrasing, however, has some variability, as Selkirk and Tateishi (1988) point out. If we change some words in (10b), we may have the same (Minor) phrasing as Korean (11b) (repeated here as (24b)).

(24) a. [[Masao-wa] [[[warau] [noraneko-o]] [mitsumeta]]]

Masao-Nom smile stray cat-Acc looked hard at

'Masao was looking at a cat that smiled.'

(Masao-wa) (warau noraneko-o) (mitsumeta)

b. (Sunɨnin) (unnɨn goyanirɨl) (poat*ta) (=11b)

The meaning of the sentence (24a) is roughly the same as that of (10b), but some words in (24a) are different in their length from those used in (10). The simple verb *warau* is shorter than *waratteiru* which consists of the verb and the progressive aspect. The form *mitsumeta*, which consists of *miru (see)* and *tsumeta (closely)*, in (24a) is longer than the simple form *mita.* Note that this change in phrasing is triggered not by the change in syntactic structure but by the change in the length of constituents. Thus, we have another support to the claim that Japanese Minor Phrasing is not syntactic but purely phonological (cf. Selkirk and Tateishi 1988).

5.2.4 Summary and the Bare Mapping Analysis

If we take Korean phrasing as purely phonological one, as Japanese Minor Phrasing, Cho's argument that Korean data become counterexamples to the end-based theory (and the direct syntax approach by Kaisse 1985) does not hold. The end-based theory and the direct syntax approach refer only to syntax-phonology interface (Major Phrasing), and not to purely phonological phenomena (Minor Phrasing). We need further facts to decide which is the best theory for syntax-phonology interface.

Let us now consider how our bare mapping theory gives an account of the phrasing in Korean and Japanese. First notice that a long word generally consists of more than one word. As we have just seen, *waratteiru* consists of *warau* and *–teiru*; *mitsumeta* can be

separated into *miru* and *tsumeta*; *noraneko* consists of *nora- (stray)* and *neko (cat)*. If we take these word or morpheme boundaries into consideration, we can deal with the length of words in terms of prosodic boundaries. Let us consider again the relevant examples discussed above. The literal translation of Cho's example (10) is now analyzed as (25).

(25) [[Masao-wa] [[[[warat-] [teiru]] [[nora-] [neko-o]]] [mita]]]
Masao-Nom smile- PROG stray cat-Acc saw
'Masao saw a stray cat that was smiling.'

Then (25) is interpreted by the bare mapping rule into (26).

(26) / Masao-wa ///// warat- // teiru //// nora- // neko-o //// mita ///

Thus we expect that the boundary deletion rule with n=3 would make a natural phrasing such as (20).

(27) Masao-wa // warat- teiru / noraneko-o / mita

This is almost the actual phrasing attested in (12). The only difference between (27) and (12) is that the verb *mita* is incorporated into the preceding prosodic phrase in (12). We can attribute the fact to the tendency of increasing unit proposed by Ghini (1993).

The next example is (24), which we now analyze as (28).

(28) [[Masao-wa] [[[warau] [[nora-] [neko-o]] [[mi-] [tsumeta]]]]
Masao-Nom smile stray cat-Acc looked hard at
'Masao looked hard at a stray cat that smiled.'

The bare phrase structure (28) is mapped onto (29).

(29) // Masao-wa //// warau /// nora- // neko-o //// mi- // tsumeta ////

If we apply the boundary deletion rule with n=3 as we did in (26), we get the phrasing in (30).

(30) Masao-wa / warau nora-neko-o / mi-tsumeta /

This phrasing is the same as the attested one shown in (24a). Thus we can correctly predict the difference in phrasing between (10) and (24a).

5.3 Heavy NP Shift

In this section, I will investigate the relation between prosody and syntactic movement. First I will discuss Heavy NP Shift as a case study. I will also show that the analysis can be extended to deal with Extraposition from NP, It-Replacement, and other rightward movements.

Let us consider sentences derived by so-called Heavy NP Shift. (31a) contains a long NP object and a short PP. Heavy NP Shift changes the order of these phrases as shown in (31b). [5]

(31) a. Ken gave [a book about golden hamsters] [to Alice]

b. Ken gave [to Alice] [a book about golden hamsters]

It is well known that the object NP must be long in order for "Heavy NP Shift" to apply, as in (31). When the object NP is not long enough as in (32a), placing it at the end of the sentence decreases acceptability as in (32b).

(32) a. Ken gave [that] [to Alice]

b. ? Ken gave [to Alice] [that]

However, it has not been clear how we can define the length of constituents. One possible analysis is proposed by Zec and Inkelas (1990), which I will review in the next section.

5.3.1 A Prosodic Constraint on Heavy NP Shift

Zec and Inkelas (1990:377) propose a constraint on Heavy NP Shift to the effect that the heavy NP must consist of more than one phonological phrase (PhP). This is illustrated in the examples (33a) and (33b).

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[5] See also Zubizarreta (1998) and Akasaka and Tateishi (2001) for discussion of this construction from the phonological point of view.

(33) a. ? Mark showed to John ($_{PhP}$ some letters)

b. Mark showed to John ($_{IntP}$ ($_{PhP}$ some letters) ($_{PhP}$ from Paris))

In (33a), the NP *some letters* makes only one phonological phrase and the sentence is awkward. In (33b) the NP *some letters from Paris* consists of two phonological phrases, which make one intonational phrase (IntP). We also expect that the constraint rules out the example (32b) above (repeated here as (34)) in the same way.

(34) ? Ken gave [to Alice] ($_{PhP}$ that)

Although Zec and Inkelas's (1990) prosodic constraint explains examples such as (33a) and (34), it cannot explain the marginality of the following examples:

(35) a. ? Mark showed to the man who was sitting next to him ($_{IntP}$ ($_{PhP}$ some letters) ($_{PhP}$ from Paris))

b. ? Ken gave to the girl who was born and brought up in Taiwan ($_{IntP}$ ($_{PhP}$ a book about) ($_{PhP}$ golden hamsters))

In (35a) and (35b), the NP at the end of the sentence consists of two phonological phrases. It seems clear that the heaviness or length of the object NP is not the only condition on Heavy NP Shift. The relative length of object NP and PP to be permuted is crucial to the acceptability. Zec and Inkelas's constraint is not sufficient in that it does not take the length of PP into account.

Zec and Inkelas's constraint is also inadequate to explain the difference in acceptability in (36a) and (36b).

(36) a. ? Mark showed to John ($_{PhP}$ some letters)

b. ?? Mark showed to John those

Both (36a) and (36b) violates their constraint which prohibits a "light" NP consisting of less than two phonological phrases to be moved to the end of the sentence. The NP *some letters* in (36a) is heavier than *those* in (36b), and makes the sentence (36a) better than (36b). This fact is not explained by Zec and Inkelas's constraint which rules out all the shifted NPs consisting of less than two phonological phrases.

Furthermore, Zec and Inkelas's constraint cannot explain the difference in acceptability between (37a) and (37b) (Whitney 1982).

(37) a. Joanie gave to Bill yesterday a picture of the Grand Canyon.

b. ?* Joanie gave to Bill a picture of the Grand Canyon yesterday.

In (a) and (b), *a picture of the Grand Canyon* is long enough to have two phonological phrases. However, the sentence (b) is unacceptable because the NP is not moved to the end of the sentence. Zec and Inkelas's constraint cannot explain the landing site of the moved NP.

5.3.2 *The Bare Mapping Analysis*

We can explain the acceptability of these sentences with the bare mapping theory. Here I assume Larson's (1988) analysis for Heavy NP Shift, or Light Predicate Raising in his terms. (31a) and (31b) have (38) in common at the point of their derivation.

(38) [Ken [*e* [a [book [about [golden hamsters]]]] [$_{V'}$ gave [to Alice]]]]

The verb *gave* may move up to the empty verb position to derive (39a) with the unmarked word order.

(39) a. [Ken [gave$_i$ [[a [book [about [golden hamsters]]]] t_i [to Alice]]]]

b. [Ken [[$_{Vi}$ gave [to Alice]] [a [book [about [golden hamsters]]]] t_i]]

If V' Reanalysis applies to the V' *gave to Alice* in (38) and reanalyzes it into V, Verb Raising moves the V up to the empty verb position as shown in (39b).

(39a), however, is not perfect from the phonological point of view, because there are five brackets between *hamsters* and *to*. The brackets in (39a) and (39b) are changed into prosodic boundaries as in (40a) and (40b) by the bare mapping rule.

(40) a. / Ken / gave / a / book / about / golden hamsters ///// to Alice ////

b. / Ken // gave / to Alice /// a / book / about / golden hamsters //////

The boundaries between *hamsters* and *to* in (40a) lead us to expect a long pause there, but such a long pause in a clause is not preferable. Let us assume that there is a preference rule to the effect that a long pause in a clause should be avoided. We might call it "Avoid Pause." If Heavy NP Shift (or V' Reanalysis and Light Predicate Raising) applies, we get a better representation (40b). The maximum number of brackets in the sentence is three, between *Alice* and *a book*. In this way we can explain why (40b) sounds more natural than (40a). Larson assumes that V' Reanalysis is optional, and we are assuming a

preference rule "Avoid Pause." Thus, we can also explain why Heavy NP Shift is basically optional.

Similarly, we can explain the examples of intonational phrasing discussed by Zubizarreta (1998).

(41) a. (Max pút) (all the boxes of home fúrnishings) (in his cár).

b. (Max put in his cár) (all the boxes of home fúrnishings).

Zubizarreta mentions that because (41a) is "unbalanced, such intonational phrasings sound awkward" (p. 149). We can explain the awkwardness with our mapping theory. The bare phrase structures of the sentences (41a, b) are the following:

(42) a. [Max [put [all [the [boxes [of [home furnishings]]]]] [in [his car]]]

b. [Max [put [in [his car]] [all [the [boxes [of [home furnishings]]]]]]]

(43) a. / Max / put / all / the / boxes / of / home furnishings ////// in / his car ///

b. / Max / put / in / his car /// all / the / boxes / of / home furnishings ///////

Suppose that languages prefer fewer boundaries between words in a sentence. Then (43a) is not preferable because there are six boundaries between *furnishings* and *in*. Let us assume the following condition for Heavy NP Shift:

(44) Heavy NP Shift satisfies Last Resort when there are a large number of boundaries between the NP and the constituent following it.

Heavy NP Shift can apply to (42a) to give (42b), which is then mapped to (43b). (43b) is preferable because it has only three boundaries between *car* and *all*. Thus we can make explicit the idea of awkward or unbalanced phrasing with this mapping theory.[6]

Note that another advantage of using this theory of phrasing is that we can formalize the notion of "heaviness" in terms of boundaries. With the theory proposed here, we can predict the unacceptability of (45b).

(45) a. [I [talked [[to Mary] [about Bill]]]]

b. [I [[talked [about Bill]]$_i$ *[*[to Mary] t_i*]*]]

In (45b), I assume that Larson's (1988) light predicate raising moves the predicate *talk about Bill* across *to Mary* to the post-subject position. I also assume that the outermost brackets in *[*[to Mary] t_i*]* are invisible because t_i is invisible.[7] If we apply the bare mapping rule to (45a, b), we get the following:

(46) a. / I / talked // to Mary // about Bill ////

b. / I // talked / about Bill /// to Mary //

The maximum number of boundaries between words in (a) is two while it is three in (b). Thus the movement of *talked about Bill* does not reduce the maximum number of

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[6] Moreover, no amount of deletion will put *Max* and *put* together as a single intonational phrase in (43a) to make (41a). See also Tokizaki (1988) for unbalanced phrasing.

[7] Thus *[[to Mary] t_i]* is not distinct from *[to Mary]* for phonological rules.

boundaries in the sentence, and in fact it increases the number. Then the movement does not satisfy condition (44), and (45b) cannot be derived.

Now let us go back to the other examples we have seen above. First, consider what happens when the object NP is not long enough as in (32). Notice that there is only one bracket between words in (47a).

(47) a. [Ken [gave [that [to Alice]]]]

b. ? [Ken [[gave [to Alice]] that]]

Heavy NP Shift makes the sentence worse as shown in (47b), where there are two boundaries between *Alice* and *that*. The output of applying the bare mapping rule to (47a, b) are (48a, b).

(48) a. / Ken / gave / that / to Alice ////

b. / Ken // gave / to Alice // that //

Then we can argue that Heavy NP Shift can apply only if it makes a phonologically better construction. (40b) is better than (40a), but (48b) is not better than (48a).

Next, we can explain the difference of acceptability between (33a) and (33b) above. (49a, b) are the structures of (33a, b), and (50a, b) are the counterparts of (49a, b) which involve no Heavy NP Shift, respectively.

(49) a. ? [Mark [[showed [to John]] [some letters]]]

b. [Mark [[showed [to John]] [some [letters [from Paris]]]]]

(50) a. [Mark [showed [[some letters] [to John]]]]

b. [Mark [showed [[some [letters [from Paris]]] [to John]]]]

These phrase structures are mapped onto the following phonological representations:

(51) a. / Mark // showed / to John /// some letters ///

b / Mark // showed / to John /// some letters / from Paris /////

(52) a. / Mark // showed // some letters // to John ////

b. / Mark // showed // some / letters / from Paris //// to John ////

Let us compare the sentence with Heavy NP Shift and the original sentence. (51a) is worse than (52a) from the phonological point of view, that is "Avoid Pause". There are three boundaries between *John* and *some* in (51a), while the maximum number of brackets between words in (52a) is two. On the other hand, (51b) is better than (52b). The maximum number of boundaries between words in (51b) is three, which is smaller than that in (52b), that is, four. Heavy NP Shift makes a phonologically better sentence in this case. Hence (49b) is acceptable while (49a) is marginal.

Let us consider the case where the PP is longer than the heavy NP. The example sentence in (35a) above has the phrase structure in (53a) and its original sentence with no Heavy NP Shift is shown in (53b).

(53) a. ? [Mark [[showed [to [the [man [who [was [sitting [next [to him]]]]]]]]] [some [letters [from Paris]]]]]

b. [Mark [showed [[some [letters [from Paris]]] [to [the [man [who [was [sitting [next [to him]]]]]]]]]]]

If the PP is long, there are a number of brackets at the right end of that PP. If the PP is longer than the NP, Heavy NP Shift or Light Predicate Raising makes a worse sentence, moving the long PP along with the V to the left of the object NP as shown in (53b). The representations in (54) show that (54b) is worse than (54a) because there are as many as ten brackets between the PP and the following NP. In this way we can explain that the applicability of Heavy NP Shift is determined by the relative length of NP and PP, not by the length of NP alone.

Similarly, we can explain the other problematic examples for Zec and Inkelas's constraint. The sentences in (36a) and (36b) have the following structures:

(54) a. ? [Mark [showed [[to John] [some letters]]]]

b. ?? [Mark [showed [[to John] those]]]

Their original sentences are (55a) and (55b).

(55) a. [Mark [showed [[some letters] [to John]]]]

b. [Mark [showed [those [to John]]]]

(54a), (54b), (55a), and (55b) are mapped onto the phonological representations (56a), (56b), (57a), and (57b), respectively.

(56) a. ? / Mark / showed // to John // some letters ////

b. ?? / Mark / showed // to John / those ///

(57) a. / Mark / showed // some letters // to John ////

b. / Mark / showed / those / to John ////

The output of Heavy NP Shift (56a) is not better than the original (57a) in phonological terms: (56a) as well as (56b) has two boundaries to the right of the verb *showed*. In other words, Heavy NP Shift has applied to (57a) to give (56a) without improvement. That is the reason why (56a) is not perfect. On the other hand, the original (57b) is phonologically perfect sentence, which has no more than one boundary between words. Heavy NP Shift applies to (57b) to give a worse sentence (56b), which has two boundaries between *showed* and *to John*. We can conclude that this inappropriate application of movement results in the unacceptability of (56b). Thus, we can explain the difference of acceptability between (56a) and (56b).

Lastly, the examples in (37a) and (37b) have the structures in (58a) and (58b).

(58) a. [Joanie [gave [[to Bill] [yesterday [a [picture [of [the [Grand Canyon]]]]]]]]]

?* b. [Joanie [gave [[to Bill] [[a [picture [of [the [Grand Canyon]]]]] yesterday]]]]

The phonological representations mapped from (58a) and (58b) are (59a) and (59b).

(59) a. / Joanie / gave // to Bill // yesterday / a / picture / of / the / Grand Canyon
////////

b. ?* / Joanie / gave // to Bill /// a / picture / of / the / Grand Canyon ///// yesterday
////

If the heavy NP is positioned to the left of the adverb *yesterday* as in (59b), the NP makes a number of boundaries between the NP and the following adverb. These boundaries violate the constraint "Avoid Pause" and make the sentence unacceptable. Heavy NP

Shift gets the best result when it moves a heavy NP to the end of the sentence as in (59a). Then the boundaries at the end of the heavy NP also come to the end of the sentence, avoiding pause in the middle of the sentence.

So far I have proposed a theory of syntax-phonology mapping and prosodic phrasing in the minimalist framework. I argued that the theory explains the data of secondary stress and Heavy NP Shift straightforwardly. I also argued that the theory can deal with the length of constituents and its effects on these phenomena straightforwardly.

5.4 An Alternative to Early Immediate Constituents Analysis

Finally, let us consider how the theory can be an alternative to Hawkins's Early Immediate Constituents (EIC) analysis. EIC is defined as in (60).

(60) Early Immediate Constituents (EIC)

The human parser prefers linear orders that maximize the IC-to-non-IC ratios of constituent recognition domains. (Hawkins 1994: 77)

For illustration, let us look at (61a, b).

(61) a. #[$_S$ [$_{S'}$ That Bill was frightened] [$_{VP}$ surprised [$_{NP}$ Mary]]]

|_____2/5=40%_____| |_2/2=100%| Agg=70%

b. [$_S$ It [$_{VP}$ surprised [$_{NP}$ Mary] [$_{S'}$ that Bill was frightened]]]

|2/2=100%| |__3/3=100%__| Agg=100%

In (61a), immediate constituents of the root S are the subject S' and the VP. The parser recognizes these constituents when he or she hears the verb *surprised*. Thus in order to

recognize two immediate constituents of S, he or she has to hear 5 words, giving a ratio of 2/5=40%. Similarly, there are two immediate constituents in the VP, and the parser has to hear two words to recognize the structure. This time the ratio is 2/2=100%. The aggregate of the two ratios is 70%. On the other hand, in (61b) the aggregate is 100%. Thus (61b) is preferred to (61a).

Another pair of sentences discussed by Hawkins is (62a, b).

(62) a. $[_S[_{NP}$Mary-ga$]$ $[_{VP}[_{S'}[_S$ kinoo John-ga kekkonshita$]$ to$]$ itta$]$

M-Nom yesterday J-Nom got married C said

2/2=100%

2/6=33.3%

'Mary said that John got married yesterday.' Agg=66.7%

b. $[_S[_{S'}[_S$ Kinoo John-ga kekkonshita$]$ to$]$ $[_{NP}$ Mary-ga$]$ $[_{VP}$ itta$]]$

yesterday J-Nom got married C M-Nom said

1/1=100%

3/3=100%

'Mary said that John got married yesterday.' Agg=100%

Hawkins claims that (62b) is preferred to (62a) because the aggregate of the ratios is 100%. However, about the half of the Japanese speakers I asked answered that (62a) is preferred to (62b). The point is that (62a) is not so awkward even though the sentence has a center-embedded S'. How can we explain this fact? EIC does not give us any explanation.

According to the mapping theory presented, we can say that the number of prosodic boundaries make the sentence awkward in violation of "Avoid Pause." The bare structures of (61a, b) and (62a, b) are (63a, b) and (64a, b), respectively.

(63) a. [[That [Bill [was frightened]]] [surprised Mary]]

b. [It [[surprised Mary] [that [Bill [was frightened]]]]]

(64) a. [Mary-ga [[[kinoo [John-ga kekkonshi-ta]] to] it-ta]]

b. [[Kinoo [John-ga kekkonshi-ta]] to] [Mary-ga it-ta]]

In English, (63a) has a sequence of four brackets, while the largest number of brackets in (63b) is two. (63a) is awkward because it violates "Avoid Pause." Extraposition of *that*-clause makes a phonologically better sentence (63b). In Japanese, (64a) has a sequence of three brackets, while the largest number of brackets in (64b) is two. We can argue that the violation of "Avoid Pause" in (64a) is not fatal and that Scrambling of embedded S' makes a slightly better sentence (64b).

5.5 Prosody and Punctuation in Japanese Processing

In this section, I argue that optional commas as well as pauses play an important role in Japanese syntactic processing. I also argue that prosody and punctuation are predictable by the syntax-phonology mapping proposed above.

Compared with European languages, Japanese allows fairly free use of commas (too-ten (point for reading)). In principle, commas can be put anywhere as long as they make the sentence easy to read: for example, after subjects, objects, and adverbs as in (65a, b).

(65) a. Watashi-wa, doitsu-de katta kamisori-o, tsuma-no otooto-ni okutta.
I-Top Germany-in bought shaver-Acc wife-Gen brother-Dat gave
'I gave my wife's brother the shaver I bought in Germany.'

b. Kyoo-wa, hisashiburini, genkina chichi-no shashin-o,
today after a long time cheerful father-Gen picture-Acc
boonasu-de katta kamera-de utsushita.
bonus-Instr bought camera-Instr took
'Today, I took a picture of my cheerful father after a long time with the camera I bought for my bonus.'

As is the case with commas in European languages, readers are supposed to read sentences (aloud or silently) with pauses where the commas are inserted. Hawkins (1994) proposes his Early Immediate Constituents (EIC) analysis and argues that the human parser prefers linear orders that maximize the IC-to-non-IC ratios of constituent recognition domains. Hawkins (1994) and Yamashita and Chang (1999) argue that long phrases tend to be fronted ahead of short ones in Japanese. However, sentences with 'short before long' order such as (65a, b) and (62a) are highly productive, and are as acceptable as ones with 'long before short' order such as (62b). (62a) and (62b) are repeated here as (66a) and (66b).

(66) a. [$_S$ [$_{NP}$ Mary-ga] [$_{VP}$ [$_{S'}$ [$_S$ kinoo John-ga kekkonshita] to] itta]
M-Nom yesterday J-Nom got married C said
'Mary said that John got married yesterday.'

b. [$_S$ [$_{S'}$ [$_S$ Kinoo John-ga kekkonshita] to] [$_{NP}$ Mary-ga] [$_{VP}$ itta]]
yesterday J-Nom got married C M-Nom said
'Mary said that John got married yesterday.'

Moreover (66a) becomes more natural and easier to understand when a comma is inserted after the matrix subject as in (67).

(67) Mary-ga, kinoo John-ga kekkonshita to itta.

I argue that one of the problems with Hawkins and Yamashita and Chang's analyses is that they do not take prosody and punctuation into account.

How do commas make sentences easier to understand? I have assumed that bare phrase structure of a sentence is mapped onto phonology. The bare mapping rule applies to (68a, b) and we get (69a, b) as their phonological structures.

(68) a. [Mary-ga [[[kinoo [John-ga kekkonshita]] to] itta]] (=60a)

b. [[Kinoo [John-ga kekkonshita]] to] [Mary-ga itta]] (=60b)

(69) a. / Mary-ga /// kinoo / John-ga kekkonshita // to / itta //

b. // Kinoo / John-ga kekkonshita // to // Mary-ga itta //

I argue that prosodic boundaries must be appropriately represented in prosody or written text. This is because the parser relies on this information in order to build up the phrase structure. In other words, prosody and written text must be faithful to the phonological structure mapped from the syntactic structure. The prosodic boundaries are represented with pauses of appropriate length in spoken form and with punctuation in written text. The comma inserted after the matrix subject in (67) suggests that there is a host of prosodic boundaries there in its phonological structure. Thus, the parser can correctly choose the intended phrase structure (68a) instead of (70a), which should be written with a comma after the adverb as in (70b).