To appear in *English Linguistics* 22:2 (2005), 380-405

PROSODY AND PHRASE STRUCTURE WITHOUT LABELS

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In an attempt to extend the minimalist program, Collins (2002) tries to eliminate syntactic labels from syntactic theory. However, labels have been used in many theories of the syntax-phonology interface. It is argued that these label-based theories have not only the conceptual problem of using labels but also empirical problems in three areas: (i) non-branching XPs, (ii) variable phrasing, and (iii) a variety of prosodic categories. These empirical problems also arise with Collins's label-free approach which uses multiple Spell-Out. An alternative theory of the PF interface is proposed which maps label-free phrase structure onto prosodic structure with boundaries.*

Keywords*: interface, bare phrase structure, branching, prosodic boundary, phonological phrase*

1. Introduction

The aim of this paper is to show that the PF interface does not refer to syntactic labels, contra phrasing theories based on labels (e.g. Selkirk (1986)). I will argue that the PF interface is not a

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* I would like to thank Yoshihito Dobashi, Joseph Emonds, Yoshihisa Goto, Shinichiro Ishihara, Yoshihisa Kitagawa, Jamal Ouhalla, Amy Schafer, and two anonymous EL reviewers for their valuable comments and suggestions. I am grateful to William Green for suggesting stylistic improvements. All remaining errors are my own.

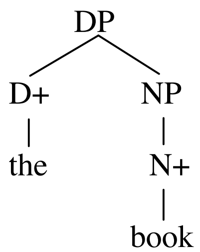
problem in eliminating syntactic labels from grammar. In section 2, I will outline the idea of eliminating labels, and will point out that the PF interface is one of the areas where labels have been used (cf. Collins (2002)). In section 3, I will point out that most of the interface theories need syntactic labels in mapping from syntax to PF. In section 4, I will argue that those label-based phrasing theories have conceptual and empirical problems. It is also argued that the same empirical problems arise with Spell-Out phrasing (e.g. Collins (2002)). In section 5, I will show that the label-free mapping proposed in Tokizaki (1999) does not have any of these problems and does have a number of favorable consequences. The conclusion is that the PF interface is not a problem in eliminating labels if we assume the label-free mapping and deletion of boundaries.

2. Eliminating Labels and PF Interface

2.1. Bare Phrase Structure

Let us first review the idea of bare phrase structure (Chomsky (1995)). Before the minimalist program, syntactic structures were built according to the X'-theory as shown in (1a). Phrase structure has labels that represent syntactic categories such as D or N and levels of projection such as X, X' and XP. The bare phrase structure of the same string is represented as (1b), which has no labels but has a lexical item itself at the branching node (Chomsky (1995:246)).

(1) a.



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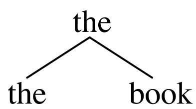
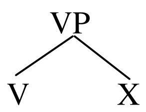
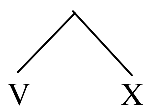


Collins (2002) explains the same point with the trees in (2).[1]

[1] Collins (2002) shows (ia) and (ib) as the set theoretic notation of (2a) and (2b), respectively.

(i) a. $\{V, \{V, X\}\}$ b. $\{V, X\}$

(2) a. 

b. 

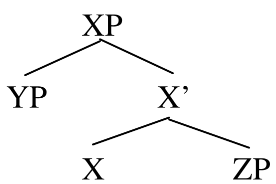
In the X'-theoretic structure (2a), V is merged with X and projects up to VP. In the minimalist theory without labels, the same syntactic object has the structure (2b), which has nothing at the branching node.

2.2. Areas Where Labels Have Been Used

Eliminating labels from phrase structure is desirable in the minimalist framework. The grammar involves bare interface conditions, which prohibit superfluous elements at the interface. Syntactic labels are not interpretable at LF and PF, and they should be eliminated from the theory. However, labels have been used in some areas of grammar, which Collins (2002) lists as (3a) to (3d).

(3) a. Basic properties of X'-theory
b. Selection (subcategorization)
c. Minimal Link Condition
d. PF interface

The basic properties of X'-theory (3a) are illustrated as (4) (cf. Jackendoff (1977), Chomsky (1986), Fukui (2001)).

(4) 

In (4), every phrase has a label and the complement and the specifier are maximal projections. It

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However, compared to (2a), (ia) has a bare phrase flavor in that it does not show the bar level such as VP.

has also been argued that the selection of a constituent by a lexical item (3b) refers to labels, as shown in (5a) and (5b) (cf. Grimshaw 1981, Chomsky 1986).

(5) a. I told on John. tell: [__ PP_{on}]

b. the destruction/*destroy the: [__ NP]

In (5a), the verb selects a PP whose label is the preposition on. In (5b) a determiner selects for an NP.

The Minimal Link Condition (MLC) (3c) roughly states that the goal G of a probe P is the closest feature that can enter into an agreement relation with P. Here 'closest feature' means that P c-commands G and there is no G' such that P asymmetrically c-commands G' and G' asymmetrically c-commands G. To see how the MLC needs to refer to labels, consider the following structure:

(6) C[+wh] you wonder [[$_{DP}$ which man] C[+wh] [stole the money why]]

To block agreement between the matrix C[+wh] and why, it has been assumed that the wh-feature of which projects up to the DP which man. The DP, but not which itself, c-commands why and can be a potential barrier G' between the matrix C[+wh] and why.

It has been argued that the interface between syntax and the PF component (3d) needs to refer to XPs because they are likely to form prosodic categories such as phonological phrase (cf. Selkirk (1986), Inkelas and Zec (1995)). We will discuss this point in the next section.

Collins (2002) tries to deal with each of these areas with alternative ideas to labels. In the following, I will focus on the problem of the PF interface (3d) and will discuss how we can deal with the PF interface without labels. In the next section, I will illustrate how the previous theories of the PF interface use labels, especially XPs.

3. Label-Based Phrasing and Spell-Out Phrasing

3.1. Models of Interface

Now let us review some models of the interface between syntax and phonology. The pre-minimalist framework assumes the inversed Y-model (7a), where S-structure is the input to Phonetic Form (PF) and Logical Form (LF) (cf. Chomsky (1995)).

(7) a.

$$\begin{array}{ccc} & \text{Lexicon} & \\ & \downarrow & \\ & \text{S-structure} & \\ \swarrow & & \searrow \\ \text{PF} & & \text{LF} \end{array}$$

b.

$$\begin{array}{ccccc} & \text{LF1} & & \text{LF2} & \\ & \uparrow & & \uparrow & \\ \text{Numeration} \rightarrow & \text{Phase1} \rightarrow & & \text{Phase2} \rightarrow \ldots & \\ & \downarrow & & \downarrow & \\ & \text{PF1} & & \text{PF2} & \end{array}$$

(7b) shows how derivation proceeds in the multiple Spell-Out model (Chomsky (2001)). Syntactic structure is Spelled-Out to PF and LF at each phase in the derivation. Note that the interface theories proposed in the 1980s and 1990s assume the inversed Y model (7a). However, the choice between the inversed Y-model (7a) and the multiple Spell-Out model (7b) does not make much difference in most cases of the PF interface. I assume the multiple Spell-Out model in the following discussion, but for ease of exposition I do not show the details of derivation by phase (See Tokizaki (1999)).

3.2. Label-Based Phrasing and Its Conceptual Problem

Let us briefly review how the previous theories of the PF interface refer to syntactic labels, especially XP versus X' and X. XP has been treated differently from X' and X in theories of the PF interface. Selkirk (1986:389) argues that a language chooses either the left or the right edge of a maximal projection as a phonological phrase boundary, as shown in (8).

(8) End Parameter Settings

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

One of her examples is from Chi Mwi:ni:

(9) a. $[_{VP} [_{V'} [_{V}$ pa(:)nzize] $[_{NP1}$ cho:mbo]] $[_{NP2}$ mwa:mba]]

ran vessel rock

'He ran the vessel on to the rock'

b. $_{PPh}($ ________________________ $)$ $_{PPh}($ __________$)$

According to Selkirk, Chi Mwi:ni selects the right edge of Xmax (=XP) as a phonological phrase (PPh) boundary. The end parameter (8a) correctly predicts that the sentence (9a) is divided into two phonological phrases as in (9b). The right edge of NP_1 makes a phonological boundary while the left edge of NP_1 and the right edge of V do not.[2] Other theories of the PF interface also refer to XP in their rules and constraints. For example, Zec and Inkelas (1990:370) propose Arboreal Mapping (10), which refers to XP in the clause (10c) (cf. Inkelas and Zec (1995:542)).

(10) <u>Arboreal Mapping</u>

a. Prominent elements are mapped into their own phonological phrases.

b. From the bottom up, branching nodes are mapped into phonological phrases.

c. No two phonological words on opposite sides of an XP boundary may be phrased together to the exclusion of any material in either XP.

Truckenbrodt (1999:228) clearly specifies XP in the constraint WRAP-XP as in (11).

(11) <u>WRAP-XP</u>

Each XP is contained in a phonological phrase.

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[2] In fact, (9) does not show that an edge of X' does not make a phonological phrase boundary. The only relevant example I know of is (i), which Selkirk (1986:386) cites from Matthew Chen's unpublished paper (1985) (cf. Chen (1987)).

(i) $[_{S} [_{NP}$ N] # $[_{VP} [_{?}$ PP # V] $[_{NP}$ N] #

The constituent Selkirk shows with (?) is considered to be V'. The right edge of it does not correspond to a prosodic phrase boundary (#).

These interface theories, which refer to syntactic labels such as XP, are not tenable within the minimalist framework. In addition to this conceptual problem, label-based theories have some empirical problems, which I will show in section 4.

3.3. Spell-Out Phrasing

Assuming that XP is special in the PF interface, Collins (2002) tries to solve the conceptual problem of using labels by proposing a label-free phrasing which uses multiple Spell-Out. He supposes that phonological phrasing rules refer to the notion of saturated constituent, which is similar to the notion of maximal projection. He suggests that a constituent is passed onto PF by Spell-Out every time it is saturated, and is marked as a potential phonological phrase. Following Chomsky's (2001) notion of Spell-Out unit, Dobashi (2003) also argues that the sister of a strong phase head (*v* and C), namely VP and IP (or TP), is Spelled-Out to PF as a phonological phrase. Here I will call this kind of approach Spell-Out phrasing.

Spell-Out phrasing does not have the conceptual problem of using labels because it does not have rules and constraints that refer to XP. However, Spell-Out phrasing also regards an XP (or a saturated constituent) as a phonological phrase, and has the same empirical problems as those that arise with label-based phrasing. In the next section, I will show three of these problems: (i) non-branching XPs, (ii) variable phrasing, and (iii) prosodic categories other than phonological phrase. I will then argue against label-based phrasing and Spell-Out phrasing.

4. Empirical Problems of Label-Based Phrasing and Spell-Out Phrasing

4.1. Non-Branching XPs

The first empirical problem of the previous analyses is the fact that an XP (or a saturated constituent) is not always an edge of phonological phrase. More precisely, data from a number of languages show that an XP is not an edge of phonological phrase when it is not branching, as in

(12a) and (13a). An XP is an edge of phonological phrase when it is branching, as in (12b) and (13b). I will use a hash (#) to show a boundary of prosodic phrases such as phonological phrase.

(12) a. ... $[_{XP}$ ... b. ...#$[_{XP}$ $[_{\alpha}$ ...

(13) a. ... $_{XP}]$ ... b. ... $_{\alpha}]$ $_{XP}]$#...

We can also illustrate the point with the following trees:

(14) a. XP b. XP

... ... # ... ... # ...

Label-based phrasing and Spell-Out phrasing need to explain why an XP is an edge of phonological phrase only in (12b) and (13b) or in (14b).[3]

First, let us look at Consonant Mutation in Mende, which changes voiceless and prenasalized consonants to voiced non-nasal consonants (Conteh et al. (1986:107)). Cowper and Rice (1987:188) argue that this rule is an external sandhi rule that applies within a phonological phrase. The phonological change occurs in (15a), where the VP containing the target consonant is non-branching. The change does not occur in (15b), where the VP is branching.

(15) a. $[_{S}$ $[_{NP}$ ndóláà] $[_{VP}$ w̲òtéà]] (<- p̲òté 'turn')
baby turn
'the baby turned'

[3] Most of the data shown in this section were originally presented in Tokizaki (1999), where it is argued that the phrasing data are problematic for the X'-theoretic phrase structure with non-branching categories. The data in fact support the bare phrase structure without non-branching categories. In this paper, I argue that the data are also problematic for label-based phrasing and Spell-Out phrasing even if we assume the bare phrase structure without non-branching categories. These analyses wrongly predict that an XP always form a prosodic category, as we will see below.

b. $[_S$ $[_{NP}$ tí] $[_{VP}$ $[_V$ kàkpángà] $[_{PP}$ ngì má]]] (-> *tí gàkpángà ngì má)
they surround him on
'they surrounded him'

In (15a) the consonant p in pòté changes into w. In (15b), the VP branches into V and PP, and Consonant Mutation does not apply to k, the first consonant in the VP. That is, kàkpángà does not change into gàkpángà. Thus, there must be a prosodic boundary blocking the change between the verb and the subject in (15b) but not in (15a). This is shown in (16).

(16) a. $[_S$ $[_{NP}$ ndóláà] $[_{VP}$ wòtéà]] (<- pòté 'turn')

b. $[_S$ $[_{NP}$ tí] # $[_{VP}$ $[_V$ kàkpángà] $[_{PP}$ ngì má]]] (-> * tí gakpángà ngì má)

This difference in phrasing is attributed to the fact that the VP in (16a) is non-branching while the VP in (16b) is branching into V and PP.

Second, word-final stress may move forward to avoid stress crash with the following word. In Italian, this phonological change, Stress Retraction, applies to a modified noun where the modifying AP is non-branching, as shown in (17a). Stress Retraction is blocked in (17b), where the AP is branching (Nespor and Vogel (1986:175)).

(17) a. Le $[_{NP}$ $[_N$ cítta] $[_{AP}$ nórdiche]] non mi piacciono. (<- cittá)
the cities Nordic not to-me please-3Pl
'I don't like Nordic cities.'

b. Le $[_{NP}$ $[_N$ cittá] $[_{AP}$ $[_{Adv}$ mólto] $[_A$ nordiche]]] non mi piacciono. (-> * cítta)
the cities very Nordic not to-me please-3Pl
'I don't like very Nordic cities.'

The word stress on cittá may move forward to avoid stress crash with the stress on the following word in (17a) but not in (17b). This is another case of the contrast between non-branching XP (12a) and branching XP (12b).

The non-branching/branching contrast also appears in stress shift in English, which is called the Rhythm Rule. Word-final stress may move forward to avoid stress crash if the following word has its stress on the first syllable. This stress shift can occur only if the following constituent is non-branching as in (18a), where persevéres may change into pérseveres. The stress shift rule is blocked if the following constituent branches as shown in (18b), where persevéres does not change into pérseveres (Nespor and Vogel (1986:178)).[4]

(18) a. John [$_{VP}$ [$_{V}$ pérsevères] [$_{AdvP}$ gládly]] (<- persevéres)

b. John [$_{VP}$ [$_{V}$ persevéres] [$_{\&P}$ [$_{AdvP}$ gládly] [$_{\&'}$ and diligently]] (->*pérsevères)

No stress shift in (18b) is due to the prosodic boundary between the verb and the branching constituent. The same contrast can also be seen between the subject and the verb, as shown in (19a) and (19b) (Inkelas and Zec (1995:543)).[5]

(19) a. [$_{S}$ [$_{NP}$ Ánnemarìe] [$_{VP}$ héard]] (<- Ànnemaríe)

b. [$_{S}$ [$_{NP}$ Ànnemaríe] [$_{VP}$ [$_{V}$ héard] [about it already]]] (-- Ànnemaríe)

The primary stress on Ànnemaríe can move forward to avoid stress clash if the following constituent, i.e. VP, is non-branching as in (19a), but not if it is branching as in (19b).

Third, the insertion of a discourse particle is allowed in front of a branching XP in Hausa. (20a) shows that a discourse particle *fa* cannot be inserted between a verb and its non-branching object. It can be inserted between a verb and its branching object as shown in (20b) (Zec and Inkelas (1990:369)).

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[4] In (18b), the coordinate structure is represented as &P, which has and as its head (cf. Kayne (1994)).

[5] I assume here that about it already in (19b) is a constituent, following Larson (1988). The VP, heard about it already, is branching in any analysis. A dash in the parentheses shows that no phonological change occurs on the base form.

(20) a. * Ya [$_{\text{VP}}$ [$_{\text{V}}$ sayi] fa [$_{\text{NP}}$ teburin]]
he bought table-DEF
'He bought the table.'

b. Ya [$_{\text{VP}}$ [$_{\text{V}}$ sayi] fa [$_{\text{NP}}$ [$_{\text{AP}}$babban] [$_{\text{N}}$ tebur]]]
he bought big table
'He bought a big table.'

This contrast can be explained if we assume that fa can be inserted at a prosodic phrase boundary. The branching NP in (20b) makes a prosodic phrase while the non-branching NP in (20a) does not.

The examples (15) to (20) show that the left edge of an XP is not always the edge of a prosodic phrase. The same is also true about the right edge of an XP, as shown in (13a) and (13b) above, repeated here as (21a) and (21b).

(21) a. ... $_{\text{XP}}$] ... b. ... $_{\alpha}$] $_{\text{XP}}$]#...

The right edge of a non-branching XP does not make a prosodic boundary as in (21a), but that of a branching XP does make a prosodic boundary as in (21b). The first case of (21) is High Deletion in Kinyambo. This rule states that a High tone in one word will cause the deletion of the rightmost High tone in the word to its left if the two words are both part of the same phonological phrase (Bickmore (1990:9, 14)). The last high tone in an NP is deleted if the NP is non-branching as in (22a). However, it is not deleted if the NP is branching as in (22b). A high tone is marked with an acute accent (´).

(22) a. [$_{\text{S}}$ [$_{\text{NP}}$ abakozi] [$_{\text{VP}}$ bákajúna]] (<- abakózi 'workers')
workers they-helped
'the workers helped'

b. [$_{\text{S}}$ [$_{\text{NP}}$ [$_{\text{N}}$ abakozi] [$_{\text{AP}}$ bakúru]] [$_{\text{VP}}$ bákajúna]] (-- bakúru 'mature')
workers mature they-helped
'The mature workers helped.'

The high tone in abakózi, a non-branching NP, is deleted in (22a) while bakúru, a word in the branching NP, keeps its high tone in (22b). This shows that there is a prosodic boundary between the subject NP and the VP in (22b), but not in (22a).

(23) a. $[_{S}$ $[_{NP}$ abakozi] $[_{VP}$ bákajúna]]

b. $[_{S}$ $[_{NP}$ $[_{N}$ abakozi] $[_{AP}$ bakuru]] # $[_{VP}$ bákajúna]]

The boundary blocks High Deletion from applying to bakúru in (23b).[6]

The second case of (21) is concerned with word-initial low pitch in Japanese (Tokizaki (1999)). The pitch pattern of an unaccented word is LHH... in Japanese. The word initial low pitch can be deleted when it is preceded by a non-branching constituent as in (24a). I will call this phenomenon Low Deletion.[7] Low Deletion does not apply to a word when its preceding constituent is branching as in (24b). Low pitch is shown with a grave accent (`).

(24) Low Deletion in Japanese

a. $[_{NP}$ $[_{NP}$ Mòmo-to] $[_{NP}$ nira-o]] yòme-ni ageta. (<- nìra)
peach-and leek-Acc daughter-in-law-to gave
'I gave peaches and leeks to my daughter-in-law.'

b. $[_{NP}$ $[_{NP}$ $[_{A}$ Àmai] $[_{N}$ momo-to]] $[_{NP}$ nìra-o]] yòme-ni ageta. (-- nìra)
sweet peach-and leek-Acc daughter-in-law-to gave
'I gave sweet peaches and leeks to my daughter-in-law.'

The NP momo-to in (24a) is non-branching while the NP amai momo-to in (24b) is branching.[8] The initial low pitch in nìra (LH) is deleted, and the pitch contour of the word becomes HH in (24a).

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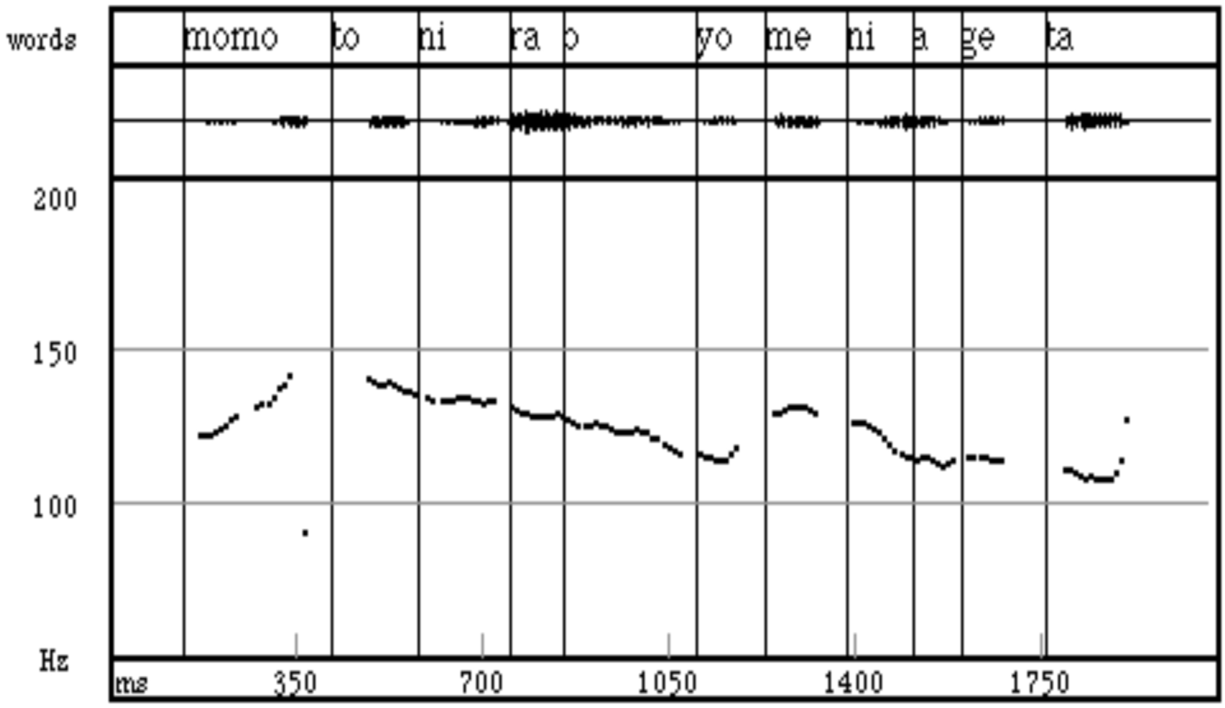
[6] In (22b) and (23b), the High tone on bakúru causes the deletion of the High tone on abakózi because the two words are not separated by a phonological phrase boundary.

[7] Word initial low pitch has also been called Initial Lowering (e.g. Selkirk and Tateishi (1988)).

[8] I assume that a conjunction particle -to is a kind of postposition and is cliticized to the

However, the initial low pitch in nìra is kept intact in (24b). The pitch contours of (24a) and (24b) are shown in Figure 1 and Figure 2, respectively.

Figure 1



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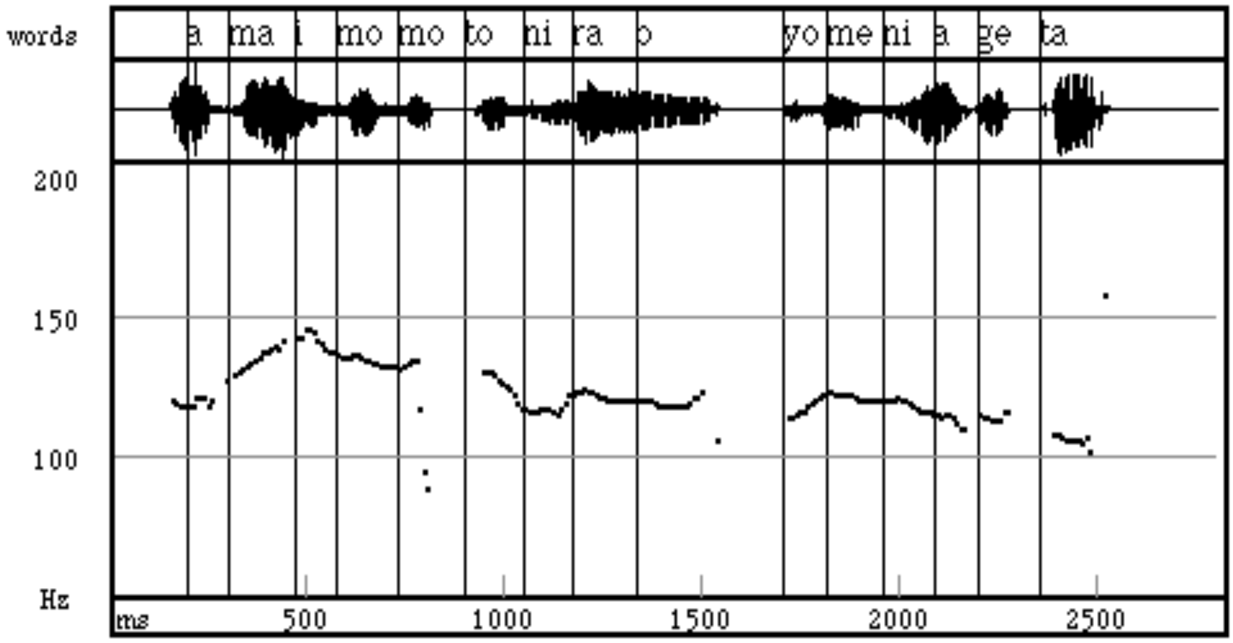
preceding word. Thus, momo-to is a non-branching NP.

Figure 2



There is no dip on ni in nira in Figure 1. Its low pitch is deleted by Low Deletion because the word nira is contained in the same prosodic phrase as the preceding word momo-to. In Figure 2, the pitch of ni in nira is lower than the preceding mora to and the following mora ra. Low Deletion is blocked by a prosodic boundary to the right of the branching constituent, namely the NP *amai momo-to*. The phrasing patterns of (24a) and (24b) are shown in (25a) and (25b), which correspond to (21a) and (21b), respectively.[9]

(25) a. $[_{NP}$ $[_{NP}$ Mòmo-to]$[_{NP}$ nira-o]] yòme-ni ageta. (<- nìra)

b. $[_{NP}$ $[_{NP}$ $[_{A}$ Àmai]$[_{N}$ momo-to]] # $[_{NP}$ nìra-o]] yòme-ni ageta. (-- nìra)

[9] There is also a prosodic boundary (#) between nira-o and yome-ni blocking Low Deletion of the low pitch in yòme-ni in (25a) and (25b). Low Deletion deletes the low pitch of àgeta in the sentences because there is no boundary between yòme-ni and ageta.

In (25a), the non-branching NP momo-to and the following NP nira-o are not separated by a prosodic boundary, and Low Deletion applies to the latter NP nìra and deletes the low pitch on it.

As we have seen from (12) to (25), the edge of XP is not always the edge of a prosodic phrase. This is a problem for label-based phrasing and Spell-Out phrasing, which define an edge of XP or a saturated constituent as an edge of a prosodic phrase.

4.2. Variable Phrasing

The second problem of the previous analyses is that they cannot satisfactorily explain the variability of phrasing. For example, the sentence (26a) is normally pronounced in one prosodic phrase. However, each word can be pronounced as one prosodic phrase as shown in (26b), for example, when the speaker is irritated (Kreidler (1989:156)).

(26) a. # We don’t want any #

b. # We # don’t # want # any #

This example shows that prosodic phrasing is not absolutely determined by syntactic structure alone.

Another example can be found in Italian. The sentence (27a) consists of four phonological phrases, shown here with ϕ. The sentence can also be pronounced in two phonological phrases as shown in (27b) (Nespor and Vogel (1986:172)).

(27) 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]$_{\phi}$

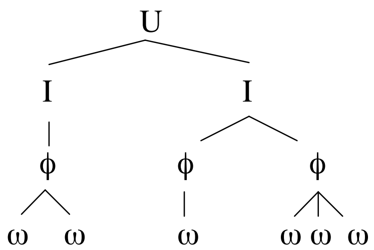
The phrasing in (27b) is attested by a phonological change, “raddoppiamento sintattico,” which lengthens the word-initial consonant if the word is not separated from the preceding word by a phonological phrase boundary. The lengthened consonants are italicized in (27b). This phonological change shows that the word with an italicized consonant is contained in the same phonological phrase with the preceding word, as in (27b).

Label-based phrasing and Spell-Out phrasing predict only one phrasing pattern for a sentence. According to these phrasing theories, the edge of an XP or a saturated constituent should always correspond to the edge of a prosodic phrase. However, the examples in (26) and (27) show that prosodic phrasing is variable. The variability of phrasing constitutes a problem for analyses using label-based phrasing and Spell-Out phrasing.[10] Theories of the PF interface must be flexible enough to allow a number of phrasing patterns for a sentence.

4.3. Other Prosodic Categories

The third problem of label-based phrasing and Spell-Out phrasing is that they do not explain any prosodic categories other than phonological phrase. It has been argued that there are a number of prosodic categories making a hierarchy, as shown in (28) (Selkirk (1984)).

(28)



In Pakistan, Tuesday is a holiday

[10] Nespor and Vogel (1986) and Dobashi (2004) propose restructuring of phonological phrases, which changes (27a) into (27b). However, it is not clear under what condition the rule applies. Moreover, it is conceptually questionable that an output of Spell-Out is restructured again at the PF interface.

This example shows four kinds of prosodic categories: utterance (U), intonational phrase (I), phonological phrase (ϕ), and prosodic word (ω). There have also been proposed more categories such as intermediate phrase, major phrase, minor phrase, and clitic group (e.g. Selkirk and Tateishi (1988), Nespor and Vogel (1986)). Label-based phrasing can deal with phonological phrase and prosodic word, with Selkirk (1986), for example, arguing that an edge of X^0 corresponds to an edge of a prosodic word. However, label-based phrasing does not explain how an utterance is divided into intonational phrases. Considering that we can assume only XP, X', and X^0, it seems impossible to specify which syntactic category corresponds to each prosodic category shown above.

Spell-Out phrasing can explain only phonological phrase or intonational phrase depending on what constituent is defined as a phase. If an XP or a saturated constituent is defined as a phase, Spell-Out sends it to PF as a phonological phrase (Collins (2002)).[11] If VP and IP are sent to PF at a phase as Chomsky (2001) argues, the unit will be an intonational phrase (cf. Dobashi (2003)). In either case, Spell-Out phrasing cannot produce other prosodic categories.[12] We should look for a unified theory that gives us a better picture of how all the prosodic categories are determined and hierarchically constructed.

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[11] In fact, Collins (2002) regards a saturated constituent as "a potential phonological phrase," which can become a phonological phrase depending on the parameter of the language. However, he does not show the details of the parameter.

[12] Moreover, the other edge of a saturated constituent does not always correspond to an edge of prosodic phrase if the idea of End Parameter Settings in (8) is right. This is another problem with Spell-Out phrasing. Recall that the left edge of NP_1 does not correspond to an edge of phonological phrase in (9).

So far, I have argued against label-based phrasing and Spell-Out phrasing. First, I pointed out that label-based phrasing has a conceptual problem in that it depends on syntactic labels, which should be eliminated in the minimalist framework. Second, I pointed out three problems with label-based phrasing and Spell-Out phrasing: non-branching XPs, variable phrasing, and prosodic categories other than phonological phrase. In the next section, I will describe an alternative theory of the PF interface that does not have these problems and has a number of favorable consequences.

5. Boundary Phrasing and Its Consequences

5.1. Boundary Mapping and Boundary Deletion

The theory of the PF interface I have explored in Tokizaki (1999, 2000) involves boundary mapping and boundary deletion. I will call this approach boundary phrasing. Syntactic phrase structure is mapped onto phonological structure by the rule (29).

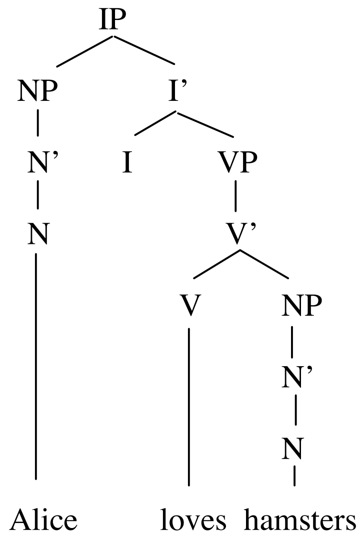
(29) Interpret boundaries of syntactic constituents [...] as prosodic boundaries / ... /.

The rule (29) interprets boundaries of syntactic constituents as prosodic boundaries. I assume that this rule is one of the linearization rules that encode hierarchical syntactic structure as a sequence of words and pauses (see Kayne (1994) and Uriagereka (1998) for linearization). I assume bare phrase structure in the sense of Chomsky (1995). For illustration, consider the following sentence:

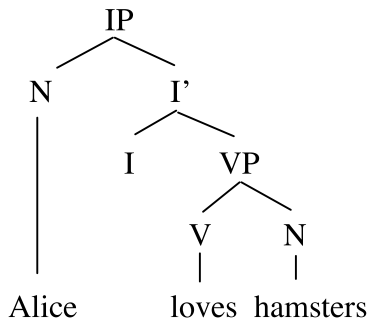
(30) Alice loves hamsters.

As Chomsky (1995:246) notes, “there is no such thing as a non-branching projection.” This is a consequence of the operation Merge, which combines two syntactic objects. Then the phrase structure of (30) is not the X-bar theoretic structure (31a) but the bare phrase structure (31b).

(31) a. $[_{IP}\ [_{NP}[_{N'}\ [_{N}\ \text{Alice}]]]\ [_{I'}\ \text{I}\ [_{VP}\ [_{V'}\ [_{V}\ \text{loves}]\ [_{NP}[_{N'}\ [_{N}\ \text{hamsters}]]]]]]]$



b. $[_{IP}\ [_{N}\ \text{Alice}]\ [_{I'}\ \text{I}\ [_{VP}\ [_{V}\ \text{loves}]\ [_{N}\ \text{hamsters}]]]]$



I also assume the following convention for invisible syntactic objects:[13]

(32) Phonologically null elements and the constituents made by merging them with other syntactic objects are invisible to phonological rules.

By "phonologically null elements" I mean the categories that have no phonetic features, such as PRO, Infl, and *v*. Given the convention (32), I and I' in (31b) are invisible to phonological rules. I is phonologically null, and I' is made by merging null I with VP. Note that IP is visible to phonological rules. It is made by merging N and I', neither of which is a phonologically null

[13] Nespor and Scorretti (1984) also argue that empty categories have no effect on the various PF rules.

element. Thus, phonological rules can "see" only substantial parts of the bare phrase structure, which is shown in (33).[14]

(33) $[_{IP}$ $[_{N}$ Alice] $[_{VP}$ $[_{V}$ loves] $[_{N}$ hamsters]]]

Following Chomsky (1995) and Collins (2002), I also assume that there are no labels in syntactic structure. With these assumptions, the mapping rule (29) applies to the "completely bare" phrase structure (34).

(34) [[Alice] [[loves] [hamsters]]]

The rule interprets the brackets in (34) and changes them into prosodic boundaries as in (35).

(35) // Alice /// loves // hamsters ///

The slashes in (35) show the basic disjuncture between words. In this theory, prosodic phrasing is produced by the boundary deletion rule (36).

(36) Delete <u>n</u> boundaries between words. (<u>n</u>: a natural number)

The rule (36) deletes a number of boundaries between words to make a longer prosodic phrase. I assume that (36) is a rule in the PF component, which interprets the basic disjuncture between words mapped from syntactic structure as the actual speech with prosodic phrasing. If we apply the rule (36) to the phonological representation (35), we can get three phrasing patterns depending on the value of <u>n</u>. If <u>n</u> is 1, the sentence is divided into three prosodic phrases as shown in (37a). If <u>n</u> is 2, it is divided into two phrases as in (37b). If <u>n</u> is 3, the whole sentence is contained in one

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[14] If we assume the VP-internal subject hypothesis as in (ia), the result is almost the same as (33), as shown in (ib) because the trace of subject and the VP are invisible.

(i) a. $[_{IP}$ $[_{N}$ Alice$]_{i}$ $[_{I'}$ I $[_{VP}$ $\underline{t}_{i}$ $[_{V'}$ $[_{V}$ loves] $[_{N}$ hamsters]]]]]

b. $[_{IP}$ $[_{N}$ Alice] $[_{V'}$ $[_{V}$ loves] $[_{N}$ hamsters]]]

The only difference between (33) and (ib) is that the label of the constituent <u>loves hamsters</u> is VP in (33) and V' in (ib). The difference disappears if we assume the label-free structure as in (34).

prosodic phrase as shown in (37c).

(37) a. / Alice // loves / hamsters // (n=1) --> (Alice) (loves) (hamsters)

b. Alice / loves hamsters / (n=2) --> (Alice) (loves hamsters)

c. Alice loves hamsters (n=3) --> (Alice loves hamsters)

I assume here that the number of boundaries to be deleted (n) corresponds to the speed of utterance. The larger n is, the faster the utterance. When the speaker utters a sentence faster, more boundaries are deleted and each prosodic phrase becomes longer. We can think of (37a) as slow speech, (37b) as medium, and (37c) as fast. Thus, we can capture the relation between the rate of speech and the length of prosodic phrases. I assume that n also corresponds to the level of prosodic categories. The larger n is, the higher the prosodic category (e.g. intonational phrase). I will return to this point in section 5.5. [15]

In this section, I outlined boundary phrasing. As shown in (29), this mapping needs only a syntactic branching structure or brackets as its input. It does not need any syntactic labels. This is a welcome result in the minimalist framework.

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[15] In principle, the value of n can range from 1 to any natural number. However, as n is related to the speed of utterance, there might be some upper limit in the linguistic performance. Note that n is also related to the levels of prosodic categories. Nespor and Vogel (1986) assume that Utterance is the largest prosodic category. However, there might be still larger prosodic categories such as Paragraph or Discourse (see Couper-Kuhlen (2001:17) and the references cited therein for the notion of declination unit; see also Tokizaki (2005)). Then it might be the case that the value of n can really be any natural number.

5.2. An Edge of Branching Categories

Now let us see how this theory explains the data we have seen in sections 3 and 4. The observation made by label-based phrasing was that an edge of XP tends to correspond to an edge of a prosodic phrase. Let us consider the Chi Mwi:ni example (9a), repeated here as (38).[16]

(38) $[_{VP}$ $[_{V'}$ $[_{V}$ pa(:)nzize] $[_{NP1}$ cho:mbo]] $[_{NP2}$ mwa:mba]]

ran vessel rock

'He ran the vessel on to the rock'

The mapping rule (29) applies to (38) and changes the syntactic brackets into prosodic boundaries to give (39).

(39) /// pa(:)nzize // cho:mbo /// mwa:mba //

If we apply the boundary deletion (36) with n=2 to (39), we get (40).

(40) / pa(:)nzize cho:mbo / mwa:mba (n=2)

This is the correct phrasing as we have seen in (9b).

Generally, when a branching XP, consisting of X and Y, merges with a head Z, the non-merging edge of the XP gets another syntactic boundary:

(41) [Z $[_{XP}$ X Y]*]*

In (41), the XP receives the italicized bracket through the merge with Z in addition to its own bracket, which has been made by merging X and Y. As a result, there are two brackets to the right of Y, which is the longest sequence of brackets in (41). The boundary mapping (29) and the boundary deletion (36) with n=1 predict a prosodic boundary there.

(42) a. / Z / X Y //

b. Z X Y / (n=1)

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[16] I assume the bare phrase structure without labels. However, I still show syntactic labels for ease of exposition.

That explains why an edge of an XP is likely to correspond to an edge of a prosodic phrase.

In fact, on the proposed account we expect the non-merging edge of a branching category to correspond to an edge of a prosodic phrase. On the other hand, neither the merging edge of an XP (= the merging edge of Z) nor the non-merging side of Z corresponds to an edge of a prosodic phrase. The head Z, a single lexical item by definition, cannot be branching and does not have its own bracket. (41) is an example of head-initial (i.e. complement-right) languages, and the prosodic boundary is on the right edge of the complement XP. In head-final (i.e. complement-left) languages, the prosodic boundary is expected to be at the left edge of the complement XP.

(43) $[[_{XP}$ Y X] Z]

(44) a. // Y X / Z /

b. / Y X Z (n=1)

This prediction is borne out in a number of languages (Tokizaki (1999)). In other words, the syntactic head parameter setting also determines the end parameter setting in (8). Then we can do away with the edge parameter in phonology, which is assumed in Selkirk (1986) and Selkirk and Tateishi (1988). This is a welcome consequence of boundary phrasing.

5.3. Branching vs. Non-Branching Categories

Boundary phrasing naturally explains why branching categories are more likely to make prosodic boundaries than non-branching ones, as we have seen in 4.1. A non-branching category has only one syntactic boundary at its edge, as shown in (12a) and (13a), repeated here as (45a). A branching category has more than one boundary at its edge, as shown in (12b) and (13b), repeated here as (45b).

(45) a. ... [... *or* ...] ...

b. ...#[[... *or* ...]]#...

The mapping rule (29) interprets these syntactic boundaries as prosodic boundaries, as in (46a) and

(46b).

(46) a. ... / ...

b. ... // ...

If the boundary deletion rule (36) deletes one boundary between words (n=1) in (46a) and (46b), no boundaries are left in (47a), while one boundary is left in (47b).

(47) a. ... ... (n=1)

b. ... / ... (n=1)

The boundary in (47b) blocks application of phonological rules whose domain is restricted within a prosodic phrase.

Now, let us reconsider the problematic cases we have seen in 4.1. The first one is Consonant Mutation in Mende (15). Assuming the invisibility of phonologically null elements (32), the input structures to the mapping rule (29) are (48a) and (48b).

(48) a. [$_{IP}$ [$_{N}$ ndóláà] [$_{V}$ wòtéà]] (<- pòté ‘turn’)
baby turn
‘the baby turned’

b. [$_{IP}$ [$_{N}$ tí] [$_{VP}$ [$_{V}$ kàkpángà] [$_{PP}$ [$_{D}$ ngì] [$_{P}$ má]]]] (->* tí gàkpángà ngì má)
they surround him on
‘they surrounded him’

The predicate is non-branching in (48a) and branching in (48b). In (48b) the verb kàkpángà merges with PP and gets another syntactic boundary, i.e. VP, to its left. This is the crucial difference between (48a) and (48b) which is retained in the outputs of the mapping rule (29), as in (49a) and (49b).

(49) a. // ndóláà // wòtéà //

b. // tí /// kàkpángà /// ngì // má ////

If we delete two boundaries between words in (49a) and (49b), we get (50a) and (50b), respectively.

(50) a. ndóláà wòtéà (n=2)

b. tí / kàkpángà / ngì má // (n=2)

In (50a), Consonant Mutation has applied to the word-initial consonant to change p to w because there is no boundary between the two words. In (50b), the remaining boundary between tí and kàkpángà blocks Consonant Mutation from applying to the word-initial consonant k, which does not change into g. Thus, boundary phrasing naturally explains the phrasing difference between branching and non-branching categories.

The other examples we have seen in 4.1 are explained in the same way. To show an example of the right edge of non-branching/branching categories, High Deletion in Kinyambo applies in (51a) (=(22a)) but not in (51b) (=(22b)).

(51) a. [$_{IP}$ [$_{N}$ abakozi] [$_{V}$ bákajúna]] (<- abakózi 'workers')
workers they-helped
'the workers helped'

b. [$_{IP}$ [$_{NP}$ [$_{N}$ abakozi] [$_{A}$ bakúru]] [$_{V}$ bákajúna]] (-- bakúru 'mature')
workers mature they-helped
'The mature workers helped.'

The results of the mapping (29) are shown in (52a) and (52b).

(52) a. // abakozi // bákajúna //

b. /// abakozi // bakúru /// bákajúna //

The boundary deletion (36) with n=2 applies to (52a) and (52b) to give (53a) and (53b), respectively.

(53) a. abakozi bákajúna (n=2)

b. / abakozi bakúru / bákajúna (n=2)

In (53a) High Deletion deletes the high tone of abakózi because the first syllable of the next word bákajúna also has high tone. In (53b) the boundary between bakúru and bákajúna blocks High Deletion from applying to the high tone in bakúru.

For reasons of space, I will not go into the analysis of the other examples shown in 4.1. However, it is clear that boundary phrasing makes the correct prediction in each case.

5.4. Variable Phrasing by Variable Boundary Deletion

We can also explain variable or optional phrasing in terms of the boundary deletion rule (36), which has a variable n in it. The bare phrase structure of the example (26) we have seen in 4.2 is (54).

(54) $[_{IP} [_{D} \text{ we}] [_{I'} [_{I} \text{ don't}] [_{VP} [_{V} \text{ want}] [_{D} \text{ any}]]]]$

(54) is mapped onto (55) by the rule (29).

(55) // we /// don't /// want // any ////

If we apply the deletion rule (36) with n=3 to (55), we get (56a). If we apply the rule with n=1, the result is (56b).

(56) a. we don't want any / (n=3)

b. / we // don't // want / any /// (n=1)

(56a) and (56b) correspond to the phrasing in (26a) and (26b), respectively. Thus, we can explain the variability of phrasing in terms of the variable n in the boundary deletion rule (36). Moreover, we can also predict that the speech rate of (56a) is faster than that of (56b) if we assume that the value of n corresponds to the speech rate.

The optional phrasing in Italian shown in (27) is explained in the same way. The input to the mapping rule (29) is (57a) and its output is (57b). I assume that *se* is a proclitic and has no syntactic boundary to its right.

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

if catch(Fut) something catch(Fut) thrushes

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

If we apply the deletion rule (36) with n=1, we get (58a), which predicts a prosodic boundary after each word. If we apply the rule with n=2, we get (58b), where the sentence consists of two prosodic phrases.

(58) a. // Se / prenderá / qualcosa //// prenderá / tordi // (n=1)

b. / Se prenderá qualcosa /// prenderá tordi / (n=2)

(58a) and (58b) correspond to the actual phrasing patterns in (27a) and (27b), respectively.[17] In this way, boundary phrasing naturally explains the variable phrasing by the variable deletion rule (36).

5.5. Prosodic Categories by Variable Boundary Deletion

We can also explain prosodic categories other than phonological phrase by changing the value of n in the deletion rule (36). Suppose that n also relates to the levels of prosodic categories. If n is larger, then (36) makes larger prosodic domains (e.g. phonological phrase or intonational phrase). The bare phrase structure of the sentence (28) is (59a), which is interpreted as (59b) by the mapping rule (29).

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

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

If we delete one boundary between words in (59b), the result is (60d), where each word by itself makes a prosodic category, namely a prosodic word. Deletion of two boundaries in (59b) makes (60c), four phonological phrases. (60b) shows intonational phrasing, resulting from deletion of

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[17] (58a) wrongly predicts that se makes a prosodic phrase by itself. It might be that se is incorporated to the next word syntactically (se-prendera). However, se can be pronounced separately, which suggests that it should be analyzed as shown in (57a). I will leave the matter open. For the analysis of clitics, see Tokizaki (2004).

three boundaries in (59b). (60a) is the topmost prosodic category, utterance. This prosodic category is predicted by deletion of four boundaries in (59b).

(60)	a.	In Pakistan Tuesday is a holiday /	($\underline{n}$=4)	Utterance
	b.	In Pakistan / Tuesday is a holiday //	($\underline{n}$=3)	Intonational Phrase
	c.	/ In Pakistan // Tuesday / is / a holiday ///	($\underline{n}$=2)	Phonological Phrase
	d.	// In / Pakistan /// Tuesday // is // a / holiday ////	($\underline{n}$=1)	Prosodic Word

Thus, we can explain the whole prosodic hierarchy in terms of the bare phrase mapping and the variable boundary deletion rule.

Another favorable consequence of this analysis is that we can explain why prosodic categories are strictly layered (cf. Selkirk (1984)). As shown in (60), deleting one more boundary in a prosodic category will produce the next higher prosodic category. For example, deleting one more boundary between words in the phonological phrases (60c) makes the intonational phrases in (60b). Thus, there cannot be a problematic hierarchy such as multiple domination or heterogeneous sisters (cf. Ladd (1996), Tokizaki (2002)).[18]

5.6. Further Consequences

The interface theory presented here is simple and has further consequences in syntax, phonology, sentence processing, and the architecture of grammar. Let us examine some of these very briefly. For reasons of space, I do not go into the details here, but see Tokizaki (2000, 2004).

First, restructuring of the phonological phrase, assumed in Nespor and Vogel (1986) and Dobashi (2004), is not necessary in the PF component. We can derive various phrasing patterns for a sentence in terms of the boundary deletion rule (36), as we have seen in 4.2 and 5.4.

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[18] This analysis allows us to dispense with prosodic category hierarchies altogether. See Tokizaki (2002) for details.

Second, we can explain why length of constituents affects prosodic phrasing. It has been observed that long constituents (e.g. long subjects) are likely to make their own prosodic categories. Consider the following sentences:

(61) a. [They [laughed [at him]]]

b. [[Those [who [were present]]] [laughed [at him]]]

(62) a. / They / laughed / at him ///

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

The syntactic boundaries in (61a) and (61b) are interpreted by (29) as prosodic boundaries in (62a) and (62b). The number of boundaries between subject and verb is one in (62a) and four in (62b). If we delete one boundary between words by the deletion rule (36) with n=1, we get the following results:

(63) a. They laughed at him

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

Then we can explain why the subject in (61b) is more likely to make its own prosodic phrase than that in (61a). Thus we can deal with the relation between prosodic phrasing and the length of constituents.

Third, Heavy NP Shift can be regarded as movement triggered by the preference for fewer prosodic boundaries between words.

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

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

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

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

There is a sequence of five boundaries between hamsters and to in (65a). There is no such long sequence of boundaries in (65b) where Heavy NP Shift has applied. This analysis provides an alternative to Hawkins's (1994) Early Immediate Constituent analysis of word order and sentence processing.

Fourth, this analysis shows that there is some isomorphism between syntactic structure and prosodic structure, contrary to the generally accepted view that the two structures are non-isomorphic. The boundaries in the former are interpreted as those in the latter by the mapping rule (29).

Fifth, this analysis takes the speed of utterance into account as we have seen in 5.1 and 5.4. This may well shed light on the study of the interface between PF and the articulatory-perceptual system and create new possibilities for solving the problems of linguistic performance.

6. Conclusion

To conclude, in this paper I reviewed previous PF interface theories, and showed that they have conceptual and empirical problems. I presented an alternative theory, which maps label-free syntactic structure onto prosodic structure, and argued that the theory explains the data straightforwardly. Now that the PF interface does not need any syntactic labels, we do not have to worry about the PF interface when trying to eliminate labels in syntax. This is a small but steady step toward the goal of the minimalist program.

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