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## Prosodic Phrasing and Bare Phrase Structure

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### 0. Introduction

In this paper, I will propose a theory of mapping from syntax to phonology in the minimalist framework. I will argue that the phrasing data from a number of languages, together with this mapping theory, give evidence for the bare phrase structure theory (Chomsky 1995). I will also discuss some consequences of this theory in phonology and syntax.

### 1. Bare Syntax-Phonology Mapping

Cinque (1993:244) proposes a simplified version of Halle and Vergnaud's (1987) Nuclear Stress Rule. One of the rules is (1), and it maps syntactic constituents into metrical boundaries, as shown in (2):

- (1) Interpret boundaries of syntactic constituents as metrical boundaries.  
(2) (( \* ) ( \* ( \* ( \* )))  
[[Jesus] [preached [to the people [of Judea]]]]

Cinque shows metrical boundaries as parentheses which have directions, right and left. The syntax-phonology mapping rule I propose here is (3):

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

This rule interprets boundaries of syntactic constituents as metrical boundaries which

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have no direction, like bars in music. I assume here that the input to the rule (3) is the bare phrase structure, and not the X-bar theoretic phrase structure. I will argue this point in section 3. For example, the rule (3) maps the right branching structure (4a) into the PF representation (4b):

- (4) a.  $[[ X ] [[ Y ] [ Z ] ]]$  (=7b)  
 b.  $// X /// Y // Z ///$

In (4b), we have two boundaries before X, three between X and Y, two between Y and Z, and three after Z.<sup>1</sup>

In this bare mapping theory, phrasing means grouping words by deleting prosodic boundaries, and its rule is (5), where  $n$  is a variable:

- (5) Delete  $n$  boundaries between words. ( $n$ : a natural number)

For example, supposing that  $n$  is 1, 2, or 3, and applying (5) to (4b), we get (6a, b, c):

- (6) a.  $/ X // Y / Z //$  ( $n=1$ )  $-->$  (X) (Y) (Z)  
 b.  $X / Y Z /$  ( $n=2$ )  $-->$  (X) (Y Z)  
 c.  $X Y Z$  ( $n=3$ )  $-->$  (X Y Z)

In (6a), one boundary is deleted in every sequence of boundaries, and there are two boundaries between X and Y, and one boundary between Y and Z. So we get (X) (Y) (Z) phrasing. In (6b), two boundaries are deleted in every sequence of boundaries, and there is one boundary between X and Y, but no boundary between Y and Z. So we get (X) (Y Z). There is no boundary left in (6c) after three boundaries are deleted in every sequence of boundaries. The whole string is contained in a phrase as (X Y Z).

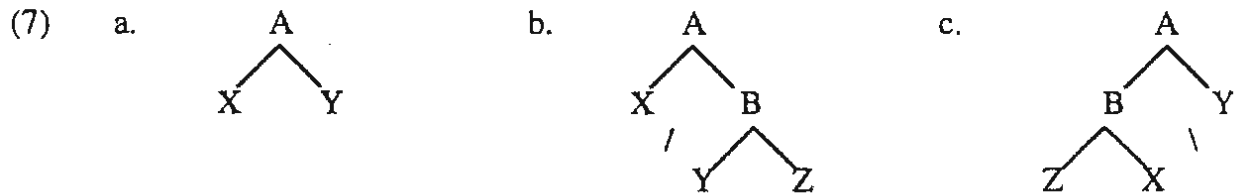
I assume here that the variable  $n$  relates to speech rates or phrasing levels. The basic idea is that if the speaker utters the sentence faster, the more boundaries are deleted, and the bigger phrases we get. We will return to the matter in section 4.2.

## 2. Branchingness in Prosodic Phrasing

The bare mapping theory gives us a new insight into the problem of branchingness in prosodic phrasing. In some languages, there are some phonological rules which apply between X and Y in (7a), but not in (7b) or (7c):<sup>2</sup>

<sup>1</sup> The basic idea of the rule (3) is not unprecedented. There are similar ideas such as depth of syntactic boundaries (Cheng, R. 1966:150), depth of embedding (Clements 1978: 29), Silent Demibeat Addition (Selkirk 1984:314, 1986:376, 388). See also Tokizaki (1988).

<sup>2</sup> Left branching structure (7c), as well as right branching structure (7b), makes a prosodic boundary, as we will see in (10) and (14). These cases pose an interesting problem on the view that the right/left branching structure are asymmetry as argued in Kubozono (1992:26, 1993:159).



Let us look at the data in turn. First, Cowper and Rice (1987:189) show that Consonant Mutation in Mende applies in (8a) and (9a) but not in (8b) and (9b):

- (8) a.  $[_S [_{NP} \text{ndóláà}] [_{VP} \text{wòtéà}]]$  <- pòté 'turn'  
       baby turn  
       'the baby turned'
- b.  $[_S [_{NP} \text{tí}] [_{VP} [_V \text{kàkpángà}] [_{PP} \text{ngì má}]]]$  -> \*tí gàkpángà ngì má  
       they surround him on  
       'they surrounded him'
- (9) a.  $\text{mèhê mé} [_{PP} [_P \text{à}]] [_{NP} \text{lòkó}]$  <- tòkó 'hand, forearm'  
       food eat with hand  
       'eat with fingers'
- b.  $\text{hé lé} [_{PP} [_P \text{a}]] [_{DP} [_{NP} \text{ngúlí}] [_D \text{í}]]]$  --  
       hang from tree Det  
       'hang from the tree'

That is, the rule applies if the constituent in question doesn't branch, but it doesn't apply if the constituent branches. In (8a) the VP *wòtéà* doesn't branch and in (9a) the complement NP of P *lòkó* doesn't branch. On the other hand, in (8b) the VP *kàkpángà* branches, and in (9b) the complement DP of P *ngúlí í* branches.

Second, According to Bickmore (1990:14), High Deletion in Kinyambo applies in (10a), but not in (10b):

- (10) a.  $[_S [_{NP} \text{abakózi}] [_{VP} \text{bákajúna}]]$  <- abakózi 'workers'  
       workers they-helped  
       'the workers helped'
- b.  $[_S [_{NP} [_N \text{abakozi}] [_A \text{bakúru}]] [_{VP} \text{bákajúna}]]$  -- bakúru 'mature'  
       workers mature they-helped  
       'The mature workers helped.'

High Deletion states that a High tone in one word deletes the High tone in the word to its left. So the high tone in *abakózi* is deleted in (10a) where the subject NP doesn't branch, but the high tone in *bakúru* in (10b) is not deleted. (10b) illustrates the left branching (7c) case.

Third, Zec and Inkelas (1990:369) argue that the discourse particle *fa* in Hausa needs to be followed by a branching constituent:

- (11) a. \*Ya [<sub>VP</sub> [<sub>V</sub> sayi] fa [<sub>NP</sub> teburin]]  
           he       bought       table-def  
           'He bought the table.'
- b.     Ya [<sub>VP</sub> [<sub>V</sub> sai]   fa [<sub>NP</sub> [<sub>A</sub> babban] [<sub>N</sub> tebur]]]  
           he       bought       big       table  
           'He bought a big table.'

In (11a), the object NP *teburin* doesn't branch, so *fa* cannot be inserted. But in (11b), the object NP *babban tebur* branches, so *fa* is allowed.<sup>3</sup>

Fourth, Nespor and Vogel (1986:175) show that Italian Stress Retraction, which avoids stress crash, applies in (12a), but not in (12b):

- (12) a.     Le [<sub>NP</sub> [<sub>N</sub> città] [<sub>AP</sub> nórdiche]] non mi piacciono. (< città)  
           'I don't like Nordic cities.'
- b.     Le [<sub>NP</sub> [<sub>N</sub> città] [<sub>AP</sub> [<sub>Adv</sub> molto] [<sub>A</sub> nordiche]]] non mi piacciono. (> \*cittá)  
           'I don't like very Nordic cities.'

The stress on the final syllable of *cittá* moves to the first syllable in (12a), but not in (12b). (12a) has a non-branching AP and (12b) has a branching AP.

Fifth, Rhythm Rule in English applies in (13a), but not in (13b) (Nespor and Vogel 1986:178, cf. Inkelas and Zec 1995:543):

- (13) a.     John [<sub>VP</sub> [<sub>V</sub> pèrseveres] [<sub>Adv</sub> gládly]] (< perseverés)  
        b.     John [<sub>VP</sub> [<sub>V</sub> perseverés] [<sub>&P</sub> [<sub>Adv</sub> gládly] [<sub>&</sub> and diligently]]] (> \*pèrseveres)

In (13b), two adverbs are conjoined to make a branching & Phrase.

Sixth, Initial Lowering in Japanese, shown as grave accents (`), doesn't occur on the first mora of the second conjunct NP *ichigo-o* if the first conjunct NP is not

<sup>3</sup> In fact, Hausa *fa* needs to be followed by a branching *constituent*, not just by more than one word, as shown in (i) (Zec and Inkelas 1990:370):

- (i)       \* [<sub>S</sub> Ya [<sub>VP</sub> [<sub>V</sub> sayi   fa [<sub>NP</sub> teburin]] [<sub>Adv</sub> jiya]]  
           he       bought       table-def   yesterday  
           'He bought the table yesterday.'

This example shows that phonological factors such as rhythm or length are not the point here.

branching, as *ringo-to* in (14a). Initial Lowering occurs on the first mora of the second conjunct NP *ichigo-o* in (14b) where the first conjunct NP *amai ringo-to* is branching:<sup>4</sup>

- (14) a. [NP [NP R<sub>ringo-to</sub>] [NP ichigo-o]] hito-kara moratta.  
 apples-and strawberries-Acc person-from got  
 'I got (some) apples and strawberries from a person.'
- b. [NP [NP [A A<sub>amai</sub>] [N ringo-to]] [NP ichigo-o]] hito-kara moratta.  
 sweet apples-and strawberries-Acc person-from got  
 'I got (some) sweet apples and (some) strawberries from a person. (*sweet* modifies only *apples*)'

So in (14a), the first mora of *ichigo* is not lowered, but in (14b) the first mora of *ichigo* is lowered because of the prosodic boundary.<sup>5</sup> This is another left-branching (7c) case.

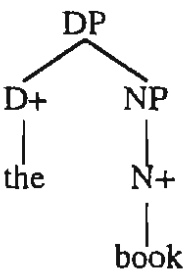
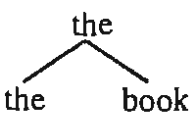
### 3. Bare Phrase Structure

All of these examples in section 2 show that the application of some rule depends on branchingness. In this section, I will argue that this fact gives an empirical support to the bare phrase structure theory.

Chomsky (1986:4) first posed the question about the existence of intermediate projection X'. He adopted the convention that single bar level structure as in (15a) need not be present when not required, as shown in (15b):

- (15) a. [NP [N' [N pictures] [of John]]]  
 b. [NP [N pictures] [of John]]

Chomsky (1995) further proposes a radical elimination of standard X-bar theory, a bare phrase structure theory, in which there are no such entities as XP, X<sup>0</sup> or a non-branching projection. For example, the string *the book* has (16b) instead of (16a):

- (16) a. 
- b. 

(Chomsky 1995: 246)

<sup>4</sup> I owe to Azuma (1992), who argues that F<sub>0</sub> resetting disambiguates syntactically ambiguous sentences similar to (14).

<sup>5</sup> This is the case in the normal speech rate. In fact, Initial Lowering can occur on *ichigo* in (14a) if the speech is slow. However, the point is that Initial Lowering must occur on *ichigo* in (14b) to express the intended meaning, irrespective of the speech rate. We can also explain the slow speech case, see section 4.2.

If we assume this theory, rules which specify XP or X<sup>0</sup> in their formulation cannot exist or must be reformulated without using such entities. Among them are Phonological Phrase Formation (Nespor and Vogel 1986), the end based theory (Selkirk 1986), Phonological Phrase Algorithm (Zec and Inkelas 1990), Wrap-XP (Truckenbrodt 1995). I will not discuss this problem any further, but will argue that the bare mapping and the prosodic phrasing facts we have seen support the assumption that there is no non-branching projections.

Let us consider the non-branching case (17a) and the branching case (17b) expressed in the standard X-bar theory:

- (17) a. [[X] [<sub>Y</sub> [Y]]]  
 b. [[X] [<sub>Y</sub> [Y] [Z]]]

Given the standard X-bar theory with non-branching projections, the numbers of boundaries between X and Y would be the same (three) between (17a) and (17b). For example, the structures of (8a) and (8b) in Mende would be (18a) and (18b), respectively:

- (18) a. [<sub>S</sub> [<sub>NP</sub> [<sub>N</sub> [N ndóláà]]] [<sub>VP</sub> [<sub>V</sub> [V wòtéà]]]]  
 b. [<sub>S</sub> [<sub>NP</sub> [<sub>N</sub> [N tí]]] [<sub>VP</sub> [<sub>V</sub> [V kàkpángà] [<sub>PP</sub> ngì má]]]]

Our mapping rule (3) would not make any difference between (18a) and (18b) if we assumed the standard X-bar theory with non-branching projections. If we applied (3) to (18a) and (18b), we would get the same number of boundaries, six boundaries, before *wotea* and *kakpanga* as shown in (19a) and (19b):

- (19) a. /// ndóláà //// wòtéà ///  
 b. /// tí //// kàkpángà // ngì má ///

If we supposed *n* is 6, there would be no boundary in both of the cases. If *n* is equal to or smaller than 5, there would be a prosodic boundary in both of the cases. Neither of them is a welcomed result.

However, if we assume the bare phrase structure theory, the structures of (8a) and (8b) (without labels) are the input to the rule (3), and their output are (20a) and (20b):

- (20) a. // ndóláà // wòtéà //  
 b. // tí /// kàkpángà // ngì má ///

There are two boundaries before the verb *wòtéà* in (20a), and three boundaries before the verb *kàkpángà* in (20b). Then if we assume that *n* is 2 for phonological phrasing, we get a boundary before *kàkpángà* in (21b) and not before *wòtéà* in (21a):

- (21) a. ndóláà wòtéà (*n*=2) <- pòté 'turn'  
 b. tí / kàkpángà ngì má / (*n*=2) -> \*tí gàkpángà ngì má

Similarly, the data from (9) to (14) show that the bare mapping rule (3) and the phrasing rule (5), together with bare phrase structure, correctly predict the difference between the application cases and the non-application cases.<sup>6</sup>

I am assuming here that phonological rules don't see phonologically null elements such as null functional heads like Infl, trace, and PRO. Then phonological rules don't see their projections such as I' or IP, either. In other words, the mapping rule (3) applies to "completely" bare phrase structures like (8a) and (8b).<sup>7</sup>

The data from Korean may seem to be a problem for this analysis. Korean Obstruent Voicing occurs in (22a) and (22d), but not in (22b) and (22c) (Cho 1990:48).<sup>8</sup>

- (22) a.  $[_{NP} [_{NP} \text{Suni-iy}] [_N \text{ɕip}]]$  → Suniɪy jip  
           Suni's house  
           'Suni's house'
- b.  $[_S [_{NP} \text{kæ-ka}] [_{VP} \text{ɕanta}]]$  -- kæga ɕanda  
           dog-Nom sleep  
           'The dog is sleeping.'
- c.  $[_{VP} [_{NP} \text{kilim-il}] [_{VP} \text{pota}]]$  – kirimil poda  
           picture-Acc see  
           'look at the picture'
- d.  $[_{NP} [_S [_{NP} \text{ki-ka}] [_{VP} \text{mæk-nin}]]] [_N \text{paj}]]$  → kiga mæɲnin ɓaj  
           he-Sub eat-Mod rice  
           'the rice he is eating'

If we assume the bare phrase structure, there is no difference between (22a) and (22b). Both of them have two boundaries between the first and the second element if we apply the mapping rule (3) to them. This case is a problem for the end-based theory and other mapping theories as well, because the right edge of NP, as well as the left edge of NP, makes a boundary in object-verb cases as in (22c). (22a) and (22d) seem to suggest us that the domain of this voicing rule is restricted within the topmost NP. How can we explain these facts?

One possible answer to this question is to make a distinction between Merge cases, like NP projected from its head N, and Concatenate cases, like S which consist of N and V. I will not go into detail here, however (see Tokizaki 1999).

<sup>6</sup> Uechi (1998) independently argues that non-branching XPs are invisible to phonology in Japanese.

<sup>7</sup> Nespor and Scortetti (1984) also argue that empty categories have no effect on the various PF rules.

<sup>8</sup> Cho (1990:48) observes that Obstruent Voicing occurs in object-verb case as (22c). All of my informants, however, pronounce the voiceless labial sound as shown in (22c).



## 4. Consequences

## 4.1 Deriving the Edge Parameter from the Head Parameter

The bare mapping theory has a number of consequences. First, the theory explains the parallelism between the head parameter and the edge parameter in the end-based theory (Selkirk 1986). (23) is a list of languages which have right and left as the edge parameter value:

- (23) a. Right edges of lexically headed XPs:  
Chi Mwi:ni (Kisseberth and Abasheikh 1974, Selkirk 1986), Kimatuumbi (Odden 1987), Xiamen (Chen 1987)
- b. Left edges of lexically headed XPs:  
Ewe (Clements 1978), Japanese (Selkirk and Tateishi 1991), Korean (Cho 1990), Northern Kyungsang Korean (Kenstowicz and Sohn 1997), Shanghai Chinese (Selkirk and Shen 1990)

Head-initial (*i.e.* complement-right) languages, such as Chi Mwi:ni and Xiamen, have right edge as the parameter value, and head-final (*i.e.* complement-left) languages as Japanese and Korean have left as the value. We can dispense with the edge parameter by deriving its effect from the head parameter with the bare mapping theory.<sup>9</sup>

Let's consider the example (24) from Chi Mwi:ni (cf. Selkirk 1986: 382, 390):

- (24) a.  $[_{VP} [_V \text{pa}(:)\text{nzize}] [_{NP} \text{cho:mbo}]] [_{NP} \text{mwa:mba}]$   
'he ran the vessel on to the rock'
- b.  $\dots\dots\dots]_{X_{max}} \dots\dots\dots]_{X_{max}}$
- c.  $_{PPh}(\text{-----}) \quad _{PPh}(\text{-----})$

Chi Mwi:ni is head-initial (*i.e.* complement-right) and has right as the edge parameter value. We can explain why this is the case with our bare mapping theory. We predict minimum number of prosodic boundaries, that is 2, between heads and complements because they are sisters in phrase structure:

- (25) a.  $/// \text{pa}(:)\text{nzize} // \text{cho:mbo} /// \text{mwa:mba} //$
- b.  $/ \text{pa}(:)\text{nzize} \text{cho:mbo} / \text{mwa:mba} \quad (n=2)$

This also holds with head-final languages like Japanese. (26a) shows that verbs take their complements to their left (Selkirk and Tateishi 1991:524):

- (26) a.  $[_S [_{NP} [_{NP} \text{Ao'yama-no}] [_N \text{Yama'guchi-ga}]] [_{VP} [_{NP} \text{ani'yome-o}] [_V \text{yonda}]]]$   
Aoyama-from Yamaguchi-Nom sister-in-law-Acc called  
'Mr. Yamaguchi from Aoyama called his sister-in-law.'

<sup>9</sup> We cannot explain optional tone sandhi in Shanghai straightforwardly if we suppose that the phrase structure of Shanghai is the same as that of Xiamen as Hale and Selkirk (1987:179) argue. One possible explanation is to suppose that the value of *n* in (5) in Shanghai is smaller than that in Xiamen. See also Selkirk and Shen (1990:335).

- b.  $_{\text{MaP}}(\text{Ao'yama-no Yama'guchi-ga})_{\text{MaP}}(\text{ani'yome-o yonda})$

In (26a), the subject NP branches. So there are four boundaries between the subject NP and the object NP, and only two boundaries between the verb and its object, as shown in (27a):

- (27) a.  $/// \text{Ao'yama-no} // \text{Yama'guchi-ga} /// \text{ani'yome-o} // \text{yonda} ///$   
 b.  $/ \text{Ao'yama-no Yama'guchi-ga} // \text{ani'yome-o yonda} / \quad (n=2)$

We can explain the phrasing (26b) straightforwardly as shown in (27b) without assuming that Japanese has left as the edge parameter value.

#### 4.2 Optionality of Phrasing

Second, the theory naturally captures the optionality of phrasing by changing the value  $n$  in (5). 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.<sup>10</sup>

For example, raddoppiamento sintattico shows that the phonological phrases (28a) can be changed into (28b) optionally (Nespor and Vogel 1986:172, cf. Ghini 1993:43):

- (28) a.  $[\text{Se prenderá}]_{\phi} [\text{qualcosa}]_{\phi} [\text{prenderá}]_{\phi} [\text{tordi}]_{\phi}$   
 b.  $[\text{Se prenderá\_qualcosa}]_{\phi} [\text{prenderá\_tordi}]_{\phi}$   
     'If he catches something, he will catch thrushes.'  
 c.  $[_S \text{Se} [_{VP} [_V \text{prenderá}] [_{NP} \text{qualcosa}]]] [_{VP} [_V \text{prenderá}] [_{NP} \text{tordi}]]]$   
 d.  $/ \text{Se} // \text{prenderá} // \text{qualcosa} /// \text{prenderá} // \text{tordi} ///$   
 e.  $\text{Se} / \text{prenderá} / \text{qualcosa} /// \text{prenderá} / \text{tordi} // \quad (n=1)$   
 f.  $\text{Se prenderá qualcosa} / \text{prenderá tordi} / \quad (n=2)$

The rule (3) maps the bare phrase structure (28c) into (28d), and the rule (5) with  $n=1$  or 2 correctly gives us the phrasing in (28e) or (28f).<sup>11</sup> Notice that Nespor and Vogel (1986:173) argues that speech rate and length plays a crucial role in determining the application of raddoppiamento sintattico. This analysis captures these factors naturally if we assume that the value  $n$  in (5) relates to speech rates, as mentioned in section 1.

Another example is third tone sandhi in Mandarin Chinese (cf. Cheng 1966: 150):

<sup>10</sup> I argued in Tokizaki (1988) that we can explain variable intonational phrasing in English with the rules similar to (3) and (5). 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.

<sup>11</sup> I assume that in (28e), *se* is cliticized phonologically to *prenderá* in spite of the fact that there is a boundary between *se* and *prenderá*.

- (29) [s [NP [A lao] [N li]] [VP [v mai] [NP [A mei] [N jiu]]]]
- |    |   |   |   |   |   |
|----|---|---|---|---|---|
|    | ↓ | ↓ | ↓ | ↓ | ↓ |
| a. | / | - | - | - | - |
| b. | / | - | - | - | - |
| c. | / | - | - | - | - |

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 (ˉ). Cheng, R. (1966) show that third tone sandhi is variable according to the speech rate in Mandarin Chinese. (29a) is slow, (29b) is mid, and (29c) is fast. This phenomenon is naturally explained in the theory presented here if we change the value of variable  $n$  from 2 to 4 in (5), as shown in (30a, b, c):

- (30)            /// lao // li //// mai /// mei // jiu ////
- |    |                              |           |
|----|------------------------------|-----------|
| a. | / lao li // mai / mei jiu // | ( $n=2$ ) |
| b. | lao li / mai mei jiu /       | ( $n=3$ ) |
| c. | lao li mai mei jiu           | ( $n=4$ ) |

#### 4.3 “Rightward Movements” in Right Branching Languages

The third consequence of this theory is that it gives us an insight into the “rightward” movements in right branching languages. The basic idea is that if a long constituent is in the middle of the sentence, it makes a long pause after that constituent because of the boundaries it has. I suppose that there is a preference rule which favors no long pause in a sentence or IP. For example, if we apply “heavy NP shift” to (31a), we get a better sentence (31b), because we can reduce the number of boundaries between PP *to John* and the heavy NP *some letters from Paris*, as shown in (32a) and (32b):

- (31) a. ?[[[Mark] [[showed] [[some] [[letters] [[from] [Paris]]]]] [[to] [John]]]]  
 b. [[Mark] [[showed] [[to] [John]]] [[some] [[letters] [[from] [Paris]]]]]
- (32) a. // Mark /// showed /// some /// letters /// from // Paris ///// to // John ///  
 b. // Mark /// showed /// to // John //// some /// letters /// from // Paris /////

In this way, we can formalize the notion “length” or “heaviness” of a constituent with the mapping rule (3). The longer or heavier the constituent is, the more brackets or boundaries it has on its right end if the constituent has right branching structure. This is another advantage of this mapping theory.<sup>12</sup>

#### 4.4 Focus and Phrasing

Fourth, this theory makes it possible to deal with the effect of focus on prosodic phrasing. I will discuss two possible approaches: strong boundaries for focused constituents, and boundary deletion for presupposed strings.

<sup>12</sup> In this sense, the theory proposed here is opposite to Ghini (1993), who reduces the syntactic notion of branchingness into the phonological concept of weight. We share the view that branchingness and weight are related to each other, however.

If we try to explain the focus effects on phrasing by marking focused elements, one possible way is to add one (or more) pair of brackets to the focused constituent. Let's take Hausa *fa* again for example. We have seen in section 2 that *fa* cannot be inserted before non-branching constituent. As shown in (33a), however, *fa* can be inserted before an emphatic non-branching constituent. We can explain this fact by adding brackets to the focus constituent, as shown in (33b):

- (33) a. [s [NP Ya] [VP [V sayi] fa [NP *teburin*]]] (cf. 11a)  
           he          bought      tabel-def. (emph.)  
           'He bought the table.'
- b. [s [NP Ya] [VP [V sayi] fa [FOC [NP *teburin*]]]] (cf. 11b)
- c. // Ya /// sayi /// teburin ///

The mapping rule (3) makes the representation shown in (33c) which has the same number of boundaries, that is 3, between *sayi* and *teburin* as the branching case (11b) has.

The addition of brackets, however, may raise a problem of making non-branching structure if it is a process in syntax. We could argue that it occurs in PF. Representation of focus is a matter of the whole architecture of grammar. I will leave this matter open.

A more interesting way to explain focus effects on phrasing is to delete the syntactic boundaries of presupposed strings. If we suppose that a sentence consists of presupposition and focus, *teburin* is focus and *ya sai* is presupposed in (33a). Let us assume that the rule of presupposition deletes all the syntactic boundaries of the presupposed string. We also delete non-branching nodes because we are assuming bare phrase structure. Then we have (34a) and the phrasing (34b) as the output of application (3):

- (34) a. {s {NP Ya} {VP {V sayi} fa [NP *teburin*]} }
- b. Ya sayi fa / *teburin* /

The deletion of brackets is supported by the following fact of extraction from NP. (35a) shows that extraction from NP is generally unacceptable, but it is allowed when the NP is a part of presupposed elements as in (35bB) (cf. Kuno 1987:24, brackets and underlines added):

- (35) a. \*Who did you destroy [a picture of]?  
       b. A: Right after Chairman Mao died, they started taking [NP pictures of the Central Committee members] off the wall.  
           B: Who did they destroy more pictures of, Chairman Mao or Jiang Qing?

We can argue that NP boundaries are deleted in (35bB) because the NP *more pictures of* is a part of presupposition.

I will not argue which of these two approaches are better here. There is also a possibility that both addition and deletion of brackets are involved in phrasing of

sentences with focus. The point is that bare mapping theory can make it easy to deal with cases of focus.

### 5. Cyclic mapping by cyclic Spell-Out

We have seen that the bare mapping theory gives support for bare phrase structure and that it has some good consequences. However, it might be argued that bare mapping theory cannot handle syntax-prosody mismatches, like the following example (36a):

- (36) a. [[This] [[is] [[the] [[cat] [[that] [[caught] [[the] [[rat] [[that] [[stole] [[the] [cheese]]]]]]]]]]]]]] (cf. Chomsky and Halle 1968:372)  
 b. // This /// is /// the /// cat /// that /// caught /// the /// rat /// that /// stole /// the // cheese ///////////////  
 c. (This is the cat) (that caught the rat) (that ate the cheese)

Our rule (3) maps (36a) to (36b). In fact, there are not more boundaries after *cat* and *rat* than the other places in (36b). How can we get the actual phrasing in (36c)?

Chomsky (1998:20) argues that a phase of derivation is CP or  $\nu$ P, and that derivation proceeds phase by phase. (37), for example, has the four phases bracketed:

- (37) [John [ $t$  thinks [ Tom will [ $t$  win the prize]]]]

Chomsky (1998:48) further proposes that Spell-Out is contingent on the feature-checking operations and that Spell-Out applies cyclically, possibly at the phase level, in the course of the (narrow syntactic) derivation. Let us assume that this approach is correct and consider the derivation of (36a). Then (36a) has the six phases bracketed:

- (38) [This [is the cat [that [caught the rat [that [stole the cheese]]]]]]]]

The following structures are sent to PF in turn in the course of the derivation:

- (39) a. [[stole] [[the] [cheese]]]  
 b. [that]  
 c. [[caught] [[the] [rat]]]  
 d. [that]  
 e. [[is] [[the] [cat]]]  
 f. [this]

If we assume that the mapping rule (3) applies every time a structure is sent to PF, the outputs are (40):

- (40) a. // stole /// the // cheese ///  
 b. / that /  
 c. // caught /// the // rat ///  
 d. / that /  
 e. // is /// the // cat ///

f. / this /

After the whole sentence (36a) is sent to PF, its PF representation is (41):

(41) / this / // is /// the // cat /// / that / // caught /// the // rat /// / that / // stole ///  
the // cheese ///

In (41), there are four boundaries before two occurrences of *that*. Thus we predict the phrasing (36c) straightforwardly. If we apply the phrasing rule (5) with  $n=3$ , we get the right result (42):

(42) this is the cat / that caught the rat / that stole the cheese (n=3)

Thus we can explain this case without the readjustment rule assumed in Chomsky and Halle (1968:372), which converts sentences with (multiply) embedded clauses into sentences dominating sister-adjoined clauses.<sup>13</sup>

## 6. Conclusion

We have seen that bare mapping rules give support for the bare phrase structure theory, and that it has some consequences in phrasal phonology and syntax. We have also seen that cyclic Spell-Out solves the problem of syntax-phonology mismatch in certain cases.

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<sup>13</sup> I am assuming here the "Merge Left" approach of Chomsky (1995, 1998). Cyclic Spell-Out may raise a problem in *wh*-constructions. I will leave the matter open. See Phillips (1996) for an interesting idea of Merge Right and its application to prosody.

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