RESTRUCTURING OF PHONOLOGICAL PHRASES IN JAPANESE AND SYNTACTIC DERIVATION

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Abstract:

Within a derivational approach to syntax, it is predicted that restructuring of phonological phrases reflects the syntactic cycle under the assumption that a phonological phrase is formed when a phonological string is mapped to the phonological component. In this paper, I argue that such a prediction is borne out, by showing that the phonological phrasing in Japanese DP's can be accounted for through the cyclic application of the restructuring within a theory of Multiple Spell-Out.

1. Introduction

In this paper, I discuss phonological phrasing in Japanese (Kubozono 1993).[1] I argue that the phonological phrasing is a reflex of syntactic derivation by showing that the restructuring of the phonological phrases takes place derivationally, reflecting the cyclic application of the Multiple Spell-Out (Chomsky 2001a.b, Uriagereka 1999). Moreover, I show that the mismatch between the syntactic and phonological constituencies, which is one of the most important issues of syntax-phonology interface literature, is a result of the derivational application of restructuring.

It is well known that restructuring of phonological phrasing applies in some languages. Inkelas and Zec 1995 argue that it applies in order to satisfy the condition that a phonological phrase should consist of two or more phonological words. Thus, the phrasing shown in (1a) is restructured as in (1b) (ω = a phonological word).

1 For phonological phrasing in Japanese, see also Kubozono 1989, 1992, McCawley 1968, Nagahara 1994, Pierrehumbert and Beckman 1988, Poser 1984, Selkirk and Tateishi 1991, among others.

(1) a. $(\omega)_{\Phi}$ $(\omega)_{\Phi}$
b. $(\omega \quad \omega)_{\Phi}$

In a derivational approach to syntax in general, it is predicted that restructuring of phonological phrases reflects the syntactic derivation under the assumption that a phonological phrase is created when a phonological string is mapped to the phonological component Φ (Collins 2001, Dobashi 2003, Uriagereka 1999). To see this point, let us consider a hypothetical sentence that consists of three (phonological) words:

(2) X Y Z

Suppose that X, Y and Z are mapped to the phonological component Φ independently of one another. If Z is mapped first, and Y second, we will have the following stage of derivation after Y is mapped to Φ.

(3) $(\ Y\ )_{\Phi}$ $(\ Z\ )_{\Phi}$

Suppose that restructuring applies to the left in this (hypothetical) language. That is, a phonological phrase containing just one phonological word is incorporated into another phonological phrase on its left. Then, at this stage of the derivation, the phonological phrase containing Z restructures to the left as in (4):

(4) $(\ Y\ )_{\Phi}$ $(\ Z\ )_{\Phi} \rightarrow (\ Y \quad Z\ )_{\Phi}$

Note, in passing, that restructuring applies for purely phonological reasons, i.e., in order to make a phonological phrase contain two or more phonological words. The representation in (3) or (4) is an output of the mapping to Φ, so no syntactic information is available when the restructuring takes place.

At the next stage of the derivation, X is mapped to Φ:

(5) $(\ X\ )_{\Phi}$ $(\ Y \quad Z\ )_{\Phi}$

At this point, the phonological phrase containing Y and Z does not restructure into the one containing X, since it already contains two phonological words. Also, the phonological phrase containing X may not restructure to the one containing Y and Z under the assumption that the restructuring is to the left. Therefore, (5) is the final representation for this derivation.

Now suppose that B is mapped to Φ first, A second, and C third, in the derivation of (6) which consists of three phonological words:

(6) A B C

Restructuring applies when A is mapped to Φ:

(7) $(\ A\ )_{\Phi}$ $(\ B\ )_{\Phi} \rightarrow (\ A \quad B\ )_{\Phi}$

Here, the phonological phrase containing B restructures to the left. When C is mapped to **Φ**, the following phrasing is obtained:

(8) (A B)$_{\phi}$ (C)$_{\phi}$

At this point, the phonological phrase containing C restructures to the one containing A and B since it contains only one phonological word:

(9) (A B)$_{\phi}$ (C)$_{\phi}$ → (A B C)$_{\phi}$

Notice that the different phonological phrasings in (9) and (5), repeated below in (10a) and (10b), respectively, result from the application of the restructuring for purely phonological reasons at each stage of the derivation.

(10) a. (A B C)$_{\phi}$
b. (X)$_{\phi}$ (Y Z)$_{\phi}$

The application of restructuring does not, and in fact cannot, see the syntactic information at all since it applies to the output of the mapping to **Φ**. Therefore, the difference between (10a) and (10b) reflects the syntactic derivation.

In contrast, in a representational approach the difference between (10a) and (10b) cannot be distinguished for purely phonological reasons since the mapping algorithm needs to refer to the syntactic difference between them, such as branchingness of the syntactic tree.[2] Otherwise we would have some ambiguity in the application of the restructuring. Suppose that the following phrasing is obtained in a representational approach:

(11) (X)$_{\phi}$ (Y)$_{\phi}$ (Z)$_{\phi}$

If restructuring were to apply to (11) for purely phonological reasons, it is equally possible to restructure Y into X, or Z into Y. That is, the phrasings in (10a) and (10b) cannot be distinguished in the representational approach for purely phonological reasons.

In what follows, I argue for such a derivational approach by using the data on Japanese DP (Kubozono 1993).

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2 For such algorithms, see Cowper and Rice 1987 within the Edge-based approach, and Nespor and Vogel 1986 in the Relation-based approach. They refer to branchingness of syntactic trees. See also Bickmore 1990.

2. DP in Japanese

2.1. Previous Analysis

Let us consider the following set of data observed by Kubozono (1993: 146):

(12) a. [[naomi-no ane-no] [marui yunomi]]
Naomi-Gen sister-Gen round teacup
'Naomi's sister's round cup'

b. [[naomi-no [ue-no ane-no]] yunomi]
Naomi-Gen upper-Gen sister-Gen teacup
'Naomi's eldest sister's teacup'

c. [naomi-no [[ume-no iro-no] yunomi]]
Naomi-Gen plum-Gen color-Gen teacup
'Naomi's plum-colored teacup'

d. [naomi-no [omoi [marui yunomi]]]
Naomi-Gen heavy round teacup
'Naomi's heavy round teacup'

(13) a. na⌈omino aneno ma⌈rui yunomi = (12a)
( )$_\phi$ ( )$_\phi$

b. na⌈omino u⌈eno aneno yunomi = (12b)
( )$_\phi$ ( )$_\phi$

c. na⌈omino u⌈meno irono yunomi = (12c)
( )$_\phi$ ( )$_\phi$

d. na⌈omino o⌈moi ma⌈rui yunomi = (12d)
( )$_\phi$ ( )$_\phi$ ( )$_\phi$ Kubozono (1993: 146)

Each of the patterns is a DP consisting of the four phrases. All the phrases are unaccented here. (12) shows the syntactic constituency (indicated by the square brackets), and (13) shows the phonological phrasing (indicated by the round brackets). The lines on the data in (13) schematically show the pitch level or fundamental frequency. The rise of the fundamental frequency, or *Initial Lowering*, indicates the beginning of the phonological phrase.

Note that in (12b)/(13b), repeated below, the syntactic constituency does not coincide with the phonological one:

(14) a. [[naomi-no [ue-no ane-no]] yunomi]
Naomi-Gen upper-Gen sister-Gen teacup

'Naomi's eldest sister's teacup' (Kubozono 1993:146)

b. na[omino u[eno aneno yunomi = (12b)

i. [ ] [ ] --- syntax

ii. ( )$_{\phi}$ ( )$_{\phi}$ --- phonology

In this DP, *ue* 'upper' modifies *ane* 'sister,' *naomi* 'Naomi' modifies the syntactic constituent made up of *ue* 'upper' and *ane* 'sister', and the syntactic constituent made up of these three elements modifies the head noun *yunomi* 'teacup'. If we divide the DP into two in terms of syntactic constituency, the first three elements correspond to one syntactic constituent, and the head noun yunomi 'teacup' corresponds to the other, as shown in (14b.i). In contrast, the prosodic behavior shows that there is a phonological boundary between *naomi-no* and *ue-no* since Initial Lowering occurs at the beginning of *ue* 'upper' (and *naomi*)). That is, the first element *naomi-no* 'Naomi-Gen' corresponds to one phonological constituent, and the last three elements correspond to the other phonological constituent, as shown in (14b.ii).

Note that such a mismatch in constituency is important because it motivates the existence of the syntax-phonology mapping. If there is no such mismatch, it would be unnecessary to postulate the mapping mechanism.

Kubozono (1993: 154), following Fujisaki and Sudo (1971), proposes the following constraint to account for the data:

(15) *Branching Constraint Hypothesis:*

Minor Phrase Formation is blocked between two elements where the right-hand member branches.

Here, "Minor Phrase" is equivalent to what I call a phonological phrase or p-phrase. Under this constraint, the phonological phrasings in (12)/(13) are accounted for in the following way. For example, in (12b/13b), the right-hand member [ue-no ane-no] 'upper sister' branches in [[naomi-no [ue-no ane-no]] 'naomi's upper sister,' and Minor Phrase Formation is blocked between *naomi-no* and *ue-no*, therefore they are phonologically phrased separately.

Notice that under (15) Minor Phrase Formation has to refer to the branchingness of the syntactic tree. In the theory of syntax-phonology mapping in general, it is desirable to restrict the syntactic information available to phonology (Inkelas and Zec 1995). That is, a theory that does not refer to the branchingness of the syntactic tree is more desirable. The present approach to restructuring does not, and in fact cannot, refer to the branchingness of the syntactic tree: It can only refer to the output of the mapping to

the phonological component **Φ**, which is non-syntactic in nature. In what follows, I show that the proposed mapping algorithm accounts for the data, without a reference to syntactic information.

2.2 Proposed Analysis

First, I will introduce some basic assumptions necessary for the analysis. I assume that the data in (12) have DP-structure (Abney 1987), and that D is a phase head (cf. Chomsky 2001b: 5):

(16) D is a phase head: its sister is spelled-out.

I assume that linear order is defined by Spell-Out since it is the only operation that connects unordered syntactic representation with linearly ordered phonological representation:

(17) Linear order is defined by Spell-Out.

I assume that Linear Order is determined in terms of heads. That is, the linear order between Spec and Head is defined in terms of the OCC feature on the head[3], and the linear order between the head and the complement is defined in terms of head parameter (Collins 2001b, Collins and Ura 2001, Fukui 2001). Thus, X precedes Y if X checks the OCC feature of Y, and X precedes Y if Y is a complement of X. I assume that a head precedes a complement in Japanese (Whitman 2001)

I adopt the following assumptions about the genitive Case particle in Japanese:

(18) a. The genitive Case is checked by D.
b. Case particles are bound to the preceding element.

Under (18), the genitive Case particle -no is attached to the right side of the specifier element of DP as a reflex of Case checking. As a result of (18b), we obtain a morphological unit consisting of a DP and a Case particle. I assume that such a morphological unit may not be disrupted by a p-phrase boundary unless some other overriding factor comes in.[4, 5]

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3 The OCC feature in the head is a feature that reguires a phrase to be in the spec of the head.

4 If a contrastive stress is assigned to the Case particle, a phonological boundary is created between the element to which the Case particle is bound and the Case particle. Nagahara 1994.

5 As John Whitman (personal communication) pointed out to me, in (19) "Case particle" could be replaced by "clitic" in general since the other particles such as *mo* 'also' seem to show a similar phonological property. I continue to assume (19) since I do not discuss the other particles here.

(19) No p-phrase boundary may intervene between X and Case particle in [X]-[Case Particle].

In the phonological component Φ, restructuring of the p-phrases takes place if there is a violation of the prosodic branching constraint (20). I assume that restructuring is to the left in Japanese:

(20) $[\ \omega\ \omega\ ]_{\phi}$
("a preferred phonological phrase is one which consists of at least two phonological words" (Inkelas and Zec 1995:544))

(21) Restructuring is to the left in Japanese.

Thus, the restructuring shown in (22a) below applies to satisfy (20), while the restructuring shown in (22b) does not apply even if there is a violation of (20) since it is to the right:

(22) a. $(\ \omega\ \omega\ )_{\phi}\ \ (\ \omega\ )_{\phi} \quad \rightarrow \quad (\ \omega\ \omega\ \omega\ )_{\phi}$

b. * $(\ \omega\ )_{\phi}\ \ (\ \omega\ \omega\ )_{\phi} \quad \rightarrow \quad (\ \omega\ \omega\ \omega\ )_{\phi}$

A question arises as to whether a Case particle in Japanese is considered to be a phonological word ω so that it qualifies as a ω in (20). If it is, then a p-phrase containing a noun and a Case particle satisfies the prosodic branching constraint (20). I assume that the Case particle is a phonological word for the following reasons. Consider (23):

(23) John-ga hon-o yomu
John-Nom book-Acc read(pres.)
( )$_{\phi}$ ( )$_{\phi}$
'John reads a book.' (adapted from Nagahara 1994)

Here, *John*, *hon*, and *yomu* are accented words. So the phonological phenomenon relevant to phonological phrasing here is downstep, a downward shift of the pitch range within a phonological phrase (see Kubozono 1993, Nagahara 1994, Pierrehumbert and Beckman 1988, Poser 1984, among others). In (23) there is a downstep between *hon-o* 'book-Acc' and *yomu* 'read,' but not between *John-ga* 'John-Nom' and *hon-o* 'book-Acc.' Assuming that the downstep occurs within a p-phrase, *John* plus the nominative Case particle *-ga* correspond to a single p-phrase, and *hon* plus the accusative Case partice *-o*, and the verb *yomu* correspond to another p-phrase in (23). Since *John* plus *-ga* corresponds to a single p-phrase, it could be the case that the Case particle is a phonological word, and the p-phrase containing *John* and *-ga* satisfies the prosodic branching constraint. However, it would also be the case that the second p-phrase cannot restructure into the first one since the second p-phrase containing the object

hon, the Case particle *-o*, and the verb *yomu* has already satisfied the prosodic branching constraint even if the Case particle *-o* is not a phonological word. To see if a Case particle is a phonological word, consider (24):

(24) John-ga hon-o yomu rashii
John-Nom book-Acc read(Pres) seem
( )$_{\phi}$ ( )$_{\phi}$ ( )$_{\phi}$
'It seems that John reads a book.'
(Poser 1984:, Nagahara 1994, cf. Kubozono 1993)

Here, *rashii* 'seem' immediately follows *yomu* 'read,' and they form a single p-phrase.[6] It is important to notice that the phonological phrasing in (24) shows that in principle the object *hon* 'book' plus Case particle *-o* may correspond to a single p-phrase on their own, excluding the verb, in contrast with (23). (24) also shows that the p-phrase containing the object *hon* and Case particle *-o* satisfies the prosodic branching constraint, and that it does not need to undergo restructuring to the preceding p-phrase containing the subject *John* and a Case particle *-ga*, indicating that the Case particle is a phonological word. Therefore, I assume the following: [7]

(25) Case particles are phonological words in Japanese.

So far, I have presented some assumptions relevant to the discussion of the Japanese data. I assume that the example to be discussed have a DP-structure, where D is a strong phase head (16). Genitive Case is checked by D, and the Case particle is bound

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6 Kubozono (1993:127-130) observes that there are cases where the accent of the second verb (AUX) shows up. That is, we may have the following optionality in phonological phrasing:

(i) John-ga hon-o yomu rashii
-Nom book-Acc read(Pres) seem
( ) ( ) ( ), or
( ) ( ) ( ) ( )

The data used in his experiments are shown below:

(ii) a. mi'ru-daro'o 'see will' = will see
ka'eru-yo'oda 'return-look' = (he) appears to return
b. no'nde mi'ru 'drink see' = try drinking
ka'ite iru 'write-be' = is writing'

I will not discuss the phonological phrasing of the "branching verbs," but the optionality does not argue for or against the claim that in principle the (non-branching) object plus a Case particle correspond to one phonological phrase of its own. Rather, it argues for the claim that the prosodic branching constraint is about preference (Inkelas and Zec 1995).

7 See Nagahara 1994:29. See also Vance 1993 and Whitman 2001 for the discussion on the prosodic status of Case Particles. See also Zec and Inkelas 1991 for the status of clitics in prosodic hierarchy.

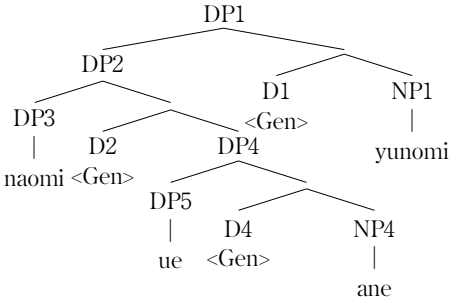
by the specifier element in the DP (18). No p-phrase boundary may intervene between the specifier element and the bound Case particle (19). The Case particle is a phonological word (25), qualifying as a "ω" in the prosodic branching constraint (20). And restructuring applies to the left to satisfy (20).

Now, let us first consider (12b/13b), repeated here, where the syntactic constituency does not coincide with the prosodic one.

(26) [[naomi-no [ue-no ane-no]] yunomi]
Naomi-Gen upper-Gen sister-Gen teacup
( )$_{\phi}$ ( )$_{\phi}$
'Naomi's eldest sister's teacup'

I assume the following syntactic structure for (26):

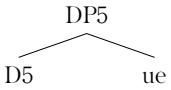
(27)



I adopt a DP-recursion structure for the two or more occurrences of the genitive Case particle *-no* (cf. Kayne 1994, Whitman 2001). I assume that in a DP-recursion structure, each D is a phase head.[8] Thus, the sister of each D is spelled-out. <Gen> under each D stands for genitive Case.[9]

Let us first consider the Spell-Out of the sister of the head of DP5.[10] I assume that DP5 has the following internal structure:

(28)



8 *Naomi* and *ue* may be base-generated within the sister of D4 and raise into the Spec of D. Since the underlying structure is irrelevant to the phonological phrasing, I will not discuss it here.

9 Within the framework of Chomsky (2000, 20001a, b), D does not have a Case feature; rather, it is a probe which has a set of uninterpretable phi-features, and the Case feature of a goal DP is deleted under Agree. I put aside these technical details here.

10 Note that the Spell-Out may apply to the sisters of D5, D4, D3 at the same time.

Since *ue* is the sister of D5, it is spelled-out and mapped to **Φ**. Similarly, *ane* and *naomi*, which are sisters of D4 and D3, respectively, may be spelled-out and mapped to **Φ**. At this point, we get the following three phonological phrases.

(29) a. $(\text{ue})_{\phi}$
b. $(\text{ane})_{\phi}$
c. $(\text{naomi})_{\phi}$

The linear order between these phonological phrases cannot be defined at this point since neither D2, D3, D4 nor D5 has been spelled-out, in terms of which the linear order among them is defined. Therefore, the restructuring cannot apply even though the p-phrases in (29) violate the prosodic branching constraint (20).

Let us next consider the Spell-Out of the sister of D2. The following linear order is defined by this spell-out:

(30) D5 << ue << D4 << ane

At this point, the genitive Case particle *-no*, which is a phonetic realization of the Case checking between D4 and DP5 containing *ue*, is phonetically realized and bound to *ue*, and the following phonological representation is obtained:

(31) $(\text{ue-no})_{\phi}$ $(\text{ane})_{\phi}$

At this point of the derivation, the p-phrase $(\text{ane})_{\phi}$ violates the prosodic branching constraint, and it undergoes restructuring to the left:

(32) a. $(\text{ue-no})_{\phi}$ $(\text{ane})_{\phi}$ →
b. $(\text{ue-no ane})_{\phi}$

The next step is to spell-out the sister of D1.[11] It is mapped to the phonological component, and the following p-phrase is obtained:

(33) $(\text{yunomi})_{\phi}$

At this point, the linear order between (33) and (32b) cannot be defined since D1 has not been spelled-out.

The next step is to spell-out the entire DP, perhaps as part of the larger structure. By this Spell-Out, D1 and D2 are spelled-out, and the linear order among (29c), (32b) and (33) is defined. D1 and D2 are phonetically realized as a Case particle *-no* and bound to the preceding element:

11 Note that this Spell-Out may occur before, or in parallel with, the Spell-Out of the sister of D4, D5, D2.

(34) $(\text{naomi-no})_\phi$ $(\text{ue-no ane-no})_\phi$ $(\text{yunomi})_\phi$

Here, p-phrase $(\text{yunomi})_\phi$ violates the prosodic branching constraint, and undergoes restructuring, resulting in (35b).

(35) a. $(\text{naomi-no})_\phi$ $(\text{ue-no ane-no})_\phi$ $(\text{yunomi})_\phi \rightarrow$

b. $(\text{naomi-no})_\phi$ $(\text{ue-no ane-no yunomi})_\phi$

(35b) is the final representation obtained for this derivation, as expected.

2.3. Comparison with the Other Proposals

In this section, I compare the proposed analysis with the representational theories. I discuss Relation-based theory and Edge-based theory.

Nespor and Vogel (1986) propose the following mapping algorithm for Japanese:

(36) *Relation-based Theory (for Japanese):*

X is a head and forms a Φ with whatever follows until another head outside of the maximal projection of X is reached. (Nespor and Vogel 1986: 183)

Within the Edge-based theory (Chen 1987, Selkirk 1986), Nagahara (1994) argues that the left edge of a lexical XP coincides with the left edge of a phonological phrase (the following formulation is due to Truckenbodt 1999. See also Selkirk and Tateishi 1991):

(37) *Edge-based Theory:*

Align-XP, L: Align (XP, L; P, L)

"For each XP there is a P such that the left edge of XP coincides with the left edge of P." (Nagahara 1994, Selkirk and Tateishi 1991, Truckenbrodt 1999)

If we apply these mapping algorithms to the example (26), reproduced in (38a) with relevant labels, each lexical head forms a phonological phrase with the following Case particle as in (38b):

(38) a. $[_{DP}\ [_{DP}\ [_{NP}$ naomi-no$]\ [_{D'}\ [_{NP}$ ue-no$]\ [_{D'}$ D $[_{NP}$ ane$]]]]$-no$]$ D $[_{NP}$ yunomi$]]$

b. $(\text{naomi-no})_\phi$ $(\text{ue-no})_\phi$ $(\text{ane-no})_\phi$ $(\text{yunomi})_\phi$

Naomi-Gen upper-Gen sister-Gen teacup

If the restructuring triggered by the prosodic branching constraint applies to (38b), we will obtain the following phonological phrasing, which is not a desired result:

(39) $(\text{naomi-no})_\phi$ $(\text{ue-no})_\phi$ $(\text{ane-no})_\phi$ $(\text{yunomi})_\phi$

$\rightarrow$ $(\text{naomi-no})_\phi$ $(\text{ue-no})_\phi$ $(\text{ane-no yunomi})_\phi$

Suppose that, contrary to what I suggested in (25), Case particles are in fact not phonological words. Then each phonological phrase in (38b) is taken to be non-

branching, violating the prosodic branching constraint. If the restructuring applies to the representation from left to right or right to left, the following phonological phrasing results:

(40) (naomi-no ue-no)$_{\phi}$ (ane-no yunomi)$_{\phi}$

In order to obtain a desired result within these approaches, we might need to stipulate that the right branching members in a syntactic constituent (that is, [[ue-no] [ane-no]] in [[naomi-no] [[ue-no] [ane-no]]]) form a single phonological phrase (cf. (15)). However, this stipulation has to refer to the branchingness of a syntactic tree, which is undesirable.

As the proposed approach gives the correct result, the desired phrasing seems to reflect syntactic cycles. The crucial steps in the derivation are (32) where non-branching p-phrase (ane)$_{\phi}$ undergoes restructuring into (ue-no)$_{\phi}$ before it is combined with the Case particle. That is, the derivational application of the restructuring plays a crucial role in the analysis of the example.

2.4. Spell-Out of Adjuncts and Other Data

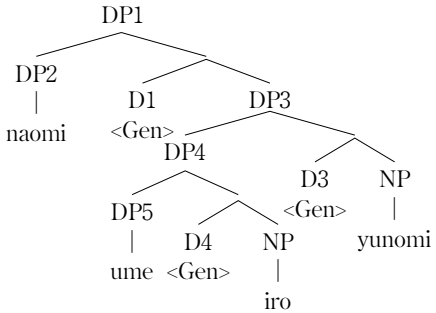
In this section, I give an account for the phonological phrasing in (12/13a, c, d). I give an analysis of the Spell-Out of adjuncts when I discuss (12/13a, d).

Let us first consider (12/13c), repeated here:

(41) [naomi-no [[ume-no iro-no] yunomi]]
Naomi-Gen plum-Gen color-Gen teacup
( )$_{\phi}$ ( )$_{\phi}$
'Naomi's plum-colored teacup'

I assume the following syntactic structure for (41):

(42)



First, Spell-Out applies within DP5, DP4, DP3 and DP2, and the following p-phrases

are created in the phonological component:

(43) a. $(\text{ume})_{\phi}$
b. $(\text{iro})_{\phi}$
c. $(\text{yunomi})_{\phi}$
d. $(\text{naomi})_{\phi}$

Since neither D1, D3, nor D4 has been spelled-out, (43a-d) are not linearly ordered.

Now, Spell-Out applies to the sister of D1, and the linear order is defined. Following Uriagereka 1999, I assume that the linear order within the branching specifier must be defined before the linear order among the specifer, the head and the complement is defined. Thus, the linear order within DP4 is defined first:

(44) ume << D4 << iro

Since D4 is realized as the Case particle *-no* and bound to *ume*, the following p-phrases are obtained:

(45) $(\text{ume-no})_{\phi}$ $(\text{iro})_{\phi}$

At this point, $(\text{iro})_{\phi}$ violates the prosodic branching constraint, and undergoes restructuring:

(46) a. $(\text{ume-no})_{\phi}$ $(\text{iro})_{\phi}$ →
b. $(\text{ume-no iro})_{\phi}$

Then, the linear order among the specifier, head, and complement is defined within DP3:

(47) ume-no << iro << D3 << yunomi

D3 is realized as a Case particle, and bound to *iro*, resulting in the following phonological representation:

(48) $(\text{ume-no iro-no})_{\phi}$ $(\text{yunomi})_{\phi}$

Here, $(\text{yunomi})_{\phi}$ violates the prosodic branching constraint, and undergoes restructuring:

(49) a. $(\text{ume-no iro-no})_{\phi}$ $(\text{yunomi})_{\phi}$ →
b. $(\text{ume-no iro-no yunomi})_{\phi}$

The next step is to spell-out the entire DP. The linear order is defined as follows:

(50) naomi << D1 << $(\text{ume-no iro-no yunomi})_{\phi}$

D1 is realized as the Case particle, and the following phonological representation is obtained:

(51) $(\text{naomi-no})_{\phi}$ $(\text{ume-no iro-no yunomi})_{\phi}$

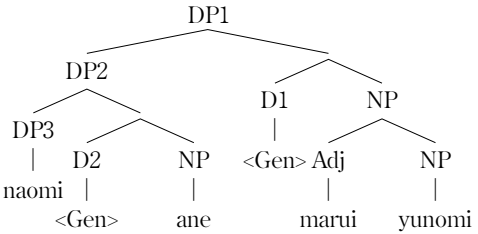
Here, there is no violation of the prosodic branching constraint, hence no

restructuring. This is the resulting phonological phrasing.

Now, let us examine the examples with adjuncts. Let us first consider (12/13a), repeated here in (52a), with its syntactic structure in (52b):

(52) a. [naomi-no ane-no] marui yunomi]]
Naomi-Gen sister-Gen round teacup
( )$_{\phi}$ ( )$_{\phi}$
'Naomi's sister's round cup'

b.



Let us start with the derivation within DP2. First, the sister of the head of DP3, *naomi*, and the sister of D2, *ane* 'sister' are spelled-out, and mapped to the phonological component:

(53) a. (naomi)$_{\phi}$
b. (ane)$_{\phi}$

Let us next consider the Spell-Out of the sister of D1. Here the adjective *marui* 'round' is adjoined to the NP *yunomi* 'teacup.' Following Chomsky (2001b), I assume the following formulation of the Spell-Out of adjoined elements:

(54) In < α, β >, α is spelled out where β is. (Chomsky BEA:20)

Here, α is adjoined to β. Under this principle, "α is integrated into the linearly ordered structure at the stage of derivation where β is spelled-out (Chomsky 2001b:20)." In order to simplify the exposition here, I will assume that α is spelled-out when β is spelled-out, and α defines the linear order between α and β. Thus, given < α, β >, when Spell-Out applies to β, α is also spelled-out and linearly ordered with respect to β.

Spell-Out of the sister of D1 and Spell-Out of the adjunct *marui* take place at the same time. I assume that the Spell-Out of the adjunct α in < α, β > defines the linear order where α precedes β (at least in Japanese). Then, the Spell-Out of the adjunct *marui* defines the linear order as in (55):

(55) marui << yunomi

In the phonological component, (56a) is obtained, and the restructuring applies, as in (56b):

(56) a. $(\text{marui})_\Phi$ $(\text{yunomi})_\Phi$ →

b. $(\text{marui yunomi})_\Phi$

The next step is to spell-out the entire DP1 (as part of a larger structure), which spells-out D1 and D2. As I mentioned above (44), the linear order within the Spec is defined before that of the entire structure. Thus, the linear order within DP2 is defined first:

(57) naomi << D2 << ane

D2 is realized as the Case marker at this point, and the following phrasing is obtained:

(58) $(\text{naomi-no})_\Phi$ $(\text{ane})_\Phi$

Here, $(\text{ane})_\Phi$ violates the prosodic branching constraint, and undergoes restructuring:

(59) a. $(\text{naomi-no})_\Phi$ $(\text{ane})_\Phi$ →

b. $(\text{naomi-no ane})_\Phi$

Note that $(\text{yunomi})_\Phi$, which has already been mapped to **Φ** before (see (56)), does not enter into (59), since the linear order between them has not been established yet at this point. It is established by virtue of D1, which has not been mapped to **Φ**.

The next step is to spell-out DP1, defining the linear order among the specifier, head and complement:

(60) DP2 << D1 << NP

D1 is realized as the Case particle on *ane*, and the following phrasing is obtained:

(61) $(\text{naomi-no ane-no})_\Phi$ $(\text{marui yunomi})_\Phi$

The important step in this derivation is where the p-phrase containing just *ane* restructures into the preceding p-phrase containing *naomi-no* before *-no* is attached to *ane*, since otherwise $(\text{ane-no})_\Phi$ would not be phrased with $(\text{naomi-no})_\Phi$.

Let us next consider (12/13d), repeated here. It involves multiple adjunction to a NP:

(62) [naomi-no [omoi [marui yunomi]]]

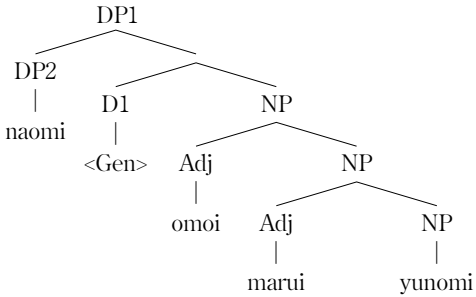
Naomi-Gen heavy round teacup

( )$_\Phi$ ( )$_\Phi$ ( )$_\Phi$

'Naomi's heavy round teacup'

I assume the following syntactic structure for (66):

(63)



First, the sister of D1 is spelled-out, and the two adjectives adjoined to the NP are also spelled-out. Since the Spell-Out of the adjuncts defines the linear order, the linear order is defined as follows:

(64) Spell-Out (*marui* in <marui, yunomi>)
Linear Order: marui << yunomi

(65) Spell-Out (*omoi* in <omoi, <marui, yunomi>>)
Linear Order: omoi << marui << yunomi

Here, the linear order between *marui* and *yunomi* is determined first as in (64); otherwise *omoi* cannot be ordered with respect to *marui* or *yunomi*.

Once the linear order is defined, the linear string in (65) is sent to the phonological component:

(66) $(\text{marui})_{\phi}$ $(\text{yunomi})_{\phi}$

Since $(\text{yunomi})_{\phi}$ violates the prosodic branching constraint, it undergoes restructuring to the left:

(67) $(\text{marui})_{\phi}$ $(\text{yunomi})_{\phi}$ → $(\text{marui yunomi})_{\phi}$

Then, *omoi* is mapped to the phonological component:

(68) $(\text{omoi})_{\phi}$ $(\text{marui yunomi})_{\phi}$

Here, no restructuring applies, since the second p-phrase consists of two phonological words.

The next step is to spell-out *naomi* within DP2.

(69) $(\text{naomi})_{\phi}$

Since D1 has not been spelled-out, the linear order between (69) and (68) cannot be defined at this point.

The next step is to spell-out DP1. The following linear order is defined:

(70) DP2 << D1 << NP

D1 is realized as the Case particle, resulting in the following p-phrasing:

(71) (naomi-no)$_{\phi}$ (omoi)$_{\phi}$ (marui yunomi)$_{\phi}$

Here, the p-phrase containing *omoi* 'heavy' would be restructured to the left. However, in order to obtain the correct result, the restructuring of (omoi)$_{\phi}$ into the preceding p-phrase needs to be blocked.

As the following example shows, the adjuncts may violate the prosodic branching constraint in Japanese:

(72) John-ga kinoo hon-o yonda
John-Nom yesterday book-Acc read(past)
( )$_{\phi}$ ( )$_{\phi}$ ( )$_{\phi}$
'John read a book yesterday' (Adapted from Nagahara 1994)

Here,[12] the adjunct *kinoo* 'yesterday' corresponds to a single phonological phrase, violating the prosodic branching constraint. Note that the crucial difference between the Spell-Out of adjuncts and that of others is the way they define linear order. Specifiers, heads, and complements are linearly ordered in terms of OCC and head parameter, while adjuncts define the linear order on their own: When α is adjoined to β, α precedes β. Then, it would not be unexpected that adjuncts show some different behavior in phonological phrasing. Therefore, I assume that Spell-Out of the adjuncts gives an instruction to Φ so that the adjuncts are exempted from the prosodic branching constraint.

Thus in (71), (omoi)$_{\phi}$ 'heavy' does not restructure into the preceding phonological phrase. Note that restructuring in (67) is not triggered by the adjunct *marui* 'round' but by *yunomi* 'teacup.' That is, even though the adjunct *marui* itself does not have to satisfy the prosodic branching constraint, the nominal *yunomi* needs to satisfy it and the restructuring applies there.

In this section, I showed that the Kubozono's paradigm in (13) can be accounted for derivationally. I also discussed how adjuncts are spelled-out and argued that they do not have to satisfy the prosodic branching constraint.

3. Optionality of Phonological Phrasing

In this section, I speculate about optional phonological phrasing within the proposed

12 The phonological phenomenon relevant to the phonological phrasing here is downstep since all the words in (72) are accented.

system.

Kubozono (1993: 165) observes the following optionality of the phonological phrasing:

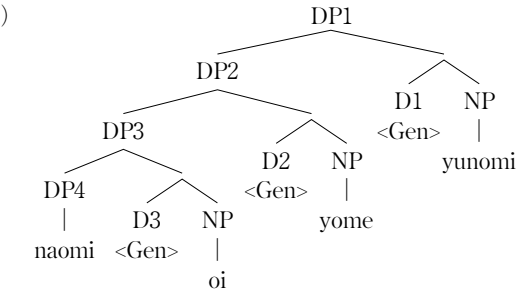
(73) [[naomi-no oi-no] yome-no yunomi]
Naomi-Gen nephew-Gen wife-Gen teacup
'Naomi's nephew's wife's teacup'

(74) a. AB/CD na⌈omino oino⌉ yo⌈meno yunomi⌉
( )$_\phi$ ( )$_\phi$
b. A/BCD na⌈omino⌉ o⌈ino yomeno yunomi⌉
( )$_\phi$ ( )$_\phi$
c. A/B/CD na⌈omino⌉ o⌈ino⌉ yo⌈meno yunomi⌉
( )$_\phi$ ( )$_\phi$ ( )$_\phi$

(73) shows the phonological phrasings shown in (74) optionally.

The syntactic structure of (73) is shown below:

(75)



Here, DP4 is in the phase edge of DP3, which is in the phase edge of DP2, which is in the phase edge of DP1. Let us apply the proposed mapping algorithm:

(76) a. S-O (Sister of Head of DP4): (naomi)$_\phi$
b. S-O (Sister of D3): (oi)$_\phi$
c. S-O (Sister of D2): (yome)$_\phi$
d. S-O of (Sister of D1): (yunomi)$_\phi$
e. S-O (DP1 as part of a larger structure): (-no -no -no)
i. Linearization within DP3: (naomi-no)$_\phi$ (oi)$_\phi$
Restructuring: (naomi-no oi)$_\phi$
ii. Linearization within DP2: (naomi-no oi-no)$_\phi$ (yome)$_\phi$
Restructuring: (naomi-no oi-no yome)$_\phi$
iii. Linearization within DP1: (naomi-no oi-no yome-no)$_\phi$ (yunomi)$_\phi$
Restructuring: (naomi-no oi-no yome-no yunomi)$_\phi$

In the first four steps (76a)-(76d), each noun is spelled-out as a sister of D. Since none of the D's has been spelled-out, the spelled-out phrases are not linearly ordered, and therefore no phonological phrases are formed until step (76e). In (76e), DP1 is spelled-out as part of a larger structure, and DP2, DP3, and DP4 are also spelled-out as part of DP1. Then, first, the linear order within DP3 is determined, and the linearly ordered string is mapped to **Φ**, and undergo the restructuring, as in (76e.i.), and the same process applies within DP2, as in (76e.ii), and then within DP1, as in (76e. iii). Then, the resulting phonological phrase is (naomi-no oi-no yome-no yunomi)**Φ**, which is wrong.[13]

As the optionality in the phonological phrasing suggests, we would need some additional account here. Note that since the three DP's are in the phase edges, they are not spelled-out until the entire structure, DP1 as a whole, is spelled-out. I suggest that a DP embedded in another DP is taken to be a root if the embedding is "very deep," and undergoes Spell-Out at some earlier point of the derivation.

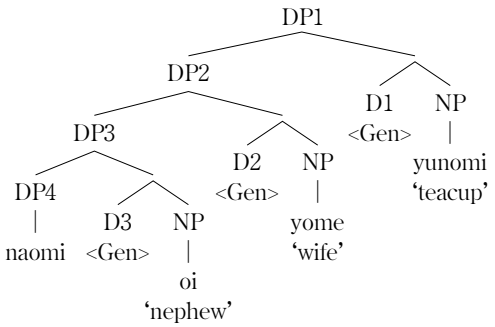
The general idea behind the notion of Multiple Spell-Out is computational efficiency. That is, computational system is "forgetful" and the multiple application of Spell-Out reduces the computational burden by "forgetting" the spelled-out domain. If so, the DP's that remain not spelled-out in the edge of the other DP phase would create an unwanted computational burden because the uninterpretable features in each DP remain checked "for a long time" under the assumption that Agree is part of Spell-Out/Transfer (Chomsky 2001b: 16). Thus, if DP2 and DP3 are spelled-out as part of DP1, we will need to locate at least three probes in different categories, D1, D2, and D3, which are scattered on a single representation when Spell-Out applies.

I suggest that DP's that remain not spelled-out in the phase edge are taken to be roots in computation to reduce the burden of computation, and Spell-Out applies to such roots. I will call such Spell-Out *forced Spell-Out*.

Under these considerations, let us return to (75), repeated here:

13 Kubozono's (1993) Branching Constraint hypothesis also predicts that entire phrase is a single phonological phrase.

(77)



Let us consider the first four steps of the derivation (76a-d) again.

(78) a. S-O (Sister of Head of DP4): $(\text{naomi})_{\phi}$

b. S-O (Sister of D3): $(\text{oi})_{\phi}$

c. S-O (Sister of D2): $(\text{yome})_{\phi}$

d. S-O of (Sister of D1): $(\text{yunomi})_{\phi}$

At this point, we have three DP phases that are not spelled-out in the edge positions. Suppose that DP4 is taken to be a root. Then, *naomi* is forced to be mapped to **Φ** independently.

(79) $(\text{naomi})_{\phi}$

When D3 is spelled out as part of the Spell-Out of the entire DP1, the Case particle is bound to *naomi* under (18b):

(80) $(\text{naomi-no})_{\phi}$

Suppose that the p-phrase resulting from the forced Spell-Out resists the restructuring since it has been spelled-out as an independent root. Then the phrasing (74b) is obtained as a result of the forced Spell-Out of DP4.

Similarly, if DP3 is taken to be a root and undergoes forced Spell-Out, then a p-phrase corresponding to DP3 resists the restructuring. Note that the restructuring within the DP3 is not blocked since "regular" Spell-Out applies there. Therefore, $(\text{naomi-no})_{\phi}$ and $(\text{oi})_{\phi}$ are phrased together, and (74a) is obtained. If each of DP4 and DP3 is taken to be a root, then the phrasing in (74c) is obtained. Note that DP2 may not be taken to be a root perhaps because it is not deep enough to be taken to be a root.[14]

14 An anonymous reviewer points out that DP5 in (42) could undergo forced Spell-Out, given my argument so far. As the phrasing in (41) suggests, forced Spell-Out may not apply to (42). I will leave the matter of "deepness" for my future research.

If this line of approach is correct, then it lends a support for the general algorithm of phonological phrasing in terms of Multiple Spell-Out. Multiple Spell-Out in combination with appropriate economy considerations gives a reason to take a phrase to be a root, and such a root corresponds to a phonological phrase which is a reflex of Multiple Spell-Out.[15]

4. Summary

In this paper, I argued for a derivational approach to phonological phrasing, by showing that the restructuring reflects the syntactic cycle. It is important to notice that a derivational approach makes it possible to apply the restructuring without recourse to any syntactic information. That is, a derivational approach makes it possible to achieve a very restrictive theory of syntax-phonology mapping. It is also important to notice that the arguments made in this paper are a support for a derivational theory in general.

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15 Note that this kind of reanalysis of a certain phrase as a root would be related to the intonational structure of the multiple embedding in English discussed by Chomsky and Halle (1968: 372):
(i) This is the cat that caught the rat that stole the cheese
The intonational pattern of this sentence is *this is the cat - that caught the rat - that stole the cheese*, where each CP phase seems to be taken to be a root. Thanks to John Bowers and John Whitman for bringing this to my attention. See Tokizaki 1999.

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