Symmetry and Asymmetry in the Syntax-Phonology Interface*

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ABSTRACT. This paper argues that syntactic brackets are interpreted as prosodic boundaries, which block phonological changes such as *Rendaku* (sequential voicing) in Japanese, and Lateralization and *n*-Insertion in Korean. It is pointed out that there are symmetry and asymmetry between left-branching and right-branching structure with respect to their blocking effect. The symmetry of left/right-branching is explained by the mapping theory developed in Tokizaki (1999, 2006). It is argued that the asymmetry of left/right-branching is due to the fact that junctures between words are shorter in left-branching structure than in right-branching structure. This analysis has interesting consequences for possible patterns in phonological changes, the asymmetric nature of syntax, and typological correlations between word orders and syllable structure.

Keywords: linearization, pause, prosody, compound, branching

1. Introduction

One of the tasks of phonology is to show how syntactic structure is linearized into a sequence of sounds and pauses. In this paper, I will argue that linearization is effected differently in left-branching and right-branching structures. It will be argued that the phonology of Japanese and Korean compounds shows that left-branching structure is linearized with shorter junctures than right-branching structure. In section 2, I will outline the mapping theory developed in Tokizaki (1999, 2006). Section 3 is a discussion of the blocking effect of prosodic boundaries, and this section aims to show the symmetry and asymmetry of left/right-branching structure. In section 4, I will argue that the left-right asymmetry is due to the difference in juncture between left-branching and right-branching structures. Section 5 shows some consequences of this analysis. Finally, I summarize and conclude my arguments in section 6.

2. Linearization of Hierarchical Structure with Silence

I have argued that the hierarchical structure of syntax is mapped onto phonology with various lengths of pause between words. The mapping rule (Tokizaki (1999, 2006)) is formulated as in (1).

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

For example, the rule (1) applies to the following sentence (2) to give its phonological representation (3).

(2) [[Alice] [[loves] [hamsters]]]

(3) // Alice /// loves // hamsters ///

A prosodic boundary is interpreted as a silence of a certain length, which can be represented

as a silent demibeat (x) as shown in (4) (cf. Selkirk (1984)).

(4) xx Alice xxx loves xx hamsters xxx

I have also argued that phonological boundaries are deleted to form larger prosodic categories. This process is represented by the rule (5).

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

If we apply (5) to (3) with *n*=1, 2 and 3, we get various levels of prosodic phrases such as prosodic words (6a), phonological phrases (6b) and an intonational phrase (6c).

(6) a. / Alice // loves / hamsters // (*n*=1) ($_{\omega}$ Alice) ($_{\omega}$ loves) ($_{\omega}$ hamsters)
b. Alice / loves hamsters / (*n*=2) ($_{\phi}$ Alice) ($_{\phi}$ loves hamsters)
c. Alice loves hamsters (*n*=3) ($_{I}$ Alice loves hamsters)

3. Symmetry and Asymmetry of Left/Right-Branching Structure

3.1. Symmetry of Left/Right-Branching Structure

This theory of syntax-phonology interface predicts that both left-branching structure and right-branching structure block phonological changes such as assimilation. This is the case in a number of languages. For example, let us consider Lateralization in Korean, which changes the coronal nasal *n* to the lateral *l* when it is adjacent to *l* (Han (1994)).[1]

(7) [hon lan] → hol lan
mix disorder 'confusion'

Note here that Korean does not allow *l* to occur in word-initial position and changes it into *n* or deletes it, as shown in (8a) and (8b).

(8) a. o lak *vs.* nak wen
joy ease 'amusement' ease garden 'paradise'
b. i lyek *vs.* yek sa
step history 'personal history' history book 'history'

Lateralization is blocked in a compound that has either left-branching or right-branching structure (cf. Umeda (1989), Lee and Ramsey (2000)).

(9) a. [[sɛŋ san] ljɔk] → sɛŋ san njɔk˥/*sɛŋ sal ljɔk˥
bear produce power 'productivity'
b. [[ku in] lan] → ku in nan/*ku il lan
want person column 'want ad'

(10) a. [sin [lolli hag]] → sin nolli hak/*sil lolli hak
new logic study 'new logic'
b. [sin [la mjɔn]] → ɕin na mjɔn/*ɕil la mjɔn
hot hand-pulled noodle 'spicy noodle (proper name)'

The structures in (7), (9) and (10) are rendered by the mapping rule (1) as (11), (12) and (13).

(11) / hon lan / hol lan

(12) a. // sɛŋ sa<u>n</u> / <u>l</u>jɔk / *sɛŋ sa<u>l</u> <u>l</u>jɔk˺

b. // ku i<u>n</u> / <u>l</u>an / *ku i<u>l</u> <u>l</u>an

(13) a. / si<u>n</u> / <u>l</u>olli hag // *si<u>l</u> <u>l</u>olli hak

b. / si<u>n</u> / <u>l</u>a mjɔn // *ɕi<u>l</u> <u>l</u>a mjɔn

In (12) and (13), the prosodic boundary to the left of a liquid (*l*) blocks Lateralization and prevents the nasal (*n*) from changing into a liquid to make a sequence of liquids (*..l l..*).

Thus the mapping rule (1) correctly predicts when Lateralization is blocked in Korean. Both left-branching and right-branching compounds are phonologically represented with a boundary that blocks Lateralization. In other words, the rule (1) correctly predicts the symmetry of left/right-branching structure with respect to blocking phonological changes.

3.2. Asymmetry of Left/Right-Branching Structure

However, there are some cases where right-branching structure blocks phonological change while left-branching structure does not. First, consider *Rendaku* (sequential voicing) in Japanese, which applies to the first consonant in a word preceded by another word ending with a vowel. For example, the first consonant in the second word in (14a) and (14b) is voiced when it is a part of compound.

(14) a. nise <u>t</u>anuki → nise <u>d</u>anuki
mock badger 'mock-badger'

b. tanuki <u>sh</u>iru → tanuki <u>j</u>iru
badger soup 'badger-soup'

The voicing rule also applies to three-word compounds if they have left-branching structure as in (15a), but it is blocked if they have right-branching structure as in (15b) (Otsu (1980)).

(15) a. [[nise tanuki] <u>sh</u>iru] → nise danuki <u>j</u>iru
mock badger soup 'mock-badger soup'

b. [nise [<u>t</u>anuki shiru]] → nise <u>t</u>anuki jiru
mock badger soup 'mock badger-soup'

Let us assume that *Rendaku* is the process that assimilates a word-initial consonant to the preceding vowel with respect to the feature [+voice]. Then *Rendaku* is blocked when there is a left bracket between a word-final vowel and a word-initial consonant as in (15b). This is explained with the mapping rule (1), which applies to (15b) to give (16) as its output.

(16) / nis<u>e</u> / <u>t</u>anuki shiru // → nis<u>e</u> <u>t</u>anuki jiru 'mock badger-soup'

The boundary between *nise* and *tanuki* blocks *Rendaku* in (16); *tanuki* does not change into *danuki* in this case.

However, the rule (1) also predicts a boundary in a left-branching compound such as (15a), which is interpreted as (17).

(17) // nise tanuk<u>i</u> / <u>sh</u>iiru / → nise danuk<u>i</u> <u>j</u>iru 'mock-badger soup'

In (17), *shiru* changes into *jiru* in spite of the fact that there is a boundary between *tanuki* and

shiru. *Rendaku* seems to ignore the prosodic boundary that is mapped from a right bracket in left-branching structure. Thus Japanese *Rendaku* is a case of left/right-branching asymmetry with respect to blocking phonological change.

Another case of left/right-branching asymmetry is *n*-Insertion in Korean. In Standard Korean, *n* is inserted before a stem beginning in *i* or *y* when it is preceded by another stem or prefix which ends in a consonant. For example, *sæk* 'color' and *yuli* 'glass' may make *sæŋ nyuli* 'colored glass'. This rule can apply in compounds with left-branching structure while it cannot in compounds with right-branching structure (Han (1994)).

(18) a. [[on chən] yok] → on chən nyok
hot spring bathe 'bathing in a hot spring'

b. [[mæŋ caŋ] yəm] → mæŋ jaŋ nyəm
cecum bowel fire 'appendicitis'

(19) a. [kyəŋ [yaŋ sik]] → kyəŋ yaŋ sik/*kyəŋ nyaŋ sik (OK in Kyungsan)
light Western food 'a light Western meal'

b. [myəŋ [yən ki]] → myəŋ yən gi/*myəŋ nyən gi (OK in Kyungsan)
fame play skill 'excellent performance'

A left bracket in a compound blocks *n*-Insertion as in (19), and a right bracket does not as in (18). The mapping rule (1) applies to (18) and (19) to give (20) and (21).

(20) a. // on chən / yok / nyok

b. // mæŋ caŋ / yəm / nyəm

(21) a. / kyəŋ / yaŋ sik // *nyaŋ (OK in Kyungsan)

b. / myəŋ / yən ki // *nyən (OK in Kyungsan)

If we assume that *n*-Insertion is blocked by an intervening boundary, we can explain why Standard Korean does not allow *n*-Insertion in (19) and (21). However, we cannot explain why *n*-Insertion is possible in left-branching compounds (18) and (20).

Note here that in the Kyungsan dialect of Korean, *n*-Insertion is possible in right-branching compounds as well as in left-branching compounds, as shown in the parentheses in (19) and (21). Then *n*-Insertion in Kyungsan Korean is a second case of left-right symmetry. However, this is different from the first case of left-right symmetry, Korean Lateralization, which is *blocked* in both left-branching compounds and right-branching compounds. Intuitively, *n*-Insertion in Kyungsan is a 'strong' enough rule to apply over a boundary, and Korean Lateralization is a 'weak' rule to be blocked by a boundary.

3.3. Toward an Analysis of Symmetry and Asymmetry of Left/Right-Branching

So far, I have shown that there are cases of symmetry and asymmetry in left/right-branching structure with respect to blocking phonological changes. These cases are summarized in (22).

(22)		left-branching	right-branching
a.	*n*-Insertion in Kyungsan Korean	OK	OK
b.	*n*-Insertion in Standard Korean	OK	*
c.	*Rendaku* in Japanese	OK	*
d.	Lateralization in Korean	*	*

We can explain the cases of symmetry (22a) and (22d) with the mapping rule (1) and the boundary deletion rule (5). Left-branching structure and right-branching structure can be schematically shown as (23a) and (23b).

(23) a. [[A B] C]
b. [A [B C]]

These structures are interpreted by the rule (1) as (24a) and (24b).

(24) a. // A B / C /
b. / A / B C //

If Lateralization in Korean applies to this representation (perhaps at the level of prosodic words), it is blocked between B and C in (24a) and A and B in (24b) by an intervening boundary. If the boundary deletion (5) with *n*=1 applies to (24a) and (24b), we get (25a) and (25b).

(25) a. / A B C
b. A B C /

This is the level of prosodic representation (phonological phrases or accentual phrases, cf. Jun (1993)) to which *n*-Insertion in Kyungsan Korean applies. There is no boundary between A, B and C in (25a) and (25b) to block *n*-Insertion.

Thus, the remaining task is how to explain the cases of asymmetry (22b) and (22c). In the next section, I will analyze the asymmetry in terms of different junctures between left-branching and right-branching structure.

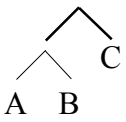
4. Junctural Difference between Left-Branching and Right-Branching Structure

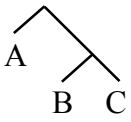
Before we tackle the asymmetry cases, let us recall the definitions of the Nuclear Stress Rule (NSR) and the Compound Stress Rule (CSR) (Liberman and Prince (1977), cf. Cinque (1993)).

(26) In a configuration $[_C$ A B]:
a. NSR: If C is a phrasal category, B is strong.
b. CSR: if C is a lexical category, B is strong iff it branches.

The *iff* clause in (26b) amounts to saying that a right-branching compound behaves like a phrasal category (26a) with respect to stress location. Given that phrasal categories in head-initial languages have right-branching structure, let us assume that left-branching structure is compound-like and that right-branching structure is phrase-like. Left-branching structure has short juncture between words; its constituents are combined tightly together. Right-branching structure has long juncture between words. If we use tree diagrams, we can express the difference between left-branching and right-branching as a difference of levels as

shown in (27a) and (27b).

(27) a. 

b. 

Left-branching structure (27a) is lower than right-branching structure (27b). The bold lines show the constituency above word level, and the fine lines the constituency below word level. To express this idea with brackets and boundaries, let us suppose that left-branching structure has weaker brackets (⟦…⟧], which are interpreted by the mapping rule (1) as weaker boundaries (//), as shown in (28).

(28) [⟦A B⟧ C] → // A B // C /

This contrasts with right-branching structure, which has strong brackets and boundaries.

(29) [A [B C]] → / A / B C //

Then the asymmetry cases (22b) and (22c) are explained straightforwardly. The *n*-Insertion in Standard Korean and *Rendaku* in Japanese are 'moderately strong' rules, which can apply between B and C over a weak boundary in (28). However, they are not 'strong' enough to apply between A and B over a strong boundary in (29).

Note that the analysis of the symmetry cases (22a) and (22d) shown in section 3.3 still holds in this revised version of mapping theory with left-right asymmetry. Lateralization in Korean, a 'weak' rule, does not apply between B and C in (28) because of an intervening weak boundary. It also does not apply between A and B in (29) because of an intervening strong boundary. Then the boundary deletion rule (5) with *n*=1 applies to (28) and (29) to give a higher-level prosodic category, e.g. a phonological phrase or an accentual phrase.

(30) a. // A B C

b. A B C /

n-Insertion in Kyungsan Korean applies to (30a) and (30b) to insert *n* between B and C in (30a) and between A and B in (30b). Thus, the symmetry cases as well as the asymmetry cases are explained straightforwardly.

5. Universality of Asymmetry in Syntax and Phonology

Let us consider some consequences of the analysis given above. First, I have proposed the hypothesis that left-branching structure has shorter juncture than right-branching structure. If this is universal in all languages, it predicts that there is no phonological change that is blocked in left-branching structure and allowed in right-branching structure, as shown in (31) (cf. Kubozono (1995)).

(31) a. [⟦A B⟧ C] → // A <u>B</u> // <u>C</u> / *

b. [A [B C]] → / <u>A / B</u> C // OK

As far as I know, there is no phonological rule with the pattern in (31). If this line of reasoning is on the right track, left/right-branching asymmetry is one of the basic properties of language.

The left-right asymmetry in phonology also seems to relate to the one in syntax. Kayne's (1994) Linear Correspondence Axiom requires that every syntactic tree is right-branching, except for the adjunction of a head into another head to make compounds. The discussion in this paper shows that this is in fact the case. Every phrase has right-branching structure; every word or compound has left-branching structure. This seems to be a point worth exploring, but I will leave it for future research.

Moreover, the proposed left-right asymmetry sheds light on the relation between word orders and syllable structure in languages. Since Lehmann (1973), it has been pointed out that languages with object-verb order tend to have simple syllable structure (cf. Plank (1998)). Let us assume that simple syllable structure allows an object to move to the left of the verb to make left-branching structure. For example, a verb phrase tends to have right-branching structure in a head-initial language, and left-branching structure in a head-final language.

(32) a. $[_{VP}$ V $[_{NP}$ .. N ..]] → / V / .. N .. //

b. $[_{VP}$ $[_{NP}$ .. N ..] V] → // .. N .. / V /

However, if we assume the left/right-branching asymmetry discussed above, head-final languages in fact have compound-like verb 'phrases'.

(33) $[_{V}$ [.. N ..] V] → /// .. N .. // V /

The object and the verb in (33), separated only by a weak boundary, are more closely connected to each other than the object and the verb in (32a), which are separated by a strong boundary. Simple syllable structure such as CV fits nicely into the shorter juncture in (33) without making a consonant cluster .

(34) /// .. CV // CV /

Then VO languages are allowed to have complex syllable structure because strong boundaries separate the coda of the verb and the onset of the object as shown in (32a).

(35) / CCCVCC / CCCVCC .. //

In fact there are a number of OV languages with complex syllable structure, which need to be reconsidered in the light of this analysis. However, the point is that left/right-branching asymmetry gives us an interesting way to investigate a correlation between syntax and phonology. I will not go into detail here (but see Tokizaki and Kuwana (2007)).

6. Conclusion

In this paper, I have argued that syntactic structure is linearized into words and pauses of various lengths. A syntax-phonology mapping rule and the deletion of prosodic boundaries explain the fact that both left-branching and right-branching structures block Lateralization in Korean and allow *n*-Insertion in Kyungsan Korean. It is also argued that left-branching structure is compound-like while right-branching structure is phrase-like. The asymmetry of juncture between left-branching and right-branching structures is reflected in *n*-Insertion in Standard Korean and *Rendaku* in Japanese.

It has also been pointed out that the analysis presented here has a number of interesting consequences for possible patterns of phonological changes, its relation to asymmetric syntax,

and the universal correlation between word orders and syllable structure. Further investigation of these topics along the lines of the above analysis may well lead to our better understanding of the nature of language.

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Notes

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[1] Lateralization applies forward as well as backward. However, I will deal with backward Lateralization only. Forward Lateralization (*l n* → *l l*) applies across a word boundary (i.e., within an utterance) as well as within a word (see Han (1994) and Sohn (1999)).

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