

Prosody and branching direction of phrasal compounds

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Abstract. This paper investigates the prosody of phrasal compounds in Japanese, English and German. In a Japanese phrasal compound, a prosodic boundary can occur within a modifier phrase but not between the phrase and the head noun. Japanese phrasal compounds contrast with English and German phrasal compounds, where a pause may occur between the modifier phrase and the head noun but not within the modifier phrase. I argue that the prosodic differences between these languages are due to the branching direction of modifier phrases: Japanese phrasal compounds have left-branching modifiers while English and German phrasal compounds have right-branching modifiers. It is argued that the data of prosodic phrasing in these languages pose some problems for Match Theory (Elfner 2012), the edge-based theory (Selkirk & Tateishi 1988) and Generalized Insertion (Ackema & Neeleman 2004).

Keywords. interface; mapping; boundary; pause; accent

1. Introduction. While phrasal compounds (e.g. *over-the-fence gossip*) have been much discussed in morphology and syntax (Lieber 1992 among others), little attention has been paid to their prosody (cf. Wiese 1996 for German). This paper investigates the prosody of phrasal compounds in a so-called left-branching language (Japanese) and (mostly) right-branching languages such as English and German.

I argue that the prosody of phrasal compounds in Japanese and English/German reveals that branching direction is crucial for prosody. The branching direction is captured by Bare Mapping from syntax to phonology (Tokizaki 1999, 2008). I argue that the prosodic facts are problematic for other theories of the syntax-phonology interface such as the edge-based theory (EB) (Selkirk and Tateishi 1988), Match Theory (MT) (Elfner 2012), and Generalized Insertion (GI) (Ackema & Neeleman 2004).

In section 2, I illustrate the prosody of Japanese, English and German. In section 3, I argue that interface theories such as EB, MT and GI make wrong predictions for the phrasing of phrasal compounds and noun phrases in German. Section 4 is devoted to the discussion of branching direction and prosody. Section 5 concludes the discussion.

2. Prosodic boundary in phrasal compounds. This section illustrates the prosody of phrasal compounds in a left-branching language (Japanese) and right-branching languages (English and German).

2.1. JAPANESE. Phrasal compounding in Japanese is productive in the sense that Japanese combines a modifier phrase with a word to create a new compound word (Kubozono (1995)) (an apostrophe shows a pitch-fall accent HL, underscore a word-initial low pitch, and a slash a prosodic boundary).

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- (1) a. [NP [mi'dori-no] / hane] bo'kin (citation form: bokin (unaccented))
 green of feather fund-raising
 'Green feather fund-raising'
 b. [TP [[[Nippon-no] so'ra]-o] / toboo] kyampe'en (citation: tobo'o (accented))
 Japan of sky-ACC fly campaign
 "'Let's fly over the Japanese sky" campaign'

Notably, a prosodic boundary occurs within a modifier phrase (NP or TP) as shown in (2a) and (3a), but not between a modifier phrase and the head noun (*bokin* and *kyampeen*) as shown in (2b) and (3b).¹

- (2) [N [NP [mi'dori-no] hane] bokin] (citation)
 green of feather fund-raising
 'Green feather fund-raising'
 a. (PU mi'dori-no) (PU hane bo'kin)
 b. * (PU midori-no hane) (PU bokin)
 c. ? (PU midori-no hane bo'kin)
 d. * (PU mi'dori-no) (PU hane) (PU bokin)
- (3) [N [TP [[[nippon-no] so'ra]-o] tobo'o] kyampe'en] (citation)
 Japan of sky-ACC let's-fly campaign
 "'Let's fly over the Japanese sky" campaign'
 a. (PU nippon-no so'ra-o) (PU toboo kyampe'en)
 b. * (PU nippon-no sora-o tobo'o) (PU kyampe'en)
 c. ?? (PU nippon-no sora-o toboo kyampe'en)
 d. * (PU nippon-no) (PU sora-o toboo kyampe'en)

The position of a prosodic boundary can be verified by the change of pitch fall accent from citation form into compound form (*bokin* > *hane bo'kin*, *tobo'o* > *toboo kyampe'en*) and the presence of word-initial low pitch (shown with underscore), which changes into a high pitch when the word follows another word ending in a high pitch in the same prosodic unit. For example, in (2a) the citation form *bokin* changes into *bo'kin* as in (PU hane bo'kin). Similarly, in (3a) the citation form *kyampe'en* changes into *kyampe'en* as in (PU toboo kyampe'en).

The prosodic phrasing in Japanese phrasal compounds is interesting because it breaks a noun-modifying phrase and makes a prosodic unit containing the head noun and a part of the modifying phrase. Note here that one prosodic phrase for the whole phrasal compound (2c) and (3c) is less natural than (2a) and (3a) but possible. In fact, the acceptability of (3c) is lower than (2c). I will discuss this matter in section 4.

2.2. ENGLISH AND GERMAN. Phrasing of phrasal compounds in English and German makes a clear contrast to that in Japanese, as shown in (4).

- (4) a. [PP over-[the-fence]] (/) gossip
 b. die [CP Wer-[war- was]] (/) -Frage
 the who was what question
 the who-was-what question

¹ As for the phrasing in (2b), another accent pattern with a pitch fall on the initial mora in the first word of the phrasal modifier is also unacceptable as shown in (i).

(i) * (PU mi'dori-no hane) (PU bokin)

Here, a pause (or phrase final lengthening) may occur between the modifier phrase and the head noun as in (5a) and (6a) but not within the modifier phrase as in (5b), (5c), (6b) and (6c).²

- (5) [N [PP over-[the-fence]] gossip]
 a. (PU over-the-fence) (PU gossip)
 b. * (PU over) (PU the-fence gossip)
 c. * (PU over-the) (PU fence gossip)
 d. (PU over-the-fence gossip)
- (6) die [N [CP Wer-[war-was]]-Frage]
 the who-was-what question
 a. (PU die Wer-war-was) (PU Frage)
 b. * (PU die Wer) (PU war-was Frage)
 c. * (PU die Wer-war) (PU was Frage)
 d. (PU die Wer-war-was-Frage)

The phrasing in English and German is rather straightforward in that a prosodic boundary cannot occur inside the modifying phrase. The tight connection between words in phrasal modifiers can be seen in the use of hyphens as shown in (5) and (6).³

3. Interface theories. This section illustrates how the prosody of phrasal compounds poses problems for previous theories of the syntax-phonology interface. I discuss the edge-based theory, Match Theory and Generalized Insertion in turn.

3.1. THE EDGE-BASED THEORY. The difference of prosodic boundary location between Japanese and English/German might seem to be explained by the edge parameter (Selkirk and Tateishi (1988)), which is set as either left-edge (Japanese) or right-edge (English and German) of XP as a prosodic boundary in a language. The edge-based theory predicts the phrasing in (7) (8) and (9) for the examples in (2), (4a) and (4b), where the brackets at the relevant edge are in bold face.

- (7) [N [NP [mi'dori-no] hane] bokin] (citation)
 green of feather fund-raising
 'Green feather fund-raising'
 ? (PU midori-no hane bo'kin)
- (8) [N [PP over-[DP the-fence]] gossip]
 (PU over-the-fence) (PU gossip)
- (9) die [N [CP Wer-[IP war-was]]-Frage]
 the who- was-what question
 (PU die Wer-war-was) (PU Frage)

The edge-based theory gives us the right result for the English. However, it does not give the phrasing in (2a) in Japanese: (PU mi'dori-no) (PU hane bo'kin).

² Kubozono (1995: 141) notes that the pause between the phrasal modifier and the modified noun in (i) is longer than that between the first word and the second of a two-word compound in (ii).

- (i) a. Save-the-homeless campaign
 b. "We love Anne Diamond" Party
- (ii) a. peach campaign
 b. labor party

³ It is interesting that German uses a hyphen between the phrasal modifier and the head noun in phrasal compounds while English, Dutch and Afrikaans do not (cf. Wiese 1996, Meibauer 2007). I will not discuss this matter here and leave it for future research.

If we try to extend the analysis into noun phrases, there arises another problem for the edge-based theory. A prenominal attributive phrase in German does not make a prosodic boundary at its right edge:

- (10) der [NP [VP [PP in Berlin] wohnhafte] Professor]
 the in Berlin living professor
 ‘the professor living in Berlin’
 a. der (PU in Berlin wohnhafte Professor)
 b. * der (PU in Berlin wohnhafte) (PU Professor)
 c. * der (PU in Berlin) (PU wohnhafte Professor)
 d. * der (PU in Berlin) (PU wohnhafte) (PU Professor)

Here, the edge-based theory wrongly predicts the phrasing in the noun phrase (10), where the right edge of the modifier VP and that of the PP are expected to make a prosodic boundary as (10d). The unacceptability of (10b) and (10c) further shows that neither of these edges makes a prosodic boundary. It is necessary to assume that the edge parameter is set as left of XP in a noun phrase (10) and as right in a phrasal compound (9). However, assigning two values for a parameter of the same phrasal category (XP) would undermine the theory based on parameters.

3.2. MATCH THEORY. Selkirk (2011) proposes Match Theory for the syntax-phonology interface, which calls for a match between syntactic and prosodic constituents, i.e. a clause and an intonational phrase (ι), a phrase and a phonological phrase (φ), and a word and a prosodic word (ω) (cf. Elfner 2012). The constraint Match(Phrase, φ) predicts the phrasing in (11) and (12) for the examples in (2), (3) and (4).

- (11) a. [N [NP [N mi'dori-no] hane] bokin] (citation)
 green of feather fund-raising
 ‘Green feather fund-raising’
 * (PU midori-no hane) (PU bokin)
 b. [N [TP [NP [N nippon-no] so'ra-o] tobo'o] kyampe'en] (citation)
 Japan of sky-ACC let's-fly campaign
 ‘‘Let’s fly over the Japanese sky’’ campaign’
 * (PU (PU nippon-no so'ra-o) tobo'o) (PU kyampe'en)
- (12) a. [N [PP over-[the-fence]] gossip]
 (PU over-the-fence) (PU gossip)
 b. die [N [CP Wer-[IP war-was]]- Frage]
 the who- was-what question
 * (PU die) (PU Wer- (PU war-was)) (PU Frage)

The phrasing in (12a) is an acceptable one, but the phrasings in (11a), (11b) and (12b) are not. One might argue that Match(Phrase, φ) can be outranked by some prosodic markedness constraints. In fact, Selkirk (2011: 469) argues that Match(Phrase, φ) is outranked by the prosodic markedness constraint BinMax(φ , ω) in Japanese, which requires that there be no more than two prosodic words in a phonological phrase (φ). She shows the effect of BinMax(φ , ω) on prosodic structure as in (13).

- (13) [NP [NP [NP N-no N-no] N-no] N-ga] \rightarrow (φ N-no N-no) (φ N-no N-ga)

Assuming the ranking BinMax(φ , ω) \gg Match(Phrase, φ), one might be able to derive the acceptable phrasing in (3a), (PU nippon-no so'ra-o) (PU toboo kyampe'en), instead of the

unacceptable phrasing in (11b). However, the example in (11a) has three prosodic words, which can be divided into two phonological phrases either as (2a) $(_{PU} \text{mi}'\text{dori-no}) (\text{hane } \text{bo}'\text{kin})$ or as (2b) $*(_{PU} \text{midori-no hane}) (\text{bokin})$. Both of these phrasings observe the higher-ranked constraint $\text{BinMax}(\varphi, \omega)$; the lower-ranked $\text{Match}(\text{Phrase}, \varphi)$ is violated in an acceptable phrasing (2a) and is not violated in an unacceptable phrasing (2b). Thus, the ranking constraints as $\text{BinMax}(\varphi, \omega) \gg \text{Match}(\text{Phrase}, \varphi)$ does not explain the acceptability of phrasing in (2a).⁴

Moreover, just changing the ranking of constraints for typological differences between languages will not give us a principled answer to the question why a language has a specific ranking and not some other ranking. Why do English and German observe $\text{Match}(\text{Phrase}, \varphi)$, which can be violated in Japanese? Why can English and German violate $\text{BinMin}(\varphi, \omega)$ and $\text{BinMax}(\varphi, \omega)$, which are likely to be observed in Japanese? Checking different types of constraint (matching between syntax and phonology, and phonological markedness) in a ranking needs global computation in grammar, which is not plausible in the minimalist program of linguistic theory (Chomsky 1995). It is necessary to look for a theory using only local computation in phonology.

Furthermore, the phrasing in the German noun phrase we have seen in the discussion of the edge-based theory is also problematic for Match Theory, which wrongly predicts the phrasing in (14b).⁵

- (14) der $[_{NP} [_{VP} [_{PP} \text{in Berlin}] \text{wohnhafte}] \text{Professor}]$
 the in Berlin living professor
 ‘the professor living in Berlin’
 a. der $(_{PU} \text{in Berlin wohnhafte Professor})$
 b. * der $(_{PU} (_{PU} (_{PU} \text{in Berlin}) \text{wohnhafte}) \text{Professor})$

The phrasing in (14b) expects a prosodic boundary between *Berlin* and *wohnhafte*, and another prosodic boundary between *wohnhafte* and *Professor*, which are in fact not present.

3.3. GENERALISED INSERTION. Ackema and Neeleman (2004) propose Generalized Insertion for phrasal compounds. Generalized Insertion inserts a phrase into an X^0 position as a word in a syntactic component. Although the mechanism of prosodic phrasing in this framework is not clear, it is expected that an inserted phrase behaves as a prosodic word, which contains no prosodic boundary. If this reasoning is right, Generalized Insertion makes a wrong prediction (15) for Japanese phrasal compounds.

- (15) a. $[_{N} [_{N} [_{N} \text{mi}'\text{dori-no}] \text{hane}] \text{bokin}]$ (citation)
 green of feather fund-raising
 ‘Green feather fund-raising’
 * $(_{PU} \text{midori-no hane}) (\text{bokin})$
 b. $[_{N} [_{N} [_{NP} [_{N} \text{nippon-no}] \text{so}'\text{ra-o}] \text{tobo}'\text{o}] \text{kyampe}'\text{en}]$ (citation)
 Japan of sky-ACC let's-fly campaign
 ‘“Let’s fly over the Japanese sky” campaign’
 * $(_{PU} \text{nippon-no so}'\text{ra-o tobo}'\text{o}) (\text{kyampe}'\text{en})$

According to the idea of Generalized Insertion, a phrasal modifier is inserted as a word to make a phrasal compound with the head noun. Then, it is not expected that a word-like modifier *midori-*

⁴ It is not relevant here that both of these phrasings violate another constraint $\text{BinMin}(\varphi, \omega)$ requiring that φ minimally consist of two ω .

⁵ Match Theory admits recursion of prosodic phrases (cf. Selkirk 2011).

no hane or *nippon-no sora-o toboo* is divided into two prosodic units as in (2a) or (3a): (PU mi'dori-no) (PU hane bo'kin); (PU nippon-no so'ra-o) (PU toboo kyampe'en). On the other hand, phrasing in English/German phrasal compounds is correctly predicted as shown in (16) and (17).

- (16) [N [PP over-[the-fence]] gossip]
 (PU over-the-fence) (PU gossip)
- (17) die [N [CP Wer-war-was]-Frage]
 the who-was-what question
 (PU die Wer-war-was) (PU Frage)

In spite of its success in explaining the facts in English and German, Generalized Insertion does not give us an answer to the question why Japanese and English/German are different with respect to phrasing in phrasal compounds.

4. Branching direction. In this section, I argue that the prosodic differences between Japanese and English/German are due to the branching direction of modifier phrases: Japanese has left-branching (head-final) modifiers as in (18) while English and German have right-branching (head-initial) modifiers as in (19) and (20).

- (18) [NP [N mi'dori-no] hane] bokin (citation)
 green of feather fund-raising
 'Green feather fund-raising'
- (19) [PP over-[DP the-fence]] gossip
- (20) die [CP Wer- [C' war-was]]-Frage
 the who- was-what question

In Tokizaki (1999, 2008), I argue that a left-branching structure has a prosodic boundary at its left-edge while a right-branching structure has a prosodic boundary at its right-edge because of a sequence of syntactic boundaries there. The mapping from bare syntactic structure (Chomsky 1995) to phonology, which I call Bare Mapping, is formulated as in (21).

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

Bare Mapping (21) interprets the phrase structures in (18), (19) and (20) as (22), (23) and (24), respectively.

- (22) // midori-no/ hane / bokin
 (23) / over / the fence // gossip
 (24) die / Wer / war was // Frage

This representation shows the basic juncture between lexical items, which are grouped into prosodic categories by deleting a number of boundaries in each sequence of boundaries. The process of boundary deletion is formulated as in (25).

- (25) Delete n boundaries between words (n , a natural number).

The boundary deletion rule (25) with $n=1$ applies to (22), (23) and (24) to give (26), (27) and (28).

- (26) / midori-no hane bokin
 (27) / over the-fence / gossip
 (28) die Wer war was / Frage

There remains a boundary between the modifier and the modified noun in (27) and (28) but not in (26). These representations show that phrasal compounds in English and German are more likely to have a prosodic boundary at their right edge than phrasal compounds in Japanese. The representations correspond to the phrasing in (29), (30) and (31), which are acceptable in English and German and possible in Japanese.

- (29) ?_(PU) midori-no hane bo'kin
 (30) _(PU) over-the-fence) _(PU) gossip
 (31) _(PU) die Wer-war-was) _(PU) Frage

Also, the boundary deletion rule (25) with $n=2$ applies to (22), (23) and (24) to give (32), (33) and (34).

- (32) midori-no hane bokin
 (33) over the-fence gossip
 (34) die Wer war was Frage

There are no boundaries in these representations, which correspond to one prosodic phrase for a whole phrasal compound as shown in (35), (36) and (37).

- (35) ?_(PU) midori-no hane bo'kin
 (36) _(PU) over the-fence gossip)
 (37) _(PU) die Wer war was Frage)

The prediction is correct for English and German. However, we need to derive the two prosodic phrases for the phrasal compound shown in (38), which are preferred to the one prosodic phrase in (29) and (35) in Japanese.

- (38) _(PU) mi'dori-no) _(PU) hane bo'kin)

In order to get this phrasing, we need to delete a boundary between the phrasal modifier and the noun and leave a boundary within the modifier. I argue that this is possible. But why is this phrasing (38) a more favorable option than (29) and (35)? I argue that the accent pattern of the first word is relevant for phrasing. The first word *mi'dori* in (38) is accented in its citation form as well as in the compound. Let us consider another example of phrasal compounds in (39), whose first word is unaccented in citation.

- (39) mizuiro -no hane bokin (citation)
 light blue of feather fund-raising
 'light-blue-feather fund-raising'
 a. ??_(PU) mizuiro-no) _(PU) hane bo'kin)
 b. *_(PU) mizuiro-no hane) _(PU) bokin
 c. _(PU) mizuiro-no hane bo'kin)
 d. *_(PU) mizuiro-no) _(PU) hane) _(PU) bokin)

The one prosodic phrase in (39c) is more acceptable than that in (35); the two-prosodic phrase pattern in (39a) is marginal. The difference in acceptability between (39c) and (35) seems to come from the accent patterns of these phrasal modifiers. The citation form *mi'dori-no* has a pitch fall accent on the first mora, which must be changed into a pitch rise when it is combined

with the following noun to make a phrasal compound of one prosodic phrase, as in (35).⁶ The citation form *mizuiro-no* has a pitch rise on the first mora, which is kept intact when it is combined with the following noun to make a phrasal compound of one prosodic phrase, as in (39c). Thus, we can conclude that the one prosodic unit for a whole phrasal compound is basically acceptable in Japanese. We can attribute the marginal acceptability of (35) to the prosodic change from the citation form in a phrasal modifier, which does not occur in an alternative phrasing in (38). The representations in (26), (27), (28), (32), (33) and (34) successfully show the acceptable phrasing patterns in Japanese, English and German.⁷

The example in (3), repeated here as (40) is explained in the same way. The phrase structure (40a) is mapped to the phonological representation (40b) with prosodic boundaries. The boundary deletion rule (25) applies to (40b) and deletes one boundary between words ($n=1$) to derive (40c).

- (40) a. [N [TP [[[nippon-no] so'ra]-o] tobo'o] kyampe'en] (citation)
 Japan of sky-ACC let's-fly campaign
 “Let's fly over the Japanese sky” campaign'
 b. // // // nippon-no / so'ra / -o / tobo'o / kyampe'en /
 c. // // // nippon-no so'ra-o tobo'o kyampe'en / ($n=1$)

The phrasing patterns in (3) are repeated here as (41).

- (41) a. (PU nippon-no so'ra-o) (PU toboo kyampe'en)
 b. * (PU nippon-no sora-o toboo) (PU kyampe'en)
 c. ?? (PU nippon-no sora-o toboo kyampe'en)
 d. * (PU nippon-no) (PU sora-o toboo kyampe'en)

The representation (40c) corresponds to the phrasing in (41c), whose marginality might seem to come from the length of the prosodic unit. However, I argue that the accent of citation form is relevant here also: a pitch fall at the end of *so'ra* and the low pitch at the initial position of *toboo'o* in their citation forms are likely to make a prosodic boundary between these two words as in (41a). Let us consider another example, which has an unaccented word *mori-o* as the second word.

- (42) [N [TP [[[nippon-no] mori]-o] mamoro'o] kyampe'en] (citation)
 Japan of forest-ACC let's-keep campaign
 “Let's keep Japanese forest” campaign'

This structure is interpreted as (43a), to which the boundary deletion rule (25) applies to give (43b).

- (43) a. // // // nippon-no / mori /-o / mamoroo / kyampeen
 b. // // // nippon-no mori-o mamoroo kyampeen ($n=1$)

⁶ In other words, the first word cannot keep its falling accent in phrasal compounds, as shown in (i).

(i) a. * (PU mi'dori-no hane) (bokin)
 b. * (PU mi'dori-no hane bokin)

⁷ I also argue that the number of boundaries to be deleted (n) in the rule (25) is related to the speed of utterance: in slower speech, the prosodic boundary between the modifier and the modified noun is left as in (27) and (28), which is deleted in a faster speech as in (33) and (34). See Tokizaki (1999, 2008).

This example with an unaccented word *mori-o* as the second word has a different paradigm of acceptability from (41) with an accented word *so'ra-o* as the second word, as shown in (44).

- (44) a. ?* (PU nippon-no mori-o) (PU mamoroo kyampe'en)
 b. * (PU nippon-no mori-o mamoro'o) (PU kyampe'en)
 c. (PU nippon-no mori-o mamoroo kyampe'en)
 d. ?? (PU nippon-no) (PU mori-o mamoroo kyampe'en)

The most natural phrasing (44c) corresponds to the representation in (43b). Thus, we can conclude that the branching direction together with Bare Mapping and the boundary deletion straightforwardly explains the phrasing in phrasal compounds. The examples with a prosodic break within a phrasal modifier in Japanese, which might seem to be counterexamples to our analysis, can be explained in terms of the requirement for a pitch fall in a word in the citation form to be kept intact in the derived phrasal compounds.

Finally, let us consider how this analysis makes a correct prediction for the phrasing in German prenominal modification as seen in (45).

- (45) a. der [NP [VP [PP in Berlin] wohnhafte] Professor]
 the in Berlin living professor
 'the professor living in Berlin'
 b. der /// in Berlin / wohnhafte / Professor /
 c. der // in Berlin wohnhafte Professor (n=1)

Bare Mapping interprets the structure in (45a) as (45b), which is changed to (45c) by the boundary deletion. The representation in (45c) correctly predicts the phrasing in (46), which has no prosodic break between the modifier and the modified noun.

- (46) der (PU in Berlin wohnhafte Professor)

Here, our analysis based on branching direction has an advantage over the edge-based theory, which assumes either the left edge or the right edge of a phrase to be the boundary, irrespective of its branching direction.

5. Conclusion. In sum, the prosody of phrasal compounds in Japanese and English/German reveals that the branching direction of the structure is crucial for the morphosyntax-phonology interface. The facts of prosodic phrasing in phrasal compounds pose problems for some interface theories such as the edge-based theory, Match Theory and Generalized Insertion. Our analysis based on Bare Mapping and boundary deletion gives us a better explanation for the phrasing in these languages, including prenominal modifiers in German. It is also pointed out that Japanese phrasing in phrasal compounds is affected by the accent pattern of words in the citation form. Of course, in order to fully understand the relation between morphosyntax and prosody, we need to investigate the precise mechanism of prosodic phrasing in pitch accent languages such as Japanese. I will leave this matter for future research.

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