

Two Types of Linking Elements within Distributed Morphology*

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1. Introduction

In morphology, much focus has been placed on an element that bridges between constituents of a compound. The element is called a Linking Element (hereafter, LE). Apart from the linking function, LEs have several other characteristics. One of them is semantic emptiness; that is, LEs are forms without meanings. Let us clarify this characteristic by using genitive compounds in English and Japanese:

- (1) a. English: women's magazine
- b. Japanese: mago-*no* te
 grandchild-LE hand
 'back scratcher'

(Mukai (2008:189))

Both -'s in (1a) and -*no* in (1b) formally correspond to genitive morphemes, but cannot be construed as a genitive case because the morphemes in (1) cannot mean what a genitive case means. For example, the phrase *the women's magazines*, in which *the* modifies *women*, means the magazines that the women have, whereas in case that *the* modifies the whole of the compound *women's magazine*, the expression means the magazines for women. Similarly, if *mago-no te* is used as a phrase, it denotes a hand or hands of a grandchild, while if it is used as a compound, it means an instrument for scratching a back. As with English and Japanese, genitive compounds are observed in other Germanic and Scandinavian languages like Danish and Swedish, as shown in (2):

- (2) a. Danish: fred-*s*-conference
 peace-LE-conference
 'peace conference'
- b. Swedish: bord-*s*-lamp
 table-LE-lamp
 'desk lamp'

(Mukai (2008:190))

* I am grateful for helpful comments to Ryohei Naya, Hiroko Wakamatsu, Shohei Nagata, and Haruki Isono. Needless to say, any remaining errors and shortcomings are my own.

In (2), the morpheme *-s-* corresponds to a genitive marker of those languages, but does not carry the inflectional value. These facts clearly show that forms of LEs are formally identical with existing morphemes, although they do not have any semantic load.

Meaningless forms like LEs pose a serious threat to the morpheme-based theory, because the theory considers a minimal unit of word formation to be a morpheme defined as a form-meaning pairing. To solve the problem, some researchers have aimed to motivate the presence of meaningless forms. For example, Mukai (2008) and Okubo (2014) adopt the framework of Distributed Morphology (Halle and Marantz (1993, 1994), Marantz (1997), Embick and Marantz (2008)) and reveal why the grammar needs LEs.

Although Mukai and Okubo are successful in capturing the semantic emptiness of LEs, there is another fact which they do not tackle with: The forms of some LEs like those in (1) and (2) stem from certain existing morphemes, while those of other LEs cannot originate from other existing morphemes. In other words, there are two types of LEs, one of which is the LE that does not mark the compoundhood of a construction and the other of which is the LE that marks it. LEs of genitive compounds belong to the former type. An exemplar of the latter type is LEs of Greek compounds. Ralli (2008, 2009) shows that a Greek compound has the LE *-o-*, as given in (3):

- (3) Greek: *domat-o-salata*
 tomato-LE-salad
 'tomato salad' (Ralli (2009:453))

According to Ralli, the semantically empty element *-o-* does not stem from any existing morphemes in Modern Greek. Ralli mentions that its origin is an ancient thematic vowel.^{1, 2} Considering the fact that *-o-* occurs only in the compound, Ralli names it a compound marker. In some languages, compoundhood is marked by changing a segment of a constituent. For instance, in addition to the example in (1b), Japanese has another LE, as shown in (4):

¹ The function of thematic vowels will be mentioned in section 4.2.1.

² As Ralli (2009:455) argues, it cannot be identified with any inflectional endings, even though in certain cases, *-o-* coincides with an inflectional ending. Consider the neuter form of the adjectival coordinate compound *asprokokino* 'white and red', composed of *aspr-* 'white' and *kokino* 'red'. In the compound, the first constituent *aspro* seems to be inflected for nominative singular. If it were correct, it could be inflected for other inflectional values. However, when the compound is inflected for plural, the form of *aspro* does not change, while the second constituent that of *kokino* changes into *kokina*. The fact that *aspro* cannot change means that it is not a fully inflected word, but consists of the stem *aspr-* and the LE *-o-*.

- (4) hana+tayori → hanad~~a~~yori
 flower+tidings ‘flower tidings’ (Itô and Mester (1986:56))

In Japanese compounds, if the beginning of the second element is an obstruent, it is voiced. This rule is called *Rendaku*. Due to this rule, the beginning of the second element *tayori* is voiced in (4). Itô and Mester (1986:57) consider *Rendaku* to be a rule introducing an LE. Given the fact that the rule is not applied in other contexts except compounds, a morpheme introduced by the rule seems to function as a compound marker.

The purpose of this paper is to explain the existence of the two types. Specifically, based on the framework of Distributed Morphology and Okubo’s (2014) analysis of LEs, I argue that LEs without the function of compound marking are the word version of expletives added at syntax, whereas LEs that function as compound markers are elements added at morphology.

The organization of this paper is as follows. Section 2 introduces the framework that this paper is based on. Section 3 reviews Okubo (2014) and shows how his analysis explains the semantic emptiness of LEs. The section also shows what part of his analysis needs to be modified. Based on the framework of Distributed Morphology and Okubo’s analysis of LEs, section 4 proposes that LEs without the function of compound marking are introduced in syntax, while those that have the function in morphology. Section 5 applies the proposal to the LEs in (1)-(4). Section 6 shows consequences of the present analysis. Section 7 concludes the paper.

2. Theoretical Background: Distributed Morphology

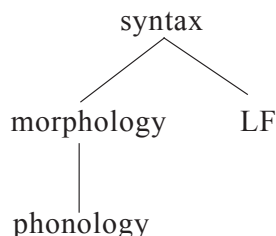
2.1. Grammatical Architecture

In this paper, I will adopt the framework of Distributed Morphology (henceforth, DM). DM is one of the minimalist versions of the morpheme-based approach, where the minimal unit of word formation is a morpheme. In contrast to traditional morpheme-based theories employing a component dedicated to word formation, DM adopts the view of syntactic word formation; small elements like words are built by syntactic operations. This hypothesis states that syntax manipulates formal features like [pl] and [past] to form words.

DM adopts the Separation Hypothesis (Beard (1995)), according to which components of a morpheme like syntax, semantics, and phonology are separated from each other. The adoption of this hypothesis leads to the divorce of the phonological forms from formal features. Hence, the features have to be

assigned phonological forms in order for phonology to interpret them. In DM, the assignment of phonological forms is done at morphology. This component is a set of rules that modify a syntactic structure so as to be readable from phonology. The system of DM is summarized as in (5).

(5)



In DM, syntax is the sole generative system, while morphology is an interpretive component. Morphology interprets outputs of syntax and transforms them into phonological forms. Importantly, not all rules of morphology operate freely. Some of the morphological rules are restricted by language-specific requirements. Some languages allow a certain morphological rule, whereas other languages disallow it. This means that morphology is a source of linguistic variation.

2.2. *Morpheme, Word, and Compound*

There are two important notions among several ones in morphology; morpheme and word. The two notions are re-interpreted in DM.

In traditional terms, a morpheme is a composite of form and meaning. In contrast, viewing that form is detached from meaning, DM considers a morpheme to be a syntactic terminal node. There are two types of morpheme; one is an abstract morpheme and the other is a Root. The characteristics of each morpheme are summarized as in (6). These morphemes are concatenated in syntax through the application of Merge.

(6) Terminals

- a. Abstract morphemes: These are composed exclusively of non-phonetic features, such as [Past] or [pl], or features that make up the determiner node D of the English definite article eventuating as *the*.
- b. Roots: These include items such as $\sqrt{\text{CAT}}$, $\sqrt{\text{OX}}$, and $\sqrt{\text{SIT}}$, which are sequences of complexes of phonological features, along with,

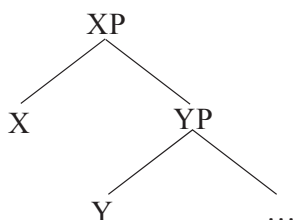
in some cases, non-phonological diacritic features. As a working hypothesis, we assume that the Roots do not contain or possess grammatical (syntactico-semantic) features.

(Embick and Noyer (2007:295))

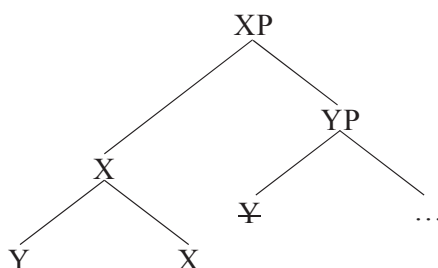
With respect to a Root, this type of morpheme is category-free and hence has to be categorized by categorizers such as *n*, *v*, and *a*, in order for it to be interpreted. Given this process, even simple words like *dog* turn out to have complex structures.

Based on the compositional view of words, DM does not think of word as the primitive notion. According to Embick and Marantz (2008:6-7), the notion is syntactically re-defined. They consider the difference between ‘two words’ and ‘one word’ to be the structural difference illustrated in (7).

(7) a. ‘Two words’



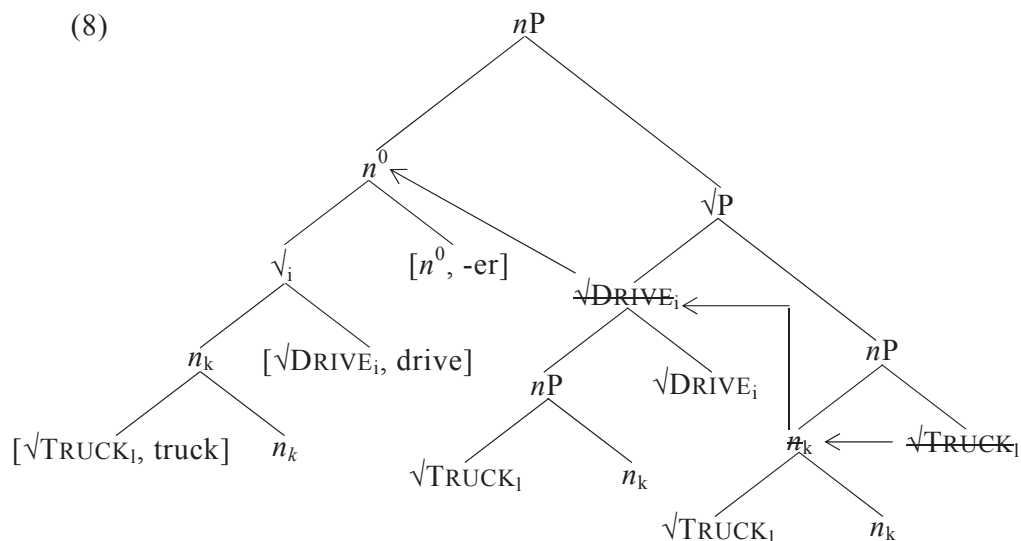
b. ‘One word’



Embick and Marantz claim that as shown in (7a), the two terminal nodes X and Y correspond to ‘two words’, but if packaging operations like head movement applies to them, the resultant complex terminal node corresponds to ‘one word’, as shown in (7b).³

³ Head movement is one of the debatable operations. For example, on the basis of the abolition of D- and S-structures and the fact that head movement violates the Extension Condition, Chomsky (2000) claims that the operation is a phonological one. By contrast, Matushansky (2006) does not admit the operation and reduces its effects to phrasal movement

The distinction between ‘two words’ and ‘one word’ urges us to re-define a compound in structural terms. A compound is traditionally defined as “a word that is made up of two other words” (Bauer (2006:719)). Given this definition, it turns out that a compound is re-defined as “a terminal made out of two or more terminals.” In addition, Harley (2009:130) claims a compound to be “a word-sized unit containing two or more Roots.” Considering these statements, Harley’s definition of a compound can be modified as a complex terminal made out of two or more terminals containing more than one Root. And, I consider that a compound is built by packaging distinct terminals into one, as shown in (7b). In particular, I adopt Harley’s (2009) analysis of compounds. Harley argues that a compound is created by head movement. For instance, the synthetic compound *truck driver* is built as shown in (8), where the arrows denote head movement.



(Harley (2009:136), slightly modified)⁴

In (8), there are four terminal nodes; two *ns*, $\sqrt{\text{DRIVE}}$, and $\sqrt{\text{TRUCK}}$. These are packaged into one by head movement represented by the arrows in (8). First, $\sqrt{\text{TRUCK}}$ moves into n_k , and second, the resultant complex terminal moves into $\sqrt{\text{DRIVE}}$, and so on. As a result, all terminals are bundled together at the terminal n^0 . The terminal n^0 is a complex one that has two Roots. Hence, it is

plus morphological merger. In this paper, I simply ignore the problem for expository purposes.

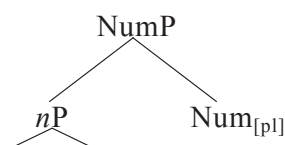
⁴ For the representation of terminals, I follow Embick and Marantz (2008).

morphologically and semantically interpreted as a compound. Because this movement is performed in syntax, where every movement is motivated by some formal feature, Harley assumes head movement to be Case-related. As a result of recursive applications of the movement, the compound *truck driver* is created.

2.3. Vocabulary Insertion

As shown in (6a), abstract morphemes do not have any phonological features. In order for them to be phonologically interpreted, a mechanism to assign phonological features to them is assumed. It is called Vocabulary Insertion, which operates in morphology. According to Embick and Noyer (2007:297), Vocabulary is defined as “the list of the phonological exponents of the different abstract morphemes of the language, paired with conditions on insertion.” Moreover, they define “such pairing of a phonological exponent with information about the grammatical (i.e. syntactic and morphological) context in which the exponent is inserted” as a vocabulary item (Embick and Noyer (2007:297)). One of the vocabulary items in English is shown in (10).

(9)



(10) $z \leftrightarrow [pl]$

The structure in (9) consists of *nP* and *Num* valued as *[pl]*, a functional head in which information about number is encoded. After the structure undergoes Spell-Out, *nP* and *Num_[pl]* are sent to morphology and at this component, they are given phonological forms. For instance, if *nP* includes $\sqrt{\text{DOG}}$, the phonological form *dog* is picked out from Vocabulary and *nP* is realized as *dog* by Vocabulary Insertion. With respect to *Num_[pl]*, the vocabulary item illustrated in (10) is selected from Vocabulary. It states that the phonological exponent */-z/* is inserted in *Num_[pl]* by Vocabulary Insertion.

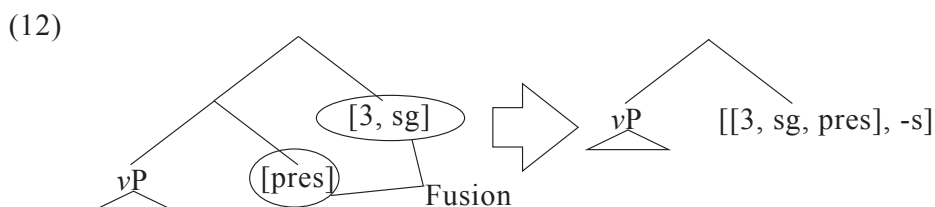
One of the characteristics of Vocabulary Insertion is that the operation is performed only once to a terminal node.

(11) Single-Vocabulary-Insertion assumption

One exponent per terminal node; that is, Vocabulary Insertion applies only once to a terminal node. (Embick and Marantz (2008:7))

For example, if Num_[pl] is realized by /-z/ through Vocabulary Insertion, the feature cannot be realized by other exponents. Given this property of the operation, I assume that as a result of Vocabulary Insertion, features are deleted.

Although every terminal node ultimately has its exponent at morphology, some terminal nodes are bundled together by undergoing morphological operations like Fusion. Fusion reduces two terminal nodes that are in a sister relation into one. The resultant terminal node undergoes Vocabulary Insertion, so that only one exponent occurs. Simply put, Fusion creates an environment for portmanteau morphemes. For instance, English has a portmanteau morpheme that attaches to a verb and the morpheme is produced by Fusion, as shown in (12).



In (12), vP denotes verbs like *kick*, *eat*, and *drink*, and the features [pres], [3], and [sg] stand for present, 3rd person, and singular, respectively. The syntactic structure on the left undergoes Fusion at morphology, as a result of which the features are bundled together. As shown in the structure on the right, the resultant terminal node undergoes Vocabulary Insertion, which assigns the phonological form -s to the node.

3. Linking Elements as the Word Version of Expletives

In section 1, we observed semantic emptiness of LEs. To explain this property, Okubo (2014) adopts the framework of DM and Mukai's (2008) view of an LE as a checker of an uninterpretable feature. Based on DM, it turns out that word structure is built in syntax. Taking this hypothesis into consideration, Okubo finds out that an LE is an expletive, which does not convey any lexical meanings and whose function is to nullify the effect of an uninterpretable feature. In addition, considering that the expletive in the phrasal domain checks off the EPP feature, Okubo considers that the expletive in the word domain is a checker of the word-version of the EPP feature. According to Okubo, the EPP feature in the word domain validates the wordhood of the entire construction. Hence, every compound has the EPP feature.

With respect to the semantic emptiness of LEs, Okubo's analysis seems to

be correct. However, it does not deal well with the difference between LEs functioning as a compound marker like the LE *-o-* of Greek compounds and LEs without the function like the LE *-’s* of English genitive compounds. The reason behind this is that Okubo considers every LE to be a checker of the EPP feature, which means that LEs are homogeneous. For instance, Okubo suggests the following two structures for compounds with LEs that attach to Roots and those with LEs that attach to categorized Roots.⁵

- (13) a. $[\sqrt{\text{ROOT}} f]$
 b. $[[\sqrt{\text{ROOT}} x] f]$

The word-version of the EPP feature is represented by f in (13). In Okubo’s analysis, f merges with a Root and a categorized Root. The former is shown in (13a) and the latter in (13b). According to Okubo, Greek has the structure in (13a) and f is checked off by the LE *-o-*, while English has that in (13b) and f is checked off by LEs like *-’s*. Therefore, there is no difference in feature between the LEs in Greek and English.

One might say that the difference in structural position between the LE *-o-* and the LE *-’s* leads to the functional difference between the two types. However, it seems to me that the statement is not correct. Embick and Marantz (2008:11) propose a generalization as to forms of morphemes; the morpheme that attaches directly to a Root has unsystematic forms, while the morpheme that attaches outside of a categorized Root has systematic forms. Put differently, the morpheme of the former type shows allomorphy, while the morpheme of the latter type does not show it. In view of this generalization, Okubo’s analysis predicts that an LE of Greek compounds should show allomorphy. However, according to Ralli (2008), an LE of Greek compounds does not show allomorphy.

Although Okubo’s analysis does not capture the functional difference in question, it correctly captures the semantically empty nature of LEs. The aim of this paper is thus not to reject Okubo’s analysis, but to modify it so as to explain the difference between LEs functioning as compound markers and those that do not have the function.

⁵ Okubo illustrates only the structures for the non-heads of the compounds. Although the entire structures of compounds are shown in this paper, in (13), I follow the footsteps of Okubo and illustrate the structures of non-heads.

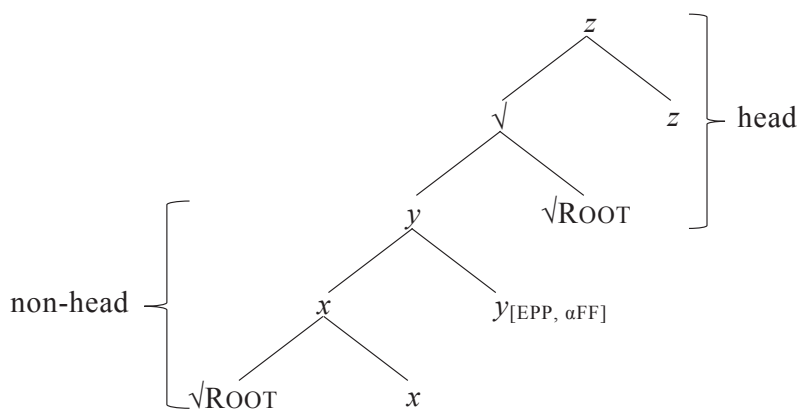
4. Proposal

This section proposes, based on the framework introduced in section 2, the derivation of compounds with LEs functioning as compound makers and those with LEs without the function. First, I will show the structure of compounds that have LEs without the function of compound marking. Second, before proposing the structure of compounds with LEs functioning as compound markers, I will show the parallelism between the compound-marking LE and thematic vowels. Third, based on Oltra-Massuet and Arregi's (2005) view that thematic vowels are inserted in a terminal node which is added at morphology, I will show how to derive the structure of compounds that have compound-marking LEs.

4.1. Structuring the Compound with LEs without the Compound-Marking Function

In this paper, I suggest the following structure for compounds with LEs without the compound-marking function.

(14)



In (14), the italicized lower cases *x* and *z* represent categorizers like *n*, *v*, and *a*, and *y* corresponds to the LE in question. The non-head of the compound in question is built by combining a Root, *x*, and *y*, whereas the head of it is composed of a Root and *z*. Although I assume with Okubo (2014) that the LE is a realization of the EPP feature, I also assume that it requires another formal feature, which is represented by [α FF]. The reason behind the addition of the feature is that LEs without the compound-marking function are universally observed, as shown in (15):

- (15) a. English: women's magazine (= (1a))
 b. Japanese: mago-**no** te (= (1b))

The two languages in (15) are genetically irrelevant. English belongs to Germanic languages, while Japanese is an isolated language. In spite of this fact, they have compounds with the LE in question denoted by the bold face letters, which originates from a genitive morpheme. This means that features realized as the LEs are introduced in syntax. In addition, given the fact that forms of the LEs are identified with those of inflections, I assume that [α FF] is a kind of an unvalued feature. The unvalued feature is uninterpretable for LF, so that it must be nullified before it is sent to LF. Adapting Harley's (2009) idea, I assume that the uninterpretable feature is nullified by the head movement of some element. Morphology interprets the feature and assigns a form to it through the application of Vocabulary Insertion.

4.2. *Structuring the Compound with the LE Functioning as a Compound Marker*

4.2.1 *The Parallelism between LEs with the Function of Compound Marking and Thematic Vowels*

In section 1, I mentioned that semantically empty morphemes like LEs are problematic for the morpheme-based theory. It has been pointed out that such morphemes are found not only in compounds but also in simple words. One of the semantically empty morphemes found in simple words is a thematic vowel. The meaningless nature of thematic vowels is pointed out by Aronoff (1994:45) and Haspelmath (2002:133). Thematic vowels are similar to LEs with the function of compound marking in that not every language shows the vowels. For example, according to Ralli (2008), Greek has LEs with the function of compound marking, while English does not have such LEs. Likewise, languages differ with respect to the presence of thematic vowels. For instance, Latin has thematic vowels, as shown below, while English does not have them.

In addition, thematic vowels have another similar property to LEs that function as compound markers. They have a function of characterizing classes of lexical items like nouns or verbs. For instance, the Latin verb has various conjugations and these conjugations are marked by several theme vowels (thematic vowels in this paper), as shown in (16).

(16) Theme vowels of Latin verbs (adopted from Aronoff (1994:45))⁶

Conjugation	Theme vowel	Present active infinitive	Gloss
first	\bar{a}	am- \bar{a} -re	‘love’
second	\bar{e}	dēl- \bar{e} -re	‘destroy’
fourth	\bar{i}	aud- \bar{i} -re	‘hear’
third	e	leg-e-re	‘pick’
third	i	cap-e-re	‘take’
third	Ø	fer-re	‘carry’

The table in (16) illustrates that there are four conjugations in Latin verbs and each conjugation is marked by different theme vowels. For example, the theme vowel \bar{a} indicates that a verb with the vowel belongs to the first conjugation, while the theme vowel \bar{e} ensures that a verb with the vowel belongs to the second conjugation. The important thing is that the forms of each theme vowel differ and therefore, each theme vowel is linked to different conjugations.

The function of thematic vowels as markers of conjugations reminds us of the function of LEs as markers of compoundhood. As we observed in section 1, Ralli (2009) argues that in Greek, the LE *-o-* occurs only in a compound. Based on this property, Ralli calls the element as a compound marker. This marker is defined as “a morphological element, deprived of any meaning, whose function is to indicate the word-formation process of compounding” (Ralli (2008:22)).

In sum, we have observed that there are two similarities between thematic vowels and LEs considered as compound markers; semantic emptiness and their function as markers of something. Taking these parallelisms into consideration, I suggest that they are generated by the same mechanism. Before fleshing the idea out, the next subsection introduces how to deal with meaningless forms like thematic vowels within the framework of DM.

4.2.2. “Ornamental” Morphology

Although structures of ‘words’ are built by combining morphemes in syntax, not every morpheme is interpretable. Some morphemes are added at morphology, depending on language-specific requirements. Since they emerge after Spell-Out, they do not participate in LF interpretation. Hence, they are ‘ornamental’ (Embick and Noyer (2007:305)). According to Oltra-Massuet (1999), a thematic vowel is one of the ‘ornamental’ morphology.

Given the semantic emptiness of thematic vowels, Oltra-Massuet (1999)

⁶ The thematic vowel *i*, which marks the third conjugation, is neutralized to *e* (Aronoff (1994:45)). The reason of this neutralization is unclear to me.

and Oltra-Massuet and Arregi (2005) argue that they are added at morphology. In particular, Oltra-Massuet and Arregi, building on Oltra-Massuet's analysis of Catalan thematic vowels, propose that Spanish has the morphological requirement in (17).

- (17) At MS ['morphology' in this paper, TO], all syntactic functional heads require a theme position.

Based on this requirement, Oltra-Massuet and Arregi (2005:47) decompose the Spanish verb *cantábamos* 'we sang' into the morphemes shown in (18).

- (18) a. cantábamos 'we sang'
 b. [$\sqrt{\text{CANT}}$ [ν Th]] [[T Th] Agr]
 cant \emptyset á b a mos

There are two functional heads in the structure: ν and T. Morphology interprets the structure and based on the requirement (17), some adjunction operation merges Th nodes to the heads. After this operation, Vocabulary Insertion applies to the Th nodes and Th adjacent to ν is realized as *á*, while that adjacent to T as *a*.

Based on the mechanism proposed by Oltra-Massuet and Arregi, I suggest that morphology introduces some features in the environment of compounds and at these features, LEs considered as compound markers like those in Greek are inserted by Vocabulary Insertion.⁷ Unlike the LE in question, as shown in section 4.1, the LE without the function of compound marking is a realization of formal features introduced in syntax.

4.2.3. *The Structure of Compounds with Compound-Marking LEs*

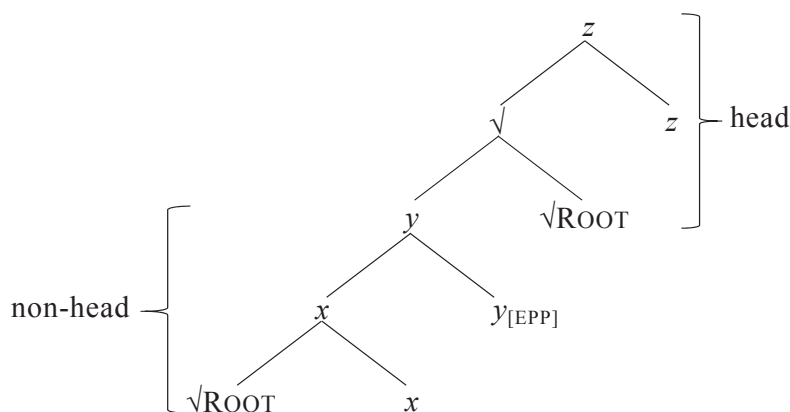
Given the discussion in the previous subsection, I propose the following structure for compounds with the compound-marking LE.

⁷ According to Embick and Noyer (2007:309), there are two strategies to add a feature at PF, as shown in (i).

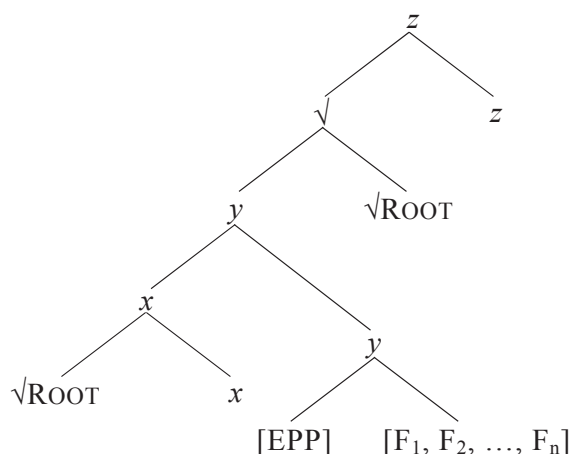
- (i) a. Feature copying: A feature [that] is present on a node X in the narrow syntax is copied onto another node Y at PF.
 b. Feature introduction: A feature that is not present in narrow syntax is added at PF.

My proposal is one of (ib).

(19) a. syntax



b. morphology



The structure in (19a) is a syntactic structure built in syntax. The structure composed of a Root, x , and y corresponds to the non-head of the compound in question, while that composed of a Root and z to the head of it. In the structure, the insertion site for the compound-marking LE does not exist. In morphology, the site, composed of the morphological features $[F_1, F_2, \dots, F_n]$, is introduced into the syntactic structure, on the basis of language-specific requirements. The insertion of such sites is performed after Spell-Out. This means that it is too late for their morphological features to affect the semantics of the syntactic structure in question, which explains the semantic emptiness of the LE in question. I assume that the node is adjoined to a functional head that has the EPP feature.

Section 5 applies the mechanism, proposed in this section, to genitive compounds, Greek compounds, and Japanese compounds. In particular, the

section argues that genitive compounds have the structure in (14), while Greek compounds and Japanese compounds have that in (19).

5. Analysis

5.1. *Compounds with LEs without the Function of Compound Marking: Genitive Compounds*

Before showing the structure of genitive compounds, let us repeat the examples of genitive compounds, given in section 1:

- | | | |
|---------|---------------------------|----------|
| (20) a. | English: women's magazine | (= (1a)) |
| b. | Japanese: mago-no te | (= (1b)) |
| c. | Danish: fred-s-conference | (= (2a)) |
| d. | Swedish: bord-s-lamp | (= (2b)) |

As mentioned in section 1, the LEs illustrated in (20) stem from genitive markers. What is important here is that genetically irrelevant languages like English and Japanese allow such LEs. Given this fact, it is possible that LEs stemming from genitive morphemes are universally allowed. I then consider the compounds in (20) to have the structure (14). In particular, I suggest that the compounds in (20) have the structure in (21).⁸ In addition, I also suggest the vocabulary item of the LE in question as in (22).

$$(21) \quad [_{n0}[\sqrt{[_{f0}[_{n0} \sqrt{\text{ROOT}_1} n]} f_{[\text{EPP}, \text{Case}]}] \sqrt{\text{ROOT}_2} n]$$

$$(22) \quad x \leftrightarrow [\text{Case}]$$

Let us show how the present analysis works. First, $\sqrt{\text{ROOT}_1}$ merges with a nominalizer n , as a result of which n^0 , corresponding to a noun, is created. Second, the resultant noun is combined with f , a functional head composed of Case and EPP features. As a result of this merger, the uninterpretable Case feature is nullified. Third, the resultant composite merges with $\sqrt{\text{ROOT}_2}$. Fourth, the complex structure, denoted by $\sqrt{}$, is combined with n . Fifth, after the Spell-Out of the resultant structure, Vocabulary Insertion applies to the structure at morphology and according to the vocabulary item in (22), f is realized by x , forms of which vary among languages. The EPP feature is deleted along with the Case feature.

Let us apply the analysis to the English genitive compound *women's*

⁸ For reasons of space, I henceforth use brackets to illustrate structures of compounds.

magazine. The first constituent includes the plural form of *woman*, so that I simply assume the Num head in the structure.

- (23) a. women's magazine
 b. $[_{n0}[\sqrt{f_0}[_{\text{Num}0}[_{n0} \sqrt{\text{WOMAN}} [n, -\emptyset]]] [_{\text{Num}_{[\text{pl}}], -\emptyset}]] [f_{[\text{EPP}, \text{Case}], -'s}]] \sqrt{\text{MAGAZINE}} [n, -\emptyset]]$
 (24) -'s \leftrightarrow [Case]

In (23b), after the structure is sent to morphology, abstract morphemes are realized by some exponents through the application of Vocabulary Insertion. The morphemes n and $\text{Num}_{[\text{pl}]}$ are realized by the null exponent $-\emptyset$. Some readjustment rule modifies the phonological form of the Root $\sqrt{\text{WOMAN}}$ and as a result, *women* appears. The morpheme f is realized by -'s, according to the vocabulary item in (24).

5.2. Compounds with the LE Functioning as a Compound Marker

5.2.1. Greek Compounds

Among several languages that have compounding, languages like Greek is different from others in that LEs in the former do not come from inflections like genitive and plural. This is illustrated in (25):

- (25) psar-o-varka
 fish-LE-boat
 'fish boat' (Ralli (2009:454))

According to Ralli (2009), the exponent *-o-* is formally identified with ancient thematic vowels.

Taking Ralli's remark into consideration, I suggest that Greek nominal compounds have the syntactic structure in (26a) and at this structure, a set of morphological features is added, as shown in (26b). The features are realized by *-o-* through the application of Vocabulary Insertion, which refers to the vocabulary item in (27).

- (26) a. syntax
 $[_{n0}[\sqrt{f_0}[_{n0} \sqrt{\text{ROOT}_1} n] f_{[\text{EPP}]}] \sqrt{\text{ROOT}_2} n]$

b. morphology

$$[_{n0}[_{\sqrt{f0}}[_{n0} \sqrt{\text{ROOT}_1} n] \boxed{[_f[\text{EPP}] [F_1, F_2, \dots, F_n]]}] \sqrt{\text{ROOT}_2} n]$$

Fusion

↓

$$[_{n0}[_{\sqrt{f0}}[_{n0} \sqrt{\text{ROOT}_1} n] \boxed{[_f[\text{EPP}, [F_1, F_2, \dots, F_n]]}] \sqrt{\text{ROOT}_2} n]$$

(27) -o- ↔ [F₁, F₂, ..., F_n]

The syntactic structure in (26) is built through the following steps. First, $\sqrt{\text{ROOT}_1}$ is nominalized by n . Second, the resultant structure is merged with f , whose feature is the EPP feature. Third, the resultant complex structure is combined with $\sqrt{\text{ROOT}_2}$. Fourth, after the merger of the complex structure $\sqrt{}$ with n , the syntactic structure is sent to morphology. This component adds a node represented as f to the syntactic structure, according to the requirement of a language. The node is added to the functional head f . It consists of a set of morphological features denoted by [F₁, F₂, ..., F_n]. This means that there are two nodes, as shown in the upper structure in (26b). Given the idea of one exponent per one node, one might raise a question of why two exponents cannot occur. To answer the question, I take into consideration the fact that Greek is one of the fusional languages and assume with Halle and Marantz (1993) that Fusion, one of the morphological operations, applies to the two nodes.⁹ As a result of this operation, these nodes are packaged into one node, as shown in the lower structure in (26b). The morphological features are realized by -o-, according to the vocabulary item in (27). The EPP feature is deleted along with the features.

Given this analysis, I consider that the compound *domat-o-salata* has the structure in (28b). For expository purposes, only the structure at morphology is shown.

(28) a. domat-o-salata

b. $[_{n0}[_{\sqrt{f0}}[_{n0} \sqrt{\text{DOMAT}} [n, -\emptyset]]] [_f[\text{EPP}, [F_1, F_2, \dots, F_n]], -o-] \sqrt{\text{SALATA}} [n, -\emptyset]]$

After the Spell-Out of the syntactic structure, morphology interprets the structure and adds the set of morphological features to f . After adding the node to the syntactic structure, the component spells out the features of the structure. The nominalizers are realized by the null exponents $-\emptyset$, while due to the vocabulary

⁹ For details of Fusion, see section 2.3.

item in (27), *f* is realized by *-o-*.

5.2.2. Japanese Compounds

In contrast to genitive compounds and Greek compounds, some compounds have suprasegmentally represented LEs. The typical example of the LEs is *Rendaku* in Japanese, as shown in (29):

- (29) hana+tayori → hanad^aayori
 flower+tidings ‘flower tidings’ (= (4))

Rendaku, which changes an initial obstruent in the second element of a compound into a voiced one, is considered by Itô and Mester (1986:57) as “a morphological process introducing a linking morpheme in a certain morphological context.” According to Itô and Mester, the rule is applied in the context of compounds, which is clearly shown in (29). The fact that only compounds undergo the rule means that *Rendaku* functions as a compound marker.

Given the function of *Rendaku* as a compound marker, I suggest that Japanese compounds are derived in the same way as Greek compounds, as shown in (30). Because there is no marker other than *Rendaku* in (29), I simply assume that Fusion occurs at morphology.

- (30) a. syntax
 $[_{n0}[\sqrt{f0}[_{n0} \sqrt{\text{ROOT}_1} n] f_{[\text{EPP}]}] \sqrt{\text{ROOT}_2} n]$
 b. morphology
 $[_{n0}[\sqrt{f0}[_{n0} \sqrt{\text{ROOT}_1} n] \boxed{f_{[\text{EPP}]} [F_1, F_2, \dots, F_n]}] \sqrt{\text{ROOT}_2} n]$
Fusion
↓
 $[_{n0}[\sqrt{f0}[_{n0} \sqrt{\text{ROOT}_1} n] \boxed{f_{[\text{EPP}, [F_1, F_2, \dots, F_n]]}}] \sqrt{\text{ROOT}_2} n]$

In this paper, employing Itô and Mester’s analysis of *Rendaku* as a rule of inserting a [+voi(cing)] feature, I assume that Japanese has the vocabulary item in (31). The feature is copied onto the initial segment of the second element of a compound and the segment hence undergoes voicing (cf. Itô and Mester (1986:58)).

- (31) [+voi] ↔ [F₁, F₂, ..., F_n]

Then, the structure of the compound in (29) is illustrated as in (32).

$$(32) \quad [_{n0}[\sqrt{[_{f0}[_{n0} \sqrt{\text{HANA}} [n, -\emptyset]]}] [f_{[\text{EPP}, [F1, F2, \dots, F_n]], [+voi]]}] \sqrt{\text{TAYORI}} [n, -\emptyset]]$$

$\begin{array}{c} [+voi] \\ \uparrow \\ \text{---} \end{array}$

After the syntactic structure of the compound in question is built, it is sent to morphology and there, it is modified through morphological processes. First, the new node with the set of morphological features is added to f . Second, Fusion collapses two features [EPP] and [F1, F2, ..., Fn] into a single node. Third, the modified structure undergoes Vocabulary Insertion. According to the vocabulary item in (31), the operation assigns a [+voi] feature to f . This feature is copied onto the initial obstruent of *tayori*, as shown by the broken arrow in (32), and then, the obstruent is voiced at phonology.

In sum, we have observed that there are two types of LEs; the LE that does not function as a compound marker and the LE with the function of compound marking. The former is added at syntax, whereas the latter at morphology. As the next section shows, the difference between the two types leads to consequences.

6. Consequences

6.1. The Recursiveness of LEs

The present analysis assumes that every compound has $f_{[\text{EPP}]}$. If the assumption is valid, my proposal has a consequence for the occurrences of LEs.

According to Selkirk (1982), a compound can be made out of other compounds. For instance, *bathroom* is combined with *towel rack* and as a result, the complex *bathroom towel rack* is built:

$$(33) \quad [[[bath]_N [room]_N]_N [[towel]_N [rack]_N]_N]_N \quad (\text{Selkirk (1982:15)})$$

The compound in (33) can be made larger by adding other nouns; for example, *bathroom towel rack designer*, *bathroom towel rack designer training*, and so on. This fact means that compounding is a recursive operation.

Given the nature of compounding and Okubo's view mentioned above, it turns out that a compound made out of other compounds have multiple f s. This statement predicts that a language has a compound in which multiple LEs occur. For example, as already shown in section 5.2.1, Greek is one of the languages having compound-marking LEs. My theory predicts that Greek has a compound allowing multiple occurrences of the LE *-o-*.

compound with the LE without the function of compound marking. However, unlike the compound-marking LE, the LE without the function of compound marking shows a different behavior. The multiple LEs in question are not observed, as shown in (36):

- (36) *Macy's boy's children's wear department is tiny.
(Anderson (2013:214))

In (36), *Macy's* functions as a possessive phrase, so that the entire expression in (36) intends to mean a department that Macy has, which is for wears of children for boys. The compound in (36) is derived as follows. First, the genitive compound *children's wear* is derived. Second, the compound is merged with *boy's* and as a result, the complex genitive compound *boy's children's wear* is built. However, it is unacceptable for some reason. It is unclear to me why multiple LEs in question are disallowed, while multiple compound-marking LEs are allowed, although the difference between the two types of LEs might be attributed to the difference in timing of insertion between the two types.

6.2. Double Marking of LEs

Some languages have both a compound-marking LE and an LE without the function of compound marking. For example, as shown in sections 5.1 and 5.2.1, Japanese has the two types of LEs. If the present analysis is correct, this fact means that in some compounds, the co-occurrence of the two types is possible.

This prediction is borne out by the following data:

- (37) ama-no gawa
heaven-LE river
'milky way' (Mukai (2008:189))

In (37), there are two LEs: One is *-no*, the LE without the function of compound marking and the other is the initial segment of the second element, the compound-marking LE fed by *Rendaku*. The double marking of LEs is explained by the following structure and morphological processes.

- (38) a. $[_{n0}[\sqrt{f0}[_{n0} \sqrt{\text{AMA}} [n, -\emptyset]]] [_{f}[[\text{EPP}], [\text{Case}]] [\boxed{\text{F1, F2, ..., Fn}}]]]$
 $\sqrt{\text{KAWA}} [n, -\emptyset]]$
- (31)
- b. $[_{n0}[\sqrt{f0}[_{n0} \sqrt{\text{AMA}} [n, -\emptyset]]] [_{f}[\boxed{[\text{EPP}], [\text{Case}]]} \boxed{[+voi]}]] \sqrt{\text{KAWA}} [n, -\emptyset]]$
- \downarrow -no feature copying \downarrow voicing
 \downarrow gawa

The syntactic structure of the compound in question is built in syntax and is sent to morphology. At this component, it is modified by the addition of a terminal node with a set of morphological features to f , as illustrated in (38a). Note that Fusion does not apply to f in (38a). I assume that Fusion is prevented from applying to f when any formal feature other than [EPP] resides in f . The lack of the operation means that the two terminal nodes [[EPP], [Case]] and [F1, F2, ..., Fn] remain intact. Given that each terminal node must have its own exponent, it turns out that the two terminal nodes are assigned exponents, respectively. As shown in (38b), the feature bundle composed of [EPP] and [Case] is realized by *-no* and the newly added features are replaced by [+voi] through the vocabulary item (31). The [+voi] feature in (38b) is copied onto the initial obstruent of *kawa* and after the feature copying, the segment is voiced at phonology. Hence, the compounds in (37) shows the double marking of LEs.

One might say that (37) is an exception because other genitive compounds do not undergo *Rendaku*. For instance, *te* ‘hand’ of the genitive compound *mago-no te* ‘back scratcher’ does not undergo voicing, while the same morpheme undergoes *Rendaku* in *kuma-de* ‘bamboo rake’. Although the double marking of LEs might be an exception with respect to genitive compounds, it is found in other types of Japanese compounds, as shown in (39):¹¹

- (39) a. *hiki+kataru* → *hiki-gataru*
 play+talk ‘play-talk’
 b. *iki+tsumaru* → *iki-dzumaru*
 go+get clogged ‘go-get clogged’

(Fukushima (2005:573))

In (39), two verbs are composed to form a compound. (39a) shows that two verbs *hiku* merges with *kataru*, whereas (39b) shows that two verbs *iku* merges with *tsumaru*. It is clearly shown that the compounds in (39) undergo *Rendaku*.

¹¹ For other examples, see Fukushima (2005:573).

What should be noted here is that the first verbs take an adverbial form or *renyookei*. According to Shimada (2013:note 7), the inflectional element *-i-* or *-e-*, which attaches to first verbs of the compounds in question, can be regarded as an LE. Given Shimada's remark, it turns out that there are two LEs in the compound in (39). Another type of compounds that show the double marking of LEs is shown in (40):

- (40) a. *sabor-i+kuse* → *sabori-guse*
 slack off-LE+habit 'a habit of slacking off'
 b. *ag-e+touhu* → *age-douhu*
 fry-LE+bean curd 'fried bean curd'

The compounds in (40) consist of a verb and a noun and the head of them is the noun. For instance, the compound *sabori-guse* in (40a) consists of the verb *saboru* and the noun *kuse*, meaning a habit of slacking off. The compounds in question show that the first constituent includes LEs and the second constituent undergoes *Rendaku*. Hence, the double marking of LEs occur in the compounds.

7. Conclusion

It is said that LEs are semantically empty and there are two types of LEs: one that has a compound-marking function and the other that does not have the function. I argued that the functional difference between the two types is attributed to their difference in feature composition. LEs without the function of compound marking realize formal features [α FF] and [EPP], while those that function as compound markers realize morphological features denoted by [F1, F2, ..., Fn]. With respect to the features of the former type, [α FF] is nullified before it is sent to LF. In addition, [EPP] does not have semantics. Hence, LEs without the function of compound marking is semantically empty. Unlike the features, morphological features are added at morphology, a component that comes after syntax. It is too late for the morphological features to affect meanings of syntactic structures. Hence, an LE with the compound-marking function, which is an exponent of the features, shows semantic emptiness.

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