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1. Introduction

Compounding and affixation in Japanese show differences in application of segmental rules. For example, several rules which apply when a past tense suffix -ta is attached to stems do not take effect in compounding even if the phonological environments appear to be identical. Examples will be provided in the next section.

This paper presents an account of the discrepancies between compounding and affixation in terms of the domain approach. The account crucially depends on a claim that compounds and affixed words have different number of domains in which phonological rules apply. According to Inkelas (1989), some compounds have two such domains while an affixed word has only one such domain. This separation of the phonological domains in compounds is responsible for the fact that some segmental rules do not apply when compounds are formed.

This paper is organized as follows. Section 2 provides examples showing the differences between compounds and affixed words. In Section 3, a possible account of the distinctions, referring to Lexical Phonology of Kiparsky (1982, 1986), will be refuted. Then, Section 4 presents an account of the discrepancies in terms of the domain approach. Finally, Section 5 offers concluding remarks.

2. The Differences

This section presents examples which show differences between compounding and affixation in application of segmental rules. I will show the discrepan-
cies between suffixation of three affixes and compounding which appear to create identical phonological environments. The suffixes are -ta "past tense", -sase "causative", and -yoo "volitional" and compounds are those whose second members start with /t/, /s/, or /y/.

A notable case of differences between affixation and compounding is seen in the comparison between words suffixed by -ta "past tense" and compounds whose second members begin with /t/. Examples in (1) demonstrate the discrepancies. In the chart, the second member of each compound is *tuduke "continue" and the compound itself means "continue to Verb", where "Verb" represents the first member of the compound. I will underline the parts relevant to show the differences and put an epenthetic /i/ in square brackets to highlight it.

<table>
<thead>
<tr>
<th>Stem</th>
<th>Past Tense</th>
<th>Compounding</th>
<th>Gloss of Stem</th>
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<tbody>
<tr>
<td>/k, g/ -- /i/</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>a. kak</td>
<td>ka[ji]ta</td>
<td>kak[ji]tuduke</td>
<td>&quot;write&quot;</td>
</tr>
<tr>
<td>b. kag</td>
<td>ka[ji]ta</td>
<td>ka[ji]tuduke</td>
<td>&quot;sniff&quot;</td>
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<tr>
<td>/b, m, n/ -- /n/</td>
<td></td>
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<td></td>
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<tr>
<td>c. tob</td>
<td>tonda</td>
<td>tob[ji]tuduke</td>
<td>&quot;fly&quot;</td>
</tr>
<tr>
<td>d. yom</td>
<td>yonda</td>
<td>yom[ji]tuduke</td>
<td>&quot;read&quot;</td>
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<tr>
<td>e. sin</td>
<td>sinda</td>
<td>sin[ji]tuduke</td>
<td>&quot;die&quot;</td>
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<tr>
<td>/r, w, t/ -- /t/</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>f. tor</td>
<td>totta</td>
<td>tor[ji]tuduke</td>
<td>&quot;take&quot;</td>
</tr>
<tr>
<td>g. yow</td>
<td>yotta</td>
<td>yol[ji]tuduke</td>
<td>&quot;get drunk&quot;</td>
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<tr>
<td>h. kat</td>
<td>katta</td>
<td>kat[ji]tuduke</td>
<td>&quot;win&quot;</td>
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<tr>
<td>epenthesis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i. kas</td>
<td>ka[ji]ta</td>
<td>ka[ji]tuduke</td>
<td>&quot;lend&quot;</td>
</tr>
<tr>
<td>no change</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>j. tabe</td>
<td>tabeta</td>
<td>tabetuduke</td>
<td>&quot;eat&quot;</td>
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As illustrated by the suffixed words in the chart, various segmental rules apply when -ta is attached to stems. First, stem final /k/ and /g/ disappear and an epenthetic /i/ shows up as demonstrated in (1a-b). Second, when the stem ends in /b/, /m/, or /n/, the stem final consonant becomes /n/ and the suffix initial consonant acquires voicing as shown in (1c-e). Third, examples in (1f-h) illustrate gemination of the suffix initial /t/ which occurs when the stem ends in /r/, /w/, or /t/. Finally, examples in (1i-j) are presented to show that no difference arises between affixation and compounding when the stem ends in /s/ or a vowel.

Compounding appears to create a phonological environment where the morpheme-final consonant precedes /t/. This condition seems to be identical with the one created by the past tense suffixation. Thus, it is expected that the segmental rules which apply to the suffixed words also take effect in compounds. In contrast to the past tense suffixation, however, compounding triggers none of the segmental changes as demonstrated by the examples in the third column in (1). Instead, an epenthetic vowel is inserted between the two members of a compound.

The segmental rules which apply in suffixation of past tense -ta are not the only cases where the differences between affixation and compounding are present. A segmental change, which I call Continuant Deletion, also distinguishes morphological types. In suffixation, morpheme-initial continuants, including sonorants, delete when they occur right after another consonant as demonstrated by the examples in (2). The examples in (2d) and (2h) show that the suffix initial consonants do not delete when a stem ends in a vowel. In the gloss, "caus" and "volt" stand for "causative" and "volitional", respectively.

(2) -sase and -yoo suffixation
a. tor+sase → torase "take-caus"
b. kak+sase → kakase "write-caus"
c. otos+sase → otosase "drop-caus"
d. tabe+sase → tabe-sase "eat-caus"
e. tor+yoo → toroo "take-volt"
f. kak+yoo → kakoo "write-volt"
g. otos+yoo → otosoo "drop-volt"
h. tabe+yoo → tabeyoo "eat-volt"

In compounding, however, morpheme-initial continuants do not delete when they occur after another consonant, as illustrated by the data in (3). Instead of the continuant deletion, insertion of a high front vowel /i/ applies when one consonant precedes another in compounds.

(3) Compounding

a. tor + sage → tor[i]sage
   "take" "lower" "withdraw"
b. kak + sokone → "fail to write"
   "write" "fail" kak[i]sokone
c. otos + sugi → otos[i]sugi
   "drop" "exceed" "drop in excess"
d. tabe + sugi → tabesugi
   "eat" "exceed" "eat in excess"
e. tor + yame → tor[i]yame
   "take" "stop" "cancel"
f. hik + yabur → hik[i]yabur
   "pull" "tear" "tear(intensified)"
g. tat + yor → tat[i]yor
   "stand" "come close" "drop by"
h. mi + yabur → miyabur
   "see" "tear" "see through"
As demonstrated by the data in (1) through (3), compounds do not undergo phonological rules which apply in affixation.

There are two possible accounts for the asymmetries between affixation and compounding. One is to refer to Level Ordering between the two morphological processes. The other, which I am arguing for in this paper, is to refer to the difference between the representations of the two morphological types. In the next two sections, I will argue against the first approach and show how the second approach account for the discrepancy.

3. Against a Lexical Phonology Approach

This section presents arguments against the Lexical Phonological account of the asymmetries between suffixation and compounding in the application of segmental rules. The argument has two parts. First, Level Ordering of suffixation and compounding may require a loop from Level 2 to Level 1. Second, Level Ordering may result in the mismatches between morphological and semantic structures.

Lexical Phonology (see Kiparsky (1982, 1985), Mohanan (1986), Borowsky (1986), and others) appears to provide us with an account of discrepancies in the application of the segmental rules in Japanese. With the Lexical Phonology approach, we may posit that suffixation and compounding belong to two different morphological levels and that the segmental rules are assigned to, or take effect in, the level in which suffixation takes place. Under this view, two orderings are possible as seen in (4). In one ordering, compounding precedes suffixation. The ordering is the opposite in the other one, that is, compounding follows suffixation.
(4) Possibility with Level Ordered Morphology

a. Level 1: Compounding
   b. Level 1: Suffixation

If Japanese were to have the model of lexicon as in (4a), the segmental rules apply only in Level 2; on the other hand, if the lexicon in Japanese were to be like the one in (4b), the application of the rules takes effect only during the Level 1 morphology.

The Lexical Phonology approach to the phonology of Japanese, however, is inadequate. Whichever model of the lexicon in (4) Japanese were to have, the lexicon has shortcomings. First, if the morphological operations were level-ordered in such a way that compounding precedes suffixation, the model is forced to have a loop because suffixes may appear inside compounds as illustrated by the examples in (5). In other words, compounding may occur after suffixation. Hyphens indicate suffixation.

(5)

a. siri-ta-gari+sugi  "want to know excessively"
b. nom-ase+tuduke  "keep making (one) drink"
c. tabe-sase+tukare  "get tired of letting (one) eat"
d. nagur-are+aruk  "keep being hit (here and there)"
e. yon-de+age  "give (one) a favor of reading"
f. kai-te+moraw  "get a favor of writing from (one)"
g. uke+ire-sase+tuduke  "keep making (one) accept"
h. yom-ase-ta-gari+sugi  "be excessively eager to want to make (one) read"

For example, compounds like the one in (5g) would have the following derivation.
(6)

Compounding: $[\text{uke} + \text{ire}]_{l_1}$
"accept"

Suffixation: $[[\text{uke} + \text{ire}]_{l_1} - \text{sase}]_{l_2}$
"make (one) accept"

Compounding: $[[[\text{uke} + \text{ire}]_{l_1} - \text{sase}]_{l_2} + \text{tuduke}]_{l_1}$
"keep making (one) accept"

As illustrated in the derivation, the outcome of the Level 2 suffixation $\text{ukeire-sase}$ goes back to Level 1 to construct a compound $\text{ukeire-sase tuduke}$.

The process in which the outcome of Level 2 goes back to Level 1 is called a loop. By definition, the loop weakens the theory of Lexical Phonology itself because it indicates that the level ordering does not have to be obeyed (see Kaisse and Shaw (1985) for more discussion on the loop). Notice here that the existence of the loop is required only because compounding and suffixation are ordered. That is, if there is no morphological ordering, there is no loop. Level Ordering is a device, in a sense, to incorporate the asymmetries between compounding and suffixation in the application of phonological rules -- some rules apply only with suffixation but not with compounding. In other words, if it is possible to account for the discrepancies without referring to Level Ordering, there is no need to order compounding and suffixation. I will present such an account in the next section.

The other ordering of morphological levels, where suffixation precedes compounding, also has a problem. In this ordering, mismatches between morphological structures and semantic structures result, as shown in (7).
In (7b), for instance, the morphological structure indicates that the compound is derived in the following manner. (In the following description of morphological processes, square brackets indicate that the forms put together between them form a constituent.) First, the causative -sase is suffixed separately to *tabe* "eat" and *tuduke" continue": past tense -ta is suffixed to *tuduke-sase" make (one) continue". The outputs are *[tabe-sase] "make (one) eat" and *[tuduke-sase-ta] "made (one) continue". Then, the suffixed forms are put together to form [[tabe-sase[[tuduke-sase-ta]] "made (one) continue to make (one) eat". It should be noticed that in this structure, the tense suffix, which is the head of the complex verb, is inside the second constituent of the compound.

On the other hand, the semantic structure shows a strict left-branching structure. First, the causative -sase is suffixed to *tabe" eat" to form *tabe-sase" make (one) eat"; the suffixed form is put together with *tuduke" continue" to make a verbal stem consisting of a compound [[*tabe-sase] *tuduke] "continue to make (one) eat"; the causative is again suffixed to the stem to make [[*tabe-sase]...
"tuduke\[-sase\] "make (one) continue to make (one) eat"; finally, the past tense suffix is attached to the complex stem, and the output is [[[tue\[-sase\] tuduke\[-sase\] -ta] "made (one) continue to make (one) eat". Notice that in the semantic structure, the head of the complex verb, past tense -ta, is in the outermost position.

In summary, Lexical Phonology approach referring to Level Ordering is inadequate to account for the asymmetries between affixation and compounding in the application of segmental rules. It either requires loops from Level 2 to Level 1 or results in mismatches between morphological structures and semantic structures of complex verbs.

4. A Domain Approach

Under a domain approach, the discrepancies between suffixation and compounding in rule applications are ascribable to the difference of the number of domains, created when a morphological operation takes place, where phonological rules apply. That is, suffixation during which segmental rules take effect has only one such domain (see (8a,c)), while compounding where only epenthesis applies has two such domains (see (8b,d)). In the figure, the capitalized SR stands for "surface representation."

(8) One domain: suffixation  Two domains: compounding
   a. [tor-ta]                   b. [tor][tuduke]  
      SR: [totta]               SR: [torituduke]  
   c. [tor-sase]               c. [tor][sage]  
      SR: [torase]              SR: [torisage]  

The domain approach offers the following account of the asymmetries. The segmental rules in question take effect only when the two consonants involved in the creation of segmental changes are adjacent within a single domain. As
illustrated in (8), only suffixation creates the environment in which two consonants are adjacent. Thus, the segmental rules take effect as demonstrated in Section 2. By contrast, compounding does not result in the creation of such environment. Instead, the morpheme-final and the morpheme-initial consonants, to which the segmental rules would apply if they were adjacent, are separated in two domains. That is, the two consonants are not adjacent. As a consequence, none of the segmental rules can apply.

In the previous section, I presented arguments against the Lexical Phonology approach to the asymmetries, and claimed that Level Ordering between suffixation and compounding is unnecessary if the discrepancies between them are accounted for without referring to the ordering of morphological types in terms of levels. The domain approach offers such an account. That is, Japanese does not have Level Ordering between affixation and compounding. Since they are not on separate, ordered levels, affixation and compounding can apply in either order without referring to loops. Furthermore, the mismatches between morphological and semantic structures would not result under the domain approach account, as shown in (9), since suffixation and compounding are not ordered.

(9)

\[
\begin{array}{c}
\text{Morphological Structure} \\
\text{"made (one) continue to make (one) eat"} \\
\text{Semantic Structure}
\end{array}
\]

As illustrated, the morphological structure matches the semantic structure. Both show identical left-branching structures.

To sum up, the domain approach is preferable to Lexical Phonology.
approach since the former does not have the flaws which the latter has.

5. Conclusion.

The asymmetries between suffixation and compounding in the application of segmental rules are due to the difference in the number of domains, where segmental rules apply, created by the morphological processes. Compounding creates two such domains whereas affixation results in the creation of one such domain. The rules which require adjacency of two consonants take effect only in affixation since such an environment is created only when a single domain is formed. Furthermore, the asymmetries can be accounted for without relying on ordering morphological processes in terms of levels. That is, Level Ordering appears to be unnecessary in Japanese as far as compounding and affixation in verbal morphology are concerned.

NOTES

The idea presented in this paper was originally developed in my dissertation in which I investigate the phonology of Japanese verbal morphology in terms of Lexical Prosodic Phonology. This paper presents the idea in a different way.

I am grateful to the following individuals for their comments and suggestions to the previous drafts of this work: Diana Archangeli, Mike Hammond, Shinsho Miyara, Yoshio Shimoji, Kentoku Yogi, and Mitsunobu Yoshida. I would also like to thank Maria Latona for correcting grammatical as well as stylistic errors. The author is of course responsible for every remaining error.

1 The compound in (lg) shows the effect of a deletion rule which I do not discuss in this paper. That is, /w/ is deleted in front of the epenthetic vowel /i/. The rule deletes /w/ in front of nonlow vowels.
waraw + tuduke → waraw[i] + tuduke → wara[i] + tuduke

In this paper, I will not present accounts for the segmental changes demonstrated by the examples in (1a-h). Instead, I will refer the interested reader to Ishihara (1991) which presents nonlinear analyses of the phenomena.

Dick Oehrle (p.c.) has pointed out the following possibility. With the assumption that morphological and semantic structures do not have to be identical, the mismatch between the two structures may not be a problem. According to him, it is possible to come with well-formed semantic structures by manipulating arguments of semantic constituents. Notice, however, that if the morphological and semantic structures are identical, no manipulation in semantics may be necessary. At this moment, I do not know how to deal with this issue. Thus, I keep this matter open for future research.

Ishihara (1991), presents arguments for positing that a compound has two domains where phonological rules apply. The arguments are based on investigation of compound accentuation and rendaku, or sequential voicing, in Japanese.

It should be noted here that the morphological structures reflect the ordering in which morphological operations take place. After all (cyclic) phonological rules apply, a compound undergoes bracket erasure which terminates the separation of domains in the compounds. Thus, when the second -sase suffixation applies, the stem tabe-sase + tuduke has only one domain. I keep the two diacritic marks "-" and "+" to indicate morphological operations that took place before the causative suffixation. For more discussion about bracket erasure see Inkelas (1989) and Ishihara (1991).
REFERENCES


論文要旨

形態型表示と規則適用

石原 昌英

本稿では、複合語形成と接辞添加は表示(representation)が異なるというInkelas(1989)等の仮説に着目し、日本語動詞の分節音規則の適用に見られる接辞語と複合語の違いの説明を試みる。例えば、過去を表す接尾詞(-ta)の接辞が起こると、二つの子音が隣接するという環境で様々な規則が適用されて音の変化が起こる。しかし、似たような環境を造り出すと思われる複合語では、接辞語に見られるような音の変化が起こらない。これには、二つの異なる要因がある。まず、接辞語と複合語では造りだされる(音韻規則が適用する)領域の数が異なるという形態型表示の違いがある。つまり、接辞語は一つの領域を持ち、複合語は二つの領域を有する。次に、問題の音韻規則が一つの領域内で隣接する二つの子音にのみ適用されるという規則の特質がある。つまり、子音の隣接という条件は、領域を一つしか持たない接辞語でのみ満たされる。複合語内で隣接すると見られる二つの子音は、厳密の意味では(規則適用の観点からは)隣接していない。従って、問題の規則は接辞語でのみ効力を発し、複合語では適用されない。

本稿ではまた、この問題に関する語彙的音韻論(Lexical Phonology)的な説明の問題点を指摘して適当ではないことを論ずる。