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# 9 Word formation and phonological processes

## 1 Introduction

The goal of this chapter is to outline the major types of word formation in Japanese from a phonological perspective.[1] In addition to laying out the main rules and generalizations, with an emphasis on phonological patterns and prosodic constraints, we will summarize previous work and sketch new developments. Theories focusing on the phonological aspects of word formation – in particular, Lexical Phonology (Kiparsky 1982) and Prosodic Morphology (McCarthy and Prince 1990b, as well as more recent optimality-theoretic developments of these theories, such as Stratal OT (Kiparsky 2000) and Optimal Interleaving (Wolf 2008)) – have led to a significantly deeper understanding of word formation and morphological structure. While covering various phonological details of Japanese word formation – affixation in sections 2 and 3, compounding in section 4, and templatic morphology in section 5 –, it is our aim to focus on general theoretical ramifications of the point under discussion, and highlight both how general phonological theory has informed the analysis of Japanese word formation in the past, and how phonological studies of different types of Japanese word formation have contributed important case studies leading to advances in the general theory of phonology, and phonology-morphology interactions.

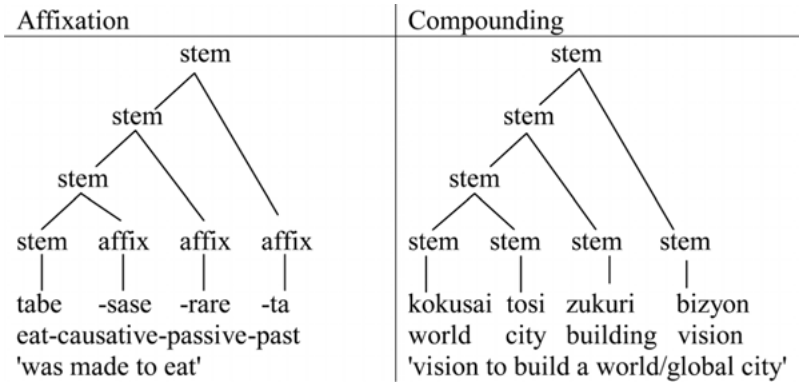
## 2 Phonology of affixation

In affixation structures, a stem and an affix together form a larger stem, to which another affix can be attached to form another even larger stem, as long as semantic and selectional restrictions are obeyed. The diagrams in (1) illustrate how affixation is structurally parallel to compounding (discussed in section 4), the difference being that each complex stem is composed of *stem*+*affix* in the former, *stem*+*stem* in the latter.[2]

**1** For the morphosyntactic aspects of word formation, see the *Handbook of Japanese Lexicon and Word Formation* edited by Taro Kageyama in this series.

**2** In order to avoid unnecessary terminological clutter, we have opted for the simple morphological bifurcation between *stem* (any morphological complex based on a root) and *affix* (bound form). We do not distinguish here between derivational and inflectional affixes, since they do not exhibit distinct phonological properties in Japanese. Unless a distinction is called for, the neutral term *stem* refers to both roots and affixed forms, as shown in (1).

(1)




Standard Japanese language dictionaries (including those for foreign language learners, such as Kenkyusha's *Japanese-English Learner's Dictionary*) usually provide appendix charts of verbal and adjectival derivational and inflectional paradigms (listing the root, present, formal present, negative, inchoative, gerundive, past, etc.), and accent dictionaries (e.g., NHK's *Nihongo Hatsuon Akusento Jiten* or Sanseido's *Shinmeikai Akusento Jiten*) devote several pages to the varying accentual patterns associated with different derivational and inflectional suffixes (see Kawahara, Ch. 11, this volume). The morphophonemics of the paradigms of inflected words (in Japanese, only verbs and adjectives have such paradigms, not nouns) have been studied in different frameworks from the earliest structural and generative traditions (Bloch 1946a,b; Martin 1952; McCawley 1968; Hattori 1973; de Chene 2010; Davis and Tsujimura 1991; Ito and Mester 2004; Sano 2012). Rather than attempting to summarize these works, we present the core phonological patterns observed in these paradigms, and point out where and how they bear on phonological theories and universals.

## 2.1 Preliminaries: phonological typology of stems and suffixes

Verbal stems come in two phonological varieties, those ending in a consonant versus those ending in a vowel (2).[3]

(2)

| C-final stems: | | | | V-final stems: | | | |
|---|---|---|---|---|---|---|---|
| nom- | 'drink' | kosur- | 'rub' | tabe- | 'eat' | nobi- | 'stretch' |
| kik- | 'hear' | tat- | 'stand' | mi- | 'see' | kurabe- | 'compare' |
| moraw- | 'receive' | oyog- | 'swim' | tome- | 'stop' | | |
| tob- | 'fly' | hatarak- | 'work' | | | | |

**3** In Japanese school grammar terminology, the C-final stems correspond to verbs with *godan katsuyō* '5-vowel conjugation', and the V-final stems correspond to verbs with *kami-ichidan katsuyō* 'i-conjugation' and *shimo-ichidan katsuyō* 'e-conjugation' (see below for some discussion).

Dictionaries list verbs in the present indicative form with the *-ru/-u* ending, and V-final stems are often referred to as *ru*-verbs (e.g., tabe*ru*, mi*ru*) and C-final stems as *u*-verbs (e.g., nom*u*, kik*u*).[4] They are easily identifiable as listed in the dictionary, with one caveat. Not all forms ending in the sequence /ru/ are *ru*-verbs, because the /r/ can also be the final consonant of the stem. Thus the stem for 'understand' in *wakaru* is /wakar/, not */waka/. Synchronically, all V-final verbal stems end in a front vowel (/i/ or /e/),[5] so a verb with any other vowel in its last syllable must be C-final (e.g., *suw**a**r-u* 'sit-present', *mam**o**r-u* 'protect-present', *kos**u**r*-u 'scrub-present'). This is only a one-way implication (back vowel /u,o,a/ → C-stem): Front vowels with /r/ occur both in V-final stems or C-final stems, leading to (segmental) homonyms in the present tense as in (3) (sometimes differing in accent, see section 3.4 below), with different morphological junctures. In other parts of the paradigm (such as the negative present show below), the two stems show different formations.

(3)

| | PRESENT | gloss | cf. NEGATIVE PRESENT |
|---|---|---|---|
| a. | ki-ru | 'wear' | ki-nai |
| | ki'r-u | 'cut' | kir-a'nai |
| b. | kae-ru | 'change' | kae-nai |
| | ka'er-u | 'return' | kaer-a'nai |
| c. | i-ru | 'be, exist' | i-nai |
| | ir-u | 'need' | ir-anai |

Using a list available on the internet of the most common Japanese verbs[6] (containing approximately 500 items), we find 312 (63%) ending in the sequence /ru/. 145 (46%) of these are V-stems, and 167 (54%) *r*-final C-stems.

(4) Verbs ending in the sequence /ru/

| *r*-final (…*Vr-u*) | | | V-final (…*V-ru*) | | |
|---|---|---|---|---|---|
| ar | 53 | 32% | e | 128 | 88% |
| ir | 51 | 30% | i | 17 | 12% |
| er | 30 | 18% | u | – | |
| or | 20 | 12% | o | – | |
| ur | 13 | 8% | a | – | |
| Total | 167 | | Total | 145 | |

**4** See section 2.2 below for the *-ru/-u* allomorphy.

**5** This restriction already goes back to Old Japanese.

**6** From http://wiki.verbix.com/Verbs/JapaneseVerbList with 492 verbs, checked against http://www.japaneseverbconjugator.com/JVerbList.asp with 418 verbs. (Verbix contains verb conjugations for many regional, national and international languages, including Japanese. Japaneseverbconjugator hosts a Japanese verb database coded to conjugate verbs in different tenses.)

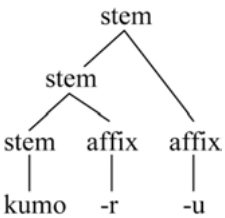
Overall, 348/493 verbs (71%) are C-final, and among the C-final verbs, the vast majority (48%) are *r*-final (5), compared to the closest contender, *s*-final verbs (14.9%).

(5) C-final verbs (total: 348)

| | | | | | |
|---|---|---|---|---|---|
| r-final | 167 | 48.0% | b-final | 12 | 3.4% |
| s-final | 52 | 14.9% | g-final | 10 | 2.9% |
| w-final | 36 | 10.3% | t-final | 7 | 2.0% |
| k-final | 32 | 9.2% | n-final | 1 | 0.3% |
| m-final | 31 | 8.9% | | | |

This preponderance of *r*-final verb stems is due to the existence of *r*-final derivational suffixes, such as the deadjectival /-mar/ (e.g., *kata-mar-u* 'hard-en', see Martin 1952: 60–61 for a list and Bloch 1946b for details), as well as the mono-consonantal stem-forming /-r/ (6).

(6) Stem-forming r-suffix




| | | | |
|---|---|---|---|
| kumo | 'cloud' | kumo-r-u | 'to become clouded' |
| kage | 'shadow' | kage-r-u | 'to be shaded' |
| nezi | 'screw' | nezi-r-u | 'to screw' |
| guti | 'grumble' | guti-r-u | 'to grumble' |
| yazi | 'jeer' | yazi-r-u | 'to jeer at' |
| dozi | 'mess' | dozi-r-u | 'to mess up' |
| hosoi | 'thin' | hoso-r-u | 'to become thin' |
| hutoi | 'fat' | huto-r-u | 'to become fat' |
| biyooin | 'beauty parlor' | biyo-r-u | 'to go to the biyōin (beauty parlor)' |
| kokuhaku | 'confession' | koku-r-u | 'to confess (love)' |
| makudonarudo | 'McDonald's' | maku-r-u | 'to eat at McDonald's' |

/-r/ is here part of the verb stem that the inflectional suffixes attach to, as shown by the fact that the conjugation paradigm keeps it intact (*kager-anai*, not **kagenai*,

*nezir-anai*, not **nezi-nai*, etc.). The stem-forming *r*-suffix is semi-productive: *X-r-u* formations are used alongside *X–suru* 'do X' compounds, where X is a loanword. Thus one finds *memo-r-u* alongside *memo-suru* 'to jot down a memo', lit. 'to do a memo.' We return to this verb-forming *r*-suffix below in section 3.4.

Verbal suffixes also come in two phonological varieties: mnemonically, C/V-suffixes and T-suffixes (7) (this classification goes back to Bloch (1946a), who calls the latter "stopped endings"). C/V-suffixes have both a C-initial allomorph and a V-initial allomorph, with the exception of the infinitive suffix, whose allomorphs are /-Ø, -i/. The T-suffixes invariably start with the consonant /t/ (or its voiced variant /d/, depending on the phonological environment), and they lack V-initial allomorphs.

(7)

| C/V-suffixes: | | T-suffixes: | |
|---|---|---|---|
| -sase, -ase | CAUSATIVE | -te, -de | GERUNDIVE |
| -rare, -are | PASSIVE | -ta, -da | PAST |
| -na, -ana | NEGATION | -tari, -dari | ALTERNATIVE |
| -ru, -u | PRESENT | -tara, -dara | CONDITIONAL ('if') |
| -yoo, -oo | VOLITIONAL | -tatte, -datte | CONCESSIVE CONDITIONAL ('even if') |
| -ro, -e | IMPERATIVE | | |
| -reba, -eba | PROVISIONAL | | |
| -rare, -e | POTENTIAL | | |
| -Ø, -i | INFINITIVE | | |

C/V-suffixation and T-suffixation, in different ways, show allomorphy effects on the suffixes themselves, and/or the stems to which they attach. Most importantly, for the purposes of this chapter, these effects reveal the syllable structural constraints and segmental patterns of the Japanese phonological system.

## 2.2 The morphophonology of C/V-suffixes

The allomorphy of the C/V-suffixes is syllable-conditioned, that is, the choice of allomorph depends on the phonological shape of the stem to which they attach. A C-stem (e.g., *nom-* 'drink') is followed by a V-initial allomorph (*nom-ase*, **nom-sase*), whereas a V-stem (e.g., *tabe-* 'eat') is followed by a C-initial allomorph (*tabe-sase*, **tabe-ase*).

(8)

| | V-stem (tabe-) | C-stem (nom-) |
|---|---|---|
| C-allomorph (-sase) | tabe-sase | *nom-sase |
| V-allomorph (-ase) | *tabe-ase | nom-ase |

The allomorphy can be understood as being guided by the two most basic universal syllable structure constraints, ONSET (requiring onsets) and NOCODA (disallowing

codas).[7] Both allomorphs are available for all verbs, but the wrong choice of allomorph will lead to a violation of one of these constraints, e.g., *[.no*m*.sa.se.] violates NoCoda, and *[.ta.be.*a*.se.] violates Onset.[8]

Relying on Onset and NoCoda to choose the relevant allomorph raises the question regarding the status of these constraints in Japanese. The syllable structure of Old Japanese is considered to be [CV] (see Takayama, this volume), with obligatory onsets (except word-initially) and without codas, but modern Japanese has many words with vowel hiatus (e.g., *a.o* 'blue'), violating Onset, as well as words with certain kinds of codas (e.g., ki*t*.te 'stamp', to*n*.de 'fly-GERUND'), violating NoCoda. In optimality-theoretic terms, this means that Onset and NoCoda are high-ranking (and hence virtually unviolated) in Old Japanese, but low-ranking (with rampant surface violations) in Modern Japanese. Their low-ranking status, however, does not mean that they are not part of the synchronic grammar. Even if mostly inert, and not triggering any phonological alternations, they are still active in choosing between existing allomorphs (see Mascaró 1996 for a general theory of allomorphy in OT, and Ito and Mester 2004 for an OT analysis of Japanese verbal allomorphy).

Purely phonological analyses (deleting and/or inserting consonants and vowels) have been proposed in the generative tradition, with ordered segmental rules (Kuroda 1965; McCawley 1968) or with autosegmental spreading and delinking (Davis and Tsujimura 1991). The rules and conditions needed to derive the surface forms, however, are necessarily construction-specific, pertaining only to the verbal conjugations.[9] Thus outside of this morphological domain, we find not consonant deletion, as in putative /nom-sase/ → [nomØase], but rather vowel epenthesis, which would yield *[nom*u*sase]. Employing some version of level-ordered lexical phonology (Kiparsky 1982) may be a possible way out, but complications still arise since a level would have to be posited that is not only specific to the verbal paradigm but also to the particular verbal affixes that undergo certain changes and not others. The OT allomorph analysis has the advantage of relying on phonological constraints for the choice of allomorphs, without having to treat what has arisen historically as synchronic phonological processes (see de Chene 2010 for further discussion).

Affixed forms, such as [[*tabe*]*sase*] EAT-CAUSATIVE 'force to eat' or [[*nom*]*ase*] DRINK-CAUSATIVE 'force to drink', are themselves also stems, and as such allow further affixation [[[*tabe*]*sase*]*rare*] EAT-CAUSATIVE-PASSIVE 'be forced to eat', [[[*nom*]*ase*]*rare*] DRINK-CAUSATIVE-PASSIVE 'be forced to drink'. For the latter form, as depicted in (9a), even though the verbal root /nom/ is a C-stem, the affixed form [[*nom*]*ase*]

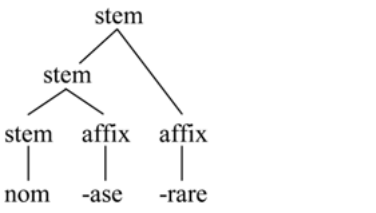
**7** In terms of the elementary syllable theory of Prince and Smolensky (1993 [2004]).

**8** The infinitive endings are /Ø, -i/ (7), where the null variant patterns with the C-allomorphs: *tabeØ(-ni iku)* '(go out) to eat' and *nom-i(-ni iku)* '(go out) to drink', and not **tabe-i* with an Onset violation, and **nomØ* with a NoCoda violation.

**9** Some forms, like the imperative ending /e, ro/, or potential ending /–e, rare/, can in any case only be dealt with as allomorphy.

is now a V-stem, ruling out the V-initial passive allomorph at this stage (*nom-ase-*are*, nom-ase-*rare*). On the other hand, suffixes ending in consonants, such as the alternate causative form /-sas,-as/, make another C-stem (9b), requiring the V-initial allomorph (nom-as-*are*, *nom-as-*rare*) (see Miyagawa 2012 and work cited there for the syntactic differences between the two types of causatives).

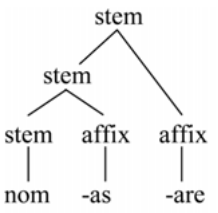
(9) a.




drink-causative-passive

cf. *nom-ase-are (ONSET violation)

b.




drink-causative-passive

cf. *nom-as-rare (NOCODA violation)

The hierarchically organized word structure makes clear that the composition of stem+affix is another (larger) stem, with further affixation following the same requirements, with no special provisos.

It is perhaps useful to contrast this kind of analysis with the approach taken in traditional school grammar (*gakkō bunpō*), based on the grammatical rules proposed by Shinkichi Hashimoto (see Hashimoto 1948). Here three types of verbal conjugations are distinguished: *godan katsuyō* ('5-step conjugation'), *shimo-ichidan katsuyō* ('lower 1-step conjugation' = *e*-row conjugation), and *kami-ichidan katsuyō* ('upper 1-step conjugation' = *i*-row conjugation). The numerals refer to the kana-syllabary arrangement, composed of CV-units in a $5 \times 10$ table, where the rows correspond to each of the five vowels of Japanese /a,i,u,e,o/, so that each column is composed of a different consonant /Ca, Ci, Cu, Ce, Co/.[10] The terminology refers to the fact that 5-step verbs (=C-stems) use all five rows of the syllabary in their conjugation (no*ma*nai, no*mi*masu, no*mu*, no*me*ba, no*mo*o 'drink'), whereas the 1-step verbs (=V-stems) use only the *e*-row (to*me*nai, to*me*masu, to*me*ru, to*me*reba, to*me*yoo 'stop') or the *i*-row (si*mi*nai, si*mi*masu, si*mi*ru, si*mi*reba, si*mi*yoo 'soak, permeate'). The terms *shimo-* 'lower' and *kami-* 'upper' refer to the row position in the syllabary (*i* occupying an upper row, *e* occupying a lower row). Since all roots and suffixes must be analyzed into CV-kana units, the roots 'drink' and 'stop' are taken to be /no/ and /to/ (instead of /nom/ and /tom/), and what is actually a root-final C is instead reanalyzed as part of the suffix, i.e., no-*ma*nai, no-*mi*masu, no-*mu*, no-*me*ba, no-*mo*o, and to-*me*nai, to-*me*masu, to-*me*ru, to-*me*reba, to-*me*yoo).[11] An especially odd result, or *reduction*

**10** A similar arrangement is found in the Sanskrit syllabary.

**11** It is not inconceivable that this approach might have some validity in terms of the way morphological segmentation is actually done by speakers, as in the well-known Maori case analyzed by Hale (1973) in his work on deep-surface disparities, where originally root-final consonants are reanalyzed as suffix-initial, resulting in a system with multiple phonologically unpredictable suffix allomorphs. The issue has remained controversial, however (see McCarthy 1981).

*ad absurdum*, of this traditional analysis is that short verbs like *miru, minai*, 'see' now have a null root since the initial consonant needs to be part of the suffix. School grammars usually note that these forms do not have a distinction between suffixes and roots, or that they simply do not have roots (in a verbal paradigm chart, the root column is empty; see Suzuki 1972 and Suzuki 1996 for a critical assessment of *gakkō bunpō*).

## 2.3 The morphophonology of T-suffixes

Different from the C/V-suffixes that have C-initial and V-initial allomorphs, the T-suffixes invariably start with the voiceless coronal plosive or its voiced variant (e.g., /-te, -de/ GERUNDIVE, /-ta, -da/ PAST, /-tara, -dara/ CONDITIONAL). As observed by Bloch (1946a), they do not have V-initial allomorphs and attach directly to both V-stems (tabe-*te* 'eat-gerund', mi-*te* 'see-gerund') and C-stems (tat-*te* 'stand-gerund', sin-*de* 'die-gerund'), the latter resulting in a surface form with a NoCoda violation. The C/V-suffixes can avoid both the Onset and the NoCoda violation by choosing the appropriate allomorph, but the T-suffixes have no such recourse in their choice of allomorphy. T-suffixation leads to a different kind of allomorphy, as illustrated in (10), namely stem allomorphy, known as the *onbin* (sound change) form.

(10)

| verbal stem | *onbin* form | GERUNDIVE | cf. CAUSATIVE-GERUNDIVE |
|---|---|---|---|
| tabe- | – | tabe-te | tabe-sase-te |
| mi- | – | mi-te | mi-sase-te |
| hasir- | hasi***t***- | hasit-te | hasir-ase-te |
| moraw- | mora***t***- | morat-te | moraw-ase-te |
| nom- | no***n***- | non-de | nom-ase-te |
| asob- | aso***n***- | ason-de | asob-ase-te |
| oyog- | oyo***i***- | oyoi-de | oyog-ase-te |
| kak- | ka***i***- | kai-te | kak-ase-te |

Although the sources of the alternations lie in historical sound changes, the phonological shapes of the alternate (*onbin*) stem forms are not accidental. Synchronically, the changes are exactly such that they produce allowed surface codas in Japanese, namely, the first half of a voiceless geminate (here, necessarily *t*, because of the following T-suffix), place-assimilated nasals (here, assimilated to the T-suffix, which itself undergoes postnasal voicing), or a vocoid (the diphthongal off-glide *i*). As pointed out in Ito (1986, 1989), the gemination condition (and related place-assimilated nasal condition) on codas in Japanese turns out to have cross-linguistic and theoretical significance in that it holds with minor variations in many typologically diverse languages, such as Lardil, Diola Fogny, Ponapean, Italian, and Finnish. This common restriction on syllable codas came to be known as CodaCond

in Optimality Theory, and continues to play a prominent role in the theory of positional licensing. T-suffixes attach to the *onbin* form of the stem and not to its basic form because attaching to the latter would lead to violations of CODACOND (e.g., **nom-de, *tob-de, *hasir.te, *kak.te*).[12]

Although the various alternations in the conjugational paradigm appear complex, it is remarkable that once the morphological and allomorphic considerations, including their historical sources, are properly understood, the phonology that is playing a role to derive the surface forms is restricted to the universal syllable structure conditions ONSET, NOCODA, and CODACOND. This result may be surprising, given what appears to be a controversy over the existence of the syllable in Japanese (Labrune 2012). While the importance of the mora in Japanese is well-known and undisputed (see Kubozono 1990, 1995, 1999, and references cited therein; see also Otake, this volume), there is actually also considerable evidence for the syllable as a prosodic constituent in Japanese (see Kawahara 2012 for a summary of acoustic and psycholinguistic evidence). In addition, by eschewing the syllable, proponents of the syllable-less theory must posit different types of moras with different properties, recapitulating syllable theory in a different terminology, but unfortunately within a network of assumptions entirely specific to Japanese. The terminology employed, such as dependent, deficient, or special moras, is reminiscent of how a weak syllable exists only in relation to the strong syllable in the foot. Could it be, then, that a *dependent/special* mora exists only in relation to the *independent/normal* mora in the syllable? Japanese-specific notations such as Q, N, and R depicting moraic obstruents, moraic nasals, and vowel length, respectively, may be useful in transliterating the kana orthography, but do not lead to cross-linguistic phonological understanding or discoveries. Denying the syllable thus comes at a cost: While it is no doubt possible to restate each syllable-based property in roundabout ways that do not refer to the syllable, such an approach would not have allowed Japanese phonological structure to serve as a window through which cross-linguistic syllable conditions could be explored.

## 3 Phonological alternations

Besides the syllable-conditioned allomorphy discussed above, affixation gives rise to several segmental processes within the syllable (section 3.1) and across syllables (section 3.2), as well as to the formation of superheavy syllables (section 3.3) and accentual alternations (section 3.4). We take up each of these cases, focusing on their

**12** Archaic gerundive forms all take the infinitive-*i* form, *nomi-te, tobi-te, hasiri-te, kaki-te*, etc.). S-final stems (*kas-*/*kasi-*) use the traditional infinitive form ending in *-i* rather than the bare root, and hence do not have an alternate *onbin* form.

cross-linguistic import and their role in the discussion and debates in theoretical phonology.

## 3.1 Palatalization, affrication, glide deletion

Affixed forms (11) show segmental alternations involving coronal obstruents and high vowels: palatalization and affrication.

(11)

| root | /nom/ 'drink' | /kas/ 'lend' | /kat/ 'win' |
|---|---|---|---|
| INFINITIVE | nom-i | kaʃ-i | katʃ-i |
| PRESENT | nom-u | kas-u | kats-u |
| IMPERATIVE | nom-e | kas-e | kat-e |

Palatalization of coronal obstruents and concomitant affrication of plosives (e.g., *si* → *ʃi*, *ti* → *tʃi*) in the environment of high front vowels is found in many languages, such as Korean, Portuguese, or Mixtec (see Bhat 1978, Bateman 2007, and Kochetov 2011). Palatalization is assimilatory, and affrication of plosives results from the articulatory difficulty of producing a complete oral closure in the palato-alveolar region. While the assimilatory change before *i* is phonetically natural and widely attested cross-linguistically, affrication before *u* (e.g., *tu* → *tsu*) is rare (even though not without parallels: a similar case occurs in Lomongo (Bantu), see Kim 2001), and its causes are not as well-understood. The linguistic term "crazy rule", referring to this process in Japanese, is due to Bach and Harms (1972), an influential early paper in generative phonology which argues that a series of natural sound changes and reasonable innovative generalizations can result in a synchronically phonetically arbitrary "crazy rule." The term has been applied to many phenomena in various other languages, in particular, surrounding the discussion of Evolutionary Phonology (Blevins 2004, etc.). Even though Japanese affrication started out as the original "crazy rule", there is some irony in the fact that it remains an open question whether the process really has no synchronic phonetic (acoustic, articulatory, or perceptual) motivation (see Kim 2001 for an aerodynamic account).

Not as well-known as the palatalization/affrication facts of Japanese, but of potential relevance in this context, is the somewhat odd depalatalization requirement before the mid front vowel *e*, where sequences such as **ʃe,*tʃe*, etc., are dispreferred (and nonexistent in the Yamato and Sino-Japanese strata of the vocabulary).[13] There are no parallel restrictions for back vowels, where both *ʃ* and *s* occur and form a phonemic contrast (*ʃa/sa*, *ʃu/su*, *ʃo/so*). With front vowels, there is no contrast in Yamato and Sino-Japanese: *i*-triggered palatalization leads to *ʃi/*si*, and *e*-triggered

**13** See Kubozono (Ch. 8, this volume) and Pintér (this volume) for the appearance of such sequences in the loan vocabulary.

depalatalization to **ʃe/se*. In terms of cross-linguistic typology, while it is not surprising that palatalization is restricted to high front vowels, the concomitant depalatalization requirement triggered by mid front vowels is odd (and perhaps qualifies as another "crazy rule": see Ito and Mester 1995, 2003 for a possible approach in terms of contrast; for general discussion of the issue of "crazy rules", see Hyman 2001, Yu 2004, and Scheer, in press).

Finally, due to the phonologically limited distribution of prevocalic glides, syllable-internal glide~Ø alternations are in evidence in the derivational verbal morphophonology. The palatal glide occurs only before back vowels (*ya, yu, yo, *yi, *ye*), leading to *y*~Ø alternations in derivations with verbal roots ending in *y* (such as *moy-* 'burn', or *hay-* 'grow') in combination with transitivizing/intransitivizing affixes (*moy-as-u* vs. *moØ-e-ru*, *hay-as-u* vs. *haØ-e-ru*). The back glide has an even more limited distribution and is found only before the low vowel *a* (i.e., ✓*wa* vs. **wi, *we, *wo, *wu*), so that *w*-final verbal roots only preserve their final glide with *a*-initial suffixes (e.g., *kaw-* 'buy': *kaw-ase* CAUSATIVE, *kaw-are* PASSIVE, *kaw-anai* NEGATIVE PRESENT, but *kaØ-i* INFINITIVE, *kaØ-u* PRESENT, *kaØ-oo* VOLITIONAL, *kaØ-eba* PROVISIONAL).[14]

## 3.2 Voicing, nasalization, feature preservation

In section 2.3 above, we saw how T-suffixes on C-stems trigger stem allomorphy, so that the resulting *onbin* stem forms are phonologically well-structured (i.e., do not violate CODACOND). Besides the noted changes in the stem, the T-suffix itself is subject to voicing alternations that reveal processes noteworthy in the context of cross-linguistic typology: postnasal voicing, nasalization, and feature preservation.

Because of the universal cross-linguistic dispreference (and avoidance) of N$\underset{\circ}{\text{C}}$ clusters (=nasal followed by a voiceless obstruent), the T-suffixes in (12) following a nasal(-final) stem appear in their voiced variant (*ʃin-de, kakon-de*), rather than their voiceless variant (**ʃin-te, *kakon-te*).

(12) Postnasal voicing: Nasal-final stems

| | n-stem | m-stem | |
|---|---|---|---|
| | *root* | /sin/ *die* | /sum/ *live* | /kakom/ *surround* |
| | *GERUNDIVE* | ʃin-de | sun-de | kakon-de |
| | *PAST* | ʃin-da | sun-da | kakon-da |
| | *CONDITIONAL* | ʃin-dara | sun-dara | kakon-dara |
| *cf.* | *PRESENT* | ʃin-u | sum-u | kakom-u |
| | *PROVISIONAL* | ʃin-eba | sum-eba | kakom-eba |

**14** For the allomorphy analysis mentioned earlier, an interesting question remains as to how the V-initial suffix is chosen for these glide-final roots, given that the glide is absent in the surface form, leading to an ONSET violation. A purely output-oriented allomorphy choice would lead to the wrong C-initial suffix (**ka-ru* instead of *kaØ-u*, etc.).

Postnasal voicing in Japanese played a crucial role in the discussions surrounding underspecification (Ito and Mester 1986; Mester and Ito 1989; Ito, Mester, and Padgett 1995) in that it seemed to constitute a case where a redundant feature specification acted in ways otherwise reserved for distinctive specifications. In illustrating the various ways in which languages choose to avoid N̥Ç (13), Pater (1999) gives the Yamato stratum of Japanese as a prime example of one of the strategies of N̥Ç avoidance, namely postnasal voicing (e.g., *nt* → *nd*).

(13) N̥Ç avoidance strategies

| | | |
|---|---|---|
| nt → | nd | Yamato Japanese, Puyo Pungo Quechua |
| | tt | Mandar |
| | nn | Konjo |
| | n | Umbundu |
| | t | Kelantan Malay |

Interestingly, not every conceivable way of resolving the N̥Ç problem is actually found in natural languages. Thus vowel epenthesis is apparently never used in this context, according to Pater – one of the first illustrations of what later came to be known as the "too-many-solutions problem" in OT (Steriade 2001).

Related to postnasal voicing is the nasalization of voiced-obstruent-final stems in (14).

(14) Nasalization: Voiced obstruent final stems

| | | b-stem | |
|---|---|---|---|
| | *root* | /asob/ 'play' | /narab/ 'line up' |
| | *GERUNDIVE* | ason-de | naran-de |
| | *PAST* | ason-da | naran-da |
| | *CONDITIONAL* | ason-dara | naran-dara |
| *cf.* | *PRESENT* | asob-u | narab-u |
| | *PROVISIONAL* | asob-eba | narab-eba |

Because of CODACOND, place assimilation/gemination occurs at the stem-suffix boundary (see section 2.3 above for examples). With a stem-final voiced obstruent, however, we find nasalization of the place-assimilated coda (*ason-de, naran-de*) rather than the voiced obstruent geminate (**asod-de, *narad-de*). Another general cross-linguistic constraint is at work here, this time, against voiced obstruent geminates (for a recent study, see Kawahara 2006, Kawahara, Ch. 1, this volume, and Kawagoe, this volume).

Finally, the voiced variant of the T-suffix occurs with stems ending in the voiced velar obstruent *g*. This would be the expected variant, if it were not for the fact that there is no stem-final trace of this obstruent voicing when the T-suffix is attached

since both *k*-final and *g*-final stems themselves occur in *onbin* forms ending in *i* ("velar vocalization").[15]

(15) Vocalization and Feature Preservation: Velar-final stems

| | | *k*-stem | | *g*-stem | |
|---|---|---|---|---|---|
| | *ROOT* | hik- *pull* | kawak- *dry* | tog- *sharpen* | tsug- *pour* |
| | *GERUNDIVE* | hii-te | kawai-te | toi-de | tsui-de |
| | *PAST* | hii-ta | kawai-ta | toi-da | tsui-da |
| | *CONDITIONAL* | hii-tara | kawai-tara | toi-dara | tsui-dara |
| *cf.* | *PRESENT* | hik-u | kawak-u | tog-u | tsug-u |
| | *PROVISIONAL* | hik-eba | kawak-eba | tog-eba | tsug-eba |

Since the voicing of the suffix can only be determined by considering the feature composition of the input, this opaque alternation has attracted the attention of optimality-theoretic analysts. Lombardi (1998) argued that it constitutes strong evidence for feature-level faithfulness (MAXFEATURE), where the input voicing feature in the input is preserved by docking onto another segment in the output. OT analyses sometimes employ such feature-faithfulness constraints (MAXFEATURE, DEPFEATURE), but most cases can be restated in terms of segmental faithfulness (IDENTFEATURE) constraints. However, as convincingly shown by Lombardi, the voicing triggered by underlying stem-final *g* in Japanese cannot be reduced to segmental faithfulness because the relevant input segment carrying the voicing feature in question arguably corresponds to the stem-final *i*, and not to the voiced suffix-initial segment *d*. The T-suffix alternation with *g*-final stems thus remains one of the few convincing cases of feature-level faithfulness in OT.

## 3.3 Superheavy syllables

Universal syllable theory countenances, besides light (monomoraic) and heavy (bimoraic) syllables, superheavy syllables (trimoraic, or even heavier) as a marked option. The syllable inventory of Japanese is no exception: The overwhelming majority of words are composed of maximally bimoraic syllables. Most of the superheavy syllables are found in the peripheral (recent Western) loan vocabulary, such as *toon* 'tone', *pataan* 'pattern', *sain* 'sign', or *toronboon* 'trombone'. In the core vocabulary, Sino-Japanese items admit no superheavy syllables, reflecting the size restriction

**15** Historically the result of intervocalic lenition of the velar stop: *aki* > *axi*> *ai*, *agi* > *aɣi* > *ai*. Velar vocalization is also found in the adjectival conjugation (archaic *waka-ki*, contemporary *waka-i* 'young').

allowing only maximally bimoraic morphemes (see Tateishi 1990, Ito and Mester 1996, and Ito and Mester, Ch. 7, this volume). In native Yamato items, on the other hand, while superheavy syllables are not found in underived forms (morpheme-internally), what appear to be superheavy syllables come about as a result of morpheme concatenation and derivation. One such case arises through the by-now-familiar affixation of T-suffixes when they attach to verbal roots of the shape /CVVC-/, such as *toor-* and *hair-*, as shown in the paradigm in (16).

(16)

| | root | 'pass' toor- | 'freeze' koor- | 'enter' hair- | 'come, visit' mair- | *cf.* | 'take' tor- | 'paste' har- |
|---|---|---|---|---|---|---|---|---|
| | GERUNDIVE | toot.te | koot.te | hait.te | mait.te | | tot.te | hat.te |
| | PAST | toot.ta | koot.ta | hait.ta | mait.ta | | tot.ta | hat.ta |
| | CONDITIONAL | toot.ta.ra | koot.ta.ra | hait.ta.ra | mait.ta.ra | | tot.ta.ra | hat.ta.ra |
| *cf.* | PRESENT | too.ru | koo.ru | hai.ru | mai.ru | | to.ru | ha.ru |
| | PROVISIONAL | too.re.ba | koo.re.ba | hai.re.ba | mai.re.ba | | to.re.ba | ha.re.ba |

Here C/V suffixes (such as the present and provisional forms shown above) choose their V-initial allomorphs (*-u, -eba*), so the last consonant in the verbal root becomes an onset (too.*ru*, hai.*ru*), and the remainder is a bimoraic syllable (*too*.ru, *hai*.ru). T-suffixes, however, have no V-initial allomorph, and the verbal root in its *onbin* form is syllabified into one syllable (*toot*.te, *hait*.te). These forms must be analyzed as containing superheavy syllables (*to'ot*.te, *ha'it*.te, etc.) accented on their first mora (*o* and *a*). If the apparent superheavies were split into two syllables (*to.*o't*.te, *ha.*i't*.te), the accent would be predicted to fall on the mora/syllable immediately preceding the T-suffix, like ha.*ʃi't*.te 'run-GERUNDIVE'. There is no tendency to shorten the vowels of superheavies like *tootte*, which remains distinct from *totte* 'take-GERUNDIVE' in all styles of speech (Vance 2008).

Other apparent instances of superheavies are less clear, and the status of such trimoraic syllables in Japanese has remained controversial. Several researchers (Kubozono 1999: 50–55; Vance 2008: 132) have provided arguments that some (or all) of the purportedly trimoraic syllables should be analyzed as broken into two syllables (monomoraic + bimoraic). The evidence comes from native intuition for syllable boundaries, the possibility of vowel rearticulation, and, most convincingly, from patterns of accentuation, requiring further investigation and analysis. Controversial cases arise with derivational (adjective- and noun-forming) suffixes that are geminate-initial, such as the denominal adjective-forming suffix *-ppoi* '-ish' and the suffix *-kko* (lit. 'child/person').

(17)

| | *-ppoi* | ‘-ish, -like’ |
|---|---|---|
| kodomo | ko.do.mop.poi | ‘childish, childlike’ |
| onna | on.nap.poi | ‘womanly’ |
| tihoo | ti.hoop.poi | ‘country-like’ |
| sutaa | su.taap.poi | ‘(pop-)star-like’ |
| doraemon | do.ra.e.monp.poi | ‘like Doraemon (cartoon figure)’ |
| ebisen | e.bi.senp.poi | ‘like shrimp-flavored rice cracker’ |
| | *-kko* | ‘person from’ (*demonym)* |
| Edo | e.dok.ko | ‘Edo-ite’ |
| Sendai | sen.daik.ko | ‘Sendai-ite’ |
| Pari | pa.rik.ko | ‘Parisian’ |
| Rondon | ron.donk.ko | ‘Londoner’ |
| Berurin | be.ru.rink.ko | ‘Berliner’ |
| Uiin | u.iink.ko | ‘Wiener’ |

Here the accentual evidence is conflicting: While *sendai’kko* (**senda’ikko*) suggests that the apparent superheavy is broken into two syllables (*sen.da.i’k.ko*), this is not persuasive for *rondon’kko* (**rondo’nkko*), which is unlikely to be syllabified as *ron.do.n’k.ko*, given that a syllable *.nk.* is otherwise unheard of in Japanese in any context. What cases like these suggest is that, rather than trying to analyze superheavies away, we need to better understand the way they behave with respect to accent rules.

Since the suffixes *-ppoi* and *-kko* are phonologically unrestricted in their combinatorics, the last syllable of the stem can become heavy (*ko.do.mop.poi*, *e.dok.ko*, etc.) or superheavy (*ti.hoop.poi*, *ron.donk.ko*, etc.) upon suffixation (i.e., modulo the reservations noted above). They can even attach to a superheavy syllable (u.*iin* ‘Wien’), resulting in an apparent ultra-superheavy tetramoraic syllable u.*iink*.ko (17).[16] Suffixation of these geminate-initial suffixes is productive, indicating that such superheavy syllables are allowed as marked options at morphological junctures.

## 3.4 Suprasegmental properties of affixation

Besides their various phonological and allomorphic differences in segmental composition discussed in the previous sections, verbal (and adjectival) stems are morphophonemically characterized by a suprasegmental property of the stem, a tonal fall (analyzed as [±accent] by McCawley 1968). The [±accent] feature is an underlying suprasegmental property of the verb (i.e., just like any segmental property, it

**16** Similar formations are found with the quotative suffix *-tte*, which freely attaches to syllables of all kinds, including superheavies (*u.iint.-te itta* ‘Vienna, (s)he said’).

is not predictable whether a certain verb is marked as [+accent] or [–accent]). On the other hand, different from segmental features like [labial], the [accent] feature is not inextricably docked onto a particular segment. As illustrated in (18), the accent (marked by an apostrophe indicating the tonal fall) migrates towards the end of the entire stem complex and ends up appearing on suffixes, not on the root that sponsors it. In the [–accent] column, there is no accentual fall in the verbal stem complex.

| (18) | [+accent] | | [–accent] | |
|---|---|---|---|---|
| ROOT | sirabe- 'investigate' | tanom- 'request' | narabe- 'line up' | susum- 'advance' |
| PRESENT | [sirabe']-ru | [tano'm]-u | [narabe]-ru | [susum]-u |
| CAUS-PRES | [sirabe-sase']-ru | [tanom-ase']-ru | [narabe-sase]-ru | [susum-ase]-ru |
| PASS-PRES | [sirabe-rare']-ru | [tanom-are']ru | [narabe-rare]-ru | [susum-are]-ru |
| CAUS-PASS-PRES | [sirabe-sase-rare']-ru | [tanom-ase-rare']-ru | [narabe-sase-rare]-ru | [susum-ase-rare]-ru |
| IMPERATIVE | [sirabe']-ro | [tano'm]-e | [narabe]-ro | [susum]-e |
| PROVISIONAL[17] | [sirabe']-reba | [tano'm]-eba | [narabe]-re'ba | [susum]-e'ba |

For T-suffixes (19), the accent is placed on the *penultimate* mora of the stem to which the T-suffix attaches (compare (18), where the accent appears on the *final* mora of the relevant stem).

| (19) | [+accent] | | [–accent] | |
|---|---|---|---|---|
| PAST | [sira'be]-ta | [tano'n]-da | [narabe]-ta | [susun]-da |
| CAUS-PAST | [sirabe-sa'se]-ta | [tanom-a'se]-ta | [narabe-sase]-ta | [susum-ase]-ta |
| CAUS-PASS-PAST | [sirabe-sase-ra're]-ta | [tanom-ase-ra're]-ta | [narabe-sase-rare]-ta | [susum-ase-rare]-ta |
| GERUND | [sira'be]-te | [tano'n]-de | [narabe]-te | [susun]-de |
| CONDITIONAL | [sira'be]-tara | [tano'n]-dara | [narabe]-ta'ra | [susun]-da'ra |
| ALTERNATIVE | [sira'be]-tari | [tano'n]-dari | [narabe]-ta'ri | [susun]-da'ri |

The difference in accentual behavior between T-suffixes and C/V-suffixes might be due to the fact that T-suffixes prosodically subcategorize for a bimoraic foot (see section 5.1 below), thereby attracting the underlying accent to the head of this foot: *si(ra'be)-ta, sirabe(sa'se)ta, ta(no'n)-da* (for discussion of prosodic subcategorization, see Inkelas 1989, McCarthy and Prince 1990b, and Paster 2006). C/V suffixes, on the other hand, form a foot with the last syllable of the stem they attach to, attracting the underlying accent to this position.[18]

**17** The disyllabic suffixes, *-re'ba* (18) as well as *-ta'ra, -ta'ri* in (19), are underlyingly accented, but their accents are deleted when preceded by accented stems: *sirabe'-re'ba → sirabe'reba*. The deletion is usually analyzed as triggered by a type of OCP violation. According to recent instrumental studies (such as Kubozono 1988/1993), however, in careful pronunciation it is possible for both accents to be realized in *sira'be-ta'ri*, but not in *sirabe'-re'ba* with accents on adjacent syllables (which conceivably incur a more serious OCP violation). If each accent is a bitonal HL complex, tonal overcrowding may also be a factor leading to simplification, a topic for future research.

**18** The distinction in accent location between the two kinds of suffixes is neutralized when the syllable preceding a T-suffix is heavy (*tano'mu, tano'nda* 'request, requested').

These accentual properties, as well as the segmental alternations discussed in the previous sections, carry over to newly formed verbs with stem-forming *-r-* (*ku'mo* 'cloud', *kumo'r(u)* 'to cloud', see section 2.1 above). Alongside the compound structure *X-suru* 'do X' with the light verb *-suru*, where X is a loanword, we also find *X-r(u)* formations, as in (20).

(20)

| | | me'mo-suru 'to jot down a memo' | mi'su-suru 'to miss, make a mistake' | ko'pii-suru 'to copy, do copying' |
|---|---|---|---|---|
| a. | PRES | [memo'r]u | [misu'r]u | [kopi'r]u |
| b. | CAUS-PRES | [memor-ase']ru | [misur-ase']ru | [kopir-ase']ru |
| c. | CAUS-PAST | [memor-a'se]ta | [misur-a'se]ta | [kopir-a'se]ta |
| d. | GERUND | [memo't]te | [misu't]te | [kopi't]te |

The accentuation is as expected: final accent in the relevant stem complex with C/V suffixes (20a,b), and penultimate accent in the same domain with T-suffixes (20c,d).

Stem forming *-r-* is not as productive as *-suru* compounding, so many loanwords do not have the *r*-form. Loanwords longer than two moras do not generally seem to acquire the *r*-suffix.[19]

(21)

| | | |
|---|---|---|
| dora'ibu –suru | 'to go for a drive' | *doraibu'-r(u) |
| kome'nto- suru | 'to make a comment' | *komento'-r(u) |
| hi'tto-suru | 'to hit, to make a hit' | *hitto'-r(u) |

The form *kopi-r(u)* cited above show shortening of its final vowel to make the stem form fit the bimoraic template. Other shortened *r*-verbs include *negu-r(u)* 'to neglect' and *sabo-r(u)* 'to sabotage, skip classes'. In computerese, *r*-forms are more prevalent and apparently do not require the stem to be bimoraic (22).

(22)

| | | | | |
|---|---|---|---|---|
| ha'ngu-suru | 'to hang' | hangu'ru | hangu'tta | 'to hang (as computer problem)' |
| huri'izu-suru | 'to freeze' | huriizu'ru | huriizu'tta | 'to freeze (as computer problem)' |

When there is a final syllabic /l̩/ in the source word (borrowed as /ru/ in the loanword) (23), as in *daburu* 'double', *toraburu* 'trouble', and *guuguru* 'Google', /ru/ is able to do double duty as the original source word ending and the stem-forming affix.

**19** This is an example of templatic word formation, in the sense of section 5 below. New adjectives involving truncation also belong in this category *kisyo-i* < *kisyoku-waru-i* 'disgusting', *kimo-i* < *kimoti-waru-i* 'unpleasant', with a trimoraic option, as in *mendo-i* < *mendo-kusa-i*, 'troublesome', *utto-i* < *uttoosi-i* 'gloomy, unpleasant'.

(23)

| | | | | |
|---|---|---|---|---|
| da'buru | 'double' | dabu'ru | dabu'tta | 'to double' PRESENT, PAST |
| tora'buru | 'trouble' | torabu'ru | torabu'tta | 'to trouble' PRESENT, PAST |
| guuguru | 'Google' | guugu'ru | guugu'tta | 'to Google' PRESENT, PAST |

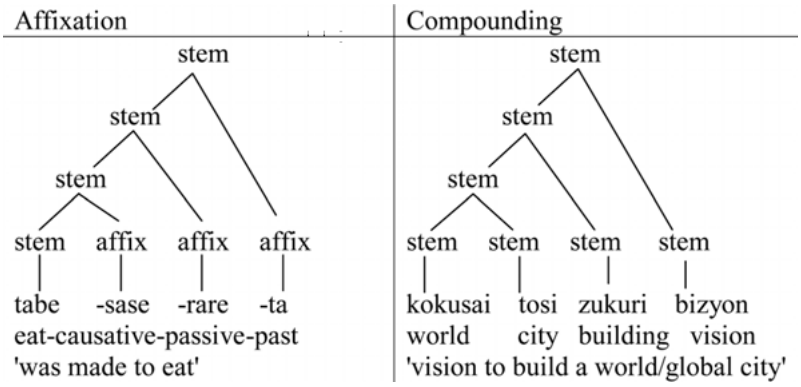
These novel *ru*-formations show that the verbal accentuation pattern is exceptionless and overrides the original noun accent, as in *da'buru* (noun) vs. *dabu'ru* (verb).

While morphophonemic properties as exemplified in Japanese affixational morphology are sometimes dismissed as idiosyncratic, or as mere historical residues, even a cursory look at the segmental, prosodic and accentual phenomena involved, some of them quite productive, reveals many interesting phonological processes and properties of Japanese, with cross-linguistic consequences that still await closer investigation.

## 4 Phonology of compounding

Besides affixation, which joins an affix to a stem to form another stem, the other major word formation process in Japanese is compounding, which joins one stem to another, as exemplified in (24), repeated from (1).

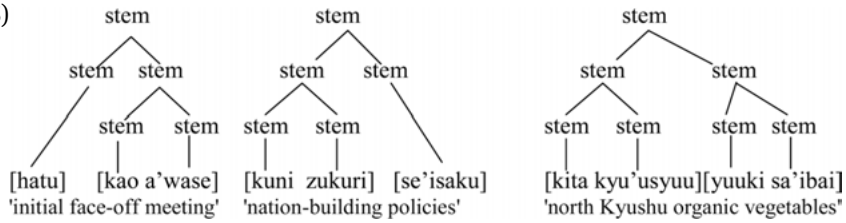
(24)




Affixation, predominantly suffixal in Japanese,[20] usually results in left-branching recursive word structure as in (24a), whereas a variety of recursive structures, with other kinds of branching, can be found in compounding (25).

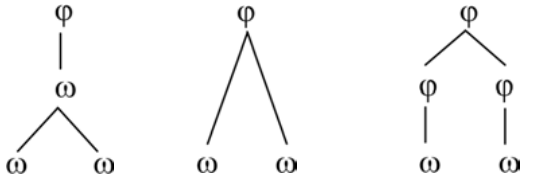
**20** Some morphemes usually analyzed as prefixes have interesting phonological properties, e.g., the honorific prefixes *go-/o-*, or the phrasal prefixes *moto-/kyuu-*, 'former', *datu-* 'escaping', etc. Whether these cases are to be properly analyzed as prefixation or as a type of compounding remains a question for further exploration (see Irwin 2012).

(25)



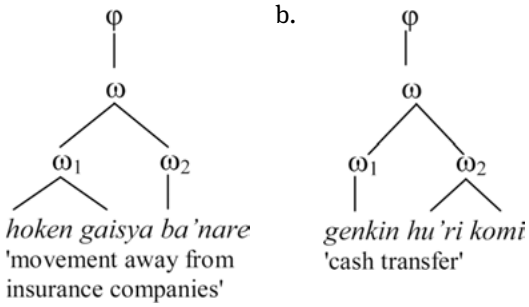

While these compounds behave syntactically as single lexical words and not as phrases (i.e., case marking only on the final stem, no optional scrambling, no internal modifiers), it turns out that they have different phonological characteristics, such as *rendaku* voicing (see Vance, this volume, and Ito and Mester 2003), junctural accent, and deaccenting (see Kawahara, Ch. 11, this volume). Building on Kubozono, Ito, and Mester (1997), Ito and Mester (2007) propose that these differences can be understood as the result of the particular way the syntactic/morphological structure is mapped to prosodic structure (see Ishihara, this volume), crucially allowing for recursion both at the word (ω) and phrase (φ) levels. Depending on various factors, a lexical compound ends up being phonologically parsed as a word compound (26a), as a phrasal compound with two prosodic words (26b), or as a phrasal compound with two phonological phrases (26c).

(26) a. word compound b. mono-phrasal compound c. bi-phrasal compound

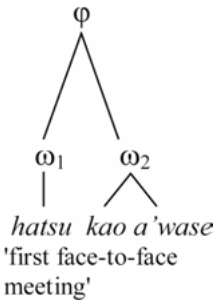



With further compounding, a number of structural possibilities are encountered, as shown in the examples in (27) taken from Ito and Mester (2007), where the lowest branching ω's are themselves word compounds.

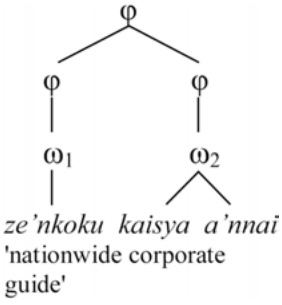
(27) a. b.



c.




d.




These complex compounds exhibit an interesting distribution of phonological properties. In (27a), $\omega_2$ undergoes *rendaku* voicing (*hanare* → ***b**anare*); but in (27b–d), $\omega_2$ does not undergo *rendaku*, although the individual stems are *rendaku* undergoers in simple compounds such as *kara-**b**uri* 'empty swing', *e-**g**ao* 'smiling face', and *takusii-**g**aisya* 'taxi company'. Junctural accent (here realized on the initial syllable of $\omega_2$, but see Kawahara, Ch. 11, this volume, for details) is found in (27a,b) but not in (27c,d), where it is precluded by the phonological length of $\omega_2$. Finally, because of the one-accent restriction on φ, there is no accent on $\omega_1$ in (27a–c), whereas in (27d), each ω constitutes a separate φ, and therefore $\omega_1$ carries its own accent. The overall pattern is summarized in (28), where we can see a clear progression with the word compound (27a) exhibiting all three properties, and the biphrasal compound (27d) exhibiting none of them.

(28)

| | (27a) | (27b) | (27c) | (27d) |
|---|---|---|---|---|
| Rendaku voicing on $\omega_2$ | *Yes* | *No* | *No* | *No* |
| Junctural accent on $\omega_2$ | *Yes* | *Yes* | *No* | *No* |
| Deaccenting of $\omega_1$ | *Yes* | *Yes* | *Yes* | *No* |

We have here introduced these phonological properties of compounds in only the broadest outline, as it is beyond the scope of this general word formation chapter to present or discuss the details (see Kawahara, Ch. 11, this volume, Vance, this volume, and references cited there).

Finally, not mentioned above, but no less pervasive in the language, is the compounding of Sino-Japanese morphemes, which is associated with a special segmental phonology and prosodic morphology, giving rise to very systematic alternations, such as vowel~Ø-alternations (*dai-gak**u*** 'lit. large-scholarship, university' vs. *gak-koo* 'lit. scholarship-building, school') and *h~p* alternations (*sip-**p**itu* 'lit. take-brush, to write', *toku-**h**itu* 'lit. special-brush, special note', *en-**p**itu* 'lit. led-brush, pencil'

*mannen-**h**itu* 'lit. ten-thousand-year brush, fountain pen'). Sino-Japanese compounding obeys very rigid restrictions on size and segmental combinatorics unknown to the rest of the lexicon (see Tateishi 1990, Ito and Mester 1996, Kurisu 2000, and Ito and Mester, Ch. 7, this volume).

## 5 Templatic word formation

So far, this chapter has focused on the phonological processes that accompany word formation, taking place when morphemes with a fixed shape are combined in various ways through affixation and compounding. In what follows, we turn our attention to what has become known as prosodic morphology since the seminal work of McCarthy and Prince (1986). Here phonology is not just an accompaniment to word formation, but takes center stage in the process itself by determining the shape of words through phonological (prosodic) templates.

Phonological representation does not consist of just a sequence of vowel and consonant phonemes, but such phonemic segments are organized into a constituent structure known as the prosodic hierarchy (Selkirk 1978; Nespor and Vogel 1983), which is not isomorphic to the grammatical (syntactic/morphological) hierarchy.

(29)

| Linguistic hierarchies | Grammatical hierarchy | Prosodic hierarchy |
|---|---|---|
| phrase-level hierarchies | sentence | υ: utterance |
| | \| | \| |
| | syntactic phrase | ι: intonational phrase |
| | \| | \| |
| | \| | φ: phonological phrase |
| | \| | \| |
| word-(internal) | morphological word | ω: prosodic word |
| hierarchies | \| | \| |
| | stem | f: foot |
| | \| | \| |
| | root/affix | σ: syllable |
| | | \| |
| | | μ: mora |

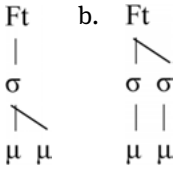
Phrasal syntactic constituents are mapped to intonational and phonological phrases, and morphological words, formed by affixation or compounding as discussed in the previous sections, are mapped to prosodic words that are internally organized into feet, syllables, and moras. In templatic word formation, such as truncation, there is no affixation or compounding, but the word shape, in particular its size, is phonologically determined by the prosodic template, which is itself dictated by independent phonological constraints.

For example, English clipped words such as *rep* for *representative* or *prof* for *professor* are not combinations of preexisting morphemes, but rather the phonology provides the prosodic shape of the clipped word, here, a heavy monosyllable. As McCarthy and Prince (1986) convincingly show, this template corresponds to the minimal prosodic word of the language (see also Lappe 2003) and constitutes the template to which the segments of the base word are mapped, resulting in formations whose prosody is invariant but whose segmentalism varies with their bases.

Templatic word formation has been investigated extensively in Japanese (Poser 1990; Ito 1990; Mester 1990; Ito and Mester 2003 [1992]; Kubozono 1995; Labrune 2002; Benua 1995), providing numerous studies on a wide-ranging variety of formations, such as clipped words, hypocoristics and nickname formation, reduplication, language games, alphabetic acronyms, baseball chants, blends, and compound truncations. Many of these studies have garnered interest not only from Japanese specialists but also from the field of phonology at large. Examples and analyses of Japanese prosodic morphological formations are routinely cited in textbooks (Kenstowicz 1994: 651–653), and in work dealing with templatic word formations.[21] Since it will not be possible here to survey all of these cases, we will exemplify in some detail those formations whose investigation has had an influence on the direction of phonological theorizing, in particular, in the developments leading to Optimality Theory.

## 5.1 The bimoraic foot template

Besides evidence from accentual patterns in compounds, Poser (1984a,b, 1990) presented extensive evidence that the bimoraic foot plays a pivotal role in Japanese word formation, in particular, in hypocoristic and other nickname formations. The bimoraic foot template $_{F}(\mu\mu)$ subsumes a single heavy (bimoraic) syllable and two light (monomoraic) syllables, as schematically shown in (30).

(30) Bimoraic foot structure: a. 

b. 


**21** Although not directly templatic, Kubozono (1990) shows that language-specific prosodic properties hold the key to the different generalizations behind the process of blending word formation in English and Japanese, where the two merged words are in a paradigmatic relation (i.e., *smog* (*smoke+fog*) is neither smoke-like fog nor fog-like smoke, but a genuine mixture of the two). Similarly, the Japanese blend *gozira* 'Godzilla' is a mix of *gorira* 'gorilla' and *kuzira* 'whale'. Following Kubozono's work, Bat-El (1996) further develops the phonological basis of blending types with evidence from Hebrew and other languages.

Hypocoristic names (31) are derived by adding the suffix /-tyan/ [tʃaN] (besides others), with various segmental alterations to the original (base) name.

| | | | | |
|---|---|---|---|---|
| (31) | megumi | 'Megumi' | > | megu-tyan |
| | keeko | 'Keiko' | > | kee-tyan, keko-tyan |
| | hiromi | 'Hiromi' | > | hiro-tyan, romi-tyan |
| | midori | 'Midori' | > | mido-tyan, mii-tyan |
| | yooko | 'Yoko' | > | yoko-tyan, yoo-tyan |
| | mariko | 'Mariko' | > | mari-tyan, mako-tyan |
| | hanako | 'Hanako' | > | hana-tyan, haa-tyan |
| | takako | 'Takako' | > | taka-tyan, taa-tyan |
| | akira | 'Akira' | > | aki-tyan, at-tyan |
| | tatuo | 'Tatsuo' | > | tat-tyan |
| | kentaroo | 'Kentaro' | > | ken-tyan, taro-tyan |
| | wasaburoo | 'Wasaburo' | > | wasa-tyan, sabu-tyan |

It is typical to find several possible hypocoristic forms for a specific personal name (as in English, with *Liz, Lisa, Eli* for *Elizabeth*, or *Al, Albie, Bert* for *Albert*). The possible variations in Japanese hypocoristics are segmental deletions at the edges of names (*hiro-tyan, romi-tyan* from *hiromi*), segment skipping (*mako-tyan* from *mariko*), and, in combination with segment deletion, vowel lengthening (*mii-tyan* from *midori*), vowel shortening (*keko-tyan* from *keeko*), and gemination from the suffix (*at-tyan* from *akira*). What unifies the hypocoristic name formation, Poser argues, is the overall size demand, namely a bimoraic foot template that is filled by the segments of the base. From the name *midori*, we find bimoraic *mido-tyan* or *mii-tyan*, but not a monomoraic **mi-tyan*.

Other types of truncatory names are also discussed by Poser (1990), such as the rustic girl's names (*keeko>o-kee, takako>o-taka*) or discretionary names of clients (*koono>o-koo-san*, *tanizaki>o-taa-san*), which have different affixal attachments and stricter segmental requirements, but the bimoraic foot template of the modified base continues to be invariant (see Mester 1990 for discussion and analysis in terms of Prosodic Morphology).

Established long compounds often have abbreviated forms that also conform to this size restriction, taking the initial foot-sized portion of each compound member (32a,b), or taking only the initial (modifying) word of the compound (32c,d). Similar abbreviation strategies also exist in English, such as taking the initial letter of each word to form an acronym (TEPCO, PC), or abbreviating the compound to its first word, as in *cell* for *cell phone*, or *super* for *superintendent*.[22] What is remarkable for

**22** Different from Japanese, English *super* is an abbreviation for *superintendent* or *supernumerary* 'extra (actor in film)', not for *supermarket*.

Japanese is the strict prosodic generalization that the abbreviated result is maximally two bimoraic feet which do not necessarily match with any morphological divisions, as shown by *(zi+te)n+* in (32e) and *(ho+ko)o+* in (32f).

(32) Compound abbreviations $_{F}(\mu\mu)\ _{F}(\mu\mu)$

| | | | | |
|---|---|---|---|---|
| a. | too+kyoo den+ryoku | → | (too)(den) | 'Tokyo Electric Power Co., TEPCO' |
| b. | paasonaru konpyuutaa | → | (paso)(kon) | 'personal computer, PC' |
| c. | kee+tai den+wa | → | (kee)(tai) | 'mobile/cell (phone)' |
| d. | suupaa-maaketto | → | (suu)(paa) | 'supermarket' |
| e. | *zi+te*n+sya tuu+kin | → | (zite)(tuu) | 'bicycle commuting' |
| f. | *ho+ko*o+sya ten+goku | → | (hoko)(ten) | 'pedestrian paradise, no-car zone' |

The bimoraic foot also serves as a size restriction for Sino-Japanese (bound) morphemes, e.g., /gen/ 'speak', /go/ 'word', /gaku/ 'scholarship, combining to form words like *gengo* 'language' and *gengogaku* 'study of language, linguistics' (see Ito and Mester, Ch. 7, this volume), and for so-called mimetics (sound-symbolic morphemes usually occurring reduplicated, e.g., *kon-kon* 'knocking' or *pota-pota* 'dripping'; see Nasu, this volume).

Different from (reduplicated) mimetics, verbal reduplication prima facie shows no evidence of a foot-size restriction. The stem form of the verb, however long, is reduplicated in its entirety, deriving an adverbial form meaning 'while V-ing' (33).

(33)

| | | | |
|---|---|---|---|
| tabe | 'to eat' | tabe-tabe | 'while eating' |
| naki | 'to cry' | naki-naki | 'while crying' |
| odori | 'to dance' | odori-odori | 'while dancing' |
| hataraki | 'to work' | hataraki-hataraki | 'while working' |

Even here, though, the foot-size restriction is lurking in the background and manifests itself this time as a minimality condition: When monomoraic verbal stems like *mi* 'see' in (34) reduplicate, both the reduplicated portion and the monomoraic base must lengthen to bimoraic size (*mii-mii*, etc., see Martin 1975: 409, and Kageyama 1976–77: 127).

(34)

| | | | |
|---|---|---|---|
| mi | 'to look' | mii-mii | 'while looking' |
| ne | 'to sleep' | nee-nee | 'while sleeping' |
| si | 'to do' | sii-sii | 'while doing' |
| benkyoo-si | 'to study-do' | benkyoo-sii-sii | 'while studying' |

Besides providing another example of the bimoraic foot at work in word formation, monomoraic lengthening in verbal reduplication provides an example of what has become known as "backcopying" in the Generalized Template Theory of reduplication developed by McCarthy and Prince (1999). The idea is the following. The base

verb *tabe-* is copied, to form *tabe-tabe*. For *mi-*, however, copying the base form would yield **mi-mi*, which does not satisfy the foot size requirement of the reduplicated portion. Lengthening just the reduplicated portion to satisfy the requirement would yield **mi-mii* or **mii-mi*, depending on whether the reduplicant is suffixed or prefixed. There is clearly no requirement that the base itself has to be minimally bimoraic, otherwise monomoraic verbs such as those in (34) could not exist. However, reduplication requires that the base and its copy should be identical. Therefore the length of the reduplicant is back-copied into the base to achieve identity, resulting in the doubly-lengthened *mii-mii*.

The significance of this back-copying case is that this small corner of Japanese templatic word formation joins a growing number of cross-linguistically attested cases of backcopying (Inkelas and Zoll 2005 for English, Downing 2000 for the Bantu language Kinande, and Caballero 2006 for the Uto-Aztecan language Guarijío), together undermining some of the main hypotheses of Generalized Template Theory (McCarthy and Prince 1999), as argued in detail in Gouskova (2007) (a similar conclusion is reached in McCarthy 2008: 297 and McCarthy, Kimper, and Mullin 2012: 210–211).

## 5.2 The optimal prosodic word

With Poser's (1984a,b, 1990) convincing demonstration that the bimoraic foot Fμμ is an important structural unit in Japanese, subsequent research found confirmation that F*-templates, where F* denotes integer multiples of bimoraic feet, indeed played a key role in many areas of prosodic morphology (Kubozono 1995; Tateishi 1989; McCarthy and Prince 1990a,b, among many others). Further investigation, however, also revealed the existence of templatic word formations involving a number of other highly systematic prosodic properties beyond the use of F*-templates. Based on the empirical findings of Ito (1990) in prosodic morphology terms, Ito and Mester (2003 [1992]) argue that word clippings, a productive word formation pattern of contemporary Japanese, do not conform to F*-templates per se, but in fact reveal a deeper generalization, namely, the emergence of the optimal (or unmarked) structure of prosodic words in Japanese.

Such truncated words, often involving long loanwords, appear in three prosodic shapes, two of which are the familiar F*-templates (singly or doubly footed structures), and the third consisting of a foot and a light (monomoraic) syllable.

| | | | |
|---|---|---|---|
| (35) | a. Fμμ | [(suto)] ~~raiki~~ | 'strike' |
| | | [(demo)] ~~nsutoreesyon~~ | 'demonstration' |
| | | [(roke)] ~~esyon~~ | '(film shooting) location' |
| | b. Fμμ Fμμ | [(riha) (biri)] ~~teesyon~~ | 'rehabilitation' |
| | | [(kon)(bini)] ~~ensu sutoa~~ | 'convenience store' |
| | | [(asu)(para)] ~~gasu~~ | 'asparagus' |

| | | |
|---|---|---|
| c. $F_{\mu\mu}\ \sigma_{\mu}$ | [(ani) me ] ~~esyon~~ | 'animation' |
| | [(dai) ya] ~~mondo~~ | 'diamond' |
| | [(paa)ma] ~~nento~~ | 'perm(anent wave)' |
| | [(kon)po] ~~onento~~ | '(stereo) component' |

Why do we find these three word-clipping patterns (henceforth referred to as F-words (35a), FF-words (35b), and Fσ-words (35c))? The final syllable in Fσ-words is necessarily monomoraic, since a heavy syllable would project a foot and count as the second F in an FF-word. If it was merely the case that there exists one more template for word clippings, Fσ, in some sense intermediate in size between F and FF, this would be descriptively interesting, but of no theoretical import. The question to ask, rather, is why, given the possibility of Fσ-words, there are no σF- words like *[*de*(*mon*)] ~~*sutoreesyon*~~ or *[*ro*(*kee*)] ~~*syon*~~, where the foot is located at the right edge and not at the left edge. According to Ito and Mester (2003 [1992]), the answer is not to be found in another restriction on feet, but rather on an edge-based restriction on prosodic words, favoring left edges of words to be properly footed, a situation found cross-linguistically (known as the initial dactyl effect). This explains why [(*kon*)*po*] is well-formed, but *[*de*(*mon*)] is not.

This left-edge matching requirement, which played an important role in Generalized Alignment Theory (McCarthy and Prince 1993),[23] is not an isolated phenomenon in clipped words, but is found in another corner of Japanese prosodic morphology, namely, in the word-reversing language game *zuuzya-go* (ZG). Here regular words are split in two and reversed (for details and analysis, see Tateishi 1989, Ito, Kitagawa, and Mester 1996, and Sanders 1999), so that the resulting ZG word starts with a foot: *karaoke* → [(*oke*)(*kara*)] 'karaoke', *kusuri* → [(*suri*)*ku*] 'drug', *kaban* → [(*ban*)*ka*] 'bag'. For words of the prosodic shape Fσ ([(*pan*)*tsu*] 'pants', [(*koo*)*ra*] '(Coca) Cola', simple reversal leads to the ill-formed σF, *[*tsu*(*pan*)], *[*ra*(*koo*)], and in just this situation, the game allows for further modification to provide the prosodic word with a left-aligned foot, [(*tsuu*)(*pan*)] or [(*tsun*)*pa*], [(*raa*)(*koo*)] or [(*raa*)*ko*]. Kubozono (2003) points out that the same asymmetry is already present in Japanese baby words (*baaba, *babaa*).

The explanation turned out to also have theoretical consequences with respect to the interpretation of the Strict Layering principle of the prosodic hierarchy, since it was crucial to be able to distinguish syllables that are parsed into feet from those that were not, paving the way for a more nuanced interpretation of Strict Layering as an optimal, ideal prosodic state rather than an absolute requirement (Prince and Smolensky (1993 [2004]); Selkirk 1996).

**23** A similar proposal has been made more recently by Selkirk (2011), who argues for the optimality-theoretic constraint StrongStart, reflecting a universal preference for prominent constituents to be initial in any level of the prosodic hierarchy.

Finally, a closer look at the three possible word types in (35) raises other questions. First, whereas the feet in FF- and Fσ- words consist of either one heavy syllable or two light syllables, F-words are always disyllabic (*suto*, *demo*, etc.), heavy monosyllables (**dai*, **paa*, **kon*, etc.) are never found. Why would this be the case, given that both are licit bimoraic foot structures? Second, given FF-words (conforming to the F*-template), why are there no FFF-words like *[(*kon*)(*bini*)(*en*)]~~*su sutoa*~~? Similarly, given F-, FF- and Fσ-, why no FFσ-words like *[(*asu*)(*para*)*ga*]su, or FσF-words like *[(*kon*)*bi*(*nee*)]~~*syon*~~? Once again, the answer lies not in a constraint on feet, but in a constraint imposed on the overall structure of prosodic words, namely, the Word Binarity constraint (Ito and Mester 2003 [1992]) requiring words to be structurally binary. As a result, prosodic words must be minimally disyllabic (hence no clipped words of monosyllabic size) and maximally bipodal (hence no clipped words larger than FF). Binarity requirements arguably hold at all other levels of the prosodic hierarchy (29). They are perhaps most well-established for foot structure (FtBin, Prince 1980), and are increasingly brought to bear on higher levels (φ-Bin, Kubozono 1988; Selkirk 2000). As is the case for Word Binarity for clipped words, precise formulations call for separate maximal and minimal versions (see Mester 1994, Selkirk 2000, and Ito and Mester 2007).

Word formation with a prosodic morphological target can thus reveal the phonologically optimal size and structure of prosodic words in a language, including alignment of prosodic word edges with foot edges, and binarity at the word level. For analytic details and further theoretical motivation, readers are referred to the work cited, as well later work where other generalizations emerged, such as Labrune's (2002) accent cut generalization (whereby loanwords are found to be truncated up to the accent), and pseudo-compound structuring documented by Sato (2002), Kubozono (2002), and others (where the second member of the (pseudo-)compound is treated as the truncated portion).

## 6 Summary and concluding remarks

This chapter started out by seeking an understanding of the phonological properties of affixal word formation (section 2), developing a phonological cross-classification of affixes, as well as an understanding of the types of phonological alternations observed (section 3), such as postnasal voicing, voicing assimilation, accent shifts, and phonologically motivated allomorphy. After outlining the phonological typology of compound structures and their prosodic implications (section 4), we turned to templatic word formations (section 5), where the shape and size of certain words (nicknames, clippings, reduplication, language games) are determined directly by phonological (prosodic) templates.

The coverage in terms of types of word formation has in no way been exhaustive. We have here focused our attention on those aspects that may not be dealt with in detail in other chapters of this volume, and that bear on cross-linguistic questions and typological issues as well as general theoretical ramifications and consequences. Many of these case studies of Japanese have served as major cornerstones in the development of general phonological theory, and others, we believe, are ripe for important future exploration.

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