ABSTRACT. This paper examines the phonological behaviour of $r$ in Japanese, arguing that it is represented in the Element Theory model by the single element $I$. Segments containing a single element are inherently weak: in the case of Japanese $r$ it is prone to elision, it can result from lenition, and it prefers prosodically weak positions. Further motivation for representing $r$ as $I$ comes from the way $r$ interacts with front vowels, which also contain $I$. We show how $r$ acts as a hiatus-breaker in non-past verbs but only in the context of a preceding $I$-vowel, $i$ or $e$.

Keywords: Element Theory, Japanese verb morphology, consonant-vowel interaction, coronals, front vowels

1. Introduction

This paper discusses the representation of the segment conventionally denoted by the symbol ‘$r$’ in Japanese. This sound is usually described as a coronal tap, though the literature on Japanese phonology has paid little attention to its structure or phonological behaviour. The descriptions that are available tend to follow standard conventions by employing features such as [+coronal] and [+flap] (Hall 1997).

In a departure from phonetic-based descriptions, this paper proposes a representation for Japanese ‘$r$’ based primarily on its phonological behaviour. In terms of its distribution, the tap $r$ can precede any vowel, as other consonants can. On the other hand, $r$ displays an inherent weakness that sets it apart from other consonants. Several aspects of $r$ point to its weakness: it shows a preference for prosodically weak positions; in some dialects it is the outcome of weakening processes, e.g. $\text{hara} < \text{hata}$ ‘flag’; and it is prone susceptible to elision in negative verb forms, e.g. $\text{hasina} < \text{hasiranai}$ ‘someone does not run’. Another unique trait of the Japanese tap, which has been overlooked in the Japanese phonology literature (cf. Shibatani 1990; Vance 1987, 2008), is its correlation with front vowels. In the formation of non-past tense verbs, either the suffix $-\text{u}$ or the suffix $-\text{ru}$ is added to a verb stem, the choice being based on phonology: $-\text{ru}$ attaches to verb stems with a final front vowel $i$ or $e$ (e.g. $\text{mi}$ ‘see’, $\text{ne}$ ‘sleep’) while $-\text{u}$ appears elsewhere, i.e. after consonant-final stems. Here, suppletive cases such as $\text{su}$ ‘do’ and $\text{kua}$ ‘come’ will be disregarded.

To describe the structure of $r$ we employ the Element Theory model of segmental representation (Harris and Lindsey 1995; Nasukawa and Backley 2008). This approach uses a small set of privative (i.e. single-valued) primes, a segment’s phonological strength correlating with the number of elements in its representation: the weaker a segment is, the fewer elements are needed to represent it. Thus, very weak consonants such as glides are typically represented by simplex (i.e. single-element) expressions. Our claim is that Japanese $r$ is the phonetic realisation of the single element $I$, which represents coronality in consonants (van de Weijer 1994, Harris 1994, Harris and Lindsey 1995). As a simplex
expression, \( \text{III} (= \text{r}) \) is inherently weak and we can expect it to be targeted by processes such as lenition and deletion. Moreover, by representing \( \text{r} \) as \( \text{III} \), we can express a direct phonological relation between \( \text{r} \) and the vowels \( i,e \), which also contain \( \text{III} \). It is through this formal relation that we gain an understanding of \( \text{r} \) distribution in Japanese verbs.

2. Element Theory

There are several reasons for choosing elements over traditional features. The set of just six elements is much smaller than the set of features, which reduces the problem of overgeneration that is inherent in most feature theories. In principle, all combinations of elements are grammatical, each combination representing a possible segment. Element Theory imposes further control on overgeneration by using only single-valued (positive) elements; this prevents the grammar from referring to the absence of segmental properties. Another advantage of employing elements is that they apply to both consonant and vowel representations (Backley and Nasukawa 2010, cf. Clements and Hume 1995). This makes it possible to express natural classes which cut across the consonant-vowel division and to capture phonological effects involving interactions between consonants and vowels.

Elements are able to appear in consonants and vowels because they are defined in terms of acoustic properties rather than articulation. It is often the case that consonants and vowels which are phonologically related have no articulatory properties in common, and for this reason, articulation-based feature theories are sometimes unable to make a formal connection between them. On the other hand, segments that are phonologically related typically do have acoustic properties in common, which Element Theory expresses by using the same element in both segments. For example, the interaction of low vowels with back (e.g. pharyngeal) consonants suggests that the two categories are related, and this relation is captured by proposing that the same \( \text{IAl} \) element is present in both: \( \text{IAl} \) contributes backness in consonants and openness in vowels. Similarly, round vowels often interact (and form a natural class) with labial consonants, which the grammar formalises by using the same \( \text{IUI} \) element to represent both categories: \( \text{IUI} \) contributes labiality in consonants and rounding in vowels. Below we discuss another natural class — one involving the coronal tap \( \text{r} \) and the front vowels \( i,e \). We propose that all three segments \( r,i,e \) contain the same element \( \text{III} \), and demonstrate how this accounts for the puzzling behaviour of ‘\( \text{r} \)’ in Japanese verb morphology. In consonants the \( \text{III} \) element contributes coronality while in vowels it is interpreted phonetically as frontness, which sheds light on the relation between ‘\( \text{r} \)’ and front vowels in Japanese non-past verbs. Japanese has a 5-vowel system which includes the front vowels \( i,e \). Since both contain \( \text{III} \), we can identify them as a natural class of \( \text{III} \) vowels: \( i \) has the single element \( \text{III} \) while \( e \) has \( \text{III} \) combined with the \( \text{IAl} \) element.

3. Coronals and front vowels

The phonological link between coronals and front vowels is now becoming widely accepted. In some models of feature geometry, for example, the two categories share the same feature
[coronal] (Clements and Hume 1995), while in Element Theory the .logout element is used to represent coronal place in consonants and frontness in vowels. Phonological evidence for a connection between coronality and vowel frontness comes from a variety of languages. In Feꞌfeꞌ-‐Bamileke (Hyman 1973), for instance, the reduplicative vowel i is fronted to i when the next syllable contains i or a coronal consonant plus any front vowel. Compare the fronted forms in (1b) with the non-‐fronted forms in (1a):

(1) Vowel fronting in Feꞌfeꞌ-‐Bamileke
a. to ti-‐to ‘to punch’
   ben pi-‐pen ‘to accept’
   cen ti-‐te: (*ti-‐te:) ‘to remove’
   c. ten ci-‐cen (*ci-‐cen) ‘to spoil’

Another example is provided by Lhasa Tibetan, where a historical process of vowel fronting changed a,o,u to e,o,y in the context of a following word-‐final coronal (which later dropped), e.g. ras [reɔ:] ‘cloth’, jul [jyy] ‘country’, chos [choɔ] ‘religion’. Further examples of the link between coronals and front vowels are documented in Hume (1992).

In most coronal segments, logout combines with other elements, e.g. t in (2a) contains logout for coronality, lhi to represent its audible release burst and l?l for occlusion or stopness:

(2) a. t = l logout l?l  b. r = logout

However, logout may also stand alone, as in (2b), when it is interpreted (in onsets) as a coronal tap r. This is confirmed by ‘tapping’ dialects of English such as Australian English, where ViV weakens to VrV, e.g. better [lˈbeər]. Element Theory views tapping as a lenition effect in which lhi and l?l are suppressed in weak positions leaving just the element logout remaining. Without lhi and l?l to provide consonantal properties, logout is interpreted as pure coronality, i.e. as a coronal tap. Tapping also occurs in other languages such as Taiwanese (Gurevich 2004), e.g. kʰutα [kʰura] ‘little hole’.

4. Japanese r

As in English and Taiwanese, r in Japanese is a product of intervocalic weakening. The lenition pattern shown in (3a) is particularly prevalent in dialects of the Tohoku region and of Koshikijima island.

(3) a. hara < hata ‘flag’  b.  t
   ira < ita ‘board’  lhi < l?l hi (intervocalic)
   ura < uta ‘song’
   mira < mita ‘someone saw’

As (3b) shows, r is a lenited reflex of t; that is, when speakers fail to phonetically interpret lhi and l?l, the surviving element logout is realised as r. This kind of lenition typically occurs in onsets that are foot-‐internal — a position now widely recognised as prosodically weak (Harris and Kaye 1990; Harris 1994, 1997). Weak positions such as this make ideal targets for lenition, the lenition process itself involving the simplification (or ‘decomposition’) of a
segment’s structure through the suppression of certain elements. The effect of simplification is to make a segment structurally less complex, which brings the segment into line with its prosodically weak context (Harris and Kaye 1990, Harris 1994, Harris and Lindsey 1995, 2000, Harris 2005, Nasukawa 2005, Backley and Nasukawa 2009). The inherent weakness of foot-internal onsets is formally expressed by the licensing path in (4):

(4)  Dependency relations defined by licensing path

\[ \text{Ons}_1 \rightarrow \text{Nuc}_1 \rightarrow \text{Ons}_2 \rightarrow \text{Nuc}_2 \]

The foot-initial syllable is prosodically strong and thus perceptually prominent; as such, its head position Nuc1 can be regarded as the head of the foot domain. By contrast, other positions are prosodically weaker (perceptually less prominent) because they are dependents of the domain head. The lowest — and therefore the weakest — position on this chain of head-dependent licensing relations is the foot-internal onset Ons2, which is only an indirect dependent (i.e. a dependent of a dependent) of the head nucleus. The inherent weakness of Ons2 makes it especially susceptible to weakening processes; consequently, in this position we are accustomed to finding single-element expressions such as \( r \).

The interaction between prosodic strength and melodic complexity shows up not only in lenition effects but also in patterns of segmental distribution. For example, Japanese \( r \) can precede any vowel, just as other consonants can. But in the native (Yamato-Japanese) vocabulary the distribution of \( r \) tends to be restricted to non-initial positions:

(5) Nouns: maru ‘circle’, sora ‘sky’
Adjectives: karui ‘light’, karai ‘hot, spicy’
Verbs: aruku ‘walk’, oderu ‘break (intransitive)’

Morphemes that do begin with \( r \) are typically bound morphemes such as verb suffixes (6a) or non-native (non-Yamato-Japanese) words (6b):

(6) a. -ru non-past, e.g. mi-ru
   -reba conditional, e.g. mi-reba
   -ro volitional, e.g. mi-ro
   -raru potential, passive, e.g. mi-raru
   (-ru potential, passive, e.g. mi-ru)
   b. rika ‘science’
   riusu ‘absence’
   rokku ‘rock ‘n’ roll’
   raito ‘light’

These distributional facts lead us to conclude that in the native stratum of Japanese vocabulary the simplex expression \( r \) is favoured in prosodically weak intervocalic positions, where there is insufficient strength to license a complex expression. In this way, we can identify a direct relation between the weakness of \( r \) as a simplex expression \( r \) and the weakness of its favoured context, intervocalic position.
Another indication of the phonological weakness of \( r \) is shown by the way this segment (together with a following vowel) elides in negative verb forms. The elision of \( rV \) then allows a following nasal consonant to geminate:

\[
\begin{align*}
(7) & \quad \text{hasinai} < \text{hasiranai} & \text{‘someone does not run’} \\
& \quad \text{kiinai} < \text{kiranai} & \text{‘someone does not cut’}
\end{align*}
\]

As (7) illustrates, the Japanese tap, which is represented by just a single element, makes a natural target for elision and assimilation processes owing to its inherent weakness.³

5. The behaviour of \( r \) in Japanese verb morphology

5.1 A traditional view

Let us now examine why the simplex expression \( \text{I} \) in Japanese is interpreted as \( r \) in an onset.⁴⁻⁵ Our explanation focuses on the behaviour of \( r \) in non-past verb forms. In traditional descriptions of Japanese, these are divided into the two types in (8a) and (8b):

\[
\begin{align*}
\text{(8) a. Type A} & \quad \quad \quad \quad \text{b. Type B} \\
\text{non-past} & \quad \text{negative (-\text{nai})} & \quad \text{non-past} & \quad \text{negative (-\text{anai})} \\
n\text{miru} & \quad n\text{minai} & \text{‘watch, see’} & \quad n\text{iru} & \quad n\text{iranai} & \text{‘cut’} \\
n\text{kiru} & \quad n\text{kinai} & \text{‘wear’} & \quad n\text{asu} & \quad n\text{asanai} & \text{‘add’} \\
n\text{neru} & \quad n\text{nenai} & \text{‘sleep’} & \quad n\text{ogu} & \quad n\text{oganai} & \text{‘sharpen’} \\
n\text{taberu} & \quad n\text{tabenai} & \text{‘eat’} & \quad n\text{omu} & \quad n\text{omanai} & \text{‘read’} \\
n\text{tazuneru} & \quad n\text{tazunnai} & \text{‘ask’} & \quad n\text{i} & \quad n\text{inanai} & \text{‘die’} \\
n\text{tobu} & \quad n\text{tobanai} & \text{‘fly’} & \quad n\text{atu} & \quad n\text{atanai} & \text{‘stand’} \\
n\text{ka(w)u} & \quad n\text{kawanai} & \text{‘buy’}
\end{align*}
\]

In Type A verbs the non-past form always ends in \( r \) followed by \( uu \), whereas in Type B verbs any consonant (including \( r \)) may appear before the final \( uu \), e.g. \( suu, muu, buu \), and so on. Moreover, the two patterns differ in terms of the behaviour of the consonant preceding \( uu \): in Type A verbs the consonant (always \( r \)) elides before \( uu \) in negatives, whereas in Type B verbs the consonant (which may be any consonant, including \( r \)) is retained in negatives. Traditionally, this difference is captured by appealing to morphology. Type A verbs are assumed to take the non-past suffix \( -ruu \), meaning that the consonant \( r \) is not part of the stem, e.g. \( ne-ruu \text{ ‘sleep’} \). By contrast, Type B verbs are thought to take a different non-past suffix \( -uu \), which makes the consonant preceding \( uu \) a stem-final consonant, e.g. \( tob-uu \text{ ‘fly’} \). According to this analysis, then, Type A verbs (with the suffix \( -ruu \)) have vowel-final stems while Type B verbs (with the suffix \( -uu \)) have consonant-final stems. Furthermore, it is assumed that this difference between Type A and Type B verbs can account for the different behaviour of \( r \) in each: in Type B words such as \( n\text{iru}n\text{iranai} \text{ ‘cut’} \), \( r \) belongs to the stem so it does not change when a negative suffix is added; but in Type A words such as \( n\text{iru}n\text{iranai} \text{ ‘wear’} \), \( r \) belongs to the non-past suffix, so when another suffix (e.g. the negative suffix \( -\text{nai} \)) replaces the non-past suffix, the \( r \) belonging to the non-past form disappears.
Now, although this analysis of non-past verb formation is capable of describing the facts, it raises several questions. First, why does Japanese need two suffixes -ru and -u for the same grammatical function? And second, if the choice between -ru and -u depends on the phonological shape of the stem (V-final vs. C-final), then should we not treat -ru and -u as phonologically conditioned variants of the same suffix? The latter question suggests the need for an alternative explanation for the patterns in (8), which we develop below.

5.2 An alternative analysis

Let us assume that Japanese indicates non-past in verbs using a single grammatical marker that has two phonological shapes, ru and u. Let us further assume that the lexical form of this marker contains only the vowel u, this vowel being the one property common to both ru and u. Our task is therefore to explain why r appears before u after certain verb stems. We propose that the non-past marker u actually has a CV structure, since a nucleus is always preceded by an onset position. This onset, which is a dependent of the nucleus, is lexically empty, i.e. it has no associated segmental material. In Type B verbs, however, it is filled by the final consonant of the stem:

(9) Type B: [ki.ru] ‘cut’ (ki.r + Øu)

This applies to all Type B verbs, no matter which consonant fills the empty onset (e.g. kiru ‘cut’, tasu ‘add’, tobu ‘fly’, jomu ‘read’, etc.) and no matter which vowel precedes this consonant (e.g. kiru ‘cut’, keru ‘kick’, karu ‘mow’, nuru ‘paint’, noru ‘get on’).

In Type A verbs, on the other hand, there is no stem-final consonant to fill the empty onset position. Instead of leaving the onset empty, however, which would create a V-V sequence of the sort that languages try to avoid (e.g. *ki.u ‘wear’, *mi.u ‘watch, see’), a coronal tap r appears in this position. The tap acts as a hiatus breaker, serving to maintain an alternating C-V pattern. The question is why the empty onset is filled by r rather than by some other consonant. To answer this, we must consider what kind of vowel can precede r in these cases. In fact, only two vowels are permitted stem-finally in Type A verbs, i (e.g. oriru ‘get off’, miru ‘watch, see’) and e (e.g. deru ‘go out’, tabe ‘eat’). As we noted in §2, the vowels i and e form a natural class in Japanese, these being the only vowels which contain the element III (i = III, e = III'). Because Element Theory uses the same elements in consonants and vowels, and because it also assumes that a single III element is interpreted as r in an onset position, it is unlikely to be a coincidence that r (i.e. non-nuclear III) is used to break up a V-V sequence when the first vowel is i or e (i.e. an III-vowel). Rather, we can interpret the appearance of r in this context as a phonological effect whereby III in the stem vowel ile is also interpreted in the following onset in order to serve as a hiatus breaker:
6. Conclusion

We have proposed an ‘insertion’ or ‘glide formation’ analysis of $r$ distribution in non-past verb forms. Of course, a deletion account of the facts is also possible, in which the non-past marker has the lexical form -ru: after a V-final (Type A) stem this marker would be pronounced as ru, and after a C-final (Type B) stem the tap would delete in order to avoid a C-C sequence (e.g. *tob-ru ‘fly’) and the suffix would be pronounced as wu. The disadvantage of this analysis, however, is that it fails to exploit the connection between the presence of $r$ and the context i/e where it appears. By contrast, the insertion account we have developed above demonstrates how $r$ and i/e are related not only in terms of their phonological structure but also in terms of distribution.

Notes

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1 Strictly speaking, I|I| represents an acoustic pattern in the speech signal — one which has two energy peaks with a characteristic energy dip in between. Language users then interpret this dip-shaped pattern either as coronality (in consonants) or as frontness (in vowels).

2 The I|I| element is also present in palatal consonants, i.e. it identifies a broader natural class comprising palatales and coronals. The coronal/palatal class is relevant to languages such as Korean and Fe?fe?-Bamileke, where coronals and palatalas behave in parallel (Backley, in prep). The two are distinguished by headedness: palatales have headed I|I| and coronals non-headed I|I|. Similarly, headedness distinguishes labials (with headed [U]) from velars (with non-headed [U]). See Backley and Nasukawa (2009).

3 The elision of $r$ in non-rhotic dialects of English receives a similar explanation. In these dialects $r$ is no longer pronounced in the weak contexts of pre-consonantal (e.g. fa(r)m) and pre-pausal (e.g. fa(r)). Again this is connected with $r$’s weakness, which results from its representation in English as the single-element expression |A| (Backley, in prep).

4 We assume that /j/ in /rja/, /rjo/ and /rju/ is syllabified in the nucleus rather than the onset in Japanese. The ill-formed */rji/ and */rje/ are attributed to *|I||I| in the same nucleus.

5 In loanwords, i and u are inserted after ts/dz and c/z respectively. i expresses the palatality (I|I|) of ts/dz, which is typically realised during the transition from the affricate to the following vowel — hence, in the release (fricative) phase of the affricate. By contrast,
palatality (II) in ɕ/z is present in the fricative itself, and does not need to extend into the vowel transition. As a result, we hear the default vowel u instead.

References