Phonetic vs. Phonological Control of Speech: Closed Syllable Vowel Shortening in Japanese Dialects

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Abstract

This paper discusses the relationship between phonetic and phonological control of speech by comparing the temporal patterns in two types of Japanese dialects: the mora-based phonological system of Standard Tokyo Japanese and the syllable-based system of Kagoshima Japanese. An acoustic study of Kagoshima Japanese reveals that mora-timing is not observed in this dialect. However, this dialect does not exhibit an effect of closed syllable vowel shortening either, which is observed in Korean and other so-called syllable languages. What is observed instead is vowel shortening in the syllable following a closed syllable: vowels following a closed syllable are noticeably shorter than those following an open syllable. Because of this vowel shortening, Kagoshima Japanese exhibits a tendency towards syllable-timing rather than mora-timing.

1. Introduction

In many languages including English and Korean, vowels in closed syllables tend to be shorter than those in open syllables (Maddieson 1985, Maekawa 1997, Lim 2000). In English, for example, the vowels in *feet* and *feed* are substantially shorter than the vowel in *fee*. Similar evidence has been reported for Korean and other languages (see Maddieson 1985 for relevant references). This tendency, known as 'closed syllable vowel shortening' (CSVS), is generally taken as evidence for a syllable-level effect of temporal compensation, or more generally, for syllable-level control of speech timing. However, CSVS is not observed in Standard Tokyo Japanese (Homma 1981). On the contrary, Tokyo Japanese exhibits an opposite tendency whereby vowels in closed syllables are as long as or longer than those in open syllables. For example, the first vowel in *am.ma* 'massage' is not shorter than the comparable vowel in *a.ma* 'priestess' (dots indicate syllable boundaries). This has been taken as evidence for a mora-based control of speech in Tokyo Japanese. Thus, the first vowel in the three-mora word *am.ma* is as long as the relevant vowel in the two-mora word *a.ma* to make the first word one and a half times as long as the second word (Port et al. 1987, Han 1994; see Warner and Arai 2000 for a review of mora and mora-timing in Tokyo Japanese). The vowel in closed syllables can be longer than those in open syllables in order to compensate for the relatively short duration of the second moraic consonant (moraic nasal in the word *am.ma*). This mora-based temporal patterning is entirely compatible with the fact that the phonological system of Tokyo Japanese is largely mora-based: it has mora-counting accentual rules and mora-counting rules of compensatory lengthening (McCawley 1968, Kubozono 1999).

This raises an interesting question concerning the relationship between phonetics and phonology: Is there always a correspondence between phonetic and phonological control of speech? This question can be tackled by comparing Tokyo Japanese with Kagoshima Japanese which, unlike Tokyo Japanese and many other dialects of the language, has a phonological system entirely based on the syllable rather than the mora: It has syllable-counting accentual rules and lacks the rule of mora-preserving compensatory lengthening.

If Kagoshima Japanese displays the same temporal pattern as English and Korean, this will hint a correlation between phonological and phonetic control of speech across dialects: dialects exhibiting a syllabic control in phonological patterning also display a syllabic control at the phonetic, temporal level, whereas those showing a moraic control in phonology also show a moraic control in phonetics. However, if Kagoshima Japanese is similar to Tokyo Japanese in temporal patterning, it will follow that temporal control does not necessarily go hand in hand with phonological control of speech, so that temporal control can be independent of phonological control.

With this question in mind, we conducted an acoustic experiment using three male native speakers of Kagoshima Japanese as subjects. In this paper, we will first sketch some phonological patterns of Kagoshima Japanese (section 2), and then report on the results obtained from this acoustic experiment (section 3). Section 4 discusses the experimental results by considering the relationship between phonological and phonetic patterning from cross-linguistic/dialectal viewpoints.

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2. Kagoshima Japanese

One of the most salient features of Kagoshima Japanese lies in the syllable-based nature of its prosodic system (Hirayama 1960, Kibe 1997, Kubozono 1999). This dialect permits only two accentual (or tonal) patterns, traditionally called A and B, no matter how long the word may be. The accent type A involves a pitch fall towards the end of the word, with only the penultimate syllable high-toned. The accent type B, on the other hand, does not involve a pitch fall and keeps only the final syllable high-toned. These two types are exemplified in (1) and (2), respectively. In these examples and in the rest of the paper, high-toned portions are capitalized and syllable boundaries are denoted by dots (.).

(1) ka.NA.da 'Canada', DOI.tu 'Germany', IN.do 'India', HA.wai 'Hawaii', in.do.ne.SI.a 'Indonesia', su.WEE.den 'Sweden'

(2) a.me.ri.KA 'America', i.gi.ri.SU 'England, Britain', hu.ran.SU 'France'

As is clear from (1) and (2), this dialect determines its accentual patterns entirely on the syllable rather than the mora. This nature is manifested in two distinct ways. This generalization does not hold in a mora-counting dialect like Tokyo Japanese. In Tokyo, the words in (1) are 'accented' basically on the antepenultimate mora, i.e. involves a pitch fall between the second and third moras from the end of the word. This is illustrated in (3).

(3) KA.na.da 'Canada', DOi.tu 'Germany', In.do 'India', HA.wai 'Hawaii', in.DO.NE.si.a 'Indonesia'

Kagoshima Japanese is not only a 'syllable-counting' dialect. The tone-bearing unit is also the syllable rather than the mora. Thus, penultimate syllables are high-toned in (1), whereas final syllables are high-toned in (2).

Another phenomenon demonstrating the syllable-based nature of Kagoshima Japanese is vowel coalescence by which a sequence of vowels turns into a monophthong. In modern Tokyo Japanese, this phenomenon is almost always accompanied by vowel lengthening, or 'compensatory lengthening', which is a phenomenon characteristic of mora-based language (Hayes 1989). Thus, vowel sequences in careful speech alternate with long monophthongs in casual speech, as in (4a), in order to keep the number of moras involved in the word. However, this concomitant lengthening does not occur in Kagoshima Japanese, where the number of syllables is kept constant. This pattern is illustrated in (4b), where dots indicate syllable boundaries (/dai.kon/ and /tai.gai/ mean 'a radish' and 'approximately', respectively.

(4) a. dai.kon–dee.kon, tai.gai—tee.gee

b. dai.kon—de.kon, tai.gai—te.ge

3. Experiment

3.1 Method

Three adult male speakers of Kagoshima Japanese (ranging from 67 to 41 in age) participated in this experiment. They were presented with a random list of the sentences in (5)-(10) and were asked to read the sentences in the list one by one for a total of eleven repetitions. Each test sentence contains a target word, which is underlined in (5)-(10). All the repetitions were recorded on a digital audio tape in a quiet room.

(5) a. kinoo kine o mita. 'Yesterday I saw a beetle'

b. kinoo kinne o mita. 'Yesterday I saw a fox.'

(6) a. otooto wa kogo o naratta. 'My brother learned old Japanese'.

b. otooto wa koggo o naratta. 'My brother learned Japanese'

(7) a. chitto kega itaka. 'Ifeel a pain with my hair.'

b. chitto kegga itaka 'I feel a pain with my buttocks'

(8) a.futoka kaga mieta. 'I saw a big mosquito'

b. futoka kagga mieta. 'I saw a big persimmon'

(9) a. sakki hega deta. 'I let out a fart little while ago'

b. sakki hegga deta. 'I saw a snake little while ago'

(10) a. unmaka dago o tsukutta 'I cooked a tasty dumpling'

b. unmaka dango o tsukutta 'I cooked a tasty dumpling'

All the repetitions except the first one were subsequently analyzed with respect to the duration of the target words. The target word in each token was then segmented into vowels and consonants according to the following criteria. First, vowel duration was measured from the starting point of voicing to its offset. Accordingly, the onset and offset of consonants were identified as the offset of voicing in the preceding vowel and the onset of voicing in the following vowel, respectively. Voice onset time is therefore included in the duration of the preceding consonant.

3.2 Results

Figure 1 summarizes the results of one speaker, HY, with the average durations of vowels and consonants for each of the six pairs of test words. Since the other two speakers showed basically the same pattern, we will focus in the rest of this paper on this particular speaker. Each bar in the figure displays the total duration of each test word in msec: the first two bars, for example, show the duration of /kine/ and /kinne/, respectively. Each bar is divided into four portions, C-V-C-V. The bars for the test words /dago/-/dango/ and /kogo/-/koggo/ include the duration of the following particle /o/, since this additional vowel could

not be acoustically separated from the final vowel /o/ of the preceding test words.

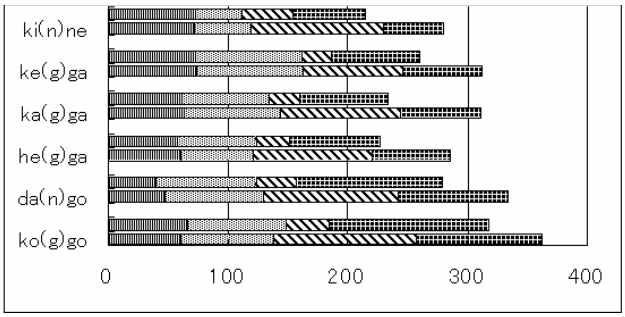

Figure 1: Average durations of the test words

This acoustic analysis has revealed several points of interest. First, geminate consonants are substantially longer than single consonants. For example, the nasal portion of /kinne/ is 110 msec long on average, whereas the corresponding portion of /kine/ is only 43 msec long. Similarly, the geminate obstruent of /koggo/ has the average duration of 118 msec, which is much longer than the single obstruent of /kogo/ (36 msec). The differences between single and geminate consonants are not as large as those observed in Tokyo Japanese, but can be readily heard by its native speakers.

A second noteworthy point is that there is no clear-cut tendency towards mora-timing despite the substantial durational difference between geminate and single consonants. As mentioned in the preceding section, Tokyo Japanese exhibits a temporal pattern by which words get phonetically longer in proportion to the number of moras they involve. For example, the word /kinne/ is three moras long and is hence 1.5 times longer than the bimoraic word /kine/ in Tokyo Japanese (see Port et al. 1987 and Han 1994 for details). This mora-timed pattern is not observed in Figure 1. In this figure, /kinne/, which has the average duration of 280 msec, is only 1.3 times as long as its bimoraic counterpart /kine/ (215 msec). Similarly, the four-mora phrase /koggo-o/ is 363 msec long and is only 1.15 times as long as the three-mora phrase /kogo-o/ (317 msec). This contrasts sharply with the fact that four-mora words are at least 1.3 times as long as three-mora words in Tokyo Japanese. This suggests that word and phrases in Kagoshima Japanese get longer as they involve a larger number of moras but not in precise proportion to the number of moras involved. Kagoshima Japanese is hence not a mora-timed language—not at least in the sense that Tokyo Japanese is mora-timed.

Here, we are faced with a peculiar situation of Kagoshima Japanese where geminate consonants are substantially longer than single consonants but words containing geminate consonants are not as long as they would be expected in a mora language like Tokyo Japanese. This may hint that temporal compensation occurs between the consonant and its preceding vowel so that the longer duration of geminate consonants is compensated for by the shorter duration of their preceding vowel. This compensation effect, or the process of closed syllable vowel shortening, is not observed in Kagoshima Japanese, however. In fact, the vowels in closed syllables are not phonetically shorter than those in open syllables. This can be seen from Figure 1, where the first vowel of the word /kinne/, for example, is slightly longer than the corresponding vowel of its counterpart /kine/ (47 msec vs. 38 msec).

Why then are words containing a closed syllable not as long in Kagoshima Japanese as they would be in Tokyo Japanese? This can be answered by comparing the duration of the vowels in the following syllable. Namely, vowels following a closed syllable are considerably shorter than those that follow an open syllable in Kagoshima Japanese. In Figure 1, for example, the final vowel of /kinne/ is 50 msec long and is 10 msec shorter than the corresponding vowel of /kine/. Likewise, the final vowel of the phrase /koggoo/ is 27 msec shorter than the final vowel of /kogoo/ on average: 105 msec vs. 132 msec. This vowel shortening effect, which we are tempted to call 'post-CS (closed syllable) vowel shortening', compensates for the presence of a coda consonant in words/phrases like /kinne/ and /koggoo/. This progressive compensation effect is observed in Tokyo Japanese, too (Han 1994), but not to the same extent as Kagoshima Japanese. In Kagoshima, this vowel shortening occurs to such an extent that word duration does not increase in precise proportion to the number of moras contained (see Maekawa 1984 for similar evidence in Akita Japanese).

3.3 Discussion

The results discussed so far suggest that Kagoshima Japanese is different from both Tokyo Japanese and Korean in temporal control. It does not exhibit a mora-timing effect that is observed in Tokyo Japanese, but it does not display an effect of closed syllable vowel shortening either, which would be observed in syllable-based languages. What we have observed in Kagoshima Japanese instead is a trading relationship between consonant duration and the duration of the following vowel (rather than that of the preceding vowel).

This is suggestive of a difference between phonological and phonetic organization of syllables. In phonology, geminate consonants are divided into two parts, with a syllable boundary in between: e.g. /kin.ne/, /kog.go/. This syllabification is motivated and urged by the fact that geminate consonants do not occur word-initially in Japanese in general. However, the temporal patterning that we have observed above suggests that geminate consonants form a syllable with the following vowel. /kinne/ and /koggo/, for example, behave as if they were syllabified as /ki.nne/ and /ko.ggo/.

This basically applies to closed syllables not involving a geminate consonant, too. The word /dango/, for example, is usually syllabified as /dan.go/ since /ng/ is not a legal word-initial consonant cluster in Japanese. At the phonetic level, however, this word exhibits a compensation effect between the word-medial consonant cluster and the

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following vowel: its final vowel is substantially (30 msec) shorter than the final vowel of the word /dago/. In other words, the presence of a 'coda' consonant makes the vowel of the following syllable shorter. This peculiar compensation effect can be understood properly if we assume that /dango/ is phonetically syllabified as /da.ngo/ rather than /dan.go/. Namely, the word-medial consonant cluster behaves in a temporal patterning as if they belonged to the following syllable.

If this interpretation is correct, it follows that Kagoshima Japanese has a different phonetic organization of the syllable from Korean and other languages. In Korean and other languages, vowels in closed syllables are substantially shorter than those in open syllables. This phonetic fact suggests that /CVCCV/ is phonetically syllabified as /CVC.CV/ with a syllable boundary *within* the geminate consonant or consonant cluster. In this sense, the phonetic syllabification is identical to the phonological syllabification in these languages. In Kagoshima Japanese, in contrast, the two types of syllabification—phonetic and phonological—are different from each other in that /CVCCV/ is syllabified as /CV.CCV/ phonetically but as /CVC.CV/ phonologically.

4. Conclusion

In this paper we have reported the results of an acoustic analysis of Kagoshima Japanese, a 'syllable dialect' whose phonological patterns are regulated by the syllable rather than the mora. Unlike Tokyo Japanese, this dialect does not display a noticeable tendency towards mora timing. Moreover, it is different from Korean and other syllable-based languages in showing no effect of vowel shortening in closed syllables. Instead, Kagoshima Japanese demonstrates a vowel shortening effect in syllables following a closed syllable: vowels following a closed syllable are phonetically shorter than those following an open syllable. This post-CS vowel shortening accounts for the absence of mora-timing on the one hand, and for the tendency towards syllable-timing, on the other.

The existence of this post-CS vowel shortening in Kagoshima Japanese has two implications regarding the relationship between phonetics and phonology. One of them is that phonetic control of speech goes hand in hand with phonological control. Kagoshima Japanese has a syllable-based phonological system and seems to make a temporal control on the basis of the syllable rather than the mora. Tokyo Japanese, on the other hand, relies on the mora both in phonological and phonetic patterning.

A second implication is that phonetic organization of the syllable can be different from its phonological organization. The temporal patterning of Kagoshima Japanese suggests that geminate consonants and consonant clusters belong to the following syllable phonetically although they split into two syllables phonologically. Thus, in Kagoshima Japanese, /CVCCV/ shows the syllabification pattern of /CV.CCV/ in temporal control, while demonstrating the pattern of /CVC.CV/ in phonological control.

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