Onset *Cy* clusters in Japanese: Evidence from vowel devoicing

Japanese has contrasts between onsets romanized as singletons and *Cy* clusters (e.g., *kaku* 'nucleus' vs. *kyaku* 'guest', *ponpon* 'tum-tum' vs. *pyonpyon* 'hop-hop'). It is uncertain whether *Cy* should be treated as a distinctively palatalized consonant or as a /Cy/ cluster; the phonetic realization is compatible with either analysis. In *kyaku* [kʲjakɯ], the [j] between [kʲ] and [a] can be interpreted either as a realization of a separate segment /y/ or as just a transition from palatalized /kʲ/ to the following vowel. A distributional argument in favor of the /Cy/ analysis notes the neutralization of the contrast before front vowels: *Ci*, *Ce*, **Cyi*, **Cye*. On the cluster analysis, the absence of */Cyi/ and */Cye/ follows automatically from the phonotactic inadmissibility of */yi/ and */ye/ (Vance and Matsugu 2008).

High vowel devoicing is a source of phonetic evidence that might bear on this question of phonemic analysis. In Tokyo Japanese, a short high vowel surrounded by voiceless consonants typically devoices (Tsuchida 1997). If the initial and final *C* in *CyuC* both represent voiceless consonants, a reasonable expectation would be that voiceless /Cʲ/ would promote devoicing, whereas the voiced /y/ in /Cy/ would inhibit it. Of course, since Japanese has no /Cʲ/ vs. /Cy/ contrast, there is no impediment to realizing a phonemic /Cy/ cluster postlexically as a palatalized consonant [Cʲ]. Thus, since vowel devoicing is also a postlexical process (Hirayama 2009), equal devoicing rates for *CuC* and *CyuC* can be taken as consistent with either /CyuC/ or /CʲuC/. However, a lower devoicing rate for *CyuC* than for *CuC* is consistent with /CyuC/ but hard to reconcile with /CʲuC/. This paper reports an experiment that tests the hypothesis that the two devoicing rates are different. The results favor /CyuC/ over /CʲuC/.

The test words included two onset types (*C* vs. *Cy*), three places of articulation (*p, t, k*) for both *C* and *Cy*, and two vowels (*i*, *u*, with *i* for the plain onset only), followed by *ta*. The syllable *ma* either preceded or followed *C*(*y*)*Vta* (e.g., *mapyuta*, *kyutama*, *mahuta*, *hitama*). To get a baseline, words with non-devoicing environments were also recorded; these words contained the same sequences as above but had *da* instead of *ta* (e.g., *mapyuda*). The recorded words were almost all nonsense words, due to the sparse occurrence of relevant forms in the existing vocabulary, but we included two actual words (*kyupura*, *rapyuta*) along with their *Ci* and *Cu* counterparts (e.g., *kipura, raputa*). Words were put in a carrier phrase and read by 14 speakers (10 from Kansai (Kyoto/Osaka) and 4 from Tokyo) 8 times. The accent was put on the first syllable. After removing 15 mispronunciations, 4,689 tokens were left for analysis.

Overall, of the 2,681 test words (those with devoicing environments), 38% were devoiced (vs. 0.2% for those with non-devoicing environments). The breakdown according to onset type (*C* vs. *Cy*) is remarkable: after *C* (N=1,786), 44% of the devoiceable vowels were devoiced, whereas after *Cy* (N=895), 25% were devoiced.

In order to determine whether this difference is significant, a mixed-effects logistic regression analysis was performed with R (ver. 3.1.1) and the *lme4* package. Onset type, speaker region, vowel position, target vowel (*i* vs. *u*), and preceding and following consonants were entered into the model as predictors, and speaker and item were entered as random intercepts and slopes (for the onset type). There was no interaction found from the distributional analysis; vowels after *Cy* were always less frequently devoiced than those after *C* in each level of the factors. Table 1 shows that after controlling for other factors, the onset type has a significant effect on the devoicing rate: vowels after *Cy* onsets are less likely to devoice than those after *C* onsets. Since speaker region also has a significant effect, in the direction expected in the literature (Tokyo speakers devoice more (79%) than Kansai speakers (21%)), we performed mixed-effects logistic regression analyses for the two groups separately and found the same onset-type effect in both groups, as shown in Tables 2 and 3.

The results support the /Cy/ cluster analysis over the palatalized /Cʲ/ analysis for the Japanese onsets of the type in question.

Table 1 Results of a mixed-effects logistic regression analysis: all speakers together (Devoicing ~ onset + speakerRegion + vowel position + vowel + precedingConsonant + followingConsonant + (1+onset|speaker) + (1+onset|item), data = HVD.vls, family = binomial, control=glmerControl(optimizer="bobyqa", optCtrl=list(maxfun=2e5)))

Factor	β-coefficient	z	p
Intercept	-5.0281	-5.697	1.22e-08 ***
Onset: *Cy* (vs. *C*)	-1.4734	-3.985	6.76e-05 ***
Speaker region: Tokyo (vs. Kansai)	5.3360	4.568	4.93e-06 ***
Vowel position: second (vs. first)	0.9853	3.767	0.000165 ***
Vowel: *u* (vs. *i*)	-1.0454	-2.413	0.015801 *
Preceding consonant: *k* (vs. *h*)	1.0862	3.736	0.000187 ***
Preceding consonant: *p* (vs. *h*)	-0.1202	-0.431	0.666338
Following consonant: *t* (vs. *p*)	3.2545	6.783	1.18e-11 ***

Table 2 Results of a mixed-effects logistic regression analysis: Tokyo speakers only

Factor	β-coefficient	z	p
Intercept	-0.6627	-0.473	0.6363
Onset: *Cy* (vs. *C*)	-2.1406	-2.322	0.0202 *
Vowel position: second (vs. first)	5.3717	7.041	1.90e-12 ***
Vowel: *u* (vs. *i*)	-0.7692	-1.541	0.1233
Preceding consonant: *k* (vs. *h*)	0.9959	1.899	0.0576
Preceding consonant: *p* (vs. *h*)	-0.3591	-0.774	0.4387
Following consonant: *t* (vs. *p*)	3.2565	5.152	2.58e-07 ***

Table 3 Results of a mixed-effects logistic regression analysis: Kansai speakers only

Factor	β-coefficient	z	p
Intercept	-4.3497	-4.938	7.89e-07 ***
Onset: *Cy* (vs. *C*)	-1.5296	-3.639	0.000274 ***
Vowel position: second (vs. first)	-0.6224	-1.941	0.052241
Vowel: *u* (vs. *i*)	-1.1268	-3.597	0.000321 ***
Preceding consonant: *k* (vs. *h*)	1.3190	3.980	6.90e-05 ***
Preceding consonant: *p* (vs. *h*)	-0.3244	-0.991	0.321803
Following consonant: *t* (vs. *p*)	3.5563	6.780	1.21e-11 ***

References

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