LEXICAL KNOWLEDGE DRIVES THE STEPWISE CONVERGENCE OF CONCATENATION-INDUCED OBSTRUENT VOICING

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Abstract

The present study tried to construct a model of concatenation-induced obstruent voicing in Japanese.[1] Total 682 participants answered whether or not voiceless obstruents at the onset of the final morpheme of nominal compounds would be voiced. Their responses to 276 kinds of two-element-compounding words in total showed that the degrees of voicing in the provisional words and pseudo-words significantly corresponded to those in the real words. Those tendencies show, first, that the central schema of the voicing phenomenon on nouns was employed; second, that meta-knowledge about the final morphemes was applied; third, that phonological properties inside the final morphemes emerged; fourth, that phonological interaction over the morpheme boundary operated; fifth, that psychological intention and sociolinguistic function emphasized the individuality of constituent morphemes. In particular, /h/ received a high degree of post-nasal voicing at the stage of interaction across the boundary because of the stable adhesive articulatory position between /N/-turned-to-/m/ and /h/-turned-to-/b/. Those multi-staged mechanism of voicing suggests the importance of lexical knowledge, phonological systems, psychological representation, and sociolinguistic functions in learning Japanese.

1 Introduction to the obstruent voicing phenomenon in Japanese

For those learning Japanese, consonant alternation is challenging. In Japanese, when two elements are concatenated into one compound, the first consonant of the final morpheme, if a voiceless obstruent, for example /k/ as in *kuri* 'chestnut (tree),' can alter to its voiced counterpart, /g/ in *yamaguri* 'wild chestnut (tree).' This sound alternation system is called *rendaku* in Japanese (Itō & Mester, 1995; Vance, 1987, 2015), and has gotten much attention among many linguists and teachers. For example, a popular family name *Kurihara* consists of two morphemes, *kuri* and *hara* 'field, plain.' Another popular surname *Matsubara* comprises *matsu* 'pine tree' and *hara*, and likewise, *Fujiwara* is composed of *fuji* 'wisteria' and *hara.* In fact, the onset of the final morpheme /h/ can remain /h/, or can change to /b/, /w/, /p/, or other phones.

With great effort, linguists have pursued the sound system semantically, morphologically, and phonologically, but have found only a couple of voiceless patterns and some statistical

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tendencies for voicing. Perhaps even today, many teachers of Japanese hold the idea that students should learn the sound of a compound word case by case. Therefore, the teachers of Japanese would like to know what kind of linguistic operations work in the concatenation-induced obstruent voicing, or abbreviated henceforth CIOV, and how to teach such an intricate sound system to their students.

2 Real life data collection

First, the present study collected the data for nominal compounds used in everyday life. Such data were dictionary entries and terms in the encyclopedias, excluding proper nouns (Asai & Ohno, 2018; Kato, 1988; Matsumura, 2006; Shinmura, 2008; Yamada et al., 2012). Place names were extracted from the database of the Japan Post. The sound forms of surnames referred to Zamma and Asai (2017). Table 1 shows the ratios of voicing at the final morpheme onsets of some representative real nouns which appeared in the phonological conditions of the present study.[2] The left-hand column labeled with a /u/ in each noun category shows the ratios of voicing at the onset of final elements when the consonants follow vowels, for example /kai+duka/ 'kitchen midden' consisting of /kai/ 'seashell' and /tuka/ 'mound.'[3] The labels /u/([ŋ]) and /N/ show the ratios of voicing when the final morpheme onsets followed velar-nasal-originated vowels and the uvular nasal phoneme, respectively, in other words for post-nasal voicing in the broad sense and in the narrow sense. Those three conditions are stated with CVV, CVV([ŋ]), and CVN structures, respectively.[4] The final morphemes were bi-moraic nouns in the native lexical stratum because those properties are fundamental and productive (Nomura, 1977; Zamma & Asai, 2017).

Table 1. Ratios of voicing in real compound nouns

Final element	Common noun			Place name			Surname		
	/u/	/u/([ŋ])	/N/	/u/	/u/([ŋ])	/N/	/u/	/u/([ŋ])	/N/
/tuka/ ('mound')	0.98	1.0	1.0	0.71	0.86	0.83	0.65	0.9	0.8
/saka/ ('slope')	0.49	0.0	1.0	0.39	0.59	1.00	0.07	0.07	0.41
/kuti/ ('mouth')	0.66	1.00	0.89	0.83	0.91	1.0	0.98	1.0	1.00
/hata/ ('field, garden')	0.38	1.0	0.5	0.39	0.44	0.85	0.14	0.29	0.88
/hasi/ ('bridge')	0.56	1.0	1.0	0.57	1.0	1.00	0.20	0.56	1.00
/hori/ ('trench, moat')	1.0	1.0	1.0	0.69	0.7	1.0	0.51	0.9	1.0

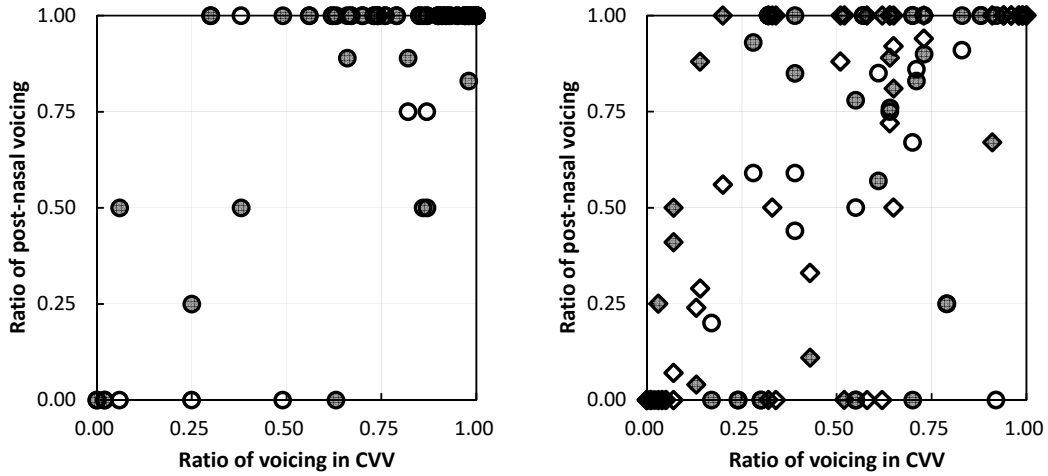
On the whole, the initial consonant of those highly productive morphemes likely received voicing when following the phonemes with nasality. The varieties in the ratios of voicing in terms of individual morphemes and genres, such as place names, family names, first names, and product names, are discussed in Asai and Ohno (2018), who point out the psychological and sociolinguistic factors in word formation.

[2] Those nouns excluded the case whereby a genitive particle was inserted between a final morpheme and its preceding element and one in which the final morpheme was transformed from a verb or an adjective, but included the voiceless case that the final morpheme onset received gemination. The values with only one decimal place indicate low precision because the number of applicable data was less than ten.

[3] The + mark shows a morpheme boundary.

[4] C, V, and N are abbreviated notations for consonant, vowel, and the uvular nasal, respectively.

Figures 1 (a)(b) show the data for real compound nouns which have 41 and 34 kinds of final morphemes for common nouns and proper nouns, respectively. The open and closed circles indicate the ratios of voicing in the phonological conditions CVV([ŋ]) and CVN, respectively, as a function of the ratio of voicing in the condition CVV. If nasality immediately before the morpheme boundary has no effect on voicing, the plots are placed on the line of direct proportion from the bottom-left origin to the top right in the figure. The plots of real nouns tend to take positions toward the top left. This means that the initial consonant of those relatively productive morphemes likely received voicing when following nasality.



(a) Common nouns (b) Proper nouns[5]

Fig. 1. Ratios of voicing in real nouns in noun categories
(Closed circles & diamonds: CVN; open circles & diamonds: CVV([ŋ]))

3 Recognition survey

3.1 Judgment survey design

In order to obtain the likelihood of CIOV, the present study set specific phonological conditions for both the first elements and the final ones. Table 2 lists the twelve kinds of initial morphemes, all of which are represented by different *Kanji* characters. English glosses are noted in single quotation marks in parentheses. The left-hand column titled 'u' lists the CVV-structured initial morphemes. Next, the central column shows the CVV([ŋ])-structured initial morphemes, whose final vowels were originally [ŋ] when it came from Chinese. The right-hand column titled 'N' shows the CVN-structured morphemes.

Table 3 lists the 26 kinds of final elements, and seven out of them have *Ps notations, which mean that those phonemic patterns have the pseudo-morphemes tentatively represented in virtual *Kanji* characters. The vowel was /a/ because of its basic properties (Maddieson, 1997). Each final morpheme was concatenated with an initial morpheme to become a compound. An example of compounds is /taN+tama/ 'one ball or single bead.' The participants looked at the two readings, in this case /taN+tama/ and /taN+dama/, printed on paper in *Hiragana*

[5] The diamonds and circles show place names and surnames, respectively.

phonograms along the *Kanji* characters, and judged which of the two sounds would be appropriate on the basis of a 4-point Likert scale.[6]

Table 2. First morphemes

Final phoneme		
/u/	/u/([ŋ])	/N/
/tou/ (‘bean, small’)	/tou/ (‘unify, whole’)	/taN/ (‘single, one’)
/tou/ (‘answer, reply’)	/tou/ (‘hit, just’)	/taN/ (‘red, careful’)
/kou/ (‘think, concept’)	/kou/ (‘lucky, fortune’)	/kaN/ (‘perfect, complete’)
/kou/ (‘instep, shell’)	/kou/ (‘smell, scent’)	/kaN/ (‘official, public’)

Table 3. Final morphemes and ratios of CIOV

Final morpheme				Provisional compound real final morpheme			Pseudo compound pseudo final morpheme		
1st consonant	2nd	reading (English gross)		/u/	/u/([ŋ])	/N/	/u/	/u/([ŋ])	/N/
/t/	/m/	/tama/ (‘ball, bead’)	*Ps	0.70	0.70	0.66	0.61	0.61	0.57
	/n/	/tana/ (‘shelf, rack’)	*Ps	0.80	0.78	0.81	0.73	0.73	0.81
	/r/	/tara/ (‘codfish’)	*Ps	0.74	0.76	0.71	0.71	0.72	0.68
/k/	/m/	/kama/ (‘pot, kettle’)	*Ps	0.74	0.69	0.76	0.60	0.62	0.69
		/kama/ (‘sickle’)		0.73	0.61	0.65			
	/w/	/kawa/ (‘river’)		0.57	0.59	0.68			
		/kawa/ (‘skin’)		0.56	0.55	0.67			
	/t/	/kata/ (‘shape, form’)		0.70	0.71	0.75			
		/kata/ (‘type, model’)		0.82	0.77	0.83			
		/kata/ (‘side, style’)		0.59	0.54	0.67			
		/kata/ (‘shoulder’)		0.48	0.49	0.58			
		/kata/ (‘wetland’)		0.76	0.77	0.77			
	/n/	/kana/	*Ps				0.59	0.57	0.60
	/r/	/kara/ (‘shell, hull’)	*Ps	0.68	0.68	0.67	0.62	0.63	0.63
	/y/	/kaya/ (‘cogon grass’)		0.65	0.64	0.69			
/h/	/m/	/hama/ (‘beach’)	*Ps	0.37	0.35	0.36	0.45	0.48	0.44
	/w/	/hawa/	*Ps				0.65	0.69	0.68
	/n/	/hana/ (‘flower’)		0.64	0.64	0.82			
		/hana/ (‘nose’)		0.72	0.71	0.77			
		/hana/ (‘brilliance’)		0.64	0.68	0.80			
		/hana/ (‘edge’)		0.72	0.64	0.74			
	/t/	/hata/ (‘field, garden’)		0.47	0.49	0.69			
		/hata/ (‘flag’)		0.52	0.46	0.65			
		/hata/ (‘loom’)		0.63	0.59	0.69			
	/r/	/hara/ (‘field, plain’)	*Ps	0.51	0.51	0.74	0.68	0.66	0.73
		/hara/ (‘belly, middle’)		0.63	0.65	0.77			

[6] The scaling had no central point, but the degrees were instructed orally and literally with real-word examples.

3.2 Judgment survey results

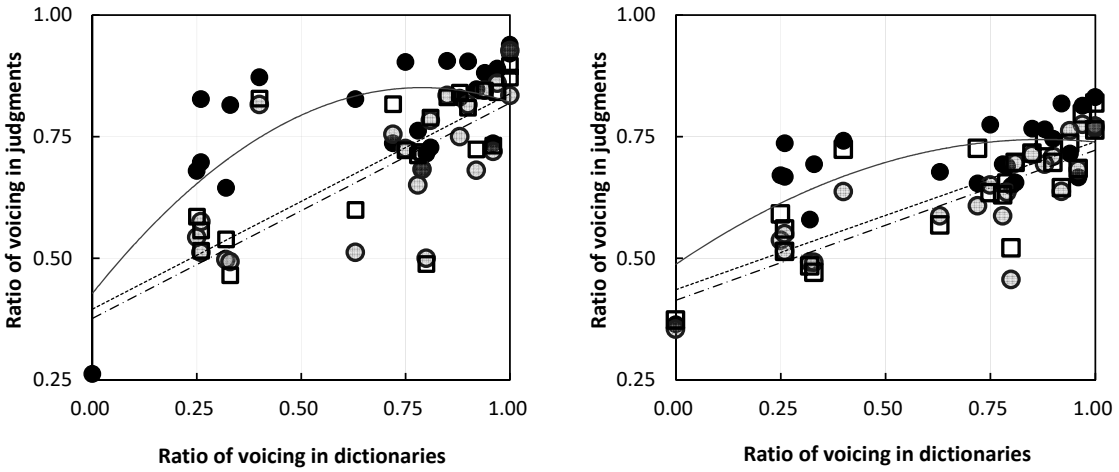
The ratios of CIOV obtained from the 640 participants' effective answers[7] are included in Table 3. Certainly, fluctuations containing statistical errors occurred; however, broadly, the ratios of voicing in the CVN condition were high, and those in the CVV condition were low. The correlation coefficient between the provisional compounds and pseudo-compounds was .72**, and those results have been thought to agree with the speakers' cognition (Asai, 2016). The dark cells are inapplicable conditions.

4 Discussions

4.1 Provisional word cognition

On the whole, the recognition by speakers for voicing was correlated with the real word use in the society, in this case, dictionary entries. The correlation coefficients between the judgment results and the dictionary data were .80*** for CVV, .82*** for CVV([ŋ]), and .65** for CVN, respectively. Also, the differences in voicing among homonyms were confirmed. In fact, that final elements are substantial, and their sound forms are internalized in the speakers' mental lexicon (e.g. Aitchison, 2003; Foster, 1976).

Figure 2 (a) shows the judgment scores calculated with the bifurcated scaling of whether the target phonemes are voiceless or voiced in the provisional words. Panel (b) shows the data obtained on the equal-interval four-point Likert scaling. Some real morphemes are asymptotically saturated to a high or low ratio of voicing. For a new compound whose final element is a productive morpheme, the ratio of voicing will unlikely converge into a high or low value (Asai & Ohno, 2018; Zamma & Asai, 2015). Thus, post-nasal voicing tends to arise in certain morphemes with a relatively low or mid degree of voicing.



(a) Bifurcated measurement (b) Four-scaled measurement

Fig. 2. Ratios of voicing in phonotactic conditions

(Closed circles & bold curve: CVN; dark circles & dotted line: CVV([ŋ]); open squares & broken line: CVV)

[7] Among 682 participants who were all L1 speakers of Japanese at four universities, the data of 42 students were eliminated because of the partial lacks of their answers.

4.2 Pseudo word cognition

From the results listed in Table 4, the ratios of voicing in pseudo-compounds showed roughly around .7, which agrees with the average ratio of CIOV in overall nouns. The ratios of voicing on /tana/ were high, and those on /hama/ were low. Those tendencies among final morphemes agree with the distributions of ratios of voicing in real nouns. Those pseudo- morphemes were stated with virtual, non-sense characters, and, therefore, the sound forms themselves are internalized in the speakers' mental lexicon.

4.3 Phonological accounts

The ratios of voicing could be high in the condition following nasality largely on some morphemes of /hata/, /hana/, and /hara/ in provisional words and slightly on /tama/, /kama/, and /hara/ in pseudo-words. The uvular nasal [N] shifts to a nasal at each place of articulation, [n], [ŋ], [ɲ], or [m], and that place assimilation due to morpheme concatenation enhances the voicing over morpheme boundary, [n+d], [ŋ+g], [ɲ+ʤ], and especially [m+b] at a restrictive small degree of freedom in articulation. On the other hand, the ratios of voicing were low on /hama/ in order to avoid the consecutive moras whose consonants have the identical bilabial place of articulation.

4.4 Psychological interpretations

When speakers meet an unknown word, they will first take a holistic view in lexical cognition. If a newly encountered word is a nominal compound, a speaker of the language will apply an average ratio of CIOV on noun category, which is about .7. Then, the speaker will apply the meta-knowledge of CIOV on the final morpheme that she/he already knows. For example, *kuri* highly likely receives CIOV, and then general speakers conceive of the /you+guri/ sound for the concatenation of /you/ 'western world' and /kuri/ 'chestnut.' Speakers learn what phonetic or inflectional forms are required (Bybee & Slobin, 1982; Marcus et al., 1992), and develop their vocabulary at their own pace and in particular fields. That orientation emerged in the voicing ratios from .2 to .9 in the bifurcated format as shown in Figure 2 (a).[8]

Proper nouns may have separate semantic properties from common nouns for general objects, and compounding may involve semantic compression according to the thoughts by Sigmund Freud (Tzvetan, 1977). In terms of the names of river bridges or some names for food and beverage products, the voiced forms of obstruents are avoided these days. One reason for such tendencies might be a preference for purity in the semantic image of the objects.

4.5 Sociolinguistic factors

Another reason for the voiceless tendency mentioned above might be a regard for high comprehension of the meaning of each element, such as /futa+ko+hasi/ 'twin bridge,' in spite of the orally established form /futa+go+basi/. The /maki+susi/ 'rolled sushi' sound is frequently observed today rather than the traditional form /maki+zusi/. These unchanged sounds are beneficial to people who are not familiar with the products or are not fluent in Japanese.

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[8] In the measurement format of the present study, the respondents likely avoided choosing either end of the options due to the centering effect in addition to their knowledge that many final morphemes basically receive CIOV.

4.6 CIOV mechanism

Lexicology, morphology, phonology, psychology and sociology behave differently in CIOV, but those factors have been expected to be succinctly interpreted, for instance, on one dimension (Prince & Smolensky, 2004), two dimensions (Chalmers, 2004; Stalnaker, 2004), or two facets (Kripke, 1980). The present study, therefore, summarizes the mechanism of CIOV as the stepwise convergence of voicing as described in Figure 3 so that the educators can explain the phenomena: first, a central schema of the CIOV phenomenon specifically on nouns; second, meta-knowledge about the final morphemes; third, phonological properties inside the final morphemes; fourth, phonological interaction over the morpheme boundary; fifth, psychological intention and sociolinguistic function, resulting in keeping the original sounds of morphemes.

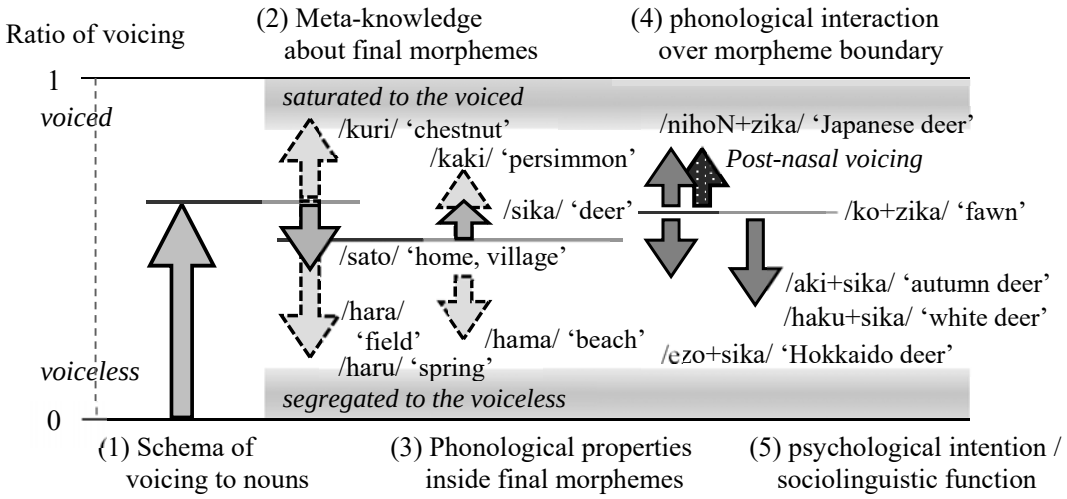

Fig. 3. Stepwise convergence of CIOV

5 Pedagogical implications

Teachers of Japanese can refer to that mechanism of voicing, and may prioritize the reasons for sound changes at word formation. Vocabulary building takes time, and simple repetition of exercises may not effectively answer the learners' questions or relieve their anxieties. The teachers can suggest the importance of not only lexical knowledge, but also phonological systems, psychological representation, and sociolinguistic functions in learning Japanese.

6 Conclusion

The present study has presented one phonological pattern establishing that post-nasal voicing applies to some morphemes particularly starting in /h/ at a relatively low or mid degree of voicing, and has tried to explain not only the contribution of the lexicon in use to the speakers' phonological cognition, but also its predictability to new words. Educators can use those interpretations to what words likely receive the voicing depending on the final morphemes, how phonological properties operate, and how psychological and sociolinguistic factors are reflected in the Japanese sounds.

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