# Aggressive Reduplication in Japanese high vowel devoicing

**Introduction**. In this study, I investigate the phonological factors that contribute to the variation in Japanese high vowel devoicing. High vowel devoicing, whereby high vowels lose their voicing between voiceless consonants, has often been considered to be a phonetic process; it has been claimed that this process occurs because voicing of high vowels fails to be achieved due to an overlap of the glottal opening gestures of the surrounding voiceless consonants (Jun et al. 1998). Such an account assumes that the application of high vowel devoicing is solely conditioned by the articulatory characteristics of the surrounding consonants and the target high vowel, along with their temporal organization. As such, it predicts that Japanese high vowel devoicing will be insensitive to the phonological structure of Japanese. Contrary to this prediction, the current study shows that phonological similarity between adjacent syllables plays an important role in the application of high vowel devoicing.

**Data.** Using a large-scale dataset from a Japanese speech corpus (Corpus of Spontaneous Japanese; Maekawa et al. 2000), I report the following phonological tendencies that affect the rate of high vowel devoicing, which are shown to be statistically significant:
(i) *Matching [+cont] condition*: <u>Devoicing is suppressed if the target vowel is preceded by a fricative or affricate and followed by a fricative.</u> (Devoicing rates: No matching [+cont] 98% vs. Matching [+cont] 77%), (ii) *Matching [+high] condition*: <u>In the matching [+cont] condition, devoicing is even more suppressed if the syllable following the target vowel contains another high vowel.</u> (Devoicing rates: Matching [+cont] & no matching [+high] 84% vs. Matching [+cont] & [+high] 71%), (iii) *Avoidance of consecutive devoicing*: <u>In the environment where the devoicing context occurs consecutively, devoicing of two vowels in adjacent syllables tends to be avoided.</u>

The matching [+cont] and [+high] conditions can be restated by making reference to the syllable structure. /CVCV/ sequences, where $V_1$ is a target high vowel and $C_1$ and $C_2$ are voiceless consonants, are parsed into $[C_1V_1]_{\sigma 1}[C_2V_2]_{\sigma 2}$ in Japanese. Given this, it can be said that devoicing is suppressed if the onsets of the adjacent syllables (i.e., $C_1$ and $C_2$) match in [+cont] (e.g., ***suso*** 'hem'). Affricates show a positional behavior, patterning with fricatives in $C_1$ as [+cont], and with stops in $C_2$ as [−cont]. In addition to the matching [+cont] condition, devoicing is further suppressed if the height of the nuclei (i.e., $V_1$ and $V_2$) agrees in [+high] (e.g., ***susi*** 'sushi'). This additive effect of the matching [+high] condition to the matching [+cont] condition suggests that devoicing rates decrease as the degree of similarity between two adjacent syllables increases.

**Analysis.** I give a formal analysis of the observed tendencies within the framework of Optimality Theory (Prince and Smolensky 1993). First, I claim that devoicing is triggered by a markedness constraint, DEVOICE, which bans a voiced short high vowel between voiceless consonants. Devoicing will occur when DEVOICE outranks a faithfulness constraint, IO-ID(vce). Additionally, I propose an OCP-type constraint for voiceless vowels, OCP-V̥ ("No voiceless vowels in adjacent syllables"), to account for the tendency of consecutive vowel devoicing to be avoided.

Further, I claim that the similarity effects described above arise due to an effort to preserve the voicing identity between the vowels in adjacent, self-similar syllables. To formalize this claim, I provide an analysis adopting Zuraw's (2002) Aggressive Reduplication. Based on McCarthy and Prince's (1995) claim that reduplicative identity effects are driven by correspondence between a base and reduplicant, Aggressive Reduplication accounts for word-internal similarity effects by introducing a constraint, REDUP, that requires word-internal substrings to stand in correspondence, and correspondence constraints ($\kappa\kappa$-CORR) that prevent any disruption of similarity between the correspondent substrings. Under this account, the similarity effects in high vowel devoicing are explained by the effect of a correspondence constraint (i.e., $\kappa\kappa$-ID(vce)) operating between adjacent syllables, which disprefer a mismatch of [voice] between the correspondent vowels when the target vowel devoices. For instance, given the ranking of OCP-V̥ ≫ κκ-Id(vce), Redup ≫ Devoice ≫ IO-Id(vce) (Tableau 1), devoicing will be blocked due to the correspondence between adjacent syllables, a situation parallel to underapplication of a phonological process in morphological reduplication (McCarthy and Prince 1995).

Crucially, non-devoicing in self-similar syllables is derived by rankings of other κκ-Corr constraints over Redup, where correspondence structure is only posited in self-similar syllables. For example, if κκ-Id(cont) outranks Redup, devoicing is only blocked when adjacent syllables match in [±cont] (Tableau 2). Similarly, if both κκ-Id(cont) and κκ-Id(hi) outrank Redup, devoicing is blocked when adjacent syllables match in [±cont] and [±high]. Less similar syllables in correspondence will violate these κκ-Corr constraints, and thus non-devoiced candidates in this environment will not be chosen as optimal. Blocking of devoicing via matching [−cont] is prevented by introducing Devoice/_[−cont], which bans a voiced short high vowel between a voiceless consonant and a voiceless [−cont] consonant. I consider this constraint to be motivated by aerodynamics of voicing. By ranking Devoice/_[−cont] over κκ-Id(cont), non-devoiced outputs with matching [−cont] is ruled out regardless of the correspondence structure, since it will violate the higher-ranked Devoice/_[−cont] (Tableau 3). I assume that the proposed rankings are probabilistically produced in order to create variation observed in the data.

In conclusion, despite Japanese high vowel devoicing being often treated as a phonetic process, this study finds that structural knowledge such as similarity relations across syllables plays a crucial role in it. The analysis further implies that Japanese speakers are sensitive to the (non-)identity of vowel voicing, even when this information is purely allophonic.

*Tableau 1*. Non-devoicing via correspondence (syllables in correspondence are marked by […]$_\kappa$)

| /susi/ 'sushi' | OCP-V̥ | κκ-Id(vce) | Redup | Devoice | IO-Id(vce) |
|---|---|---|---|---|---|
| ☞ a. [su]$_\kappa$[ʃi]$_\kappa$ | | | | * | |
| b. [su̥]$_\kappa$[ʃi]$_\kappa$ | | *! | | | * |
| c. [su̥]$_\kappa$[ʃi̥]$_\kappa$ | *! | | | | ** |
| d. suʃi | | | *! | * | |
| e. su̥ʃi | | | *! | | * |

*Tableau 2*. κκ-Id(cont) ≫ Redup blocks devoicing when onsets match in [+cont]

| /suso/ 'hem' | OCP-V̥ | κκ-Id(cont) | κκ-Id(vce) | Redup | Devoice | IO-Id(vce) |
|---|---|---|---|---|---|---|
| ☞ a. [su]$_\kappa$[so]$_\kappa$ | | | | | * | |
| b. [su̥]$_\kappa$[so]$_\kappa$ | | | *! | | | * |
| c. [su̥]$_\kappa$[so̥]$_\kappa$ | *! | | | | | ** |
| d. suso | | | | *! | * | |
| e. su̥so | | | | *! | | * |

*Tableau 3*. Devoice/_[−cont] rules out non-devoicing via matching [−cont]

| /kuki/ 'stem' | OCP-V̥ | Devoice/_[−cont] | κκ-Id(cont) | κκ-Id(vce) | Redup | Devoice | IO-Id(vce) |
|---|---|---|---|---|---|---|---|
| a. [ku]$_\kappa$[ki]$_\kappa$ | | *! | | | | * | |
| ☞ b. [ku̥]$_\kappa$[ki]$_\kappa$ | | | | * | | | * |
| c. [ku̥]$_\kappa$[ki̥]$_\kappa$ | *! | | | | | | ** |
| d. kuki | | *! | | | * | * | |
| ☞ e. ku̥ki | | | | | * | | * |

**References** **Jun**, S-A, M. E. Beckman., S. Niimi. and M. Tiede. (1998). Electromyographic evidence for a gestural-overlap analysis of vowel devoicing in Korean. *UCLA Working Papers in Phonetics* 96. 1-42. **Maekawa**, K., H. Koiso, S. Furui and H. Isahara (2000). Spontaneous speech corpus of Japanese. *Proceedings of the 2nd Conference of Language Resources and Evaluation*, Athens. 947-952. **McCarthy**, J. and A. Prince (1995). Faithfulness and reduplicative identity. In J. Beckman, L. Walsh Dickey and S. Urbanczyk (eds.) *Papers in Optimality Theory*. Amherst: GLSA. 249-384. **Prince**, A. and P. Smolensky (1993). *Optimality Theory: constraint interaction in generative grammar*. Ms, Rutgers University & University of Colorado, Boulder. **Zuraw**, K. (2002). Aggressive reduplication. *Phonology* 19. 195-439.