Complete *and* incomplete neutralizations between underlying and derived geminates in Japanese: Evidence from three gemination processes

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Experimental studies have suggested that underlyingly contrasted pairs of sounds (e.g., voicing contrasts, vowel length contrasts) that are usually analyzed as phonologically neutralized may actually be different in the production. This is called incomplete neutralization. One well-studied example of this is final devoicing of voiced obstruents in languages such as German, Catalan, Dutch, Polish and Russian (e.g., Dinnsen & Charles-Luce 1984, Matsui 2015, Port & O'Dell 1985, Slowiaczek & Dinnsen 1985, Warner et al. 2004): voiceless obstruents derived by the devoicing rule are slightly different than underlying voiceless counterparts on the surface, although the differences are not as large as those found in the environments where the distinction is maintained (e.g., in medial position). Other examples of incomplete neutralization include flapped /t/ and /d/ in American English (e.g., Braver 2011) and vowel lengthening in Japanese (Braver & Kawahara 2012). Incomplete neutralization has been problematic in phonological theories; while we would expect identical realization of the neutralized pair of sounds, this prediction may not be borne out in the phonetics (see discussion in, e.g., Oostendorp 2008).

Not all neutralization processes are incomplete, however. For example, Lahiri et al. (1987) find that the vowel length rule gives rise to complete neutralization in Dutch. Piroth and Janker (2004) also report complete neutralization for German final devoicing.

What makes incomplete and complete neutralization different? When is neutralization incomplete? Fourakis and Iverson (1984) and Warner et al. (2006) argue that it is orthography that causes incomplete neutralization in German and Dutch, respectively. However, in Warner et al., while they look at geminates that are created by morphological concatenation, Dutch does not have surface geminates; thus, their results may be due to this surface constraint in the language. Moreover, there is little to no discussion of (intra)linguistic factors to the question.

This paper investigates whether different types of processes, specifically different stages in derivation, might explain the difference between complete and incomplete neutralization. In particular, I look at three gemination processes in Japanese to examine if derived geminates are different from the underlying ones. The results of a production experiment suggest that there are in fact differences depending on the process.

The first gemination process is Sino-Japanese (SJ) compounding: e.g., get(u)+hu → *geppu* 'loan' (vs. e.g., *geppu* 'burp' with an underlying geminate). The second is adverb formation by suffixation; gemination occurs when a suffix *-to* attaches to the base (*-to* adverbs): e.g., *do+tto* (warau) '(laugh) all at once' (vs. *dotto* 'polka dots'). This gemination would occur later than the SJ compound formation, since it involves suffixation. The third process occurs when adjectives are emphasized: itai 'painful' → *ittai* 'very painful' (vs. *ittai* (nonsense word)). This process can be analyzed as occurring at the lexical level (as in Lexical Phonology, i.e., morphophonologically), but speakers could manipulate the duration of the geminates phonetically, i.e., post-lexically, depending on the degree of emphasis.

In each of these processes, minimal pairs consisting of words containing derived geminates and corresponding monomorphemic words (see Appendix for the full list) are recorded. Seven speakers from Tokyo or nearby areas produced five repetitions of words in carrier phrases. Underlying and derived geminates were recorded separately (but on the same day), because eliciting derived geminates required instructions. Words with underlying geminates were semi-randomized together with fillers and read by the participants (randomized each time). Target words were presented either in *hiragana* or *katakana*, with the underlying geminates shown in orthography (e.g., げっぷ 'burp'). In eliciting derived geminates, targets were presented without explicit geminates in orthography, so speakers applied gemination when they read the words: in SJ compounds, words were presented in *kanji* (Chinese characters); in *-to* adverbs, targets were presented in *hiragana* without gemination (e.g., どと for *dotto*), but the context was given (e.g., 会場が＿とわく) and speakers were asked to refer to the context when they read; in emphatic adjectives, the targets were presented in regular orthography (e.g., 痛い) and speakers were asked to emphasize them when they read.

I measured the duration of the geminate CVCCV(V) and the geminate plus the following vowel CVCCV(V) using Praat, and took the ratios of the former to the latter (CVCCV(V) / CVCCV(V)) for comparison. I used R (ver. 3.1.1) and *lme4* and *lmerTest* packages to perform linear mixed effects analyses of the relation between the geminate ratios and the type of geminates (i.e., derived vs. underlying). I

entered into the model the geminate type as fixed effects, and speaker, item (both random slopes), and repetition (intercepts) as random effects.

Derived geminates in SJ compounds and underlying geminates (e.g., *gep+pu* ‘loan’ vs. *geppu* ‘burp’) were not significantly different: the geminate ratios estimated by the model were 78.7% and 78.3%, respectively (t = -0.627, p = 0.551). Derived geminates in *-to* adverb formation and underlying geminates reached statistical significance: derived ones were slightly longer (estimated 76.2%) than underlying ones (estimated 74.4%) (t = -2.643, p = 0.0395). Finally, geminates derived through emphasis were also significantly longer (estimated 64.3%) than underlying geminates (estimated 60.2%) (t = -3.187, p = 0.0189). If we compare the *t*/p-values, we can see that the magnitude of effects is larger for emphatic geminates than *-to* adverbs. This is found more clearly if speaker and item are entered into the model with random intercepts: the absolute t-value is not much different for *-to* adverbs (-3.584, p = .000388), but becomes much larger for emphatic geminates (-15.58, p < .000); thus, if the direction of the data is ignored, the difference between emphatic geminates and underlying geminates is much greater than the difference between *-to* adverb geminates and underlying geminates.

This experiment shows that processes that are usually analyzed as yielding the “same” geminates can actually derive segments that are phonetically different: in some processes (SJ compounds), derived segments are the same as underlying ones; in other processes (*-to* adverb formation and emphasis), the resulting geminates are different. Moreover, if we compare *-to* adverb geminates and emphatic geminates, the emphatic ones differ more from the underlying geminates than *-to* adverb geminates do.

I attribute these differences between complete and incomplete neutralizations to the stage of the derivation in which the process occurs. In compounding, the derived geminates are indistinguishable from the underlying ones. Suffixation is also a lexical process, but it derives geminates in the phonetics that are slightly different from underlying ones. Lastly, emphatic gemination could also be analyzed as a lexical process (i.e., morphophonological), but the derived geminates can be prolonged in the phonetics/post-lexically. This analysis therefore provides insights into the nature of derived segments in phonology.

Appendix – minimal pairs in comparisons

	Underlying	SJ		Underlying	*-to* adverb
hatto	ハット	法度	*hatto*	ハット	はっと(__する)
chokki	チョッキ	直帰	*sukitto*	スキット	すきっと(あたまが__する)
betto	ベット	別途	*hutto*	フット	ふっと(__気づく)
hokke	ほっけ	法華	*dotto*	ドット	どっと(会場が__わく)
geppu	げっぷ	月賦	*nitto*	ニット	にっと(__笑う)
rokku	ロック	六区			

	Underlying	Emph. adj.		Underlying	Emph. adj.		Underlying	Emph. adj.
huttoi	フットイ	太い	*sekkoi*	セッコイ	せこい	*ittai*	イッタイ	痛い
kussai	クッサイ	臭い	*dassai*	ダッサイ	ださい	*kattai*	カッタイ	固い
hossoi	ホッソイ	細い	*chikkai*	チッカイ	近い	*takkai*	タッカイ	高い