



The role of L1 durational correlates in L2 acquisition: A production study of Japanese geminates by Italian, French and English L2 learners

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Abstract

This study explores experimentally some of the characteristics of durational production cues in non-native pronunciation of the Japanese consonantal length contrast for three learner groups: Italian, French and English native speakers, based on the different phonological properties of their L1 regarding the presence/absence of such a contrast. Specifically, this paper investigates whether the phonetic implementation of this contrast is based on the same cues as native speakers, or on their L1 production cues. Previous studies have pointed out the crucial role of the presence of a consonantal length contrast in the learner's L1 in L2 acquisition of a similar contrast. However, the present results suggest that although this might be the case when building separate phonemic categories for short and long consonants, in terms of phonetic implementation, the presence of a consonantal length contrast in the L1 might hinder the acquisition of a native-like timing control.

Keywords: L2 pronunciation, geminate consonants, Japanese, durational contrasts, L2 learners.

1. Background

Consonantal length is contrastive in Japanese and opposes singletons (short consonants) to geminates (long ones). Minimal pairs involving this contrast can be found in abundance across all the strata of the Japanese lexicon (e.g. *kata* [kata] 'shoulder' vs. *katta* [katta] 'bought', *iti* [itʃi] 'one' vs. *itti* [ittʃi] 'agreement') [1]. Depending on the lexical stratum, geminate consonants occur in order to achieve various functions such as: a morphophonological process in compounding or verbal inflection (native and Sino-Japanese stratum), emphatic meaning (mimetics), achievement of a preferred prosodic structure or preservation of the mora or syllable structure of the source language (loanwords) (see [2] for a comprehensive review).

Both the abundance of minimal pairs, and the crucial role of geminate consonants in the Japanese lexicon suggest their high functional load [3, 4, 5].

Accordingly, their acquisition appears to be fundamental for comprehensibility and intelligibility [5], and therefore an efficient communication with Japanese native speakers.

A wide body of research on L2 Japanese is devoted to the investigation of the acquisition of Japanese geminate consonants [6]. What these studies point out is that among the Japanese segment inventory, geminate consonants in particular are challenging for learners, and this especially when their L1 doesn't have a contrast in terms of consonantal length [6, 7, 8]. This claim suggests that the presence of a consonantal length contrast in a L1 makes the acquisition of geminate consonants less challenging for its native speakers, when compared with native speakers of other languages without such a contrast. The present study proposes to (i) compare the pronunciation of Japanese geminate consonants by learners of three different L1 background with regard to the presence or absence of a consonantal length contrast: Italian, French and English, (ii) identify experimentally durational cues for L2 learners' production, (iii) provide acquisition data on understudied learner groups. Indeed, although many studies on the acquisition of geminate consonants can be found in the literature, they focus mainly on Asian (typically Chinese or Korean) and English native speakers. Considering the crucial role that phonetic data might represent for improvement of teaching methods, there is a need for more acquisition data on understudied populations.

The choice of the three learner groups in this study was made in order to target understudied learner populations (French and Italian), and based on the phonological properties of their L1s regarding the presence or absence of a consonantal length contrast.

In Japanese, gemination (also called *sokuon*) is observed for stops, fricatives and affricates. Nasals may also emerge as geminated (*hatsuon*) although they are not contrastive [1] in Japanese. Phonetically, the length contrast between geminate and singleton consonants in Japanese is reflected in a variation in the consonant closure duration. Previous studies report that the primary acoustic correlate for

gemination in Japanese is the closure/frication duration: the duration of the closure for a geminate is at least twice the same duration for a singleton consonant [9, 10, 11, 12]. They also show the importance of the duration of the preceding and following vowels as secondary acoustic cues. The preceding vowel is longer before a geminate than a singleton and the following vowel follows the opposite pattern.

In Italian, stops, fricatives, affricates, liquids and nasals can be geminated, and contrast with their singleton counterparts (e.g. *fato* ‘fate’ vs. *fatto* ‘fatto’, *pane* ‘bread’ vs. *panne* ‘creams’) [13]. Phonetically, Italian native speakers make the same use of the closure duration as primary acoustic cue for gemination as Japanese native speakers, with an increase in duration ranging from 73% (fricatives) to 194% (liquids) [13, 14, 15, 16]. The literature also points out the role of the preceding vowel as secondary cue for gemination. However, in contrast with Japanese, Italian native speakers produce a shorter preceding vowel when in a geminate environment (around -30%) [13, 14, 15, 16, 17].

French, like other Western roman languages, underwent a degemination process from the 7th to 8th century, and as a result, although many occurrences of double consonants in the spelling can be found in modern French, they rarely reflect the actual pronunciation and can be either geminated, non-geminated and variably geminated [18]. A distinction should be made between cases of phonetic (non-contrastive) and phonemic (contrastive) gemination: Phonetic gemination is the most common in French and surfaces typically in two cases: When a sequence of identical consonants occurs at a word or morpheme boundary (this is also the case in English), or with a pragmatic contrast as an “educated” pronunciation of a double consonant (e.g. *sommaire* ‘summary’ [sɔmmɛʁ] ~ [sɔmɛʁ]). Examples of the latter can be found typically in teachers’ speech. Cases of phonemic gemination are rare and mostly observed in the distinction between imperfect and conditional of the verbs *courir* ‘to run’ and *mourir* ‘to die’ [18]. As a native speaker of French, however, the author doubts the phonetic reality of this contrast in native speakers’ perception and production.

Lastly, gemination in English is non-contrastive and is mostly due to consecutive identical consonants at a word or morpheme boundary (e.g. *cat tail*) [19].

2. Experiment

A production experiment using a reading task was run in order to investigate the pronunciation of geminate consonants by the three learner groups. 25 L2 learners of Japanese were recruited in Japan for the experiment based on two main criterias: (i) their L1

and (ii) their Japanese proficiency. The selection was made carefully in order to record participants with a sufficient L2 proficiency (from intermediate level) so that the interference of the participant’s reading skills on their pronunciation would be minimal (with regard to reading mistakes and speech rate). Three groups of speakers (N=25) were recorded such as, 8 English (4 female, 4 male, M= 20.7), 10 French (7 female, 3 male, M= 27.2) and 7 Italian (3 female, 4 male, M= 28.8) native speakers. 8 Japanese native speakers (JNS) (5 female, 2 male, M= 22.5), were also recruited as a control group.

The reading task was composed of 18 near minimal pairs, for which each member of the pair contained either a VCV or VCCV sequence, with identical preceding and following vowels. Near minimal pairs were found by a systematic dictionary search in order to find combinations for all 5 Japanese vowels (a, i, u, e, o) and a subset of the consonants (k, t, p, s, n). The 36 target words were inserted in sentences that the participants were asked to read.

Recordings were conducted using a headworn microphone (Shure WH-30) and a Linear PCM recorder (TASCAM DR-100MKIII) with a 44.1kHz sampling frequency and a 16bits quantization. Segment duration measurements were made from the recorded files using Praat [20]. Data analysis and testing of the statistical skews were conducted using R [21].

3. Results

The measurements for native speakers are consistent with findings from previous studies. A clear difference was observed between singleton consonants and their geminate counterparts in the closure duration, the primary acoustic cue, with a mean durational ratio of 2.08. A significant correlation was also observed for the preceding vowel that was longer (+18%, $p=.001$) in a geminate environment, and although following vowels tend to be shorter after a geminate consonant (-9%, $p=.06$ ns.) this was non-significant. This last point is however not surprising as it was already pointed out in the literature that the difference in the following vowel duration is less consistent than for the preceding one [22].

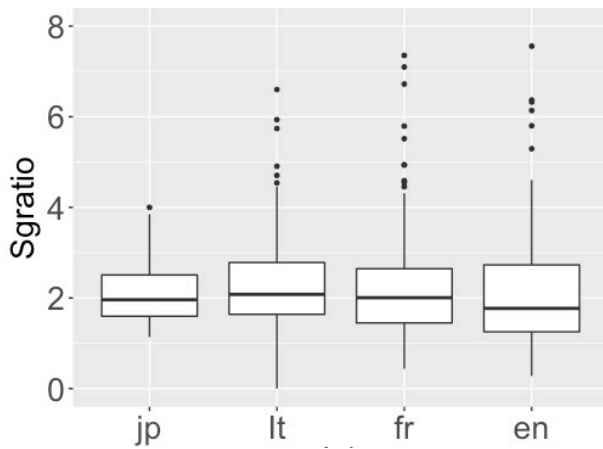
3.1. Singleton-geminate ratio

The results for mean raw durations (Table 1) indicate that all learners were able to make a clear distinction between the singleton and geminate consonants using the closure/frication duration: It appears that all three learner groups rely on the same primary acoustic cue for gemination as Japanese native speakers.

Table 1: SG ratio and raw durations by L1.

L1	Mean SG ratio	Duration S/G
Japanese	2.08	7/15
Italian	2.31	9.6/19
French	2.35	9/18
English	2.29	10.7/20

Although a difference can be observed between Japanese native speakers and L2 learners in terms of speech rate, as indicated by the mean raw durations, the values for SG ratios are consistent with those of native speakers, and no significant difference could be observed ($p=.3$) for SG ratio between the four speaker groups (Figure 1).

**Figure 1:** SG ratio by L1.

This suggests the successful creation of two distinct phonemic categories for short and long consonants, that is, L2 learners from all three groups have successfully acquired the Japanese consonantal length contrast. Furthermore, the difference in terms of raw duration indicates that they are able to maintain consistent durational ratios across speech rate.

The present results offer a contrast with those of previous studies [23] for English native speakers for example] where underdifferentiation of the contrast was observed in L2 learners' pronunciation. Namely, their SG ratios were lower than for Japanese native speakers, and the difference in closure duration non-consistent between the two environments. Inversely, in the present case, learners exhibit a tendency to have a higher SG ratio than native speakers, which suggests that they are well aware of the durational contrast and (consciously or not) enhance it. We postulate that this difference with findings from [10] might be related to the Japanese proficiency level of the participants that all had at least an intermediate level of proficiency in the present study but were beginners in [23].

3.2. Vowel duration

The data for vowel durations (Table 2) indicates different patterns for L2 learners when compared to Japanese native speakers, as well as between the three learner groups.

Table 2: Variations in vowel duration in geminate environment by L1.

L1	V1 duration	V2 duration
Japanese	+18% ($p=.001$)	-9% ($p=.06$, ns.)
Italian	-10% ($p=.03$)	+13% ($p=.11$, ns.)
French	+2% ($p=.59$, ns.)	-3% ($p=.62$, ns.)
English	+9% ($p=.23$, ns.)	+9% ($p=.33$, ns.)

A significant difference in preceding vowel duration was observed for Italian learners, which was shorter before a geminate consonant, a pattern similar to their L1. This indicates that, similarly to the case of Japanese native speakers, the preceding vowel duration is a secondary acoustic correlate for gemination for Italian learners, but that they use it in the opposite way, based on their L1 production cues. No significant difference was observed for the duration of the following vowel in Italian learners' pronunciation.

In English and French groups, no significant difference was observed between both preceding vowel durations between singleton and geminate environment, and following durations between singleton and geminate environment. This suggests an absence of effect of gemination on the surrounding vowels for these two groups, and consequently that vowel durations do not constitute active cues in their pronunciation.

3.3. More about Italian L2 learners

Results in 3.1. above for vowel duration have shed light on the fact that Italian learners appear to be using their L1 production cues for phonetic implementation of Japanese geminates. Another interesting pattern, in their pronunciation of Japanese affricates, suggests the use of L1 cues for Italian learners. As shown in Table 3, the observed mean SG ratio for affricates in Italian learners' pronunciation indicated a less straightforward contrast between the closure duration of singleton and geminate consonants when compared with other L1 groups.

Table 3: SG ratio for affricates.

L1	SG ratio
Japanese	2.22
Italian	1.62
French	3.37
English	2.32

While in Japanese, the contrast between singleton and geminated affricates is reflected in the closure duration only [24], in Italian both closure and frication are lengthened [15], resulting in less lengthening of the closure itself. Here again, the durational patterns observed for Italian learners appear to match those of their L1.

4. Discussion and conclusion

This study examined the pronunciation of the consonantal length contrast in Japanese by Italian, French and English L2 learners. Findings show that although the primary acoustic cue for all learners was closure/frication duration, only Italian learners were using the surrounding vowel duration as a secondary cue.

All learners had successfully acquired distinct phonological representations for singleton and geminate consonants, and were able to maintain the distinction across speech rate. Although previous studies pointed out that acquiring geminate consonants was especially challenging for learners when their L1 doesn't have a consonantal length contrast [6, 7, 8], our results show that at least from the intermediate level, all learners were able to produce it accurately. As the present study is cross-sectional, no claim can be made concerning the early stages of acquisition, but we can postulate that Italian learners had an advantage in building the phonemic categories for short and long consonants as these already existed in their L1 phonological system.

However, when it comes to phonetic implementation, the present experiment indicated that Italian learners rely on pre-existing durational correlates associated to the phonemic categories corresponding to the two consonant types in Italian. In contrast, results for English and French L2 learners showed that they behave in a similar way in terms of timing control, that is, they don't make use of vocalic cues. Although the lack of phonetic data for geminates in these two languages makes it difficult to make any claim, this suggests that the cases of phonemic gemination reported in French are not active in native speakers' minds.

Incomplete acquisition of the timing control was observed for all three learner groups, but while in the case of Italian learners the acquisition appears to be hindered by L1 cues, the absence of such cues for the two other learner groups suggests that phonetic

implementation might be easier to acquire for learner populations whose L1 doesn't have conflictual cues (see a summary in Table 4). These results are consistent with Flege's [25] Speech Learning Model, which predicts that the presence of a similar phonemic category in a learner's L1 makes the acquisition more challenging.

Table 4: Phonemic categories building and phonetic implementation

L1	Italian	English French
Contrast	+	-
Phonemic categories	+	-
Phonetic implementation	-	+ (?)

The implications for teaching of such a dichotomy between building phonological representation and phonetic implementation is that the focus of the instruction for geminate pronunciation should be different depending on the learners' L1 phonological characteristics. As such, when consonantal length is not contrastive in a learner's L1, instruction should focus on easing the acquisition of new phonemic categories, while others would benefit from explicit instruction putting emphasis on durational cues for vowels.

Lastly, a recent study [26] on the acquisition of gemination by Chinese learners found similar results: While the primary acoustic cue, and distinct phonemic categories were successfully acquired for singleton and geminate consonants, this was not the case for the timing of the surrounding vowels. Moreover [26] also pointed out the crucial role of the non-native timing control of surrounding vowels for comprehensibility. Preliminary comprehensibility tests ran on the present experimental data seem to suggest that Italian learners are judged by native speakers as having a lower comprehensibility than the two other groups. Although at this point it is difficult to relate lower comprehensibility for Italian learners to their use of L1 cues in their pronunciation of geminate consonants, this shall be explored further in future experiments.

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