TIMING OF SECOND LANGUAGE SINGLETONS AND GEMINATES

Barış Kabak, Tanja Reckziegel & Bettina Braun

University of Konstanz, Germany
baris.kabak@uni-konstanz.de; tanja.reckziegel@hotmail.com; bettina.braun@uni-konstanz.de

ABSTRACT

This study investigated the realization of Italian geminate-singleton contrasts by naïve and advanced L2 speakers of Italian whose L1 was German, a language with no consonantal length contrasts. We show that geminate-singleton differences could be established by all groups although there were significant differences in the geminate-singleton duration ratios across groups (Italian > advanced learners > naïve). Closer inspection reveals that the advanced L2 learners' approximation to the native Italian duration ratios was mainly due to an improved (shorter) realization of singletons. Our results suggest that the native-like timing of geminates is difficult to acquire even with a considerable amount of exposure to Italian, and that learners widen the geminate-singleton difference by readjusting the timing of an already existing category.

Keywords: consonantal length, L2 acquisition, Italian, German

1. INTRODUCTION

The timing of segments is one of the phonetic cues to establish segmental oppositions across the languages of the world. Accordingly, languages may contrast long and short segments, in both consonants and vowels, to establish meaning differences (e.g., Italian: /fato/ 'fate' vs. /fat:o/ 'done'). Failure to acquire the timing differences among such oppositions in an L2 may lead to foreign accented speech or even lexical or grammatical mistakes.

Much of the work on the L2 acquisition of phonology focused on segmental contrasts, and investigated various phonetic and phonological factors in their perception and production (see [1] for a review). On the other hand, whether or not L2 learners can reliably perceive and produce length differences in the L2, and to what extent the phonetic realization of length is modulated by the first language (L1), have been relatively understudied. While listeners are claimed to have access to duration in cross-linguistic vowel perception irrespective of the existence of vowel length in their L1 (e.g., [3, 4]), significant cross-language differences were shown behaviorally [10] as well as electrophysiologically [11], suggesting that those L1 groups that employ duration as a contrastive feature are better able to achieve native-like perception of vowel length contrasts. Accurate perception, however, does not necessarily guarantee native-like category formation, leading to differences between native and non-native speakers in their realization of target sounds [5].

In this paper, we explore whether consonantal length is easily accessible to L2 learners, and whether the native-like timing of geminates can ultimately be acquired. Our focus is on the realization of intervocalic long consonants (geminates) vs. short consonants (singletons) by L2 learners whose L1 does not have this contrast. There are only very few studies on the L2 acquisition of consonantal length contrasts. Most of them investigated the production of Japanese geminate-singleton contrasts by adult [6, 9], and child [7] native speakers of English, thereby exclusively focusing on plosives. The findings from these studies suggest that, irrespective of their level of proficiency and amount of exposure to Japanese, English speakers have difficulty with acquiring Japanese geminates, as evidenced by their significantly shorter closure durations for geminates and smaller geminate-singleton ratios than native speakers'. Recently, [8] has shown that inexperienced English learners of Japanese were able to distinguish singletons from geminates, and to lexically contrast singleton and geminate words albeit with significantly lower accuracy than both experienced learners and native language controls. Experienced learners, however, did not differ from native speakers in the listening task, suggesting that their one-year experience with Japanese was sufficient to become native-like. Their productions were, however, judged by native Japanese listeners to be significantly less accurate than those of native Japanese participants.

Since geminate-singleton contrasts seem to be achievable in perception even for those who have

no experience with geminates, we explored how temporal properties of geminates produced by L2 speakers differ from target language geminates. Furthermore, we tested how L2 learners' geminate productions approximate the target norms, not just for stops but for a large sample of phonemes. Cross-linguistically, geminate sonorants and voiced stops are claimed to be more marked than geminate obstruents and voiceless stops, respectively. The disfavor of geminate sonorants has been attributed to confusability because sonorants are spectrally closer to surrounding vowels than plosives are, and consequently their consonantal durations are more difficult to perceive (e.g., [13]). On the other hand, the rarity of geminate voiced stops has been claimed to arise due to aerodynamic reasons (e.g., [13]). Hence we also investigated whether L2 acquisition of geminates mirror these typological tendencies.

2. PRODUCTION STUDY

The target language was Italian, which contrasts singletons from geminates both within and across morpheme boundaries. All Italian consonants except for /z/, /j/ and /w/ can be geminated. Our learner population consisted of native speakers of German, which does not make contrastive use of geminate consonants although long consonants may emerge across words or morphemes (e.g., *mit Ton* 'with sound', *mitteilen* 'to convey'). We conducted a repetition study with a large set of singleton-geminate contrasts, testing two groups of German natives: a naïve group and advanced L2 learners of Italian.

2.1. Methodology

2.1.1. Participants

The naïve group contained 10 native speakers of German with no prior learning experience with Italian (6 female, mean age 23). The advanced learner group consisted of 10 native speakers of German (8 female, mean age 26.7), who studied Italian between 5 and 10 years in high school and university and/or had lived in Italy between 6 months and 3 years. All learners self-rated their knowledge of Italian as "very good" to "fluent". Eight native speakers of Italian (4 female, mean age= 23.8) served as controls. All of them were born and lived in Northern or Northern-Central Italy before coming to Germany. All participants were paid a small fee. None reported having any hearing problems or speech disorders.

2.1.2. Materials and procedure

Nonce minimal pairs of the form CV.CV and CVC.CV were created with 12 singleton-geminate contrasts. They were selected based on their availability in both languages (/p,t,k,b,d,g,f,s,v,m, n,l/). Each contrast was used in 5 different nonce words, where the first consonants were /p/, /t/, or /k/, followed by a vowel from the set /a,e,i,o,u/. The word-final vowels were /a,o,e/ yielding a total of 120 nonce words (12 consonants x 2 lengths x 5 words). A 23 year-old male Standard Italian speaker from Rome produced the nonce words in isolation. Recordings were done in a soundproof room, using a TASCAM HD-P2 portable recorder (44.1kHz, 16Bit).

Participants were told that they would hear nonce words that will be potential brand names in Italian. Their task was to assign a definite article, *la* (feminine) or *il* (masculine). Each participant heard the nonce words in random order over headphones. Trials started with a short beep, followed by 700 ms silence, followed by the nonce word. After 1250 ms the word was played again. Upon hearing the test word the second time, participants produced the test word with an article (e.g., *il tuppe*, *la tessa*) twice. Prior to the experiment, there was a practice session with 10 different items. Responses were recoded digitally (44.1kHz, 16Bit) in a soundproof room. This task posed no problem for German speakers since German also has masculine and feminine articles.

2.1.3. Analyses

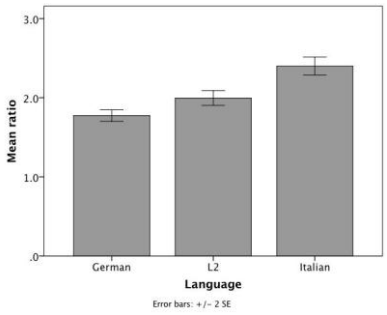
Using Praat [2], the second productions of the test word were analyzed. For plosives, closure duration was measured, as it is claimed to be one of the most reliable cues for geminate-singleton distinctions in plosives. The onset of the closure was set at the point where energy in high frequency bands dropped (often coinciding with a cessation of the formants of the preceding vowel) and the offset of the closure at the burst. For fricatives we measured the duration of friction. For nasals, we used information on the waveform (drop in amplitude) and wide-band spectrogram (reduction in energy, presence of antiformants). We did not measure vowel durations preceding geminates, which is known to provide yet another cue for singleton-geminate distinctions in Italian, since our primary purpose here is to shed light on the temporal characteristics of L2 singletons and geminates inherent in consonants.

Overall, there were 3360 data points (120 nonce words x 28 speakers). In 44 cases (22 naïve, 13 advanced learners, and 6 Italians), participants produced a different consonant or the consonant could not be annotated reliably (1.3% of the data). Outlieres that lay 2.5 standard deviations or more off the group means for singletons and geminates were not considered (3.7% of the data).

2.2. Results

Consonant durations of the remaining 3481 tokens were aggregated by participants. To investigate whether all groups differentiate geminate from singleton consonants, we calculated geminate-singleton duration ratios and subjected them to a univariate ANOVA with ratio as dependent variable and phoneme (/p,t,k,b,d,g,f,s,v,l,m,n/) and language group (German, L2, Italian,) as fixed factors. Results showed main effects of phoneme ($F(11,300) = 7.1$, $p < 0.001$) and language group ($F(2,300) = 53.0$, $p < 0.001$), but no interaction ($p > 0.4$). Post hoc tests for phoneme (LSD; least square difference) showed that /m,b,p,v,g/ had the smallest ratio (average 1.77), and /n,l,d,t,s,f,k/ had the highest ratio (average 2.16, $p < 0.05$). Post hoc tests for language group (LSD) showed significant differences between all three groups (German: 1.8, L2: 2.0, Italian: 2.4$p < 0.001$); see Figure 1.

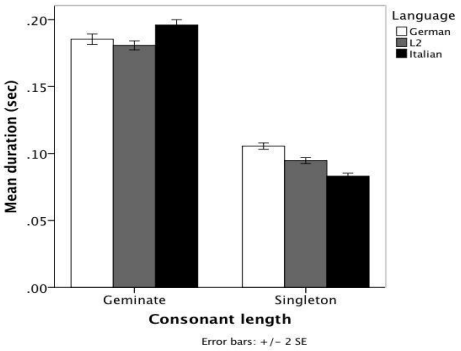
Figure 1: Mean duration ratios for the three language groups. Whiskers represent standard error.



To investigate whether the development in the duration ratio of the advanced learner group was due to an improvement in the production of singletons or geminates, we calculated a repeated measures ANOVA with duration as dependent variable and consonant length (singleton vs. geminate) as within-subjects factor and language group and phoneme as fixed factors. Results showed main effects of consonant length ($F(1,300) = 2565$, $p < 0.0001$), phoneme ($F(11,300) = 18.5$, $p < 0.001$), an interaction between language and consonant length ($F(2,300) = 25.6$, $p < 0.001$), and an interaction between phoneme and consonant length ($F(11,300) = 3.1$, $p = 0.001$).

To test the nature of these interactions, the dataset was split by consonant length. Durations were subjected to a univariate ANOVA with duration as dependent variable and language and phoneme as fixed factors. For singletons, there was a main effect of language ($F(2,300) = 49.3$, $p < 0.001$) and a main effect of phoneme ($F(11,300) = 29.9$, $p < 0.001$), but no interaction ($p > 0.25$). Post hoc tests for phoneme (LSD) showed that /ɡ ,d,l/ (mean duration 76.4ms) were significantly shorter than /b,n,k,v,t/ (94.3ms), which in turn were significantly shorter than /p,m,s,f/ (114.6ms). Post hoc tests for language showed that the duration of singleton consonants was significantly shorter for Italian participants (mean 84.5ms) than for the advanced learners (mean 96.1ms; $p < 0.001$), which in turn was shorter than that of the naïve group (106.8ms; $p < 0.001$); see Figure 2.

Figure 2: Mean durations for geminate and singleton consonants, split by language.



Durations for geminate consonants showed a main effect of language group ($F(2,334)=3.3$, $p < 0.05$) and of phoneme ($F(11,334)=9.8$, $p < 0.001$), but again no interaction ($p > 0.9$). Post hoc tests for phoneme showed the shortest durations for voiced obstruents (/b,d, ɡ ,v/, average 165ms) and the longest durations for voiceless obstruents and sonorants (/p,t,k,f,s,m,n,l/, 200ms). Post hoc tests for language group showed that the naïve German and advanced learner groups did not differ from each other (average 185ms; $p > 0.7$) for geminate durations, which were significantly shorter than those of Italian speakers (196ms; $p < 0.05$).

3. DISCUSSION AND CONCLUSIONS

Both German groups were able to differentiate geminates from singletons in production despite the absence of this contrast in their L1. The geminate-singleton duration ratio of the advanced

learner group, however, was different from that of the naïve group, approaching but not reaching the target Italian ratio. This suggests that the non-native contrast in question poses a difficulty even after a significant amount of exposure to the target language, yielding crosslinguistic support for previous studies conducted on Japanese [6, 7, 8, 9] and extending them to a larger range of sounds.

Strikingly, the developmental trajectory in advanced learners' geminate-singleton ratios was not due to an improvement in the timing of geminates but rather due to shortening of singletons. For both German groups, geminate durations were significantly shorter than those the target language group, suggesting that L2 learning did not affect the timing of geminates. For singletons, we observed not only a difference between native and non-native speakers of Italian, but also a developmental trajectory that stems from significantly shorter, hence more target-like, productions of singletons by the advanced learner group compared to the naïve group. These findings are on a par with [6], where English advanced learners of Japanese produced singleton stops with longer closure durations and geminate stops with shorter closure durations than Japanese native speakers. We take these findings to suggest that L2 learners are better at readjusting an existing category in their L1 (i.e., singletons) rather than showing an improvement in a novel category. They also lend support for the observation that novel category formation in L2 does not necessarily imply native-like production [5].

Regarding our second research question as to whether typological tendencies are mirrored in L2 acquisition, the prediction was that advanced learners should be more likely to achieve native-like timing of geminates among obstruents than sonorants. Although phoneme was a main factor in all analyses, it exhibited no interaction with language group, suggesting that obstruents and sonorants were equally non-target-like for both German groups. Instead, the consistent pattern that seemed to be modulated by phoneme type for both geminates and singletons was that voiced obstruents had shorter durations and were more likely to have smaller geminate-singleton ratios than voiceless obstruents. This finds a straightforward explanation given the aerodynamic difficulty in maintaining stop voicing throughout the supralaryngeal closure [12], and consequently accords with the crosslinguistic rarity of geminate voiced stops [13].

In conclusion, on a par with previous findings on the accessibility of duration in the perception of vowel contrasts, we argue that consonantal length contrasts can be maintained even by non-native speakers although their precise phonetic implementation is difficult to master.

4. REFERENCES

[1] Altmann, H., Kabak, B. 2010. Second language phonology. In Kula, N., Botma, B., Nasukawa, K. (eds.), *Continuum Companion to Phonology*. London: Continuum, 298-319.

[2] Boersma, P., Weenink, D. 2009. Praat: Doing phonetics by computer (Version 5.1.05). *http://www.praat.org/*

[3] Bohn, O.-S. 1995. Cross-language speech perception in adults: first language transfer doesn't tell it all. In Strange, W. (ed.), *Speech Perception and Linguistic Experience*. MD: York Press, 279-304.

[4] Cebrian, J. 2006. Experience and the use of non-native duration in L2 vowel categorization. *Journal of Phonetics* 34, 372-387.

[5] Flege, J.E. 1995. Second language speech learning: theory, findings, and problems. In Strange, W. (ed.), *Speech Perception and Linguistic Experience*. Timonium, MD: York Press, 233-277.

[6] Han, M.S. 1992. The timing control of geminate and single stop consonants in Japanese: A challenge for nonnative speakers. *Phonetica* 49, 102-127.

[7] Harada, T. 2006. The acquisition of single and geminate stops by English speaking children in a Japanese immersion program. *Studies in Second Language Acquisition* 28, 601-632.

[8] Hayes-Harb, M., Masuda, K. 2008. Development of the ability to lexically encode novel second language phonemic contrasts. *Second Language Research* 24, 5-33.

[9] Mah, J., Archibald, J. 2003. Acquisition of L2 length contrasts. In Liceras, J.M., et al. (eds.), *Proc. 6th Generative Approaches to Second Language Acquisition Conference*, 208-212.

[10] McAllister, R., Flege, J.E., Piske, T. 2002. The influence of L1 on the acquisition of Swedish quantity by native speakers of Spanish, English and Estonian. *Journal of Phonetics* 30, 229-258.

[11] Nenonen, S., Shestakova, A., Huotilainen, M., Näätänen, R. 2005. Speech-sound duration processing in a second language is specific to phonetic categories. *Brain and Language* 92, 26-32.

[12] Ohala, J. 1983. The origin of sound patterns in vocal tract constraints. In MacNeilage, J. (ed.), *The Production of Speech*. New York: Springer Verlag, 186-192.

[13] Podesva, R. 2000. Constraints on geminates in Burmese and Selayarese. *Proceedings of West Coast Conference on Formal Linguistics* 19, 343-356.