

## EPG Insights into First-language Influence on Second Language Gestural Timing

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A great deal of research within the laboratory phonology enterprise has expanded our understanding of connected speech, particularly as regards the timing and sequencing of gestures. Studies on gestural sequencing among second language (L2) learners have overwhelmingly found decreasing first language (L1)-based influence and more target-like gestural timing with increased language experience/proficiency (e.g., Levy & Strange, 2008 for perception; Levitt, 1991; Yanagawa, 2006; Oh, 2008; Fan, 2011 for production; but see Zsiga, 2003 for limits on the effects of L1 influence and L2 proficiency). In spite of the relevance of these findings for theories of L2 speech learning, current models (e.g., Flege, 1995) have overlooked how coarticulatory patterns from the L1 influence those of the L2.

The present study seeks to make two contributions to our understanding of the L2 acquisition of coarticulation via an EPG study of Japanese-speaking learners' production of English /kt/ clusters. First, we wish to expand the empirical base. To date, most previous studies have looked at learners whose L1 either prohibits clusters (e.g., L1 Mandarin in Fan, 2011; Luo, 2017) or allows for a large range of consonant sequences (e.g., L1 Czech in Šimáčková & Podlipský, 2015; L1 Russian in Zsiga, 2003). By examining the production of Japanese-speaking learners whose L1 allows only for homorganic clusters and thus falls between these two extremes, we set out to determine whether learners with an intermediate-size L1 cluster inventory like Japanese evince similar challenges in acquiring new coarticulatory patterns. Second, most previous research has been acoustic; articulatory research allows for more detailed insights into patterns of coarticulation particularly as concerns the degree of gestural overlap.

Three L1 Japanese and 3 L1 Canadian English speakers' production of English word-medial and -final /kt/ clusters (e.g., *victory*, *attract*) were elicited via a carrier-sentence and a passage reading task. Using EPG, 420 /kt/ tokens (10 words \* 7 repetitions \* 6 speakers) were collected at 100 Hz sampling rate using custom-made, 62-electrode artificial palates, then annotated. Temporal changes in alveolar and velar contact were extracted, and lag between the two gestures in /kt/, measured as the distance between alveolar and velar contact maxima (Figure 1), was calculated then submitted to a linear mixed effects model (fixed factors: Language, Position in the Word, Task; random factors: Word, Speaker). Significantly greater lag was observed for the L1 Japanese-L2 English speakers (the effect of Language:  $X_{(1)}^2 = 7.2$ ,  $p = 0.007$ ) and in the passage reading task (the effect of Task:  $X_{(1)}^2 = 20.92$ ,  $p < 0.0001$ ); no effect was found for Position, and there were no significant interactions. A comparison of the Japanese-speaking learners' L2 productions to their L1 sequences (e.g., [ikʏto]), recorded previously, revealed similar lag values, and both clusters and sequences were realized similarly as voiceless releases or aspiration. We propose that these learners analyze English clusters as being like those resulting from high vowel devoicing in their L1 rather than as homorganic (phonological) clusters, and, as a consequence, transfer their L1 timing patterns to their L2 with little or no modification.

In summary, our results demonstrate once again the challenges of acquiring L2 coarticulation under the influence of entrenched L1 patterns. Moreover, the Task effect observed is consistent with Major's (2001) Ontogeny model, which predicts a greater degree of transfer in less structured tasks.

Keywords: coarticulation, clusters, English, Japanese, second language

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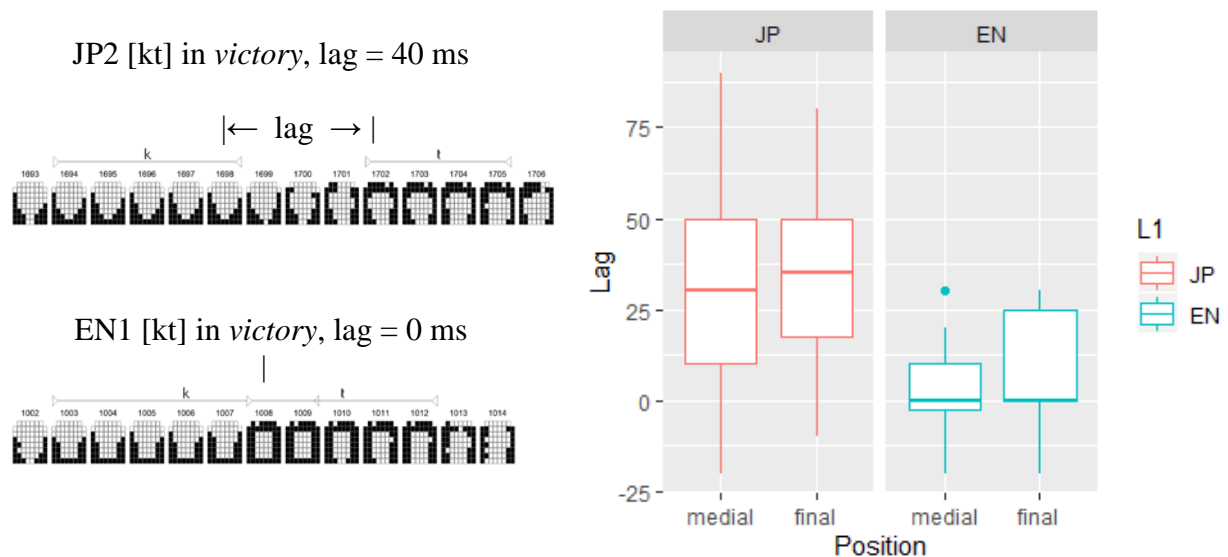


Figure 1: Sample palate frames for /kt/ and lag measurements (left); lag by Language and Position in the Word (right).