



Research Article

A longitudinal study of the second language acquisition of a three-way stop contrast

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ABSTRACT

The goal of this paper was to document how native (L1) speakers of a language with a two-way stop contrast acquire a three-way stop contrast in a second language (L2). Mandarin presents a two-way stop contrast cued primarily by VOT, whereas Korean presents a three-way stop contrast cued jointly by VOT and the f_0 of the following vowel. Mandarin and Korean stop productions from 12 L1 Mandarin novice L2 learners of Korean were subjected to acoustic analysis. Results revealed a wide variety of production patterns, suggesting that the learning of an L2 contrast may not always be predicted by cross-language acoustic correspondences. Six of the participants were recorded again both six and 12 months later. The longitudinal results showed that some learners were unable to produce the Korean contrast in a native-like way even after one year of intensive L2 instruction. Learners whose initial production strategy was consistent but incorrect fared worse after one year than learners whose productions initially exhibited more variability. These results contribute to our understanding of both the L2 acquisition of “new” and “similar” categories and also how well naïve perceptual assimilation can predict L2 production.

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1. Introduction

Stop consonants have been widely investigated in the L2 literature, with most studies focusing on the L2 acquisition of a two-way stop contrast by L1 speakers of languages that also have a two-way stop contrast (e.g., Caramazza, Yeni-Komshian, Zurif, & Carbone, 1973; Flege, 1991; Flege & Eefting, 1987, 1988). In the vast majority of these studies, the stop contrasts in both the L1 and the L2 are differentiated primarily by voice onset time (VOT), which is a temporal measure that relates the stop burst and an onset of voicing. When the onset of voicing precedes the stop burst the stop is said to be characterized by lead VOT (or “pre-voicing”), and when the stop burst precedes the onset of voicing it is described as having lag VOT. Lisker and Abramson (1964) showed that cross-linguistic differences in stop contrasts are often manifested through how VOT is distributed across each language's stop categories. For example, some languages, like Dutch, exhibit a two-way stop contrast in word-initial position between stops with lead VOT and short lag VOT, whereas other languages, like English, contrast stops with short and long lag VOT. Although this English stop contrast is generally thought of as one of voicing rather than aspiration, in word-initial position the “voiced” stops are typically realized with short lag VOT (Ladefoged, 1999).

When two languages use VOT to cue stop contrasts differently, L1 speakers of one of the languages learning the other language as an L2 will often fail to produce L2 stops with native-like VOT. For example, when L1 speakers of a language that has voiceless stops with short lag VOT (represented as /p, t, k/), such as French, produce English voiceless stops, which have long lag VOT (and are also represented as /p, t, k/), the L2 English voiceless stops are typically realized with short lag VOT (Caramazza et al., 1973; Swanson, 2006), suggesting that the English voiceless aspirated stop categories have been phonologically equated with L1 voiceless unaspirated stop categories. Cases of VOT mismatches such as these are well documented in the literature, such as English and Dutch (Flege & Eefting, 1987), English and Spanish (Flege, 1991; Flege & Eefting, 1988), English and Brazilian

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Portuguese (Sancier & Fowler, 1997), and Spanish and Swedish (Stölten, Abrahamsson, & Hyltenstam, *in press*). With increased L2 experience, L2 learners often learn to either differentiate between similar L1 and L2 categories or to produce the stops in both languages with a “compromise” VOT (Williams, 1980), such that, for example, more experienced L1 French learners of English would produce voiceless stops with lag VOT in French longer than monolingual French production and lag VOT in English shorter than monolingual English production, and vice versa for more experienced L1 English learners of French (e.g. Fowler, Sramko, Ostry, Rowland, & Hallé, 2008; Hazan & Boulakia, 1993). These findings are generally in line with the predictions made by the Speech Learning Model (SLM; Flege, 1995, p. 238), which proposes that L2 production is guided primarily by perceptual targets. According to this framework, for an L1 French learner of English, English /t/ would be produced with shorter lag VOT because it is “similar” to French /t/ (that is, perceptually, French /t/ is a similar enough French sound to English /t/), and an L1 French learner’s perceptual target for /t/ is in the short lag VOT range. The SLM predicts that “new” categories, which are not perceived by the learner as being similar to an existing L1 category, may be easier to learn because they are not classified as equivalent to any native sound.

Accordingly, when both the L1 and L2 have a two-way stop contrast that can be differentiated by VOT alone, it is straightforward to predict which L2 category will be phonetically realized as which L1 category by novice L2 learners: the stop categories with the greater positive VOT values in both languages will be equated with each other, and then likewise with the stop categories in both languages with the lesser positive (or greater negative) VOT values. Crucially, such patterns found in native speakers and L2 learners of these European languages are reinforced by the orthographic equivalence between the categories (e.g. long lag English /t/ and short lag Dutch /t/ are both written as <t>). We should not expect cases in which, for example, an L1 Dutch speaker consistently produced English /t/ with pre-voicing and English /d/ with short lag VOT, presumably assimilating English /t/ to Dutch /d/ and English /d/ to Dutch /t/.

Stop contrasts in many languages, however, involve more than two categories, rely on acoustic cues other than VOT, or are not written with the same graphemes as the stops in well-studied European languages. The current study investigated the case of L1 speakers of Mandarin, a language with a two-way contrast between short-lag and long-lag VOT stops, learning Korean, a language with a three-way stop contrast differentiated by both VOT and *f*0 in word-initial position. In this scenario, the L2 learner cannot simply substitute a different L1 stop category for each L2 stop category in the same way that an L1 Dutch speaker could substitute Dutch /d/ for English /d/ and Dutch /t/ for English /t/. If an L2 learner of Korean tried this, he or she would necessarily be forced to use the same L1 category for two different L2 categories: while such a strategy is certainly possible, it would not result in production that would be perceived as correct by native Korean listeners.

1.1. L2 acquisition of Korean stops

Seoul Korean (hereafter, Korean) has a three-way phonation type stop contrast between fortis (tense), lenis (lax), and aspirated stops, which have historically been described as having short lag, intermediate lag, and long lag VOT, respectively, in word-initial position. VOT was supported by a secondary cue, the *f*0 of the following vowel, which helped to distinguish lenis stops, with a low *f*0, from fortis and aspirated stops, which had a high *f*0 (Han & Weitzman, 1970; Kagaya, 1974). More recent acoustic studies of younger Korean speakers have continued to find the same *f*0 difference between lenis stops and fortis and aspirated stops (cf. Kang, 2014; Kang & Guion, 2008; Silva, 2006), but have also found that this younger generation of speakers has neutralized the difference in VOT between the lenis and aspirated stops in word-initial position, with both being realized with long lag VOT. This sound change has resulted in the word-initial lenis-aspirated contrast being realized as an *f*0 difference, whereas VOT still functions to differentiate fortis stops from both lenis and aspirated stops.

Studies of non-native perception of the Korean stop contrast have shown that fortis stops are more readily perceived as different from lenis and aspirated stops, and that lenis and aspirated stops are often perceived as similar to each other. In perceptual assimilation studies that have tested L1 listeners from languages with a two-way VOT stop contrast, such as Japanese (Yasuta, 2004), English (Schmidt, 2007), and Mandarin (Holliday, 2014), it was found that Korean fortis stops were perceived as unaspirated stops (or voiced or short-lag VOT) in the vast majority of trials, and both Korean lenis and aspirated stops were perceived as aspirated (or voiceless or long-lag VOT), with lenis stops sometimes being a slightly less good category fit depending on the place of articulation and vowel context.

Thus, it has been shown that Korean lenis and aspirated stops are often perceived as the same category, and not the same category as fortis stops, by non-native listeners whose L1 has a two-way VOT stop contrast. The Perceptual Assimilation Model (PAM; Best, 1995), which makes predictions about the relationship between perceptual assimilation and discrimination of non-native speech sounds by naïve listeners, predicts that discrimination between non-native sounds that assimilate to a single L1 category should be poor, and discrimination between sounds that assimilate to different L1 categories should be good. PAM therefore predicts that discrimination between Korean lenis and aspirated stops by naïve L1 Mandarin listeners should be poor, and discrimination between Korean fortis and either lenis or aspirated stops should be good.

The perception of Korean stops by L2 learners, on the other hand, could be quite different. In the extension of PAM to L2 learners, PAM-L2, Best and Tyler (2007) point out that the linguistic experience of L2 learners differs from naïve listeners in ways that could affect how they assimilate L2 sounds to L1 categories. For example, the phonological status or orthographic representation of an L2 sound is both irrelevant and inaccessible to a naïve listener, but such information could be very salient to an L2 learner and could certainly impact perception. Best and Tyler (2007, p. 28) cite the example of French /r/ (realized as [ʁ]), which although is acoustically quite distinct from English /r/ (realized as [ɹ]), could nonetheless be assimilated to English /r/ at the phonological level. Thus, because the L2 learner must process both phonetic and phonological information, L2 learners’ perception could diverge from that of naïve

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