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Word-Initial Stops in Korean and English Monolinguals and Bilinguals*

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Oh, Mira & Daland, Robert. 2011. Word-Initial Stops in Korean and English Monolinguals and Bilinguals. *Linguistic Research* 28(3), 625-634. The theoretical status of early bilinguals is an area of some controversy. This study investigates subphonemic variation in Korean and English by monolinguals, and bilinguals who were born in the US (simultaneous), moved to the US as young children (early), or moved to the US during late adolescence (late). Speakers were recorded producing word-initial stops in a phrase-medial context. Measurements included stop VOT, H1-H2 and initial pitch on the following vowel. Bilingual productions were generally similar to monolinguals'. However, early and simultaneous bilinguals exhibited a 3-way VOT contrast for Korean stops that was recently neutralized to a 2-way contrast in Korea (Silva 2006). These findings are discussed with respect to transfer/convergence effects and phonetic change in Korea.

Key Words bilingualism, Korean, VOT, English, stops, pitch, H1-H2

1. Introduction

Bilingualism is simultaneously common and poorly understood. One practical challenge is that the term itself is used inconsistently in the literature. In this paper, 'bilingual' will refer to speakers who are fluent in two languages. This definition is not intended to imply that all bilinguals are the same. Indeed, the problem is just the opposite - bilinguals are quite heterogeneous.

Age of acquisition (AoA) - the age at which a speaker begins to be immersed in a new language, is the best-known predictor for ultimate attainment (Flege 1995). Speakers immersed by 6 (*early bilinguals*) acquire a native-sounding accent, while speakers immersed later than 16 (*late bilinguals*) exhibit *accent transfer* from their

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L1 (Tahta et al., 1981; Flege, 1991). Thus, early bilingual speech *sounds* the same as monolinguals, but there is debate as to whether bilinguals differ in fine-grained acoustic detail.

The empirical data seem to conflict. Khattab (2000) found that bilingual Arabic-English children produced the Arabic /b/ differently from the English /b/; in each language bilinguals' /b/ also differed from monolinguals'. Sundara et al. (2006) reports similar results for coronal stops produced by simultaneous French-English bilinguals and monolinguals. In contrast, Kang & Guion (2006) found that early Korean-English bilinguals did not differ from monolinguals with respect to their language's respective stops; on this basis it was argued that early bilinguals possessed independent, native-like language systems, whereas late bilinguals did not.

In light of the empirical uncertainty, it seems wise to replicate and extend research on bilinguals. The present study does exactly that - like Kang & Guion (2006) it is a production study of Korean-English bilinguals. However, this study goes beyond previous studies in several ways. One is the more fine-grained differentiation between simultaneous and early bilinguals. Another is the use of Korean monolinguals from Korea.

2. Language Background

2.1 English Stops

English exhibits a 2-way laryngeal contrast for stops, e.g. *buy~pie*. Word-initial voiceless stops are aspirated; voiced stops are phonetically voiceless unaspirated, with occasional prevoicing (Lisker & Abramson 1964). In addition to Voice-onset time (VOT), other properties may also be cues for perception to stop voicing in English. For instance, the vowel following a voiceless stop is shorter than that following a voiced stop (Allen & Miller, 1999; Metz et al., 2006), and F0 of the voicing onset after a voiceless stop is higher than that following a voiced stop (Ohde, 1980).

2.2 Korean Stops

In contrast to the 2-way laryngeal contrast of English stops, Korean exhibits a 3-way laryngeal contrast, *e.g. pul* (lenis) 'fire' ~ *ppul* (tense)[6] 'horn' ~ *phul* (aspirated) 'grass'. Korean stop contrasts are perceived on the basis of both VOT and pitch (Kim, Beddor & Horrocks 2002). Relative to aspirated stops, tense stops have a shorter VOT. Lenis stops have a lower vowel-initial F0 than aspirated and tense stops.

This general picture is complicated by the fact that Korean has experienced a phonetic change. A 1964 study (Lisker & Abramson 1964) reported that the mean VOT values for all 3 categories differed: tense (12 ms), lenis (33 ms), aspirated (104 ms). But a cross-sectional study in 2006 (Silva 2006) found that the VOT contrast between lenis and aspirated stops collapsed in speakers born between about 1960 and 1980, with contemporary speakers producing a VOT of 60-80 ms for both. The finding was also supported by Kang & Guion (2008).

It has also been reported that Korean and English stops may be distinguished by breathiness, as indicated by H1-H2, the amplitude difference in first and second harmonics (Ahn 1999).

3. Methods

3.1 Participants

A total of 33 participants were included; their characteristics are reported in Table 1.

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[6] Korean romanization is used throughout the paper because the IPA lacks symbols for Korean tensed stops.

Table 1. Participants' Language Background. Speaking Scores Indicate Self-reported Speaking Proficiency.

Category	Gender	English speaking	Korean speaking	Avg. age of AoA	Avg. age
Mono-E	9F, 4M	7	0	0	21
Mono-K	4F, 4M	0	7	0	27
Simul	1F, 5M	7	5	0	26
Early	3F, 0M	7	6	6	27
Late	2F, 1M	6	7	12.5	24

3.2 Stimuli

English targets were *pie*, *buy*, *tie*, *die*, *kye*, *guy*; they were presented in the carrier phrase *Say* ___, *too*. Korean targets were *pal*, *phal*, *ppal*, *tal*, *thal*, *ttal*, *kal*, *khal*, *kkal*; the carrier was *Iketto* ___ *ita* 'This is _____.'

3.3 Procedure

Recordings were done in a sound-attenuated room in Korea (Seoul Korean monolinguals) and the US (all others) using a head-mounted microphone.

Participants were instructed to read the sentences on the monitor of the computer in front of them at a comfortable speaking rate. The stimuli were presented using the Alvin software, and productions were digitally recorded as WAV files. Three tokens of each item were recorded for a total of 450 English tokens (25 speakers x 6 words x 3 tokens) and 540 Korean tokens (20 speakers x 9 words x 3 tokens). Bilinguals were recorded in two sessions, one for each language.

3.4 Measurements

Recordings were manually segmented and labeled in Praat (v5.2.16), discarding poor tokens. Measurement was done using VoiceSauce (v1.08).

VOT - vowel onset at the first full glottal pulse

F0 (normalized) - first 1/9 of the vowel following the stop; divided by the speaker's average F0 across all vowel tokens

H1-H2 - measured vowel-initially, like F0

Tokens with a normalized F0 < .8 (indicating a pitch-halving error) were discarded.

4. Results

Tabular and graphical summaries are given below, followed by statistical analysis.

Table 2. VOT (ms), Normalized F0, and H1–H2 (dB) of Monolinguals and Bilinguals for Each Laryngeal Category. Normalized F0 is a Percentage, e.g. 110 Means 10% Higher than the Speaker's Average.

Stop	Meas	Mono	Simul	Early	Late
Eng vcd	VOT	19	20	15	22
	F0%	106	102	100	106
	H1-H2	1.2	1.3	4.7	1.7
Eng vcls	VOT	91	83	61	85
	F0%	113	119	110	117
	H1-H2	5.0	6.7	9.6	6.7
Kor asp	VOT	78	83	79	66
	F0%	129	132	131	127
	H1-H2	7.2	8.6	7.9	6.6
Kor lenis	VOT	80	63	60	67
	F0%	85	85	83	89
	H1-H2	6.7	8.0	10.6	3.7
Kor tense	VOT	18	13	12	16
	F0%	119	123	114	106
	H1-H2	2.3	2.0	8.3	2.7

All t-values reported below are derived from linear mixed-effects regression in R (*lmer {lme4}*) with participant as a random effect, and place and laryngeal category x language status as fixed effects. *P*-values are estimated via Monte Carlo sampling (*pvals.fnc {languageR}*), since *df* is undefined or unknown for mixed-effect models (Pinheiro & Bates 2000). Only the VOT, F0, and H1-H2 measurements are reported here; place effects are not reported because the focus here is on the laryngeal systems, which differ between the two languages. The statistics given below report all and only positive results; non-significant results were omitted for clarity and brevity.

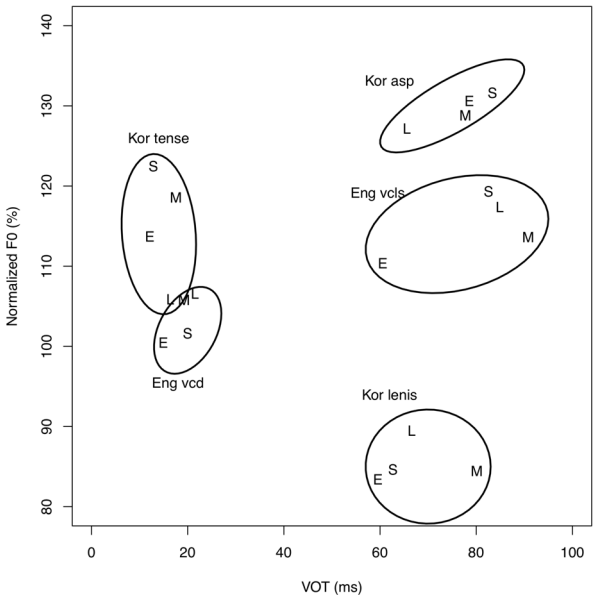

Figure 1. Stops by Laryngeal Category. M=monolingual, S=simultaneous bilingual, E=early bilingual, L=late bilingual.

4.1 Korean Stops

Monolinguals did not exhibit a VOT contrast between aspirated and lenis stops (t=.74, p=.46), and late bilinguals did not differ from monolinguals. However, early bilinguals' lenis VOTs were shorter than aspirated (t=-4.2, p=2e-4), as were simultaneous bilinguals' (t=-5.4, p<1e-4). There was a 3-way contrast for F0 for all speakers; early and simultaneous bilinguals weren't different from monolinguals. However, late bilinguals' tense stops had lower F0 than monolinguals' (t=-2.3, p=.02). As for H1-H2, across all speakers tense stops had lower H1-H2 than aspirated stops (t=-6.2, p<1e-4), but lenis stops did not. Early bilinguals had higher H1-H2 than monolinguals for both lenis (t=2.4, p=.02) and tense (t=4.1, p=1e-4) stops.

4.2 English Stops

Across all speakers, there was a VOT contrast for voicing (t=29.2, p<1e-4). For

voiceless stops, simultaneous bilinguals' VOTs were 8 ms shorter than monolinguals' (t=-2.3, p=.02), and early bilinguals' were 30 ms shorter than monolinguals' (t=-5.5, p<1e-4). Voiceless stops had a higher F0 than voiced across all speakers (t=7.7, p<1e-4); and simultaneous bilinguals' voiceless stops were higher than monolinguals' (t=4.1, p=1e-4). Voiceless stops were also more breathy than voiced across speakers (t=8.2, p<1e-4) as indicated by H1-H2 values. Early bilinguals were more breathy than monolinguals (t=2.1, p=.04), and simultaneous bilinguals' voiceless stops were more breathy than monolinguals' (t=2.4, p=.02).

4.3 Interlanguage Stops

Tense stops did not differ from voiced stops in VOT (except for a 7 ms difference in simultaneous bilinguals; t=-2.5, p=.01). However, tense stops were distinguished from voiced stops by F0, with the notable exception of late bilinguals (t=-.2, p=.85). Tense stops were distinguished from voiceless stops by VOT. However, bilinguals did not exhibit different F0's for tense vs. voiceless stops, again with the notable exception of late bilinguals (t=2.9, p=.005). Voiceless stops were distinguished from lenis stops by F0. Simultaneous and late bilinguals also distinguished these stops using VOT, but early bilinguals did not (t=.1, p=.90).

5. Discussion

Several generalizations may be made from these data. First, every bilingual group was broadly similar to monolinguals for the stops of both languages. Second, late bilinguals exhibited a merger between English voiced and Korean tensed stops. Third, to the extent that there were monolingual-bilingual differences, early and simultaneous bilinguals generally patterned together. Finally, early bilinguals' voiceless stops had VOTs that were 25 ms shorter than other speakers.

5.1 L2-to-L1 Transfer: Tense~Voiced Merger

The late bilinguals exhibited a merger between tense and voiced stops - for this group, the Korean and English stops were not different in VOT or F0. This appears

to be an L2-to-L1 transfer effect, since late bilinguals differ from monolinguals on tensed stops in F0, and because they achieve the monolingual standard in the L2 for voiced stops.

5.2 Linguistically Conservative Bilinguals?

Silva (2006) reports that Korean speakers over 50 produce a VOT contrast between lenis and aspirated stops (conservative pattern), while Korean speakers under 30 in Korean do not (innovative pattern), although both generations contrast F0 between lenis and aspirated stops. His study is also supported by Kang & Guion (2008). The late bilinguals and monolinguals in this study exhibited the innovative pattern, which is expected since they learned Korean in Korea as children and are under 30. In contrast, the early and simultaneous bilinguals exhibited the conservative pattern. One interpretation is that English exposure caused these bilinguals to acquire a language system that differed from what they were exposed to. However, it seems more reasonable to suppose that just the opposite is the case - early bilinguals in America acquired the conservative pattern spoken by their parents, while the late bilinguals in Korea acquired the innovative pattern spoken by their peers.

5.3 Early Bilinguals' Voiceless Stops

A clear finding of this study was that early bilinguals had voiceless stops that were considerably shorter than monolinguals. The VOT that early bilinguals produce is the same as for their lenis stops, which suggests this is an interlanguage convergence effect. This finding stands in contrast to the more general pattern of early and simultaneous bilinguals achieving the monolingual standard in both languages (modulo the sound change effect of the previous section).

6. Conclusion

This study documented several subphonemic differences between Korean-English bilinguals and monolinguals. Late bilinguals exhibited a tensed-voiced stop merger,

evidently an L2-to-L1 transfer effect. Early and simultaneous bilinguals exhibit a VOT contrast between lenis and aspirated stops that has been neutralized in Korea, presumably because their parents speak the conservative variant. Early bilinguals produce voiceless stops with short VOTs like the ones they use for lenis stops. These findings increase our understanding of the consequences of multiple-language exposure.

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