CHAPTER 8

Trying to hit a moving target
On the sociophonetics of code-switching

Barbara E. Bullock and Almeida Jacqueline Toribio
The University of Texas, Austin

In this chapter we examine the phonetic reflexes of code-switching in bilingual production. We demonstrate that, in code-switching, bilinguals maintain distinct phonological categories for voiceless stops with respect to the Voice Onset Time (VOT) variable, but their speech may manifest various interlingual effects at the level of phonetic implementation, including divergence, convergence, hyper-articulation, and transfer. We argue that this diversity of outcomes reflects normal variation and that the specific phonetic result of code-switching may be characterized by appeal to linguistic-internal factors (i.e., inherent differences between the contributing languages) and linguistic-external factors (e.g., proficiency, language practices, perceptions of congruence).

Keywords: code switching, phonology, voice onset time, variation, transfer

Introduction

Of all of the various forms of bilingual linguistic behavior, code-switching (henceforth, CS) is the most evident and immediate declaration of a speaker's bilingualism. For many researchers, CS provides direct insights into the ability of bilinguals to manage and to deploy different linguistic systems even while alternating between them. This ability arises from a confluence of cognitive, linguistic, and social factors, each of which is normally studied independently of the other. Cognitive approaches generally focus on CS as an index of a bilingual’s ability to selectively inhibit or activate a language. Linguistic approaches, in turn, aim to discern the knowledge of language that bilinguals must possess to enable them to switch between the two systems in systematic ways. Finally, sociolinguists explore why and under what conditions bilinguals may choose to code-switch. Although each dis-
code-switching, where each language is understood to be a relatively static entity. But much more rare in the vast literature on CS is the acknowledgement that bilin-
guals may actually do something to their languages when code-switching. That is, that the structures produced when bilinguals engage in CS may reflect small but significant linguistic changes relative to their own monolingual productions.

The focus of this investigation is on the phonetic production of bilinguals, an area that has been neglected in linguistic and sociolinguistic approaches to the study of CS, which tend to focus exclusively on the position of a code-switch with respect to higher order linguistics domains such as morpho-syntactic constituents or pragmatic-discursive components. The lack of attention to the phonological repercussions of CS may ensue from the traditional division between borrowing and CS. The former is generally assumed to involve the phonological adaptation of words from the source language into the lexicon of the recipient language, whereas CS, which occurs spontaneously, does not. Thus, only borrowings are assumed to be instructive about cross-linguistic phonological perception and production. Code-switches, on the other hand, arguably affect only the low-level phonetic properties of the sound system and, even then, only as temporary perturbations. Yet, as psycholinguists have recognized, the low-level, gradient nature of phonetics can offer insights into how bilinguals process and produce in two languages that differ along a given acoustic-phonetic dimension. Moreover, sociolinguists, working largely on monolingual or bi-dialectal communities, have consistently documented the relation between phonetic variation and factors such as social status, group identity, speech register, etc., an enterprise referred to as sociophonetics (see Thomas 2002 for an overview).

The present work spans the void between the psycholinguistic research on language switching and the knowledge gleaned from sociophonetics. We argue that the component languages of a bilingual engaged in CS should not be expected to be invariable, monolingual-like systems but, instead, these languages – used independently or in conjunction, as in CS – can provide us with evidence of a rich repertoire of bilingual forms. Moreover, we argue that the variable outcomes produced by bilinguals are probably not reducible just to differences in proficiency or language dominance. Rather, CS data reflects various sociophonetic strategies that bilinguals have at their disposal to maintain contrast between their languages while, at the same time, articulating them together. A speaker’s language proficiency, metalinguistic knowledge, and language socialization all likely contribute to the selection of strategies he or she employs when engaged in CS.
Psycholinguistic studies

Psycholinguists, focusing on the underlying cognitive mechanisms and neural organization responsible for bilingual speech, have conducted numerous experiments under the rubric of language switching (see Kutas et al., 2009, for an overview). Language switching tasks require participants to change their language of response at a predestined point in the utterance. They are designed to allow researchers to assess whether or not there is a cognitive 'cost' to language alternation in terms of response times. In the phonetic realm, language switching research generally seeks to determine whether the language of presentation, termed the base or precursor language, affects the perception or production of the response or guest language.

To date, nearly all phonetic switching studies use stimuli that probe the phonetic categorization of the voiced /b, d, g/ versus voiceless /p, t, k/ series of stops (see Bullock 2009, for an overview). One important acoustic cue for distinguishing between these series of stops is Voice Onset Time (VOT), defined as the interval, measured in milliseconds, between the burst release of the consonant closure and the onset of voicing in the following vowel. VOT spans a continuum, and languages vary according to where they place the transition point between stops that are perceived to be voiced versus those perceived to be voiceless. For instance, Spanish voiceless stops are produced with a short voicing lag (averaging ~ 0–30 ms.) while English voiceless stops are produced with a long lag (averaging ~ 30–120 ms.), which often creates a perceptible period of aspiration. However, there is good deal of variation in the production of voiceless stops in each language so that there are points along the continuum at which the languages may overlap. The gradient nature of the voicing lag for voiceless stops makes it an ideal testing ground for examining whether or not the component languages of a bilingual can be seen to interact and influence each other in CS.

Imagine what a Spanish-English bilingual must do to articulate a sentence such as (1), in which the voiceless stops are underlined:

(1) I will call Tía Carmen mañana.
   ‘... Aunt Carmen tomorrow.’

Each stop potentially presents a broad range of target VOTs, although the range itself differs between the two languages. Essentially, the target phoneme, /k/, is the 'same' category across languages, but its articulation ideally represents a language-specific distinction. That is, the initial /k/ of English "call" should be produced within the appropriate range for English, while the initial /k/ of Spanish "Carmen" needs to be produced within the respective Spanish range. Significantly, those
ranges could, at times, overlap. While code-switching, then, a bilingual needs to hit a moving a target from the phonetic point of view.

A number of distinct phonetic outcomes of the bilingual’s behavior while engaged in CS can be envisioned (relative to his or her behavior when not code-switching.)

i. There is no change in one or both languages. That is, the respective average VOT for /k/ in one or both languages remains the same, indicating that the speaker code-switches immediately and completely at the phonetic level in one or both directions.

ii. The respective average VOT for /k/ in one or both languages merges toward that of the other, indicating that there is some degree of cross-linguistic assimilation.

iii. The respective average VOT for /k/ in one or both languages moves away from that of the other, indicating that there is some degree of cross-linguistic dissimilation.

On this view, a range of inter-systemic influences on CS is possible. Under scenario (i), CS has no effect on phonetic production in one or both languages. That is, the bilingual is able to maintain monolingual-like values while switching, indicating a fine degree of articulatory control. Scenarios (ii) and (iii) indicate that CS does have an effect on phonetic production, either drawing the languages closer together from a phonetic perspective (ii) or moving them apart (iii). Scenario (ii), in particular, potentially allows for a complete neutralization of VOT across languages, where a bilingual could collapse the VOT distinction across languages into a single phonetic category.

In large part, the psycholinguistic literature on the phonetics of language switching is focused on the effect of the base language on the perception of the guest language (Caramazza et al. 1973, Williams 1977, Elman et al. 1977, Soares & Grosjean 1984, Grosjean & Soares 1986, Grosjean 1988, Hazan & Boulakia 1993, Bürki Cohen et al. 1989, Li 1996). In essence, these studies endeavor to determine whether the base language biases a bilingual’s perception of guest language tokens such that the perceptual cut-off point for the voicing distinction in the guest language is shifted toward that of the base language. The materials are designed using natural or synthesized stimuli embedded within a base or carrier phrase, as illustrated in (2).

(2) Elman et. al. (1977: 972) switching stimuli
   a. “Write the word /pa/”
   b. “Escriba la palabra /pa/”

A shift in the p ity to fully sup r though some r boundary shift neutral VOT v during CS. The ences between Hazan & Boulaki e the phonetic le these findin guals may be a lingual speake categories for t necessarily im ticipating a co stops across la are possible, as Swi the conseque guages. First, a source of inter uate their pro base language, tion. Secondb ly, into a bas Rather, the gu sibly, may be i its foreignnes where a prope alternaate langu


Here, the stim is not difficult articulate the;
A shift in the perceptual boundary is interpreted as evidence of a bilingual's inability to fully suppress the auditory–acoustic properties of the base language when processing in the guest language. The results of these studies have been mixed, although some report evidence of a cost in perceptual switching, as evidenced by a boundary shift toward the base language when processing stimuli with language-neutral VOT values.

There are comparatively few switching studies devoted to phonetic production during CS. Those that do exist conclude that bilinguals produce categorical differences between languages with respect to the VOT variable (Caramazza et al. 1973, Hazan & Boulakia 1993, Grosjean & Miller 1994). This is taken as evidence that, at the phonetic level, the switch between languages is complete. The interpretation of these findings has been extended to support the hypothesis that "in normal speech" (Green 1998) or "under natural circumstances" (Thomas & Allport 2000), bilinguals may be able to inhibit one lexicon in production. However, the fact that bilingual speakers are capable of producing non-overlapping or distinct phonetic categories for their voiceless stops across languages while engaged in CS does not necessarily imply that CS has no effect on phonetic production. Rather than anticipating a complete effacement of the categorical distinction between voiceless stops across languages, we might expect that more subtle phonetic reflexes of CS are possible, as we have outlined above in (i–iii).

Switching studies, as currently designed, may be too restrictive to fully probe the consequences of CS on the sounds systems of the bilingual’s component languages. First, such studies assume that the base language is static and that it is the source of inter-lingual transfer when it could well be the case that bilinguals modulate their production of the base language in anticipation of a switch. That is, the base language, as well as the guest language, could be a target for phonetic adaptation. Secondly, the insertion of a single guest word or, often, a single nonce syllable, into a base language carrier phrase may not adequately replicate natural CS. Rather, the guest element may be more akin to a lexical borrowing or, quite possibly, may be interpreted as an element that is to receive a contrastive focus due to its foreignness. Consider, for instance, the stimuli of Grosjean & Miller (1994), where a proper name, in this case "Carl," is the guest word to be pronounced in the alternate language phonetics (in French in (3a) and in English in (3b)):

(3) Grosjean & Miller (1994: 203) stimuli for production study
   a. “During the first few days, we’ll tell him to copy Carl constantly.”
   b. “Pendant les premiers jours, il faudra qu’il copie Carl constamment.”

Here, the stimulus is a homonym with a similar pronunciation across languages. It is not difficult to imagine, then, that a bilingual participant might actually over-articulate the guest word to distinguish it from its base language homonym.
In sum, psycholinguistic switching studies have been instructive about the efficacy with which bilinguals alternate between different phonetic systems. However, we expect that, by their experimental design, such studies present a conservative picture of the effects of CS on the sound systems of the bilingual's languages. Moreover, the conclusions reached in switching studies of production seem to be at odds with the results of sociophonetic studies, where a variety of behaviors among bilinguals are revealed when the sub-phonemic level is examined.

Sociophonetic studies

The linguistic literature on bilingual pronunciation is rife with evidence that bilinguals—even those who have acquired a second language early in life and who can pass as native speakers of their L2—often produce compromised phonetic values relative to those of monolinguals (see Flege & Eefting 1987a,b). More intriguing for the present study, however, is evidence that the VOT value of bilinguals in their first language has been shown to be vulnerable to the influence of a strong second language in various ways. For instance, the L1 values of bilinguals have been observed to converge toward those of their L2 (see Flege & Hillenbrand (1984) on French-English bilinguals and Major (1992) on English-Portuguese bilinguals). Conversely, Flege & Eefting (1987a,b) found that a bilingual’s first language VOT values may equally well diverge from that of their L2, thereby enhancing the VOT contrast between languages while exaggerating the values of the native language relative to the production of monolinguals. Finally, Sancier & Fowler (1997) documented that the VOTs of the languages of a Portuguese-English bilingual move in tandem—shorter voicing lags in a Portuguese-speaking environment and longer lags in an English-speaking one. They refer to this phenomenon as gestural drift. This drift can take place in a relatively short period of time, as a bilingual moves between environments in which one language or the other is dominant. Such findings suggest that the low level phonetic implementation of a contrast for bilingual speakers remains remarkably flexible and subject to modification in accord with his or her linguistic experience.

The gradient shifts attested in the phonetic production of bilinguals can be taken as evidence that the phones of the two languages reside in a common phonological space (Flege 1995). Under this view, the co-influence between the languages can be understood as micro-adjustments at the phonetic level that result from the necessity to accommodate sounds that are perceived to be 'similar' within that same space. This kind of accommodation is likely motivated by principles of cross-linguistic perceptual organization that are not yet well understood.

However, at the individual level, since all speakers also use their group idiom relatively to that influence. Particul 2007, 2009) on lingual children and their mother's sociophonetic va acoccted form: variety of their netic repertoire (see Queen 201

The present st

When consider production inc
Further, it wot representing t
putting them tv of bilinguals p
One would ex bilinguals are
and use both l
ociophonetic st
in monolingu
i

Guiding questi

The overall stu
production in
switching stud
less stop cate
level, our stud
of a more sub

out the efficacy s. However, we
משרגים. Moreover, to be at odds
ience that bilin-
fe and who can
phonetic values
ore intriguing
uals in their
strong second
have been ob-
rand (1984) on
ese bilinguals).
language VOT
ning the VOT
ative language
r (1997) do-
ingual move in
ent and longer
s gestural drift.
ilingual moves
ant. Such find-
ust for bilingual
accord with
uals can be
mmon pho-
etween the lan-
evel that result
'similar' with-
ed by principles
erstood.

However, sociophonetic accommodation can also be intentional. At an individual level, speakers are known to adjust their rate of speech, their pitch, loudness, etc., even their overall accentness for communicative reasons. At the social level, speakers also use linguistic variables to convey information about themselves and their group identity and, when doing so, they often alter the form of their speech relative to that of their interlocutors, either as expressions of solidarity or dissonance. Particularly relevant in the present context is the work of Khattab (2002a, b, 2007, 2009) on phonetic accommodation among Arabic-English simultaneous bilingual children. In case studies of naturalistic conversation between these children and their mothers, Khattab reveals that the children demonstrate considerable sociophonetic variation within and across their languages to the point of producing accented forms of one of their native languages to conform to the second language variety of their parents. She suggests that bilinguals have an expanded sociophonetic repertoire that must be considered as part of their phonological competence (see Queen 2001, Fagyal 2005 on bilinguals' sociophonetic repertoires).

The present study

When considered together, the linguistic and sociophonetic literature on bilingual production indicates that the phonetic systems of bilingual speakers are malleable. Further, it would appear that bilinguals may follow different perceptual paths in representing their component languages and may use multiple strategies when putting them to use. Such observations have generally been gleaned from studies of bilinguals performing in one of their languages at a time, i.e., monolingually. One would expect that the potential for co-influence would be increased when bilinguals are performing bilingually. Because CS requires a bilingual to activate and use both languages simultaneously, evidence of the various linguistic and sociophonetic strategies followed by bilinguals should be more apparent in CS than in monolingual speech. This provides the conceptual motivation for the present investigation, a part of which has been previously published (Bullock et al. 2006).

Guiding questions

The overall study seeks to redress the limitations of the previous research on VOT production in language switching paradigms (reviewed in § 2 above). While switching studies established that bilinguals maintain categorically separate voiceless stop categories across languages while switching between them at a lexical level, our study aimed to determine whether evidence of cross-linguistic influence of a more subtle nature would be revealed in bilingual CS at the sentential level.
Unlike the switching studies, we did not assume that cross-linguistic influence would be uni-directional (i.e., from the base language to the guest language); rather we tested directionality as an independent variable. One primary goal of Bullock et al. (2006) was to examine the possibility that the phonetic system of the L2 might be more vulnerable to inter-lingual influence than the L1, since L1 phonetic categories are arguably established early. To anticipate the findings somewhat, we found that this was not the case; therefore, we extended the study to include participants with more balanced bilingual proficiency. We report here on the behavior of three groups of bilingual participants – Spanish L1-late English L2, English L1-late Spanish L2, and early Spanish-English bilinguals – focusing on the overall patterns of their responses and how to interpret these patterns.

Methodology

The studies included 288 test sentences one third were test sentences and two thirds were fillers. The test items comprised 24 monolingual (12 Spanish and 12 English) sentences plus 72 code-switched sentences (36 English→Spanish and 36 Spanish→English). All stimuli included three voiceless stops, with tokens of /p, t, k/ counterbalanced across all sentences. Samples of the monolingual stimuli appear in (4).

(4) a. Monolingual English
   Who took the gap from my pen?

b. Monolingual Spanish
   Para quién es la torta?
   "For whom is the cake?"

The 72 bilingual sentences each included three voiceless stop tokens embedded in three different contexts or sites: before the code-switch, directly at the switch site, and in a post-switch position. The pre-switch and post-switch positions could occur anywhere from two to six syllables away from the switch site. Examples of the bilingual stimuli, tagged for the appropriate sites, appear in (5).

(5) a. Todos mis amigos talked Spanish as kids.
   ↑pre-switch   ↑switch   ↑post-switch

b. The typhoon damaged techos y paredes.
   ↑pre-switch   ↑switch   ↑post-switch

Coding the data for 'switch site' allowed us to measure the effect of the direction of a switch (from Spanish to English or vice versa) and it allowed us to analyze whether or not subjects would phonetically anticipate and recover from a code-switch.
guistic influence language); rath-
ery goal of Bul-
system of the L2
ince L1 phonetic
is somewhat, we
y to include par-
on the behavior
L2, English L1-
g on the overall

tences and two
. Spanish and 12
. Spanish and 36
h tokens of /p, t,
gual stimuli ap-
ns embedded in
it the switch site,
itions could oc-
Examples of the
the direction of a
alyze whether
ode-switch.

Data from 33 bilinguals participants are reported on here: 8 early Spanish-English bilinguals and 25 late bilinguals – 15 L1 Spanish and 10 L1 English. All participants completed the tasks without disfluencies or significant pauses in their monolingual and CS productions. Participants were categorized as early bilinguals if their age of onset of acquisition of English was under 5 and if they had sustained regular use of both languages since that time. For the early bilingual participants, the average age of onset of English acquisition was 3. The average age of L2 onset for the L1 Spanish bilinguals was 12 and that for the L1 English bilinguals was 14. The average age of all participants was comparable, ranging from 26 to 31. The groups differed in their assessment of their Spanish and English proficiencies, with the early bilinguals self-reporting the best balance of bilingual proficiency. Spanish and English proficiencies were respectively self-assessed on a seven-point scale, where 1 represents low proficiency, as follows: 6.31 and 6.48 for early bilinguals; 7 and 4.5 for L1 Spanish bilinguals; 5.75 and 7 for L1 English bilinguals. All participants were recruited on campus. The early bilinguals were university students and faculty of various disciplines. More notably, the late bilinguals (L1 Spanish and L1 English) were all employed as Spanish teachers.

The study was completed on the university campus over two days, separated by one week. The first day of testing, was 'monolingual': participants were asked in Spanish to read aloud the monolingual Spanish sentences and to complete a Spanish proficiency test. On the second day, bilingual and English language activities were presented with an interval between them. First, participants read the CS sentences and after a recess, they responded to language history and language attitude questionnaires presented in English by an English-speaking researcher, and, finally, they read aloud the monolingual English sentences. The stimuli were presented in randomized blocks (monolingual English, monolingual Spanish, bilingual CS), using e-Prime. Participants’ reading of the sentences was recorded using a Marantz PDM 660 flash recorder and a head-mounted unidirectional microphone and digitized at 44 kHz 16bit quantization. All target tokens of /p, t, k/ were extracted and measured using Praat, developed by Boersma (2001). The figure below illustrates a waveform and spectrograph of one participant’s production of the bilingual sentence (5a).

These measures were submitted to statistical analysis using a two-way repeated measures ANOVA with two (language: Spanish, English) by four (site: monolingual, pre-switch, switch, post-switch) by three (phoneme: /p/, /t/, /k/) factorial design. The significance level was set at *p<.05 for all analyses.
Figure 1. Spectrograph of code-switched sentence

**Results**

For each group, there was a significant main effect for language, site, and language by site. (There are no statistical differences for phonemes.) All groups showed a highly significant effect of language, where mean Spanish VOTs were significantly lower than mean English VOTs across the board. Within each group there was equally a significant effect of site within each language. Our focus is to compare bilinguals' mean English VOTs in their monolingual productions with their mean English VOTs in their bilingual productions, and similarly, their mean Spanish VOTs in their monolingual productions with their mean Spanish VOTs in their bilingual productions. The descriptive statistics of the mean VOTs for each site within each participant group are displayed in Table 1.

Note that with respect to the monolingual VOTs, the early bilingual group has the most dispersed mean VOT values between languages (22ms. in Spanish vs. 60ms in English). Surprisingly, their mean VOT for Spanish actually shows shorter voicing lags than their L1 Spanish–late L2 English counterparts. They also produce mean English VOT (60ms.) values that very closely approximate those of the L1 English–late L2 Spanish speakers (61ms.). We can state that, with respect to these numbers, the early bilingual group is the one that performs the closest to a monolingual-like norm in both languages, more or less reflecting their self-reported balanced proficiency.

Table 1. Mean VOT

<table>
<thead>
<tr>
<th>Language</th>
<th>Monolingual</th>
<th>Pre-switch</th>
<th>Switch</th>
<th>Post-switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spanish</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>English</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The results of within a language

Table 2. English

<table>
<thead>
<tr>
<th>Level</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>Spanish</td>
</tr>
<tr>
<td></td>
<td>Early bilinguals</td>
</tr>
<tr>
<td></td>
<td>L1 English</td>
</tr>
</tbody>
</table>

Table 3. Spanish

<table>
<thead>
<tr>
<th>Level</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>Spanish</td>
</tr>
<tr>
<td></td>
<td>Early bilinguals</td>
</tr>
<tr>
<td></td>
<td>L1 English</td>
</tr>
</tbody>
</table>

As shown in (when switch Spanish into I gual VOT me gence toward: post-switch s
Table 1. Mean VOT values in ms. by language, site, and group

<table>
<thead>
<tr>
<th></th>
<th>Early bilingual</th>
<th>L1 Spanish</th>
<th>L1 English</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monolingual</td>
<td>.022</td>
<td>.025</td>
<td>.031</td>
</tr>
<tr>
<td>Pre-switch</td>
<td>.023</td>
<td>.023</td>
<td>.028</td>
</tr>
<tr>
<td>Switch site</td>
<td>.026</td>
<td>.026</td>
<td>.031</td>
</tr>
<tr>
<td>Post-switch</td>
<td>.025</td>
<td>.027</td>
<td>.032</td>
</tr>
<tr>
<td>Monolingual</td>
<td>.060</td>
<td>.055</td>
<td>.061</td>
</tr>
<tr>
<td>Pre-switch</td>
<td>.051</td>
<td>.043</td>
<td>.055</td>
</tr>
<tr>
<td>Switch site</td>
<td>.057</td>
<td>.048</td>
<td>.056</td>
</tr>
<tr>
<td>Post-switch</td>
<td>.063</td>
<td>.054</td>
<td>.060</td>
</tr>
</tbody>
</table>

The results of the statistical analysis of the significant interactions between sites within a language are displayed in Tables 2 and 3.

Table 2. English VOT monolingual vs. bilingual sites

<table>
<thead>
<tr>
<th></th>
<th>Pre-switch site (E→S)</th>
<th>Switch site (S→E)</th>
<th>Post-switch (S→E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1 Spanish</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Early bilinguals</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>L1 English</td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Spanish VOT monolingual vs. bilingual sites

<table>
<thead>
<tr>
<th></th>
<th>Pre-switch site (S→E)</th>
<th>Switch site (E→S)</th>
<th>Post-switch (E→S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1 Spanish</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Early bilinguals</td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>L1 English</td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As shown in Table 2, for each group, the English VOT means at the pre-switch (when switching from English to Spanish) and switch sites (when switching from Spanish into English) differ significantly from the participants' English monolingual VOT means. In each case, the phonetic change is in the direction of convergence towards Spanish, regardless of the direction of the language switch. At the post-switch site, the VOT average recovers to the participants' monolingual
English values, indicating that the effect of CS on phonetic production is localized rather than global through the utterance. Unlike the English results, the Spanish results in Table 3 show considerable variation across groups. The L1 Spanish bilinguals demonstrate stable Spanish VOT mean values, with no significant differences between monolingual and bilingual conditions. The L1 English participants do show significant effects with respect to their Spanish monolingual productions in anticipation of a switch to English. However, the Spanish VOTs produced in this pre-switch position are significantly lower than those they produce in monolingual Spanish; that is, the shift is away from English, not toward English. Only the early bilingual group showed significant convergence of Spanish VOT mean values toward English VOT values while engaged in CS. This merger occurred after switching from English into Spanish and persisted through the utterance. This is, in essence, the base-guest effect targeted in switching studies.

Discussion

Overall, the above results reveal that bilinguals do maintain separate phonological categories for voiceless consonants across languages. Nonetheless, there is significant evidence of the effect of CS on phonetic production. The effect can be bilateral, with each language influencing the other, or unilateral, with only one language being affected. Significantly, the L1 is not impermeable to influence from the L2; the L1 English group and the early bilinguals both showed convergence in the L1 system. In addition, the results indicate that the direction of the switch does not necessarily determine the phonetic outcome, since all groups show convergence of English towards Spanish irrespective of whether English is the 'base' or the 'guest' language. In summary, bilinguals demonstrate diverse effects of CS on production in one or both languages: they demonstrate phonetic anticipation of a switch, phonetic perseveration from a switch, and these shifts can be divergent or convergent in consequence and asymmetric in direction, affecting only one language.

It is to be noted that the English language results were uniform across all groups, but the Spanish language results were dispersed. The question that arises, then, is how to account for the disparity between languages. We surmise that the results can be interpreted by reference to both linguistic-internal differences (i.e., inherent differences between Spanish and English) and linguistic-external differences (e.g., differences in proficiency, language practices, metalinguistic awareness across groups). We begin by considering the findings for English. Recall that all groups showed significant effects of CS on English VOT, both before the switch to Spanish and at the switch from Spanish, in the direction of Spanish. That is, at these sites, all groups showed evidence of phonetic convergence toward Spanish. This pattern could well arise from linguistic differences between English and
Spanish. English permits a wider span of VOT values for voiceless stops, ranging from \(\sim 30-120\) ms. However, it may be that more precision is required to maintain short lag Spanish stops, which range from \(\sim 0-30\) ms. If this is the case, then there is more 'room' for convergence in English than in Spanish, and English VOTs can lower toward Spanish language values while remaining recognizably English-like. Therefore, inherent differences between Spanish and English could in part explain the similar behavior observed across groups.

And although it may seem counterintuitive, proficiency differences across groups could also be implicated in explaining their similar behavior. First, the L1 Spanish bilinguals were of relatively low English language proficiency with respect to other groups. It is possible that they could not easily control their English VOT in CS, hence, they experienced 'normal' interference from Spanish to English, L1→L2. The L1 English bilinguals, who were Spanish language instructors, may have over-controlled their Spanish VOT. Thus, they produced Spanish-accented English immediately before and at the switch site. In this respect, it could be said that these speakers showed a 'hypercorrective' effect, where their L2 Spanish had a significant influence on their L1 English, L2→L1. Thus both groups of late bilinguals showed identical patterns of inter-linguistic influence from Spanish to English, although likely for different reasons. It is unclear whether the same shift in the early bilingual group can be attributed to interference or hypercorrection. As will be discussed below, the early bilinguals, unlike the late bilingual groups, also showed inter-lingual effects in their Spanish. We suggest that the bilateral nature of their performance, L1→L2, reflects phonetic convergence.

Turning to the Spanish monolingual and bilingual language productions, we find disparate behaviors across groups. Recall that the early bilinguals showed significant effects of CS on Spanish VOT at and after switch site; the L1 English bilinguals showed significant effects of CS at the pre-switch site, but in the wrong direction; the L1 Spanish bilinguals showed no significant differences between their monolingual and CS Spanish productions. Here, the challenge is to account for the dissimilar behavior across groups. Again, we can appeal to both linguistic-internal and -external explanations. The L1 English speakers have high mean VOT values in their monolingual productions (31 ms). Exceeding these values could potentially push the consonants noticeably out of the Spanish range. Therefore, there is no merger toward English. In this instance, convergence in CS is phonologically constrained. Note that these speakers demonstrate significantly lower Spanish VOT means in anticipation of a switch to English — that is, divergence away from English. But immediately upon switching, their English VOT values are also significantly lowered toward the Spanish range. The overall effect is one of gestural drift, with the probable function of maintaining or enhancing the contrast between Spanish and English. In contrast, for the L1 Spanish bilinguals, the potential influence of English...
on Spanish is likely mitigated by their low English proficiency. For these speakers, Spanish might be said to serve as a phonetic 'matrix' language so that they produce monolingual-like Spanish and Spanish-accented English in their CS productions. Finally, the early bilingual group, with the lowest overall mean VOT in monolingual Spanish, has the phonetic latitude to converge toward English-like VOT in Spanish and the proficiency to bring about such convergence.

The sociophonetics of code-switching

When interpreted from the perspective of the psycholinguistic switching paradigm, the results of our study are clearly unanticipated. The research aim of the switching studies is to examine bilingual control as determined by the ability to fully and immediately 'turn off' the phonetics of the base language when switching into the guest language. Instead, what we have found is evidence that all bilinguals can modulate the phonetic properties of their languages in anticipation of a switch as well as show signs of phonetic carryover after a switch. Moreover, when we examine the phonetic performance of both languages of a bilingual, a variety of phonetic outcomes of CS are revealed. From our perspective, cognitive control is but one factor in guiding the phonetic performance of bilinguals and its role may be limited. We infer from the fact that all the bilinguals in this study proved capable of maintaining separate categories for their voiceless stops that they can exercise control of their languages while code-switching. More intriguing is that they appear to be able to take different paths in resolving cross-linguistic phonetic differences within these categories while engaged in CS. These result in different outcomes, which can be identified as follows:

i. Divergence (maintain or enhance contrast) L1→L2
ii. Convergence (compromise) L1→L2
iii. Interference: L1→L2
iv. Hypercorrection: L2→L1

We speculate that the path that bilinguals may take depends partially on how alike or how different they perceive phonetic differences to be. In all studies of bilingual phonetic production, it is taken for granted that the voiceless stops constitute perceptually congruent phoneme categories across Spanish and English. However, the notions of perceptual and structural congruence remain ill-defined and it is not known if perceptual similarity across the languages of a bilingual is driven by universal perceptual principles (Johnson 2004) or if congruence is a relative notion that may vary between individuals and groups (Sebba 2009).
Sebba (2009) argues on the basis of observations of the morpho-syntax of CS that inter-lingual congruence may, in part, be constructed by individual speakers. Accordingly, individuals who differ in terms of language proficiency, practice, education and metalinguistic awareness may employ different strategies in order to treat inter-lingual categories as somehow equivalent in CS. For example, he notes that Moroccan French-Arabic bilinguals must reconcile gender differences that arise in CS between the two languages. The resolution strategies that these speakers adopt are not uniform. For instance, example (6) appears to show a lack of gender agreement between the feminine Arabic adjective for "whole" (feminine) and the masculine French noun for "journey" (masculine). However, it is to be noted that the corresponding noun in Arabic is feminine, thus the speakers who produce such forms are employing 'hybrid' agreement, where the adjective agrees with the translation equivalent of the overtly expressed noun. Other French-Arabic bilinguals show different agreement or 'harmonization' strategies.

(6) dak'le trajet kulha
that_Ar the_Fr-M journey_Fr-M whole_Ar-F
'the whole journey' (Bentahila and Davies 1983: 327)

Following Sebba, the harmonization patterns of Moroccan Arabic-French bilinguals may be either partly constructed by individual speakers who differ in their metalinguistic knowledge (e.g., the above 'mixed' agreement pattern is observed among educated speakers), or they may be acquired as a conventionalized community norm. Thus, CS patterns may manifest considerable variability across speakers and across bilingual communities, even when the same language pairing is involved.

Applying Sebba's notions to the CS findings here, the patterns of divergence (in L2 Spanish) and hypercorrection (in L1 English) that were witnessed among the L1 English bilinguals - all of whom were university Spanish instructors - may evidence a strategy employed by educated speakers, metalinguistically aware, and highly proficient L2 speakers. In contrast, the unidirectional interference of Spanish on English among the L1 Spanish bilinguals may arise from their low level of English language proficiency coupled with their extensive use of the L1 (recall that they too were Spanish instructors). The early bilinguals demonstrated a symmetrical convergence pattern, with each language merging toward the other. Various explanations have been presented, based on linguistic and proficiency differences, i.e., their contributing languages have the phonetic latitude to allow for convergence, and the speakers possess a high degree of proficiency in both languages. But it may be likely that these bilinguals have been socialized into language alternation and CS in their home communities and with their school peers. That is, their language use patterns may lead to more phonetic convergence. In this respect, the early bilinguals
possibly show conventionalized patterns in their CS forms, where compromise between the two languages may be the norm when both languages are engaged.

Conclusion

This work has demonstrated that CS does have significant phonetic reflexes in bilingual production, but the direction of influence between the bilingual's two languages is not predetermined or uniform. The inter-lingual influence can be asymmetric, affecting only one language, or it can be bi-directional, affecting both. And the direction of influence can be toward or away from the language that is not immediately selected in the CS utterance. Returning to the metaphor of our title, we have seen that all the bilinguals under examination here are accurate in hitting the appropriate, respective phonetic ranges for their component languages. At the same time, their targets within those ranges may move slightly in their attempt to maintain cross-linguistic contrast while also 'harmonizing' their two systems with respect to segments that are, perhaps in varying senses, perceived to be congruent. We have suggested that bilinguals' strategies of harmonization are diverse and motivated by language-internal and -external factors that cannot be easily reduced to the common variables in bilingual studies, such as L1 dominance or age of acquisition.

These findings and conclusions invite further research, and a number of testable hypotheses readily present themselves. First, we have suggested that the implementation of the English voicing contrast permits a great deal of latitude in the expression of voiceless stops. It would prove instructive, therefore, to study a pairing of languages that differ with respect to the implementation of the voicing contrast, for instance, Chinese and English. Other phonological variables also merit attention. While we have focused attention on gradient, low level phonetic properties, it is worthwhile to examine categorical phonological differences, which ought to be more salient – for instance, the presence of vowel reduction in English versus its absence in Spanish.

Second, we have suggested that enhancing contrast – referred to above as hypercorrection – might be a strategy employed by educated and metalinguistically aware bilinguals. This predicts that groups matched for proficiency, language usage patterns, etc., but who differ in terms of education and metalinguistic awareness should show different patterns. In addition, we have argued that convergence may be conventionalized, acquired as part of the bilingual's sociophonetic repertoire (in the sense of Khattab). However, the notion of 'conventionalized norm' should be scrutinized, as bilingual communities may differ with respect to how they harmonize the two systems in CS. Therefore, further research on naturalistic CS within diverse bilingual communities is essential.
References


Introducing

Predicting

Codeswitching more language only when variety - this happens