

# Phonetics and Phonology of Heritage Languages

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## 23.1 Introduction

What do adult heritage speakers know about the sound system of their heritage language (HL), their first-acquired, yet weaker, language? Conversely, how do heritage speakers pattern in the sound system of their dominant language, which, despite currently being their stronger language, was not the one they were exposed to first? This chapter examines these two interrelated questions by surveying the state of the science in HL phonetics and phonology, with a view toward outlining directions for future research in this burgeoning field (Polinsky and Kagan 2007; Montrul 2015; Rao 2016a; Polinsky 2018).

First, let me start with some notes about terminology. The term “heritage speakers” can be (and has been) used to refer to diverse (sub)populations of language users that share the core characteristic of an “interrupted” trajectory of exposure to their first language (L1), where the discontinuity is brought about by intensive exposure to a second language (L2).<sup>1</sup> Intensive L2 exposure, however, may occur due to a variety of life events (e.g., volitional immigration, forced migration, international adoption), which differ in their effect on HL acquisition. For example, international adoptees generally receive less initial, as well as intermittent, exposure to their HL

<sup>1</sup> The use of scare quotes here to describe the onset of L2 exposure as an “interruption” is intentional, because this description may imply that continuous, monolingual exposure to a target language is, or should be, the norm. On the contrary, many languages do not develop, and are not used, in a monolingual ecology (see, e.g., Lüpke and Storch 2013); in fact, the majority of language users across the world can be described as bilingual or multilingual (Tucker 2001). Thus, it is worth bearing in mind that, when monolinguals are identified as a baseline or standard of comparison in the literature, this is not necessarily because monolinguals should be considered normal or even the most common type of user of the given language. Rather, they provide a useful picture of what the language (and grammar) *can* look like, when the intricacies of language contact at both individual and societal levels are removed from the equation.

compared to second-generation immigrant bilinguals raised in HL-speaking households. In what follows, I will use the term “heritage speaker” (HS) loosely, to refer to any bilingual whose L1 (HL) was learned primarily at home as a minority language and whose L2 was learned primarily outside the home as the societal (majority) language, and will use more specific descriptors (e.g., “overhearer,” “listener,” “talker”) when fine-grained distinctions in the nature of HSs’ experience with the HL are necessary. That said, the focus of this chapter is on HSs who continued to use and/or hear their HL during childhood (as opposed to HSs who were cut off from their HL, and may not even have any conscious memory of it; compare Choi et al. 2017), because these HSs exemplify the most common situation of language shift within migratory contexts. Related to this, the nature of the minority language context means that the HS populations under discussion will usually comprise switched-dominance bilinguals (i.e., L2-dominant speakers), but this will not always be the case.

Much of the research into HL phonetics and phonology has been spurred by two recurrent observations about HSs. The first is that, even if they may have significant gaps in their vocabulary or grammar of the HL, HSs may have little to no trouble with aural comprehension and, when they speak the HL, can sound very much like a “native” speaker (i.e., an “expert” speaker who has reached some notional peak level of proficiency, generally due to having been immersed in the language from birth to adulthood). The second observation is that, even though their listening and pronunciation skills may be strong, HSs tend to differ subtly from L1-dominant native speakers, such that they can be readily identified by native speakers as not exactly “native.” The themes of similarity and difference vis-a-vis native speakers of the HL, as well as late-onset L2 learners, are thus pervasive in the literature on HL phonetics and phonology.

Following from these themes, the majority of studies of HL phonetics and phonology to date has focused on HSs’ knowledge and performance in their HL and has devoted little attention to examining HSs’ dominant L2, which often appears to be native-like. Increasingly, however, researchers are carrying out systematic investigations of HSs’ dominant language as well, treating HSs as the bilinguals they are. This development is consistent with a “multicompetence” view of the L2 user, which predicts bilingual–monolingual differences at a number of levels (Cook 1997, 2003), as well as with mounting evidence that a bilingual’s divergence from monolingual norms may begin to occur early in bilingual development and, furthermore, persist despite weak proficiency in and infrequent use of the other language (Chang 2012, 2013, 2019a; Cho and Lee 2016). In short, the assumption that HSs do not differ from monolingual native speakers in their dominant language has become more questionable, thus increasing the impetus to directly test both languages in HSs. Accordingly, this chapter

addresses the existing research on HSs' dominant language along with the research on their HL.

The rest of the chapter is organized as follows. I begin in Section 23.2 by reviewing the research examining HL production at a holistic level, including accent, intelligibility, and identifiability. I then delve into specific properties of segmental (23.3) and suprasegmental production (23.4), as well as salient patterns in speech perception (23.5). Throughout this discussion, I consider the evidence for maintenance (or loss) of phonemic contrasts, phonological alternations and processes, and phonotactic constraints. In Section 23.6, I provide a synthesis of these findings, including their implications for theories of bilingualism, and conclude with comments on future directions.

## 23.2 Global Qualities of Speech Production

Impressionistically, HSs often seem to sound similar to native speakers (NSs) when speaking the HL, yet not quite the same. This impression of a high quality, albeit not exactly native-like, accent in the HL has been reflected in several different studies examining NSs' perception of HSs' speech, as well as their ability to classify HSs socio-demographically.

To take one example, a series of studies on Spanish HSs in the United States who were engaged in learning their HL in college reported a significant advantage of HSs over late-onset L2 learners (L2ers) in terms of holistic accent in Spanish (Au et al. 2002; Knightly et al. 2003). In these studies, accent was measured in terms of subjective ratings from NSs (using a five-point Likert scale with "5" indicating the most native-like) and on two types of speech samples: (1) longer samples from a semi-spontaneous narrative and (2) shorter samples – namely, target phonemes within a carrier sentence. HSs showed a sizable advantage over L2ers on both the narrative accent ratings ( $M_{HS} = 3.0$ ; cf.  $M_{L2er} = 2.4$ ) and the phoneme accent ratings ( $M_{HS} = 3.4\text{--}3.6$ ; cf.  $M_{L2er} = 2.8\text{--}3.0$ ). At the same time, HSs' accents were rated clearly below NSs' accents ( $M_{NS} = 4.4\text{--}5.0$ , depending on sample type). However, note that the HSs in these studies comprised "childhood over-hearers" (i.e., HSs with early experience hearing the HL, but little to no early experience producing it). A later study using a similar design thus included a group of "childhood speakers" with early experience producing the HL as well (Au et al. 2008). These HSs were rated closer to NSs, but still not the same ( $M_{HS} = 3.4\text{--}3.8$ ; cf.  $M_{NS} = 4.4\text{--}5.0$ ); a separate study on Korean HSs in the United States showed this pattern as well (Oh et al. 2003).

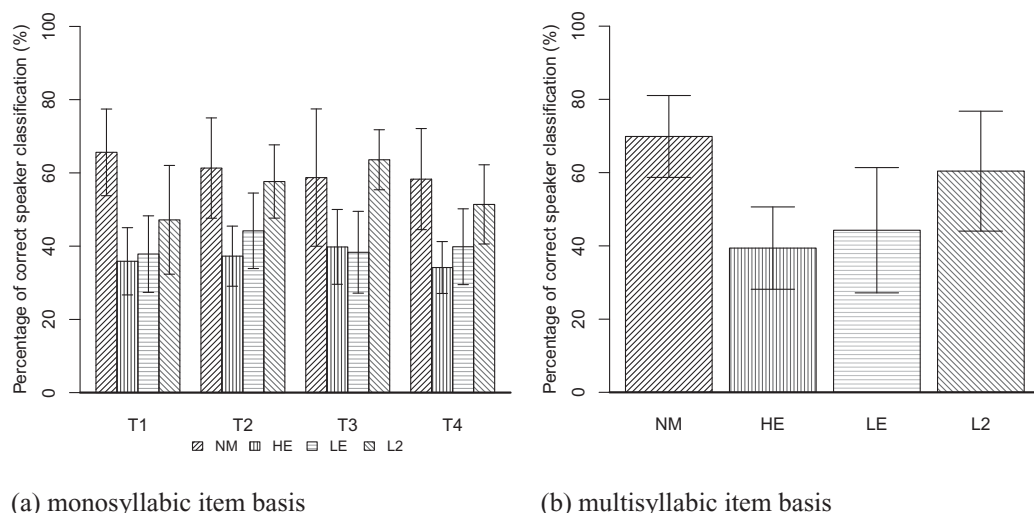
Work on European Portuguese HSs has produced similar results. For example, a study comparing Portuguese HSs raised in a majority German language environment with L1 German L2ers and monolingual Portuguese

NSs found that the HSs obtained holistic accent ratings (of semi-spontaneous speech samples from various production tasks) in between the L2ers' and the NSs' (on a nine-point scale where "1" represents the most native-like:  $M_{HS} = 1.79$ ,  $M_{L2er} = 7.24$ ,  $M_{NS} = 1.11$ ; Flores and Rato 2016). The majority of the HSs in this study were "returnees" living in Portugal at the time of the study; thus, recent immersion experience with the HL could be responsible for the closer patterning of these HSs vis-a-vis NSs (at a group level) as compared to the Spanish HSs discussed previously. Interestingly, however, when various possible predictors of accent ratings, including length of residence (LOR) in Portugal before and after migration, were investigated statistically, only age of emigration/arrival (to the German-speaking host country, i.e., AOA) was found to be a significant predictor. This result echoes a pattern found in earlier research on accentedness among Korean-English bilinguals in the United States (Yeni-Komshian et al. 2000), which also reported the strongest predictiveness for AOA and little predictive value of LOR (but compare Kupisch et al. 2014). An additional point of similarity with the Korean-English bilinguals in Yeni-Komshian et al. (2000) pertains to variability: like Korean-English bilinguals, the Portuguese HSs in Flores and Rato (2016) were observed to be much more variable in their accent ratings compared to NSs (as well as L2ers), and follow-up work by Flores et al. (2017) showed the same pattern, with some HSs receiving accent ratings in the range of NSs but others not. I return to the matter of variability among HSs in §3.

The intermediate nature of HSs' HL production – at once closer to native-like than L2ers' yet not exactly the same – is also apparent in research that examined accent using categorical classification judgments rather than Likert-scale ratings. For example, on the basis of naturalistic speech samples, French, German, and Italian HSs were classified as "foreign" (as opposed to "native") by NSs of the respective language approximately 67 percent of the time on average, less often than L2ers were (>80 percent of the time) yet more often than monolingual NSs were (10 percent of the time) (Kupisch et al. 2014). Echoing findings based on scale ratings, Kupisch et al. (2014) also found that HSs were the most variable in terms of classification: In contrast to the NSs and L2ers, the vast majority of whom were consistently classified (correctly) as "native" and "foreign," respectively, only about half of the HSs tended to be classified as "foreign," while the other half tended to be classified as "native" or classified inconsistently. Furthermore, the classification of HSs was associated with the most uncertainty, with NS judges reporting being "uncertain" or only "semi-certain" of their classification of HSs nearly 40 percent of the time. Related findings on Italian HSs in Germany were reported by Lloyd-Smith et al. (2020), who also observed stronger predictiveness of a composite Italian use score (including several dimensions of Italian experience, including size of the social

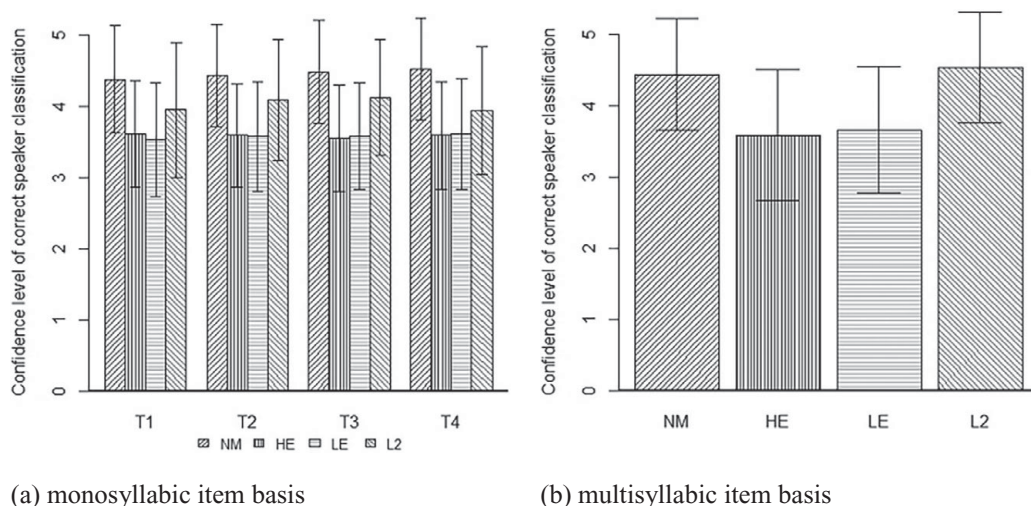
network and formal education in the language) than of age of acquisition of the majority language (cf. Yeni-Komshian et al. 2000; Flores and Rato 2016).

Classification data on Western Armenian, Russian, and Mandarin Chinese HSs in the United States, collected with slightly different methods but the same basic metric of NS judgments, add to a picture in which HSs' accent in the HL is perceived as more ambiguous than L1-dominant NSs' and L2ers', at least by NSs. On the one hand, Western Armenian NSs were able to identify HSs as US-born speakers (as opposed to NSs raised in a Western Armenian language environment) with little difficulty, even on the basis of short (word-length) speech samples (Godson 2003, 2004). On the other hand, Russian NSs had quite a lot of difficulty correctly classifying HSs as individuals who were not born in Russia, even given a sizable (seven-second) speech sample (Polinsky 2018: 118–121). This apparent socio-demographic ambiguity is reflected in a pattern documented for Mandarin HSs in which HSs as a group were more difficult to classify correctly (as “American-born Chinese”<sup>2</sup>) than NSs or L2ers were (Chang and Yao 2016; see also Kupisch et al. 2014). This pattern was highly consistent, holding for every type of speech sample included in that study: monosyllabic samples carrying each of the four lexical tones, as well as multisyllabic samples ranging from two to four syllables in length (Figure 23.1). Moreover, an additional analysis of confidence ratings given



**Figure 23.1** Demographic classifiability of the groups in Chang and Yao (2016), averaged over talkers. Panel (a) shows classifiability on the basis of monosyllabic items (separated by tone); panel (b), based on multisyllabic items. Groups are Mandarin NSs (NM), HSs with high exposure (HE) and low exposure (LE) to Mandarin, and L2ers (L2). Error bars show standard error

<sup>2</sup> Note that this was the label offered for the HS category because it was more likely to be familiar to the NS judges than the term “heritage speaker”; however, not all the HSs evaluated in this study were literally born in the United States.



**Figure 23.2** Confidence levels associated with correct demographic classifications in Chang and Yao (2016), by talker group. Panel (a) shows confidence ratings (on a 1–5 scale; 5 = most confident/certain) from classifications based on monosyllabic items (separated by tone); panel (b), based on multisyllabic items. Groups are Mandarin NSs (NM), HSs with high exposure (HE) and low exposure (LE) to Mandarin, and L2ers (L2). Error bars show standard error

on target classification judgments replicated the result reported in Kupisch et al. (2014), wherein listeners were the least confident about their classifications of HSs (Figure 23.2). Although the source of this pattern – which may be due to NSs having a lower degree of exposure to and/or familiarity with HSs, to HSs showing a wide range of pronunciation patterns, or to some combination of these factors – is not entirely clear, it is a striking pattern supporting the view that HSs are language users distinct from both L2ers and L1-dominant (i.e., “uninterrupted”) NSs.

Whether HSs also differ from “uninterrupted” NSs in the majority language has been less studied, but some results suggest that, insofar as differences in accent and/or intelligibility exist, they tend to be much less detectable in the majority language than the HL. For example, the US-based Korean-English bilinguals in Yeni-Komshian et al. (2000) with an AOA of 1–5 years, though sometimes rated as more foreign-accented in English than English NSs, received English accent scores that, as a group, were overlapping with those of English NSs (whereas their Korean accent scores generally did not fall within the range of Korean NSs’; see Yeni-Komshian et al. 2000: 138–139). Additionally, Kupisch and colleagues (Kupisch et al. 2014; Lloyd-Smith et al. 2020) tested HSs in their majority language (either French, German, or Italian) and, using the same methodology of accent measurement as for the HL, found that, with very few exceptions, HSs’ accent in their majority language was perceived on par with monolingual NSs’. As for intelligibility, Spanish HSs in the United States were found, at a

challenging signal-to-noise ratio, to be less intelligible in Spanish than Spanish NSs but just as intelligible in English as English NSs (Blasingame 2018). Thus, at the level of holistic accent as well as intelligibility, the current evidence points to the conclusion that, in their (dominant) majority language, HSs tend to be largely indistinguishable from NSs.

### 23.3 Segmental Production

Findings on perceived accent in HSs suggest that, at a global level, HSs tend to differ in their production of the HL from L2ers and L1-dominant NSs, but leave open the question of which aspects of their production give rise to this impression of difference. A growing body of research, however, has been contributing acoustic phonetic data to address this question, with targeted studies comparing HSs, L2ers, and NSs on their realization of specific segmental properties such as voice onset time (VOT) and vowel formants (most often,  $F_1$  and/or  $F_2$ ). Much of this research has been based on specific theories of L2 phonetic and phonological acquisition (for a recent review, see Chang 2019b). For example, the Perceptual Assimilation Model (PAM; Best 1994, 1995) and Perceptual Assimilation Model-L2 (PAM-L2; Best and Tyler 2007), as theories that typologize nonnative phonological contrasts in terms of their perceptual mapping to L1 contrasts, have influenced studies testing perception, especially the discrimination of L2 contrasts. Production studies, on the other hand, have often been framed in terms of the Speech Learning Model (SLM; Flege 1995, 1996, 2007), a theory of L2 phonetic development in both perception and production that differentiates L2 sounds in terms of being “new,” “similar,” or “identical” vis-a-vis the L1 inventory. Among the tenets of the SLM, three are particularly relevant to HL sound systems: (1) coexistence of L1 and L2 sounds in a shared mental phonetic space, with bilinguals striving to maintain contrast between them, (2) an increasing likelihood of perceptually conflating L2 sounds with L1 counterparts with a later age of L2 acquisition, and (3) bidirectionality of influence between perceptually linked L1 and L2 sounds. Note that the third tenet, by allowing for L2 influence on the L1, does not grant the L1 a special status, at least with respect to susceptibility to crosslinguistic influence, and is instead consistent with the occurrence of “incomplete acquisition” and/or attrition of the HL/L1 in different contexts of bilingualism (Montrul 2008; Schmid 2013). This contrasts with another kind of view of the L1 (in particular, early linguistic exposure) as privileged (e.g., leading to a “neural commitment” to L1 sounds that differs qualitatively from L2 outcomes; Kuhl 2000).

Whether oriented toward one of these theories or not, several studies of segmental production in the HL have focused on or included analyses of

oral stop consonants (i.e., plosives). In the work on Spanish HSs discussed earlier (Au et al. 2002; Knightly et al. 2003), the speech samples submitted to perceptual evaluation (in particular, word-initial and -medial tokens of the Spanish voiced and voiceless stops produced intervocalically within a frame sentence) were also submitted to acoustic analysis of several properties: VOT (i.e., the latency between a stop's release burst and the onset of voicing) and closure duration of voiceless stops, and the degree of voicing (binned into three categories of "voiceless," "partial voicing," and "full voicing") and lenition of voiced stops. Although there were no significant differences among groups with respect to closure duration, HSs approximated the short VOTs of NSs much more closely than L2ers, who produced (English-influenced) longer VOTs; in fact, HSs' VOTs did not differ significantly from NSs' in either initial or medial position (compare Kim 2011). HSs also showed a tendency to produce partial voicing and full voicing of voiced stops (i.e., to approximate Spanish norms for implementation of voiced stops) and to apply intervocalic voiced stop lenition at rates in between NSs' and L2ers' (for evidence of further differences in lenition among "regular speakers," "childhood speakers," and "childhood addressees" and depending on age of onset of the majority language, see Rao 2015, and Amengual 2019). Similar results were reported for German HSs in France, who produced the canonically long-lag German voiceless stops with slightly shorter VOTs than monolingual NSs and German-French bilinguals in Germany, but still within NS ranges (van de Weijer and Kupisch 2015; Lein et al. 2016).

Acoustic studies of HLs in Canada have also addressed HSs' stop production, including the role of sociolinguistic, typological, and phonological factors. For example, cross-generational comparisons of VOT in the canonically short-lag voiceless stops of Italian, Russian, and Ukrainian showed a tendency for first-generation immigrants to diverge from homeland norms (in terms of longer VOTs) only slightly, whereas second-, third-, and fifth-generation HSs tended to show more divergence from these norms; however, there was variation across the different HL groups, with Italian HSs showing less divergence from homeland norms than Russian or Ukrainian HSs (Hrycyna et al. 2011; Nagy 2015; for similar cross-generational data on UK-based Sylheti HSs' stop production, see Mayr and Siddika 2018). Although this variation could be due to differences in sociocultural dimensions, including the size and cohesiveness of the HL community and attitudes toward cultural integration into the host country, correlations with the construct of "ethnic orientation," including "speakers' self-identified ethnicity and exposure to their HL, and attitudes toward the heritage language and culture" (Hrycyna et al. 2011: 167) were weak or not significant (compare Oh and Au 2005). On the other hand, work on Calabrian Italian HSs also examined VOT – specifically, in relation to the socio-



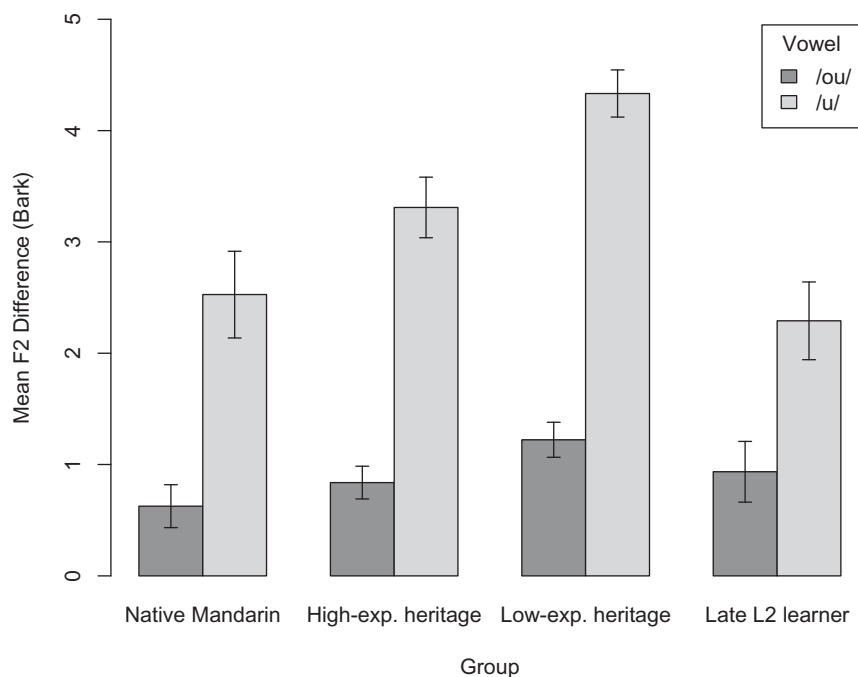
indexical feature of voiceless stop aspiration – and found effects of speaker generation (which were not always linear) as well as of speaker sex (Nodari et al. 2019), while work on Polish HSs showed a positive correlation of Polish stop devoicing with rates of code-switching with English (Łyskawa et al. 2016). A study of Tagalog HSs explored the possible influence of phonological markedness as well, finding that HSs produced the canonically short-lag voiceless stops of Tagalog with VOTs showing little influence from English's voiceless (phonologically marked) stops (including with respect to effects of lexical stress), but the voiced stops, which are canonically lead-voiced, with more apparent influence from English's voiced (phonologically unmarked) stops (Kang et al. 2016). These findings thus contradicted the hypothesis that influence from the majority language would be stronger from marked, as opposed to unmarked, categories (Newlin-Lukowicz 2014).

Research on stop production in heritage Korean has additionally provided compelling evidence of conservatism in HSs (Kang and Nagy 2016). In this work, Korean HSs in Toronto were compared to Korean NSs in Seoul with respect to an ongoing sound change in the implementation of the lenis and aspirated stop series, which have become less distinct in terms of VOT and more distinct in terms of onset fundamental frequency ( $f_0$ ) over time. This change has rapidly progressed in the homeland (Seoul) variety, led by young females, and consistent with other studies, Kang and Nagy observed young female NSs in Seoul to rely almost entirely on  $f_0$  to distinguish these stops. On the other hand, young HSs in Toronto continued to rely on VOT to produce this contrast, and there was little evidence of a sex difference in their reliance on VOT. That is, younger HSs showed a pattern of stop production reminiscent of an older stage of Seoul Korean and did not appear to be innovating in the manner of younger homeland NSs, which Kang and Nagy speculated may be due to the dominant role of VOT in the voiced–voiceless stop contrast in English. Converging results were reported for second-generation Korean HSs in California as well; interestingly, however, “1.5 generation” HSs (i.e., late childhood arrivals to the United States) patterned more like homeland NSs than like second-generation HSs (Cheng 2019b). Taken together, these findings highlight the relevance of three considerations in the analysis of HL sound systems: (1) the fundamental differences in target language input and exposure between a diaspora (HL) context and the homeland context, (2) linguistic aspects of HSs' specific brand of bilingualism, and (3) the continuity and variability inherent in the demographic variable of speaker generation, often treated as categorical in research on HSs.

Apart from stops, other consonant types, such as fricatives, taps, trills, and approximants, have also been investigated in acoustic studies of HL production. For example, research on Mandarin HSs in the United States

analyzed aspects of sibilant fricatives – in particular, the centroid and peak amplitude frequency of Mandarin alveolar /s/ and postalveolar /ʃ/ – finding that HSs tended to be better than both L2ers and NSs (who were L2 learners of English) at distinguishing these fricatives from similar English fricatives (Chang et al. 2009, 2011); moreover, there was no evidence of HSs having lost (or failed to acquire) any of the HL phonemic contrasts tested. Studies of Spanish HSs' production of the Spanish tap–trill contrast and lateral approximants additionally showed effects of both language dominance and language mode: HSs were less likely to approximate canonical production in terms of number of occlusions in the trill /r/ and  $F_2 - F_1$  values for the lateral /l/ when they were dominant in English and/or put into bilingual mode, and these effects for /l/ were clearest for the combination of English dominance and bilingual mode (Amengual 2016, 2018; see Kim and Repiso Puigdeliura 2020, for data on frequency of lingual constriction in HSs' production of the tap). Despite these effects, however, the tap–trill contrast was maintained by most HSs, if by greater use of duration vis-a-vis NSs, thus converging with the results of Chang et al. (2011).

Complementing data on consonantal production, other studies of HL production have focused on vowels, demonstrating the relevance of factors such as phonological environment, phonetic distance between crosslinguistically corresponding vowels, and the precise comparison group. For Western Armenian HSs in the United States, for example, the influence of English was evident for vowels acoustically close to English vowels (/i ε a/), but not for the back rounded vowels /o u/ that lie farther from English counterparts (Godson 2003, 2004), consistent with the SLM's prediction that L2 sounds distant from L1 sounds are likely to be perceived as different (and are thus likely to motivate formation of a separate L2 category that resists assimilatory crosslinguistic influence from the L1). Along similar lines, Mandarin HSs in the United States produced back rounded vowels of Mandarin (characterized by lower  $F_2$  values) as clearly distinct from those of English (characterized by higher  $F_2$  values), and were also found to outperform L2ers and L1-dominant NSs in terms of establishing crosslinguistic distance between corresponding vowels in the two languages (Chang et al. 2010, 2011; see Figure 23.3). This advantage for HSs in making crosslinguistic distinctions at a phonetic (i.e., non-contrastive) level is also in line with the SLM's prediction that systematic phonetic differences between L1 and L2 sounds will be better perceived by early than late L2 acquirers. As for the role of phonological environment, this was predictive of Toronto-based Cantonese HSs' production of mid /ε ɔ/, which showed an allophonic split conditioned by a velar context; consequently, the split could be attributed in large part to majority language influence (Tse 2016a,b, 2019). On the other hand, majority language influence is often much less clear when HSs are compared to L1-dominant,



**Figure 23.3** Acoustic distances (in mean  $F_2$  over the entire vowel duration, in Bark) between corresponding Mandarin and English back rounded vowels in Chang et al. (2011), by group. Groups are (from left to right) Mandarin-dominant NSs, HSs with high or low exposure to Mandarin, and L2ers. Error bars show standard error

but not homeland monolingual, NSs (i.e., a group better approximating the HL input to HSs; Solon et al. 2019).

Studies of HL vowel production have also addressed the role of demographics, dialectal and stylistic variation, language mode, code-switching, dominance, and proficiency. A recent study of Spanish HSs in the North Midland dialect region of the United States, for instance, tested the hypothesis that the North Midland feature of fronted /u/ would cause HSs to produce Spanish /u/ also as fronted (Cummings Ruiz 2019). Contrary to this hypothesis, however, HSs actually produced Spanish /u/ as even more back (i.e., with lower  $F_2$  values) than monolingual NSs. As an instance of cross-linguistic dissimilation (namely, from the more front English /u/), this production pattern is consistent with the SLM's hypothesis that new category formation in early L2 acquirers may lead to dissimilation of nearby sounds in order to maximize contrast within the shared mental phonetic space. In other work examining vowel quality and duration across different tasks, HSs' Spanish vowel production was also observed to show similar patterns of stylistic variation as monolingual NSs' and other bilinguals' and to be influenced by code-switching with English as well as the presence of lexical stress (Ronquest 2016; Elias et al. 2017). In the case of Cantonese HSs

in Toronto, speaker generation and sex showed an interaction in predicting conversational vowel production in the HL (Tse 2016b, 2019), while for Shanghainese HSs in China, speaker generation, language mode, and cross-linguistic similarity (with the dominant societal language, Mandarin Chinese) were all found to significantly modulate the intrusion of Mandarin into Shanghainese vowel production (Yao and Chang 2016). Additionally, statistical modeling of Spanish HSs' normalized vowel production data (in comparison to those for Spanish NSs and L1 English L2ers) provided support for examining both dominance and proficiency as "separate but related constructs" related to HSs' linguistic behavior (Shea 2019). Even so, it is clear that individual dominance in the HL does not rule out majority language influence on the HL, as shown by the Spanish-influenced merger of Galician mid-vowel contrasts in Galician-dominant HSs (Mayr et al. 2019), nor does dominance in the majority language rule out target-like acquisition of HL phonological processes such as unstressed vowel reduction (Amengual and Simonet, 2020; but compare Asherov et al. 2016, for evidence of hybridized vowel reduction in HL Russian in Israel).

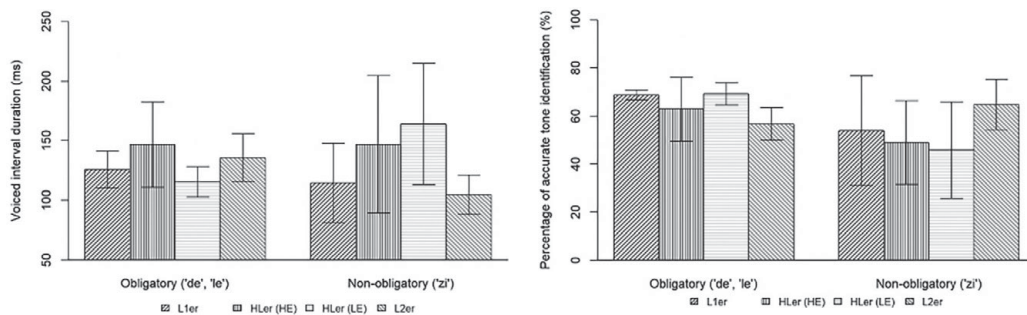
As alluded to in Section 23.1, studies of HSs' production of the majority language remain less common than studies focusing on the HL, but the available acoustic data support the view that HSs as a group are often indistinguishable from NSs of the majority language and, where there is a detectable difference from NSs, this difference tends to be quite subtle (Section 23.2). For example, the California-based Spanish HSs in Au et al. (2002) produced mean VOTs for English voiced and voiceless stops that were "comparable to published results from monolingual native English speakers" (fn. 5, 241), such that they did not differ significantly from the L1 English NS group (for converging results on Spanish HSs in the Midwest, see Kim 2011). Along similar lines, second- and third-generation Sylheti HSs in London and Cardiff produced English stops, vowels, and approximants in a manner resembling NSs (McCarthy et al. 2011, 2013; Mayr and Siddika 2018), while Korean HSs in California, both second-generation and "1.5 generation" HSs, showed evidence of having acquired the local dialect features in their English vowel production (Cheng 2019a). On the other hand, Tagalog HSs in Canada produced English voiced stops with apparent influence from the lead-voicing characteristic of Tagalog (Kang et al. 2016; for similar data on US-based Polish HSs, see Newlin-Lukowicz 2014), and non-standard or non-monolingual-like properties have been observed in the English vowels of Norwegian HSs in the United States and the English interdental fricatives of Dutch HSs in Canada (Natvig 2016; Cornwell and Rafat 2017). In these latter cases, however, the divergence from majority language norms is small and/or involves variability, such that it is often not clear whether it is consequential – namely, reliably perceptible to listeners of the majority language.

## 23.4 Suprasegmental Production

The literature on HSs' production of suprasegmental properties is considerably smaller than that focusing on segmental properties, but there are now several different studies addressing aspects of HL prosody such as stress, voice quality, lexical tone, and intonation. For example, research on US-based Spanish HSs by Kim (2020) found that HSs' production of lexical stress contrasts between words bearing penultimate vs. final stress differed significantly from monolingual NSs', especially in the use of duration, showing a similarly large amount of overlap between the two word types as in L2ers' production. Additional work on Spanish HSs' production of focus revealed that HSs tended to use a mix of strategies for expressing focus, including both the non-prosodic (i.e., syntactic) strategies favored by NSs and the prosodic strategies (e.g., post-focal deaccenting) favored by L2ers, suggesting that "heritage speakers are flexible in their use of linguistic strategies as they are able to extract resources from their two language systems" (Kim 2019). Spanish HSs' production of voice quality (as reflected in spectral tilt measures) was also found to differ from NSs' in that, like L2ers (L1 English speakers), HSs, especially female HSs, often produced utterance-final creaky voice in Spanish, consistent with influence from voice quality variation in the majority language (Kim 2017).

Adding to this picture have been studies of tone production by Mandarin Chinese HSs in the United States (Chang and Yao 2016, 2019). In this work, HSs as a group were observed to approximate NSs' production of Mandarin's four main tones (T1–T4) more closely than L2ers in a number of ways: the pitch contour of T3 (a low-falling tone), durational shortening of tones in connected speech, and rates of T3 reduction in non-final contexts. In other respects, however, HSs' tone production tended to resemble L2ers'. For instance, HSs' tones in isolation were not generally more intelligible to NSs than were L2ers'. In connected speech, by contrast, HSs' tones were significantly more intelligible than L2ers'. As for perceived goodness, HSs' intelligible tones, both in isolation and in connected speech, were rated as higher quality than L2ers', although not as good as NSs'. Thus, given the limited consistency in between-group patterning observed across different tones, contexts, and measures, these findings on Mandarin HSs suggested that "early heritage language experience can, but does not necessarily, result in a phonological advantage over L2 learners" (Chang and Yao 2016: 134).

In addition to production of T1–T4, production of Mandarin's "neutral" tone (T0, a short tone surfacing on weak syllables) was also examined in this research, in both obligatory contexts (i.e., where a target item must be pronounced with T0 as opposed to some other tone) and non-obligatory contexts (Chang and Yao 2019). Like the data on T1–T4, data on T0



(a) duration of T0

(b) intelligibility of T0

**Figure 23.4** Acoustic and perceptual properties of Mandarin's neutral tone (T0) as produced in Chang and Yao (2019), averaged over talkers and separated by context. Panel (a) shows duration (in ms); panel (b), intelligibility (i.e., percent of time the tone was correctly identified as T0 by native listeners). Groups are Mandarin NSs (L1ers), HSs with high exposure (HE) and low exposure (LE) to Mandarin, and L2ers. Error bars show standard error

production showed significant between-group variation in duration; however, the nature of this variation differed from that observed for T1–T4. In contrast to the shorter durations they produced for T3 in non-final contexts, HSs produced T0 in non-obligatory contexts with significantly *longer* durations than did L2ers (see Figure 23.4a). To put it another way, in the case of non-obligatory T0, L2ers, rather than HSs, were more successful at approximating the short durations of NSs. Consequently, L2ers' production of T0 was also more intelligible as T0 compared to HSs' (Figure 23.4b), although HSs nevertheless received higher goodness ratings for their intelligible T0 tokens than L2ers did. These results thus converged with those on T1–T4 in indicating that differences between HSs and L2ers “are not unidirectional, but instead vary across aspects of the language” (Chang and Yao 2019: 2291).

A central factor related to the directionality of between-group patterning (e.g., whether, for a given variable, HSs or L2ers will be closer to NSs) is speakers' linguistic experience with the HL – in particular, their dialectal exposure and experience with standards and norms that are reinforced by formal education in the target language. Thus, in Chang and Yao (2016), L2ers were found to produce overly long durations for T3 in connected speech, ostensibly because their initial exposure to T3 in the classroom had consisted of focused productions in isolation, where T3 is standardly produced with a long contour including not only a pitch fall but also a final rise; this pattern for T3 was much less apparent in HSs. On the other hand, HSs were found to produce T3 reduction (i.e., “half Tone 3”) at rates exceeding even NSs', which could be attributed in part to a greater percentage of the HS group having been exposed to southern dialects of Mandarin in which T3 reduction is frequent across contexts. Along the same lines, in

Chang and Yao (2019), it was HSs – not L2ers – who were found to produce overly long durations for T0 in non-obligatory contexts. Like the HS–L2er disparity in T3 reduction rates, this result could also be explained in terms of differences in dialectal and educational exposure: Whereas at least some HSs were primarily exposed to southern dialects in which T0 may alternate with another tone (e.g., T3) in non-obligatory contexts, L2ers were primarily exposed to standard Mandarin, which is based on northern Mandarin varieties in which T0 is typically realized even in non-obligatory contexts.

Taken together, these findings highlight the importance of considering the details of HSs' experience with their HL and the manner in which HSs' experience may diverge from that of the NSs and/or L2ers under study. In particular, the likelihood of variation and divergence in experience poses a major challenge for a group-based approach to studying HL sound systems. For example, Mandarin HSs in Chang and Yao (2016) showed, as a group, higher levels of acoustic variability in production of T1–T4 than both NSs and L2ers; however, as pointed out in that study, this higher variability cannot be attributed to HS status per se, as it may be due in part to a higher degree of variation in dialectal exposure and/or educational experience with Mandarin within the HS group compared to the NS and L2er groups. While one approach to addressing variability is, of course, to attempt to control dialect and/or educational experience more strictly, in some cases this may not be entirely feasible, due to fundamental experiential differences between two populations (e.g., limiting a HS group to those formally educated in the HL may leave one with very few HSs, who are not necessarily representative of the population at large). Therefore, future research on HL sound systems stands to benefit from more individual-centric analyses, where variability is not reduced but rather accounted for statistically, such as the modeling approach taken in recent work (e.g., Shea 2019).

With regard to intonation, there has long been interest in HSs' intonation as a possible contributor to a "heritage accent," but systematic empirical research documenting the properties of HSs' intonation in the HL is relatively scarce. This may be due in part to a methodological challenge for crosslinguistic intonation research: the lack of broad consensus on analytical conventions that can be used across languages. In the case of Russian HSs in the United States, for example, "[a]ny comparison of English and Russian intonation is made more difficult by conflicting methods of describing intonational form" (Andrews 1993: 165). Nevertheless, such HSs have been described impressionistically as producing English-influenced intonation in the HL – in particular, with "the substitution of American-English intonational patterns for standard Russian ones in neutral declarative utterances and in yes/no questions" (Andrews 2001: 528; see also Polinsky 2018: 120–121). More recent studies of US-based HSs' intonation in HLs such as French (Bullock 2009), Korean (Shin 2005), Norwegian

(Dehé 2018), and Spanish (Zárate-Sández 2015; Colantoni et al. 2016; Rao 2016b) have brought quantitative and/or acoustic data to bear on the issue of HL intonation, leading to a nuanced picture. The recurring theme in these studies is indeed one of crosslinguistic influence from the majority language (English) but also clear, if not always native-like, acquisition of some HL-specific intonational features (e.g., accentual phrase-initial tone height, prenuclear peak alignment). For example, in a small-scale study using acoustic analysis as well as perceptual evaluation of low-pass filtered speech, Shin (2005) found that Korean HSs produced intonation closer to NSs' than did L2ers, such that the prosody in HSs' filtered speech was perceived as "Korean" by NSs much more often (58–75 percent of the time) than L2ers' (11–19 percent); nevertheless, HSs' prosody was still frequently perceived as nonnative-like.

Work on HL intonation has pointed out a number of factors that influence the observed intonation patterns of HSs, including task type (Colantoni et al. 2016) and utterance type (Rao 2016b), and cautioned against interpreting majority language influence in terms of a deficit model. Indeed, the specific conditions under which HSs are asked to produce HL intonation (in particular, the degree to which HSs may be familiar or comfortable with a task such as free narration vs. reading) has a significant effect on their production, leading Colantoni et al. (2016) to recommend that "metalinguistic tasks, such as reading aloud, should be implemented with caution" (1). Furthermore, the fact that divergence in HL intonation patterns associated with specific syntactic patterns may occur in spite of apparent control of the syntax raises the possibility that "contact-influenced prosodic innovations among heritage speakers may serve as additional communication resources for the expression of discourse-pragmatic distinctions rather than as mere replacement strategies" (Bullock 2009: 165), echoing the sentiments of Kim (2019) regarding Spanish HSs' mixed strategies for the expression of focus and of Nagy (2016) on viewing HSs' language varieties as "new dialects." Certainly, it is clear that more research remains to be done on HL intonation, and as the field converges on analysis standards for more languages (see Hualde and Prieto 2016), one can expect that this will lead to increased research activity in the study of HL intonation.

To close this section, it is worth mentioning that there is very little research on HSs' suprasegmental production in the majority language, thus leaving open a clear path for future research in this area. In one of the few studies on this topic, Turkish HSs in the Netherlands were observed to produce focus prosody in Dutch somewhat differently from Dutch NSs, in a manner consistent with influence from Turkish (van Rijswijk et al. 2017). Norwegian HSs in the United States were also found to produce English polar questions with some apparent intonational influence from the HL (Dehé 2018). On the other hand, Mandarin-dominant Southern Min HSs in



China produced focus prosody in Mandarin with no apparent influence from the HL (Chen et al. 2014). In addition, US-based Korean HSs produced English-specific syllable structures (e.g., coda consonants disallowed in Korean) in code-switched contexts with no apparent phonotactic influence from the HL, in contrast to the pattern observed for Korean NSs (Kim 2010). As for younger HSs, a recent study of kindergarten-age Urdu HSs' production of Cantonese tones in Hong Kong found that, in comparison to age-matched Cantonese NSs, the HSs produced Cantonese tones with lower intelligibility and greater confusion between tones, which could be attributed in part to influence from the HL (Yao et al., 2020). However, given that lexical tone can show a protracted trajectory of development even for NSs (e.g., Wong and Strange 2017), this snapshot of early divergence between HSs and NSs may or may not be reflected in how HSs produce the majority language in adulthood. In short, work on HSs' suprasegmentals in the majority language is in its nascent stages, and much more research is needed to understand when and to what degree HSs may pattern uniquely in this regard.

### 23.5 Speech Perception

The depth of perceptual advantages that accrue to HSs, even those who may not have actively used the HL for many years, has been the subject of a great deal of research examining HSs across a continuum of HL experience, ranging from international adoptees with no conscious memory of the HL to second-generation immigrant bilinguals who continue to use the HL regularly. Although this literature contains some examples of apparent "forgetting" of the HL (Pallier et al. 2003; Ventureyra et al. 2004), the bulk of the studies in this area evince a significant impact of early linguistic experience on speech perception, both in the HL and in the majority language. Indeed, this pattern should not be surprising, given theoretical claims about the transformative, and lasting, impact of early linguistic exposure. For example, the theory of "automatic selective perception" (Strange 2011) posits that L1 experience tunes the perceptual mechanism to be maximally efficient for the L1 (i.e., sensitive to only those cues important for perceiving L1 contrasts), leading to difficulties in perception of an L2 that requires sensitivity to different cues, while the "native language magnet" theory argues for a "neural commitment" to the L1 that affects the perception of other languages (Kuhl 2000; Zhang et al. 2005).

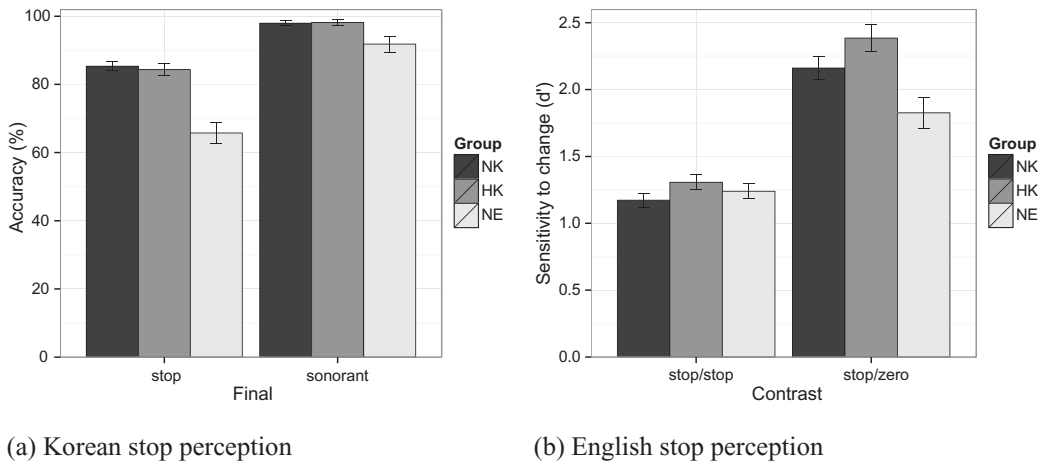
Accordingly, several studies focusing on segmental contrasts have documented a perceptual advantage of HSs over L2ers and, under certain conditions, perceptual abilities for HSs that are on par with NSs'. For example, Hindi HSs with minimal HL exposure after age 2 outperformed L2ers in

perception of the Hindi /t̪/-/t̪/ place contrast and /t̪<sup>h</sup>/-/d̪<sup>h</sup>/ voicing contrast (Tees and Werker 1984), while Korean HSs, including Korean adoptees with minimal HL exposure prior to relearning their HL in adulthood, outperformed L2ers in perception of Korean stop laryngeal contrasts, rate of perceptual learning of these contrasts, and/or transfer of perceptual learning to production of these contrasts (Oh et al. 2010; Cheon and Lee 2013; Choi et al. 2017). These and other studies used a variety of experimental methods differing in terms of task demands, which have revealed the task- and stimulus-dependent nature of HSs' perceptual performance. Using the AX discrimination paradigm as well as a sequence recall task taxing working memory, for instance, Lee-Ellis (2012) tested US-based Korean HSs on perception of the Korean-specific /s/-/s\*/ contrast and found that HSs were significantly more accurate than L2ers across tasks, but resembled NSs only in the perceptually easiest task (discrimination with no talker variability). Along similar lines, US-based Russian HSs outperformed L2ers in perception of Russian palatalization contrasts across different sound pairs, contexts, and tasks, often with native-like levels of accuracy, but were significantly less accurate than NSs on the less acoustically distinct (and less frequent) pair of word-final /p/-/p<sup>j</sup>/ (Lukyanchenko and Gor 2011).

The perceptual advantage of HSs is found in perception of suprasegmental properties of the HL as well. In the case of lexical stress in Spanish, HSs outperformed L2ers in perceiving penultimate vs. final stress contrasts and in fact resembled monolingual NSs in this respect; however, there was also a significant effect of generation, whereby later generations of US-born HSs patterned more like L2ers in terms of a bias toward penultimate stress (Kim 2014, 2015). Echoing a pattern seen in other combined perception-production studies (e.g., Oh et al. 2003), Spanish HSs' advantage on stress contrasts was larger in perception than production, where they showed a strong resemblance to L2ers (Kim 2019; see Section 23.4). Other studies have similarly suggested that HSs have a perceptual advantage in perception of prominence and intonation in the HL (Zárata-Sández 2015; Laleko and Polinsky 2017). As for lexical tone, Mandarin HSs showed an advantage over L2ers in the categoricalness and stability of their tone perception and resembled NSs in their ability to recognize the starting pitch level of a tone, while at the same time resembling L2ers in their overreliance on pitch level (Yang 2015). Perceptual divergence from homeland NSs was also reported for young US-based Cantonese HSs' perception of both acoustically similar and distinct tone contrasts, although HSs performed much better on distinct tone contrasts (Kan and Schmid 2019). Much as in segmental perception, however, in tone perception the impact of early HL exposure can be quite long-lasting, as evidenced by the significant advantage in perceptual learning of Hokkien tone contrasts shown by Singapore-based HSs with no conscious memory of the HL (Singh and Seet 2019).

Apart from task type, HS generation, and acoustic similarity of HL contrasts, several other variables have emerged as predictors of HSs' perceptual behavior in the HL, including age of onset of the majority language (i.e., age of reduced contact with the HL) and assimilability of a given HL contrast to contrasts of the majority language/L2 (Ahn et al. 2017), age of testing and degree of literacy, especially in a developmental context (Kan and Schmid 2019), language mode (Antoniou et al. 2012), and proficiency level (Gor 2014), and the usefulness of a multivariate approach in particular is evident in the increasing number of studies that apply a sociolinguistic lens to HSs' linguistic behavior (e.g., Nagy 2016; Tse 2019). For example, Escalante (2018) found that Spanish HSs who traveled to coastal Ecuador were not necessarily more successful at perceiving the local dialect feature of /s/-aspiration than L2ers; although the most accurate participant was indeed a HS, more predictive of perceptual accuracy overall than HS status were the factors of phonological context, prior exposure to /s/-aspirating dialects, and proficiency level. Recent findings on perceptual adaptation by Mandarin HSs in Australia further pointed out the relevance of the social context of HL use (Cutler et al. 2019). In this work, Mandarin HSs who used the HL regularly were found to retune phonemic boundaries in accordance with exposure to unfamiliar talkers in the majority language (English), but not in the HL – a disparity that mirrored the much smaller number of interlocutors the HSs reported for the HL compared to the majority language. In other words, the social context of HL use, which involved regular exposure to a limited, and largely unchanging, set of talkers, apparently did not promote the development of perceptual adaptation mechanisms in the HL. An interesting avenue for future research, therefore, would be to test the degree to which these perceptual adaptation mechanisms may develop in HSs in response to changes in the context of HL use (e.g., study abroad in a HL-dominant language environment).

As for HSs' perception of the majority language, there is, again, less research on this topic in comparison to research focusing on HL perception, but existing studies, which generally focus on English as a majority language, have shown little evidence of a perceptual deficit vis-a-vis NSs of the majority language and, instead, evidence of perceptual benefits for the majority language. For example, the Hokkien HSs examined by Singh and Seet (2019) showed no significant differences from English NSs in a battery of grammatical, semantic, and sound-based English tasks, which included discrimination of English-specific phoneme contrasts (e.g., /z/ vs. /ð/, /d/ vs. /ð/). Similarly, the Korean HSs examined by Lee-Ellis (2012) showed no significant differences from English NSs in perception of the English-specific phonotactic contrast between word-medial consonant clusters and consonant–vowel sequences (e.g., /kasta/ vs. /kasuta/), across tasks; in fact, there was a nonsignificant tendency for the HSs to outperform the English



**Figure 23.5** Perception of unreleased stops in Chang (2016) averaged over listeners and separated by item type. Panel (a) shows percent accuracy in identifying the final sound of stop-final (left) and sonorant-final (right) Korean nonce items. Panel (b) shows sensitivity to a change ( $d'$ ) in English minimal pairs differing in final stop identity (left) or in presence/absence of a final stop (right). Groups are Korean NSs (NK), HSs (HK), and English NSs (NE). Error bars show standard error

NSs on discrimination of this English contrast. This apparent perceptual advantage over monolingual English NSs came out to be statistically significant in a study of US-based Korean HSs' perception of unreleased stops in both the HL and the majority language (Chang 2016). In this study, not only did HSs' perception of Korean resemble Korean NSs', their perception of English surpassed English NSs' (see Figure 23.5). Crucially, both in Chang's and in Lee-Ellis's studies, listeners who shared the same L1 background as the HSs but did not receive as early and as extensive exposure to English (i.e., Korean NSs) performed significantly worse on English perception than English NSs did; that is, there was a clear potential for HSs' experience with the HL to have a negative effect on their English perception. Despite this possibility, however, in both of these cases HL experience had either no such effect or even a beneficial effect, an outcome described by Chang (2016: 805) as a "best-case scenario" for early bilingual experience. The generalizability of this outcome to other HS communities and to other linguistic features awaits further investigation.

## 23.6 General Discussion

Research on HL sound systems is notable for its breadth (including work on diverse HLs, majority language contexts, and phonetic and phonological features) but also for several recurring themes that have emerged out of the specific cases examined to date. Perhaps the most abundantly attested is the finding that early exposure to a HL, even if relatively brief, leads to

significant phonetic and/or phonological learning, although the depth and the accessibility of acquired HL knowledge show considerable variation related to structural linguistic factors (e.g., phonological environment, proximity to aspects of the majority language), demographic and sociolinguistic factors (e.g., HSS' age of reduced contact with the HL, immigrant generation, gender, size of the HL social network), input and usage-based factors (e.g., education, dialectal exposure, rate of code-switching, language dominance, proficiency), and methodological factors (e.g., task type and difficulty, language mode, dependent measure). Other frequently observed outcomes include intermediate patterning between NSs and L2ers (e.g., Knightly et al. 2003; Chang and Yao 2016), a wide range of individual variability (e.g., Kupisch et al. 2014; Flores and Rato 2016), and a relatively higher level of performance in perception as compared to production (e.g., Kim 2019), consistent with the interconnected, yet staggered, development of perception and production observed in monolingual L1 acquisition. In addition, although a broad comparison between segmental and suprasegmental production is limited by the smaller number of findings on suprasegmentals, it appears that suprasegmentals – at least certain global prosodic features such as intonation – may evince more frequent divergence from NS norms compared to segmentals. Viewed in relation to the early onset of exposure to HL prosody *in utero*, this disparity may seem surprising; however, given the oftentimes long developmental trajectory of L1 prosodic features, this should not be very surprising at all. Notably, such innovations at a suprasegmental level provide an explanation for why HSS who look similar to NSs at a segmental level may nevertheless be perceived by NSs as having a “heritage accent” in the HL.

For HSS to show, broadly, some degree of convergence or integration of the HL and the majority language is in fact expected under a “multicompetence” view of bilinguals, and as alluded to in Sections 3–5, several findings concerning adult HSS' phonetic and phonological systems are consistent with predictions of theoretical models such as Flege's SLM and Best's PAM. For example, degrees of crosslinguistic similarity between contrasts, which play a central role in PAM, were indeed predictive of perceptual discrimination of HL contrasts (Ahn et al. 2017), while HSS' successful maintenance of both within- and between-language contrasts, variability in behavior related to crosslinguistic proximity between the HL and the majority language, and closer patterning to NSs relative to L2ers (e.g., Au et al. 2008; Chang et al. 2011) followed from the shared L1–L2 phonetic space, the preference to maximize contrast within this space, and the inverse correlation between age of L2 onset and phonetic sensitivity that are posited in the SLM. However, although there are some studies directly investigating the early stages of HL development in childhood, which can already show divergence from NS norms (e.g., Cho and Lee 2016; Kan and Schmid 2019), it

remains a largely theoretical question how the ostensible advantage of early HL exposure leads to the specific profile of HSs' linguistic knowledge in adulthood (e.g., it is often ambiguous whether development involves attrition and/or "incomplete acquisition" *per se*). Thus, longitudinal research tracking HSs over time in comparison to relevant peer groups would make significant contributions to our understanding of the lifespan development of HSs' phonetic and phonological systems (for an example concerning the majority language of UK-based Sylheti HSs, see McCarthy et al. 2014).

Besides widening their temporal scope, another way in which future studies are likely to improve our understanding of HL phonetics and phonology is by strengthening connections to two different literatures: the cognitive science literature on bilingualism and the sociolinguistic literature on indexicality and persona construction. In regard to the first, numerous researchers have argued for the existence of bilingual advantages in a range of domains (e.g., Bialystok et al. 2004; Antoniou et al. 2015; de Leeuw and Bogulski 2016), yet few have focused on HSs *per se* (compare Gabriel et al. 2018, who found Russian and Turkish HSs in Germany showed an advantage over monolingual German NSs in production of French voiceless stops). As for the sociolinguistic literature, a challenge, and an opportunity, for future research on HSs will be to grapple with the reality that an observed divergence of HSs from monolingual NS norms, which can often appear to reflect a passive "interference" of the majority language, may not be passive at all, but rather sociolinguistically motivated, under control, and deployed strategically as a flexible resource for constructing one's social identity and signaling group membership (Alam and Stuart-Smith 2011; D'Onofrio 2018). Naturally, this latter possibility raises an important question: When are HSs' non-monolingual-like behaviors (especially at the phonetic and phonological levels, which are typically salient loci of sociolinguistic variation) sociolinguistically motivated, and when are they not? It will be crucial for future research to approach HSs' linguistic data with this question in mind, in order to be able to give them the properly nuanced interpretation that they deserve.

While diversifying conceptual approaches to studying HSs will surely enrich the field of HL phonetics and phonology, it is also worth mentioning the empirical gaps in this area that are clear directions for future research. As discussed in Section 23.4, studies focusing on HL suprasegmentals are relatively sparse, and in particular there is a need for more work on HL intonation and rhythm, including in widely studied HLs such as Spanish (Rao and Ronquest 2015; Yakel 2018) and in intonational perception (Laleko and Polinsky 2017). Moreover, whereas a considerable number of studies discussed in Section 23.3–5 have addressed implicit phonological knowledge (pertaining to aspects such as phonemic contrasts, phonological

processes, and phonotactic constraints), few have examined highly abstract or metalinguistic dimensions of phonological knowledge such as syllabification (Shelton et al. 2017). Studies investigating these facets of linguistic knowledge will provide valuable insights into HL sound systems.

In addition, work on HSS' majority language is currently lacking, yet very much needed to round out the picture of HSS' unique profile of bilingualism. For example, given HSS' bilingual experience, one question that arises is whether HSS might differ in intelligibility in their majority language compared to monolingual NS peers. On the one hand, as discussed in Section 23.2–4, there are occasional hints in the (small) literature on HSS' majority language that HSS may acoustically diverge, if ever so slightly, from their monolingual NS peers, but whether these differences negatively affect intelligibility – or, for that matter, are reliably perceptible at all – is typically unclear. On the other hand, it has also been suggested that, perhaps due to greater experience speaking the majority language to non-native speakers (e.g., family members from the first generation of immigration), HSS might tend to produce the majority language in a clearer or more enunciated fashion than NS peers (see Polinsky 2018: 141–144, for data on final stop realization in English as the majority language of US-based HSS from a variety of HL backgrounds); this would predict that HSS would be generally *more* intelligible in the majority language than NS peers. Interestingly, findings on US-based Spanish HSS do not show such an intelligibility advantage, although, crucially, they also show no disadvantage (Blasingame 2018). However, much more research – ideally, in a variety of majority language contexts – will be required to formulate any general principles underlying the phonetics and phonology of HSS' majority language.

In closing, I would like to end on a methodological note. To produce a full, richly elaborated picture of adult HSS' phonetic and phonological knowledge, it will be crucial to expand the scope of individual studies in two ways. First, more bilingual studies (i.e., studies examining both languages within the same sample of HSS), as opposed to studies examining only the HL or only the majority language, are needed to understand the dynamics of crosslinguistic interaction within HSS' linguistic repertoire. Second, more combined, and longitudinal, studies of both perception and production, as opposed to studies targeting one modality, are needed to understand how perception and production may lead, lag, or otherwise support each other over the course of HL development. In short, there is room in the study of HL sound systems not only for theoretical and conceptual diversification, but also for methodological innovation, both of which hold the potential to deepen the insights about HL sound systems to be gained in the years to come.

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