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CHAPTER 17

PHONETIC DRIFT

CHARLES B. CHANG

17.1 Introduction

This chapter addresses the phonetic changes that occur in one's native language (L1) due to recent experience in another language (L2), a phenomenon referred to as PHONETIC DRIFT. Before proceeding, it is important to define precisely what I mean by 'phonetic drift' in light of various other uses of this term. The earliest published instance of the term 'phonetic drift' in the linguistic literature is from Sapir (1921/2004), who uses it to discuss contact-induced diachronic sound change:

> We may suppose that individual variations arising at linguistic borderlands—whether by the unconscious suggestive influence of foreign speech habits or by the actual transfer of foreign sounds into the speech of bilingual individuals—have gradually been incorporated into the phonetic drift of a language. (p. 165)

Other researchers have also used this term in a diachronic sense, but to refer to language-internal phonetic shifts in a category distribution (e.g., Solé & Recasens, 2012; Garrett & Johnson, 2013). Thus, the term 'phonetic drift' is often used to refer to diachronic change in 'macro' language (i.e., language at the level of the speech community), which may or may not be due to contact with another language.

In this chapter, too, the focus is on change over time; however, I am concerned specifically with those L1 phonetic changes that follow from language contact (i.e., L2 experience) within a speaker's lifetime. Consequently, I will discuss these developments primarily at the level of the individual (i.e., 'micro' language, or an idiolect), with a view toward elucidating the individual cognitive mechanisms behind such developments and their relationship to diachronic sound change in a speech community. Therefore, I will use the term 'phonetic drift' (or 'drift' for short) mainly to refer to *L2-influenced phonetic change in an individual's L1 system*. Since most of the research on phonetic drift examines the L1 production of L2 users, that is the focus of this chapter; however, it should be noted that phonetic drift is also reported in perception (Tice & Woodley, 2012; Namjoshi et al., 2015; cf. Cutler et al., 1992) and in L2 non-users (i.e., L1 speakers with only ambient L2 exposure).

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In the context of the following chapters in this section as well as others in this volume, an additional terminological question that arises is whether there is a difference between phonetic *drift* and phonetic or phonological *attrition* (see also Chapters 18 and 19 on Phonetic Attrition by de Leeuw and Celata, respectively). In short, I will be discussing as cases of drift ostensibly short-term L1 changes, both in early- and late-onset L2 learners, which are attributable to *recent* L2 experience (e.g., because the change or divergence from L1 norms coincides with concomitant L2 exposure), whereas I will reserve the term 'attrition' to refer to long-term L1 changes in late-onset L2 learners which are unlikely to be due to recent L2 experience only (e.g., because the change perseveres long after a decline in L2 exposure). Naturally, this leads to the question of how drift relates to attrition, a question to which I will return in Section 17.5.

Studies of phonetic drift have been concerned with a number of different questions, some related to the dynamics of language contact and bilingualism (e.g., Yeni-Komshian et al., 2000; de Leeuw et al., 2010; Yao & Chang, 2016) and others related to the nature of phonetic processing and linguistic representation (e.g., Chang, 2012; Namjoshi et al., 2015). In this chapter, I will review findings that relate to three main questions:

(1) What features of the L1 are subject to phonetic drift?
(2) What is the cognitive mechanism (or mechanisms) behind phonetic drift?
(3) What factors increase or decrease the likelihood of phonetic drift?

To preview some of the current answers to these questions, virtually all aspects of L1 speech are subject to drift, but different aspects do not drift in the same manner, possibly due to multiple routes of L2 influence coexisting at different levels of L1 phonological structure. However, because the literature has generally examined L1 change in terms of sound categories rather than routes of influence, the rest of this chapter is organized by category type: Section 17.2 covers drift in consonants (e.g., in voice onset time (VOT)), Section 17.3 covers drift in vowels (e.g., in formant frequencies), and Section 17.4 covers drift in suprasegmentals (e.g., in fundamental frequency).

17.2 Phonetic drift of consonants

An abundance of acoustic studies have reported phonetic drift in consonants. The majority of this research has focused on oral stops (i.e., plosives)—in particular, the feature of VOT, the primary acoustic correlate of stop voicing contrast. In addition, some studies have reported drift in fundamental frequency (f_0), a secondary acoustic correlate of voicing contrast; these are discussed further in Section 17.4 since f_0 also serves as a primary cue to suprasegmental contrasts (e.g., tone, intonation). Finally, there are a few studies reporting drift in consonants other than stops (namely, fricatives and approximants). The recurring theme throughout these studies is that it is common for L1 consonants to drift in one or more ways following the onset of L2 experience, even in adult L2 learners for whom L1 categories might be considered to be relatively stable (i.e., 'fully acquired').

As for the mechanism behind phonetic drift of consonants (as well as vowels), Flege (1995, 1996, 2002) articulated an influential proposal based on crosslinguistic

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PERCEPTUAL LINKAGE in a theory called the Speech Learning Model (SLM). According to the SLM, speech sound categories continue to develop over the lifespan; L1 and L2 sounds coexist in a shared mental phonetic space; and an L2 sound that is, at a position-specific allophonic level, 'similar' to an L1 sound tends to undergo a perceptually-based, automatic 'equivalence classification' with that L1 sound. Equivalence classification results in similar L1 and L2 sounds becoming linked under the same category and, consequently, converging towards each other phonetically. Since L1-L2 equivalence classification becomes more likely as L1 categories widen over the course of normal L1 development, the probability of cross-linguistic perceptual linkage increases with a later onset of L2 learning. Late L2 learners are thus particularly subject to L2 influence on the L1, whereas early L2 learners are more likely to notice the systematic phonetic differences between close L1 and L2 sounds and, therefore, to establish a distinct category for the L2 sound. When L1 and L2 sounds are separated categorically in this way, they may develop independently, resulting in native-like realization of both; however, they may also dissimilate from each other to maximize cross-linguistic distance within the shared L1-L2 phonetic space, leading to divergence from native phonetic norms (e.g., Mack, 1990; Yusa et al., 2010).

Several studies of late L2 learners have reported results consistent with the SLM view of the cross-linguistic interactions leading to phonetic drift. In one study of L1 French to L2 English and L1 English to L2 French speakers (Flege, 1987), the VOT of the voiceless coronal stop /t/, which is short-lag in French but long-lag in American English, showed drift in both L1 groups for speakers immersed in their L2: L1 English speakers living in France produced English /t/ with shorter-than-native VOT, while L1 French speakers living in the US produced French /t/ with longer-than-native VOT. Similar results were reported by Major (1992, 1996) for L1 English to L2 Portuguese speakers living in Brazil. In addition, L1 Korean to L2 English speakers living in the US were shown to produce Korean fortis stops, which have slightly shorter VOT norms than English voiced stops (Chang, 2012), with longer-than-native VOTs that were virtually identical to the VOTs these speakers produced for English voiced stops (Kang & Guion, 2006).

Although the above studies give suggestive evidence of phonetic drift in late L2 learners, they were not concerned with the extent to which the L1 phonetic changes persist and, consequently, were based only on cross-sectional comparisons, which have the inherent limitation of assuming that any cross-group differences providing a picture of 'apparent time' are due to the independent variable of interest (in this case, L2 experience) rather than some other factor that has not been brought under experimental control. This limitation makes it crucial to confirm such findings in longitudinal research, and indeed there are a few studies that have documented drift longitudinally within individuals. One example is a case study that followed an L1 Portuguese late learner of English as she travelled between Brazil and the US (Sancier & Fowler, 1997). This study showed that the VOT of L1 (as well as L2) voiceless stops drifted toward the VOT norms of the most recently experienced ambient language; thus, the speaker's VOT in L1 stops was observed to be significantly longer following a few months of L2 immersion in the US, an effect perceptible to native listeners. This drift was attributed to three factors: similarity between the L1 and L2 sounds (cf. Flege's SLM), humans' tendency toward imitation, and the recency effect on memory.

The effect of recent (as opposed to temporally distant or cumulative) L2 experience on L1 production was further clarified in a series of longitudinal studies on L1 English late

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learners of Korean who were recent arrivals to Korea (Chang, 2012, 2013). This work contributed three novel findings to the literature in this area: (1) early drift, (2) modulation of the recency effect, and (3) multi-level cross-linguistic linkages. First, in contrast to previous studies, which had focused on experienced L2 learners, Chang (2012) examined inexperienced (i.e., novice) learners, finding that phonetic drift was not only evident, but relatively pronounced, during the first weeks of elementary L2 instruction. As in Sancier & Fowler (1997), the VOT of learners' L1 voiceless stops drifted toward the longer VOT norms of a similar L2 stop series (in this case, the Korean aspirated stops); however, the amount of drift was larger than in Sancier & Fowler (1997). This disparity led to a follow-up study comparing inexperienced to experienced learners (i.e., those with prior exposure to the target L2) enrolled in the same language programme (Chang, 2013). Contrary to the assumption that phonetic drift would be positively correlated with L2 experience/proficiency (e.g., Major, 1992), this study revealed that experienced learners showed *less* drift during the same time period of L2 learning, as shown in Figure 17.1 (which illustrates this effect for VOT as well as f_0, discussed further in Section 17.4). This result supports the view that the potential for recent L2 experience to lead to drift decreases over the course of L2 acquisition, which may be due to an L2 novelty effect for novice learners (Chang, 2013) and/or developmental changes in the relative strength of the L1 vs. L2 systems (Jacobs et al., 2016).

As for the third finding of multi-level cross-linguistic linkages, this relates to the theoretical basis for phonetic drift assumed in Chang (2012)—namely, a cross-linguistic acoustic distance that is perceptible. For an L2 sound to be 'similar' (in SLM terms) to an L1 sound such that the two become perceptually linked, the L2 sound should be not so different that it is perceived as 'new', yet different enough that it is not perceived as 'identical'. Thus, for any given acoustic dimension, L1 sounds are predicted to drift only when the distance from a 'similar' L2 sound is at least as large as the just-noticeable

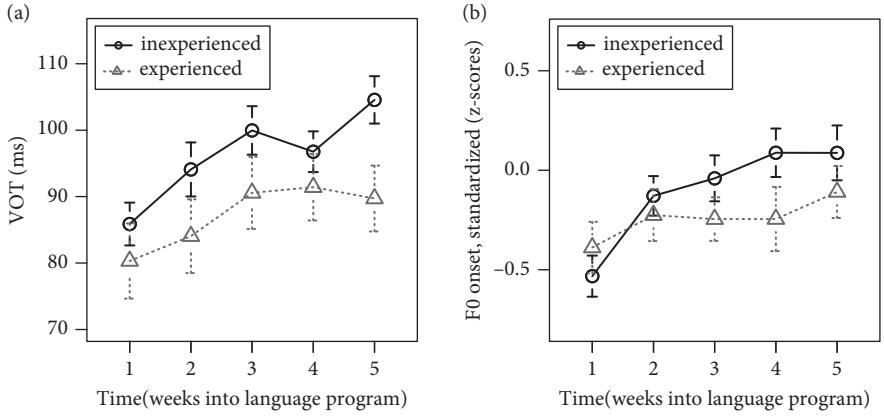

FIGURE 17.1. Phonetic drift of English voiceless plosives in learners of Korean

(A) drift in VOT for all learners; (B) drift in onset f_0 for female learners. The two learner groups are inexperienced (circles) and experienced (triangles). Error bars show 95% confidence intervals.

Source: Chang (2013: Figures 1 & 3).

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difference (JND) in that dimension. For VOT of the L1 (English) voiceless stops in Chang (2012), it was therefore predicted that /p/ and /k/ would drift, as the respective VOT norms for the similar Korean /p^h/ and /k^h/ are each longer by an amount that exceeds the JND for VOT in this range; in contrast, /t/ was predicted not to drift, as the VOT norm for Korean /t^h/ is longer by an amount that does not reach the JND. Results separated by stop indicated that /t/ did not fail to drift, but rather drifted along with the other voiceless stops; at the same time, /t/ showed less drift than both /p/ and /k/. These findings thus suggest that production of L1 /t/ was influenced by linkages to the L2 at two levels: the individual *sound* and the *natural class* of sounds. The class-level linkage of L1 voiceless stops to L2 aspirated stops precipitated the drift of all voiceless stops (including /t/) due to the perceptibly longer overall VOT norm for the L2 class, whereas the segment-level linkage of L1 /t/ to L2 /t^h/ moderated the amount of drift for /t/ due to the relatively close VOT norm for L2 /t^h/.

Given that the examples of drift discussed above were all found in L2 immersion contexts, a question that arises is whether drift also occurs in non-immersion contexts. Findings from a few studies examining L1 English late learners of Spanish in the US suggest that this is the case. In one study of advanced learners who used the L2 regularly in their professions (Lord, 2008), drift was evident in the VOTs of L1 voiceless stops, which were shorter-than-native for all stops but significantly so only for /k/. Further evidence along these lines was reported in a larger cross-sectional study of learners exemplifying a wide range of L2 proficiency levels from elementary to master's level (Herd et al., 2015); the learners in this study, the majority of whom had never been immersed in the L2 for more than a week, produced VOTs for L1 voiced stops that were more negative (thus, more L2-like) the higher their level of study, with master's students consistently showing long negative VOTs. The cross-sectional results in these two studies converge with the results of a longitudinal study that tracked, and phonetically trained, five learners in an elementary Spanish course (Schuhmann & Huffman, 2015). Some (but not all) of these learners showed downward drift in VOT (i.e., VOT shortening) of L1 voiceless stops and/or a tendency toward downward drift in VOT of L1 voiced stops, suggesting again that phonetic drift is not dependent on an L2 immersion environment.

To close this section, it should be mentioned that, although most findings of drift in consonants come from studies of stops, other types of consonants are clearly subject to change as well. For example, in a cross-sectional study of fricatives in L1 Taiwanese Amoy learners of Mandarin Chinese in the US (Peng, 1993), proficient, but not un-proficient, Mandarin speakers showed movement of their L1 fricative /h/ toward the similar L2 fricative /x/ with respect to frequency range and spectral energy. Recent cross-sectional studies of L1 German late learners of English living in Canada (de Leeuw, Mennen, & Scobbie, 2013) and the UK (Ulbrich & Ordin, 2014) provided further evidence of L1 change in the formant properties (i.e., F_1, F_2, F_3) of lateral and rhotic approximants, due to L1-L2 differences in velarization and rhoticity. Note that the L1 changes in these studies were examined only after a period of extensive L2 experience, so it is unclear whether they reflect drift per se, as opposed to attrition (see Section 17.5). Nevertheless, findings of L2-influenced change in fricatives and approximants as well as stops suggest that phonetic drift is a wide-ranging phenomenon that may affect a variety of L1 consonants.

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17.3 Phonetic drift of vowels

Like consonants, vowels also drift due to L2 experience, and in accordance with the SLM, this drift has often been explained in terms of cross-linguistic influence at an allophonic (i.e., segmental) level. However, the literature on vowels is similar to the literature on consonants in showing L2 influence at a higher (in particular, global or systemic) level as well. Segment-level and system-level effects of an L2 are not necessarily mutually exclusive, although there is some indication that the systemic influence of an L2 inventory may override the segmental influence of one L2 vowel. In this section, we consider both sources of vocalic drift as well as their interaction.

A few cross-sectional studies have reported drift of selected L1 vowels due to the influence of a similar L2 vowel. In one of the earliest studies of this type, Flege's (1987) study of L1 French to L2 English and L1 English to L2 French speakers, late L2 learners were tested on their production of the high back rounded vowel /u/, which shows a significantly higher norm for F_2 in American English than in French. Since drift was expected to involve movement toward the phonetic norms of a similar L2 vowel, L1 French to L2 English speakers were predicted to produce French /u/ with higher-than-native F_2 values, and L1 English to L2 French speakers to produce English /u/ with lower-than-native F_2 values. Indeed, the L1 French speakers showed the predicted drift pattern; however, the L1 English speakers did not, producing their L1 vowel close to native norms. These results were replicated in a later study of L1 Mandarin to L2 English and L1 English to L2 Mandarin speakers (Chang et al., 2011). Although the reason for this asymmetry in drift remains unclear (see Chang, 2010, pp. 163–4, for one possible explanation based in properties of human audition), what the asymmetry suggests is that drift cannot be predicted solely on the basis of cross-linguistic differences between similar sounds; rather, there are other intervening factors (which we discuss further in Section 17.5).

In addition to the data from these cross-sectional studies, further evidence of vocalic drift has come from a number of recent longitudinal studies. In one study of L1 Japanese learners of English taking up residence in an L2 environment, a year of L2 immersion was found to result in drift of some L1 vowels (specifically, /i a/) in terms of increased F_2 values, but only for child learners and not for adult learners (Oh et al., 2011).[1] On the other hand, research on adult L1 French speakers receiving phonetic training has shown clear effects of concentrated L2 exposure on L1 vowels (Kartushina, 2015; Kartushina et al., 2016). In this work, monolingual French speakers underwent an hour of production training on each of two target vowels, Danish /ɔ/ (which is perceived as similar to, as well as a good exemplar of, the L1 /o/) and Russian /ɨ/ (which is not perceptually similar to any L1 vowel, but acoustically closest to /ø y i/, in that order). Examination of pre- and post-training production of these L1 vowels revealed no drift of /o/ or /i/, but significant drift of /ø/ and /y/; furthermore, the L2 training effect was stronger for /ø/ than for /y/. These results thus suggest, in line with the SLM and Chang (2012), that drift is dependent on the disparity between L1 and L2

[1] Note that the inclusion of child learners in the participant sample crucially distinguishes this study from studies of attrition, which typically focus on adult learners whose L2 acquisition starts clearly after a critical/sensitive period.

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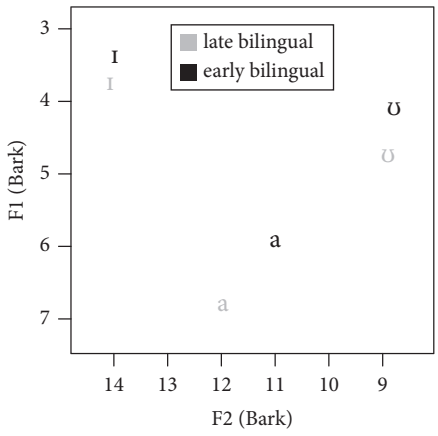

FIGURE 17.2. L1 Quichua vowels (/ɪ ʊ a/) according to timing of L2 onset

Note: The late and early L2 learner groups are plotted in gray and black, respectively.

Source: adapted from Guion (2003: Figure 6).

sounds falling within a 'sweet spot' of cross-linguistic distance (i.e., not so small that there is no room to drift, but not so large that the L2 sound is no longer in the phonetic neighbourhood of the L1 sound); however, drift is not dependent on perceptual similarity specifically, as even the Russian /ɨ/, which would qualify as a 'new' L2 sound under the SLM, appeared to precipitate drift in this case.

Whereas the above studies examined a subset of learners' L1 vowels, other studies have looked at the whole L1 vowel inventory and found evidence for vocalic drift at a systemic level. In one such study of L1 Quichua to L2 Spanish speakers (Guion, 2003), early L2 learners produced all L1 vowels with lower F_1 values than late L2 learners; that is, more L2 experience was linked to a global raising of the L1 vowel space, as shown in Figure 17.2. Crucially, this pattern of drift could not be explained in terms of the attracting influence of the closest individual L2 vowel, because the L1 vowels did not consistently converge toward this vowel. Instead, Guion (2003) accounted for this pattern in terms of maximizing dispersion with respect to the L2 vowel system, which contains two mid vowels /e o/ that could put pressure on the high vowels of Quichua to go higher.

However, a different mechanism for this type of systemic drift was proposed in the longitudinal work of Chang (2011, 2012, 2013) on L1 English late learners of Korean. Besides showing drift in VOT (as discussed in Section 17.2), these studies showed, for female learners, a consistent raising of the L1 vowels, much as in Guion (2003). Unlike the case of L1 Quichua to L2 Spanish, however, the systemic drift observed in Chang (2011) could not be explained in terms of cross-linguistic dissimilation, as the drift resulted in a *lower* degree of cross-linguistic dispersion. It could also not be explained in terms of separate individual vowel shifts, as the L1 vowels did not uniformly assimilate toward or dissimilate from the closest L2 vowel. Instead, the drift was attributed to convergence toward the L2 via a cross-linguistic linkage between the global formant levels associated with the L1 and L2 vowel systems. Since the L2 (Korean) inventory contains fewer low and mid vowels (i.e., those with relatively high F_1 values) than the L1 (English) inventory, the average F_1

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of the L2 vowel system is lower than that of the L1 system, resulting in phonetic drift taking the form of a decrease in F_1 (i.e., vowel raising).

This systemic raising of L1 vowels might also be explained in articulatory terms, as the result of cross-linguistic differences in articulatory setting (see, e.g., Gick et al., 2004). To be specific, the default (i.e., rest) position for the tongue in a given language might be relatively higher when the language's phonological inventory leads to more production of high vowels on average; such cross-linguistic differences in default tongue height could explain the systemic raising observed in Chang (2011) in terms of a lower default tongue position for the L1 being pulled toward the higher default tongue position for the L2. Crucially, however, the articulatory account predicts the same direction of vocalic drift for female and male learners (because the L1-L2 inventory differences are the same regardless of talker sex), yet this is not borne out by the male learners examined in Chang (2012, 2013). These male learners were, instead, found to drift in the opposite direction of female learners, which was attributed to the fact that, for male learners, the average F_1 of the L2 vowel system (modelled by L2 instructors who were female) was *higher*, rather than lower, than that of their L1 system. Although the global features of L2 vowels that learners acquire, and drift toward in their L1, remain to be fully specified, what these results suggest is that these features are probably not articulatory, but acoustic in nature.

Despite involving quite different sets of L1 vowels, a point of overlap between Guion (2003) and Chang (2011) is the fact that drift took the form of vowel raising. This leads to the question of whether the raising in these studies was based on L1-L2 comparisons at all or was simply a default pattern of drift. One study that helps to address this question is a cross-sectional investigation of two L1 Dutch to L2 English speakers, identical twin sisters who differed in terms of their L2 experience (Mayr et al., 2012). While one sister ('TZ') remained in the Netherlands, where both sisters grew up, the other sister ('MZ') had moved to the UK as a young adult and had thus been immersed in the L2 for many years. Acoustic analyses showed that MZ produced most (seven out of nine) of the L1 monophthongal vowels with higher F_1 values (i.e., lower in the vowel space) than TZ did. This vowel lowering pattern was consistent with L1-L2 differences in average F_1, which, in this case, was higher for the L2 system than the L1 system (Mayr et al., 2012, p. 696). Additionally, it supports the view that systemic drift of vowels does not necessarily involve raising, but instead depends on the nature of acoustic differences between the L1 and L2. The findings of recent research on L1 Polish to L2 English and L1 Polish to L2 German speakers provide additional evidence that systemic drift may be realized in a variety of ways (Sypiańska, 2016).

The role of system-level differences in influencing vocalic drift was further highlighted in a longitudinal study of L1 English late learners of French (Lang & Davidson, in press). This study tracked novice learners during a study-abroad programme in Paris and also compared these novice learners to advanced learners who were long-term Paris residents. Whereas the advanced learners showed evidence of vocalic drift, particularly in F_1, the novice learners did not, in contrast to the results of Chang (2011, 2012). This apparently delayed onset of L2 effects from French vis-à-vis Korean suggests that the progression of vocalic drift may be influenced by specific properties (e.g., size, crowdedness) of the L1 and L2 vowel systems that come into contact in L2 learners.

The last study to be discussed in this section relates to the effect of phonological context and the lexical (i.e., whole word) level. The relevance of these factors for vocalic drift

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was shown in a study of L1 Shanghainese to L2 Mandarin speakers in Shanghai, which examined how production of Shanghainese /ɛ/ has been influenced by the similar Mandarin vowel /ej/ (Yao & Chang, 2016). This study tested two groups of speakers (younger and older), two language modes (mono- and bilingual), and three types of L1 lexical items cognate with L2 lexical items (one type whose phonological form was maximally similar to that of the L2 cognate, and two types that were each less similar). The crucial result has to do with item type: although all three types of L1 item contained /ɛ/ and were cognate with an L2 item containing /ej/, more drift of /ɛ/ was observed in the first type than in the other two, suggesting that L2 influence from /ej/ was modulated by the degree of similarity between the lexical contexts in which the vowels were embedded. That is, vocalic drift was influenced by L1-L2 linkage not only at the level of the segment (i.e., /ɛ/ and /ej/), but also at the level of the lexical item. This case of drift is thus similar to the case of English /t/ in Chang (2012) in evincing multiple layers of cross-linguistic comparison affecting phonetic drift.

17.4 Phonetic drift of suprasegmentals

Although the literature on drift in suprasegmentals is not as extensive as the literature on drift in segmentals, there are now a number of studies demonstrating that suprasegmental features of the L1, much like segmental features, are influenced by L2 experience. This literature contains both cross-sectional and longitudinal data and mostly addresses drift related to pitch (namely, f_0 level and alignment). The wider literature on contact varieties suggests that rhythm, too, may be influenced by bilingualism (e.g., Low et al., 2000; Carter, 2005), but there are as yet no systematic investigations of drift in L1 rhythm during late-onset L2 learning.

Drift in f_0 level has been documented in a few studies on Korean and English in contact. For example, a cross-sectional study of L1 Korean to L2 English speakers found that L2 experience was correlated with increased onset f_0 values after L1 lenis stops (Yoon, 2015). In the longitudinal research on L1 English late learners of Korean discussed in Section 17.2 (Chang, 2012, 2013), drift was found both in the VOT of voiceless stops and in the onset f_0 of the vowel following these stops. There was an effect of gender on drift in f_0, which arose only for female learners. Further, there was an effect of prior L2 experience, as drift was greater for inexperienced than experienced learners (Figure 17.1B); nevertheless, drift in f_0 was evident in both groups, as well as for both voiced and voiceless stops. In fact, upward drift in f_0 was expected after both L1 stop types due to the pitch accent associated with the perceptually most similar L2 stop types (i.e., fortis, aspirated). Unexpectedly, however, f_0 also drifted upward in the absence of any stops—namely, in vowel-initial items (see Figure 17.3). This result was explained in terms of a control mechanism for f_0 that is, to some extent, shared across languages (and, thus, influenced by global f_0 properties of an L2 including overall f_0 level). At the same time, f_0 increased more in stop-initial than vowel-initial items, suggesting that the f_0 properties associated with the fortis and aspirated stops specifically were also at play. Thus, similar to the case of VOT, drift in f_0 was influenced by

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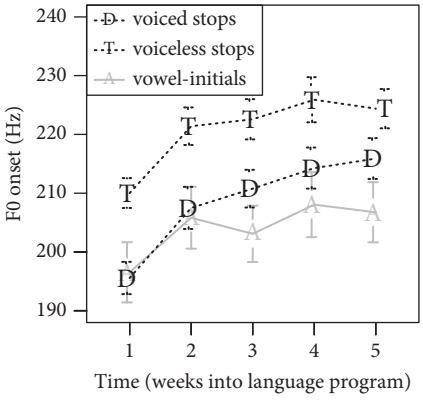

FIGURE 17.3. Phonetic drift of onset f_0 in English words produced by female learners of Korean, by initial segment type

Note: Error bars show 95% confidence intervals.

Source: Chang (2012: figure 7).

a multifaceted relationship between the L1 and L2, here involving overall f_0 level (i.e., a global property) as well as the natural class-level properties of specific stop types.

In addition to f_0 level, change may also occur in f_0 alignment. This type of change was found in a cross-sectional study by Mennen (2004), which examined the temporal alignment of the f_0 peak in an intonation contour as realized by L1 Dutch late learners of Greek and native speakers of Dutch and of Greek who did not know the other language (i.e., control groups). The Dutch learners and controls were living in the Netherlands or in Scotland, while the Greek controls were living in Scotland. They were compared on their production of a prenuclear rise (LH*), which is present in both languages but peaks earlier and is subject to different phonological conditioning (by vowel length) in Dutch than in Greek. Most Dutch learners of Greek produced the rise in Dutch differently than the Dutch controls, in addition to producing the rise in Greek differently than the Greek controls. On the other hand, one learner produced the rise in both Dutch and Greek like the respective control groups. Taken together, the findings of this study, as well as of a later study of L1 German to L2 English speakers (de Leeuw et al., 2012), converge with findings on segmental properties (Sections 17.2 to 17.3) and overall accent (Yeni-Komshian et al., 2000; de Leeuw et al., 2010) in showing that L2 experience often, but not always, leads to L1 changes that diverge from native phonetic norms.

Importantly, however, the intonational changes in Mennen (2004) cannot be explained in terms of the same type of L1-L2 linkage (and phonetic convergence) posited in the SLM for segments. This is because positing convergence between L1 and L2 tonal phones would predict that the relatively late peak alignment pattern of the L2 should result in later L1 peak alignment, whereas this is not the pattern observed. Instead, the Dutch learners of Greek tended to produce *earlier* L1 peak alignment than the Dutch controls in short vowels (where the peak typically occurs late, although not as late as in Greek), while producing similar L1 peak alignment as the Dutch controls in long vowels (where the peak typically occurs early). Thus, in this case L2 influence did not take the form of assimilation of L2-specific phonetic implementation; rather, it appeared in a smaller differentiation of L1 long and

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short vowels in terms of peak alignment (i.e., attenuation of an L1-specific contrast). These findings are consistent with the view that drift of certain suprasegmental features may operate differently than drift of segmental features, although much more research on suprasegmental changes (including targeted studies of drift per se as opposed to divergences that may reflect attrition) is needed to shore up any claim about segmental-suprasegmental disparities in L1 change.

17.5 Discussion and conclusion

To return to Questions (1) to (2) from Section 17.1, recent experience with an L2 can affect many features of the L1, but the specific effect varies across features as well as other dimensions such as the developmental profile of the L2. The literature on L2 learners contains findings of L1 change in the VOT of stops, spectral characteristics of fricatives, approximants, and vowels (e.g., F_1, F_2, F_3), f_0 level, and f_0 alignment. One route of L2 influence on the L1 is through equivalence classification of an L2 sound with an L1 sound and their resulting perceptual linkage, as proposed in the SLM. However, this type of L1-L2 linkage only predicts phonetic drift at a segmental level, whereas drift has also been observed at other levels: the natural class of sounds, the vowel system, and overall f_0 level. This multifaceted nature of drift implies that L2 knowledge may be linked back to the L1 in multiple ways, which are often seen to jointly influence L1 production.

As for the factors affecting the likelihood of phonetic drift, i.e. Question (3), these include linguistic, cognitive, and socio-demographic variables, some of which are related to the individual differences in drift observed in the literature. First, the specific L1 feature at issue is relevant, as some features may be inherently more grounded in somatosensory feedback (see, e.g., Chang, 2010), decreasing the likelihood of drift, or include language-general aspects of representation or control, increasing the likelihood of drift. This cross-feature variation is seen, for example, in differences between drift in vowel quality (Section 17.3) and drift in f_0 (Section 17.4). Furthermore, the acoustic distance between an L1 structure and a close L2 structure is crucial, as it needs to be 'just right': large enough to be perceptible and/or provide room for the L1 structure to drift, but small enough for the L2 structure to qualify as an attractor (Flege, 1995; Chang, 2012; Kartushina et al., 2016). Prior L2 experience is also relevant, as it diminishes the potential influence of recent L2 exposure, and L1 categories that are inherently less variable (i.e., more stable in their realization) may generally be more resistant to drift (Chang, 2013; see also Tobin, 2015).

Apart from variation in prior L2 experience, factors contributing to individual differences in L2 acquisition are also likely to be correlated with at least some of the individual differences that have been observed in phonetic drift (Huffman & Schuhmann, 2015a,b; Schuhmann & Huffman, 2015; Schwartz et al., 2015). These include cognitive, affective, and attitudinal variables such as executive control, affinity for the culture and/or people associated with the L2, and motivation (for an overview, see Dörnyei & Skehan, 2003). Although individual differences in drift remain largely unaccounted for, recent work relating variation in drift to variation in inhibitory abilities (Lev-Ari & Peperkamp, 2013) presents a promising first step toward a better understanding of the source of these individual differences in L1 malleability.

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Given the surface similarity between drift and attrition, one may ask how a particular instance of L1 phonetic change can be classified as one vs. the other. In Section 17.1, we distinguished drift from attrition on the basis of perseverance as well as underlying cause, with attrition lasting in the absence of a proximal L2 stimulus (i.e., recent L2 experience) and drift not. Few studies, however, have actually tracked L2 learners through alternations in language environment, with the result that it is often unclear whether observed L1 changes are short-term, long-term, or medium-term (i.e., reversible, but not quickly or easily) and, more problematically, impossible to tease apart the effect of L2 exposure from the role of L2 acquisition, L2 knowledge, or L2 use.

Thus, the exact source of phonetic drift, within the broad construct of recent L2 experience, remains largely unaddressed, raising a number of interesting questions. Can phonetic drift arise, for instance, solely through ambient L2 exposure, without L2 knowledge or use? Very little research has directly addressed this question, but one study of monolingual French speakers (Caramazza & Yeni-Komshian, 1974) suggests that the answer may be yes. In this study, French speakers in Canada produced less prevoicing (i.e., less negative VOTs) for voiced stops and longer positive VOTs for voiceless stops than French speakers in France, indicating convergence toward the norms of Canadian English despite not actually speaking English. Note, however, that these results were not replicated in a later study (Fowler et al., 2008), which may be due in part to a change in the relative sociolinguistic status of French vis-à-vis English in Canada during the time between the two studies.

Complementing Caramazza & Yeni-Komshian (1974), results from a follow-up study to Chang (2012, 2013) further suggest that some aspects of drift are due primarily to L2 exposure (and, therefore, persist as long as L2 learners are in an L2 environment) whereas others are tied to L2 use (Chang, 2015, submitted). In this study, a subset of the L2 learners examined in Chang (2012, 2013) were examined again at the end of a year in the L2 environment. An early drop-off in L2 use was found to lead to a reversal of drift in f_0 and F_1, but not in ~~VOT~~, or F_2, suggesting that once an L2 has been acquired to a certain level, it is difficult for phonetic drift to subside completely in an L2 environment. When L2 learners return to an L1 environment, it may be the case that many of the L1 changes observed in an L2 environment are eventually reversed, and certain cross-sectional comparisons are consistent with this hypothesis. For example, the inexperienced and experienced learner groups in Chang (2013), both arriving directly from an L1 environment, were similar in their L1 production at the start of the study, suggesting that the L1 (re)immersion that followed the experienced learners' previous L2 learning largely erased any drift that may have occurred during the previous L2 experience. It bears repeating, however, that no longitudinal research has provided direct evidence of what happens to the L1 phonetically when L2 learners disengage from the L2 and return to an L1 environment.

Despite the relative lack of evidence on the effects of L1 reimmersion, some researchers (e.g., Stolberg & Münch, 2010) have argued that L2-influenced changes in an L1 should not be defined in terms of their perseverance, because it may be the case that all behavioural changes resembling attrition are reversible once robust contact with the target language is renewed. Under this view, there is no principled reason (such as a distinction between 'competence', or knowledge, and 'performance', including factors such as language activation and accessibility) for distinguishing between long-term and short-term changes to the L1 system. In contrast to this view, I consider the null hypothesis, at this point in our

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understanding of L1 development over the lifespan, to be that some aspects of L1 change do not reverse themselves even after renewed L1 contact. In other words, regardless of language environment, L2 learners may continue patterning differently from monolingual L1 users in certain ways, a view supported by the findings of bilingual-monolingual differences throughout the psycholinguistic literature (for a review, see Grosjean & Li, 2013).

In closing, the conceptual proximity of drift and attrition invites the essential question of how phonetic drift relates to phonetic and phonological attrition. I consider phonological attrition to comprise long-term changes that cross a phonemic boundary; this includes, for example, change in the application of L1 phonological rules that add, delete, or switch segments from one category to another (e.g., Dmitrieva et al., 2010; Joh et al., 2010; Cho & Lee, 2016). Phonetic attrition, by contrast, comprises long-term changes that are subphonemic, while phonetic drift comprises short-term changes of this type. Recall that the crux of the distinction between drift and attrition is in the timeline and, by implication, the source of change: whereas drift is a short-term effect attributable to recent L2 experience, attrition is a long-term effect arising from extensive, and not necessarily recent, L2 contact. Drift may thus be viewed as the beginning of a trajectory of L2-influenced change in the L1 that, if not reversed, leads ultimately to attrition (for late L2 learners) or to 'incomplete acquisition' (for early L2 learners; see Montrul, 2008). As suggested in Chang (2013), one factor that seems to reduce the magnitude of drift is alternation between periods of L1 and L2 immersion, which gives the L1 system the opportunity to retune to L1 norms; this suggests that the scenario of continuous L2 immersion is particularly conducive to progressing from drift to attrition. In this regard, it should be noted that the literature on L1 change is, in fact, dominated by cases of ongoing L2 immersion, which is why many of the findings reviewed in this chapter are inherently ambiguous between exemplifying drift or attrition.

Looking forward, there are many open questions regarding phonetic drift, but two overarching questions are particularly worth highlighting here. First, how exactly does L2 exposure, as opposed to L2 use, lead to phonetic drift as well as contact-induced diachronic sound change? In the case of Caramazza & Yeni-Komshian (1974), for example, it is not clear whether the divergence from L1 norms in monolinguals with ambient L2 exposure is a direct L2 effect (i.e., phonetic drift arising from ambient L2 exposure) or an indirect L2 effect (i.e., faithful acquisition of different L1 norms from the drifted or attrited production of L2-speaking parents). Second, how does drift of the L1 in L2 learners resemble and/or differ from drift of the L1 and/or L2 in third-language (L3) learners? The burgeoning field of L3/Ln acquisition (see, e.g., Cabrelli Amaro, 2017) is beginning to address this type of question and represents an exciting area of future research into the dynamics of language development and interaction in an increasingly multilingual world.

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