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Research Article

Place contrast enhancement: The case of the alveolar and retroflex sibilant production in two dialects of Mandarin

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ABSTRACT

While segmental contrasts are under prosodically strong conditions, acoustic properties encoding the contrastive features are generally exaggerated, which gives rise to phonological enhancement. One exception that previous research found for such prosodic effects is on consonantal place of articulation (Cole, Kim, Choi, & Hasegawa-Johnson, 2007; Silbert & de Jong, 2008). Whether this is an issue of the nature of the segments under study, or a language-specific phenomenon is worth further investigation. This paper builds on Chuang and Fon's (2010) study of Taiwan Mandarin alveolar and retroflex sibilants and extends the examination to another dialect of Mandarin, Beijing Mandarin. With a series of map tasks to elicit natural yet well-controlled data, this study asks whether contrastive focus realizations of the alveolar–retroflex contrast vary across vowel contexts between the two dialects. Results show that, consistent with Silbert and de Jong's finding for place distinction in English fricatives, focal prominence may result in the exaggeration of non-contrastive dimensions (i.e., longer syllable and frication duration as well as higher frication amplitude) without enhancing feature-defining properties (i.e., a greater acoustic distance between alveolar and retroflex sibilants). It is suggested that the place feature, particularly in coronal sibilants, is generally less subject to cue-enhancing hyperarticulation, regardless of languages and dialects.

1. Introduction

A large body of literature has been dedicated to studying the effects of prosody on segmental contrasts. One important question researchers ask is what acoustic correlates of the sounds under study are affected in various prosodic conditions, and further, whether the acoustic distinctiveness of phonologically contrastive sounds is enhanced through prosodic strengthening. In prosodically prominent conditions, a greater vowel contrast or an expanded acoustic vowel space has been observed on F1 and F2 measures (e.g., Beckman, Edwards, & Fletcher, 1992; Cho, 2005; de Jong, 1995, 2004; Hay, Seelinger, Mandulak, & Zajac, 2006; Mo, Cole, & Hasegawa-Johnson, 2009). Prosodically conditioned phonetic variation has also been found for voicing of consonants. In domain-initial position, voice onset time (VOT) increases for English voiced and voiceless stops (Keating, 1984; Umeda, 1977). The voicing contrast also adjusts to changes in prosodic prominence like stress and focus, as a larger contrast between voiced and voiceless categories is observed in lexically stressed syllables (Lisker & Abramson, 1964, 1967) and under accentuation (Choi, 2003; Cole et al., 2007). However, these prosodic effects are less clear on the contrast of place of articulation. While expecting increased acoustic distinctiveness under phrasal accent, Cole et al. (2007) actually found the place contrast between English /p, t, k/ to be uniformly strengthened (i.e., all phoneme categories undergo increases in the acoustic measures of VOT and closure duration to similar extent such that there is no greater separation between categories) instead of being enhanced (i.e., a greater separation between categories). On the other hand, the burst spectrum measures show a reduced place contrast in the accented condition, and the *F*0 measure shows little effect of accentuation on the place distinction. In Silbert and de Jong's (2008) study of the focus effects on the place contrast for English fricatives, they reported that focus generally increased fricative and syllable durations as well as noise power, but it did not result in enhanced spectral features of the phonological contrast. In contrast, Maniwa, Jongman, and Wade

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(2009) in their recent study reported that nearly all the spectral, temporal and amplitudinal properties they measured were modified in clear and contrastive productions of English fricatives, although significant place contrast enhancement (in terms of acoustic distance between fricative pairs) was only observed in duration and amplitude measures. Taken together, the effects of prosodic strengthening generally result in adjustments in production. However, they do not affect all contrastive dimensions and give rise to an enlarged place contrast, insofar as English stops and fricatives are concerned.

Whether the consonantal place features being more resistant to cue-enhancing hyperarticulation is a language-specific phenomenon can be probed by extending the same investigation to a different language. The alveolar–retroflex[1] contrast in Mandarin is a good candidate for this line of research. There are five places of articulation for Mandarin fricatives and affricates. Among them, only the retroflex sibilants /ʂ, tʂ, tʂʰ/ and their alveolar counterparts /s, ts, tsʰ/ are subject to neutralization, where the alveolars are the default forms. For many speakers of Taiwan Mandarin, a major regional dialect of Mandarin, the retroflex sibilants are replaced with their alveolar counterparts in casual speech but are reverted for disambiguation purposes (Chung, 2006). In addition to communicatively driven hyperarticulation, evidence of prosodically driven hyperarticulation was found in Chuang and Fon's (2010) study of spontaneous speech in Taiwan Mandarin. Their speakers differed in the alveolar and retroflex productions in accented vs. unaccented conditions. Specifically, two strengthening strategies associated with accentuation were observed: (1) the contrast is *strengthened* where the spectral center of gravity (COG) of both sibilants increase, and (2) the contrast is *enlarged* by producing the alveolar or retroflex sibilants or both toward a more extreme direction (i.e., retroflexes have a lower spectral COG and/or alveolars have a higher COG). Compared to previous studies of strengthening effects on English place contrasts, Chuang and Fon's study may suggest that Mandarin (i.e., Taiwan Mandarin) has a consonant inventory that is subject to prosody-induced hyperarticulation.

Alveolar–retroflex neutralization also occurs in an other major dialect of Mandarin, Beijing Mandarin (e.g., Chen, 1991; Zhu, 1998). However, hyperarticulation effects on the alveolar–retroflex contrast in Beijing Mandarin have received little attention because phonologists (e.g., Duanmu, 2000; Lin, 2007) generally describe a well-distinguished and consistent contrast for Beijing Mandarin, where communicatively driven hyperarticulation may seem unnecessary and prosodically driven hyperarticulation absent. Having said that, a comparison of Beijing Mandarin and Taiwan Mandarin would allow us to investigate whether prosody-induced strengthening effects vary between two dialects of the same language that potentially realize the same consonantal place contrast differently.

While setting out to establish whether prosodic strengthening effects vary by the magnitude of a place contrast realized in different dialects, this study also investigated whether strengthening effects vary by the magnitude of the place contrast realized in different vowel contexts. In Mandarin, sibilant realizations have been found to be subject to vowel coarticulatory effects. Jeng (2006) reported that with all else held constant, the spectral COG measured over the alveolar and retroflex sibilants followed by a rounded vowel is lower than when followed by a non-rounded vowel. In addition, the vowel context is also an important factor in the magnitude of the Mandarin alveolar–retroflex contrast, as a smaller alveolar–retroflex contrast in the /u/ context was observed in Jeng's Taiwan Mandarin data. In Li's (2009) study of Taiwan Mandarin alveolar and retroflex production, he found a smaller COG difference between the two sibilant categories before high vowels, with which he argued the high vowel context to be where place neutralization is more likely to occur. However, sibilant productions in the /i/ and /u/ contexts were collapsed in Li's analysis, hence, it is unclear whether the separation between the two categories in the /i/ and /u/ contexts was both smaller compared to that in the /a/ context. In this regard, strengthening patterns would be examined in all /a, i,[2] u/ vowel contexts in this study. On the one hand, Beijing Mandarin and Taiwan Mandarin have the same phonotactics in terms of sibilant–vowel combinations, and therefore, we expected Beijing Mandarin speakers' sibilant productions to be similarly subject to the aforementioned vowel coarticulatory effects. On the other hand, the set-up of this study, where factors of vowel context and dialect may both interact with prosodic effects, calls into question whether stronger strengthening effects would be manifested in a vowel context and in a dialect where the alveolar–retroflex contrast is rendered weaker.

In this study, we manipulated prosodic effects in terms of contrastive focus, thereby extending Chuang and Fon's (2010) research to an investigation of cross-dialect focus effects on sibilant place of articulation. It should be noted that the prosodic effects examined in Chuang and Fon were in terms of the levels of phrasal prominence (specifically, accented vs. unaccented conditions), whereas we investigated the strengthening effects of focus (i.e., contrastively focused vs. non-focused conditions). Given that prosodic prominence-induced and contrastive focus-induced strengthening effects may not have entirely the same acoustic manifestations (Cho, Lee, & Kim, 2011), this study also raised the question as to whether similar strengthening and enhancement effects as those observed by Chuang and Fon would be present with our focus manipulations.

2. Methods

2.1. Experimental considerations

Compared to Chuang and Fon (2010), this production study controlled the factor of lexical frequency in stimulus construction. As high-frequency forms tend to induce phonetic reduction (e.g., Bybee, 2002 for lenition of English consonants; Tseng, 2005

[1] Due to impressionistic or articulatory observations of Mandarin speakers from different regions, Mandarin alveolar sibilants have been variously termed as dentals (Chao, 1968), alveolars (Kratochvil, 1968; Ladefoged & Maddieson, 1996; Luo & Wang, 1981) and denti-alveolars (Lee & Zee, 2003). Mandarin retroflex alveolars have been considered to be laminal post-alveolars /ʂ, tʂ, tʂʰ/ (Ladefoged & Maddieson, 1996), apical post-alveolars /ʃ, tʃ, tʃʰ/ (Lee & Zee, 2003) or just retroflexes /ʂ, tʂ, tʂʰ/ (Duanmu, 2000). In this study, these two categories of sounds will be consistently called alveolars and retroflexes.

[2] The /i/ vowel surfaces as the central apical vowel [ɨ] after Mandarin alveolar fricatives and affricates; the other variant of /i/ is [ɯ] and only appears after retroflex consonants.