

# A Comparative Study of L1 and L2 Vowel Quality

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## 1 Introduction

Phoneme acquisition in a second language (hereafter, L2) for adults seems to be very difficult, especially for an L2 that is very distinct from one's native language (hereafter, L1). Many second language studies have explored this issue, but most of the data are based on non-natural speech (Flege et al., 2003; Cebrian, 2006), such as reading word lists. This paper presents empirical results of a comparative study comparing the vowel production of native (L1) and non-native (L2) speakers in spontaneous Mandarin speech.

## 2 Database

The speech data in the Chinese-as-a-second-language corpus were videotaped in third-year Chinese classes at the University of Illinois at Urbana-Champaign between 2004 and the present. There are two formats, namely: "Variety Show" and "Debate" (Shih, 2006). In this paper, L1 speech data were from the native Mandarin-speaking Chinese instructor and L2 speech data were collected in the "Variety Show" format from a student whose native language is English. The L2 learner gave a 4 minute speech in which she played the role of the host for a whole variety show. The L1 speaker gave an 8 minute speech at the end of the class, in which she commented on the show. The duration of each vowel was measured and the first three formant values, F1, F2 and F3 of the vowel at five points, 0%, 25%, 50%, 75%, 100% of the vowel duration were extracted automatically.

## 3 Analysis of the data

The result of the durational analysis showed that L2 has shorter vowel durations in most cases, compared with L1 durations. While the L2 learner in general speaks

faster, three vowels [ɨ, ʏ, ə] show longer mean durations than the corresponding vowels produced by the L1 speaker. Two of these vowels, [ɨ, ʏ], are unique in the L2 vowel inventory and [ə] has different behavior in Mandarin.

The results of the analysis of formant values show that the vowel space of [i, ɨ, ʏ, e, ə, o] in L2 speech is at a position close to that of L1, implying that the L2 learner acquires these sounds well in terms of formant values, with the exceptions of [u] and low vowels [a, ɑ]. It is noticeable that [u] of the L1 speaker is further back than that of the L2 learner due to the fact that the vowel [u] is further back and more rounded (lower F3) in Mandarin (F3: 2087 Hz) than in English (F3: 2763 Hz). The L2 learner generally uses English [u] in L2 production. As for low vowels, [a] is an allophone of [ɑ], which is fronted and raised in the context of an alveolar coda [n] in Mandarin. However, the distribution of [a] and [ɑ] by the L2 learner is opposite to that of L1, suggesting that the L2 learner's pronunciation is affected by orthography when she learns the L2 sound system.

In the formant trajectories of [u] as shown in Figure 1, the F2 of the L2 learner is higher than that of the L1 speaker throughout the duration of the vowel. The effect of backness and lip rounding is to lower the formant values; as shown in the lower F2 of the vowel [u] in L1 production (Mandarin [u] maintains the backness and rounding). This pattern shows that the L2 speaker uses English [u] in Mandarin speech production. In Figure 2, the F2 of the [a] of the L2 learner is lower than that of the L1 speaker throughout almost the entire duration. This pattern suggests that the [a] in L2 production is further back than that of L1. In the formant trajectories of [ɑ] as shown in Figure 3, the F1 of the L2 learner is slightly lower than that of the L1 speaker, while the F2 of the L2 learner has similar values at the start point but is higher than that of L1 throughout the rest of the duration of the vowel. This pattern suggests that the vowel space of [ɑ] of the L2 learner is higher and more fronted than that of the L1 speaker. In fact, the formant values of [ɑ] of the L2 learner are similar to [ɑ] of the L1 speaker, implying that the L2 learner has trouble pronouncing [a] and [ɑ] distinguishably.

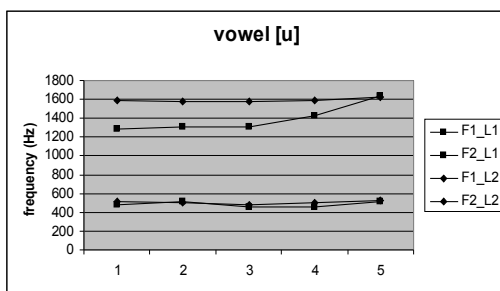


Figure 1. Formant trajectories of [u]

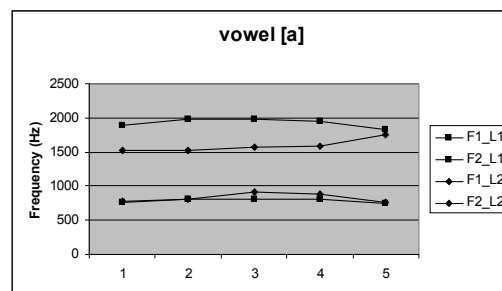


Figure 2. Formant trajectories of [a]

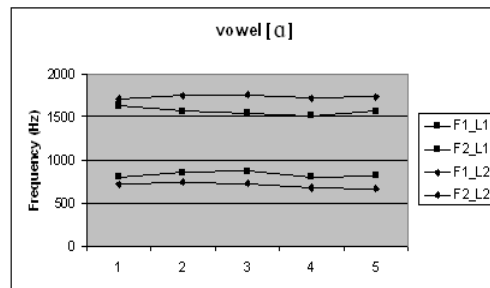


Figure 3. Formant trajectories of [a]

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The results of the analysis of formant values show that the vowel space of [i, ɨ, ʌ, e, ə, o] in L2 speech is at a position close to that of L1, implying that the L2 learner acquires these sounds well in terms of formant values, with the exceptions of [u] and low vowels [a, a]. It is noticeable that [u] of the L1 speaker is further back than that of the L2 learner due to the fact that the vowel [u] is further back and more rounded (lower F3) in Mandarin (F3: 2087 Hz) than in English (F3: 2763 Hz). The L2 learner generally uses English [u] in L2 production. As for low vowels, [a] is an allophone of [a], which is fronted and raised in the context of an alveolar coda [n] in Mandarin. However, the distribution of [a] and [a] by the L2 learner is opposite to that of L1, suggesting that the L2 learner's pronunciation is affected by orthography when she learns the L2 sound system.

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A formant analysis of the vowel [a], conditioned by the preceding consonants showed that the L2 learner shows considerable fronting and raising in the context of

[t] and [n], while the L1 speaker does not.

In most Mandarin language teaching textbooks, pronunciation is annotated using the Pinyin Romanization system. In this system, the vowels [a] and [ɑ] are both represented by the letter “a”. In English, the vowel within the words ‘tan, tang, dan, dang, fan, fang’ is consistently the mid front vowel [ɛ], while in Mandarin, the vowel is conditioned by the following coda. Therefore, the L2 learner positions the low back vowel [ɑ] in Mandarin more fronted and higher, like the English [ɛ], and the central low vowel [a] in Mandarin as a low back vowel. It is likely that the L2 learner has difficulty producing the Mandarin low vowels [a] and [ɑ] due to the orthographic influence on learning pronunciation

## 4 Conclusion

Duration and formant studies reveal language learning strategies employed by fluent L2 speakers that may have a long-term impact on their accents such as the transfer of phoneme and coarticulation effects and orthographic influences. Interestingly, a speaker's level with their vowel production is not always matched by formant accuracy. A new vowel in L2 may be produced hesitantly with long duration but with accurate formant trajectories, while a vowel learned by phoneme transfer may be produced with short duration, suggesting that the speaker is comfortable with the sound, but with erroneous formant values. This study has implications for language teaching and for speech technologies concerning the identification and correction for foreign accents.

## LE-References

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