Is Nasalization Phonological or Coarticulatory in Chinese?
An Acoustic Study on Beijing Mandarin and Chengdu Dialect

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Introduction

The Current Study:
- This study aims to understand the vowel nasalization in two distinct Chinese varieties, Beijing Mandarin (BM) and Chengdu Dialect (CD).
- It adopts the linking hypothesis in Solé (1992, 1995) to examine whether these Chinese dialects have phonological (allophonic) or phonetic nasalization.

Linking Hypothesis (Solé 1992, 1995):
- **Phonological nasalization**
- The nasalized portion of the vowel varies with speech rate, i.e., the proportion of nasalisation remains constant across speech rates.
- **Coarticulatory nasalization**
- The nasalized portion stays relatively constant regardless of speech rate.

Figure 1. Phonological Nasalization (Example from an American English Speaker in Solé 1992)

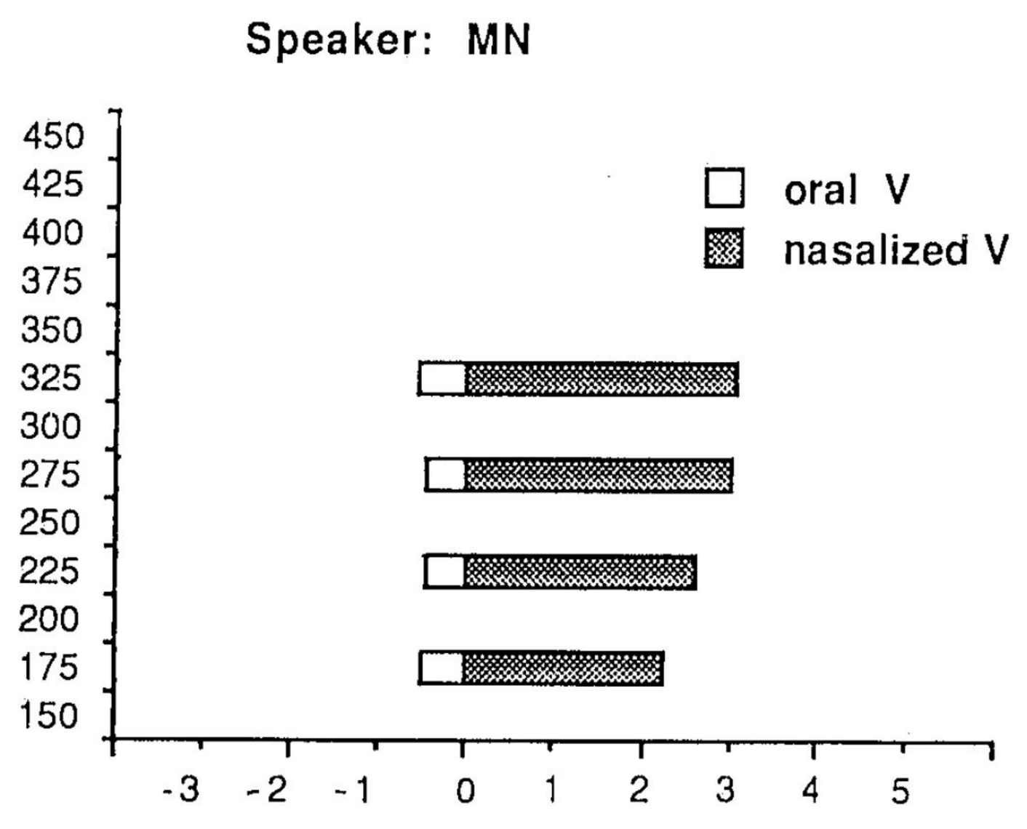
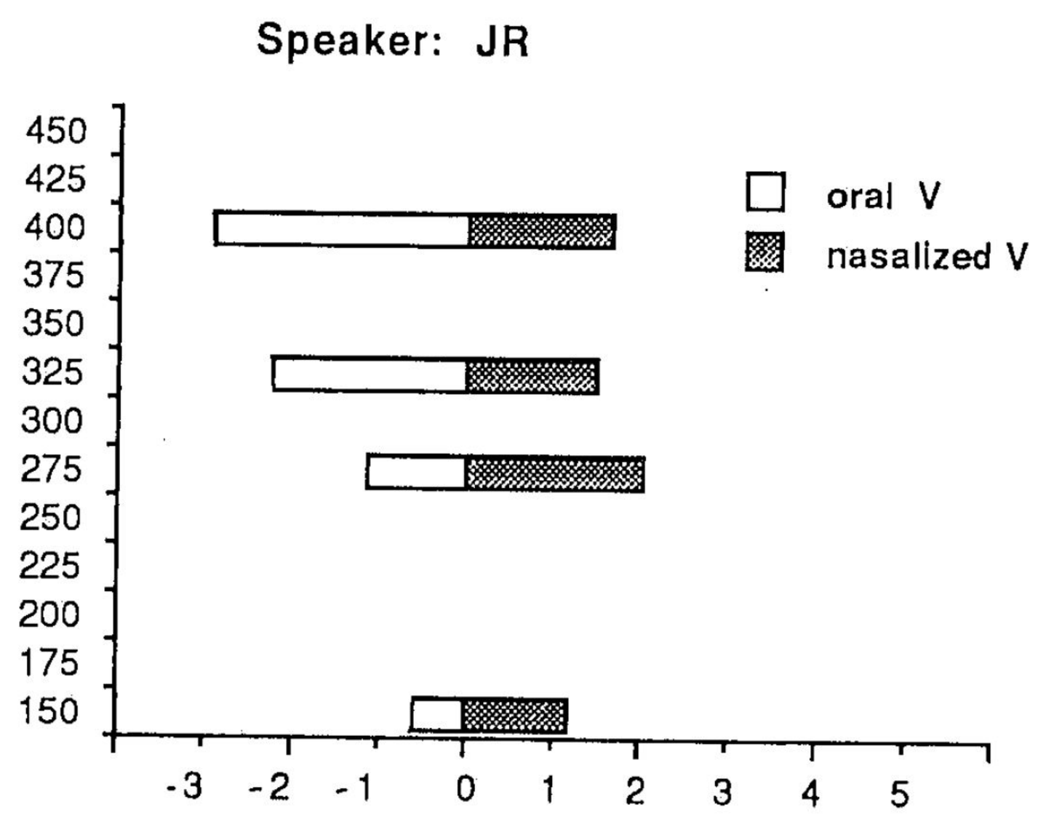


Figure 2. Coarticulatory Nasalization (Example from a Spanish Speaker in Solé 1992)



Phonological Properties

- In BM and CD, phonological nasalization is non-contrastive.
- Both varieties have nasal coda consonants, the dental nasal [n] and the velar nasal [ŋ] (Duanmu 2007).
- Chengdu has the same nasal inventory as that of Mandarin underlyingly (Duanmu, 1999; 2007).
- CD lacks the bilabial nasal consonant in syllable final positions, which has possibly merged into [n] diachronically (Zee, 1985).

Methods and Materials

Participants:
- 2 native speakers of Beijing Mandarin, female, aged 24-27
- 5 native speakers of Chengdu Dialect 2 female, 3 male, aged 24-29

Experiments:
- Reading tasks from a list with orthographic words
- Recorded with a handheld nasometer (Glottal Enterprises, Syracuse, NY)
- 3 repetitions of real words and filler words in a carrier phrase
- 2 speech rates, fast and slow

Target words:
- Filler words (4 for BM, 0 for CD)
- Target words consisted of [CVn], [CVŋ] and [CV] words

Figure 3. Handheld nasometer

Figure 4. Split channel recording in Praat

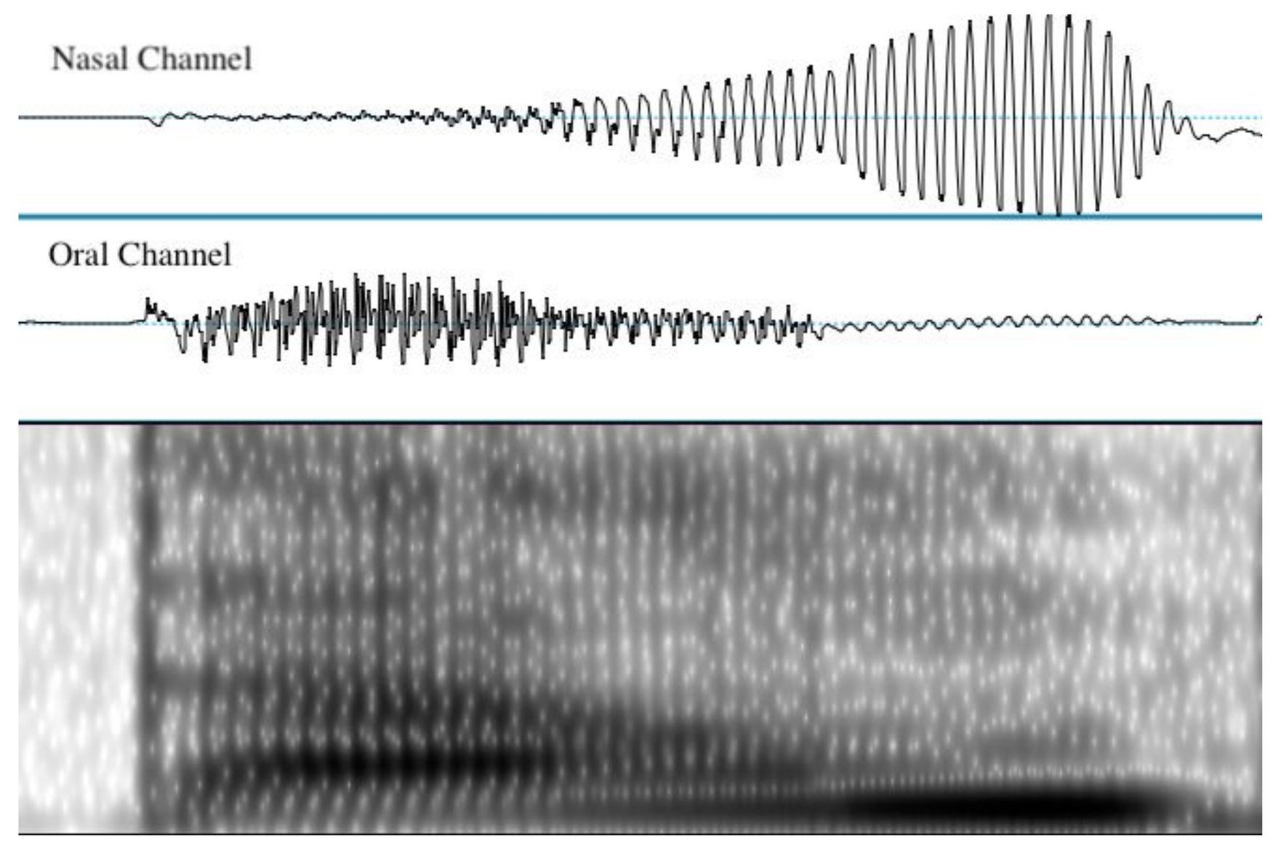


Table 1. Beijing Mandarin Target words

BM [CVŋ]	BM [CVn]	BM [CV]
[gə̄ŋ]	[gə̄n]	[gə̄]
[tʂə̌ŋ]	[tʂə̌n]	[tʂə̌]
[fāŋ]	[fān]	[fā]
[lǎŋ]	[lǎn]	[lǎ]

Table 2. Chengdu Dialect Target Words

CD [CVN]	CD [CV]
[bǎŋtʰwe]	[bátʰiæn]
[dǎŋpʰai]	[dǎpʰɪn]
[dāntʰiæn]	-
[də́npʰɚ]	-
[bīntʰiaʊ]	[bítʰi]
[fōŋkoʊ]	[fōkæ]

Results

- **Vowel nasal intensity plots:**
  - Nasal intensity taken at every 10% increment of the vowel
  - [CV] oral segment as nasality baseline
- **Summary:**
  - BM and CD show the same trend in nasal intensity trajectory
  - Nasalization at around 40% into the vowel
  - Consistent nasalization cross speech rates
  - Consistent ratio of the nasal portion of the vowel
  - Vowel nasalization in CD and BM is phonological, not co-articulatory!

Figure 5. Beijing Mandarin vowel nasal intensity

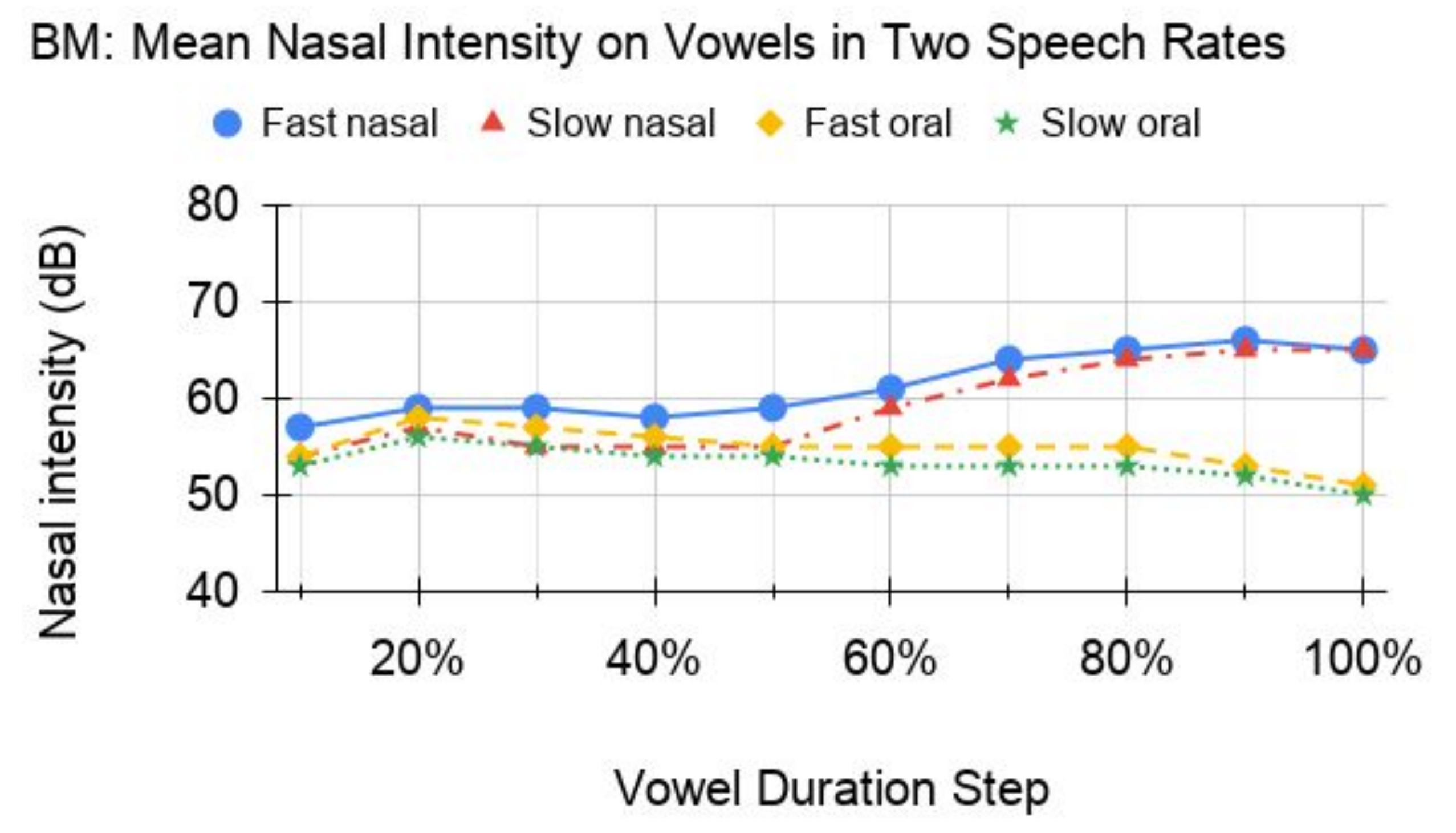
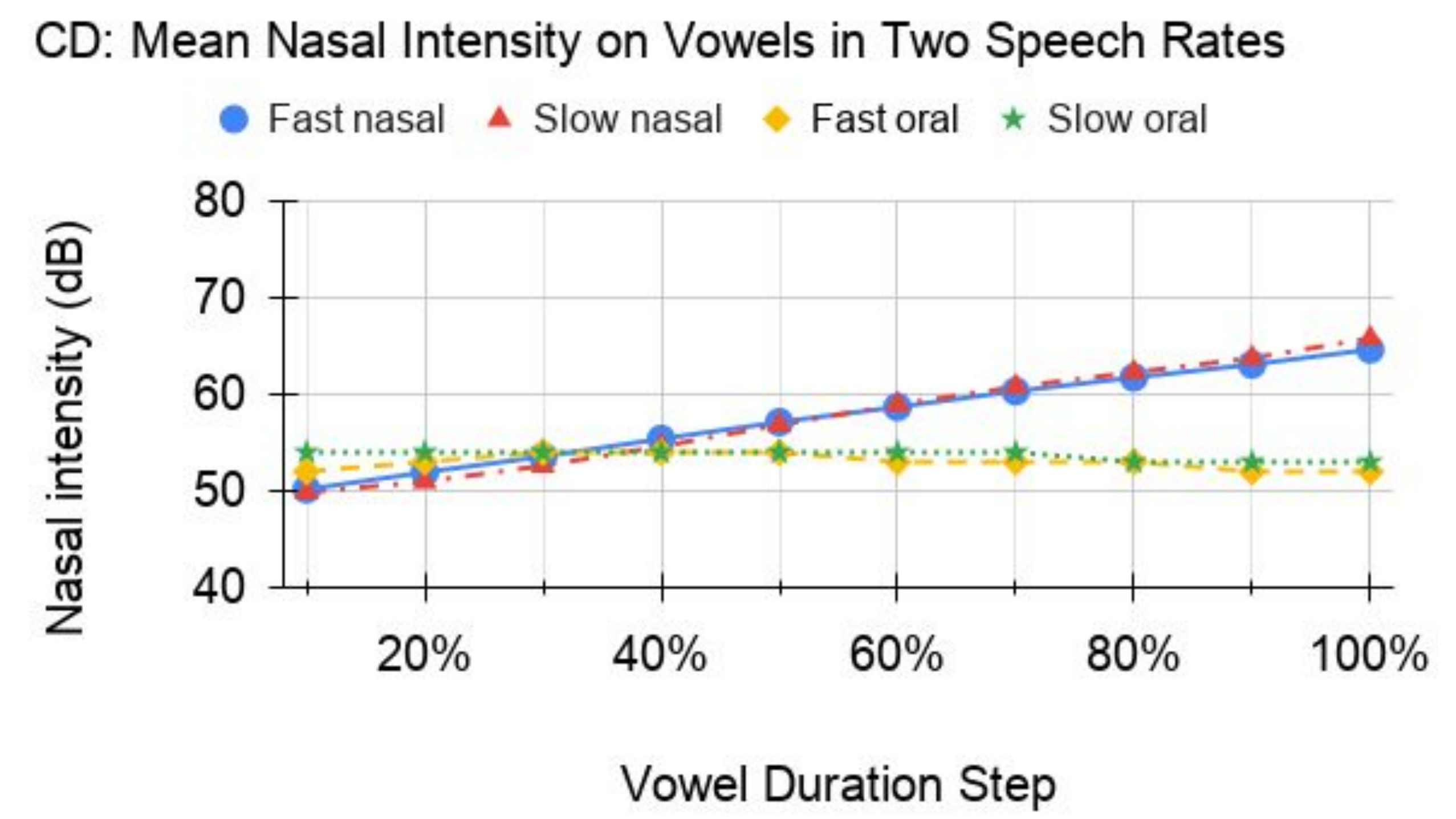


Figure 6. Chengdu Dialect vowel nasal intensity



Conclusion & Discussion

Findings:
- Adopted experimental approach in investigating cross-dialectal patterns
- Confirmed Duanmu's (2011) claim that Chinese nasalisation is phonological
- Distinguished between phonological and phonetic processes
- Cannot determine the underlying representations for vowels

Inter-speaker variation and language change:
- Individual variability of production and perception can link to sound change (Beddor et al., 2018).
- Cross-dialectal differences in the production of nasality may be a source for language change.
  - \`Waning' of coarticulatory effect
  - Loss of nasal coda(s)
  - Change in nasalized vowels

Future projects:
- Separate underlying vowel nasality from allophonic vowel nasality
- Nasalisation variation in dialects
- Production and perception of nasalization and language change
- Careful phonetic study of nasalisation in Chinese dialects and the development of nasal vowel contrasts in the world's languages

Selected References

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