English vowel quality effects on nasal gemination in Mandarin loanwords: Corpus data vs. bilingual production & perception experimental results

This study, couched within the broader issue of what factors condition nasal gemination in Mandarin loanword adaptation, presents the distributions of nasal gemination in corpus, and production and perception experimental data generated from Mandarin-English bilingual speakers in which intervocalic English nasals are variably adapted as either geminates or singletons in Mandarin. The corpus data indicate that the English prenasal vowel features and stress location determine nasal gemination in Mandarin loanwords, i.e. nasal gemination is contextualized. The findings in both experiments show that the bilingual strategies for nonce word adaptations show similarities to the Mandarin loanword patterns observed in the corpora. We argue that the experimental results provide evidence that the perceived duration and nasalization of the English prenasal vowels determine which variant is preferred.

Corpus Data Based on a dictionary corpus with 2400 sound-based loanwords, we identified that nasal gemination in Mandarin loanwords is attributed to the quality of the English prenasal vowel (vowel type condition) and the primary word stress location (stress location condition). English intervocalic nasals are prone to be adapted with nasal gemination in Mandarin loanwords (90.8%) when the English prenasal vowel is lax, non-high and stressed, e.g., *Diána*→[tai.a**n**.**n**aː] (prenasal stressed lax low vowel) vs. *Brúno*→[puː.luː.**n**woː] (prenasal stressed tense high vowel) and *Boníta*→[pwoː.**n**iː.taː] (postnasal stressed vowel). Free variation occurs when the English prenasal vowel is [ə], e.g., *Tíffany*→[tiː.fa**n**.**n**ei]~[tiː.fuː.**n**i]. We propose that the geminate variant is preferred due to (i) a better match for vowel duration between an English lax vowel and a short vowel in a Mandarin closed syllable, and (ii) a better match for vowel nasalization in non-high vowels. We therefore hypothesize that the perceived vowel duration and nasalization of English prenasal vowels play a crucial role in inducing the geminate variant. Nasal insertion in Mandarin loanwords is for better acoustic cue matching.

Experiments A production and a perception experiment were conducted to find out (i) whether the English prenasal vowel quality and stress location condition nasal gemination in Mandarin loanwords, and (ii) which adaptation form is preferred under what contexts. Both experiments were run on the same 24 Mandarin-English bilinguals. ***Production Exp.*** All participants listened to 127 (42 test items & 85 filler items) English nonce-word inputs on Psychopy and orally recorded a Mandarin adaptation for each input. Participants were allowed to ignore Mandarin orthographical and tonal effects. ***Perception Exp.*** The participants listened to the same nonce words, but in triplets twice in the ABX and BAX formats with an input (X, e.g., [bǽni]) and two possible adapted Mandarin outputs (A and B, e.g., [pa**n.n**i] and [pa.**n**i]). They were asked to choose which adapted Mandarin form, with or without nasal gemination, sounded more similar to the source word.

Perception & Production Exp. Results. In comparing inputs with stressed prenasal lax vs. tense vowels in disyllabic words, the results from both experiments present a significantly higher rate in producing the geminate variant [CVN.NV] to match the [CV_{Lax}NV] structure (Fig. 1), which followed the vowel type condition identified in the corpus. The results from both experiments do not align with the stress location condition, i.e. [ˈCV_{Lax}NV] and [CVˈNita] do not differ significantly (Fig. 2). However, [CV_{Lax}ˈNita] triggers significantly more nasal gemination than [CV_{Tense}ˈNita] in both experimental results (Fig. 3). For the free variation pattern with English [CVCəNV], 27.9% of the targeted nasals were geminated in production; however, 60.2% responses in the ABX task chose nasal germination (Fig. 4). Compared to vowel quality, stress location does not seem to play an active role under the experimental condition. Moreover, the results from both experiments show that the lax low vowels trigger more nasal gemination than non-low vowels. The tendency is stronger in the production data than the perception data. (Fig. 5).

Discussion & conclusion The production and perception experimental results support our hypothesis that English prenasal vowel duration and nasalization contribute to the emergence of the geminate variant in Mandarin loanwords: 1) English prenasal lax vowels trigger nasal gemination in Mandarin loanwords more than tense vowels; 2) stress location condition was not identified in both experimental results; 3) a higher gemination rate occurs as a result of a very short prenasal schwa in perception than in production; 4) prenasal low vowels trigger a higher gemination rate than non-high vowels for its higher degree/longer duration of vowel nasalization (Beddor, 1993; Hajek & Maeda, 2000). The relative lower gemination rate in the prenasal stressed lax vowel context in the experiment (production: 50%, perception: 72.5%, corpus: 90.8%) may be attributed to a difference in individual prenasal vowel percepts. The lack of stress effect can be explained as follows: 1) English-Mandarin bilinguals often experiencing difficulties in English lexical stress. Among the three acoustic cues for stress perception, F0, duration, and intensity, tonal language speakers often mainly rely on the perception of F0 (Wang (2008)); 2) Mandarin-English bilinguals have more accurate lexical stress perception for trochaic stress pattern than iambic (Yu & Andruski (2010)); 3) the prenasal vowel of the test items (CV'Nita) were measured heavily nasalized on Praat. In conclusion, this study contributes to a better understanding of which phonetic cues modulate nasal gemination in Mandarin loanwords and how they do so. It also showcases multiple sources for one contextualized (intervocalic nasal) adaptation process: linguistic contexts, auditory vs. non-auditory (cf. Smith (2006)), and the similarities and differences in perception and production experiments.

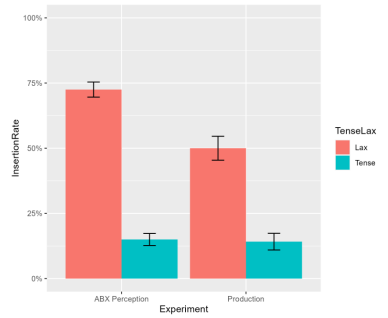

Fig.1. Nasal gemination rate with different prenasal vowel quality and stressed prenasal vowels: 'CV $_{Tense}$NV vs. 'CV $_{Lax}$NV

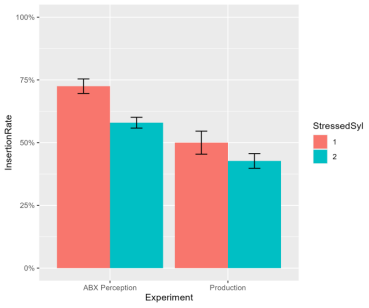

Fig. 2. Nasal gemination rate with the stress on the first and second syllable: 'CV $_{Lax}$NV vs. CV'Nita

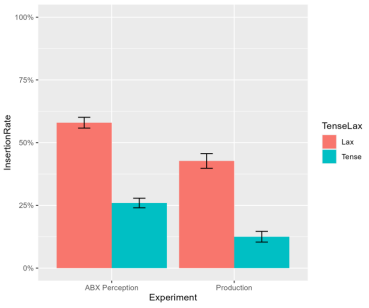

Fig.3. Nasal gemination rate with different prenasal vowel quality and stress on the postnasal vowel: CV$_{Lax}$'Nita vs. CV$_{Tense}$'Nita

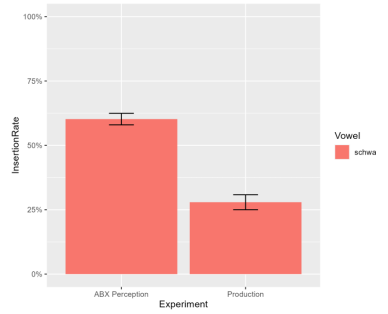

Fig.4. Nasal gemination rate when the prenasal vowel is [ə]: CV́ CəNV

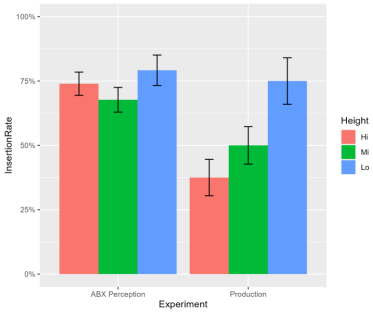

Fig.5. Nasal gemination rate in relation to the prenasal lax vowel height: 'CV $_{Lax}$NV