Disentangling varying degrees of contrast for Mandarin /in/-/iŋ/ rhymes through word-level patterns

Suyuan Liu and Molly Babel

University of British Columbia (Canada)

Words provide the fodder for phonological generalizations. That is, an individual generates their phonological knowledge from their lexicon (e.g., Beckman et al., 2011; Cychosz et al., 2021). This is separate from the creation of actual form-to-meaning mapping (e.g., Panther et al., 2023), but the creation of phonological contrast is supported by a form's association with a unique reference (e.g., Creel, 2022). While one's phonology is thus built from experienced items, it can be studied independently in its abstracted form. Laboratory phonologists often study speakers' phonological knowledge outside of its lexical contexts (e.g., quantifying the degree of similarity between /ɑdɑ/ and /ɑrɑ/ for English listeners and Spanish listeners, for whom the contrast is allophonic and phonemic, respectively; Boomershine et al., 2008). We posit that removing sound structure from its lexical context sows confusion.

As our test case, we revisit Mandarin nasal codas, which have received substantial focus in the Mandarin phonetics and phonology literature (e.g., Faytak et al., 2020; Fon et al. 2011; Hsu and Tse, 2007; Luo, 2015; Mou, 2006; Wang et al., 2018). Standard Mandarin only has two codas /n/ and /ŋ/. These codas exhibit various degrees of contrast depending on the preceding vowel and the Mandarin variety. Given the subtlety of nasal place information acoustically (e.g., Narayan, 2008), such patterns are not surprising. In this project, we focus on the /in/-/iŋ/ contrast in Shanghai Mandarin (ShM) and Beijing Mandarin (BjM). In ShM, /in/-/iŋ/ shows a loss of contrast in both production and perception (Faytak et al., 2020; Luo, 2015). A case in point of the utility of word-level information: while Beijing Mandarin listeners are observed to contrast /in/ and /iŋ/ in lexical production, they showed little ability to perceive the difference in nasal codas in VC sequences (Faytak et al., 2020).

We recruited BjM and ShM speakers for a task that included the production of /in/-/iŋ/ minimal pairs and two perception tasks with four documented pronunciation variants for nasal codas: [in], [iɲ], [iŋ], [iəŋ] as stimuli. Both perception tasks focused on word-level phonological knowledge of frequency-matched lexical items, with one focused on word identification (2AFC) and the other a goodness rating task. Productions were coded by a phonetically trained Mandarin-English bilingual and a Spanish-English bilingual. The data have been analyzed using Bayesian multilevel models using brms (Bürkner, 2021). At the group-level, BjM listeners' productions and word categorizations align well: speakers produce a contrast between /in/ and /iŋ/ words, variably producing [iŋ] and [iəŋ] for the /iŋ/ lexical set and robustly perceiving both as /iŋ/ words. Contra Faytak et al. (2020), BjM listeners exhibit a clear contrast for nasal codas in perception when words are listeners' focus. The ShM results are different, and somewhat more complicated. In production, ShM speakers showed a low but extant degree of distinction of [iŋ]-[iəŋ] for /in/-/iŋ/ contrast. Perceptually, the Bayesian model showed little evidence for the degree of contrast for the variants that only differ by nasal (i.e. [in], [iɲ], [iŋ]) for ShM listeners. [iəŋ] variants were perceived as the best category exemplar by both groups. For each minimal pair, the exact patterns for the /in/-/iŋ/ contrast differ by lexical items.

Altogether, these results underscore the role for the lexicon in helping attend to and parse phonological contrasts. Word-level information may be particularly useful for auditorily challenging contrasts like coda nasals. Our results, coupled with the extant literature, demonstrate the need to consider words when we consider sound patterns of Mandarin nasal codas.

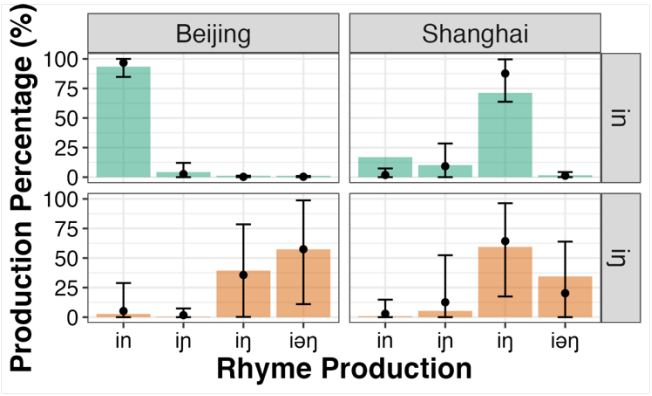

Figure 1: Percentages of production variants for /in/- or /iŋ/-word (rows) for the two groups (columns). The error bars show the 95% HDI of posterior predictions for each group.

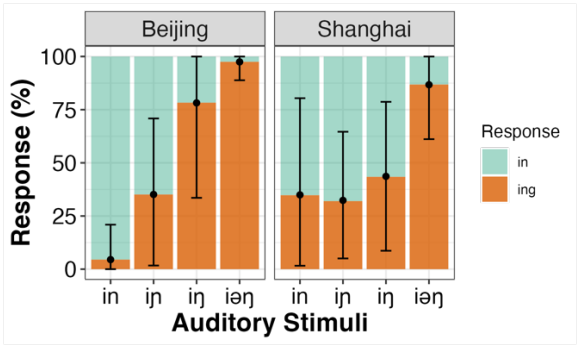

Figure 2: Word categorization results showing percentage of /iŋ/-word responses (y-axis). Error bars present the mean and 95% HDI of posterior predictions of /iŋ/-responses.

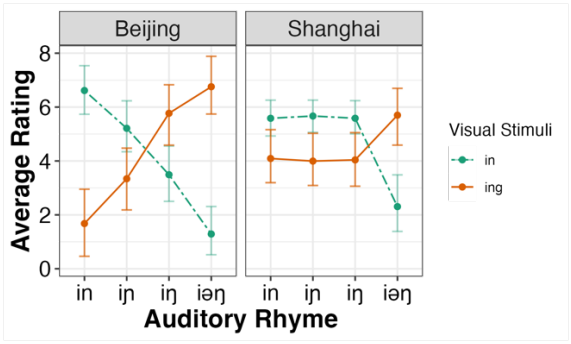

Figure 3: Goodness ratings showing the rating (y-axis) from 1 (worst) to 7 (best) for the stimuli types (x-axis). The error bars indicate the 95% HDI of posterior predictions.

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