

Perception-production link by position in the imitation of Korean nasal stops

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In the phonetic imitation literature, a common observation is that not all cues are imitated equally. Specifically, primary cues (or phonologically relevant/critical cues) are more consistently imitated than other secondary/phonetic cues [1,2,3]. These primary cues are likely to be directly linked across perception and production. This study investigates the variation in perceptual cue weights based on the position (word-initial or word-medial) in the imitation of Korean nasal stops, revealing a disparity in the perception-production link between these positions.

In Korean, nasal stops undergo *initial denasalization*, resulting in varied realizations from weak nasals to voiced oral stops word-initially, a process attributed to domain-initial consonant strengthening [4]. Because of this process, nasality becomes a less informative cue in identifying nasals in the initial position (e.g., /to/ “way” vs. /no/ “paddle” → [to] vs. [do~no]). On the other hand, while obstruents in Korean lack contrastive voicing [5], voiced obstruents can surface intervocalically due to *intervocalic voicing* [6, 7]. This makes nasality the primary cue in identifying nasal in the medial position (e.g., /hata/ ‘do’ vs. /hana/ ‘one’ → [hada] vs. [hana]), which contributes to an asymmetry across the two positions, with a stronger reliance on nasality cues in the medial position compared to the initial position [8].

This study consisted of (i) an imitation task where 32 Korean speakers (22F, 10M; $M = 21.9$ yrs.) were asked to imitate the model stimuli as closely as possible and (ii) an identification task where they were instructed to identify the presence of a nasal upon hearing the stimuli. The order of the two tasks was counterbalanced across participants. The stimuli used in both tasks were constructed from 7-step continua ranging from a voiced oral ([b, d]) to a nasal stop ([m, n]) in initial CV or medial VCV positions across three vowel contexts ([a, i, u]) (e.g., [ba] or [aba]). In the imitation task, participants were instructed to imitate stimuli at step 1 (oral), step 4 (ambiguous) and step 7 (nasal) on the continua, while in the identification task, participants were exposed to all items on the continua. Endpoint stimuli were produced by a speaker whose native language contrasts voiced oral and nasal stops in both initial and medial positions, with the continua manipulated using Tandem-Straight [8].

The results of the nasal identification task replicated previously observed asymmetrical behaviors based on the position: stimuli along the voiced oral-nasal continua in the initial position were more likely to be identified as nasals than those in the medial position, where more categorical perception was observed (Fig. 1), confirming listeners’ stronger reliance on nasality cues in the medial position. Given the individual variability in categorization of step 4 (ambiguous) stimuli (Fig. 2), participants were grouped based on their categorization patterns to explore the link between perception and production. The *nasal* group (N=5) identified the ambiguous stimuli as nasals more than 75% of the time, the *oral* group (N=8) less than 25%, and the *intermediate* group between these two extremes (N=19).

The imitated stops were analyzed in terms of the degree of nasality, by measuring *alp0* on the following vowel, an indicator for nasalization (where a lower number means higher nasality). The findings of the imitation task (Fig. 3) revealed that nasality was more *categorically* imitated in the medial position, as indicated by a large difference across the steps in *alp0*, with the ambiguous step 4 clustering with the nasal step 7 in the nasal group and with the oral step 1 in the oral group. In the initial position, however, nasality was either closely imitated as present in the stimuli (the oral group) or imitated without any discernible difference (the nasal and the intermediate group), indicating a gradient or lack of imitation in production. Perception-production link at an individual level will also be considered. Taken together, this study illustrates a case where cue reliance can vary by position and this variability is manifested in its connection to production.

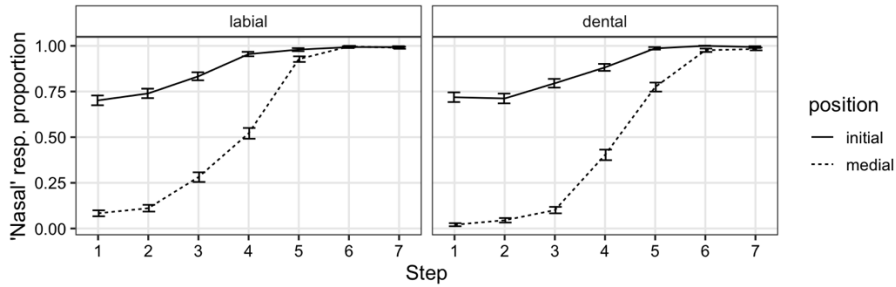


Fig 1. Perceptual categorization of initial and medial stimuli ranging from voiced oral (step 1) to nasal stops (step 7)

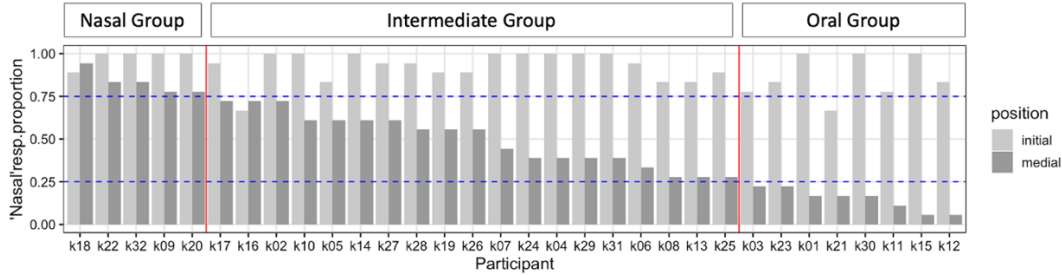


Fig 2. Nasal response proportion of step 4 ambiguous stimuli by participant

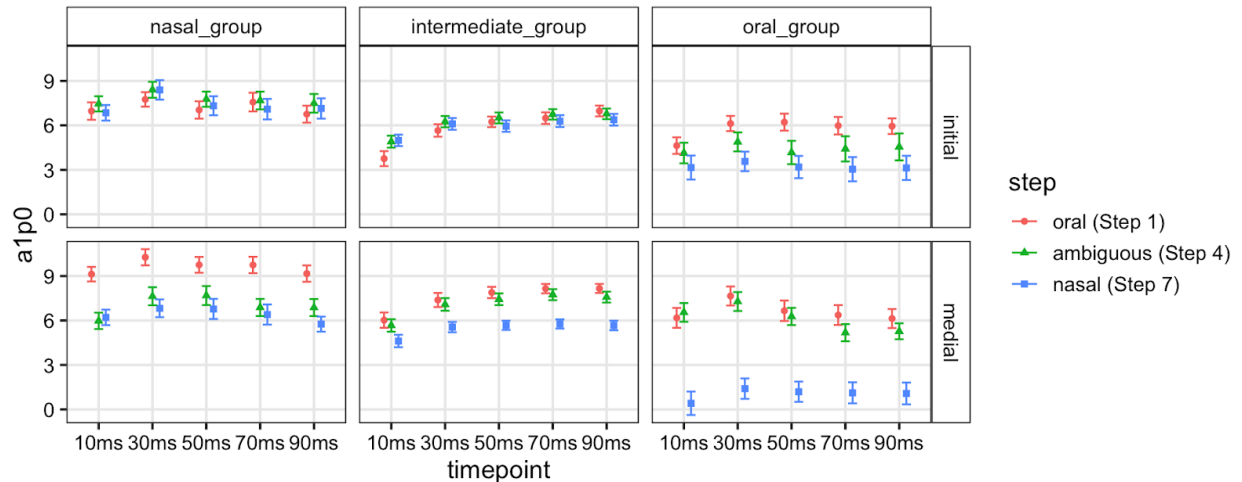


Fig 3. A1-P0 in the vowel following oral-ambiguous-nasal stops (step 1, 4, 7) measured at absolute time points (10 ms to 90 ms with a 20 ms interval) from the vowel onset

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