Learned performance or auditory bias: carryover vs. anticipatory nasal coarticulation

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Vowels (V) adjacent to nasal consonants (N) often show nasal coarticulation (nasalization), which increases or decreases gradiently. In NV sequences, the velum remains open after the release of N's oral constriction, causing carryover nasalization (a decreasing cline). In VN sequences, the velum opens before the N's oral constriction is made, causing anticipatory nasalization (an increasing cline).[1] Cross-linguistically, anticipatory nasalization is less prominent in articulation but more prominent in perception than carryover nasalization;[2] it is more likely to interact with phonological processes (e.g. neutralizing an oral vowel-nasal vowel contrast)[3] and can serve as a source of information about upcoming nasal consonants.[4][5] These asymmetries raise the question: Is there an auditory bias that favors anticipatory nasalization? Or can listeners detect both types of nasalization equally well, but then utilize them as information sources asymmetrically? In other words, does the apparent asymmetry originate at the level of information availability, or information processing? We hypothesize that any asymmetry which favors anticipatory nasalization is not inherent to auditory perception, and instead exists at the level of listeners' weighting of evidence. This may happen because anticipatory nasalization is predictive of upcoming nasal consonants and attending to it may thus speed word recognition, while attending to carryover nasalization can offer no such predictive benefit.

Experiment 1: In a bidirectional gating experiment, participants heard syllables (NVC: mob, CVC: bob, CVN: bomb) in which the first or last consonant was replaced with noise. Native listeners of American English responded with whether they heard the missing consonant as oral or nasal. In both the anticipatory (bob vs. bomb) and carryover (bob vs. mob) conditions, participants were more likely to respond correctly as they heard more of a stimulus (fig. 1). Performance in the carryover condition was worse, but above chance at the 200 ms gate. In other words, perception was asymmetric, but both carryover and anticipatory nasalization were used as sources of information in these stimuli.

Experiment 2: Having shown listeners capable of responding based on both types of nasalization in E1, a discrimination study tested whether listeners detect carryover and anticipatory nasalization symmetrically well. In a 4IAX task, which reduces the influence of language-specific knowledge to more directly test auditory sensitivity,[6] participants heard two pairs of CVC syllables (four stimuli per item) and identified the pair containing a difference between vowels. The stimuli varied in the level of nasal coarticulation (from oral to heavily nasalized on a synthesized 10-step continuum); items varied in the direction of nasal coarticulation (carryover vs. anticipatory) and whether the differing stimulus pairs were separated by one vs. four continuum steps. 1-step differences were not discriminable (performance equivalent to chance), while 4-step differences were readily discriminable (performance above chance; fig. 2). Vowels with carryover and with anticipatory nasalization both patterned this way. This symmetric sensitivity to carryover and anticipatory nasalization suggests that the typological/perceptual asymmetry arises not from an auditory bias against the detection of carryover nasalization, but from language-specific knowledge.

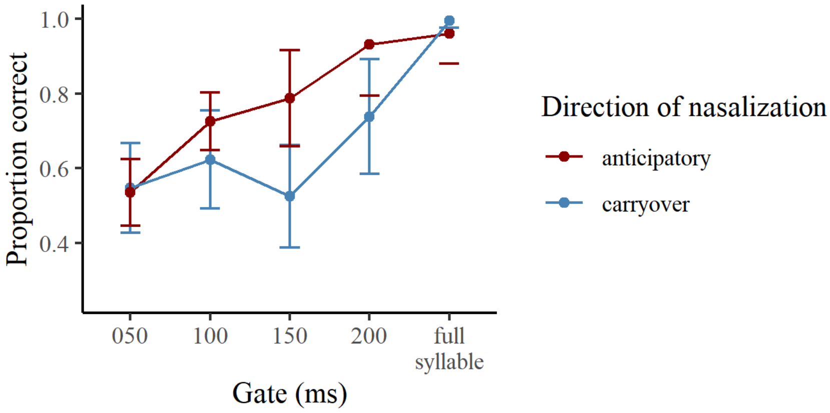

Fig. 1. Experiment 1: proportion correct for listeners' *bob* vs. *mob* (blue) responses and *bob* vs. *bomb* (red) responses at gates of 50 ms, 100 ms, 150 ms, 200 ms, and the full syllable.

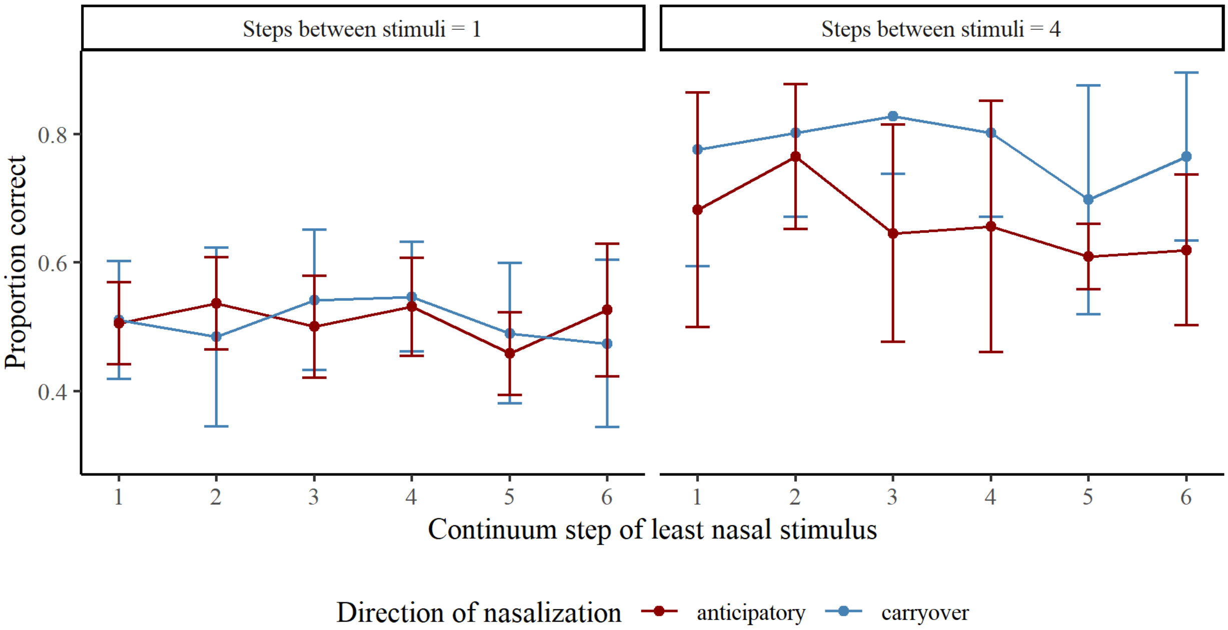

Fig. 2. Experiment 2: proportion correct for listeners' responses to items containing a 1-step difference (left) or a 4-step difference (right) between stimuli, and vowels with either carryover (blue) or anticipatory (red) nasalization, with the most oral stimulus in the item varying along the first six steps of a 10-step oral-nasal vowel continuum.

References

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