

Equilibrium Dynamics of Near-Merger: Functional Load and Contrast Persistence

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Phenomenon. Near-merger shows that contrast loss need not proceed as an all-or-nothing collapse. As Labov et al. (1991) show, speakers may continue to produce small but systematic phonetic differences even when the corresponding perceptual contrast is no longer reliably maintained. This pattern is difficult for models that assume tight production–perception coupling or treat merger as the inevitable endpoint of phonetic reduction. This study argues instead that near-merger can be a possible equilibrium state: a locally stable configuration in which production preserves residual contrast while perception is substantially weakened. The empirical case is the Cantonese T2–T5 contrast. T2 is high-rising and T5 is low-rising; the two tones are phonetically similar across much of the syllable and are distinguished most clearly near the contour offset. Previous work has documented ongoing Cantonese tone merger or near-merger in Hong Kong and related varieties (Mok et al., 2013; Zhang, 2019), and Soo and Babel (2023) further show that lexical competitors sharpen Cantonese tone categorization. This makes T2–T5 a useful test case for asking when a system stabilizes as non-merger, near-merger, or full merger.

Model. The study develops an exemplar-based production–perception model in which the two domains are represented as separate but interacting stores. The model is initialized with empirical T2–T5 productions from non-merging speakers in Mok et al. (2013). Each epoch begins with lexical selection: a production exemplar is sampled, realized with target undershoot inspired by Xu and Wang (2001), and then optionally adjusted by contrast-driven hyperarticulation if the selected word participates in a T2–T5 minimal-pair relation. This implements the idea that functional load and lexical competition can create pressure for greater phonetic distinctiveness (Lindblom, 1990; Wedel et al., 2013; Wedel and Fatkullin, 2017; Wedel et al., 2018). The resulting token is stored in production and transmitted to perception. Perception is modeled as kernel-based categorization over a separate perceptual exemplar space. Building on exemplar approaches to sound change (Pierrehumbert, 2001; Tupper, 2015), the model departs from implementations in which ambiguous tokens are filtered out: ambiguous tokens are stored in both perceptual categories, while production tokens are written back only to the intended lexical item after lexical recovery. Perceptual ambiguity can therefore accumulate and exert an averaging pressure across categories, while production can continue to preserve lexically guided target structure. Functional load is operationalized locally through minimal-pair structure: the total lexicon size is held constant while the number of T2–T5 minimal-pair competitors is varied from $FL = 0/7$ to $FL = 7/7$. As lexical support increases, the production system converges on progressively larger stable separations; in the absence of minimal-pair support, it converges to merger.

Results. The simulations show three regimes. When lexical support is absent, both production and perception converge to merger. When lexical support is very high, both systems maintain a robust contrast. Between these extremes lies a broad near-merger regime: production remains positive and stable, but perception is much weaker or nearly collapsed. In the FL sweep, production distance increases from 0.000 at $FL = 0/7$ to 0.716 at $FL = 6/7$ and 3.579 at $FL = 7/7$. Perception, however, remains at or near zero from $FL = 0/7$ through $FL = 6/7$, rising robustly only at $FL = 7/7$. The model therefore does not merely predict that low-functional-load contrasts are more prone to merger. It predicts a more specific trajectory: reduced lexical support first produces production–perception mismatch, because ambiguous perceptual storage collapses perceptual separation before lexical

support is weak enough to erase production structure. Near-merger is therefore not a transient residue on the way to full merger, but a structured equilibrium regime generated by the interaction of phonetic reduction, perceptual categorization, production constraints, and lexical organization.

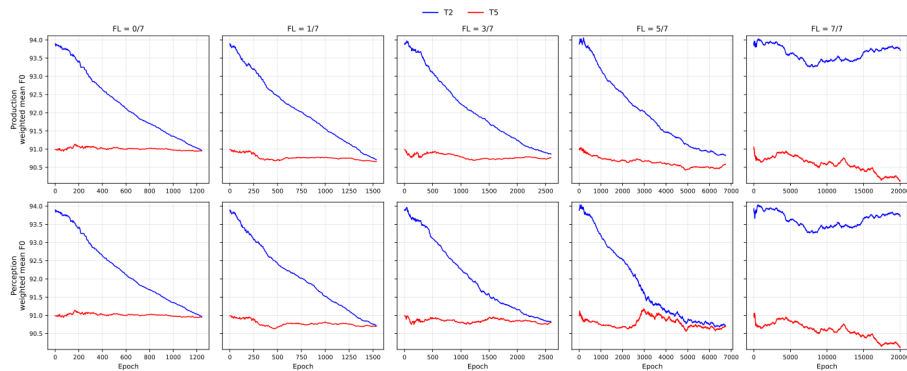


Figure 1: Production (top) and perception (bottom) trajectories across lexical-support conditions.

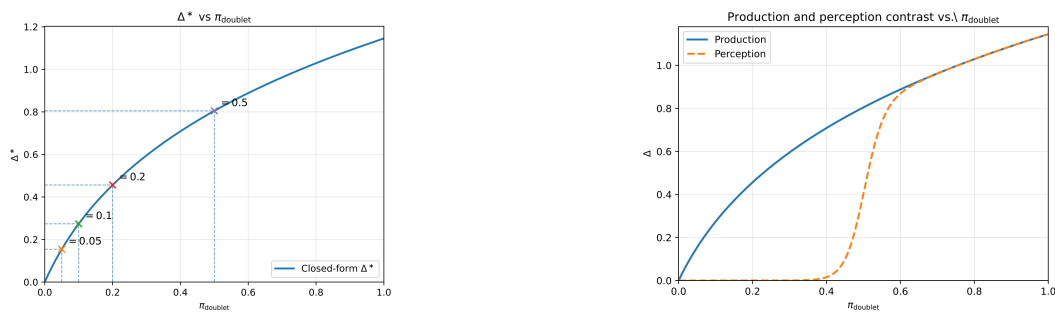


Figure 2: Left: production equilibrium. Right: convergent production–perception distances.

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