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Tongue Root as Enhancement and Emergence

Noriko Yamane
Hiroshima University

1. Introduction

Tongue root distinctions present a persistent puzzle in phonetics and phonology. Are they best analyzed as discrete phonological features, as coordinated gestural patterns, or as artifacts of biomechanical constraints? Each perspective offers valuable insights, yet none fully accounts for the complex and variable behavior of tongue root movement across languages. This squib asks: what happens if we do not treat these levels—phonological, gestural, and biomechanical—as mutually exclusive? What can we see if we intentionally examine the overlap?

Recent studies using ultrasound imaging have significantly expanded our understanding of tongue root dynamics, particularly in languages with [±ATR] vowel harmony systems. These investigations show consistent patterns of tongue root advancement or retraction, but also reveal considerable intra- and inter-speaker variability, raising questions about the nature of the contrast. Is tongue root advancement a binary phonological feature? A gradient phonetic process? Or a biomechanically natural movement that language exploits?

This phenomenon matters theoretically because phonological systems are assumed to organize speech sounds into cognitively meaningful units—phonemes, features, and prosodic structures. Yet tongue root behavior often blurs these boundaries. In some cases, the contrast behaves like a stable phonological distinction. In others, it appears gradient and sensitive to articulatory or acoustic context. Additionally, biomechanical research suggests that tongue root motion may be shaped by muscle coordination and constraints in the vocal tract, not solely by linguistic intention.

Rather than forcing tongue root phenomena into one explanatory model, this squib proposes a more integrative approach. By aligning findings from feature theory, articulatory phonology, and speech biomechanics, we can better understand how languages structure and exploit articulatory resources. Tongue root distinctions may be precisely the kind of hybrid category that reveals the interplay between abstract linguistic structure and the physical realities of speech production.

The case of tongue root thus invites a broader rethinking: when categories resist clear-cut classification, perhaps it is not the categories that are at fault, but our insistence on strict boundaries. A more layered, dynamic view may reveal not only how languages differ, but also how the human speech system flexibly balances cognitive, physical, and communicative demands.

2. Tongue Root in Laryngeal Contrast

The status of tongue root (TR) activity in laryngeal contrasts remains a complex and underexplored area of phonetic and phonological research. A growing body of ultrasound studies has examined the articulatory behavior of the tongue root during the production of laryngeal consonants, revealing both recurring patterns and surprising variability across

languages. These studies raise foundational questions: Is tongue root advancement or retraction a phonologically controlled gesture? Or is it a biomechanically motivated consequence of voicing or aspiration?

This section presents attested data from multiple languages, all based on ultrasound imaging of the vocal tract. The goal is to illustrate how tongue root activity correlates—or fails to correlate—with phonological laryngeal categories such as voicing and aspiration.

English exhibits a two-way laryngeal contrast between voiceless (/p t k/) and voiced (/b d g/) stops. Ultrasound studies (Ahn 2018) report that voiced stops tend to be produced with a more advanced tongue root compared to their voiceless counterparts. This pattern appears to reflect a general strategy to facilitate voicing by expanding the pharyngeal cavity, thereby reducing oral pressure. The observation supports an articulatory interpretation that tongue root advancement may enhance or maintain transglottal airflow for voicing.

Similar results are observed in Brazilian Portuguese, which also features a binary voicing contrast. Tongue root is more advanced during the production of voiced stops (Ahn, 2018). This parallel with English suggests that TR advancement in voiced segments may be a common biomechanical strategy across unrelated languages, even in the absence of a phonological [ATR] feature.

Mandarin Chinese presents a contrast between aspirated and unaspirated stops (e.g., /p^{h}/ vs /p/), but ultrasound data reveal no consistent TR activity associated with either category (Ahn et al., 2024). This finding suggests that aspiration, unlike voicing, may not require—or trigger—systematic tongue root positioning. This challenges the idea that laryngeal features generally induce tongue root activity and highlights the need for fine-grained articulatory distinctions in characterizing such contrasts.

Seoul Korean's three-way contrast among lax, tense, and aspirated stops (e.g., /p/, /p*/ and /p^{h}/) also does not show consistent TR movement across categories (Kwon & Ahn, 2020). Although Korean laryngeal categories have been proposed to differ in glottal tension and timing, the absence of a clear TR pattern again underscores the non-uniformity of TR involvement in laryngeal contrast. This dissociation adds complexity to the typology of TR gestures and questions assumptions about their automatic involvement in laryngeal marking.

In contrast, Kalasha—a Dardic language with a three-way contrast among voiceless aspirated, voiceless unaspirated, and voiced stops—shows significant TR advancement during voiced stop production (Hussain & Mielke, 2020). This aligns with the English and Portuguese data and provides further support for the generalization that voiced stops are often accompanied by tongue root advancement, potentially to facilitate phonation.

Yemba, a Bantu language, provides a somewhat different pattern. Rather than a binary [ATR] system or a strict voicing contrast, Yemba speakers exhibit tongue root *retraction* to enhance aspiration (Weller et al., 2023). This appears to be a phonetic strategy to delay voicing onset and increase aspiration. The presence of TR retraction—rather than advancement—demonstrates that tongue root gestures may be recruited for multiple articulatory goals, not only voicing support.

Recent ultrasound studies on Japanese stops (Tan & Yamane, 2024) also reveal tongue root advancement during the production of voiced stops. Despite the general perception that Japanese voicing is weakly implemented, the TR advancement pattern closely parallels that of

English and Brazilian Portuguese. This finding suggests that even in languages without strong aerodynamic cues for voicing, TR gestures may still be used to support phonological contrasts.

3. Theoretical Implications

The cross-linguistic data on tongue root (TR) activity in laryngeal contrasts challenges several foundational assumptions in phonological theory. Across languages, TR advancement appears consistently in voiced stops in some systems, while it is entirely absent or even reversed (i.e., retracted) in others. This variation is not easily accounted for by traditional theories that presume stable, universal mappings between phonological features and articulatory gestures.

In *The Sound Pattern of English*, Chomsky and Halle (1968) proposed a system of universal, innate distinctive features, with binary oppositions such as [±voice] and [±ATR] encoding phonological contrasts. However, this system presumes that features map directly and uniformly to articulatory parameters, a notion undermined by the variability in TR behavior observed across languages. For example, if phonetically voiced consonants universally entailed TR advancement as part of its articulatory realization, we would expect consistent advancement across languages, including Korean intervocalic lenis, which is not the case.

Keyser and Stevens's (2006) **enhancement theory** provides a useful lens here. According to this view, phonological contrasts are supported by articulatory enhancements that increase perceptual distinctiveness. TR advancement may serve as such an enhancement for voicing contrasts by expanding the pharyngeal space and promoting transglottal airflow. In this account, tongue root gestures need not be contrastive themselves; rather, they are recruited to support other contrasts and may become phonologized over time. This view is compatible with the idea that sound change often begins with gradient, phonetic variation before becoming categorical. In that sense, the presence of TR advancement in non-contrastive contexts (e.g., Japanese voiced stops) may represent early stages in this process.

From a different perspective, Browman and Goldstein's **articulatory phonology** framework proposes that speech is organized in terms of articulatory gestures—coordinated movements of speech articulators that serve as basic units of phonological contrast. This view is in line with enhancement theory, and supported by many other examples (e.g., in English, lip rounding to postalveolar fricative /ʃ/ to enhance the contrast with /s/; lip rounding and lateral bracing to /ɹ/ to enhance the contrast with /l/). Within this framework, TR gestures could be seen as part of the gestural constellation for voiced stops. However, note that TR is not only one of the strategies that enhances voice contrast, but it seems to include other contrasts such as long vowels (Coretta, 2020) and geminates (Morimoto et al., 2024).

These findings leave us with several theoretical tensions. If TR gestures can be either contrastive, enhancing, or absent, how should they be represented in phonological theory? Should we treat TR as a multi-level phenomenon—biomechanically grounded, phonetically emergent, and potentially phonologized? Or should we revise our assumptions about feature representations to allow for more fluid interactions between phonetics and phonology?

Grounded Phonology (Archangeli & Pulleyblank, 1994) provides an important insight here: phonological features are not abstract or arbitrary, but rooted in phonetic and perceptual grounding. In this view, the occurrence and distribution of features like [ATR] are constrained by articulatory possibilities and acoustic consequences. One key observation is the sympathetic relationship between tongue root position and vowel height—TR advancement is phonetically

compatible with tongue body raising (as in [+ATR] mid and high vowels), while TR retraction enhances tongue body lowering (as in [−ATR] low vowels). This physical coupling underlies many cross-linguistic tendencies in vowel systems and has consequences for understanding which phonological patterns are likely to emerge or be maintained.

We propose that similar implicational patterns may be extended to consonantal systems as well. For instance, a gesture that expands the pharyngeal cavity — such as tongue root advancement — can facilitate voicing by maintaining transglottal airflow. Conversely, a narrowed pharyngeal space — through TR retraction — can enhance aspiration by increasing intraoral pressure and delaying voicing onset. These biomechanically grounded gestures, while not always contrastive, may function as enhancement features that co-occur with, support, or even condition the phonologization of laryngeal distinctions.

This is where an **Emergent Phonology** view (Archangeli & Pulleyblank, 2015; 2022) becomes particularly valuable. Rather than assuming that phonological features are innately fixed, emergent approaches argue that features arise from recurrent, phonetically motivated patterns in speech. In this framework, articulatory configurations such as [expanded pharynx] or [narrowed pharynx] may start as gradient enhancement strategies and, over time, become part of a language's contrastive inventory—depending on their functional load and perceptual salience. The variability in TR gestures across languages thus reflects not inconsistency, but the dynamic, usage-sensitive nature of phonological systems. This perspective helps us better understand why some gestures stabilize as phonological categories while others remain gradient or context-dependent.

This view may also offer a solution to the 'mapping problem' (Archangeli & Pulleyblank, 2015; 2022). In languages like Japanese, the phonological classification of voiced obstruents is often acoustically ambiguous. As noted by Gao & Arai (2019), word-initial voiced stops in Japanese are frequently devoiced, much like in English, making it difficult to reliably distinguish voiced and voiceless categories based on voicing onset alone. This contrasts with true voice languages such as Brazilian Portuguese or Russian, where word-initial prevoicing provides a robust acoustic cue for voiced stops. In Japanese, however, the lack of prevoicing weakens the perceptual salience of the voicing contrast in initial position. If voicing cannot be reliably encoded through acoustic properties, then an articulatory gesture such as tongue root advancement may serve as a compensatory strategy. From an emergent phonology perspective, this gesture—though possibly gradient and non-contrastive—could stabilize over time as a phonological marker, reinforcing the voicing category in contexts where acoustic evidence is insufficient. This suggests that articulatory cues, not just auditory ones, play a critical role in how phonological contrasts are maintained and acquired, particularly in systems with ambiguous or underspecified acoustic realizations.

Ultimately, the data encourage a more dynamic view of phonological systems, one that allows for optional, language-specific recruitment of gestures like TR to achieve broader communicative goals. Rather than viewing the absence of consistency as a problem, we might see it as evidence of the flexibility and adaptability of the human speech system.

The case of tongue root gestures, then, opens a space to rethink how we model contrast, enhancement, and markedness. While traditional theories have provided invaluable tools, the growing articulatory evidence suggests the need for updated frameworks that can accommodate gradient, optional, and phonetically grounded patterns—without collapsing them all into abstract phonological features.

4. Conclusion

The variability of tongue root (TR) gestures in laryngeal contrasts calls for a more flexible, phonetically grounded view of phonological structure. While TR advancement and retraction appear in some languages to enhance voicing or aspiration, others show no consistent pattern. This challenges fixed feature-to-gesture mappings and supports models like Grounded Phonology and Emergent Phonology (Archangeli & Pulleyblank, 1994, 2022; Mielke, 2008), where features arise from articulatory and perceptual pressures. In Japanese, for example, devoiced word-initial stops (Gao & Arai, 2019) obscure acoustic cues to voicing, and TR gestures may function as compensatory cues to maintain contrast.

Seen in this light, maintaining strict boundaries between phonological, gestural, and biomechanical domains may obscure the very interactions that give rise to linguistic structure. By examining their overlap, we begin to see how a single articulatory gesture—such as tongue root advancement—can simultaneously serve phonological, perceptual, and physiological functions. This overlap explains both the recurrence and variability of TR behavior across languages. It also suggests that many phonological patterns emerge not from categorical rules alone, but from the dynamic interaction of cognitive, articulatory, and communicative pressures.

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