

Downstream aerodynamic effects of obstruent sequencing in Korean stops

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A preceding obstruent can substantially alter the aerodynamic conditions under which a following consonant is produced, increasing supraglottal pressure and reducing transglottal airflow—i.e. an increase in aerodynamic load [1]—yet the extent to which such downstream effects are realized across different laryngeal categories remains underexplored [2]. In stop systems with multiple laryngeal contrasts, this question bears directly on how segmental implementation interacts with local aerodynamic load [3]. The present study investigates how obstruent sequencing influences airflow, intraoral pressure, and glottal timing in Korean stops, asking whether downstream aerodynamic effects are uniform across the lenis, aspirated, and fortis series or differentially realized depending on laryngeal configuration [4,5].

We analyze coordinated aerodynamic, electroglottographic (EGG), and acoustic data from 12 native speakers of Seoul Korean. Speakers produced nonce forms designed to manipulate stop type (lenis, aspirated, fortis), place of articulation (bilabial, alveolar), and phonological context, comparing stops following an obstruent with those following a vowel. Additional recordings were made both with and without the aerodynamic mask to ensure signal clarity for acoustic and EGG measures. The primary dependent measures include post-release airflow, average intraoral air pressure, closure duration (in medial contexts), Open Quotient (OQ), $H1^*-H2^*$, and voice onset time (VOT). Static measures were analyzed using linear mixed-effects models, while time-varying measures were analyzed using generalized additive mixed models.

Results show that a preceding obstruent imposes broadly similar aerodynamic constraints across all three Korean stop series relative to post-vocalic contexts (**Fig. 1**) [2,6]. Across stop types, post-obstruent stops exhibit increased closure duration and elevated intraoral pressure (**Fig. 1a,c**), consistent with increased supraglottal pressure at release. Total airflow is reduced post-obstruently (**Fig. 1b**), indicating decreased transglottal flow under these conditions. Importantly, while these effects are observable across the entire stop system, their magnitude differs systematically by stop type. The lenis series shows the strongest downstream effects, including robust pressure increases and pronounced reductions in airflow, in some contexts approaching values observed for fortis stops. Aspirated stops show smaller and less consistent adjustments, while fortis stops are comparatively stable across contexts.

EGG and spectral measures converge with the aerodynamic findings (**Fig. 2**). Post-obstruently, lenis stops show significant decreases in OQ and $H1^*-H2^*$, indicating reduced glottal openness and tighter laryngeal configuration. Similar but weaker effects are observed for aspirated stops, and minimal effects for fortis stops. Crucially, despite these adjustments, lenis stops do not uniformly merge with fortis stops, instead occupying an intermediate phonetic space whose realization depends on local aerodynamic conditions.

These findings demonstrate that obstruent sequencing induces systematic downstream aerodynamic inheritance across the Korean stop system, but that this inheritance is differentially realized depending on laryngeal specification. The heightened susceptibility of lenis stops suggests that segments lacking extreme laryngeal settings are more responsive to contextual aerodynamic load. More broadly, the results highlight how low-level aerodynamic pressures propagate across segmental boundaries and interact with segment-specific laryngeal configurations, shaping fine-grained phonetic variation in stop production [9].

Table 1. Example sentences by word position, preceding segment, and focus condition. Glosses capture both variants; the difference between contexts is reflected in the parenthetical alternatives. The first word in the parenthesis corresponds to post-obstruent sentence and the second to post-vocalic.

Context		Post-obstruent	Post-vocalic	English Gloss
Word Initial	Corrective	A: <i>neka kaj mit pilalako hes^Λ?</i> B: <i>ani. kaj mit <u>talalako</u> hes^Λ.</i>	A: <i>neka kaj wi pilalako hes^Λ?</i> B: <i>ani. neka kaj wi <u>talalako</u> hes^Λ.</i>	A: You said <i>pila</i> (under/over) river? B: No. I said <i>talalako</i> (under/over) river.
	Postfocal	A: <i>neka san mit talalako hes^Λ?</i> B: <i>ani. <u>kaj mit</u> talalako hes^Λ.</i>	A: <i>neka san wi talalako hes^Λ?</i> B: <i>ani. <u>kaj wi</u> talalako hes^Λ.</i>	A: You said <i>tala</i> (under/over) mountain? B: No. I said <i>talalako</i> (under/over) river.
Word Medial	Corrective	A: <i>neka kaj mit ikkalako hes^Λ?</i> B: <i>ani. kaj mit <u>italako</u> hes^Λ.</i>	A: <i>neka kaj mit ikkalako hes^Λ?</i> B: <i>ani. kaj mit <u>italako</u> hes^Λ.</i>	A: You said (<i>ika/ikka</i>) under river? B: No. I said (<i>ita/ittalako</i>) under river.
	Postfocal	A: <i>neka san mit ikkalako hes^Λ?</i> B: <i>ani. <u>kaj mit</u> ittalako hes^Λ.</i>	A: <i>neka san mit ikkalako hes^Λ?</i> B: <i>ani. <u>kaj mit</u> ittalako hes^Λ.</i>	A: You said (<i>ika/ikka</i>) under mountain? B: No. I said (<i>ita/ittalako</i>) under river.

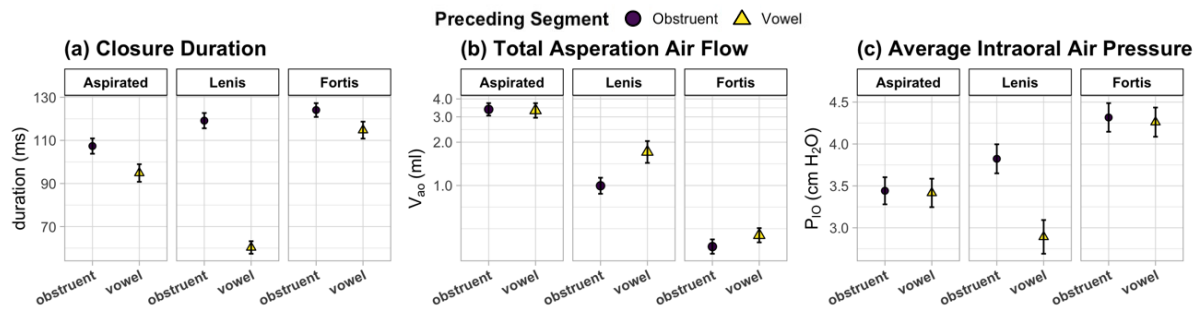


Figure 1. Results for consonantal (a) closure duration, (b) total airflow, and (c) average intraoral air pressure. Unified-model comparisons show significant post-obstruent lenis–fortis differences ($p < 0.05$) for all measures.

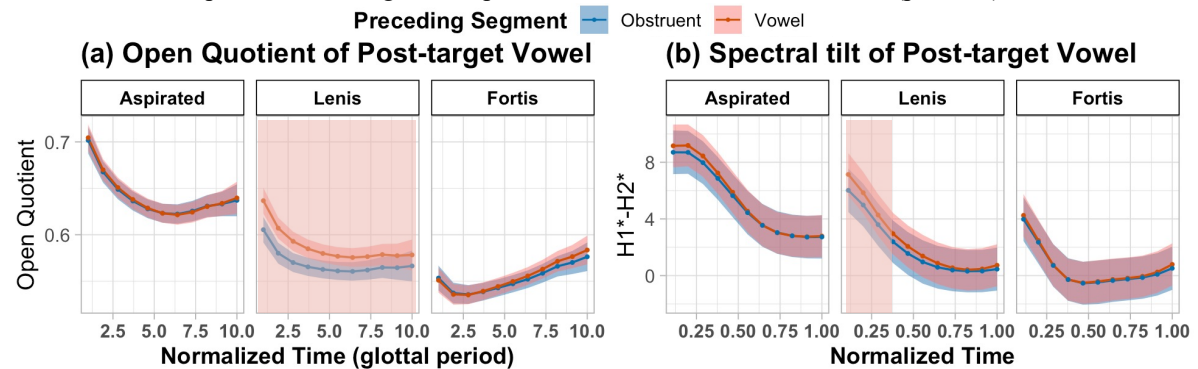


Figure 2. Predicted GAMM trajectories for (a) Open Quotient and (b) H1–H2. Post-obstruent (blue) and intervocalic (red) contexts are shown with 95% confidence ribbons, and pink shading marks intervals of significant divergence. Unified-model comparisons show that post-obstruent lenis stops differ from fortis stops on both measures, with the sole exception of word-medial position, where the contrast is not significant.

References

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