

Summary

- We investigated perceptual learning of the Korean three-way plosive contrast (lenis, aspirated, and fortis) by native English speakers.
- Unlike VOT continua in other languages, this contrast is distinguished by complex trading relations between VOT and pitch.
- Participants learned a vocabulary of 18 Korean pseudowords comprised of six minimal triplets, e.g.: **반** /pan/ **판** /pʰan/ **빤** /pan/
- Fortis** stops most closely resembled listeners' existing English voiced stop categories: $/p/ \approx /b/$ $/t/ \approx /d/$ $/k/ \approx /g/$
- Lenis** and **aspirated** stops were harder to distinguish because both were encompassed by listeners' existing English voiceless stop categories.
- Low proficiency learners** acquired the fortis stop, but did not differentiate the lenis and aspirated stops.
- High proficiency learners** acquired the fortis stops, and exhibited progress at distinguishing the lenis and aspirated stops.
- Both groups acquired these contrasts most accurately for bilabial stops and least accurately for alveolar stops.

Methods

Participants

- N = 37 English monolinguals (12 M, 25 F)
- Mean age 23.1 years (18-33, $sd=3.7$)
- No prior experience with Korean

Stimuli

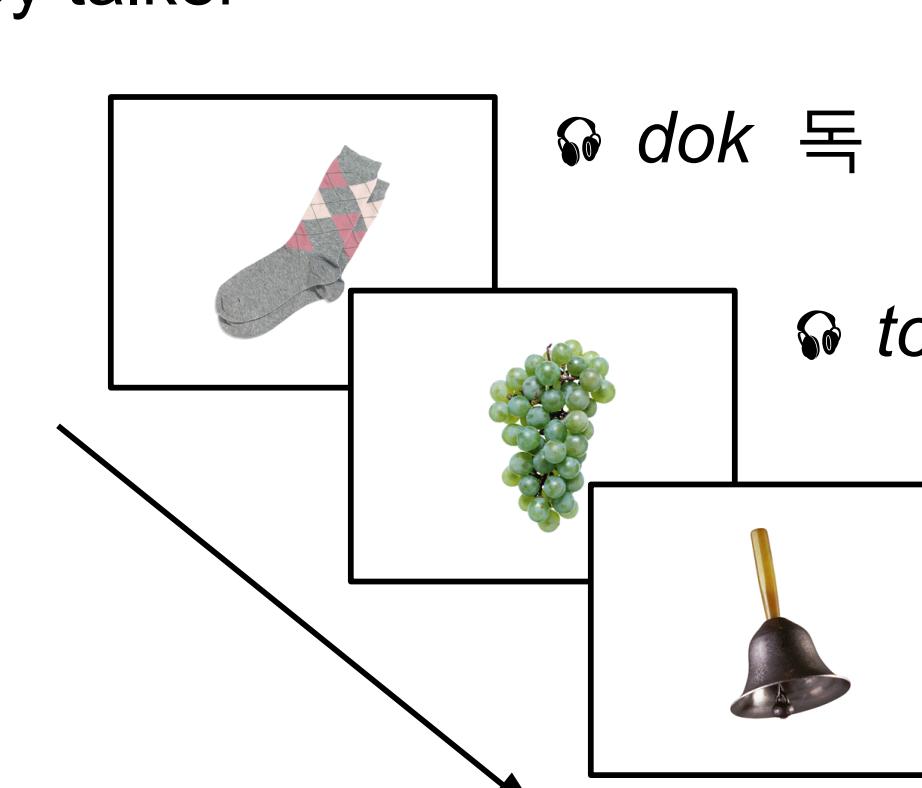
- 18 Korean pseudowords in 6 triplets
- Produced by 4 native Korean speakers (2M, 2F); (all English bilinguals from Seoul)
- Each word was associated with a distinct photograph of an object

Training Procedures

- 4 computer-based training sessions:
- Daily familiarization of items in minimal triplets, including active practice with feedback
- Daily attainment test with no feedback on the entire vocabulary (18 words \times 4 talkers = 72 trials)
- 60 day follow-up (attainment test only)

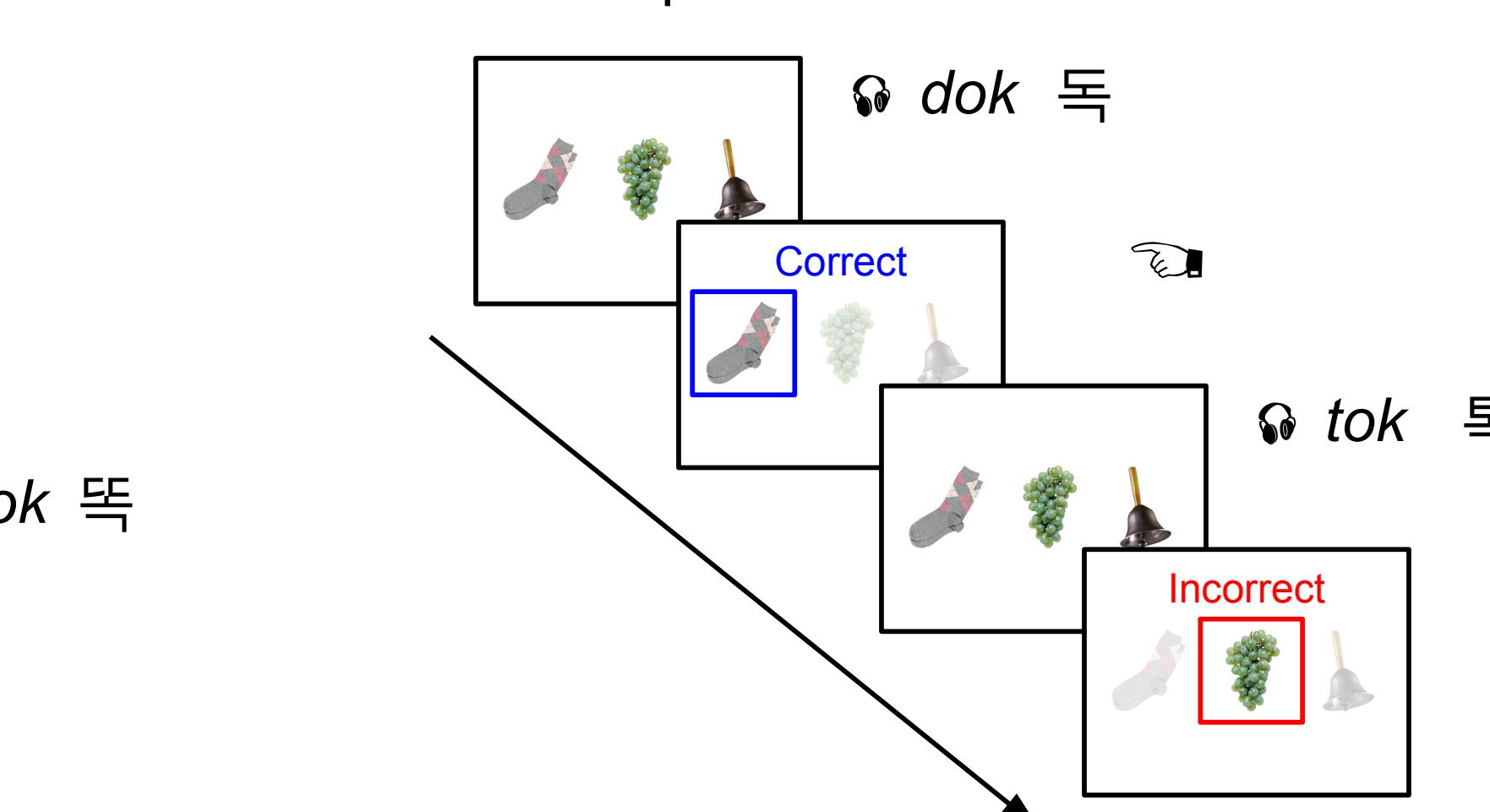
Familiarization

24 trials / minimal triplet (3 words \times 2 repetitions \times 4 talkers) Blocked by talker



Active Practice

24 trials / minimal triplet
Corrective feedback provided



Acquisition of the complex three-way Korean plosive contrast by native English speakers

Tyler Perrachione¹, Amy Finn², Jennifer Minas², Caitlin Tan², Brian Chan², & John Gabrieli²

¹Department of Speech, Language, and Hearing Sciences; Boston University

²Department of Brain and Cognitive Sciences; Massachusetts Institute of Technology

BOSTON
UNIVERSITY

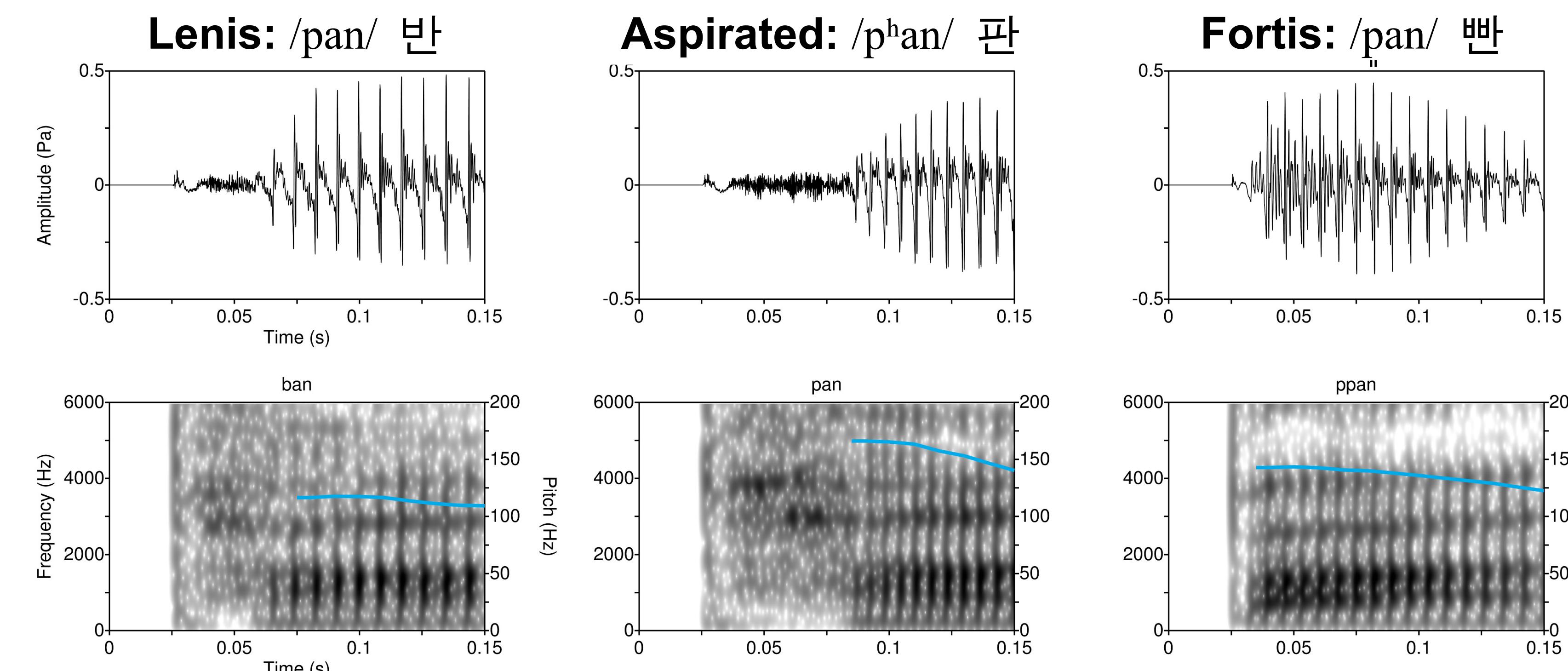


Acoustic Phonetics

Korean Plosive Categories

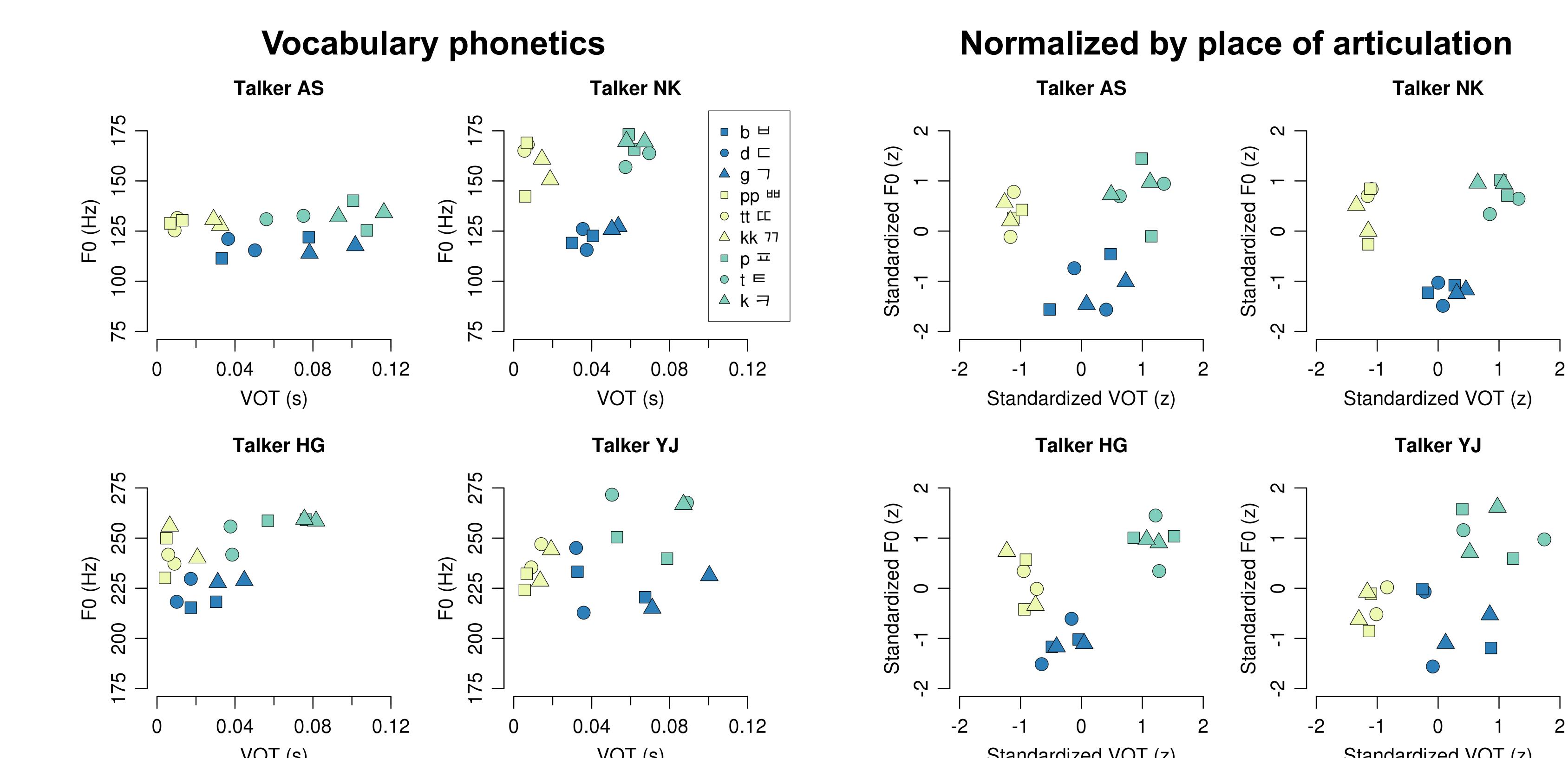
Stop consonants in Korean are distinguished by a 3-way laryngeal contrast. This contrast involves trading relations between voice-onset time (VOT) and onset F0.

- Lenis** stops have a positive VOT, aspiration, and low onset F0.
◦ IPA: /p/ /t/ /k/ Revised Romanization: "b" "d" "g" Hangul: ㅂ ㄷ ㄱ
- Aspirated** stops have a long positive VOT, aspiration, and a modal onset F0.
◦ IPA: /pʰ/ /tʰ/ /kʰ/ Revised Romanization: "p" "t" "k" Hangul: ㅍ ㅌ ㅋ
- Fortis** stops have a short positive VOT, no aspiration, and a modal onset F0.
◦ IPA: /p/ /t/ /k/ Revised Romanization: "pp" "tt" "kk" Hangul: ㅃ ㄸ ㄲ



Training Vocabulary Phonetics

- The acoustic-phonetics of our training vocabulary were consistent with the ranges reported in the literature.
 - Onset F0 differed across the 3 laryngeal contrasts: $F_{2,6} = 14.8$; $p < 0.005$, $\eta^2 = 0.061$
 - VOT differed across the 3 laryngeal contrasts: $F_{2,6} = 62.6$; $p < 0.0001$, $\eta^2 = 0.83$
 - VOT also significantly related to place of articulation $F_{2,6} = 14.0$; $p < 0.006$, $\eta^2 = 0.46$

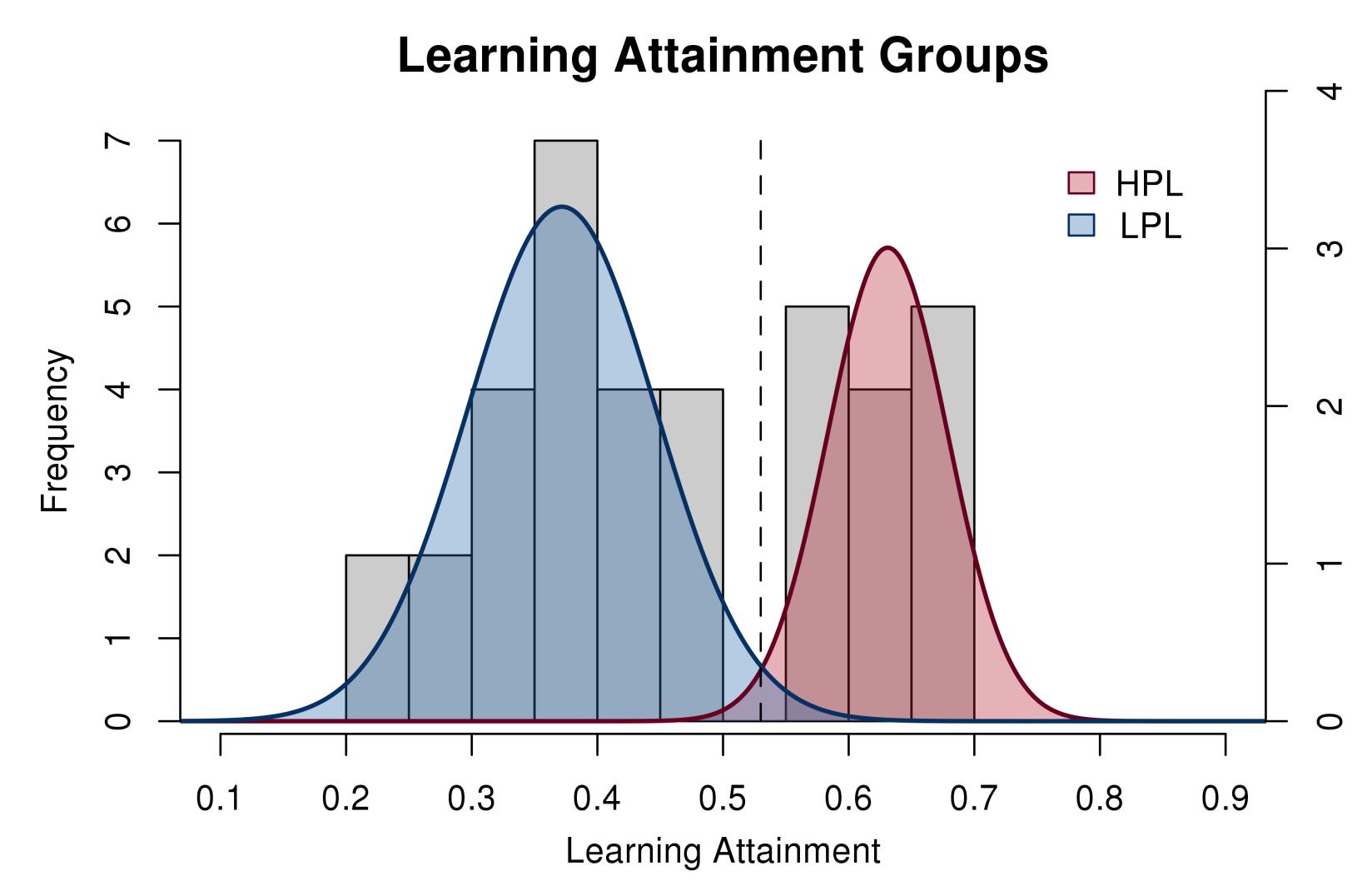


Vocabulary Learning

Learning Outcome

All learners improved after training, but individual attainment was highly variable:

- Attainment range: 22% - 69%
- Mixture-model analysis of day 4 learning attainment suggests 2 learner groups:
 - High proficiency learners (HPL)**
 - N=14, mean vocabulary acquisition: $63\% \pm 5\%$
 - Low proficiency learners (LPL)**
 - N=23, mean vocabulary acquisition: $37\% \pm 7\%$

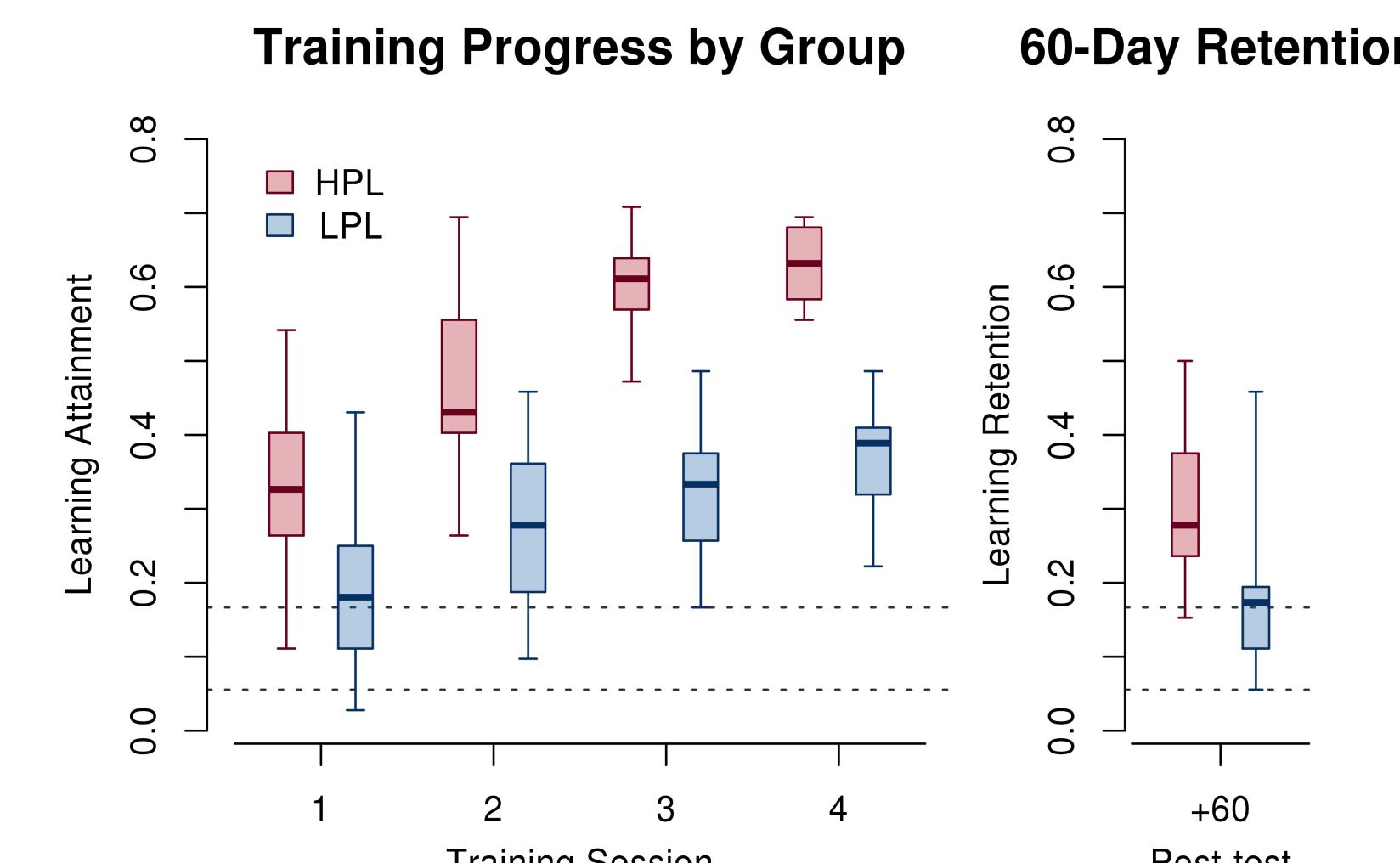


Patterns of Acquisition

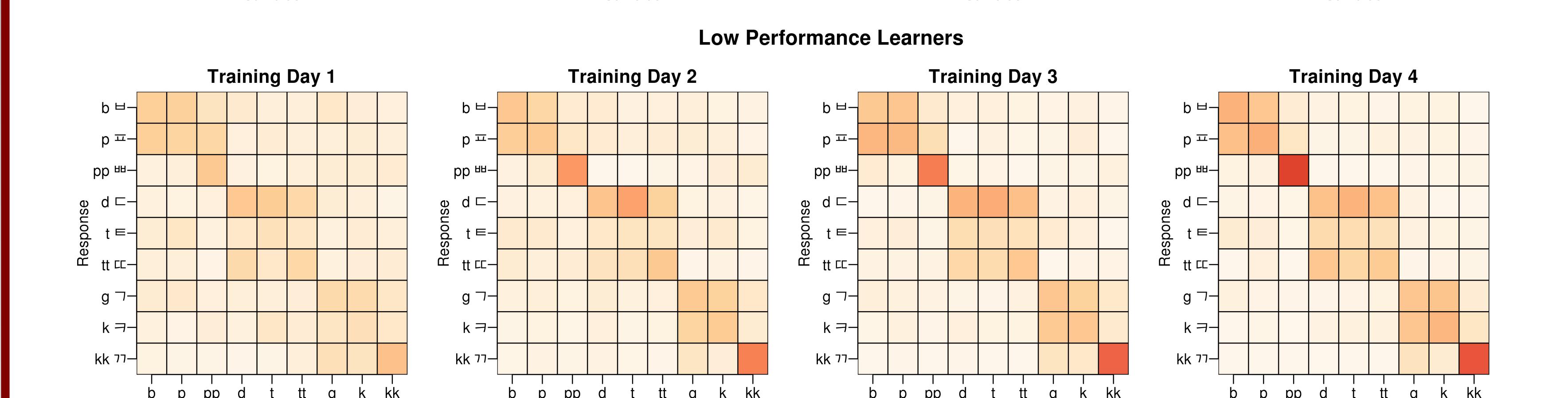
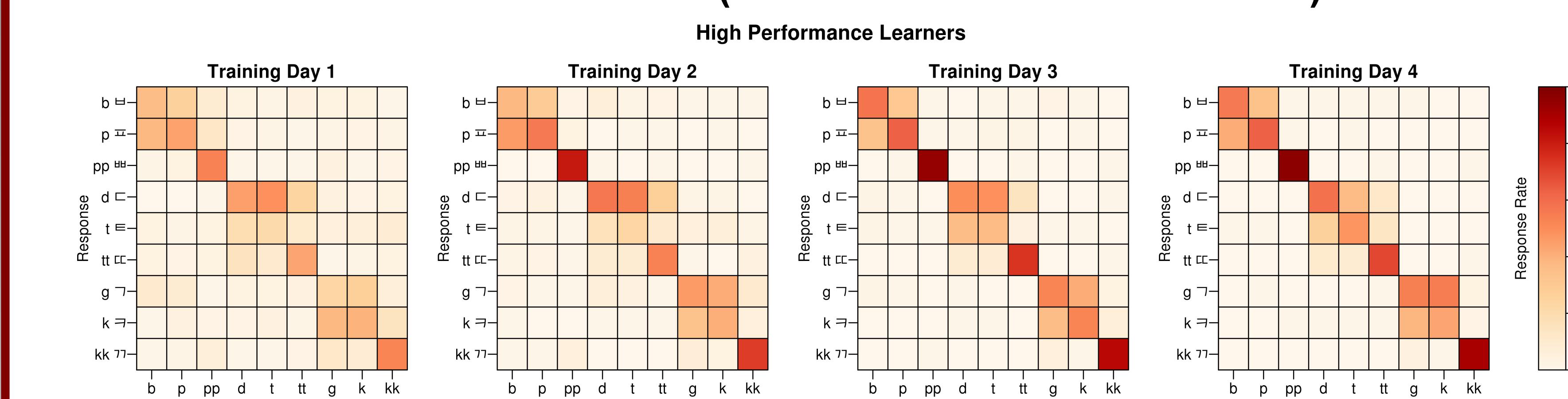
HPL: fortis ($83\% \pm 12\%$); lenis ($55\% \pm 12\%$); aspirated ($51\% \pm 11\%$)

LPL: fortis ($50\% \pm 17\%$); lenis ($32\% \pm 11\%$); aspirated ($30\% \pm 15\%$)

Both groups learned **bilabial** stops best (HPL: 70%; LPL: 44%); then **velar** (HPL: 63%; LPL: 44%); and both found **alveolar** (HPL: 57%; LPL: 22%) most challenging.



Identification Matrix (onset consonant confusions)



We thank Nayeon Kim, Zhenghan Qi, Hyowon Gweon, Nathaniel Kim, Yea Jin Kaeser-Woo, Abraham Shin, and Arim Choi Perrachione.

Contact: Tyler Perrachione
Communication Neuroscience Research Laboratory @ BU
tkp@bu.edu
<http://sites.bu.edu/cnrlab/>