# Limits of Short-Term Perceptual Training for Enhancing Seoul-Korean Listeners' Use of English Lexical Stress in Spoken Word Recognition

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## 1. Background

- High-Variability Phonetic (perceptual) Training (**HVPT**) enhances the identification of difficult second-language (**L2**) sound contrasts more than Single-Talker (perceptual) Training (**STT**) (e.g., Japanese listeners' perception of English /l/-/ɹ/; Bradlow et al., 1997; Huensch & Tremblay, 2015; Iverson et al., 2005; Lively et al., 1993; Logan et al., 1991)
- Unclear whether its benefits extend to the automatic lexical activation and competition processes that underlie spoken word recognition (Melnik & Peperkamp, 2021)
- The present study seeks to answer this question with training on the perception of an understudied linguistic phenomenon, **lexical stress**
  - **English** (L2): Lexical stress is signaled by vowel quality > duration, pitch (depending on pitch and phrase accents), intensity (e.g., Beckman, 1986; Beckman & Edwards, 1994; Fry, 1955; Gay, 1978; Ladd, 2012; Lieberman, 1960; Lindblom, 1963)
  - **Seoul Korean** (L1): No lexical stress or tonal contrasts; prominence is realized intonationally at the phrase level (e.g., Jun, 1998, 2000)
- Beneficial HVPT effects found for Seoul Korean listeners' encoding of English lexical stress in **short-term phonological memory** (Tremblay et al., 2022)
- Beneficial perceptual training effects found for Seoul Korean listeners' **weighting of cues** to English lexical stress (Tremblay et al., 2023)
- Do these effects extend to the use of English lexical stress in **spoken word recognition**?

## 2. Research Question

- Does HVPT enhance the automatic lexical activation and competition processes that underlie spoken word recognition in Seoul Korean L2 learners of English (more than does STT)?

## 3. Participants

- 45 native English listeners (mean age: 20.7 SD: 4.1)
- 49 Seoul Korean L2 learners of English
  - 24 in HVPT group (mean age: 24.1, SD: 2.9)
  - 25 in STT group (mean age: 23.9, SD: 3.4)

| | Age 1st Exposure | Years of Instr. | Self-prof. (1-5) | Self-Accent (1-10) | LexTALE score (Lemhöfer & Broersma, 2012) |
|---|---|---|---|---|---|
| HVPT: mean (SD) | 8.6 (1.5) | 11.1 (2.5) | 2.5 (0.7) | 5.9 (1.9) | 67.4 % (10.3) |
| STT: mean (SD) | 8.5 (1.9) | 13.2 (4.1) | 2.4 (0.7) | 5.7 (1.9) | 69.1% (6.7) |

## 4. Materials and Procedures

### Overall Protocol

| | |
|---|---|
| Day 1 | Pre-test: Visual-world eye-tracking experiment |
| | ↓ |
| Day 2 ~ Day 9 | 8 days of training sessions |
| | ↓ |
| Day 10 | Post-test: Visual-world eye-tracking experiment |

### Training

VR = vowel reduction
NVR = no vowel reduction

- **HVPT Stimuli** (41.7% with H*L−, 16.6% with L*H−, 41.7% unaccented)[a]
  - Recorded by 2M & 2F not in pre-/post-test
  - Session 1~4: 288 tokens: (28 VR + 8 NVR words)[b] * 2 stress patterns * 2 talkers * 2 repetitions
  - Session 5~8: 288 tokens: (28 VR + 8 NVR words)[b] * 2 stress patterns * 4 talkers
- **STT Stimuli** (41.7% with H*L−, 16.6% with L*H−, 41.7% unaccented)[a]
  - Recorded by 1F from HVPT
  - Each session: 288 tokens: (28 VR + 8 NVR words)[b] * 2 stress patterns * 4 repetitions
- **Task:** Forced-choice word identification with explicit feedback on accuracy (noun-verb minimal pairs)

[a]Distribution of pitch accents based on Im et al. (2018)
[b]Distribution of VR-NVR words based on Cutler & Carter (1987)

### Visual-World Eye-Tracking Experiment (adapted from Connell et al., 2018)

**Materials** (not used in training)

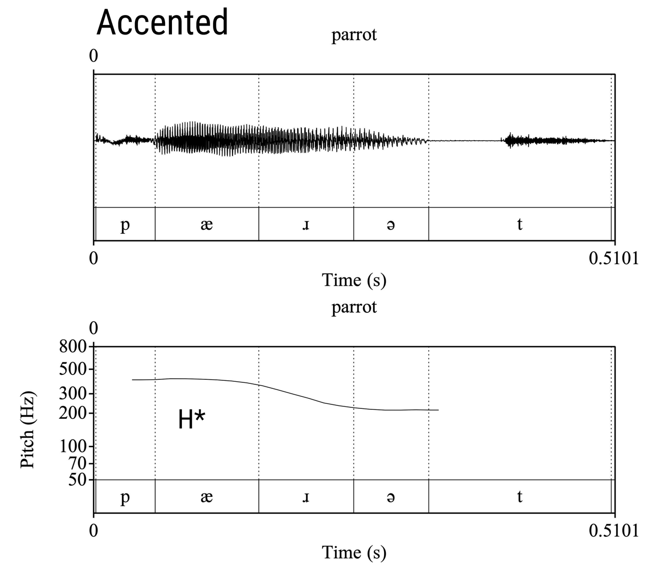
2 (vowel quality) x 2 (stress ) x 2 (prosody)

| Vowel Quality | Stress | Target Word | Competitor Word |
|---|---|---|---|
| Reduction | Different | *PArrot* | *paRADE* |
| | Same | *PArrot* | *PArish* |
| No Reduction | Different | *SURface* | *surPRISE* |
| | Same | *SURface* | *SURplus* |

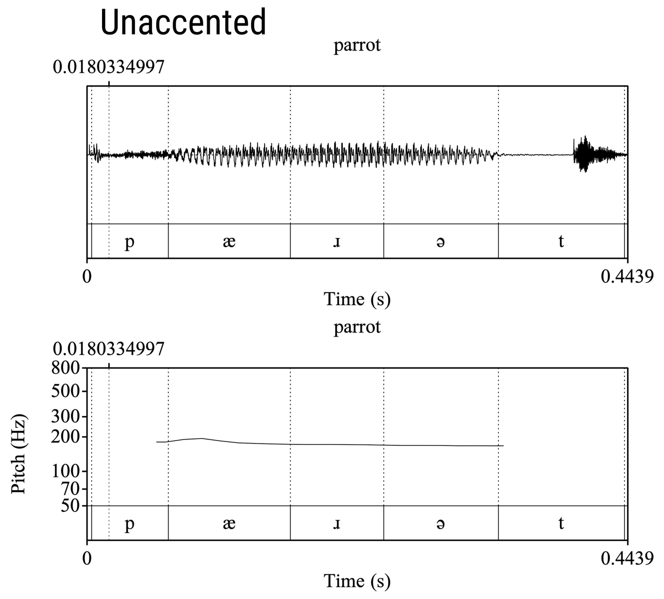
- <u>Prosody</u>: Accented (H*) vs. unaccented target words matched in duration
- <u>Items</u>: 64 different experimental word sets distributed in 4 lists (2 for stress and 2 for prosody), 128 filler trials

**Acoustics**

Accented




Unaccented




**Procedures**


🎧 *Click on… parrot*

## 5. Data Analysis

- Fixations to target and competitor words time-locked with the onset of target word
- Growth-curve analysis (GCA) on log-odd-transformed differential proportions of target and competitor fixations from 200-800 ms
  - Fixed effects: time polynomials (i), (ii) stress, (iii) vowel quality, and (iv) prosody (both groups), and (v) test session and (vi) training type (Korean listeners)
  - Random effect: Participant, with time polynomials as random slope
  - Prediction: HVPT > STT → Significant **interaction between time, stress, test session,** and **training type**, with Korean listeners showing greater target-over-competitor proportions of fixations in the <u>stress mismatch condition</u> after HVPT

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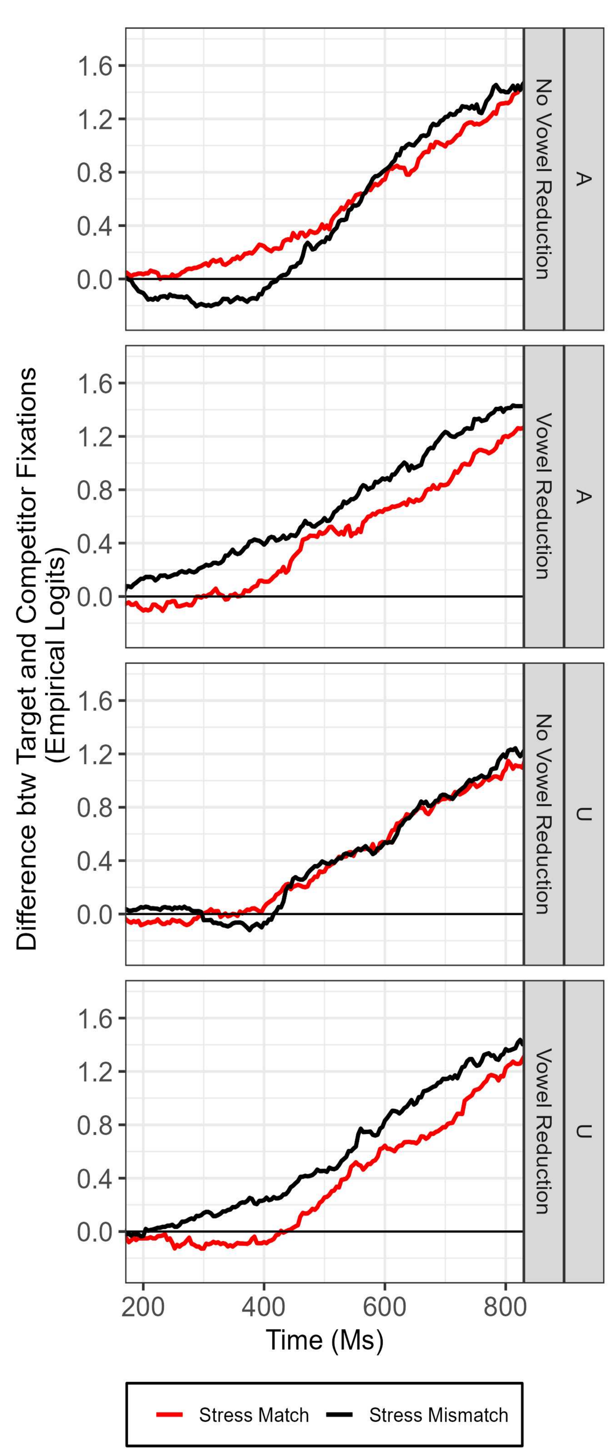
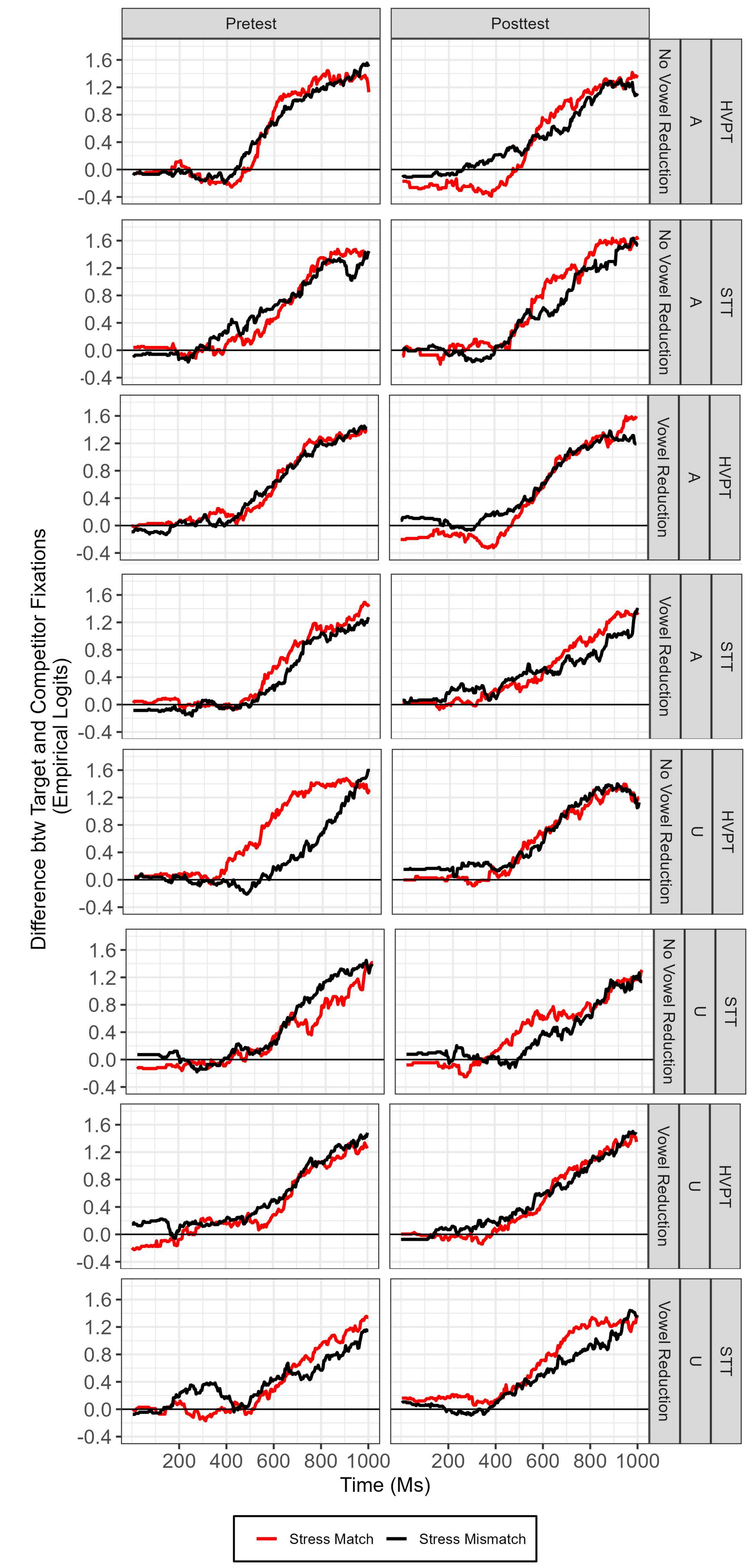
## 6. Results

### English Listeners




- GCA
  - **time** (quadratic, cubic) **x stress x vowel quality** ($p$ < .013-.021)
    - Vowel reduction:
      - **stress** ($p$ < .001)
    - No vowel reduction:
      - **time** (quadratic, cubic) **x stress** ($p$ < .001-008)

### Korean Listeners




- GCA: accented condition with non-reduced vowel
  - No sig. interaction involving stress
- GCA: accented condition with reduced vowel
  - **time** (cubic) **x stress x testing session x training type** ($p$ < .015)
- GCA: unaccented condition with non-reduced vowel
  - **stress x test session** ($p$ < .001),
  - **stress x test session x training type** ($p$ < .003)
  - **time** (linear) **x stress x test session x training type** ($p$ < .03)
- GCA: unaccented condition with reduced vowel
  - No sig. interaction involving stress

## 7. Discussion

- The predicted interactions were found, but the beneficial effect of HVPT seems to be driven primarily by the condition where the target and competitor words match in lexical stress (unexpected)
- Unclear whether HVPT enhances the automatic lexical activation and competition processes that underlie spoken word recognition
- Lack of robust effect of HVPT and/or of training may be due to automatic lexical activation and competition processes needing more time to adapt and become effective
- Further analyses needed to understand this complex data set

## References

● Beckman, M. E., & Pierrehumbert, J. (1986). Intonational structure in English and Japanese. *Phonology Yearbook, 3*, 255-310. ● Beckman, M. E., & Edwards, J. (1994). Articulatory evidence for differentiating stress categories. In P. A. Keating (Ed.), *Phonological structure and phonetic form: Papers in laboratory phonology III* (pp. 7-33). Cambridge: Cambridge University Press. ● Bradlow, A. R., Pisoni, D. B., Akahane-Yamada, R., & Tohkura, Y. i. (1997). Training Japanese listeners to identify English /r/ and /l/: IV. Some effects of perceptual learning on speech production. *J. Acoust. Soc. Am., 101*, 2299-2310. ● Connell, K., Hüls, S., Martínez-García, M. T., Qin, Z., Shin, S., Yan, H., & Tremblay, A. (2018). English learners' use of segmental and suprasegmental cues to stress in lexical access: An eye-tracking study. *Lg. Learning, 68,* 635-668. ● Cutler, A., & Carter, D. M. (1987). The predominance of strong initial syllables in the English vocabulary. *Computer Speech and Language, 2*, 133-142.● Fry, D. B. (1955). Duration and intensity as physical correlates of linguistic stress. *J. Acoust. Soc. Am., 27*, 765-768. ● Gay, T. (1978). Physiological and acoustic correlates of perceived stress. *Language and Speech, 21*, 347-353. ● Huensch, A., & Tremblay, A. (2015). Effects of perceptual phonetic training on the perception and production of second language syllable structure. *J. Phon., 52*, 105-120. ● Im, S., Cole, J., & Baumann, S. (2018). The probabilistic relationshiop between pitch accents and information status in public speech. *Proceedings of 9th International Conference on Speech Prosody* (pp. 508-511). Poznán, Poland. ● Iverson, P., Hazan, V., & Bannister, K. (2005). Phonetic training with acoustic cue manipulations: A comparison of methods for teaching English /r/-/l/ to Japanese adults. *J. Acoust. Soc. Am., 118*, 3267. ● Jun, S.-A. (1998). The Accentual Phrase in the Korean prosodic hierarchy. *Phonology, 15*, 189-226. ● Jun, S.-A. (2000). K-ToBI (Korean ToBI) labeling conventions. *UCLA Working Papers in Phonetics, 99*, 149-173. ● Ladd, D. R. (2012). *Intonational Phonology* Cambridge: Cambridge University Press. ● Lemhofer, K., & Broersma, M. (2012). Introducing LexTALE: a quick and valid Lexical Test for Advanced Learners of English. *Behav. Res. Methods, 44*, 325-343. ● Lieberman, P. (1960). Acoustic correlates of word stress in American English. *J. Acoust. Soc. Am., 32*, 451-454. ● Lindblom, B. (1963). Spectrographic study of vowel reduction. *J. Acoust. Soc. Am., 35*, 1173-1181. ● Lively, S. E., Logan, J. S., & Pisoni, D. B. (1993). Training Japanese listeners to identify English /r/ and /l/ II: The role of phonetic environment and talker variability in learning new perceptual categories. *J. Acoust. Soc. Am., 94*, 1242-1255. ● Logan, J. S., Lively, S. E., & Pisoni, D. B. (1991). Training Japanese listeners to identify English /r/ and /l/: A first report. *J. Acoust. Soc. Am., 89*, 874-886. ● Melnik, G. A., & Peperkamp, S. (2021). High-variability phonetic training enhances second language lexical processing: Evidence from online training of French learners of English. *Bil., Lg, & Cog. 24,* 497-506. ● Tremblay, A., Kim, H., Dobbs, K., Kim, S., & Cho, T. (2022). Perceptual training enhances Seoul Korean listeners' use of vowel quality and pitch cues to English lexical stress. *JASA*, *152*, A74. ● Tremblay, A., Kim, H., Kim, S., & Cho, T. (2023). *Perceptual training enhances the use of vowel quality cues to lexical stress: The benefits of intonational variability.* Presentation given at the 2023 International Congress for Phonetic Sciences, Prague, Czech Republic.