UC Merced

Title
Can F3 be Used to Teach Japanese Adults /r/ and /l/?

Permalink
https://escholarship.org/uc/item/744045d7

Journal
Proceedings of the Annual Meeting of the Cognitive Science Society, 27(27)

ISSN
1069-7977

Authors

Holt, Lori L.
Ingvalson, Erin M.
McClelland, James L.

Publication Date
2005

Peer reviewed

Can F3 be Used to Teach Japanese Adults /r/ and /l/?

Erin M. Ingvalson (eingvals@andrew.cmu.edu)
Department of Psychology, Center for the Neural Basis of Cognition, Carnegie Mellon University
Pittsburgh, PA 15213 USA

Lori L. Holt (lholt@andrew.cmu.edu)
Department of Psychology, Center for the Neural Basis of Cognition, Carnegie Mellon University
Pittsburgh, PA 15213 USA

James L. McClelland (jlm@cnbc.cmu.edu)
Department of Psychology, Center for the Neural Basis of Cognition, Carnegie Mellon University
Pittsburgh, PA 15213 USA

Can native Japanese speakers be successfully taught to differentiate the English sounds /r/ as in "rock" and /l/ as in "lock"? Earlier investigations using synthesized stimuli (Strange & Dittman, 1984) showed poor generalization to natural speech, while training on speech of several speakers (e.g., Bradlow et al, 1997) led to long-lasting improvements that generalized but still did not approach native levels.

Acoustic measurements of /r/ and /l/ reveal the primary distinction is the third formant (F3) onset frequency. For /r/, onset is low and rises to the vowel; for /l/, onset is higher and stays relatively flat. Yamada and Tohkura (1990) found that while native American English speakers are sensitive to this cue, native Japanese speakers seem to rely on the second formant (F2).

We hypothesized that by limiting training stimuli such that the only difference between /r/ and /l/ tokens was the F3 onset would result in both robust learning for the training set and generalization to novel stimuli.

Methods

Two earlier experiments demonstrated the F3 cue could not be learned using fixed stimuli even after extensive exposure. The current study sought to train the distinction using adaptive training beginning with the F3 cue in isolation.

All stimuli were created using the Klatt (1988) synthesizer. Four vowel contexts were created: /ra/-/la/, /ræ/-/læ/, /ri/-/li/, and /ru/-/lu/. Within vowel context the only difference between stimuli was F3 onset. Sixteen stimuli comprised the continuum for each context; the most extreme stimuli had /r/ onsets of 1601 Hz and /l/ onsets of 3400 Hz.

Training consisted of 500 trials per day for eight days. Six consecutive correct responses resulted in a move to more difficult stimuli. Six participants received feedback and six did not; only /ra/-/la/ was used in training. Six control participants were also recruited; these participants took the pre- and posttests without training between the test sessions.

To test for generalization, the pre- and posttests used all four vowel contexts. The tests were tests of discrimination, identification using the synthetic stimuli and identification of natural speech. Stimulus presentations were blocked by vowel. For the natural speech test, natural speech of four native American English speakers was used. Contrasts were either word initial, initial cluster, intervocalic, or word final (i.e., r/l V, C r/l V, V r/l V, or V r/l).

Results and Discussion

No strong training effects were found, though the group trained with feedback showed limited improvement on the trained /ra/-/la/ and on word-initial /r/ and /l/ in the natural speech test. No other groups showed improvement.

Contrary to our hypotheses, focused, extensive training on the F3 distinction did not lead to robust generalization nor to learning of the trained context. Our current research is investigating whether and how native Japanese speakers who have learned English very well in adulthood make the /r/-/l/ distinction. Our hope is that this information will result in a training regime that produces robust learning and generalization.

Acknowledgments

References

Klatt, D. H. (1980). Software for a cascade-parallel formant synthesizer. *Journal of the Acoustical Society of America, 67,* 971-995.

Bradlow, A. R., Pisoni, D. B., Akahane-Yamada, R., & Tohkura, Y. (1997). Training Japanese listeners to identify English /r/ and /l/: IV. Some effects of perceptual learning on speech production. *Jouranl of the Acousitcal Society of America, 101,* 2299-2310.

Strange, W. & Dittman, S. (1984). Effects of discrimination training on the perception of /r-l/by Japanese adults learning English. *Perception & Psychophysics, 36,* 131-145.

Yamada, R. A., & Tohkura, Y. (1990). Perception and production of syllable-initial English /r/ and /l/ by native speakers of Japanese. *Proceedings of the 1990 International Conference on Spoken Language Processing,* 757-760.