How does incremental cue training affect lexical tone learning?

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BACKGROUND

- Listeners' **weighting of perceptual cues** for distinguishing speech sounds is known to be language specific [1].
- Discrimination of Mandarin lexical tones requires attention to both pitch direction and pitch height:
  - Relative to first language (L1) Mandarin listeners, **pitch direction underweighted by L1 English learners** of L2 Mandarin [2].
- **Incremental cue training** methods:
  - Phonetic salience of cues initially exaggerated and gradually faded over training.
  - Only used for segmental cues previously.

➢ Here we test incremental cue training for lexical tone training, relative to a baseline method:

- For **learners with and without L1 lexical tone.**

METHODS AND RESULTS

Participants

- 80 L1 English listeners and 80 L1 Mandarin listeners:
  - English listeners had no tonal language experience.

Stimuli

- Artificial four-tone system, loosely based on Mandarin (Fig. 1).
- Nine syllables: /pa:, ta:, ka:, pi:, ti:, ki:, pu:, tu:, ku:/

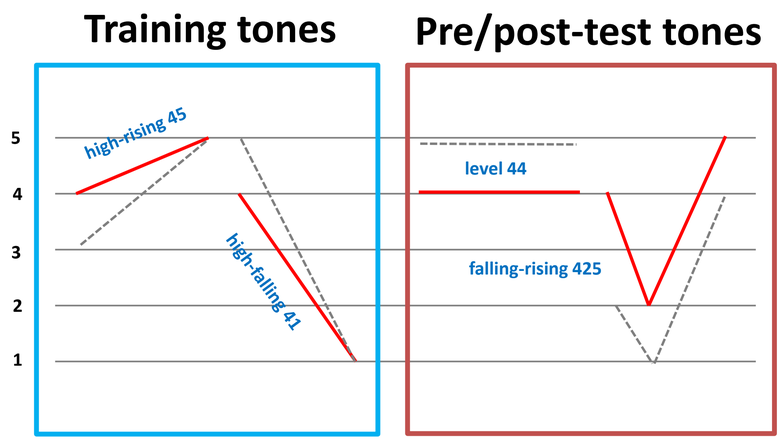

***Figure 1**: Artificial tone system (dotted lines are Mandarin tones).*

Procedure

- ABX tonal discrimination task:
  - *"Is Sound 3 more like Sound 1 or Sound 2?"*
- Pre- and post-test blocks:
  - Tonal contrast: level (44) vs falling-rising (425).
  - No feedback.
- Three training blocks: baseline vs exaggerated (Fig. 2):
  - Tonal contrast: high-rising (45) vs high-falling (41).
  - Feedback: "correct" or "incorrect".

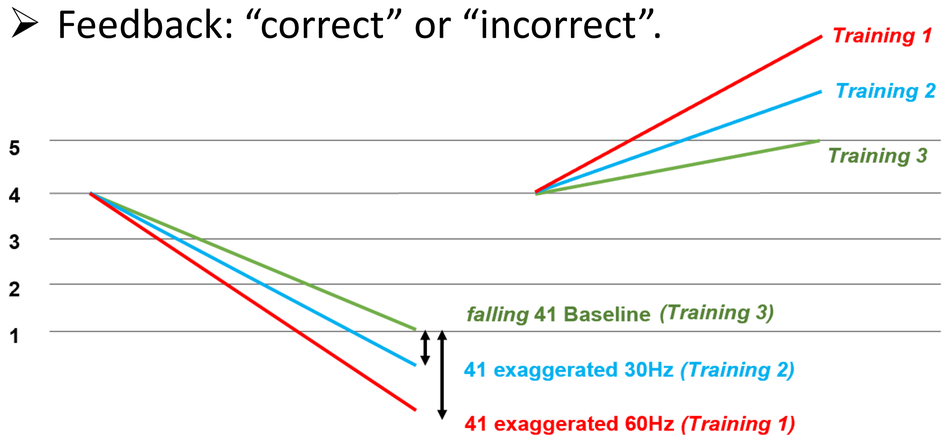

***Figure 2**: Exaggerated vs baseline training tones.*

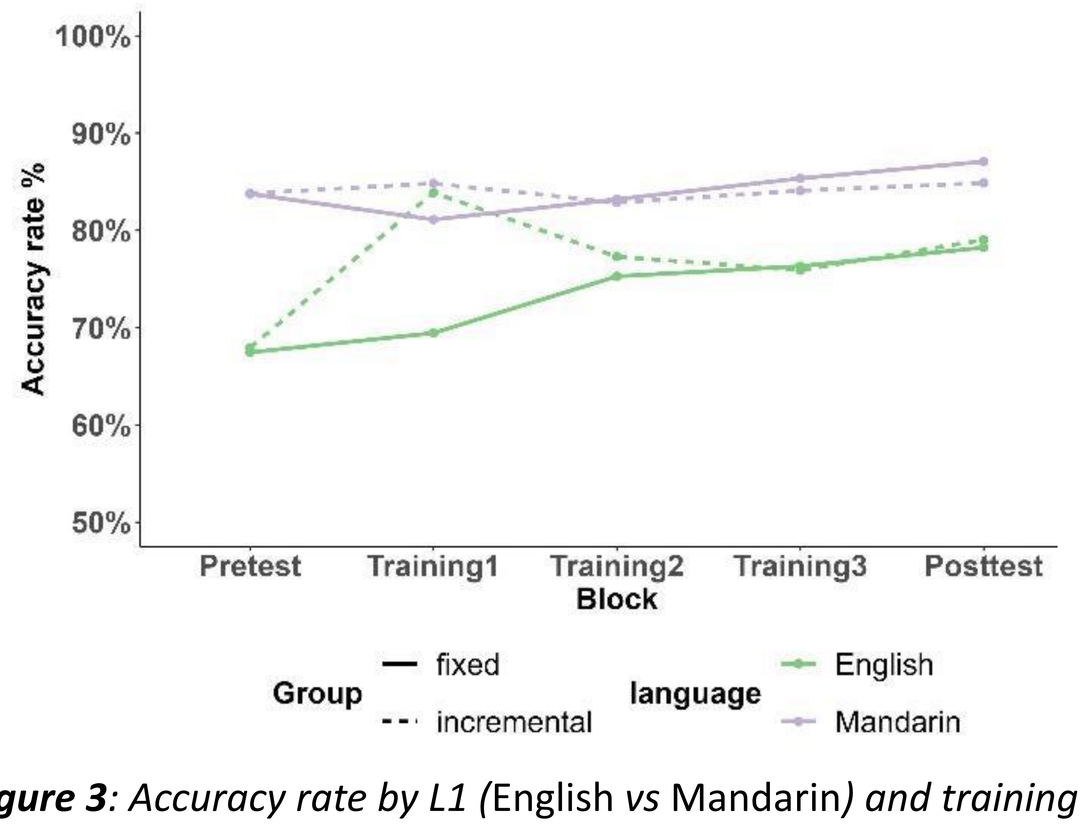

***Figure 3**: Accuracy rate by L1 (*English *vs* Mandarin*) and training ("*incremental*" vs "*fixed*") for pretest, training blocks and posttest.*

Accuracy analysis (Fig. 3)

- Statistical modelling = linear-mixed effects models in R.
- Higher accuracy for Mandarin and English listeners.
  - Test: $\chi 2(1) = 41.01$, $p < .001$.
  - Training $\chi 2(1) = 6.08$, $p = .01$.

***Training blocks**:*

- Improvement over training blocks: $\chi 2(2) = 24.62$, $p < .001$.
- **Higher accuracy for Incremental training**: $\chi 2(1) = 9.09$, $p = .002$
- Interactions: Language x Group, $p < .001$;
  Block x Group, $p < .001$, Block x Language x Group.
  - **English L1 group with Incremental training**: best performance in **Block 2, with greatest tone exaggeration**.

Test blocks

- Improvement from pretest to posttest: $\chi 2(1) = 43.67$, $p < .001$.
- Language x Block interaction: $\chi 2(1) = 4.46$, $p = .03$.
  - Greater improvement for English L1 listeners.

DISCUSSION

- Training with **strongly exaggerated tonal contrasts improves performance**, but benefit does not sustain when exaggeration reduced.
  - Overall accuracy better for Mandarin L1 listeners.
  - Only English L1 listeners benefit from stimulus exaggeration.
  - NB: **Mandarin listeners' reaction times are longer** throughout, likely due to odd near-familiarity of stimuli.
- Ongoing work: Does perceptual boost from cue exaggeration generalise to baseline stimuli given multiple separate training sessions?
  - If so, does enhanced pitch discrimination also boost tonal word learning?

References. [1] Kuhl & Iverson (1995). Linguistic experience and the "perceptual magnet effect", In W. Strange (Ed.), *Speech perception and linguistic experience: Issues in cross-language research.*
[2] Chandrasekaran et al. (2010). Individual variability in cue-weighting and lexical tone learning. *Journal of the Acoustical Society of America*, *128*.

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