Learning Estonian quantity by Chinese and English native speakers

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Introduction. Native language experience affects the perception [1–3] and learning [4–5] of foreign speech sounds. Here, we focus on learning Estonian, a less-studied quantity language that features a unique combination of duration and pitch cues in disyllabic words. Estonian has three quantity degrees, where Q1 (short) and Q2 (long) differ primarily in syllable duration ratio, and Q2 and Q3 (overlong) differ in both syllable duration ratio and the pitch of the first syllable [6]. We investigate how speakers of Mandarin Chinese, a tonal language that relies heavily on pitch information, and speakers of English, in which vowel length constitutes a phonemic contrast, perceive and learn Estonian quantity.

Method. **Participants**. 34 Chinese native speakers (15 F; 19–25 years) and 20 English native speakers (13 F; 18–31 years; data collection ongoing) attended a pretest-training-posttest experiment in China and the US, respectively. 30 Estonian native speakers (15 F; 18–27 years) attended a single experimental session without receiving any training in Estonia. **Stimuli**. The stimuli were pseudo-Estonian words. In addition to the typical Q1, Q2, and Q3, we created a flattened Q3 (FQ3) by replacing the pitch contour of Q3 with that of its corresponding Q2. Q3 and FQ3 thus differ only in pitch (Figure 1). **Procedure**. Stimuli were paired in an AX discrimination task in all labs. Chinese and English speakers received no feedback on the pre- and post-tests, but received corrective feedback during the training phase. Estonian speakers received no feedback. **Analysis**. We focus on three contrasts: Q1vsQ2 representing the Estonian duration, Q2vsQ3 representing the Estonian duration-pitch combination, and Q3vsFQ3 featuring a single pitch cue absent in Estonian quantity.

Results. **(1) Prior to training**, English speakers outperformed Chinese speakers in perceiving Estonian duration (i.e., Q1vsQ2), whereas Chinese speakers outperformed English speakers in perceiving Estonian duration-pitch combination (i.e., Q2vsQ3). In the pitch-only condition (i.e., Q3vsFQ3), Chinese speakers performed best, followed by Estonian and English speakers (Figure 2, Table 1). **(2) After the training**, both Chinese and English speakers' perceptions of Estonian duration (i.e., Q1vsQ2) improved and approached native-like performance. For the Estonian duration-pitch combination (i.e., Q2vsQ3), Chinese speakers remained at ceiling, whereas English speakers' perception significantly improved, approaching native-like performance. Chinese speakers' perception of pitch remained at ceiling (i.e., Q3vsFQ3), whereas English speakers' perceptions significantly improved (Figure 2, Table 1). **(3) During the training**, Chinese speakers showed a significant non-linear relationship across trials when learning Estonian duration (i.e., Q1vsQ2) (Figure 3, Table 1).

Discussion. **First**, non-Estonian speakers are sensitive to different features of Estonian quantity, depending on their native language. Without any training, Chinese speakers showed a significant advantage in perceiving the Estonian duration-pitch combination due to their efficient use of pitch information, but English speakers outperformed Chinese speakers in perceiving the Estonian duration because vowel length constitutes a phonemic contrast in English but does not serve a phonological function in Chinese. **Second**, Chinese speakers improved in perceiving Estonian duration, but their learning was unstable because it was a foreign, difficult cue, as reflected in a fluctuating curve across trials. **Third**, Chinese speakers demonstrated a great advantage in perceiving the pitch information. As long as a pitch cue is involved, Chinese performed nearly at ceiling. **Taken together**, our results showed that native language background affects both learning outcomes and the learning trajectory.

References

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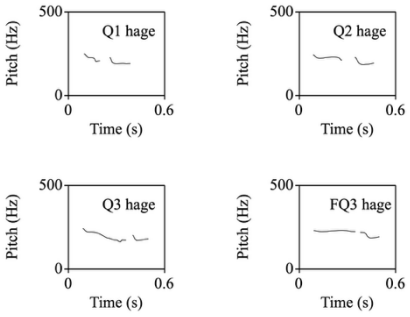
Figures and Tables

Figure 1: Illustration of stimuli



Note. The same base pseudoword *hage* has four variants: Q1, Q2, Q3, and FQ3

Figure 2: Pre- and Post-Tests Results

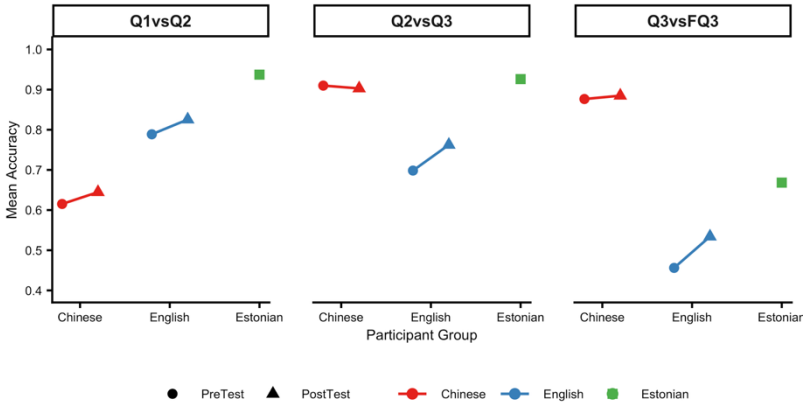


Figure 3: Learning Trajectory

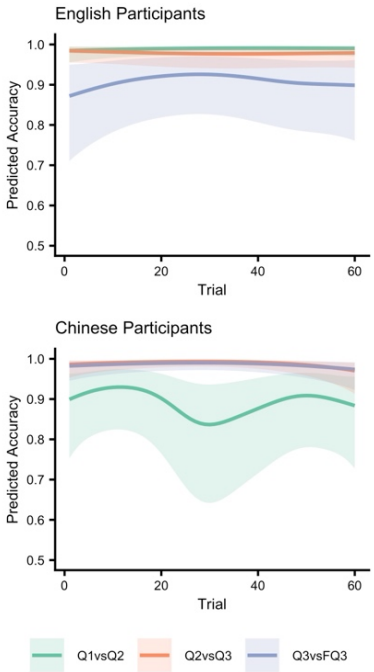


Table 1: Summary of Results

	Q1vsQ2 (Estonian duration)	Q2vsQ3 (Estonian duration-pitch combination)	Q3vsFQ3
(1) Prior to training	CHN < ENG < EST	CHN = EST > ENG	CHN > EST > ENG
(2) After training	CHN improved; ENG improved	ENG improved	ENG improved
(3) During training	CHN showed non-linear relationship across trials		

Note. CHN: Chinese speakers; ENG: English speakers; EST: Estonian speakers; <: underperform; >: outperform

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