

## Observing Pitch Gestures Enhances Phonological and Semantic Processing of Newly-Learned L2 Mandarin Words

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**Introduction.** Tonal languages, such as Mandarin, use lexical tone to distinguish between meanings, resulting in minimal pairs of words that differ only in terms of their pitch contours. For speakers of atonal first languages (L1s) such as English, learning to use novel suprasegmental features, such as lexical tone, may present additional challenges over-and-above the inherent difficulty of learning novel segmental features of L2 words [1]. These challenges may be overcome by observing gestures consistent with the vertical conceptual metaphor of pitch, in which pitch is associated with spatial height [2]. This study uses the N400 event-related potential (ERP), which reflects processing effort, to reveal the extent to which congruency of observed gestures with the vertical conceptual metaphor of pitch affects semantic and phonological processing of newly learned L2 words differing minimally in lexical tone. We predict that learning via gestures congruent with the vertical conceptual metaphor of pitch will generate increased N400 response differences for mismatching vs. matching stimuli following learning in the lexical tone discrimination task, which taps into phonological processing, as well as the word meaning association task, which taps into semantic processing.

**Methods.** Adult L1 English speakers (n=29) with no tonal language experience completed a pre-test, a learning task, and a post-test. In total, 6 pairs of words differing minimally in lexical tone were presented as part of the pre-test, post-test, and learning tasks. Each word stimulus was about 1 second in duration. In the pre-test, which consisted of a lexical tone discrimination task, pairs of Mandarin words with either matching or mismatching lexical tones were presented. In this test, the 12 words were randomly presented 12 times each for a total of 144 trials. In the learning task, pairs of Mandarin words differing minimally in lexical tone were presented in one of three learning conditions: congruent gestures, with gestures conveying the pitch contours of lexical tones (e.g., moving a hand downward diagonally for falling pitch); incongruent gestures, with gestures conveying the pitch contours of other lexical tones (e.g., moving a hand diagonally downward for rising pitch); or no gesture, with no hand movement (Fig. 1). In this task, 6 word pairs were presented in 6 blocks, with 36 word-pair presentations in total. The post-test consisted of the same lexical tone discrimination task presented in the pre-test; a word recognition task in which 16 learned and novel words were presented in 10 blocks; and a word-meaning association task in which 12 Mandarin words were paired with text of their English translations or translations of the other words in minimal pairs and presented in 6 blocks. During these tasks, N400 event-related potentials were measured.

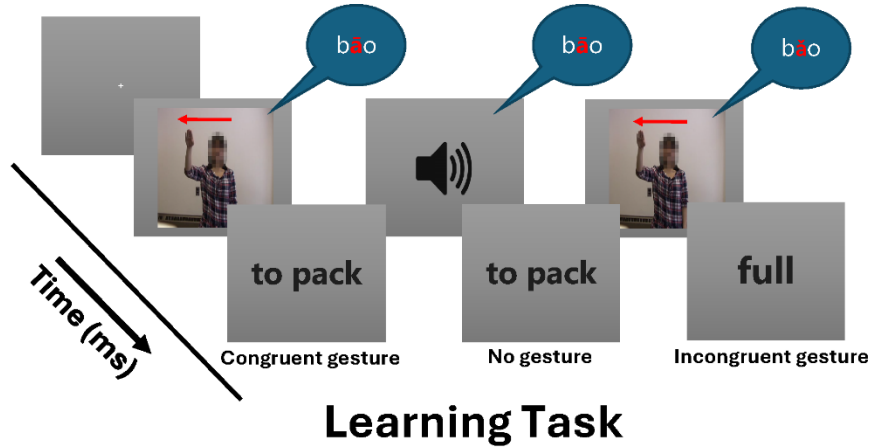
**Results.** In the post-test, the congruent gesture learning condition resulted in a larger right posterior N400 for mismatching than matching stimuli in the lexical tone discrimination and word-meaning association tasks. In contrast, the incongruent and no gesture conditions resulted in less differentiated right posterior N400 responses for matching and mismatching stimuli in these tasks in the lexical tone discrimination and word-meaning association tasks (Fig. 2).

**Discussion.** Our preliminary findings suggest the difference in right posterior N400 responses between learning conditions reflects increased sensitivity to lexical tone in both phonological and semantic processing in newly-learned L2 Mandarin words after exposure to gestures congruent with the vertical metaphor of pitch. These results demonstrate that observing gestures consistent with the vertical conceptual metaphor of pitch when learning L2 words

differing minimally in lexical tone enhances subsequent phonological and semantic differentiation between them in atonal L1 speakers.

**References.** [1] Pelzl (2021). *SSLA*. [2] Morett et al. (2022). *Cognition*.

**Fig. 1.** Illustration of the Learning Task for Congruent, Incongruent, and No Gesture Conditions



**Fig. 2.** Post-Test Bilateral Posterior\_N400 Responses and Topographic Maps for Matching vs Mismatching Stimuli in (A) Congruent, (B) Incongruent, and (C) No Gesture Conditions

