EFFECTS OF LINGUISTIC EXPERIENCE AND TONE TRAINING ON CANTONESE TONE WORD LEARNING

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ABSTRACT
The current study investigated the influence of phonemic tone training on Cantonese tone word learning. Native English listeners completed a brief Cantonese tone training program before learning the meanings of 15 vocabulary items distinguished by Cantonese tones. Their performance in tone word learning was compared against groups of native Thai and English listeners who received no tone training prior to tone word learning. English tone-trainees and Thai participants attained similar levels of word identification proficiency by the end of training, both significantly better than the non-tone trained English listeners. The results suggest that pitch attunement can be advantageous when learning tone words.

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1. INTRODUCTION

1.1. Background
Research has suggested that the difficulties facing adult listeners perceiving foreign sound contrasts may stem from the fact that during native language (L1) development, listeners become attuned to the specific acoustic cues relevant for distinguishing L1 contrasts, subsequently reducing their sensitivity to other non-native acoustic cues [4]. However, linguistic experience has been found to mediate the acquisition of non-native contrasts, with the interaction of L1 and newly-forming phonetic categories shaping perception (e.g. [2]). Lexical tone research has proposed that cross-linguistic differences in tone perception can be in part explained by the relationship between native and non-native tone category representations [2]. For example, Mandarin participants best perceived Cantonese lexical tones with similar tonal counterparts in Mandarin.

While the majority of studies have focused their attention on the perception of individual contrasts, studies have examined how linguistic background affects using non-native contrasts to distinguish meaning (e.g. [1]). Linguistic experience was found to play a role in using non-native lexical tones to distinguish word meaning. For example, Thai listeners outperformed English listeners at acquiring Cantonese tone words [1], suggesting that prior experience with using pitch lexically can beneficially transfer.

Moreover, research suggests that having a domain-general attunement to pitch information, through native tone language experience or even extensive pitch experience from musical training, can be advantageous in acquiring lexical items that are distinguished by non-native tones [1, 5]. However, it is not yet known whether short-term pitch exposure prior to word learning will lead to improved word identification, or how it will compare to the performance of tone language listeners.

1.2. The current study
The present research investigates the effect of short-term laboratory tone training with non-tone language (English) listeners on learning words contrasted by Cantonese tones. The aim was to determine whether exposure to tone facilitates tone word learning, and how this experience compares to that of tone language (Thai) listeners. This was achieved by providing a brief tone identification training program to a group of English listeners (Tone-Training
group) before their embarking on a Cantonese word learning program and comparing their results to groups of Thai and English listeners who received only word training (Word-Only groups).

2. METHODS

2.1. Participants

Fifty adults with no knowledge of Cantonese or any other lexical tone language, other than their native language, were included in this study. All participants had less than 5 years of musical experience, and no experience within the last 5 years. Thirty-two were native Canadian English speakers, subdivided into a Tone Training group (TT; 12 females, 4 males; mean=22 years) and a Word-Only group (WO-E; 10 females, 6 males; mean=24 years). Eighteen listeners were native speakers of Standard Thai (i.e., Thai Word-Only group, WO-T; 10 male, 8 female; mean=22 years).

2.2. Stimuli

2.2.1. Tone training

Five CV monosyllables (se, jau, tso, seisui, ju) were produced with five Cantonese tones (high-level, high-rising, low-falling, low-rising, and low-level) by four native Cantonese speakers (2 male, 2 female), for a total of 25 real-word training stimuli.

2.2.2. Tone identification

Two novel native speakers (1 male, 1 female) produced five CV monosyllables (ji, low, si, pej, fu) with five Cantonese tones for 25 stimuli.

2.2.3. Word training

Three CV monosyllables (tsou, k”aaj, wu) produced with five Cantonese tones were recorded by four speakers (2 male, 2 female) not used in tone identification or training. These 15 words were associated with meanings represented by pictures selected from a set of 260 standardized pictures, controlled for visual complexity and cultural familiarity [3]. All speakers were recorded in a sound-attenuated booth at a 44.1 kHz sampling rate.

2.3. Procedure

2.3.1. Tone training

Three 30-minute sessions of tone training were provided for TT over the course of 7-10 days. Each training session consisted of 6 blocks of 50 trials (300 trials=4 speakers x 5 syllables x 5 tones x 3 repetitions). Listeners heard a stimulus and were required to indicate the tone they heard by pressing the number on the keyboard corresponding to the appropriate tone diagram. They received feedback on their response accuracy along with the correct answer.

2.3.2. Tone identification (ID)

All groups completed a tone ID test before starting word-training. Listeners were first familiarized with the tones, listening to each tone in isolation and viewing its associated tone diagram on the screen. They completed 15 familiarization trials, similar in format to the tone training that TT received, identifying the tone of each stimulus and receiving feedback on their accuracy.

The test was comprised of a five alternative forced-choice ID task, where the participants identified the tone of each stimulus without any feedback on their accuracy. All groups identified 100 randomized stimuli (5 syllables x 5 tones x 2 speakers x 2 repetitions) presented with an inter-stimulus-interval of 3 seconds. TT completed this task before tone training and before word training (serving as a pre- and post-test for tone training).

2.3.3. Word training

All groups completed the word training program over 4 days, with 2 training sessions per day (except for the last day of training with only one session). Stimulus presentation and testing procedures were modeled after training in [5].

Every training session was comprised of 5 training blocks, 2 review blocks and a session test. Each training block involved listening to 4
repetitions of 3 words while viewing pictures of their meanings (2 speakers x 3 words x 2 repetitions). Each block concluded with a quiz, matching each stimulus with their picture (4 speakers x 3 words), with feedback provided. Both review blocks were comprised of all 15 words and provided feedback after each response. Each session concluded with a test where participants identified all 15 words learned in the training program without feedback. The test involved the 15 training words produced by all 4 speakers (60 trials).

3. RESULTS

3.1. Tone training
To confirm that tone training was effective, pre- and post-training tone identification test scores were compared against a control group in a 2-way analysis of variance (ANOVA) with Group (control, TT) as a between subjects factor and Test (pre, post) as repeated measures. Results revealed a significant Test x Group interaction [F(1,30)=8.606, \(p=.006\)]. Subsequent 1-way ANOVAs for each test with Group as the independent variable yielded no significant group difference on the pre-test (\(M=56\%\), \(p=.525\)), but significantly better scores by the TT group (74%) than the control (62%, \(p=.008\)) on the post-test.

3.2. Pre-word training tone identification
Mean percent correct scores were submitted to a 1-way ANOVA with Group (TT, WO-E, WO-T) as the independent variable to compare their tone ID ability before starting word training (Fig. 1). Bonferroni-adjusted post hoc analyses indicated that TT (74%) was significantly more accurate than WO-E (47%, \(p<.0001\)) and WO-T (36%, \(p<.0001\)). WO-E was also significantly better than WO-T (\(p=.036\)).

3.3. Word training
Overall attainment in word ID accuracy was determined by comparing percent correct scores for the first and last word training session tests (Fig. 1). A 3-way ANOVA with Group (TT, WO-E, WO-T) as a between-subjects factor and Tone and Session (first and last) as repeated measures yielded a significant main effect of Session [F(1,47)=393.351, \(p<.0001\)], as well as a significant Session x Group interaction [F(2,47)=4.568, \(p=.015\)]. One-way ANOVAs for each session with Group as the independent variable found no significant difference on the first session [F(2,47)=2.660, \(p=.080\)], but a significant group difference by the last training session [F(2,47)=5.908, \(p=.005\)]. Bonferroni-adjusted comparisons indicated that by the end of training, TT (73%) and WO-T (71%) significantly outperformed WO-E (54%) (\(p=.022\)). No significant difference was found between WO-T and TT (\(p=1.00\)).

Additionally, the ANOVA yielded significant Tone x Group [F(8,47)=2.902, \(p=.004\)] and Session x Tone x Group interactions [F(8,47)=1.954, \(p=.054\)]. One-way ANOVAs were performed on scores from the last session for each group with Tone as the independent variable (Fig. 2). Significant main effects of Tone were found for each group
associating. T may have relied on mechanisms for tone training to aid word ID performance. Pitch lexically; however, they drew upon recent experience to help them succeed. TT lacked experience with using pitch lexically for WO (47%). For WO-T, high-level (83%), high-rising (72%) and low-falling (76%) tone words were significantly better than low-rising ones (53%, \(p<.004\)).

4. DISCUSSION

Tone training successfully enhanced TT’s ability to identify non-native tones, resulting in their significantly outperforming both WO-E and WO-T at tone ID prior to word learning. After word training, TT and WO-T were both achieving higher levels of word ID accuracy than WO-E. Given that TT obtained greater success in word ID than WO-E, this suggests that higher tone ID scores aided TT in word learning. As in [5], it appears that attunement to pitch information can facilitate tone word acquisition, such that they may establish more stable tone representations allowing them to develop their pitch-to-semantic mapping mechanisms more easily. Results from this study indicate that for non-tone language listeners, even short-term tone training can have a substantive impact on tone word learning, allowing for the attainment of comparable levels of success as tone language listeners at an initial stage of learning.

That WO-T achieved similar levels of word ID success is interesting, as they were significantly worse than TT at identifying tones. This may suggest that their L1 experience with using pitch lexically provided aid during non-native tone word learning. Such findings suggest that WO-T and TT may draw upon different aspects of their experience to help them succeed. TT lacked experience with using pitch lexically; however, they drew upon recent tone training to aid word ID performance. WO-T may have relied on mechanisms for associating pitch to meaning developed during first language acquisition to help their non-native word learning performance [1].

Furthermore, word ID results by tone may reflect an influence of linguistic background. High-level tone words had by far the highest accuracy rates for the English groups. WO-T performed best on high-rising, low-falling and high-level tone words. High-level tone words might have been easier to acquire, as Thai and English listeners possess similar tones in their native tonal or intonational inventories. Additionally, rising and falling tone words may have been easier to learn for WO-T due to similar tonal counterparts in Thai. These results are in line with prior findings which point to the influence of L1 on non-native phonemic tone perception [2], extending it to tone word ID.

In sum, these findings provide some insight into the factors influencing non-native tone word acquisition, as short- and long-term pitch experience appear to play a significant role.

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