THE INFLUENCE OF TONAL AWARENESS AND MUSICAL EXPERIENCE ON TONE WORD LEARNING

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ABSTRACT

Phonological awareness has been shown to play a significant role in language learning. The present study examined the effect of improving pitch identification ability and tonal awareness on Cantonese tone word learning. A group of native English listeners received three days of Cantonese tone training to first improve their tone perception. They then learned the meanings of 15 vocabulary items distinguished by Cantonese tones (i.e., word identification training), along with groups of native English non-musicians and musicians who did not receive tone training. Both the tone-trainees and the musicians obtained similar word identification proficiency levels by the end of word training and were both significantly better than the non-tone trained non-musicians. These results lend support for phonetic-phonological-lexical continuity, as enhancing listeners' tonal awareness and identification ability of tonal cues significantly contributed to success in tone word learning.

Keywords: Cantonese tone, phonemic tone awareness, tone word learning, musical experience

1. INTRODUCTION

Research has pointed to a variety of factors that can influence the acquisition of non-native tonal contrasts, such as the influence of native language (L1) prosodic or tonal structures (e.g. [3]) and the musical background of the listeners (e.g. [1]). While the majority of previous literature has investigated the influence of such factors on the perception of individual phonemic tonal contrasts (e.g. [3]), recent research has examined how listeners learn to use non-native contrasts in a broader linguistic context, such as differentiating word meaning [2, 8]. Consistently, linguistic experience has been shown to play a role, as tone language listeners were found to have greater success than non-tone language listeners at utilizing non-native tones to make lexical distinctions [2]. Additionally, studies have reported that success in using phonemic tones to differentiate vocabulary items is associated with participants' musical experience, presumably due to the overlap in their use of pitch as the primary perceptual cue, as well as their ability to perceive the acoustic tonal differences [8].

The connection between tone identification ability and learning words distinguished by tones has led to the "phonetic-phonological-lexical continuity" hypothesis. It posits that basic auditory abilities, such as perceiving phonetic contrasts, have a substantive impact on performance in a higher-level linguistic context, suggesting the involvement of a bottom-up perception process [5, 8]. Additionally, research has found phonological awareness to be an important factor in language learning (e.g. [8]). Furthermore, processing research has suggested that attention can yield improved speech contrast detection by non-native listeners [4]. Such attention may be necessary in more cognitively demanding tasks, such as lexical decision, as perceptual performance of foreign contrasts typically decline in such contexts [7]. Based on these findings, it could be assumed that focusing listeners' attention on phonemic tones and improving their tonal awareness through tone training would result in better performance in a broader linguistic context such as word learning.

As previous research has not examined the effect of improving tonal awareness on tone word learning, the present research intends to address this issue. This was achieved by providing Cantonese tone identification training to native English listeners prior to a Cantonese tone word learning program (Tone-Training group) and comparing their performance on the word learning task against English non-musicians and musicians who only received word training (Word-Only training groups).

Extensive pitch experience, such as musical training, has resulted in greater success with using non-native tones to distinguish word meaning [9]; thus, we expect that Word-Only musicians will outperform Word-Only non-musicians at word identification. Given that pre-word learning pitch

identification ability can be a predictor of word learning success [9], it follows that increasing tonal awareness and pitch identification accuracy will increase participants' chances for success. Therefore, we also predict Tone-Training non-musicians to achieve greater word learning success than their Word-Only counterparts.

2. METHODS

2.1. Participants

Sixty-six native Canadian English adults with no prior knowledge of Cantonese or any other lexical tone language participated in this study. They were assigned to four groups. Three groups were comprised of non-musicians ("N"), with less than 5 years of musical experience, and no experience within the last 5 years. Sixteen listeners were included in the Tone Training group (TT-N; 12 females, 4 males; *mean*=22 years). Sixteen listeners were assigned to a Control group (C-N; 12 females, 4 males; *mean*=20 years), to gauge the effect of tone training. Sixteen were included in the Word-Only group (WO-N; 10 females, 6 males; *mean*=24 years). Additionally, eighteen musicians ("M") were recruited as Word-Only participants (WO-M; 12 female, 6 male; *mean*=23 years). Musicians were defined as having at least six years of continuous musical training and the current ability to play an instrument, with an average of 16 years experience.

2.2. Stimuli

2.2.1. Tone identification

Two native Cantonese speakers (1 male, 1 female) produced five CV monosyllables (*ji, low, si, pej, fu*) with five Cantonese tones (high-level, high-rising, low-falling, low-rising and low-level), for a total of 25 real-word stimuli.

2.2.2. Tone training

Four new speakers (2 male, 2 female) produced five CV monosyllables (*se, jau, tso, seui, ju*) with five Cantonese tones, totaling 25 real-word stimuli.

2.2.3. Word training

An additional four novel speakers (2 male, 2 female) not used in the tone identification or tone training produced three CV monosyllables (*tsou, k^{w}aaj, wu*) with five Cantonese tones. These 15 words were assigned meanings (common concrete nouns), as represented by a picture presented on the screen. Pictures were selected from a set of 260 standardized pictures, controlled for visual complexity and cultural familiarity [6]. All speakers were recorded in a sound-attenuated booth at a 44.1 kHz sampling rate.

2.3. Procedure

2.3.1. Tone identification (ID) pre-/post-test

All groups first completed a familiarization task in order to become familiar with the five Cantonese tones and learn how to identify them. They heard each Cantonese tone pronounced in isolation and viewed a corresponding tone diagram on the screen. Participants were then asked to respond after each stimulus, identifying the tone they heard by pressing the number on the keyboard corresponding to the appropriate tone diagram. They received feedback on the accuracy of their response as well as the correct answer. This task used productions of */ju/* by the female tone ID talker. Three randomized repetitions produced a total of 15 trials.

The main task was a five alternative forced-choice ID task, where participants identified the tone of each syllable, similar to the familiarization section. However, they received no feedback on their identification accuracy. They identified 100 randomized stimuli (5 syllables x 5 tones x 2 speakers x 2 repetitions), presented with an inter-stimulus-interval of 3 seconds. C-N completed this task twice, approximately 7-10 days apart. TT-N completed this before tone training and before starting word training, and the two WO groups completed one test before starting word training.

2.3.2. Tone training

TT-N received three 30-minute sessions of tone training administered over the course of 7-10 days. Every training session was comprised of 300 trials (4 speakers x 5 syllables x 5 tones x 3 repetitions) divided into 6 blocks of 50 trials each. Training followed a similar format as the familiarization task, as listeners heard a stimulus and were asked to indicate which tone they heard from a choice of 5 options. They received feedback on their response accuracy and the correct answer for each trial.

2.3.3. Word training

Word training was completed over 4 days, with 2 training sessions per day (except for the last day of training where there was only one), with a 15-

minute break between training sessions. TT-N and WO groups learned the full set of 15 training words and their meanings in each session. Listeners were trained on sound-meaning associations to simulate a more "natural" learning paradigm. Stimulus presentation and testing procedures were modeled after training in [8].

Each training session included 5 training blocks, 2 review blocks and a session test. Each training block consisted of listening to 4 randomized repetitions of 3 words while viewing pictures of their meanings (2 speakers x 3 words x 2 repetitions). Participants were then quizzed on the three words learned in each block, matching stimuli with their pictures (4 speakers x 3 words), with feedback provided. Both review blocks were comprised of all 15 words. Review 1 had a choice of 6 options (15 trials), and Review 2 had participants selecting the meaning from all 15 potential options (30 trials). Both review blocks provided feedback after each response, similar to the block quizzes. Each session concluded with a test where participants identified all 15 words learned in the training program without feedback. The session test followed the same format as the final review block, involving the 15 training words produced by all 4 speakers (60 trials).

3. RESULTS

3.1. Tone training

To determine whether tone training resulted in a significant improvement in identification accuracy, the proportion of correct responses was tabulated for the pre- and post-training tone ID tests for C-N and TT-N. The mean percent correct scores were submitted to a 2-way analysis of variance (ANOVA) with Group (C-N, TT-N) as a between subjects factor and Test (pre, post) as repeated measures. A significant main effect of Test [$F(1, 30)=64.428$, $p<0.0001$] and significant Test x Group interaction [$F(1, 30)=8.606$, $p=.006$] were found. Additional 1-way ANOVAs for each test with Group as the independent variable yielded no significant group differences on the pre-test (M=TT-N: 58%, C-N: 54%; [$F(1, 30)=.413$, $p=.525$]). However, TT-N achieved significantly higher accuracy rates than C-N by the post-test (M=TT-N: 74%; C-N: 62%) [$F(1, 30)=7.995$, $p=.008$], indicating that tone training had resulted in significantly better tone identification accuracy.

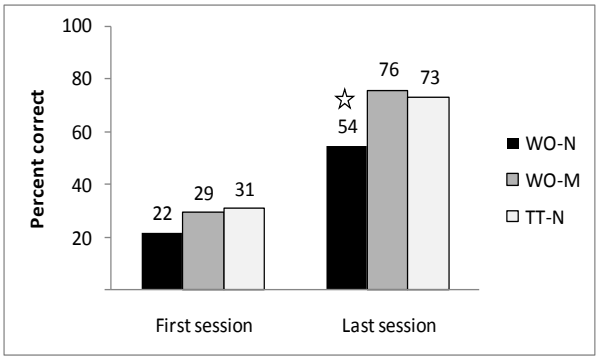
3.2. Pre-word training tone identification

A 1-way ANOVA was constructed using the mean percent tone ID scores from the tone test completed prior to word training for WO groups and TT-N (i.e. post-tone training ID test) to compare their tone ID ability before the start of word learning. The ANOVA yielded a significant main effect of Group [$F(2, 47)=29.632$, $p<0.0001$], and post-hoc (Bonferroni) analyses revealed no significant difference between TT-N (M=74%) and WO-M (M=74%; $p=1.00$), but that both groups had significantly higher tone ID accuracy scores than WO-N (M=47%; $p<0.0001$).

3.3. Word training

Overall improvement in word ID accuracy was determined by calculating the percent correct scores for the first and last word training session tests (Figure 1). These scores were submitted to a 2-way ANOVA with Group (TT-N, WO-N, WO-M) as a between-subjects factor and Session (first, last) as repeated measures. Results revealed a significant main effect of Session [$F(1,47)=436.285$, $p<0.0001$], indicating that a significant improvement in word ID accuracy was made across groups as a result of training.

Figure 1: Mean percent correct for first and last word training session tests by group.

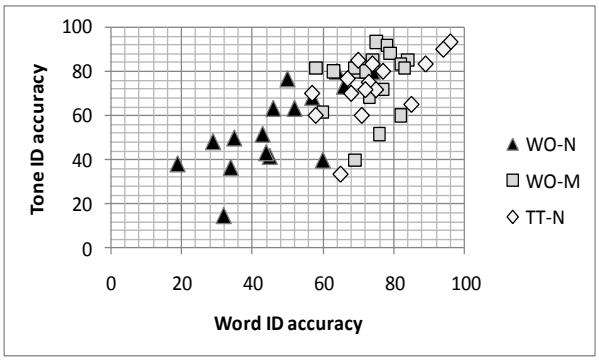


Furthermore, a significant Session x Group interaction was found [$F(2,47)=4.407$, $p=.018$]. Subsequent 1-way ANOVAs for each session with Group as a factor indicated that there was no significant group difference on the first session [$F(2,47)=3.080$, $p=.055$]; however, by the last session, significant group differences had emerged [$F(2,47)=8.912$, $p=.001$]. Bonferroni-adjusted pairwise comparisons demonstrated that both TT-N and WO-M achieved significantly higher accuracy rates by the end of training than WO-N

(p<.005). No significant difference was found between WO-M and TT-N (p=1.00).

To determine the relationship between pre-word training tone ID and final word training session scores, a linear regression model was constructed (Figure 2). Results showed that tone ID scores significantly predicted word ID accuracy [R^2=.498, F(1,48)=47.651, p<0.0001], in that the higher tone ID scores by WO-M and TT-N were correlated with their greater word ID accuracy, while WO-N with lower tone ID scores showed lower word ID accuracy. This indicates that the superior tone sensitivity found in WO-M and TT-N was an important factor in their word learning success.

Figure 2: Mean percent correct tone ID scores against mean percent last session word ID scores by group.



4. DISCUSSION

Our hypotheses were confirmed, in that TT-N's tonal ID ability significantly improved as a result of tone training, and this enhanced tonal awareness had a significant effect on their ability to use non-native lexical tones to distinguish word meaning. All groups obtained similar scores on their first session of word learning; however, increasing TT-N's tonal awareness to a level similar to WO-M before the start of word training resulted in both groups achieving significantly higher word ID accuracy than WO-N by the end of word training. Similar to [8], tone ID scores before the start of word training also predicted word ID scores, such that participants who achieved higher tone ID accuracy (i.e. WO-M and TT-N) were more likely to obtain greater word ID proficiency.

Musical training or a tone language background have both been found to aid non-native tone word learning [2, 8], suggesting that a heightened domain-general attunement to tonal distinctions can be advantageous when learning words distinguished by tonal cues. In the context of these studies, the current findings indicate that for learners without pre-existing tonal awareness from a musical or L1 background, even 3 training sessions can heighten their sensitivity to non-native pitch patterns enough to be highly beneficial in identifying words using such pitch patterns. Furthermore, the present study provides further evidence of "phonetic-phonological-lexical continuity" [8], as improving lower-level phonetic abilities (i.e. tone ID) significantly contributed to greater success in a higher-level linguistic task (i.e. word ID). These results suggest that non-native phonetic details first need to be encoded before listeners are able to effectively utilize them to make lexical distinctions.

5. ACKNOWLEDGMENTS

This research is supported by a Discovery Grant from the Natural Sciences and Engineering Research Council of Canada (312457-2006).

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