

# Effect of tone training on Cantonese tone-word learning

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**Abstract:** The present study examined the effect of improving lexical tone identification abilities on Cantonese tone-word learning. Native English non-musicians received training on Cantonese tones before learning the meanings of words distinguished by these tones. Their results were compared to English non-musicians and musicians who received no tone training. The tone-trainees obtained a similar level of word identification proficiency as musicians by the end of training and were significantly better than non-tone trained non-musicians. These results lend support for phonetic-phonological-lexical continuity in learning because enhancing listeners' perception of lower-level tonal information significantly contributed to success in a higher-level linguistic task.

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## 1. Introduction

Long-term pitch experience, both linguistic and non-linguistic (e.g., musical training), has been shown to significantly affect the perception of lexical tone contrasts as well as the ability to utilize such contrasts to make lexical distinctions. Previous research has suggested that long-term exposure to native tonal contrasts or non-linguistic musical pitch aids listeners in better attuning to the pitch modulations of non-native tonal distinctions, as both tone-language listeners and musicians identified and discriminated lexical tones more accurately than non-tone-language non-musicians (Lee and Hung, 2008; Wayland and Guion, 2004). Moreover, short-term pitch experience (e.g., tone training) can also facilitate the perception of non-native tonal contrasts (Francis *et al.*, 2008; Wang *et al.*, 1999). For example, Wang *et al.* (1999, 2003) reported that after training American English listeners to identify Mandarin tones, they not only improved their tone identification accuracy but also generalized these improvements to new talkers, stimuli, and the production domain. However, studies have yet to investigate how short-term training on lower-level tonal information translates into a higher-level linguistic domain such as word learning.

The ability to perceive the acoustic distinctions between sounds is a necessary initial step toward being able to utilize them in higher-level linguistic contexts. The importance of acoustic information for speech learning has been demonstrated with both infants (Werker *et al.*, 2002) and adults (Cooper and Wang, 2012; Wong and Perrachione, 2007). Wong and Perrachione (2007) reported that listeners who were highly proficient at identifying pitch patterns, as a result of long-term musical experience, were the most successful learners of vocabulary items distinguished by lexical tones. The authors termed it a “phonetic-phonological-lexical continuity” (p. 566), whereby lower-level auditory abilities that facilitated the perception of phonetic contrasts had a significant impact on a higher-level lexical task. This highlights the

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involvement of bottom-up as well as top-down processes in word learning, in that there appears to be a substantive relationship between these different levels of information (i.e., auditory-phonetic-phonological-lexical).

Given that previous research has primarily examined the influence of short-term pitch experience on lower-level abilities such as phoneme identification (Francis *et al.*, 2008; Wang *et al.*, 1999), the current study extends the earlier work of Cooper and Wang (2012) by investigating the effect of short-term pitch experience on higher-level lexical (Cantonese tone-word<sup>1</sup>) learning by training native English speakers on Cantonese tones prior to a tone-word learning program. The results are compared to the English musicians and non-musicians from Cooper and Wang (2012), who completed only the tone-word learning program, to examine how listeners with short-term pitch experience compare to listeners with and without significant (musical) pitch experience. The phonetic-phonological-lexical continuity hypothesis would predict that improving listeners' tonal awareness and lower-level phonetic abilities through tone training should result in their achieving greater success in a subsequent tone-word learning program relative to non-musician listeners who did not receive any tone training. The non-musicians who receive short-term pitch experience from tone training might also perform at a level on par with musicians who received no lexical tone training but instead benefit from long-term musical pitch experience.

## 2. Method

The participants included 32 native English speakers, who had not previously participated in the Cooper and Wang (2012) study, with no prior experience with Cantonese or any other lexical tone language. They self-reported normal hearing and cognitive abilities and were all non-musicians ("N"), defined as having less than 3 yr of musical experience and no experience within the last 5 yr (Wong and Perrachione, 2007). Sixteen of these participants were assigned to a Tone Training group (TT-N; 12 females, 4 males; *M age* = 22 yr) and 16 to a Control group (C-N; 12 females, 4 males; *M age* = 20 yr). The performance of TT-N was compared to the performance of the English non-musician (*n* = 14) and musician (*n* = 12) groups that participated in word training only from Cooper and Wang (2012), here referred to as Word Only groups (non-musicians: WO-N; musicians: WO-M).

The experimental setup for the different groups is illustrated in Table 1. Among the four groups, TT-N participated in all the test and training programs in the following order: (Pre-tone-training) Tone identification (ID) test, Tone training, (post-tone-training) Tone ID test (identical to the pre-tone-training ID test), Tone-word training, and session tests. In order to gauge whether tone training was effective, TT-N's performance on the two tone ID tests was compared to that of C-N, who also





learning success [ $R^2 = 0.555$ ,  $F(1,40) = 49.928$ ,  $p < 0.0001$ ], indicating that participants with higher tone identification scores before word learning ultimately achieved higher levels of word learning proficiency.

#### **4. Discussion and conclusion**

The results of the present study revealed that short-term tone training had a significant impact on the ability to use non-native tones to distinguish word meaning. While all groups obtained similar tone-word ID scores on their first day of word learning (Fig. 1), increasing TT-N's tonal awareness through tone ID training to a level similar to WO-M resulted in TT-N achieving similar levels of proficiency as WO-M by the end of word learning, with both scoring significantly higher than WO-N. Furthermore, consistent with [Wong and Perrachione \(2007\)](#), tone ID scores were a significant predic-

attention to the acoustic information relevant for distinguishing the tonal contrasts and enhanced their tonal awareness, in that it improved their ability to isolate and identify components of linguistic units ([Wong and Perrachione, 2007](#)). The present results indicate that focusing attention on non-native phonetic information initially can facilitate

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