The Effects of Tone Types and Bilingual Experiences on Attentional Control in Cantonese Tone Dichotic Listening Task

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Bilingual individuals are suggested to outperform monolinguals in attentional control by the practice of focusing on one language and suppressing unused languages. Soveri et al. [1] used the Forced-attention Dichotic Listening (FADL) task to test how monolinguals and bilinguals showed different performances in consonant processing. Participants were simultaneously exposed to two stimuli and to respond according to conditions. The non-forced (NF) condition asked for a clearer stimulus and introduced a right-ear advantage (REA). Both forced conditions (forced-left, FL; forced-right, FR) required attentional control with differed demands by focusing on and reporting stimuli in the instructed ear. The FL called for higher demands, as its incongruent pattern (i.e., left-ear advantage, LEA) with the NF, than the FR. Bilinguals performed better than monolinguals, with greater accuracy improvements in instructed ears from NF to forced conditions (e.g., in the left ear from NF to FL condition) [1]. However, the between-group design overlooked individual bilingual experiences, which should be a continuous variable representing L1-dominant (monolingual-like) to balanced bilinguals [2]. Additionally, the ear advantage of tone processing in the NF differs from that of segments (e.g., consonants) and varies with tone types [3]. For example, Cantonese tones triggered an overall LEA. But contour tones processing showed a stronger REA compared to level tones [4]. Therefore, this study explored Cantonese-English bilinguals’ attention control abilities for two types of Cantonese tones and the impact of individuals’ bilingual experience on the FADL task.

This study recruited 60 Cantonese-English bilingual participants between 18 and 25 in Hong Kong. As shown in Fig.1, the participants completed a language history questionnaire [5], a tone training, and the target FADL task. The Multilingual Language Diversity (MLD) score from the questionnaire measured bilingual experiences, as it considers dominance and proficiency of all languages (max:4) the participants learned. The stimuli were produced by a speaker who did not merge Cantonese tones, and all stimuli were normalized at 511 ms and 70 dB. The tone training involved identifying contour and level tones, with feedback to enhance the mapping of tones and labels (T1-T6). In the FADL task, participants were presented with dichotic stimuli of contour tone pairs (e.g., /ji2/ ‘chair’ vs. /ji4/ ‘son’) and level tone pairs (e.g., /ji1/ ‘doctor’ vs. /ji3/ ‘meaning’). In each trial, participants were required to report the tone played to the instructed ear in each attention condition (NF, FL, and FR) by pressing keys (1-6).

For the tone type effect of attention control abilities, the accuracy of ears (left, right) was compared across conditions (NF, FL, FR) and tone types (contour, level). Results of an ANOVA showed an interaction of tone type, ear, and condition (F(2,708) = 15.1, p<.001). Post-hoc analysis showed no significant difference in ear advantage for both tone types but a larger instructed-ear advantage contour tone than the level tone (see Fig.2). This greater instructed-ear advantage improvement from NF to FL or FR suggested better control abilities for contour tone. The difficulties in distracted conditions can be smaller for contour tones since more cues (i.e., both pitch height and direction) are provided than level tones [4].

For the bilingual effect, accuracy in the instructed ear was compared between the forced condition corresponding to the instructed ear (FL or FR) and the baseline condition (NF) in two mixed-effects models. For the right-ear accuracy, the interaction of condition (FR vs. NF) and MLD was significant (z = 8.2, p<.001), indicating that participants with higher MLD (i.e., more balanced usage and higher proficiency) greatly improved the REA in the FR condition for both tone types (see Fig.3). The model on left-ear accuracy did not reveal any significant main effect or interaction of MLD (see Fig.4). Two forced conditions varied in attentional demands for their congruency with the NF. The higher-level bilinguals (with higher MLD) can better manage the limited attentional resources to focus on the incongruent ear than the lower-level bilinguals (with lower MLD) in the high-demand (FR) condition. In the FL, all bilinguals performed similarly since the demand was easy to meet regardless of more or less bilingual experience [6]. The findings suggested the bilingual advantage in attentional control [1] but further specified the modulation of task demand with the consideration of gradient bilingual experience [2]. The bilingual effect needs to be further investigated for bilinguals with different dominant language pairs (e.g., two Chinese dialects).
Figures

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Each participant entered one of the A, B, C, D blocks of training and test. (Each block is with different tone type order and condition order.)

**Figure 1:** Overview of the procedure

**Figure 2:** Left and right ear accuracy across NF, FL, FR conditions for contour (red) and level (green) tones

**Figure 3:** Right-ear accuracy improvement from NF to FR (incongruent) among bilinguals with different MLD scores in contour tone (red), level tone (green), and regardless of type (blue dash line)

**Figure 4:** Left-ear accuracy improvement from NF to FL (congruent) among bilinguals with different MLD scores in contour tone (red), level tone (green), and regardless of type (blue dash line)

References


