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An Implicit Association Test on Audio-Visual Cross-Modal Correspondences

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Abstract

Automatic connections between sounds and visual shapes have been documented for some time (c.f., Spence, 2011). We replicated audiovisual correspondences with simple linguistic sounds /i/ and /u/, this time produced in the lexical tones of Mandarin Chinese, using a modified version of the implicit association test (IAT). Although congruent blocks were significantly faster than incongruent ones ($p < .001$), no effect of tone congruence was observed. Since tone was an unattended stimulus dimension, we argue that attention modulates sensory congruence in implicit association tasks of this nature.

Keywords: multisensory perception, sound symbolism, implicit association test

1. Introduction

There is ample evidence of cross-modal correspondences between visual shapes and speech sounds in the literature. This kind of non-arbitrary mapping was first observed by Köhler, whose participants showed strong preference to pair a round shape with 'maluma' and an angular shape with 'takete' (Köhler, 1929:1947). D'Onofrio (2013) also documented a front vowel /i/-pointy, back vowel /u/-curvy preference pattern. However, their pseudowords consisted of vowels and consonants, giving rise to a confounding.

In addition to the sound of phonemes, non-linguistic pitch also gives rise to associations with visual shape: high pitch is matched to angular shapes; low pitch is matched to round shapes (Marks, 1987). Only one study has previously investigated cross-modal mapping preferences for linguistic tones. Shang and Styles (2014) report both Chinese dominant and balanced Chinese-English bilinguals share a Tone 1-curvy, Tone 4-pointy mapping tendency. See **Figure 1**. However, these results have only been seen in tasks where participants are asked to think about the relationship between the shape and the sound, meaning that their responses could reflect something 'strategic' or a kind of introspection, rather than an 'automatic' process.

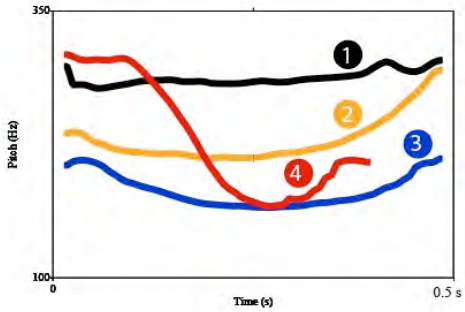

Figure 1. Time by frequency plot of 'oo' uttered in four Mandarin Chinese tones

The implicit association test (IAT) can overcome the above-mentioned ambiguity. Parise and Spence's (2012) modified version of the IAT showed that participants' performance improves when the set of stimuli assigned to a

given response key share a cross-modal mapping (the congruent conditions), as compared with conditions in which a set of unrelated stimuli are assigned to the same response key (the incongruent conditions). Given the IAT's advantage in probing implicit relationships, we explored the associations between visual shapes and simple vowel sounds articulated in the lexical tones of Mandarin Chinese, using a modified version of the IAT for the first time.

2. Methods

Eighteen participants from Nanyang Technological University participated in the experiment for course credit. Sixteen were Chinese-English bilinguals. The other two were bilinguals in English and other languages.

In terms of pitch change, Tone 1 is stable and Tone 4 changes much more than Tone 1. According to the 'pitch change hypothesis', the greater the pitch change within a Mandarin Chinese tone, the pointer the shape of its associations (Shang & Styles, 2014). We therefore expect Tone 4 would facilitate congruent matches for Tone 4 with the pointy shape, while Tone 1 would facilitate congruence of Tone 1 with the round shape (**Figure 2**).

Figure 2. A congruent vowel-shape mapping

Counterbalanced across the study, were two tones of Mandarin Chinese (Tone 1 & Tone 4). However, since the task instructions asked people to press a key in response to which vowel they heard ('ee' or 'oo'), the congruence of the tone to the visual shape can be considered to be an implicit variable.

3. Results and discussion

We detected a main effect of vowel congruence ($p < .001$), suggesting the congruent blocks (/u/-curvy and /i/-pointy) were significantly faster than the incongruent blocks (/u/-pointy and /i/-curvy). No further effects or interactions with tone were observed.

The vowel congruence in our Chinese-English bilinguals is consistent with previous English-language vowel-shape matching (e.g., D'Onofrio, 2013) and an explicit vowel-shape mapping task in Chinese-English bilinguals (Shang & Styles, 2014), suggesting the Chinese-English bilinguals showed a strong effect of vowel identity. However, no tone effect was observed.

In our task, tone was embedded as an unattended dimension in the current IAT task, and the attentional demands of the task may have been too great to allow tone congruence to be observed. Ongoing investigations will inform us of whether tone congruence will emerge in IAT tests when it is the attended dimension.

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