

Abstract of thesis entitled:

Tonal processing in Cantonese

Submitted by JIA, Shiwei

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Abstract

In order to investigate the issues of: 1) how tonal dimensions affect tonal processing, 2) how stimulus type affects tonal processing, and 3) how task requirement affects tonal processing, four experiments were conducted on Cantonese tone perception.

Experiments 1 and 2 were two dichotic-listening (DL) experiments. They manipulated the same independent variables (IVs): 1) f0 direction (level and contour) and 2) stimulus type (syllable, pseudo-syllable, and hum), but used different tasks (a discrimination task and an identification task in Experiments 1 and 2, respectively).

Experiments 3 and 4 were two event-related potential (ERP) experiments. They manipulated the same IVs: 1) f0 direction (level and contour), 2) f0 height-deviation (large and small), and 3) stimulus type (syllable and hum), but the tasks were different (passive oddball task in Experiment 3 and active oddball task in Experiment 4). The effects of tonal dimension (f0 direction and f0 height) were used to examine how acoustic features (low level) modulate tonal processing. Moreover, the effects of

stimulus type and task requirement were used to test the effect of lexical involvement (high level) on tonal processing.

In Experiments 1 and 2, a left-ear advantage (LEA) was found for Cantonese tone processing in both discrimination and identification tasks. However, for the Mandarin tone, an LEA and a right-ear advantage (REA) were found in discrimination and identification tasks, respectively. In the Cantonese condition, the processing speeds of tone for syllables and pseudo-syllables were faster than that for hums, and the performance on the level tone was better than that on the contour tone.

Experiment 3 showed that the MMN and P3a elicited by syllables were larger than those elicited by hums. The level tones elicited earlier and larger MMN and P3a than the contour tones did, and large f0 height-deviations elicited earlier and larger MMN than small f0 height-deviations did. In Experiment 4, the N1, P2, N2, and P3b were elicited in the syllable condition, and the N2 and P3b were elicited in the hum condition. In the syllable condition, the level tone elicited earlier and larger P2 and P3b and earlier N2 than the contour tone did. Large f0 height-deviations elicited earlier and larger N1 and P3b and earlier N2 than small f0 height-deviations did. In the hum condition, the level tone elicited earlier and larger MMN and P3b than the contour tone did, and large f0 height-deviations elicited earlier and larger MMN and P3b than small f0 height-deviations did.

Therefore, both tonal dimension and stimulus type affect lexical tone processing. Tonal processing is modulated by both the low-level acoustic features and the high-level linguistic memory. Neither the *acoustic model*, which only emphasizes the acoustic features, nor the *functional model*, which only emphasizes the linguistic functions, can explain all of the results. The *Auditory Cognitive Science (ACS) framework*, which considers the roles of both acoustic features and linguistic functions, seems more appropriate to describe these results.

## 摘要

本文研究了粵語聲調加工中：1) 聲調維度對聲調加工的影響，2) 刺激類型對聲調加工的影響，3) 任務難度對聲調加工的影響。實驗一、二為雙耳分聽實驗，它們操縱同樣的自變量：1) 基頻方向（平調、非平調），2) 刺激類型（音節、假音節、和合成喻聲），但採用不同任務（實驗一、二分別採用辨別和識別任務）。實驗三、四為腦電實驗，它們操縱相同的自變量：1) 基頻方向（平調、非平調），2) 基頻音高偏離幅度（大、小），3) 刺激類型（音節、合成喻聲），但採用不同任務（實驗三、四分別採用被動 oddball 和主動 oddball 任務）。聲調維度（基頻方向和基頻音高）的效應用來檢測聲學特徵對聲調加工的作用。刺激材料與實驗任務的效應用來檢測語義記憶對聲調加工的作用。

實驗一、二發現在粵語聲調加工中，不管是辨別還是識別任務，左耳都具有優勢。但在普通話聲調加工中，辨別和識別任務中分別呈現左耳和右耳優勢。在粵語中，對音節和假音節的反應快於對合成喻聲的反應，對平調的反應快於對非平調的反應。實驗三發現，與合成喻聲相比，音節誘發更大的 MMN 和 P3a。與非平調相比，平調誘發更早、更大的 MMN 和 P3a。與小基頻音高偏離相比，大基頻音高偏離誘發更早、更大的 MMN。實驗四發現，音節條件誘發了 N1，P2，N2，和 P3b，合成喻聲條件誘發了 N2 和 P3b，這反映了刺激類型效應。在音節條件，與非平調相比，平調誘發更早、更大的 P2 和 P3b 以及更早的 N2。大基頻音高偏離比小基頻音高偏離誘發更早、更大的 N1 和 P3b，以及更早的 N2。

在合成噏聲條件下，與非平調相比，平調誘發更早、更大的 MMN 和 P3b，大基頻音高偏離比小基頻音高偏離誘發更早、更大的 MMN 和 P3b。

結果表明，聲調維度和刺激類型都可以影響声调加工。即，聲調加工受到聲學特徵和語言記憶的雙重調節。僅強調聲學特徵的聲學特徵模型和僅強調語言記憶的功能模型都不能解釋全部結果。聲學認知模型可以更好的解釋本實驗的結果，因為此模型同時強調聲學特徵和腦內語言記憶的作用。