

LEXICAL TONE REPRESENTATION OF MANDARIN-SPEAKING TODDLERS

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1. INTRODUCTION

Infants and toddlers have detailed representations for their known vocabulary items

- Consonants (e.g., Swingley & Aslin, 2000; Fennel & Werker, 2003; Halle & de Boysson-Bardie, 1996)
- Vowels (e.g., Mani & Plunkett, 2007)

Toddlers are sensitive to the phonological distances among consonants (White & Morgan, 2008).

Research Question

It is unknown whether toddlers are sensitive to different phonological distances among lexical tones.

Lexical tones in Mandarin

Four tones (See Fig. 1):

- Tone 1 (high level)
- Tone 2 (high rising)
- Tone 3 (low dipping)
- Tone 4 (high falling)

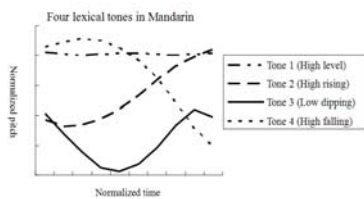


Fig. 1 Time-normalized and pitch-normalized F0 contours of the four lexical tones in Mandarin, produced by a female native speaker. (data from Lee Sung Hoon, Graduate School, Chinese Academy of Social Sciences)

- ◆ Smaller phonological distance: Tone 2 vs. Tone 3 (Lee, 2010)
- ◆ Larger phonological distance: Tone 2 vs. Tone 4, Tone 3 vs. Tone 4 (Lee, 2010)

2. METHOD

Participants: 20 Mandarin - learning toddlers; 19-26 months old

Speech stimuli

Two monosyllabic key familiar words, one in Tone 2 and one in Tone 3

- Tone 2 (rising tone): yang2 ("sheep")
- Tone 3 (low dipping tone): wan3 ("bowl")

Procedure

Intermodal preferential looking procedure following White & Morgan (2008)

Two pictures in pair, side by side; one familiar, one unfamiliar (of unknown objects and animals) (See Fig. 2)



Fig. 2 Two examples of the pictures presented to the subjects in the key trials

Each trial 6.5s in length; 8 key trials

Key test trial types (within subject design):

- Correct pronunciation (CP): yang2, wan3
- Mispronunciation (MPT2/3): yang2 mispronounced as yang3, wan3 mispronounced as wan2
- Mispronunciation (MPT4): yang2 mispronounced as yang4, wan3 mispronounced as wan4

Prediction

If toddlers represent phonological distances for lexical tones, then response difference would be greater for Tone 2/3 to Tone 4 mispronunciations than Tone 2 to Tone 3 and Tone 3 to Tone 2 mispronunciations.

3. RESULTS

Measure: proportion of looking to the target target looking time divided by the sum of target looking time and distractor looking time

Analysis window: starting 400msec from the onset of the first production of the target, to 2 sec (See Fig. 3)

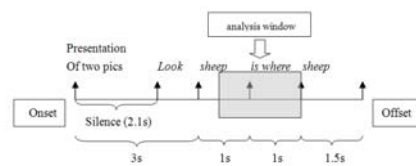


Fig. 3 The structure of a trial

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3.1. Target proportional looking (TPL)

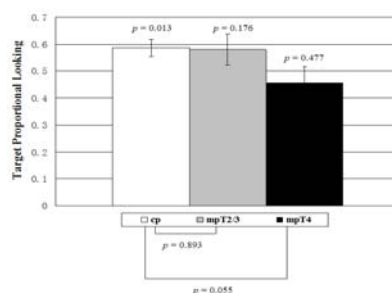


Fig. 4 Proportion of looking time to target in CP vs. MP trials

◆ Comparison to chance level (0.5): children recognized the target words only in CP

CP significantly above chance, $p = 0.013$, 2-tailed

Greater MP Tone 2/3 to 4, not different from chance level, $p = 0.477$, 2-tailed

Smaller MP Tone 2 to 3, Tone 3 to 2, not different from chance level, $p = 0.176$, 2-tailed

◆ CP vs. MPs comparisons: mispronunciations of tones with greater phonological distance impede target recognition

Greater distance: CP vs MP Tone 2/3 to 4, $p = 0.055$, 2-tailed

Smaller distance: CP vs MP Tone 2 to 3, Tone 3 to 2, $p = 0.893$, 2-tailed

3.2. Longest looking (LLK)

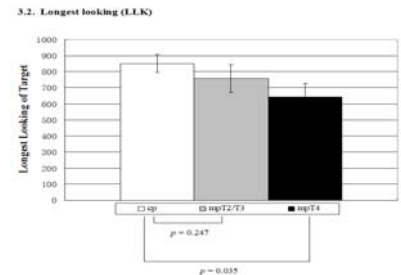


Fig 5. Longest looking time to target in CP vs. MP trials

◆ CP vs. MPs comparisons: mispronunciations of tones with greater phonological distance impede target recognition

Greater distance: CP vs MP Tone 2/3 to 4, $p = 0.035$, 2-tailed

Smaller distance: CP vs MP Tone 2 to 3, Tone 3 to 2, $p = 0.247$, 2-tailed

4. DISCUSSION

◆ Toddlers' lexical tone representations are sensitive to different degrees of phonological distances; Tone 2 and Tone 3 are both more distinct from Tone 4 than Tone 2 and 3 to each other.

◆ Infants showed no distinctive representations for Tone 2 versus Tone 3, possibly because

Tone 2 & 3 are similar phonetically and acoustically;

Tone 2 & 3 are neutralizable in specific environment – tonal sandhi;

◆ Since preverbal tone-learning infants can discriminate T2 and T3 (Gao, Shi & Li, 2010), the Tone 2-3 confusion must be at the phonemic level involving the lexicon.

◆ Task sensitivity:

no tonal MP effect: familiar-familiar pairings (Gao, Shi, & Li, 2011)

yes tonal MP effect: familiar-unfamiliar pairings (White & Morgan, 2008; the present study)

References

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Acknowledgement

This work was supported by the CASS Key project fund and the Chinese Social Science Fund to the third author and the first author, and grants from NSERC, SSHRC and CFI to the second author.

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