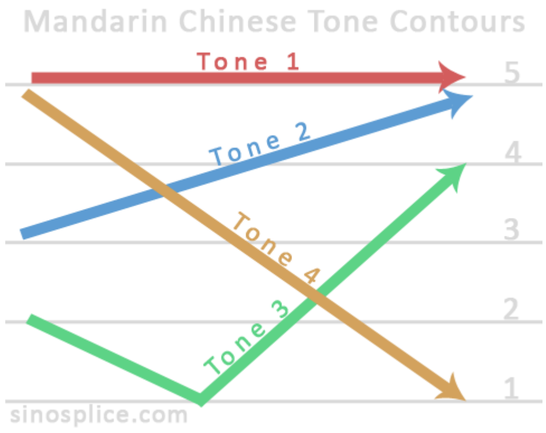
Perception of Lexical Tones in Chinese-English Bilinguals and Language Learners

Thomas Holt, Benjamin Zinszer, and Ping Li

Introduction

- In Chinese (Mandarin dialect), four tones are used to convey semantic information
- The four tones are a high tone, a rising tone, a falling then rising tone, and a falling tone
- For example, “mā” means “mother” while “mǎ” means “horse”



Lexical Tone Categorization

- Categorical perception is the ability of humans to perceive continuous changes in a signal as discrete groups (Xi et al., 2010).
- More recent attention has been given to determining whether categorical perception applies to the contrast between lexical tones in tonal languages.
- Past ERP studies have shown an early negative potential called the Mis-Match Negativity (MMN) in response to hearing lexical tones from different categories (between-category contrasts) (Xi et al., 2010; Zhang et al., 2011).
- So far, most studies on lexical tone categorization have focused on native speakers (Xi et al., 2010; Zhang et al., 2011).
- For my PIRE project, I plan to study people learning Chinese as a second language, in addition to both adult and child native speakers of Chinese.

Research Objectives

- Investigate variation in categorical perception and MMN response with respect to bilingual developmental factors:
  - L1 or L2 status of Chinese
  - L2 proficiency in learners
  - Immersion (China vs. USA)
- Gain a better understanding of the neurological processes underlying lexical tone categorization.
- Identify the onset of categorical perception of lexical tone in L2 learners
- Inform and improve second language instruction of lexically-intonated languages like Chinese

Research Design

Participants: Five groups of bilinguals and language learners:

In State College, Pennsylvania, United States (native English speakers) -
- beginner adult learners of Chinese
- advanced adult learners of Chinese

In Beijing, China (native Mandarin Chinese speakers) -
- adult learners of Chinese
- adult native speakers of Chinese
- young children acquiring Chinese as their first language

	Beijing, China	State College, USA
Beginning L2 Learner	L1-English students of Chinese at BNU	L1-English students of Chinese at PSU
Advanced L2 Learner		
Native Speaker	Students at BNU and BNU’s primary school (L1 Mandarin Chinese)	

Materials:
- 11 computer-generated intonations of the /ba/ syllable, ranging from a strong rising to strong falling tone
- 32-channel electroencephalogram to measure evoked responses to tones

Study A: Behavioral

- The eleven tones will then be randomly sorted and participants will be asked to judge whether each tone is a rising tone or a falling tone.

Xi et al., (2010) . Tones of the syllable “ba” which will be used for the study

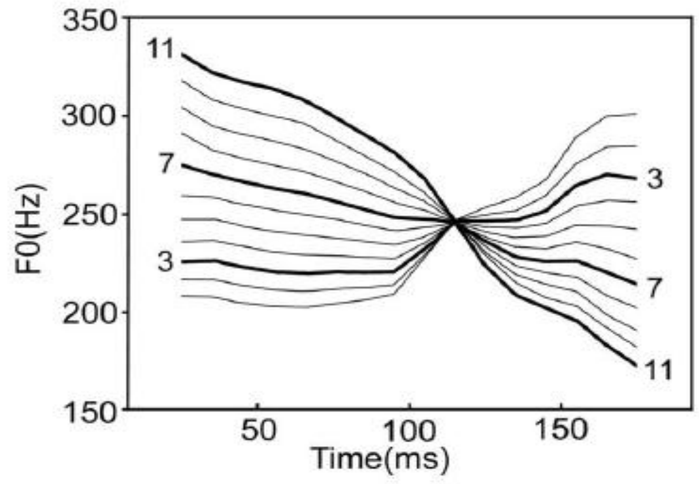


Figure. 1. Tone contours of the continuum from /ba2/ to /ba4/.
Continua 3, 7 and 11 are marked with thick lines.
doi:10.1371/journal.pone.0020963.g001

Participants	Hypotheses
Adult Native Speakers	Will perceive the falling tone with high agreement starting at tone 7.
Child Native Speakers	Will make a less clear distinction (lower agreement) between the rising and falling tones around 7.
L2 Learners at BNU	Will also distinguish the falling tones from the rising tones more gradually like child native speakers
Advanced L2 Learners at PSU	Will begin to distinguish the tones more categorically (steeper transition) compared to the early learners in the US, but more gradually than the immersed learners in China.
Beginner L2 Learners at PSU	Will only be able to clearly distinguish the third and eleventh tone as distinct rising and falling respectively.

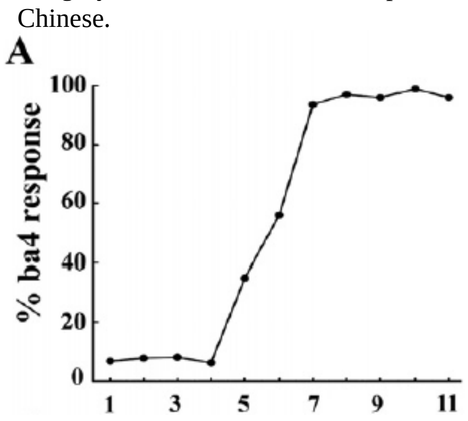
Study B: ERP

Procedure: Participants will watch a silent, subtitled movie as the standard tone is alternated with two of the other tones.

“Within” Condition: the standard tone will be alternated with another tone from the same category (tone 11, within-category deviant).

“Between” Condition: the standard tone is alternated with another tone from a different category (tone 3, between-category deviant).

Xi et al., (2010). Between and within category deviant tones for native speakers of Chinese.



The ERP device will measure evoked response potentials for each set of tones (standard, within-category deviant, and between-category deviant).

Hypotheses:
- The adult native speakers will have an early (~170 ms) Mis-Match Negativity (MMN) in response to hearing the between-category deviant tones.
- Young children (< 9 yo) and early learners will not show an MMN
- Unimmersed second language learners of Chinese will lack an MMN, regardless of ability, but the immersed learners may have this response.

References

Pasden, John. Tone Contours in Mandarin Chinese. Digital image. Flickr. Sinosplice, 9 Dec. 2008. Web. 16 Jan. 2012. <http://www.flickr.com/photos/jpasden/3095772902/>.

Xi, J., Zhang, L., Shu, H., Zhang, Y., & Li, P. (2010). Categorical perception of lexical tones in Chinese revealed by mismatch negativity. *Neuroscience*, *170*(1), 223-31. Elsevier Inc. doi:10.1016/j.neuroscience.2010.06.077

Zhang, L., Xi, J., Xu, G., Shu, H., Wang, X., & Li, P. (2011). Cortical dynamics of acoustic and phonological processing in speech perception. *PloS one*, *6*(6), e20963. doi:10.1371/journal.pone.0020963

Thanks to members of the Brain, Language, and Computation Lab, The Center for Language Science, and the PIRE Committee