THE ROLE OF LANGUAGE AND MUSICAL EXPERIENCE IN TALKER IDENTIFICATION: INVESTIGATING LANGUAGE FAMILIARITY EFFECT

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INTRODUCTION

BACKGROUND

➢ Pitch (f0) is an important dimension in talker identification (e.g. Gelfer, 1988).

➢**Language Familiarity Effect**

• Talker identification is easier in one's native language than in unfamiliar languages (Perrachione, Pierrehumbert & Wong , 2009)

• Perrachione et al. (2009) found overall better talker recognition in Mandarin listeners compared to English listeners, but attributed the advantage to Mandarin listeners' familiarity with English phonology.

➢**Tonal language experience improves pitch-related processing**

• Native tonal language users have better lexical tone discrimination relative to speakers of non-tonal languages (e.g. Wayland & Guion, 2004); better tone mimicking ability (Hao, 2012) , even for unfamiliar tonal languages; enhanced pre-attentive brainstem pitch encoding (Krishnan, Swanminathan & Gandour, 2009); enhanced production and perception of musical pitch (nonlinguistic) (Pfordresher& Brown, 2009)

• No study has investigated whether enhanced pitch processing → better talker identification.

QUESTION 1: Should the observed enhanced talker identification in Mandarin listeners be attributed to their tonal language experience or their familiarity with English?

➢**Musical experience improves pitch-related processing**

• Musical experience predicts pre-training pitch contour identification performance (Wong& Perrachione,2007); musicians detect a pitch change in spoken sentences better than non-musicians in native and unfamiliar languages(Marques et al., 2007).

• Yet few studies have directly examined the role of musical experience in talker identification– a highly pitch-related process.

QUESTION 2: Does musical experience enhance talker identification in both native and unfamiliar languages?

OUR STUDY

➢ Add a Spanish condition to Perrachione et al., (2009) to examine the effect of tonal language experience above and beyond language familiarity, in order to address Question 1 [see above]

➢ Explore the role of musical experience in talker identification and especially examine its role in not only native but also unfamiliar languages

OVERARCHING HYPOTHESIS: Pitch processing abilities are related to talker identification.

Specific HYPOTHESES:

➢Q1: Tonal language users will have enhanced talker identification than speakers of atonal languages, controlling language familiarity and musical experience.

➢Q2: Musicians will have better talker identification in general than non-musicians.

RESULTS

TALKER IDENTIFICATION RESULTS

➢ 2 native language * 2 musical experience* 3 language condition repeated measures ANOVA (Fig. 1)

• Main effect of Language Condition, $F_{2,158}$ = 18.982, p < .001)

• Main effect of Musical experience, $F_{1,79}$ = 3.67, p = .059

• Interaction between Native Language and Language Condition, $F_{2,158}$ = 62.428, p<.001.

• No effect of Native Language, p = .078.

Fig1. Talker Identification
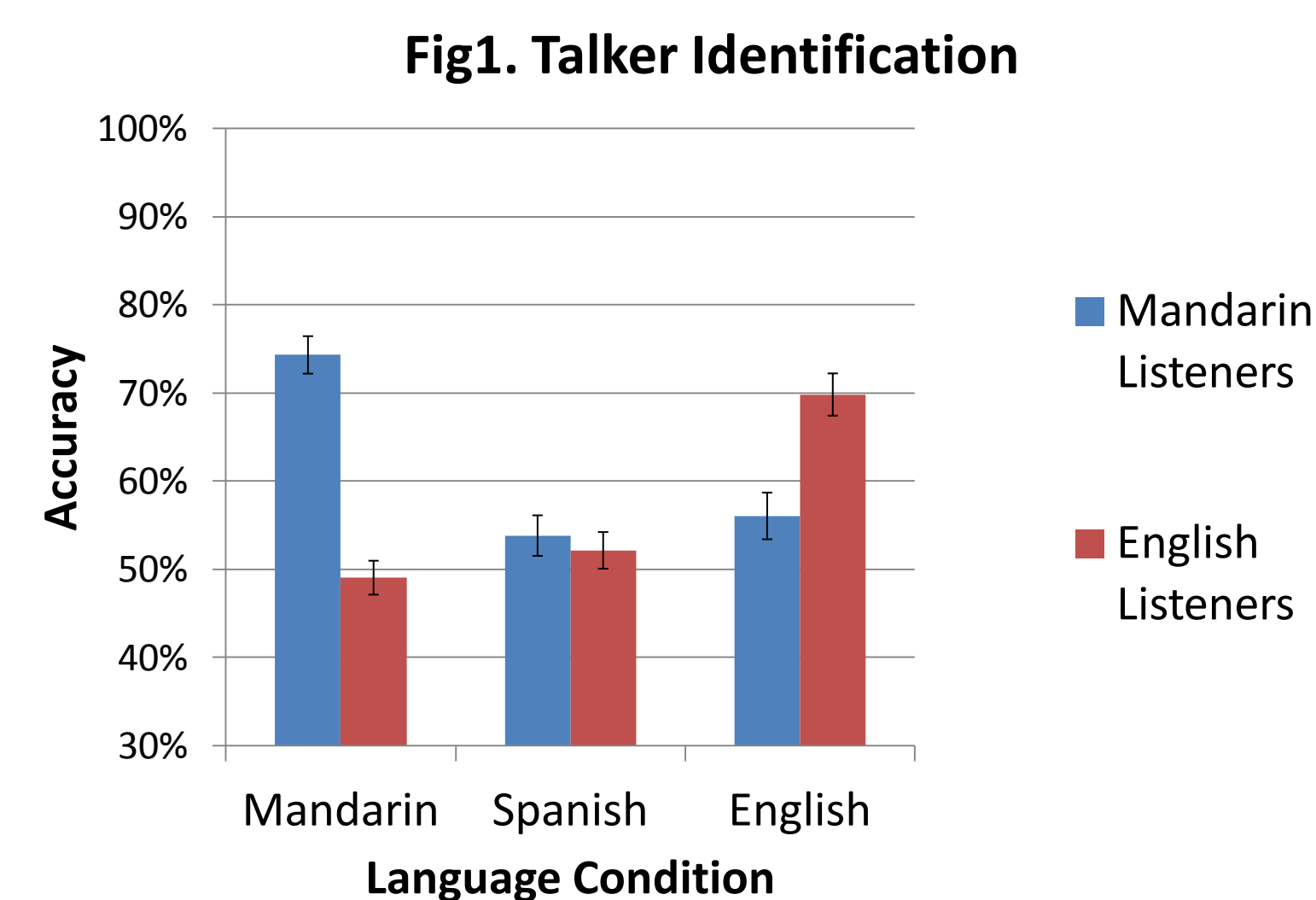
➢ Replicated Perrachione et al. (2009) findings:

• **Language Familiarity Effects : better talker identification in one's native language over unfamiliar languages (Native Language X Language Condition Interaction)**

➢ No advantage for tonal language users in talker identification in general (p = .078)

The role of language experience: Mandarin Speakers

Table 1. Correlations between English intelligibility score and talker identification measures

Language Condition	Intelligibility	Mandarin	Spanish
Mandarin	.437[**]		
Spanish	.562[**]	.404[*]	
English	.329[*]	.349[*]	.354[*]

*p< .05; ** p< .01(2-tailed).

➢ English intelligibility scores significantly correlated with talker identification accuracy in all language conditions : Mandarin, Spanish and English

➢ Surprisingly, English intelligibility scores was NOT correlated with the magnitude of language familiarity effect

➢ Talker identification accuracies between language conditions NOT correlated after controlling for English intelligibility

• **Language familiarity effect cannot be wholly attributed to familiarity with the phonological system of a certain language: Mandarin speakers do no better in English than Spanish**

• **Some general language-related processing abilities may account for talker identification performance in one's native language as well as unfamiliar languages: Correlation between English intelligibility and performance on *all* talker identification conditions.**

The role of musical experience

➢ English listeners only (Fig. 2a)

• **Overall, significant difference between English vs. other two languages (no difference between Mandarin vs. Spanish) , p<.001: Language Familiarity Effect**

• **Musicians are better than non-musicians in unfamiliar languages :**

    ○ Mandarin: t(42) = 2.204,p<.05

    ○ Spanish: t(42) = 2.109, p<.05.

➢ Mandarin listeners only (Fig. 2b)

• **Significant difference between Mandarin vs. other two languages (no difference between English vs. Spanish) , p<.001: Language Familiarity Effect**

• **No difference between musicians vs. non-musicians**

➢ The role of musical experience

• **Pronounced in unfamiliar languages, but not in native language**

• **Pronounced in English listeners, but not in Mandarin listeners**

Fig2a. English Listeners

Fig2b. Mandarin Listeners
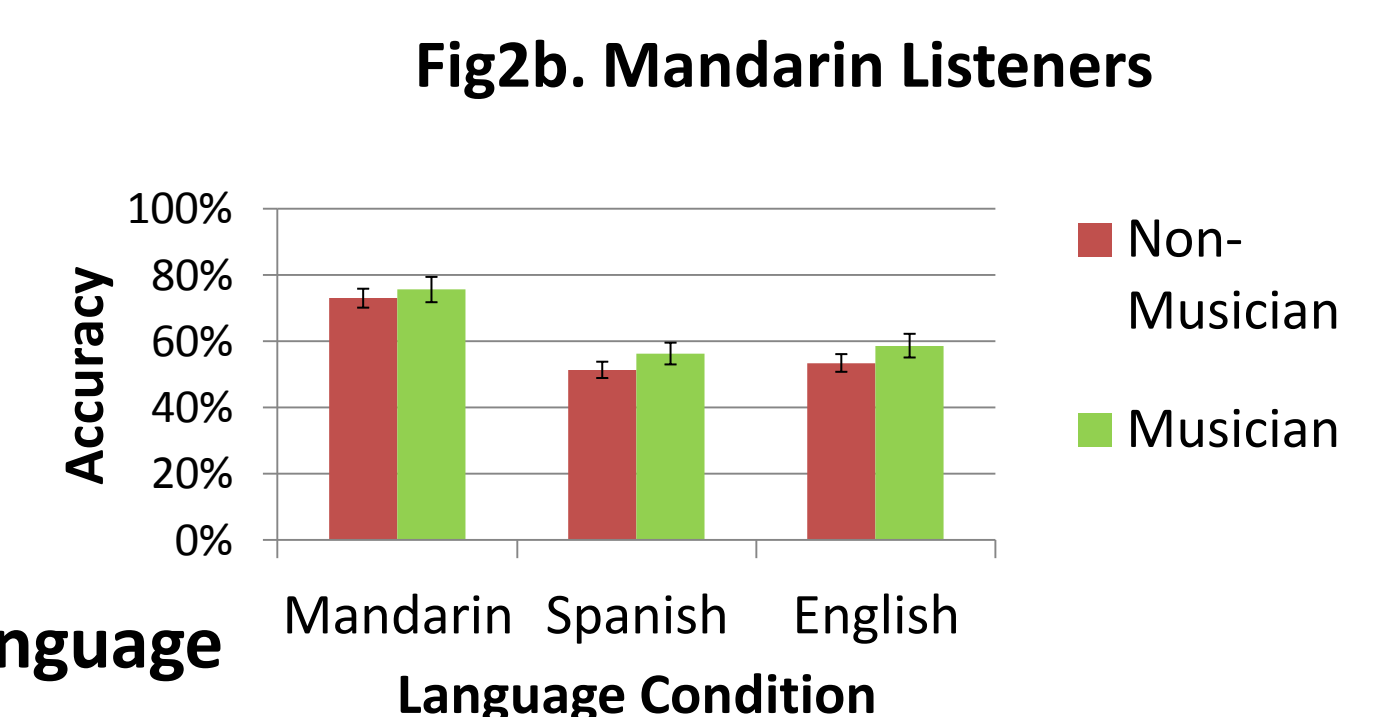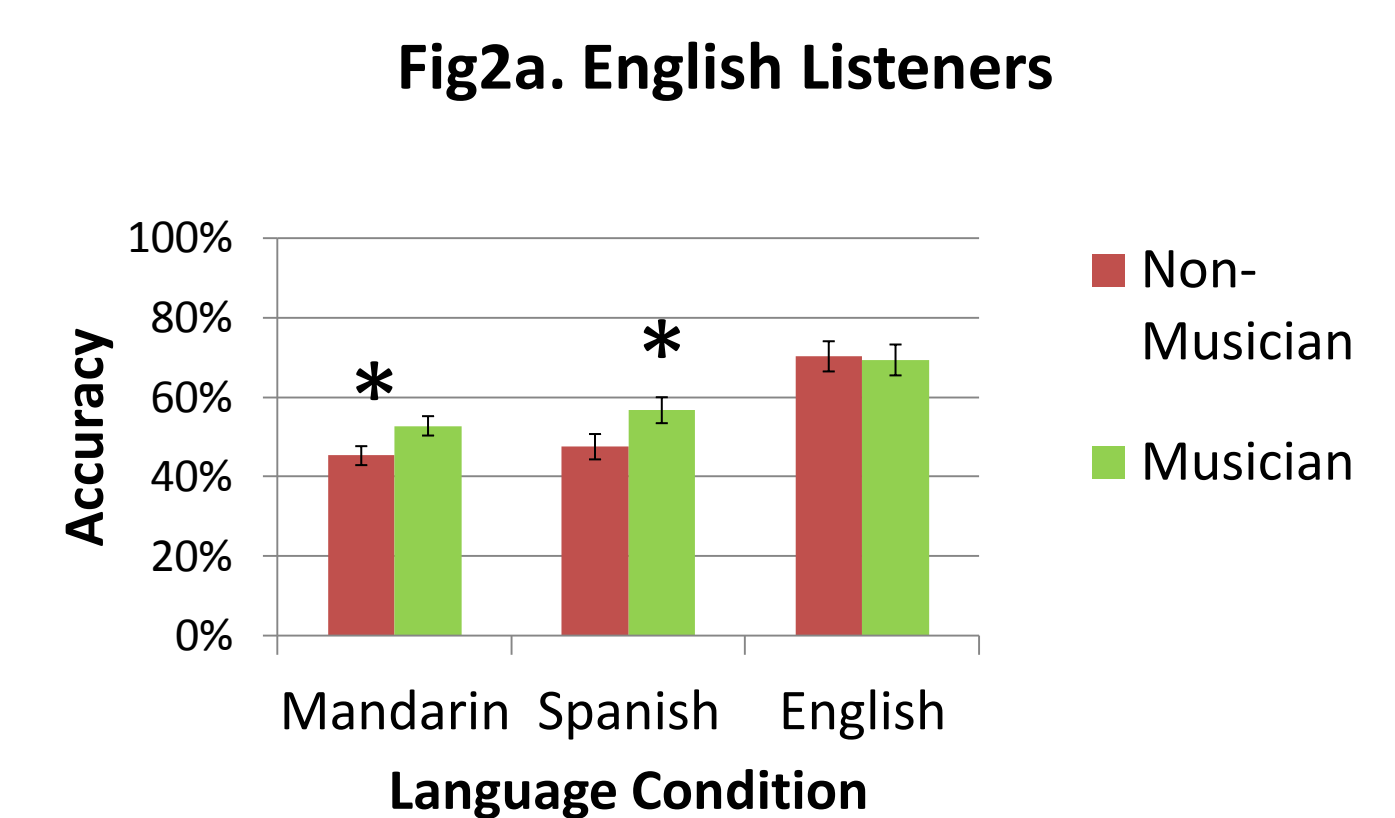
METHODS

STIMULI

ENGLISH INTELLIGIBILITY TEST

• 1 native American-English speaker with no discernible accent

• 3 sentence lists adapted from Bamford-Kowal-Bench (BKB) sentence lists (Bamford & Wilson, 1979)

• Embedded in white noise at a +5 dB signal-to-noise ratio

TALKER IDENTIFICATION

• 5 native male speakers in each language condition (American-English, Spanish, Mandarin) with no discernible idiosyncratic characteristics

• 10 sentences in each language condition (5 training sentences, 5 test sentences)

• Sentence duration, and variation of F0 controlled across language conditions

• All recordings recorded at 22.05 kHz and normalized for RMS amplitude to 70 dB SPL

PARTICIPANTS

Undergraduate and graduate students

44 native-English listeners (23 musicians, 21 non-musicians)

39 native-Mandarin listeners (14 musicians, 25 non-musicians)

    • With participants who knew Spanish from birth or scored below chance in talker identification task excluded

    • 30 English listeners learnt Spanish at school, Mandarin listeners were naïve of Spanish

TASKS

ENGLISH INTELLIGIBILITY ASSESSMENT:

• Participants transcribed sentences onto paper

• Each list consisted of 16 simple declarative sentences with 3 or 4 keywords each for a total of 50 keywords per list

TALKER IDENTIFICATION TASK:

• Blocked by Language Condition: Mandarin, Spanish, or English, counterbalanced

• *Familiarization*: Expose to 5 talkers from 5 training sentences with talker identity being told, 2 times X 5 sentence X 5 talkers, blocked by sentences

• *Practice*: Learn to identify with feedback on the 5 trained sentences, 3 times X 5 sentence X 5 speakers, random order

• *Generalization* : Identify those talkers from 5 novel sentences , 3 times X 5 sentences X 5 speakers, random order

DISCUSSION

Talker Identification: The Role of Language Experience

➢ **Within non-native languages, language familiarity can't account for relative differences in performance:** enhanced performance in Mandarin listeners can't be attributed entirely to their English familiarity, given that their performance doesn't differ in English vs. Spanish condition, and the English intelligibility score doesn't correlate with the magnitude of language familiarity effect.

➢ **However, talker identification may be supported by a more domain-general language "aptitude":** English intelligibility score correlates with all language conditions.

➢ There is a trend that Mandarin speakers are better (p=.078) at this task than English speakers, **suggestive of an influence of tonal language experience on pitch processing, and thus on talker identification.**

Talker Identification: The Role of Musical Experience

➢ Musicians have a benefit over non-musicians when identifying talkers in unfamiliar languages, but such benefit is not demonstrated in tonal language users. **This may indicate a lack of additive effect of musical experience on top of tonal language experience.**

    → **Taken together, these results suggest an interaction between language skills and pitch processing ability in talker identification**

WORKS CITED:

Gelfer, M. P. (1988). Perceptual attributes of voice: Development and use of rating scales. *Journal of Voice, 2*, 320–326.

Hao, Y. (2012). Second language acquisition of Mandarin Chinese tones by tonal and non-tonal language speakers. *Journal Of Phonetics, 40*(2), 269-279.

Krishnan, A., Swaminathan, J., & Gandour, J. T. (2009). Experience-dependent Enhancement of Linguistic Pitch Representation in the Brainstem Is Not Specific to a Speech Context. *Journal Of Cognitive Neuroscience, 21*(6), 1092-1105.

Marques C, Moreno S, Castro SL, Besson M. 2007. Musicians detect pitch violation in a foreign language better than non-musicians: behavioural and electrophysiological evidence. *J Cogn Neurosci. 19*, 1453–1463.

Perrachione, T. K., Pierrehumbert, J. B., & Wong, P. M. (2009). Differential neural contributions to native- and foreign-language talker identification. *Journal Of Experimental Psychology: Human Perception And Performance, 35*(6), 1950-1960.

Pfordresher, P. Q., Brown, S., (2009). Enhanced production and perception of musical pitch in tone language speakers. *Attention, Perception & Psychophysics, 71*, 1385-1398.

Wayland, R. P., & Guion, S. G. (2004). Training Chinese and Chinese listeners to perceive Thai tones: A preliminary report. *Language Learning, 54*(4), 681–712.

Wong, P. C. M., & Perrachione, T. K. (2007). Learning pitch patterns in lexical identification by native English-speaking adults. *Applied Psycholinguistics, 28*, 565–585.

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