General Language Ability Predicts Talker Identification

Xin Xie[1] and Emily Myers[1,2]

[1]*Department of Psychology;* [2] *Department of Speech, Language, and Hearing Sciences*

University of Connecticut

Language and Brain Lab

INTRODUCTION

LANGUAGE INFLUENCES TALKER IDENTIFICATION

➢**Language Familiarity Effect:** Talker identification is easier in one's native language than in unfamiliar languages [1, 2].

➢ Individuals vary widely in their ability to identify talkers even in the native language.

Q1. *How much* prior linguistic knowledge is required to promote the LFE ?

- Early bilingualism predicted faster voice learning in the L2 [3].
- ***A role of L2 proficiency?***

Q2. *What type* of linguistic knowledge drives the LFE?

- Knowledge of sound structures in one's native language helps [4, 5].
- ***A role of the ability to encode subtle phonetic detail?***
- ***Does lexical information facilitate the use of phonetic detail in talker ID?***

OVERARCHING HYPOTHESIS: Speech processing abilities (in L1 & L2) account for individual differences in talker ID and the *size* of LFE.

METHODS

EXPERIMENT 1

L2 proficiency → Talker ID in L2?

PARTICIPANTS

44 native-English listeners

39 native-Mandarin listeners (L2 English)

- Age of Acquisition: M = 10.33, SD = 2.73
- Age of Arrival: M = 22.00, SD = 4.23
- Musical training experience matched with English listeners

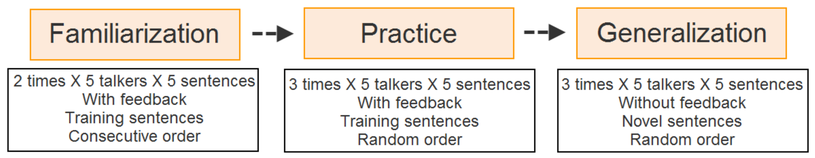
TASKS

SENTENCE-IN-NOISE TRANSCRIPTION TASK:

•3 BKB-R lists [6]: 16 simple English declarative sentences with 3 or 4 keywords each, resulting in a total of 50 keywords per list.

TALKER IDENTIFICATION TASK:

•Blocked by language condition: Mandarin, Spanish, or English; counterbalanced (5 native male speakers in each language condition)



EXPERIMENT 2

L1 phonetic perception → Talker ID in L1?

PARTICIPANTS

63 native-English listeners

TASKS

TALKER IDENTIFICATION TASK (see Exp 1):

•Blocked by Language Condition (English, Jabberwocky English, English)

- *Try angling the camera for a more interesting picture.* (English)
- *More in a tri- campic lingting turress angra the forture.* (JE)

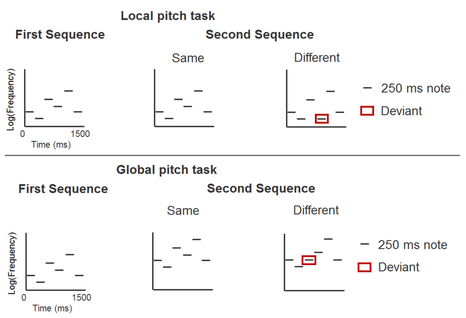
PITCH PERCEPTION TASK

•40 pairs of pure tone sequences (20 same, 20 different)

•Each sequence contained six pure tones

•Local pitch task: changes in *height*

•Global pitch task: changes in *contour*



PHONETIC PERCEPTION (consonant and vowel)

•Consonant: 9 tokens varying along a /da/-/ta/ continuum

2AFC: A "da" or a "ta"? 1 practice cycle, 12 test cycles

•Vowel: 7 tokens along the /ɛ/ - /æ/ continuum

2AFC:The vowel in "bed" or as in "bad"?

1 practice cycle, 12 test cycles

RESULTS

EXPERIMENT 1: L2 proficiency → Talker ID

Does L2 proficiency predict talker ID in L2 and the *size* of LFE between L1, L2 and other unfamiliar languages?

➢**Talker ID in L1 was enhanced, but better language abilities in a L2 did not minimize the size of the LFE (L1-L2) (Fig.1):**

2 *Listener group* × 3 *Language condition* ANCOVA with years of musical training as a covariate.

➢Listener group × language condition interaction ($p < .001$).

➢No difference between non-native languages ($ps > .10$).

➢ **L2 proficiency correlated with talker ID performance across all language conditions (Table 1).**

➢ No correlation between L2 proficiency and the *size* of LFE (LFE-English: $r = .11$, $p = 0.52$; LFE-Spanish: $r = -.05$, $p = 0.76$).

➢Correlations between talker ID across language conditions disappeared after controlling for L2 proficiency.

- Late L2 language experience did not enhance L2 talker ID, relative to that in unfamiliar languages.
- A *general* talker learning ability was related to L2 proficiency.

Fig.1 Talker identification as a function of language experience

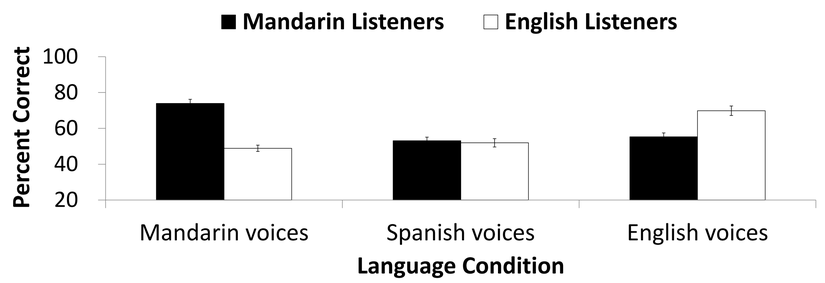


Table 1. Performance of Mandarin listeners: The matrix of partial correlations (controlling for musical experience) between L2 English proficiency and talker ID.

Language condition	Mandarin	Spanish	English
Mandarin	1		
Spanish	0.35*	1	
English	0.36*	0.36*	1
L2 proficiency	0.45**	0.59**	0.34*

EXPERIMENT 2: L1 phonetic perception → Talker ID

Do L1 phonetic perception skills predict talker ID in L1 and the *size* of LFE between L1 and unfamiliar languages?

➢**Phonetic perception and pitch perception independently contributed to talker ID (Table 3).**

➢**Pitch perception was correlated with talker ID in an unfamiliar language only, not with native language conditions.**

➢ LFE was not attributable to individual differences in *nonlinguistic* auditory processing ability, at least not pitch processing skills.

➢**Phonetic perception measures (independent of pitch processing skills) positively correlated with talker identification accuracy across all language conditions (*ps* < .05).**

Does lexical information provide an *additional* benefit in using phonetic detail in talker ID in L1?

➢**LFE was observed for L1 and was enhanced by lexical information (Table 2).**

➢Talker ID in English and JE conditions > Mandarin ($ps < .001$)

➢Talker ID in English condition > JE condition ($p < .001$)

- Native phonetic perception skills were correlated with talker ID in a *language-general* manner, independent of *nonlinguistic pitch* processing skills.
- Talker ID was better in the presence of lexical information.

Table 2. Descriptive statistics for all individual differences measures.

	Measure	Mean	SD	Min	Max
Talker identification	Mandarin	0.48	0.15	0.17	0.85
	JE	0.62	0.19	0.15	0.97
	English	0.71	0.13	0.41	0.93
Auditory	Pitch	-0.01	0.22	-0.49	0.42
Phonetic	Vowel	6.3	2.23	0.10	9.19
	Consonant	7.49	1.77	1.45	9.19

Table 3. The correlation matrix for measures on talker ID, pitch sensitivity and phonetic perception.

	Mandarin	JE	English	Pitch	Vowel	Consonant
Mandarin	**1**					
JE	0.52**	**1**				
English	0.39**	0.49**	**1**			
Pitch	0.32**	0.23	0.13	1		
Vowel	0.52**	0.41**	0.31**	0.16	**1**	
Consonant	0.38**	0.26*	0.29*	0.18	0.50**	**1**

Note: Phonetic measures reflect the slope of the categorization curve. The higher the score, the better separation between tokens of the two phonemes. *$p < .05$; ** $p < .01$.

DISCUSSION

A *language-general* capacity underlies individual variation in talker identification skills.

➢ Previous studies have shown a categorical effect of native language benefit [1] and a gradient effect of early bilingualism [3] in talker identification.

➢ We replicated the LFE effects in native listeners, but found no sign of LFE in late bilinguals.

- Mandarin listeners were equal in identifying Spanish and English speakers; L2 English proficiency did not predict the *size* of LFE (L1-L2).

➢ The linguistic knowledge of a *specific* language, either L2 (Experiment 1) or L1 (Experiment 2), did not explain how well a listener can identify speakers of that particular language, compared to the baseline talker identification accuracy in an entirely unfamiliar language.

➢ Performance assessing language abilities (either native or nonnative) correlated with talker identification across all language conditions.

❖ **A *language-general* aptitude may exert a major influence on talker identification, regardless of the language being spoken.**

Lexical-to-phonetic feedback potentially facilitates talker identification in one's native language.

➢ Language comprehension contributed to LFE (cf. [5]).

- English listeners were more accurate identifying talkers in normal English than Jabberwocky English, and more accurate in Jabberwocky English than Mandarin. Lexical information enhanced native talker identification.

❖ **Top-down cues from the lexicon may strengthen acoustic-phonetic cues associated with the talker .**

❑ **Together, sensitivity to acoustic-phonetic detail is a good candidate for this *language-general* capacity, which may be transferrable across languages, but also can be promoted by feedback from higher levels of linguistic structure in one's native language.**

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