Talker identification is not improved by lexical access in the absence of familiar phonology

Deirdre McLaughlin, Cecilia Cheng, Emily Thurston, Sara Dougherty & Tyler Perrachione

Department of Speech, Language, & Hearing Sciences, Boston University

BOSTON UNIVERSITY

Summary

- Listeners identify talkers more accurately when they are familiar with both the **sounds** and **words** of a language.
  Goggin et al., 1991; Perrachione & Wong, 2007; Perrachione et al., 2011; Fleming et al., 2014; Orena et al., 2015; Perrachione et al., 2015; McLaughlin et al., 2015

- It is unknown whether **lexical access alone** can facilitate talker identification in the **absence of familiar phonology**.

- In two experiments, listeners learned to identify talkers in three conditions: listeners' native language (English), an unfamiliar, foreign language (Mandarin), and a foreign language paired with subtitles that primed native language lexical access (subtitled Mandarin).

- Talkers in the foreign language were identified no better when native language lexical representations were primed (subtitled Mandarin) than from foreign-language speech alone, regardless of whether listeners had received one or three days of talker identity training.

- In a third experiment, listeners learned to identify talkers in four conditions: Native English speech, English speech with a light Mandarin accent, English speech with a strong Mandarin Accent, and Mandarin speech.

- Listeners' performance decreased as the degree of foreign accent, and thereby foreign phonology, increased.

- Taken together, the results of these three experiments suggest that the facilitatory effect of lexical access in talker identification depends on the availability of familiar phonological forms.
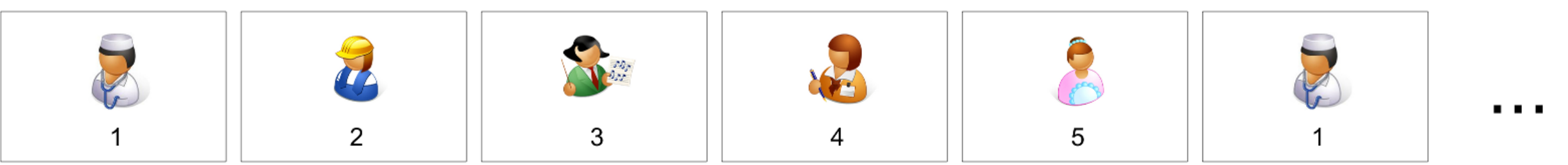
General Methods

Talker Identification Training & Testing

In each condition, listeners learned to identify 5 talkers by the sound of their voice, matching each talker to a unique avatar. Training entailed 5 alternating blocks of passive listening (10 trials each) and of active practice with corrective feedback (10 trials each). Talker identification ability was assessed by a test (50 trials) without feedback.
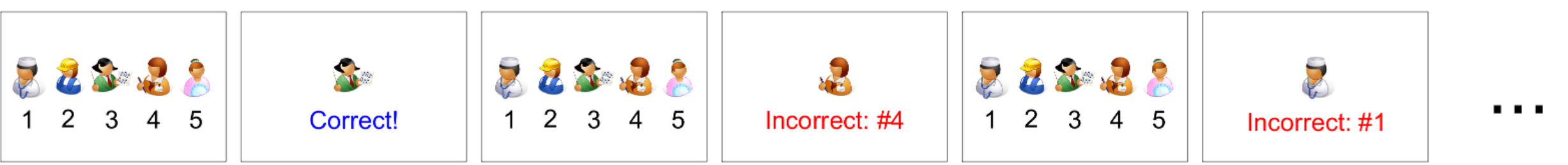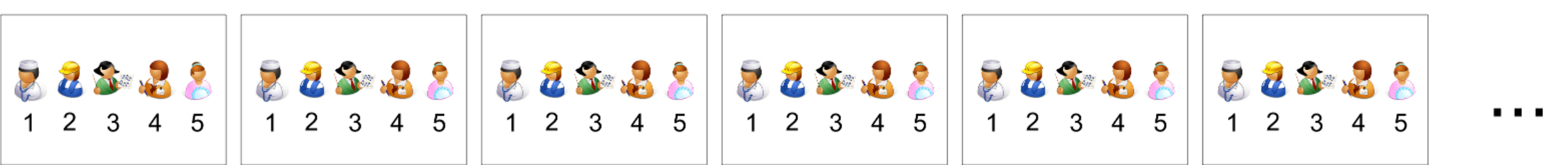
A. Task design

| Listen | Practice | Listen | Practice | Listen | Practice | Listen | Practice | Test |

B. Passive listening (10 trials per block)
1 2 3 4 5 1 ...

C. Practice with feedback (10 trials per block)
1 2 3 4 5 *Correct!* 1 2 3 4 5 *Incorrect: #4* 1 2 3 4 5 *Incorrect: #1* ...

D. Test without feedback (50 trials total)
1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 ...

Experiment 1

Methods:

Participants:
Native English-speaking listeners (N=16).

Stimuli:
20 English-Mandarin Hybrid Sentences recorded by native Mandarin (N=10) and native English (N=10) speakers.

Procedure:
Participants learned 5 voices in each of 4 conditions in a 2×2 factorial design:
(i) English; (ii) English with priming; (iii) Mandarin; (iv) Mandarin with priming.

Priming:
In the Mandarin with priming condition, English subtitles primed listeners to expect accented English speech.

English-Mandarin Hybrid Sentences

Mandarin	English Gloss
陪你晚到了 pʰeɪ ni wan taʊ lə péi nǐ wǎn dào le	"Pay me one dollar" pʰeɪ mi wʌn dɑlə
喂狗吃烤荔枝 weɪ koʊ tʂhi kʰaʊ li tʂi wèi gǒu chī kǎo lì zhī	"We go to college" wi goʊ tʰu kɑlədʒ
妈妈喜欢芒果 ma ma ɕi xan maʊ tʂi mā mā xǐ huān mào zi	"Mama sees one mouse" mamə siz wʌn maʊs

Results:

More accurate in native language
$F_{1,15} = 250.66$, $p \ll 0.001$, $\eta^2_G = 0.57$

No main effect of lexical priming
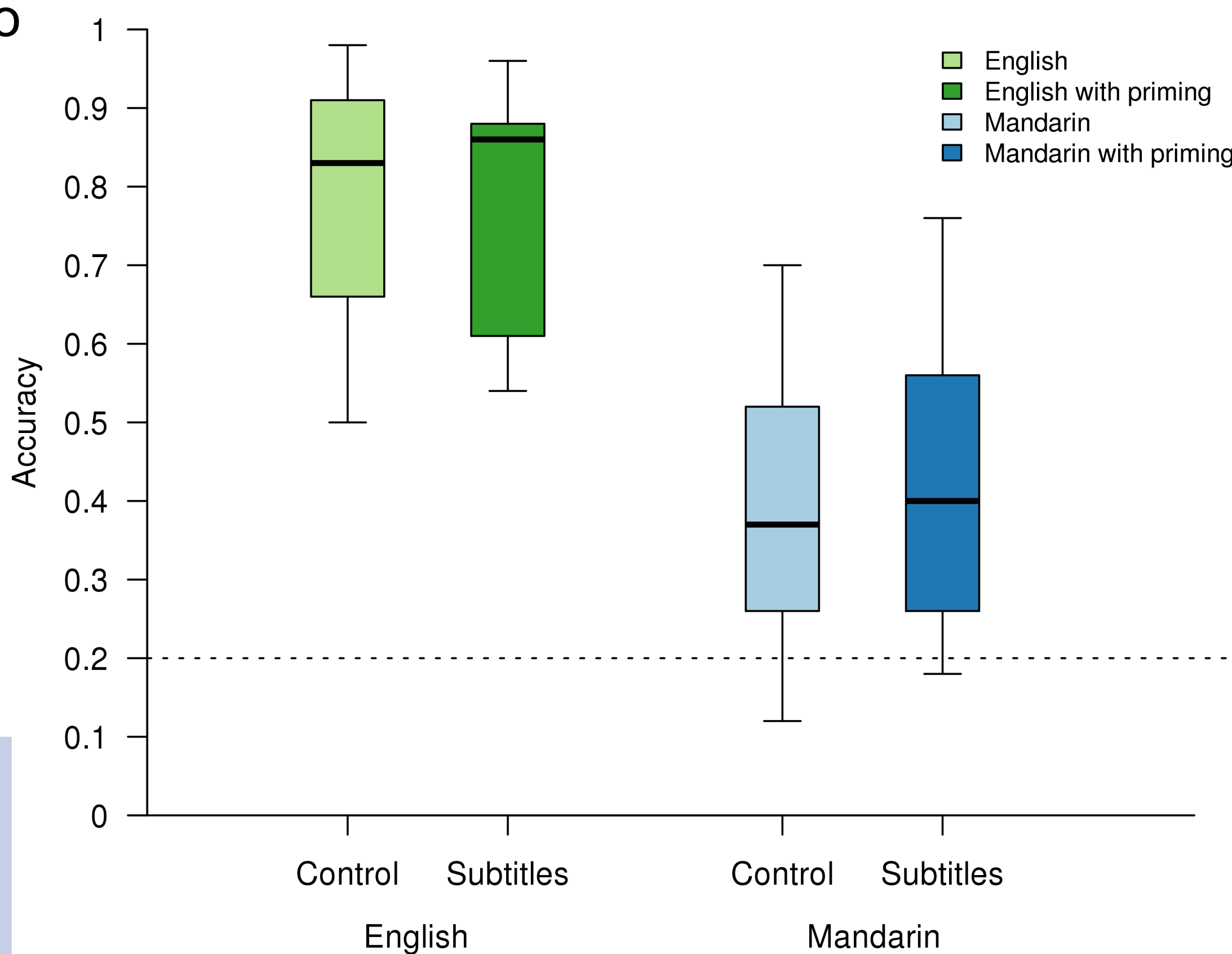$F_{1,15} = 0.32$, $p = 0.58$, $\eta^2_G = 0.0035$

No language × priming interaction
$F_{1,15} = 0.81$, $p = 0.38$, $\eta^2_G = 0.0035$

Lexical access does not appear to facilitate talker identification in the absence of familiar phonology.

Experiment 1 — boxplot of Accuracy for English (Control, Subtitles) and Mandarin (Control, Subtitles). Legend: English, English with priming, Mandarin, Mandarin with priming.

Experiment 2

Methods:

Participants:
Native English-speaking listeners (N=16).

Stimuli:
Native Mandarin speakers (N=10) reading English-Mandarin Hybrid sentences and Mandarin sentences (Fu et al., 2011)
Native English speakers (N=5) reading length-matched sentences (McLaughlin et al., 2015)
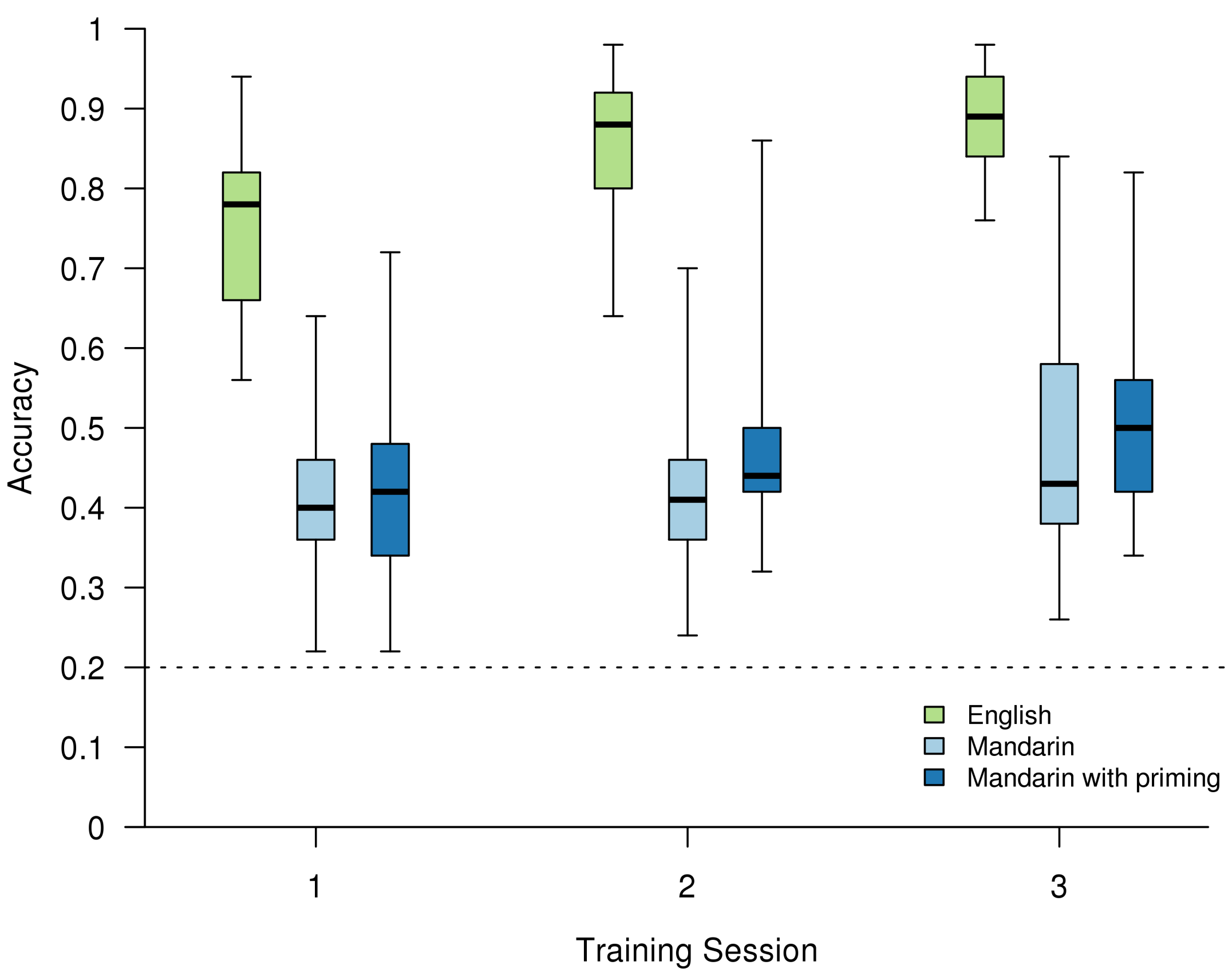
Procedure:
Participants learned 5 voices in each of 3 conditions over 3 days: (i) English; (ii) Mandarin; (iii) Mandarin with priming.

Priming:
In the Mandarin with priming condition, English subtitles primed listeners to expect accented English speech.

Results:

Priming in Mandarin:
Significant effect of training day
$F_{1,17} = 19.29$, $p < 0.0005$, $\eta^2_G = 0.12$

No effect for priming in Mandarin
$F_{1,17} = 0.95$, $p = 0.34$, $\eta^2_G = 0.04$

Familiar vs. Unfamiliar Sentences:
Significant effect of familiarity
$F_{1,17} = 18.47$, $p < 0.0005$, $\eta^2_G = 0.09$

No condition × familiarity interaction
$F_{1,17} = 1.08$, $p = 0.31$, $\eta^2_G = 0.009$

Even with additional training, listeners do not appear to take advantage of lexical knowledge during talker identification with an unfamiliar phonology.

Experiment 2 — boxplot of Accuracy across Training Sessions 1, 2, 3. Legend: English, Mandarin, Mandarin with priming.

Experiment 3

Accentedness Ratings:
Native English listeners (N=12) heard all pairs of native Mandarin speakers (N=21) reading matched Harvard sentences (210 trials) and indicated the more accented talker. Talkers were ordered by overall accentedness rank
(Thurstone, 1927; Meltzner & Hillman, 2005)

Methods:

Participants:
Native English-speaking listeners (N=8).

Stimuli & Procedure:
Listeners learned 5 voices in 4 conditions:
(i) English L1,
(ii) Low Accent English L2 / Mandarin L1,
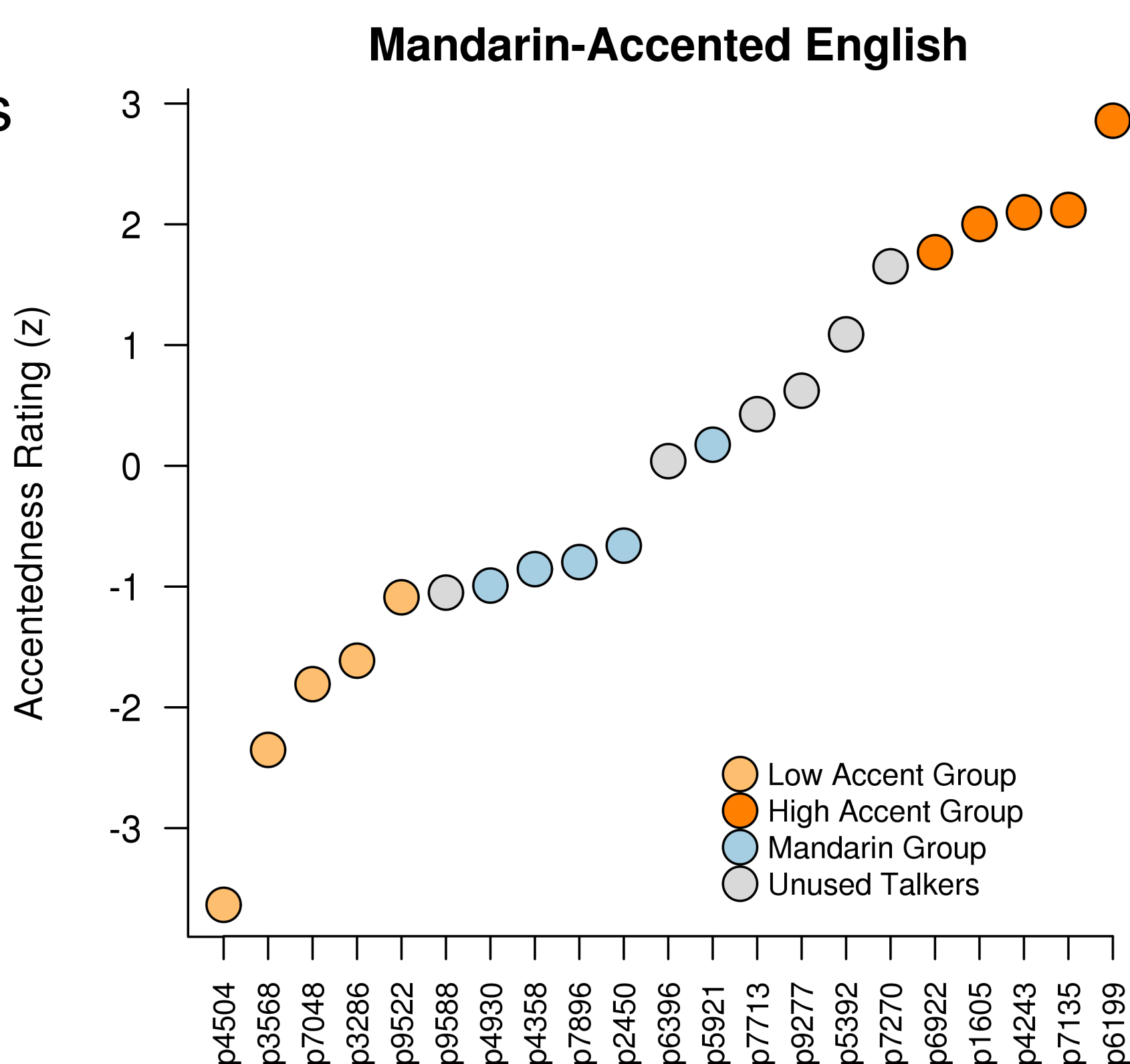(iii) High Accent English L2 / Mandarin L1,
(iv) Mandarin L1

Preliminary Results:
Low-Accented talkers identified better than High-Accented ones
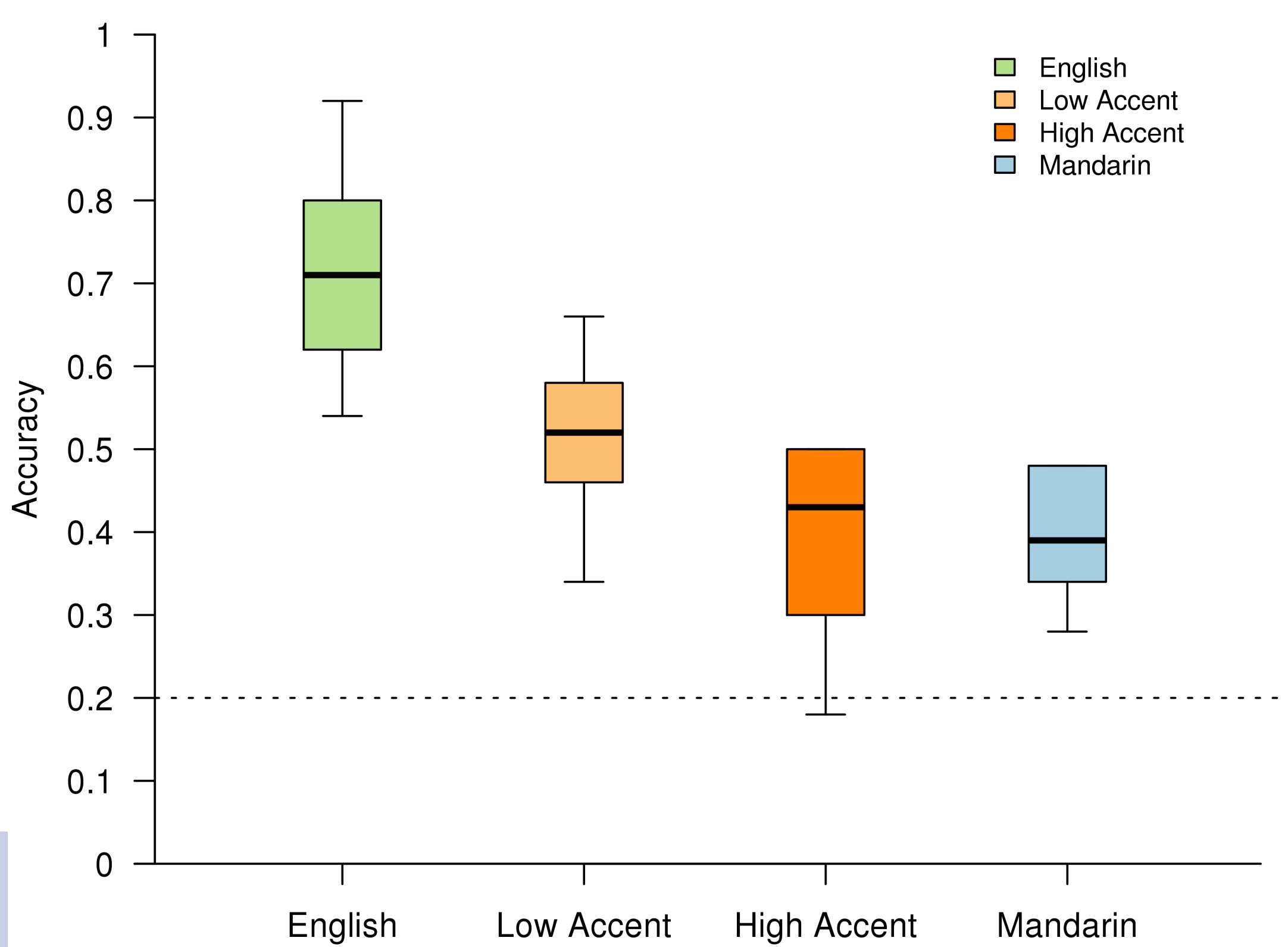$t_7 = 3.41$, $p < 0.02$, Cohen's $d = 1.20$

High-Accented talkers identified no better than those in Mandarin
$t_7 = 0.13$, $p = 0.90$, $d = 0.05$

Low-Accented talkers identified less accurately than native English
$t_7 = 6.89$, $p < 0.0005$, $d = 1.83$

Phonological similitude appears to facilitate talker identification.

Mandarin-Accented English — Accentedness Rating (z) across talkers. Legend: Low Accent Group, High Accent Group, Mandarin Group, Unused Talkers.

Experiment 3 — boxplot of Accuracy for English, Low Accent, High Accent, Mandarin. Legend: English, Low Accent, High Accent, Mandarin.

References

Flemming et al. (2014). *PNAS, 111, 13795-13798.*
Fu, Zhu, & Wang (2011). *JASA, 129, 267-273.*
Goggin et al. (1991). *Mem. & Cog., 19, 448-458.*
IEEE (1969). *IEEE T. Acoust. Speech, 17, 225-246.*
McLaughlin et al. (2015) *ICPhS XVIII*
Meltzner & Hillman (2005) JSLHR, 48, 766-779.
Orena et al. (2015). *Cognition, 143, 36-40.*
Perrachione & Wong (2007) *Neuropsychologia, 45.*
Perrachione et al. (2011). *Science, 333, 595.*
Perrachione et al. (2015) *ICPhS XVIII*
Thurstone (1927). *Psych. Rev., 34, 273-286.*

Acknowledgments

Communication Neuroscience Research Laboratory