

# Attention versus adaptation in processing talker variability in speech

Sung-Joo Lim, Jessica A. A. Tin, Allen Qu & Tyler K. Perrachione

Department of Speech, Language & Hearing Sciences, Boston University

BOSTON UNIVERSITY

## Introduction

- Listeners are slower and less accurate at recognizing speech spoken by multiple talkers compared to one consistent talker [1,2].
- Two potential explanations for the impact of talker variability:
  - **Benefit from adaptation:** Listeners become perceptually adapted to speech characteristics of a talker (i.e., talker adaptation), which facilitates rapid speech recognition of the talker's speech [3,4].
  - **Disruption from discontinuity:** Abrupt discontinuity in acoustic stimulus features disrupts attentional focus during speech processing [5,6].
- **Research Questions:**
  - Does a longer duration of exposure to one continuous talker lead to faster recognition of speech spoken by the same talker?
  - Does a longer duration of exposure to one continuous talker lead to greater interference in recognizing speech when a new talker is encountered?

## Methods

### Participants

- Native English young adults with normal hearing (age: 18–33 years)
- Experiment 1 (N=23) & Experiment 2 (N=28)

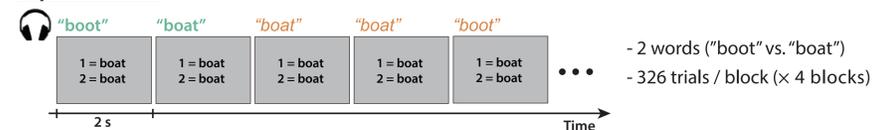
### Stimuli

- Naturally-spoken CVC words ("boot", "boat", "bet", "bat"), recorded by four native American-English talkers (2 female; 2 male)
- RMS matched in amplitude (65 dB SPL)

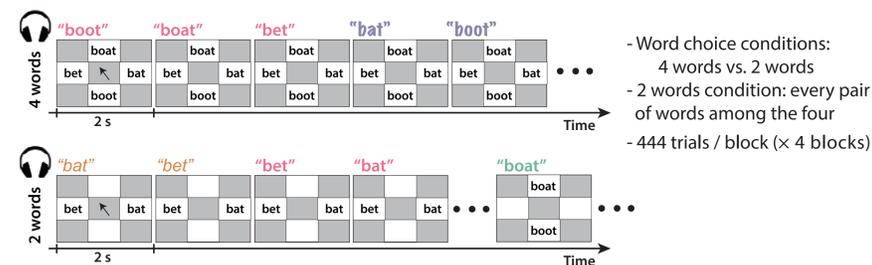
### Task design & procedure

- Speeded word identification task; 2 s inter-trial interval; no feedback
- Variation in the number of trials presenting words spoken by a single talker: spans of 2–7 consecutive trials prior to the talker switch
- Equal transition probabilities between words, across talkers, span lengths

### Experiment 1



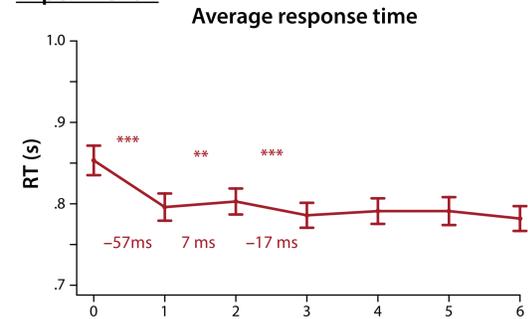
### Experiment 2



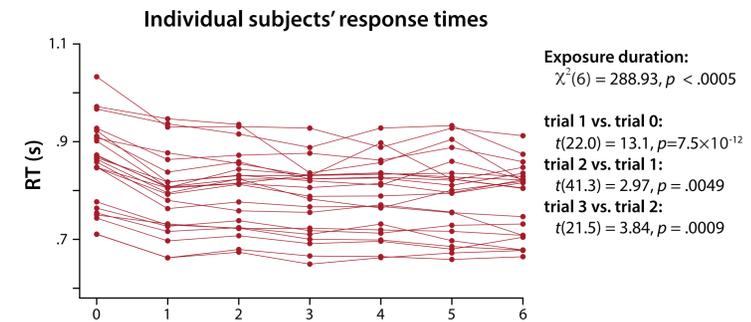
### Data analysis

- Word identification speed: log-transformed response time of correct trials
- Linear mixed-effects modeling analyses (lme4 in R v3.3.3)
  - (1) The effect of repeated encounters of a talker on the word identification of the talker
  - (2) The effect of the duration of exposure to a preceding talker on the subsequent word identification when the talker switched

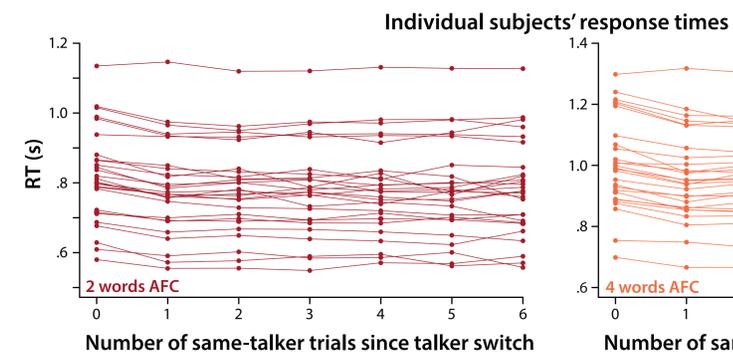
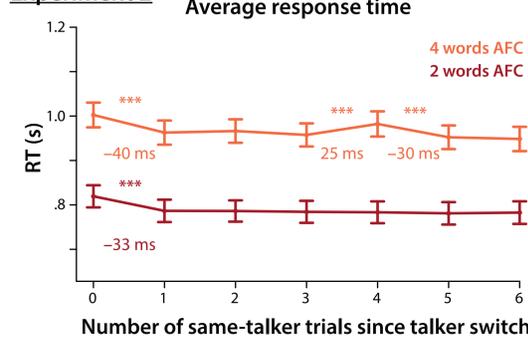
### Experiment 1



## Effect of repeating encounters of a talker



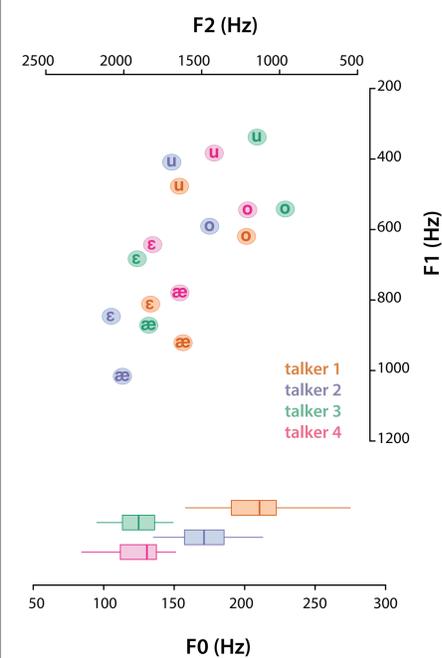
### Experiment 2



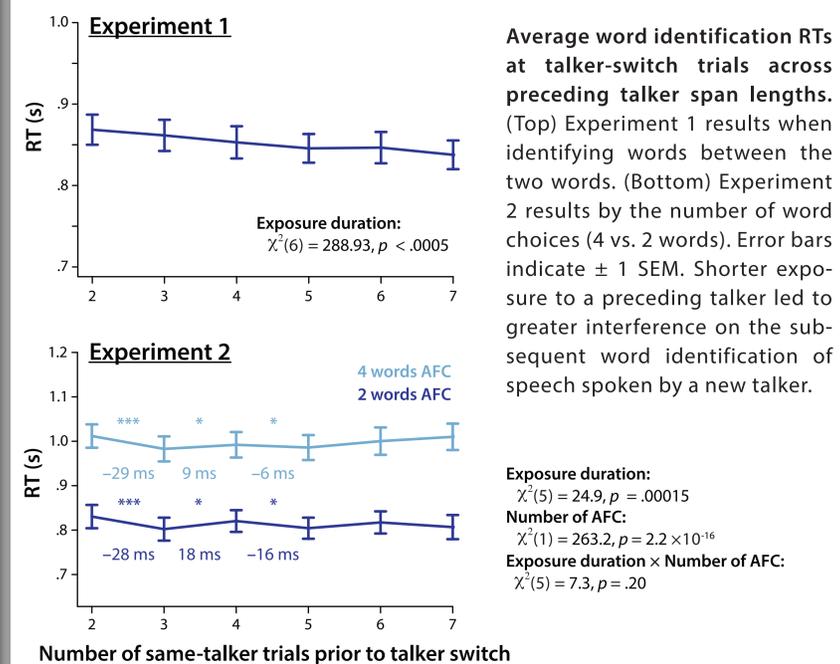
Listeners' word identification RTs for repeated exposure to one continuous talker from the first encounter with the talker. (Top) Average and individuals' RTs in Experiment 1. (Bottom) Average and individuals' RTs by the number of possible word choices (4 vs. 2 words) in Experiment 2. Error bars indicate  $\pm 1$  SEM.

A single repeated exposure to a talker after a talker switch led to significantly faster identification of a subsequent word spoken by the same talker. But additional exposure to the same talker did not lead to faster RTs.

## Stimulus variability



## Effect of exposure to a preceding talker



## Discussion

- A single exposure to a talker facilitated speech processing. However, longer exposure to the same talker did not lead to additional facilitation.
- Identification of a word spoken by a new talker was not further disrupted by longer exposure to a preceding talker. Rather, more frequent switches in talkers interfered with subsequent word identification.
- Our findings are inconsistent with the idea that speech processing is facilitated by adaptation to a talker's speech over time.
- Our results suggest that there is a cost of interference from processing the change to a new talker's speech.
- Discontinuity in talkers can interfere with speech processing by disrupting listeners' attentional focus in forming a coherent auditory stream [5–8].

## References

- [1] Nusbaum, HC & Magnuson, JS (1997). *Talker variability in speech processing*, pp.109–132.
- [2] Choi, JY, Hu, ER, & Perrachione, TK (2017). *Atten Percept Psycho*, 80: 784–797.
- [3] Johnson, K (1990). *J Acoust Soc Am*, 88: 642–654.
- [4] Kleinschmidt, DF & Jaeger, TF (2015). *Psychol Rev*, 122: 148–203.
- [5] Best, V et al. (2008). *PNAS*, 105:13174–13178.
- [6] Bressler, S, et al. (2014). *Psychol Res*, 78:349–360.
- [7] Shinn-Cunningham, BG (2008). *Trends Cogn Sci*, 12(5): 182–186.
- [8] Lim, S-J, Shinn-Cunningham, BG, Perrachione, TK (in press). *Atten Percept Psycho*

This work was supported by grants from the NIH (R03DC014045), Brain and Behavior Research Foundation NARSAD Young Investigator grant to TKP and from the NIH (T32DC013017) to SJL.

sungjoo@bu.edu; tkp@bu.edu