



Effect of different spatialization methods on auditory spatial attention

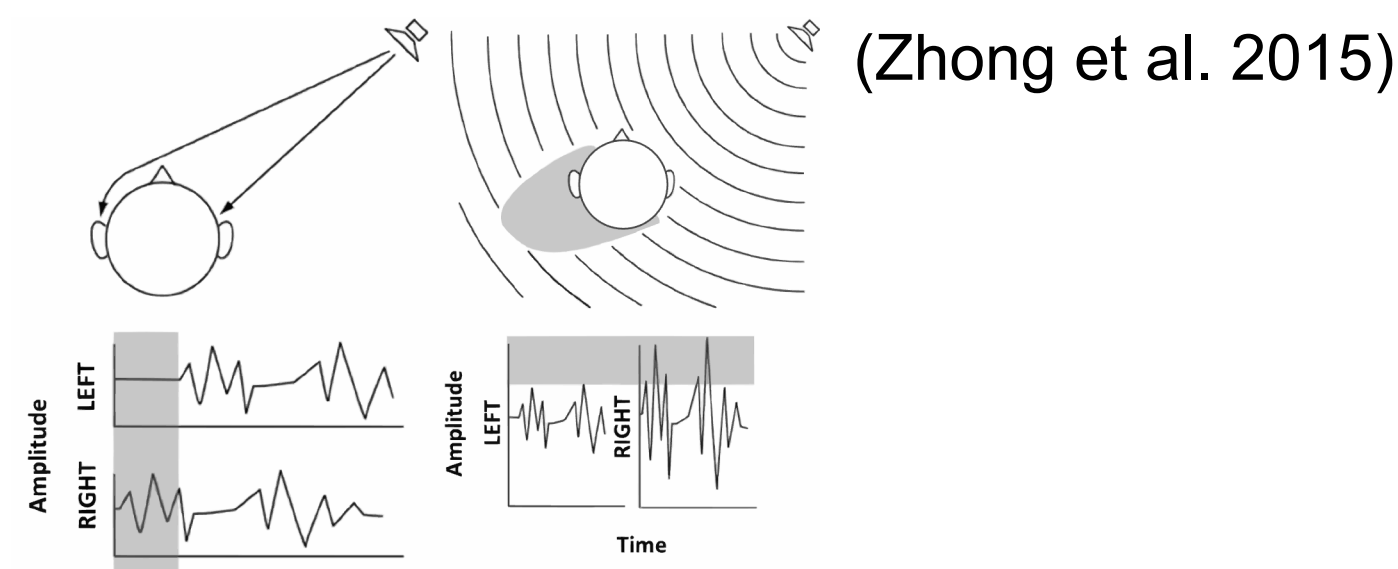
Wusheng Liang¹, Christopher Brown², Barbara G. Shinn-Cunningham¹

¹Carnegie Mellon University, ²University of Pittsburgh

Contact information: wushengl@andrew.cmu.edu

INTRODUCTION

- Impoverished spatial cues (i.e., ILD and ITD spatialized cues) produced weaker neural signatures of attention, even though behavioral differences were negligible. (Deng et al. 2019)
- Compare methods for spatializing stimuli
 - Head-related transfer functions (HRTFs)
 - Interaural level differences (ILDs)
 - Interaural time differences (ITDs)



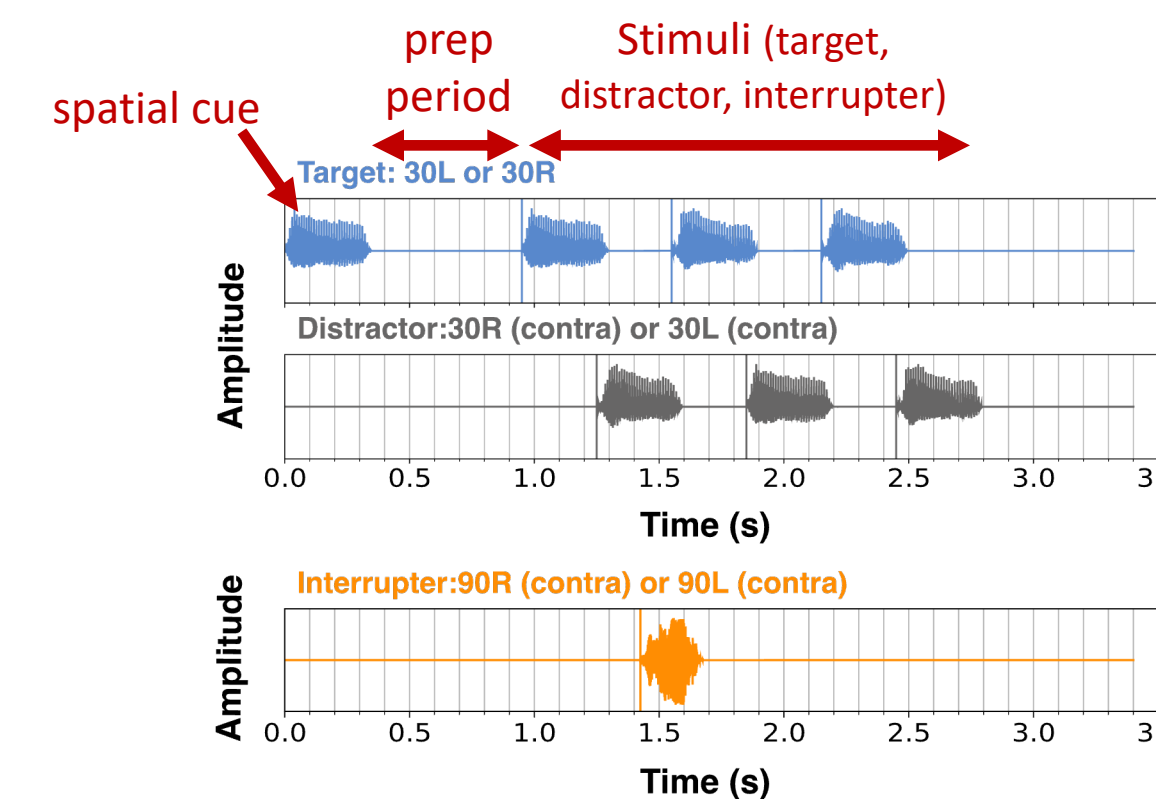
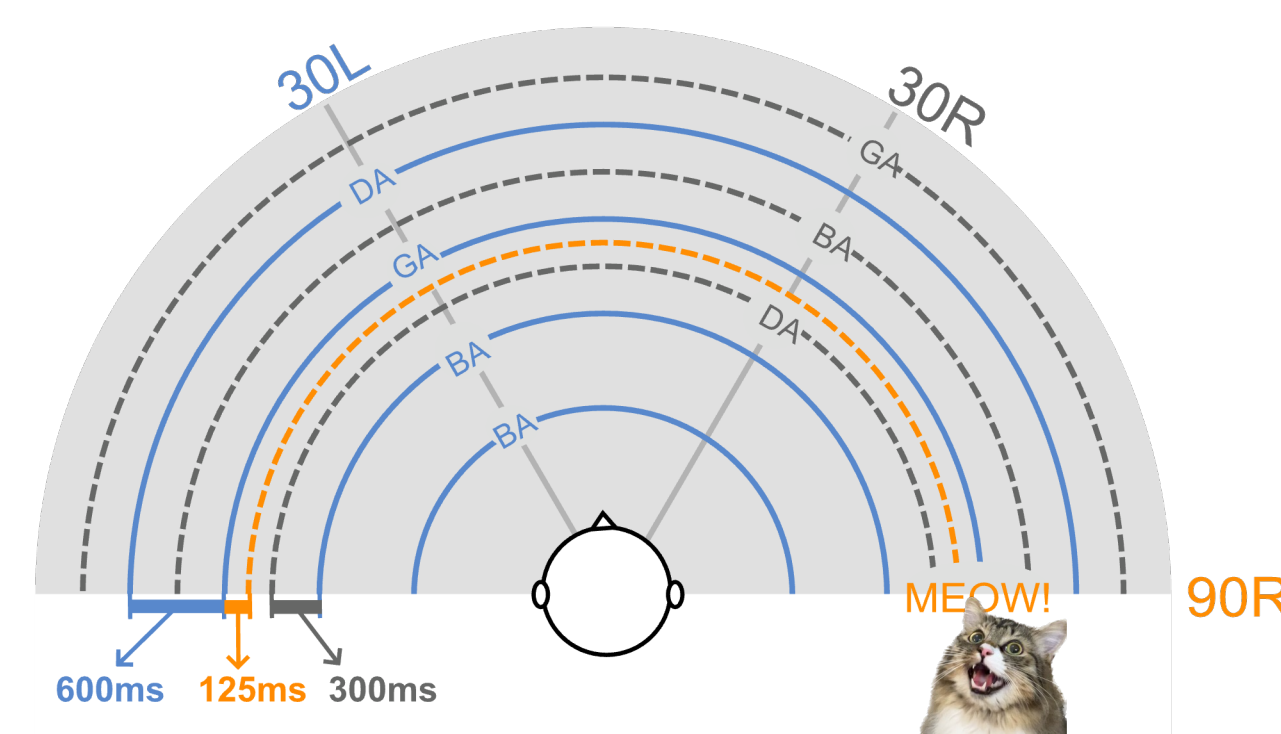
- During a spatial selective attention task, will a bottom-up interrupter be more disruptive with unnatural spatial cues?

METHODS

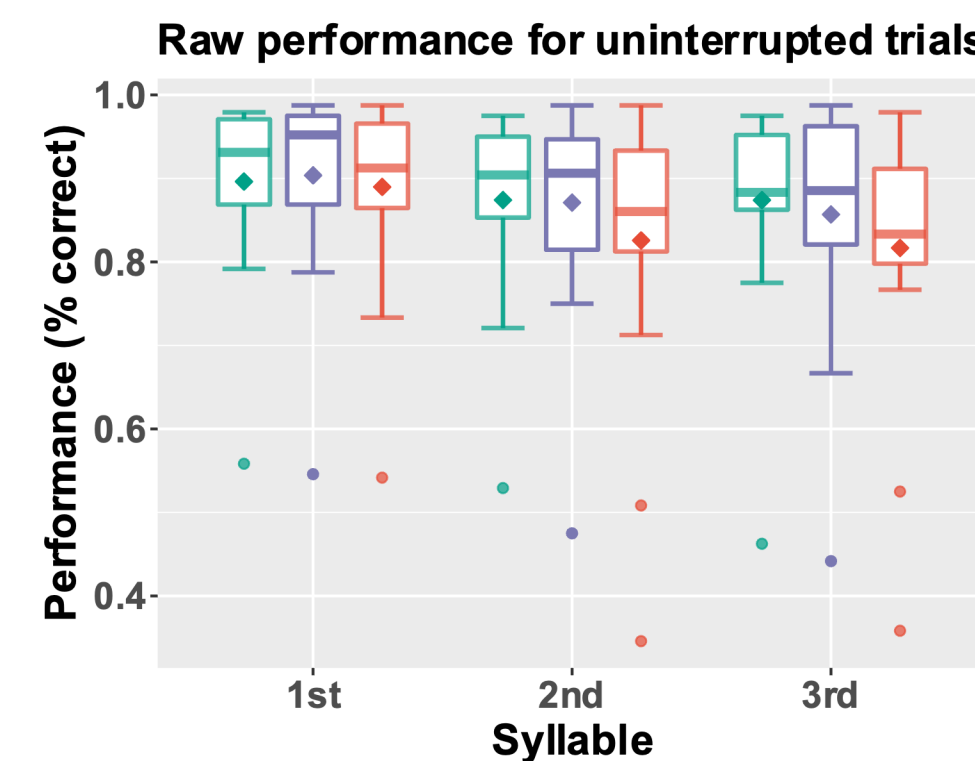
- 18 subjects
- Task: spatial attention with interrupters
 - 3 target syllables from target direction
 - 3 distractor syllables from contralateral hemisphere
 - 25% of trials had interrupter (MEOW!!) after 1st and before 2nd target syllable, 90° contralateral to target
- Stimuli spatialized using
 - Individualized Head-Related Transfer Functions Measured for individuals in anechoic chamber
 - Frequency-specific ILDs minimum-phase representation of individual HRTF
 - Frequency-specific ITD all-pass representation of individual HRTF
- EEG recorded with 32 channel BioSemi system
 - Extracted event-related potential N1 component evoked by interrupter
 - Calculate attentional modulation index (AMI) from parietal alpha power: attend left – attend right

ITD cues produce worse behavioral performance and less lateralized alpha power during spatial selective attention.

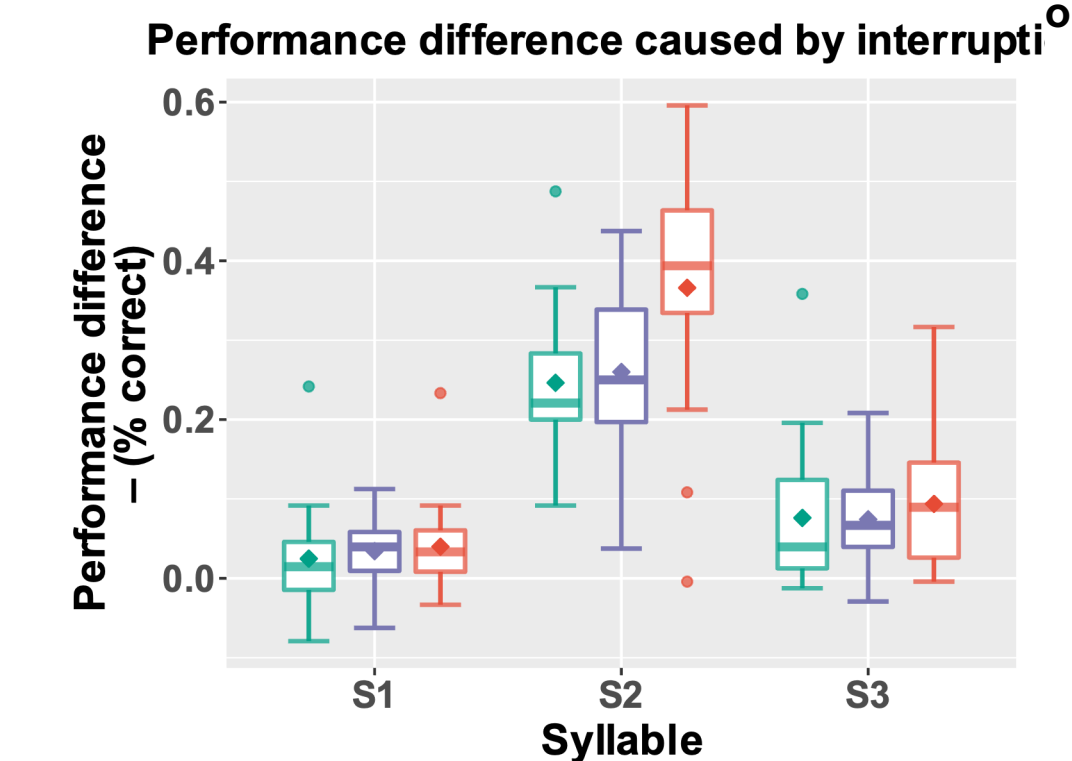
Stimulus timing and spatial configuration



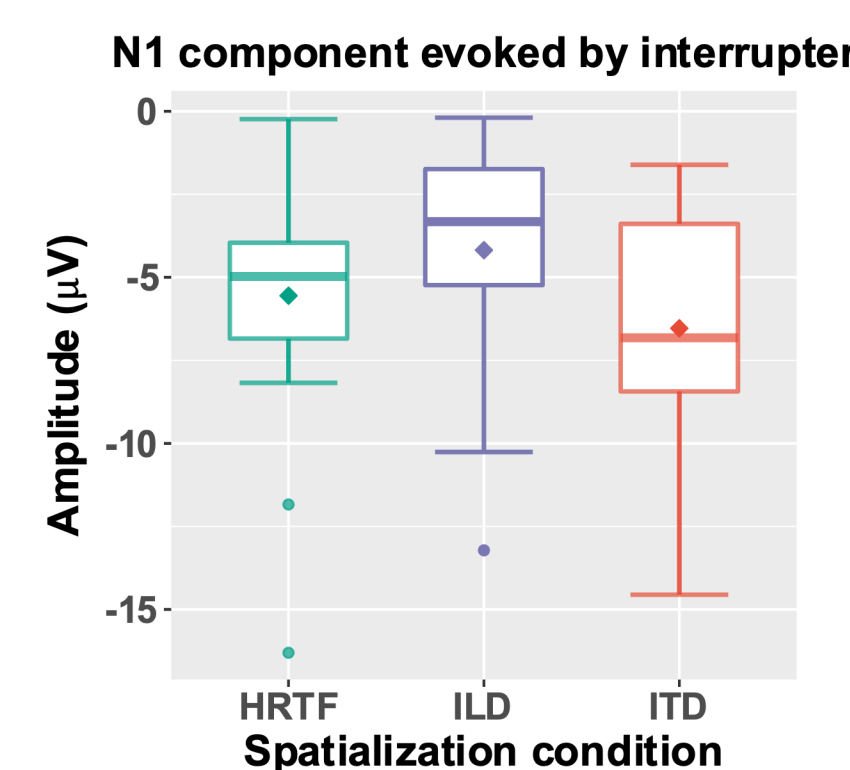
Overall, recall for uninterrupted trials was worse for ITD stimuli



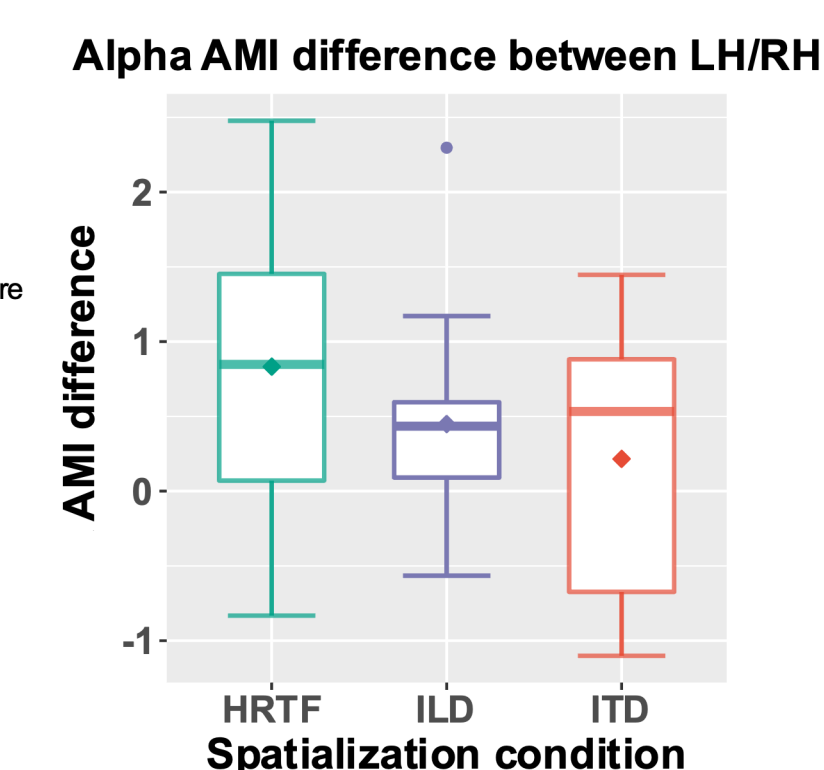
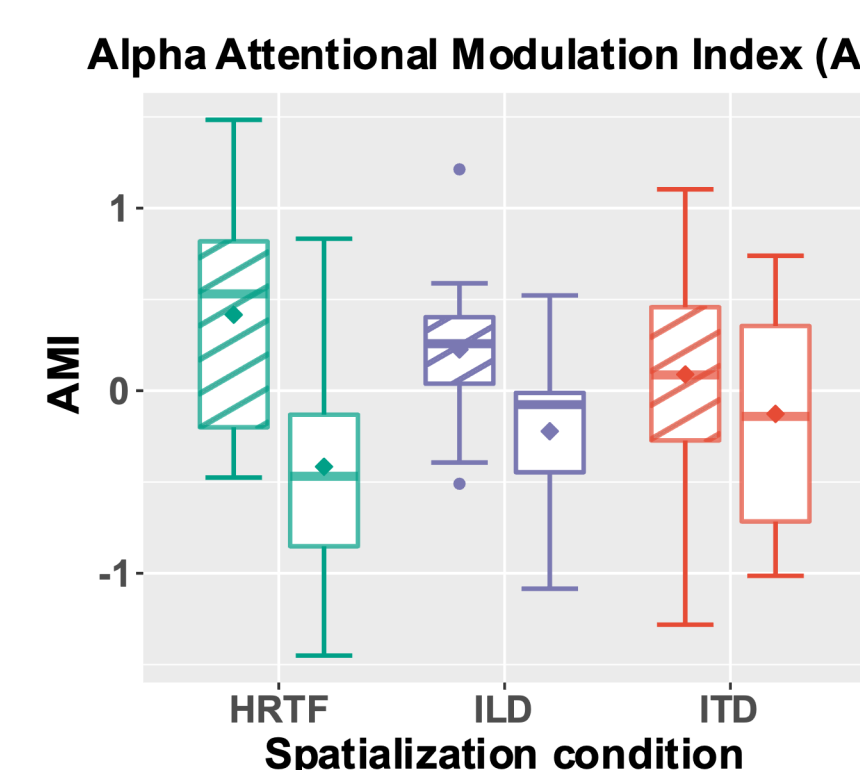
The interrupter had a larger effect on syllable recall with ITD stimuli



The interrupter evoked a larger N1 response for ITD than ILD stimuli



In prep period, ITD stimuli produced no significant parietal alpha lateralization (spatial attention signature)



RESULTS

- The degradation in syllable recall performance due to the interrupter differed with spatialization condition (repeated-measure 2-way ANOVA, $p=0.002$).
- The interrupter N1 amplitude (EEG) differed with spatialization condition (repeated-measure 1-way ANOVA, $p<0.001$)
 - Interrupter N1 was smaller for ILD than ITD spatialization (post hoc pairwise t-tests, $p<0.001$).
- Parietal alpha was significantly lateralized for HRTF and ILD, but not ITD spatialization (Bonferroni-corrected t-tests on AMI difference between LH and RH channels, $p=0.003$, $p=0.015$, and $p=0.45$, respectively).

DISCUSSION

- People are more likely to be disrupted during a selective attention task with ITD spatialized stimuli than with realistic HRTF or ILD spatialized stimuli.
- N1 amplitude may index the amount of auditory information let through (Teder-Sälejärvi et al, 1999). The interrupter evoked a large N1 with ITD cues, consistent with a failure to suppress irrelevant information and in line with behavioral results.
- Alpha power lateralization, a signature of top-down spatial attention (Deng et al. 2019, Wöstmann et al. 2016), is weak for ITD and strongest for HRTF spatialization, supporting the view that realistic cues produce better control of spatial selective attention.

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