



Age-related deficits in alpha-band modulation during probabilistic cueing of visual spatial attention

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Introduction

- The modulation of alpha (8–13 Hz) band oscillations has become a canonical marker of visual spatial attention [2].
- Previous studies have demonstrated age-related deficits in alpha modulation during visual spatial attention [3].
- However, it remains unexplored that to what extent the deficits in alpha lateralization was related to behavioral effects in visual spatial attention.
- Here we tried to investigate the effects of normal aging on alpha lateralization and its relationship with behavioral effects during visual spatial attention.

Methods

Paradigm

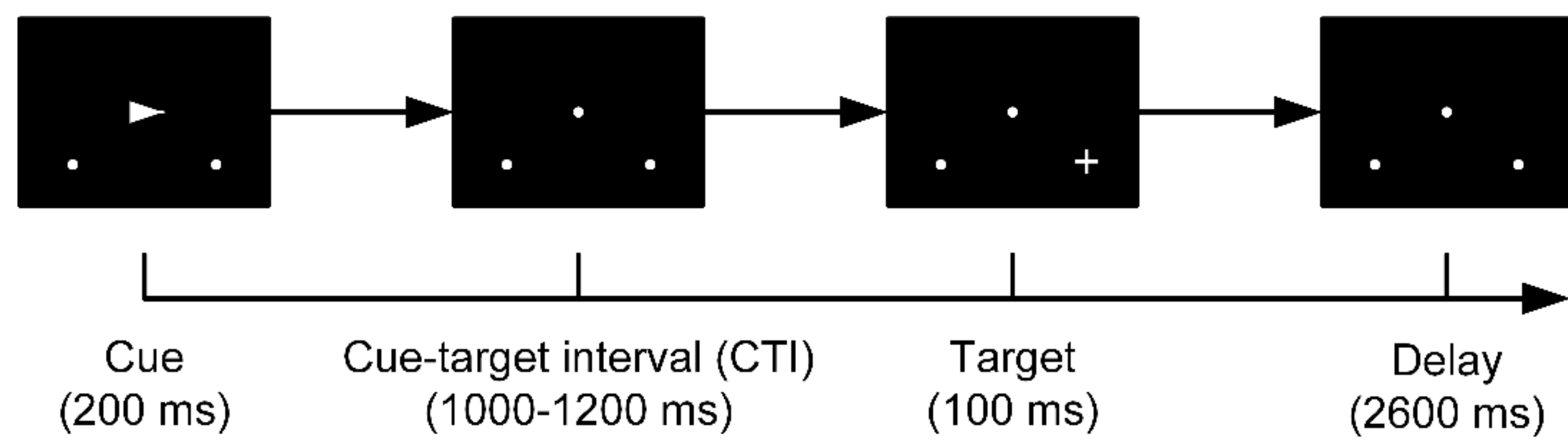
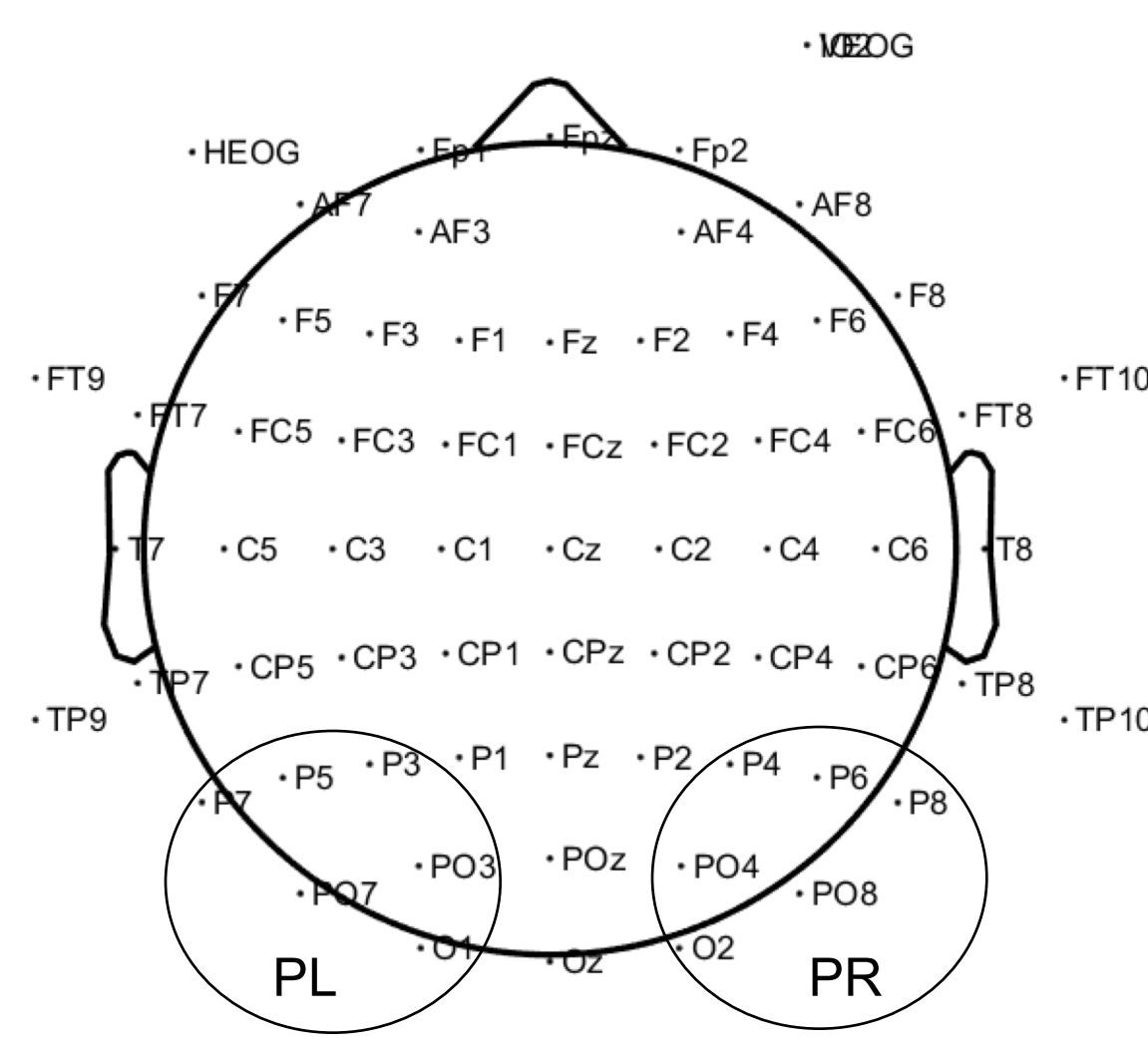


Figure 1. The spatial attention task with probabilistic cueing (~74% valid). Each subject was required to covertly orient attention to either the left or the right visual location via a cue, and make a button response as accurately and quickly as possible when the target presented later was a plus sign (50% probability) in both attended and unattended visual field.

Data Acquisition and Analyses

- 24 healthy young subjects
- 30 healthy older subjects
- 64-channel scalp EEG recording
- EEG preprocessing in MATLAB
- Two posterior ROIs
 - PL:** P3, P5, P7, PO3, PO7, O1;
 - PR:** P4, P6, P8, PO4, PO8, O2.
- Cue-related alpha power were calculated by averaging averaged across the 6 electrodes within each ROI (PL, PR).
- Sensory facilitation resulted from visual spatial attention was indexed by examining the N1 time-locked to visual targets within two ROIs.



Results

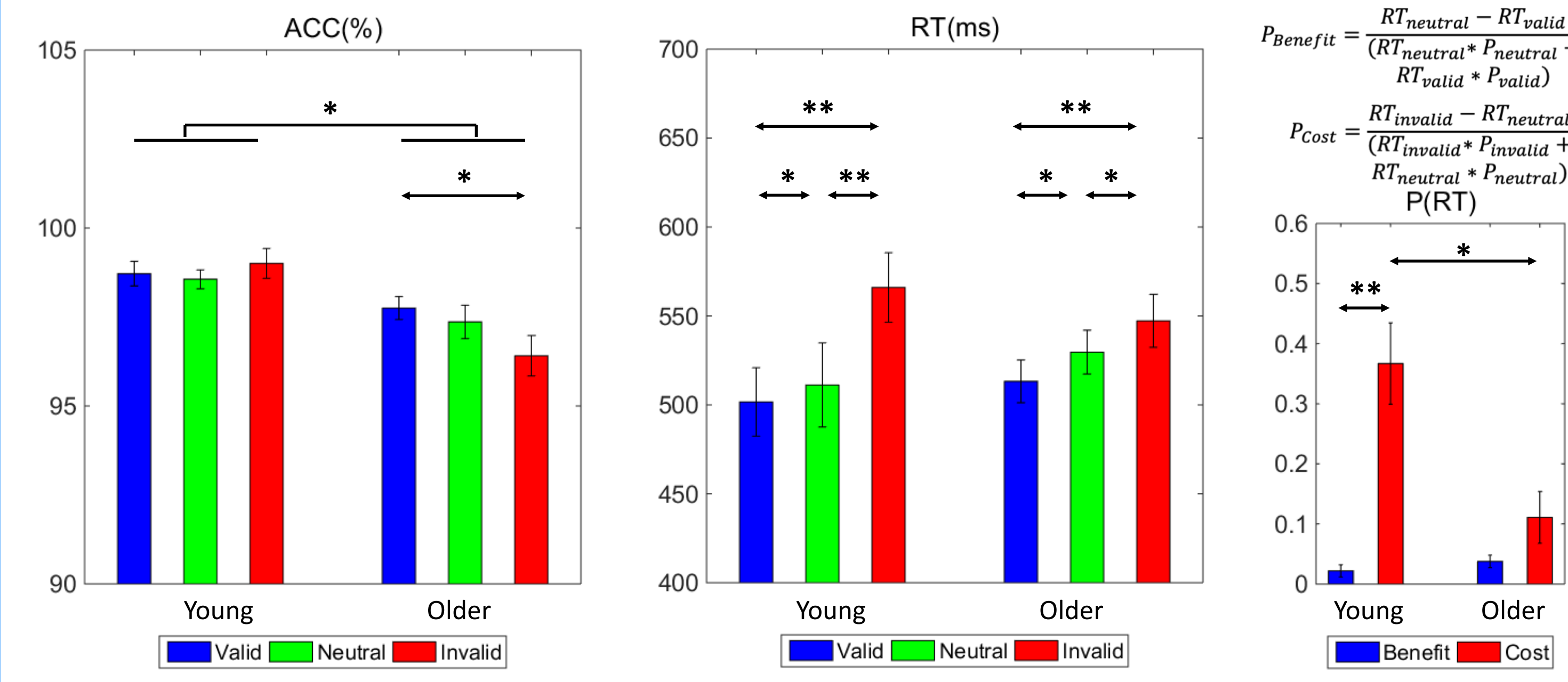
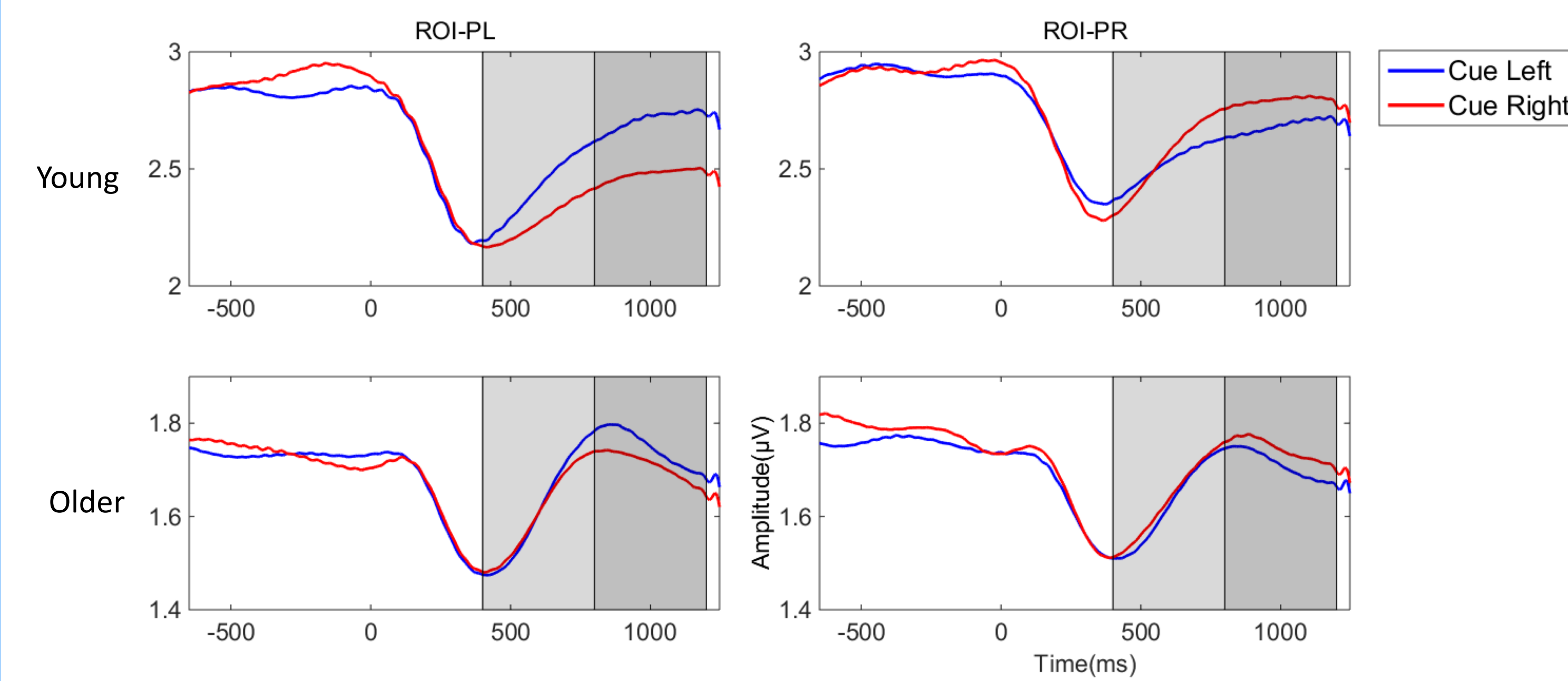
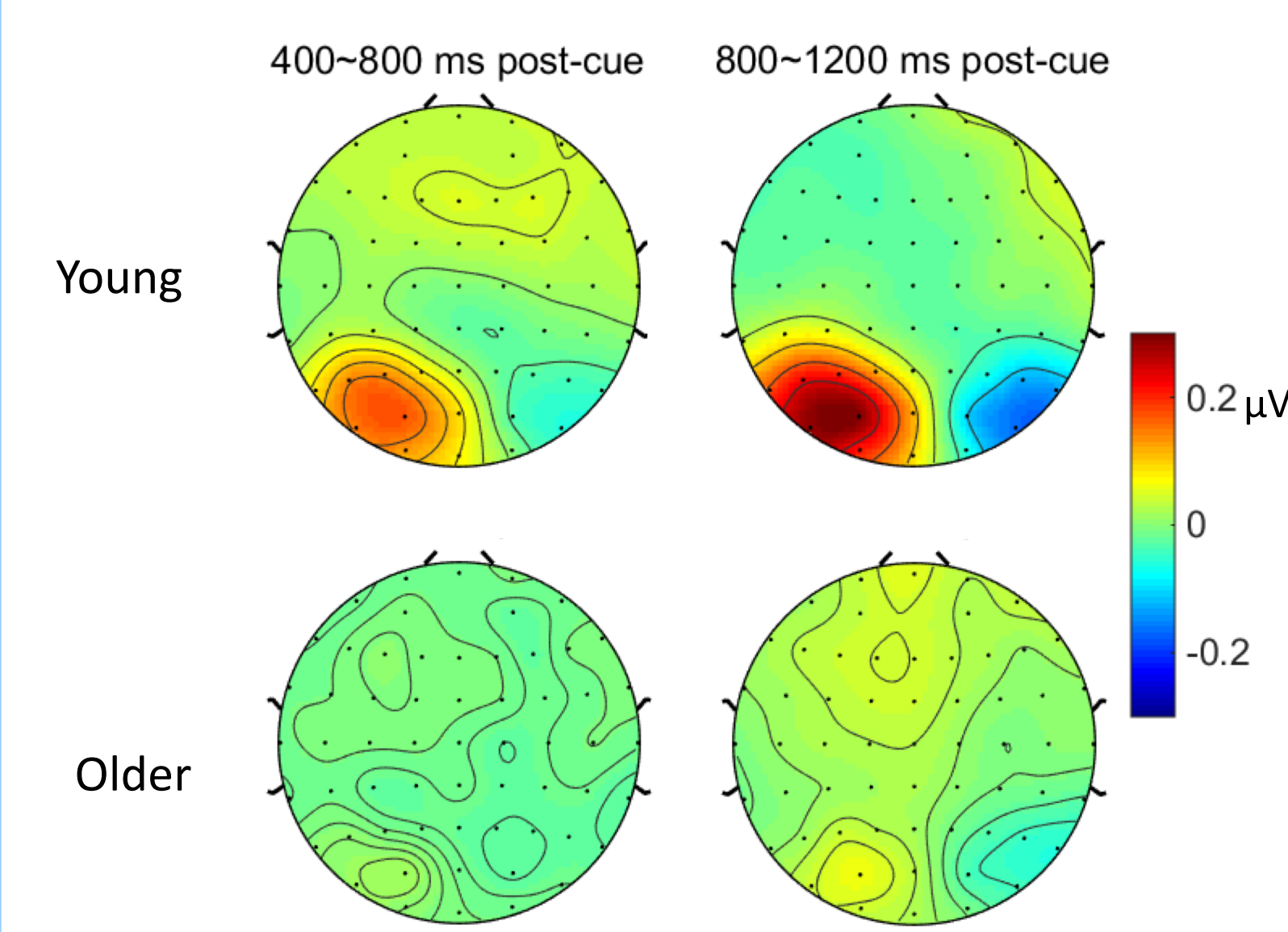


Figure 2. Behavioral performance. Both young and older adults showed classical attention cueing effects, namely, significant longer reaction time (RT) in invalid trials than that in valid trials. Moreover, when computed as the proportional cueing effects (benefit and cost separately) using the equations shown in the figure, significantly lower cueing cost was observed in older adults compared with young adults (*: $p < 0.05$; **: $p < 0.001$).

(A) Cue-related alpha-band power



(B) Cue left minus Cue right



(C) Normalized alpha-band power

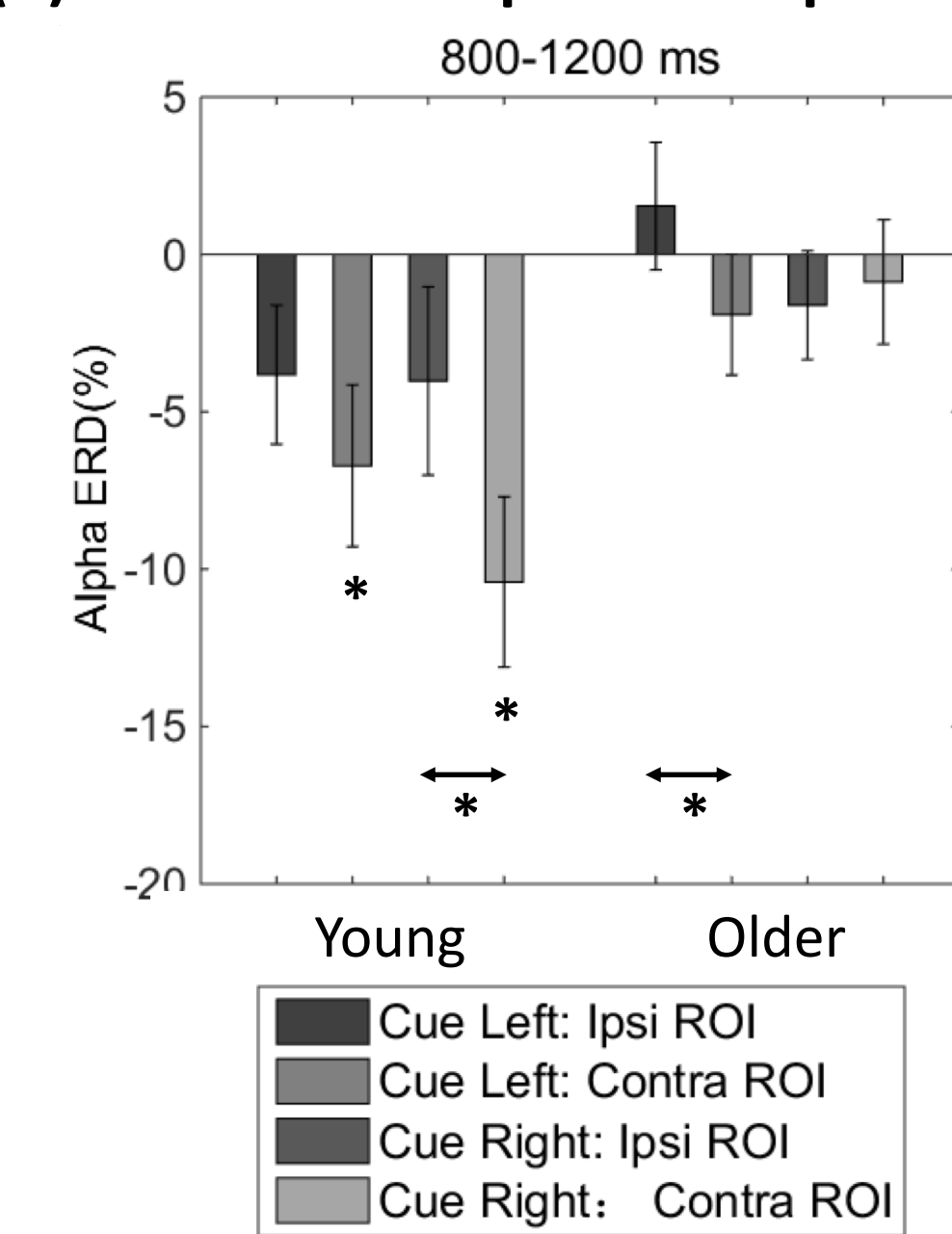


Figure 3. Young subjects showed significant alpha power lateralization over posterior areas during preparatory spatial attention, however, older adults showed the absence of alpha lateralization in the same time interval. Error bars indicate SEM in Panel C. (*: $p < 0.05$).

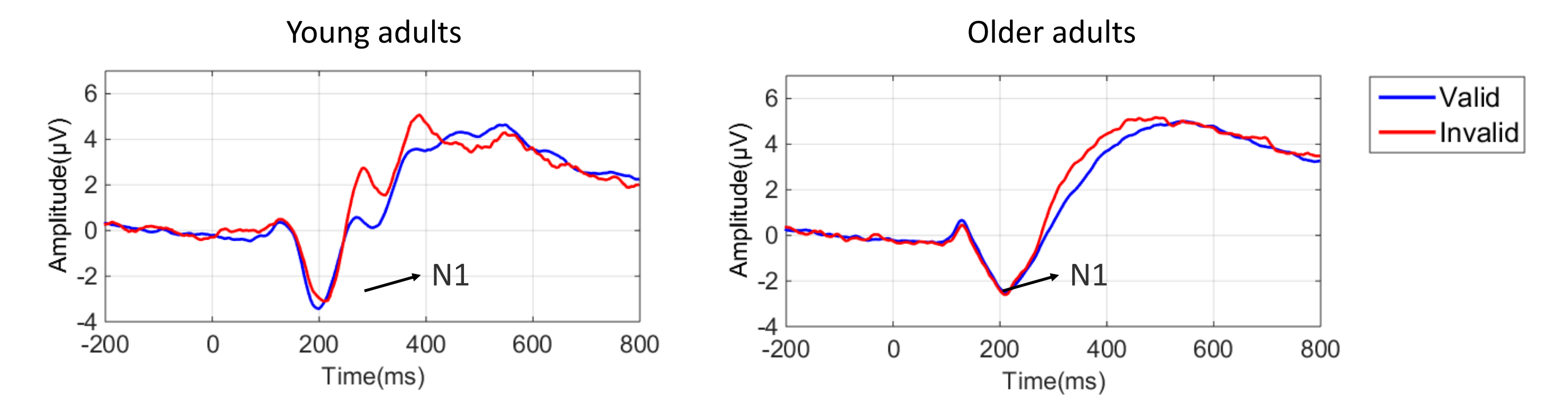


Figure 4. Target-related ERP waveforms within contralateral posterior ROIs. Young adults showed significant attentional modulation of target-evoked N1 ($p = 0.041$), but older adults did not show significant attentional modulation of target-evoked N1 ($p = 0.566$).

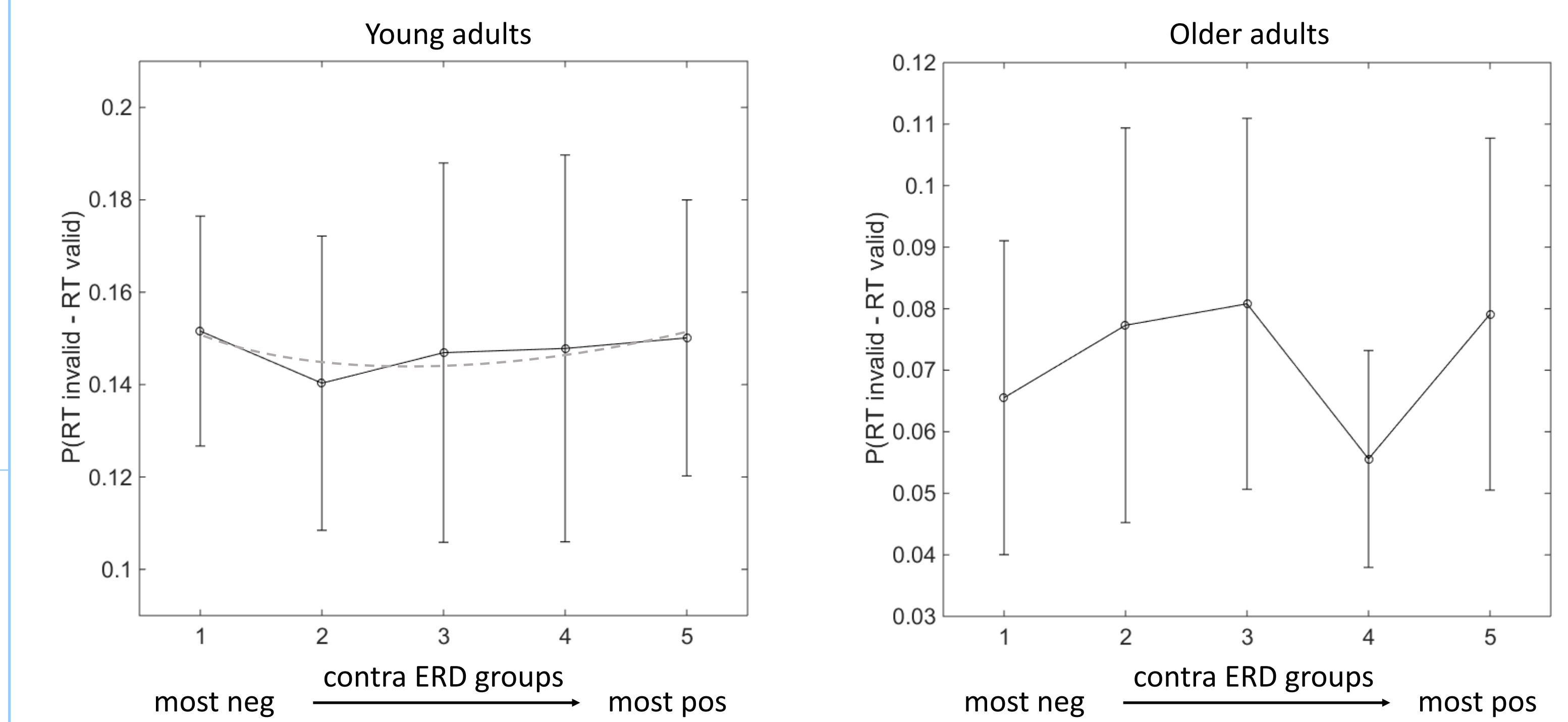


Figure 5. Contralateral alpha ERD sorted proportional cueing effects. Young and older adults showed different pattern of cueing effects when trials were sorted by the magnitude of contralateral alpha ERD within each subject. An U relationship seems to be presented only in the young group. Error bars indicate SEM.

Summary

- Both young and older adults showed classical attentional cueing effects.
- The classical cue-related alpha modulation, especially the alpha lateralization that was typically observed in young adults, declined significantly in older adults.
- The attentional modulation of target-evoked N1 amplitude was reduced in older adults compared with young adults.
- The within-subject relationship between alpha modulation and behavioral effects in visual spatial attention seems to be changed due to normal aging.

References:

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