

Beyond Blink Rate: Ocular and Neural Blink Signatures in Mild Cognitive Impairment

Shao-Yang Tsai1, Andrew Law2,7, Andrew Frank3,4, Nicole D. Anderson1,5, Jocelyn Keillor2,7, Zoha Rabie1, Jessica Qiu1,5, Jed Meltzer1,5, Allison B. Sekuler1,5,6, Eugenie Roudaia1

1. Rotman Research Institute, Baycrest Academy for Research and Education; 2. Aerospace Research Centre, National Research Council of Canada; 3. Bruyère Health Research Institute; 4. University of Ottawa; 5. University of Toronto; 6. McMaster University; 7. Carleton University. Contact: stsai@research.baycrest.org

Background & Research Questions

- Spontaneous eye blinking has been proposed as an index of dopaminergic function1 and as a potential biomarker of MCI/AD2,3.
- However, blink rate shows a complex trajectory in AD: increased in MCI2 but reduced in dementia3. Blinking is also affected by sex, age, and task demands4, complicating its use as a biomarker.
- Beyond blink rate, blink timing may reveal how older adults coordinate blinks with task events;
- Moreover, low-frequency EEG activity following blinks is sensitive to aging and cognitive load5,6, and may be altered in MCI.

- How does MCI impact blink behaviour and blink-related EEG?
- How do active vs. passive tasks shape blink timing and EEG?
- How reliable are blink behaviour and EEG metrics?

Procedures

Participants table with columns: Group, Sex, n, Age Mean (SD), MoCA Mean (SD). Rows for Control and MCI groups, split by sex.

Session 1: Neuropsychological battery + EEG recording
Session 2: 7-14 days after session 1, EEG only

Visual representation of tasks: CIT, RSO, SRT, DOT, and RSO. Includes a table describing each task: Type, Stimuli, Response, ITI, and Duration.

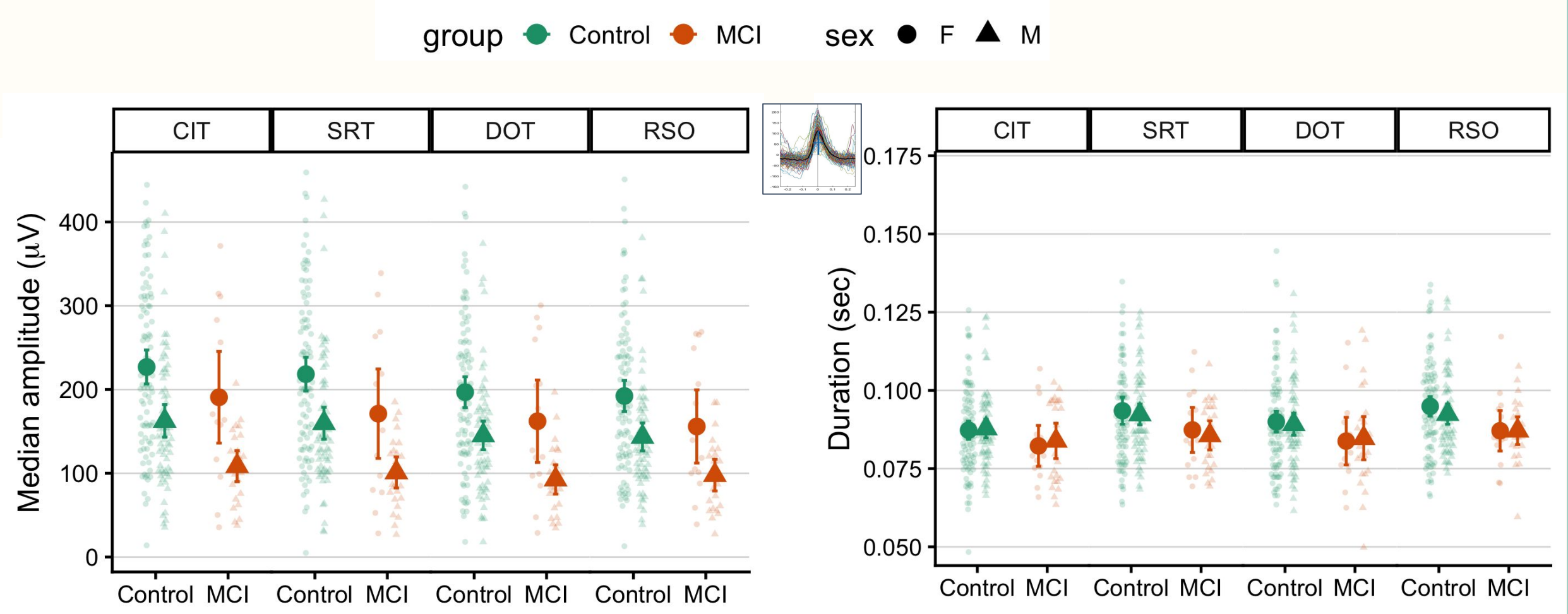
Blink detection and blink-locked EEG analyses

Diagram showing blink detection process and EEG analysis. Includes a table for Blink-locked EEG parameters: ICA removal, filter, and epoch.

References:

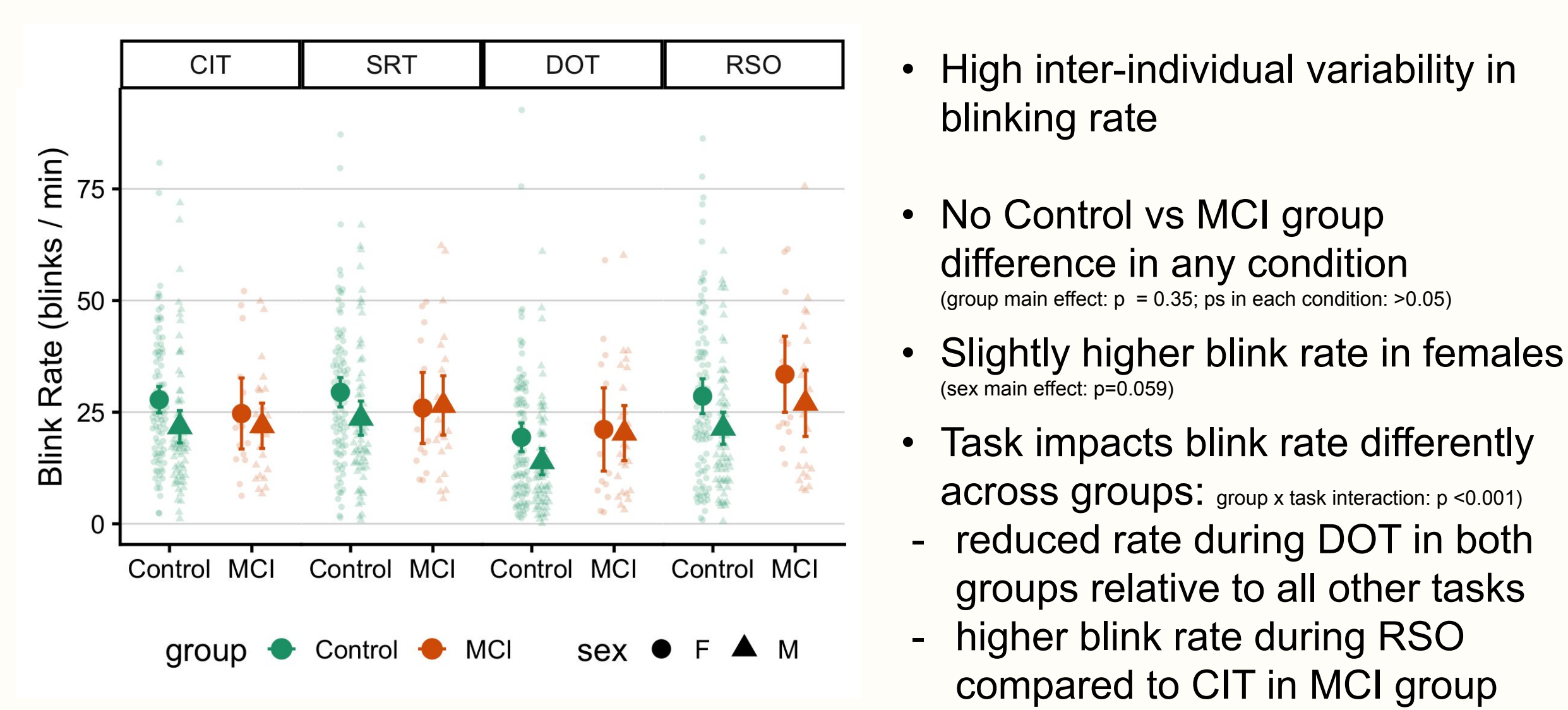
List of references including studies on blink rate, cognitive impairment, and EEG analysis.

Morphology of blink EOG



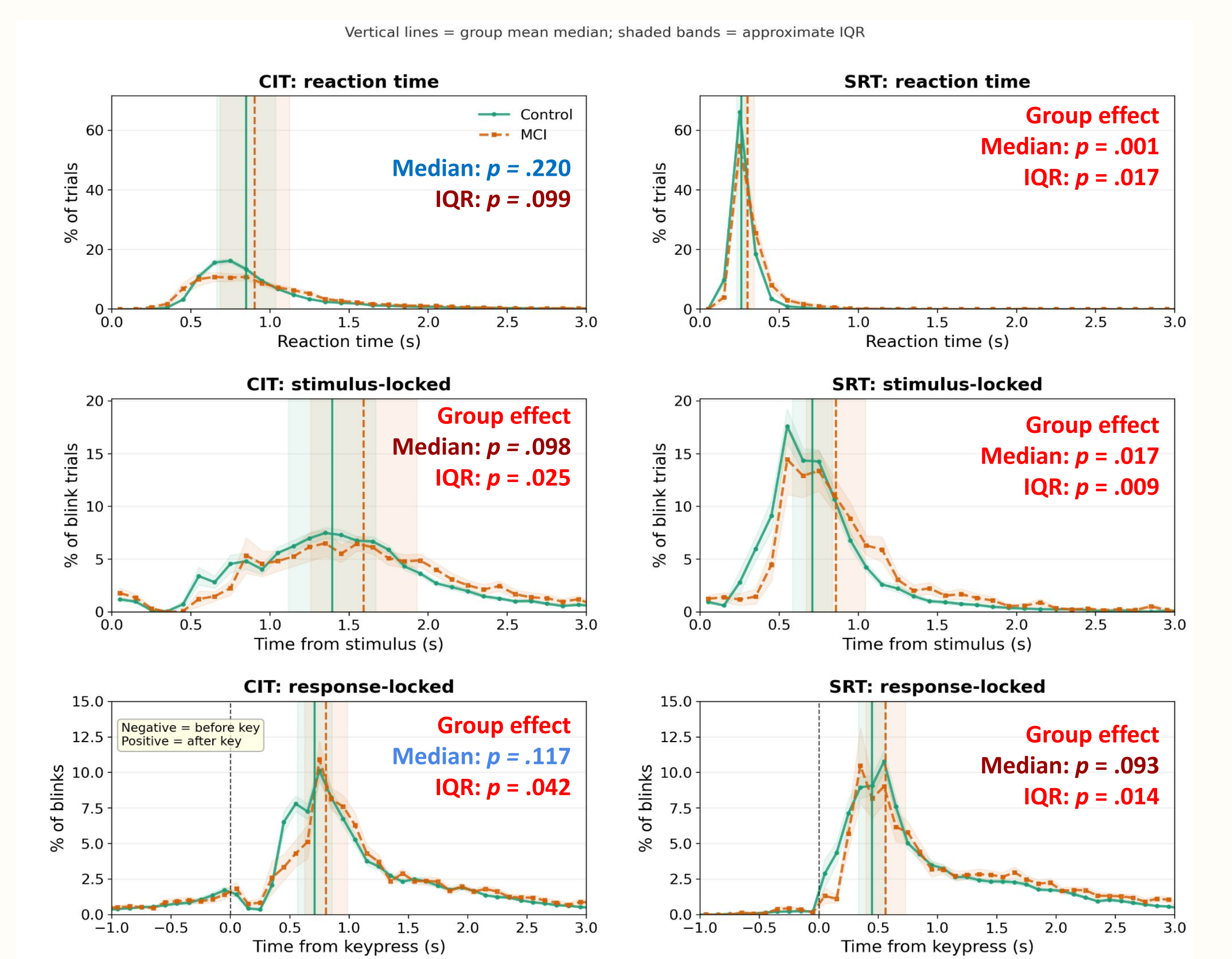
- MCI group show lower blink amplitudes and shorter blink durations than Controls
- Females show higher blink amplitudes than males, with similar durations.
- Blink amplitudes are higher for active (CIT, SRT) than passive tasks (DOT, RSO)

Spontaneous blink rate in active and passive tasks



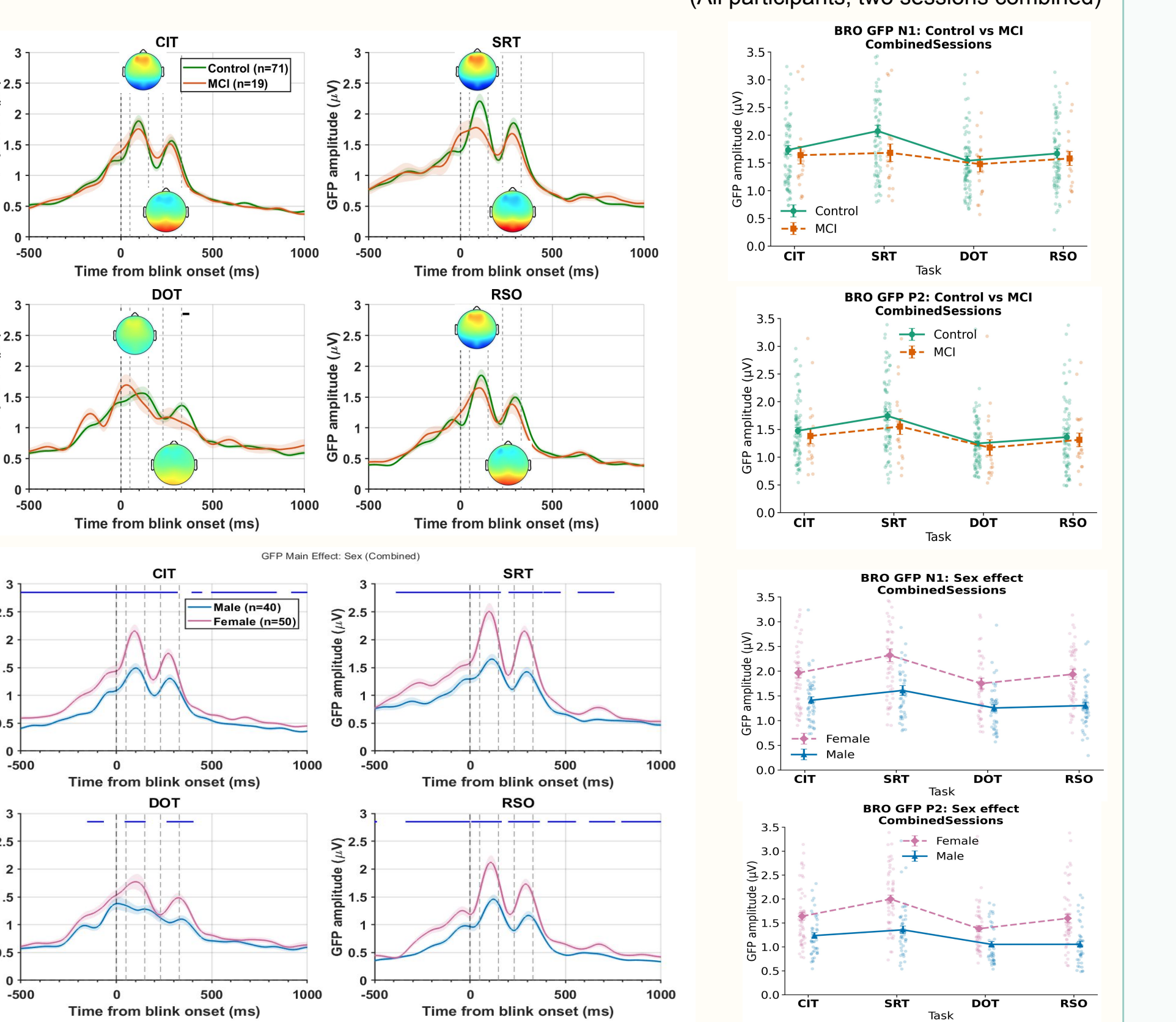
- High inter-individual variability in blinking rate
- No Control vs MCI group difference in any condition (group main effect: p = 0.35; ps in each condition: >0.05)
- Slightly higher blink rate in females (sex main effect: p=0.059)
- Task impacts blink rate differently across groups: group x task interaction: p <0.001
 - reduced rate during DOT in both groups relative to all other tasks
 - higher blink rate during RSO compared to CIT in MCI group

First blink timing following stimuli and responses



- Median response times were slower in MCI group in SRT, but not CIT.
- The time to first blink following the stimulus was longer in the MCI group compared to Controls in the SRT task
- MCI participants showed broader first blink timing distributions in both tasks

Blink-locked delta-band EEG



- Global field power (GFP) of delta-band EEG shows two peaks post blink, corresponding to a negativity over POz around 50-150 ms (N1) followed by a positivity around 230-330 ms (P2).
- GFP is modulated by task (SRT > CIT≈RSO > DOT) for N1 and P2
- GFP is higher in females than males across all tasks and windows
- There is no group (MCI vs. Control) effect in GFP or ERP (POz)

Test-retest reliability

Table showing ICC(3,1) point estimate for Blink rate, Blink amplitude, Blink duration, and First blink after stimulus/median/IQR.

ICCs were estimated across all participants. Reliability was strongest for blink rate, blink amplitude, and median first-blink timing; blink-locked GFP showed moderate reliability.

Summary and conclusions

- Blink EOG amplitude is reduced in MCI, possibly reflecting ocular, oculomotor, and/or retinal changes associated with AD. With good test-retest reliability, this measure has 'biomarker potential'.
- In contrast, blink rate was not sensitive to MCI status, despite showing effects of task and sex, and having good reliability.
- The time from stimulus/response to the subsequent blink was sensitive to MCI status: MCI participants blinked later (in SRT task) and showed broader timing distributions (in both tasks). Test-retest reliability was good for the median timing.
- Blink-locked delta-band EEG was stronger for females and varied with task, but was not affected in MCI and showed moderate reliability, limiting its potential as a biomarker.

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