

RESEARCH QUESTION

Drivers can get distracted by spoken content they are trying to follow, or by their own wandering thoughts (mind-wandering). Both can slow down reactions to sudden events on the road. **Do these two types of distraction look different in the brain, or do they share a common pattern of brain activity?**

METHOD

Data

Public BCIT Mind Wandering dataset (OpenNeuro ds004121); 64-channel BioSemi EEG; N = 19 participants.

Task

Three 30-minute simulated drives; participants pressed a button when a police car appeared.

- A Task-relevant: traffic-safety news audio
- B Task-irrelevant: sports-report audio
- C Internal focus: mindfulness breathing

Attentive vs Distracted

For each participant, the fastest 25% of reaction times were labelled Attentive and the slowest 25% Distracted.

EEG Analysis

Automated artifact rejection (InnoBrain pipeline) was applied to a 5-s post-stimulus segment. Relative PSD was measured across temporal, frontocentral, and parieto-occipital ROIs.

STATISTICS & RESULTS

Paired t-tests with Benjamini–Hochberg FDR correction (Attentive vs Distracted); repeated-measures correlation (rmcorr) between single-trial RT and band power.

ROI	Alpha t(18)	pFDR	Theta t(18)	pFDR
Temporal	2.78	.012	−5.22	< .001
Frontocentral	3.42	.004	−4.59	< .001
Parieto-occipital	4.19	.001	−3.59	.003

Distracted vs Attentive; paired t-tests with BH-FDR correction across 6 tests. Alpha was higher and theta lower in the distracted state.

Effect size: $d_{av} = 0.37\text{--}0.25$ ($d_z = 1.20\text{--}0.64$), absolute values.

CONCLUSIONS

- Whether drivers were distracted by spoken content they were trying to follow or by their own thoughts, their brains **showed the same pattern**: more alpha waves (linked to relaxed, inattentive states) and fewer theta waves (linked to mental effort).
- The pattern held both across drivers and within the same person from moment to moment, especially above the ears (temporal regions), and could help cars detect drifting attention and warn the driver.

LIMITATIONS

Single public driving-simulator dataset (N = 19) with small-to-moderate effects.

KEY PATTERN

Higher alpha and lower theta accompanied slower responses; pooled conditions limit condition-specific conclusions.

Data: BCIT Mind Wandering dataset, Touryan et al. (2022).

Funding: InnoBrain AB.

Conditions did not differ in RT, accuracy, alpha, or theta (all $p > .10$).

ALPHA ↑ WHEN DISTRACTED

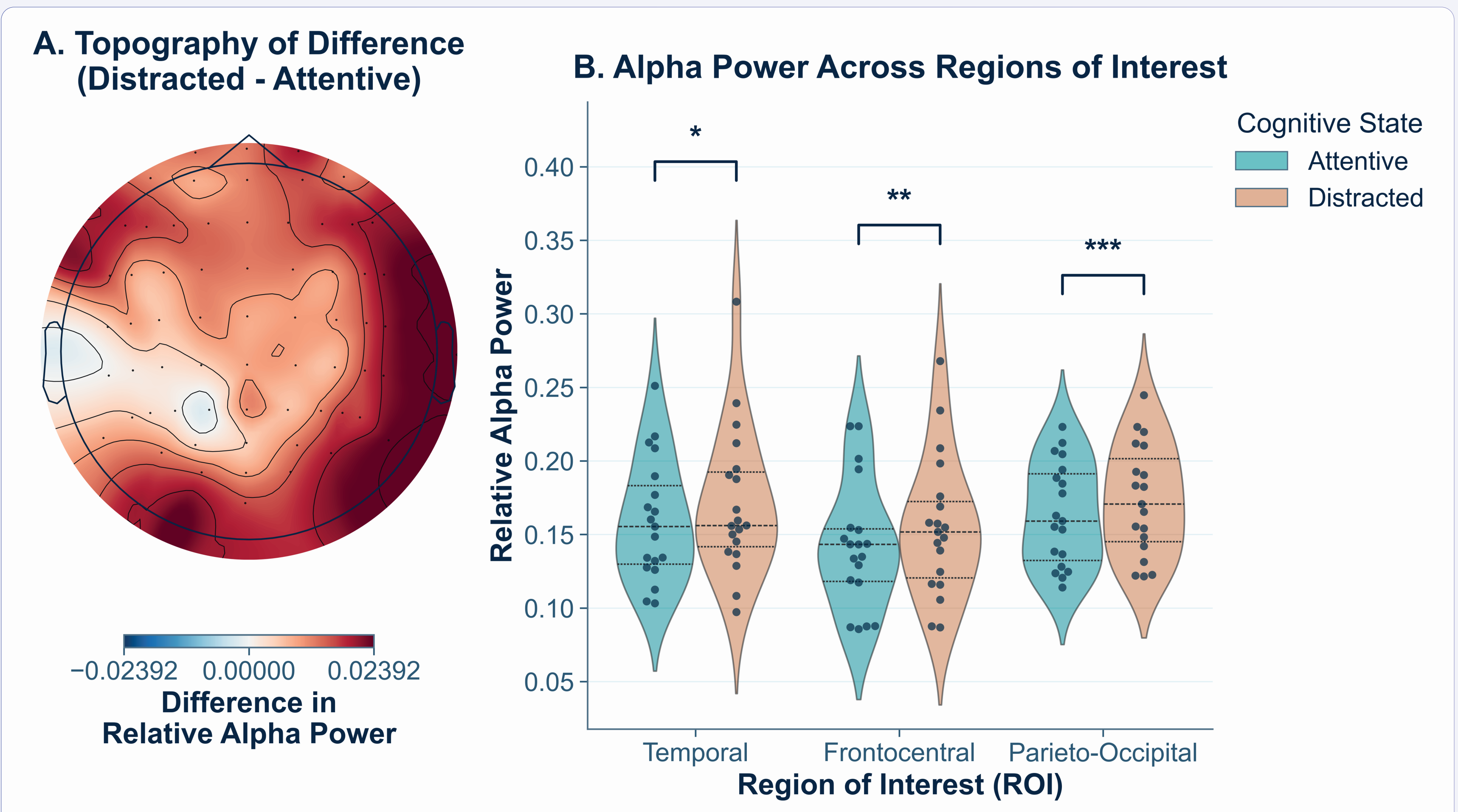


Fig 1. Relative alpha power: scalp topography of Distracted – Attentive (red = more alpha) and ROI comparison. *, **, *** indicate $p < .05$, $p < .01$, $p < .001$ (uncorrected; FDR values in table).

THETA ↓ WHEN DISTRACTED

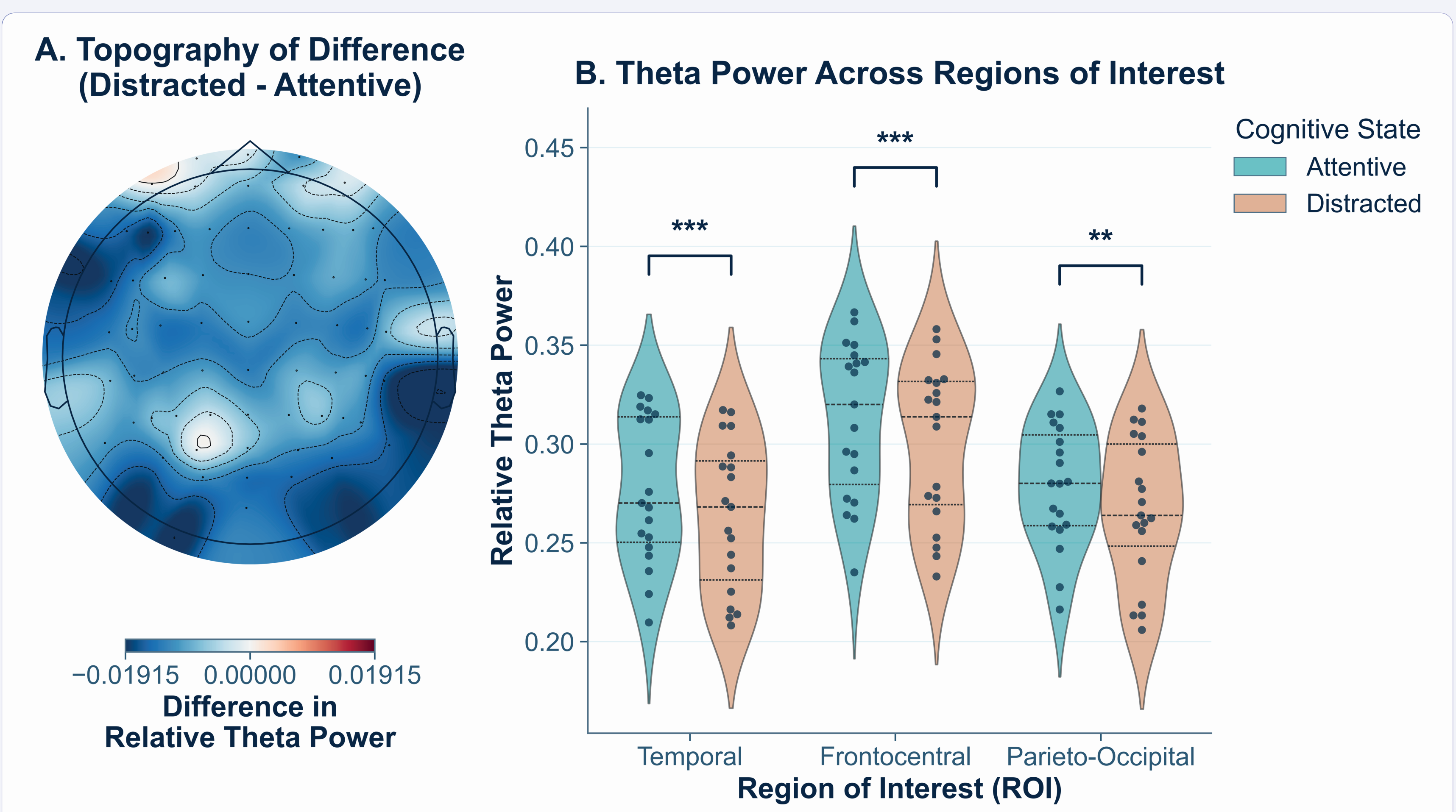


Fig 2. Relative theta power: scalp topography and ROI comparison; blue indicates lower theta. ** $p < .01$, *** $p < .001$ (uncorrected; FDR values in table).

SINGLE TRIALS: SLOW RT = ALPHA ↑, THETA ↓

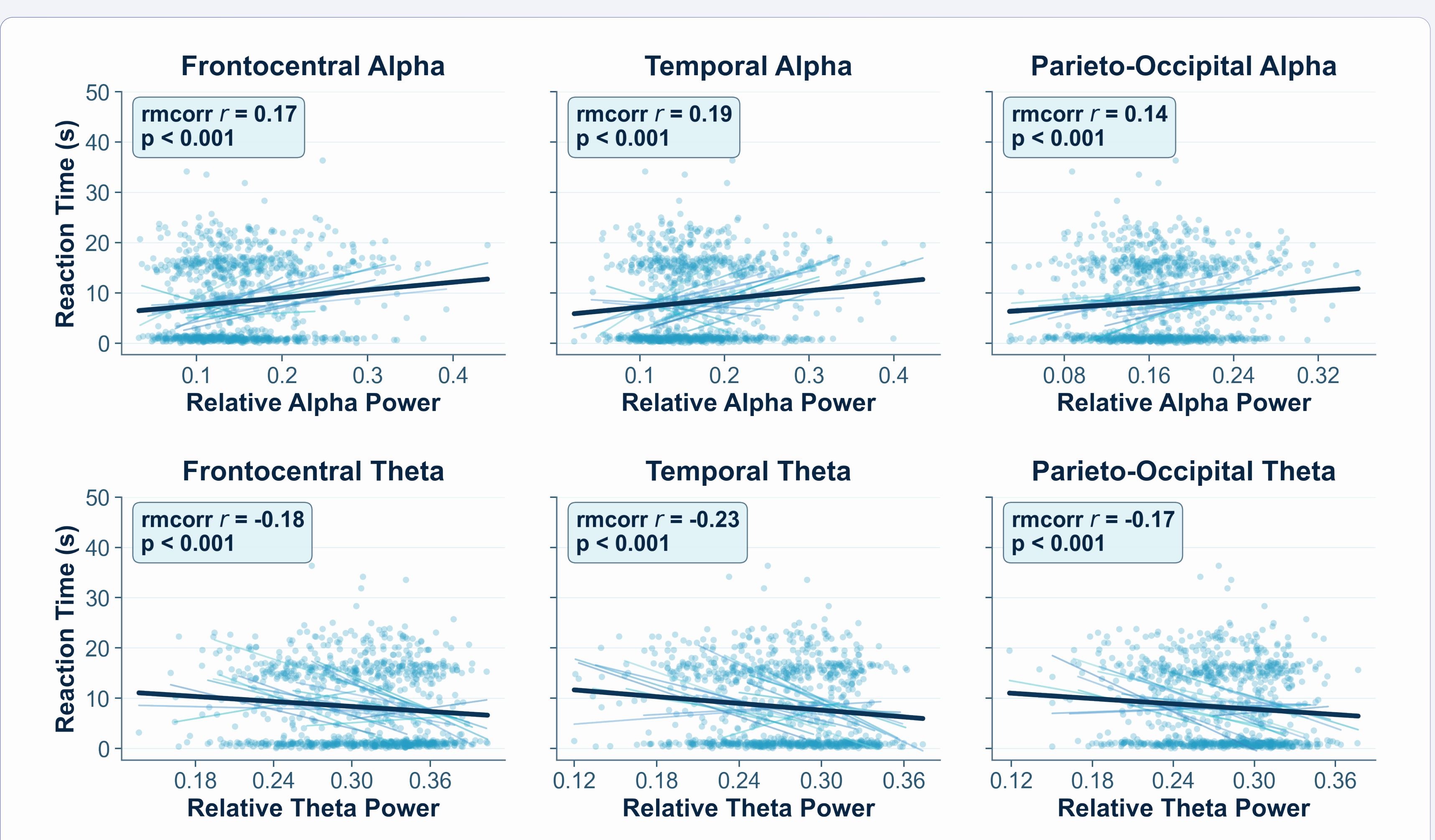


Fig 3. Repeated-measures correlation between reaction time and relative power. Coloured lines show individual participants; black lines show the common within-person slope. Alpha: $r_m = 0.19\text{--}0.14$; theta: $r_m = -0.17$ to -0.23 ; all $p < .001$, strongest over temporal.