

Background

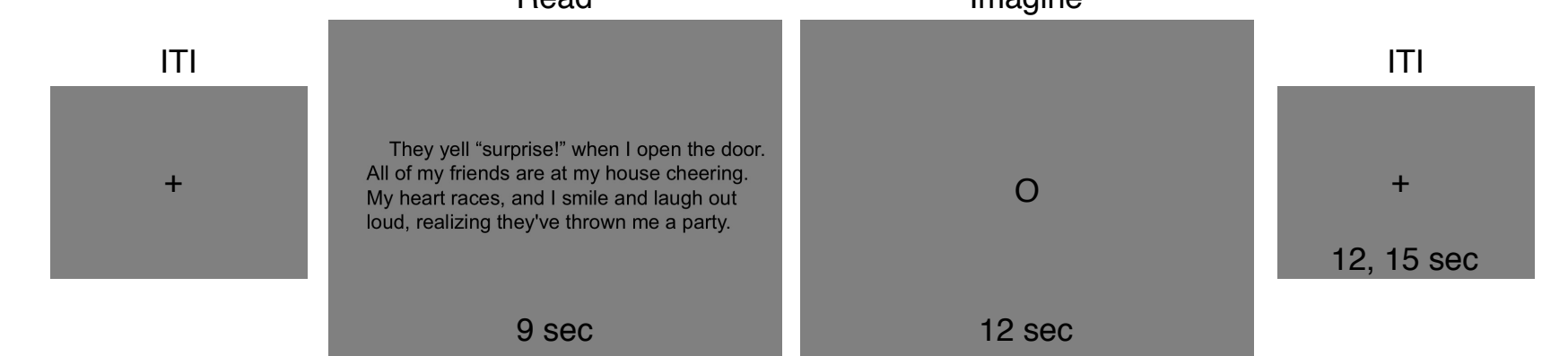
Mental imagery is a critical factor in the etiology and maintenance of many psychiatric disorders, as well as a component in gold-standard treatment options. At the level of hemodynamics, research has demonstrated that mental imagery **activates emotion networks** of the brain. Scalp-recorded EEG has also shown an **increase in alpha-band activity** during mental imagery tasks.

To define the neurophysiology of mental imagery, we combined the information from blood oxygen level-dependent (BOLD) signals with concurrently recorded EEG alpha-band power during a visual script-driven mental imagery task.

Method

Participants: 21 undergraduate students, 7 female, $M_{age} = 19$

Stimuli: 57 pleasant, neutral, and unpleasant scenes



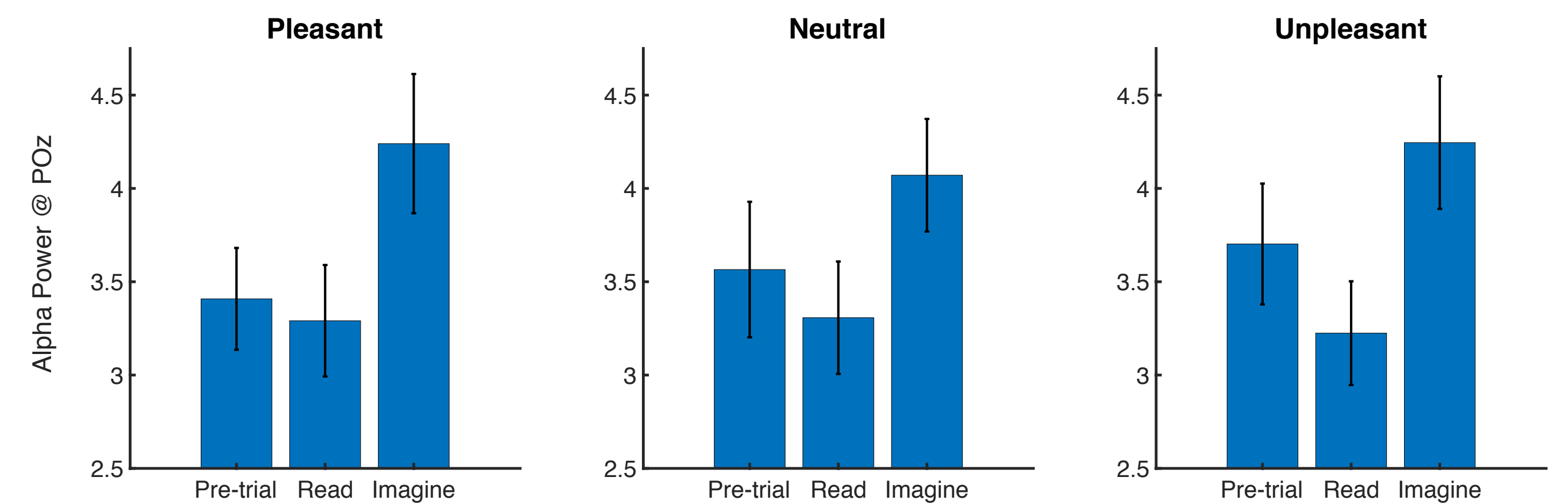
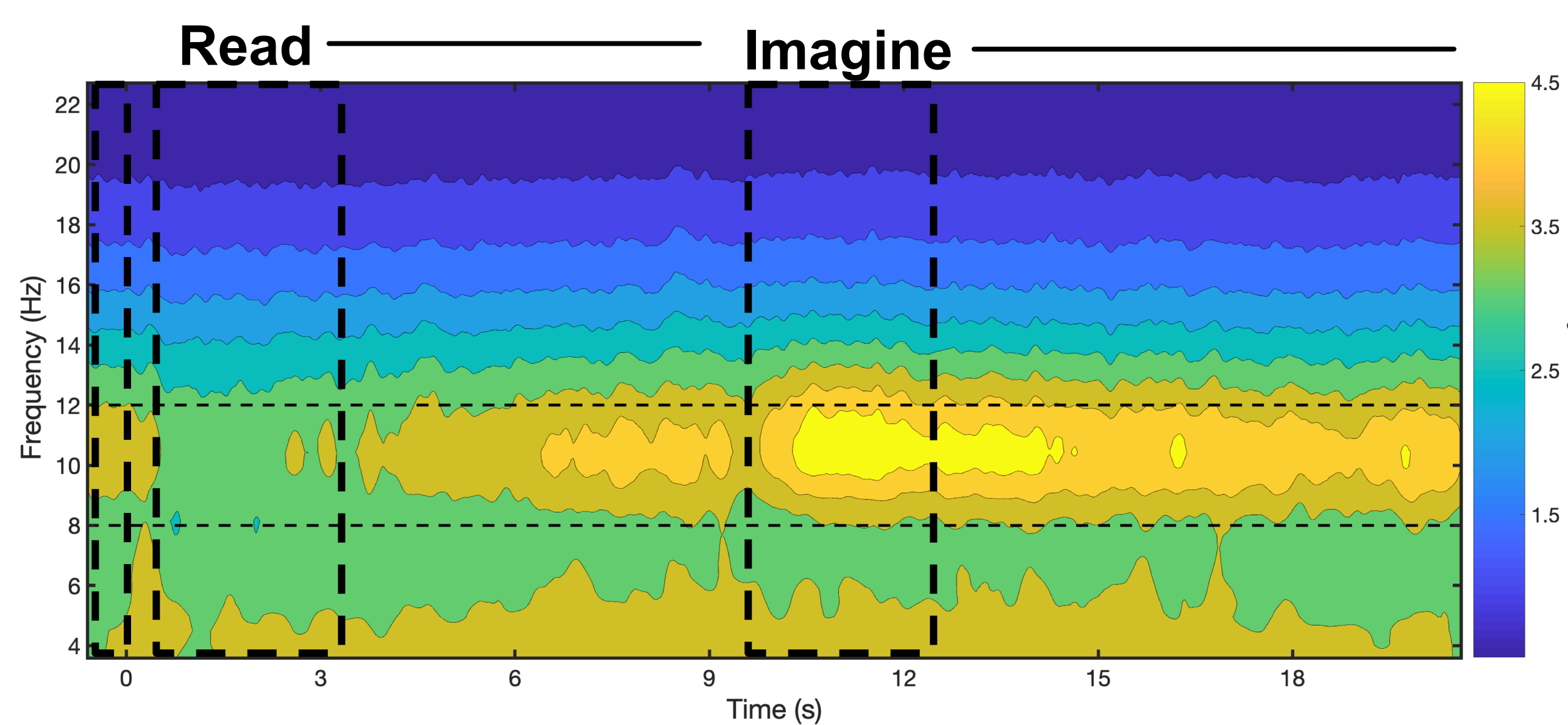
Analyses:

- TR-based:** BOLD percent change at *each* TR correlated with alpha-band SNR for each TR segment
- Trial-based:** Maximum BOLD percent change during the Imagery period correlated with baseline-corrected alpha power during Read and Imagery periods across trials

Results

Alpha

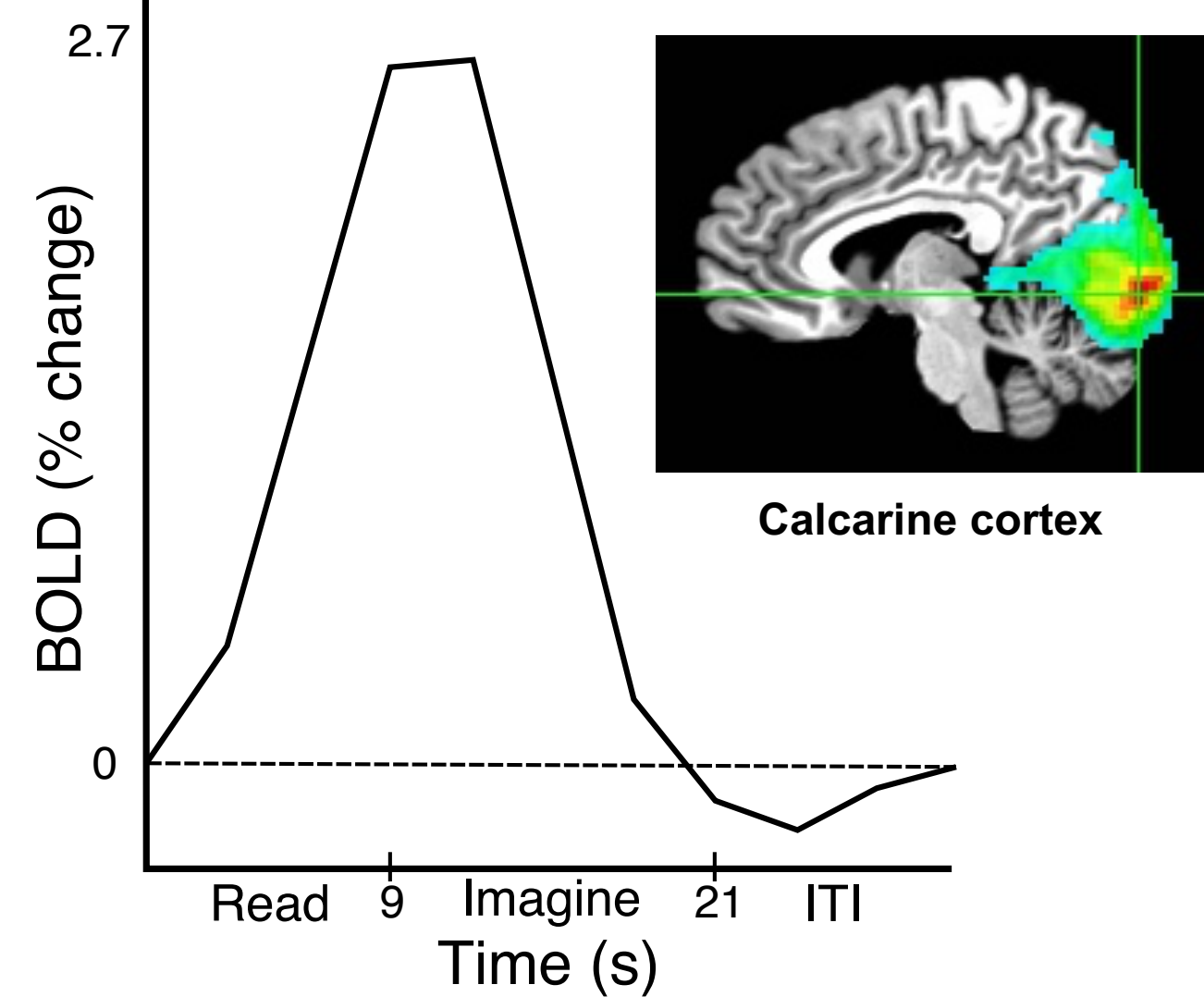
Time-frequency analyses demonstrate a decrease in the alpha-band during the Read period and a corresponding increase during the Imagery period, which exceeds pre-trial alpha power, regardless of valence.



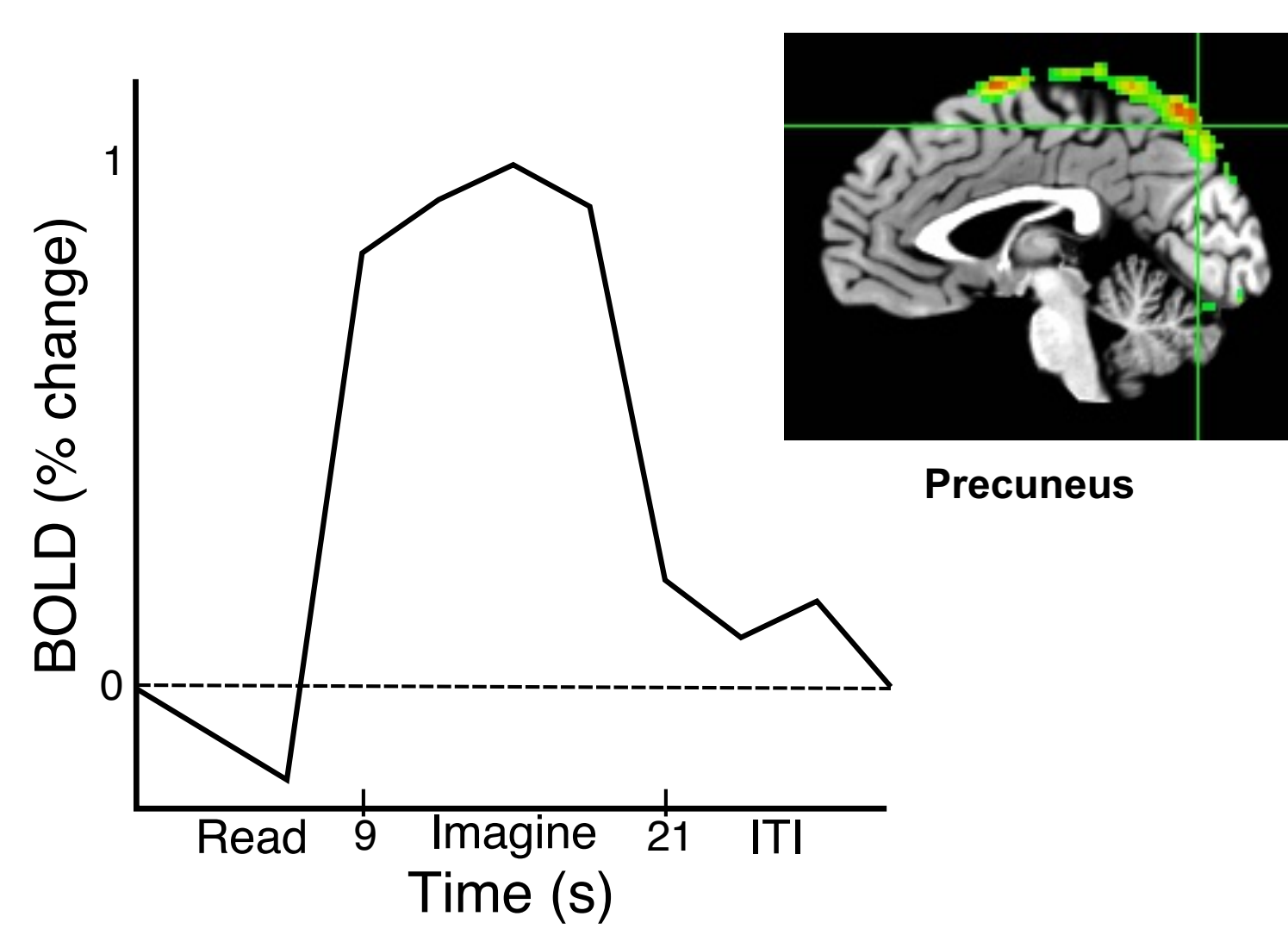
Effect of timewindow: $BF_{10} = 645,000,000,000,000$
Effect of valence: $BF_{10} = 0.069$

BOLD

Read Effect

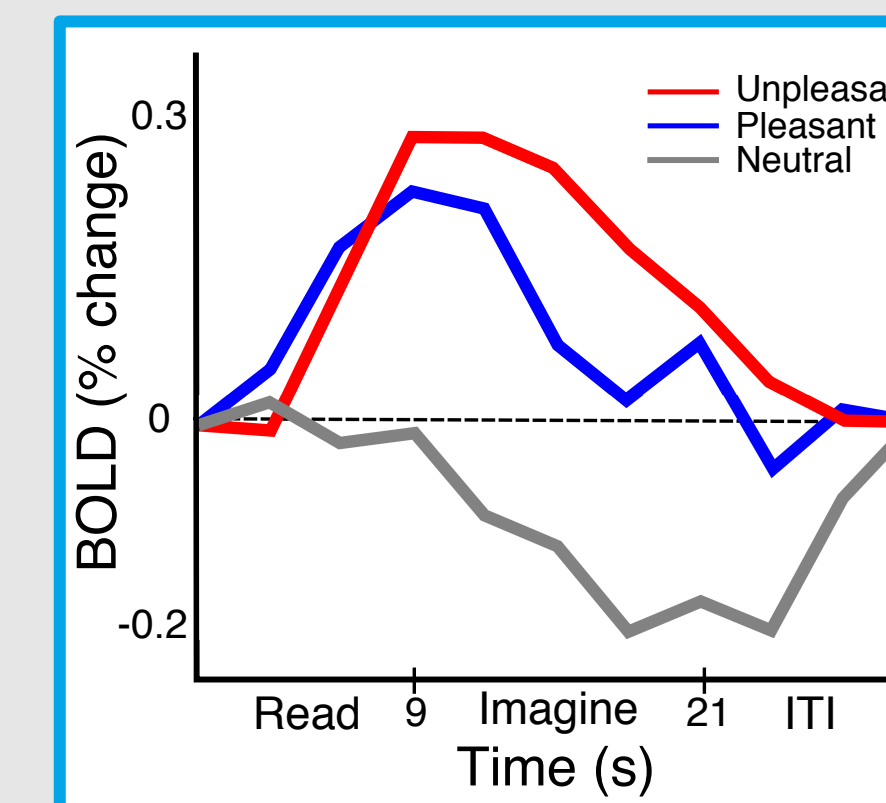


Imagine Effect



Valence Effects

Pleasant vs Neutral



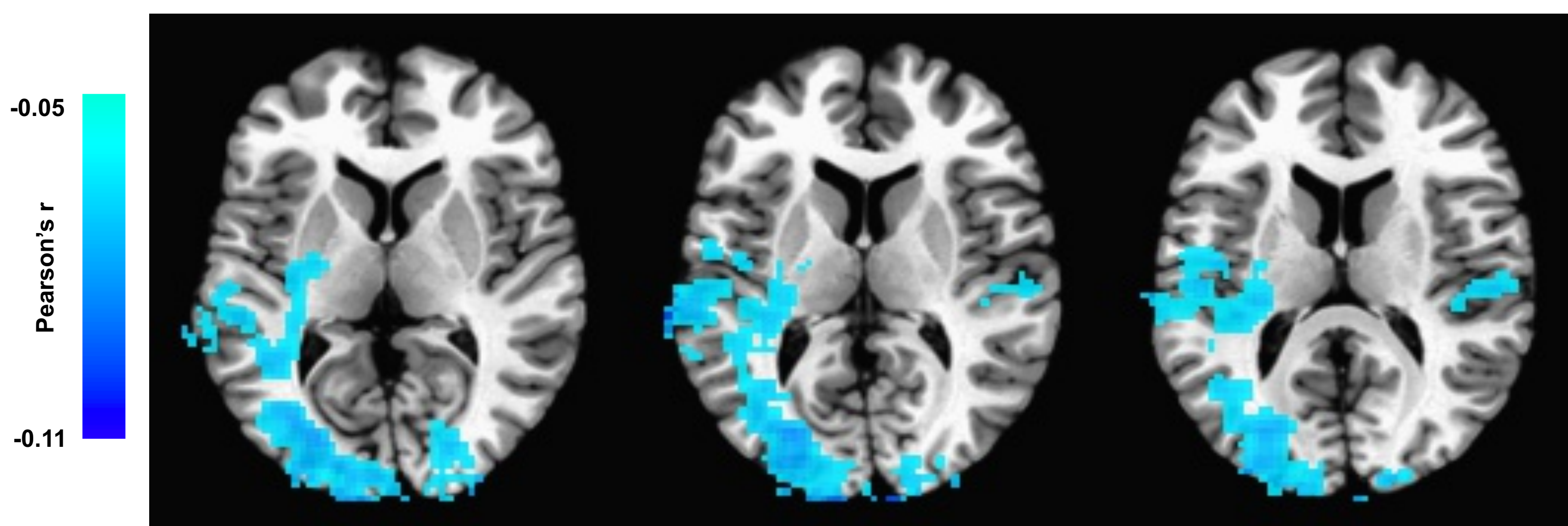
Unpleasant vs Neutral



Replicated effects of valence and arousal in the precuneus and prefrontal cortex during emotional mental imagery

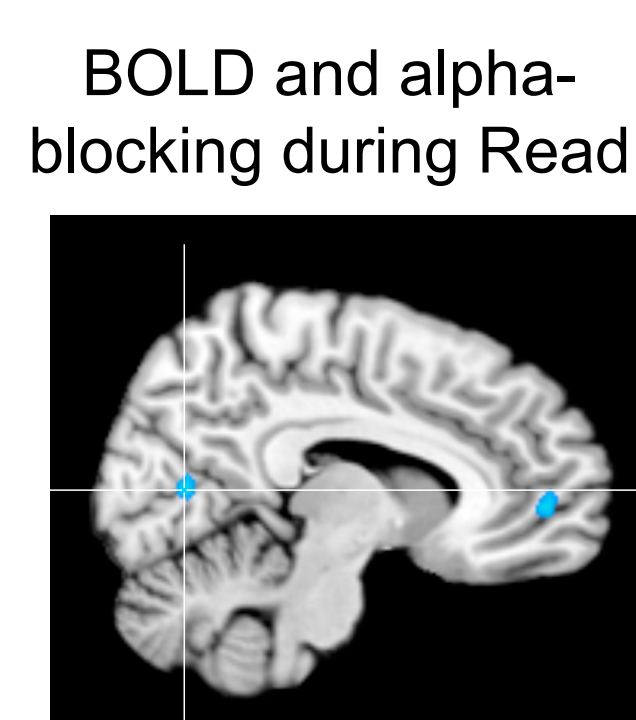
Alpha-BOLD

TR-based analysis

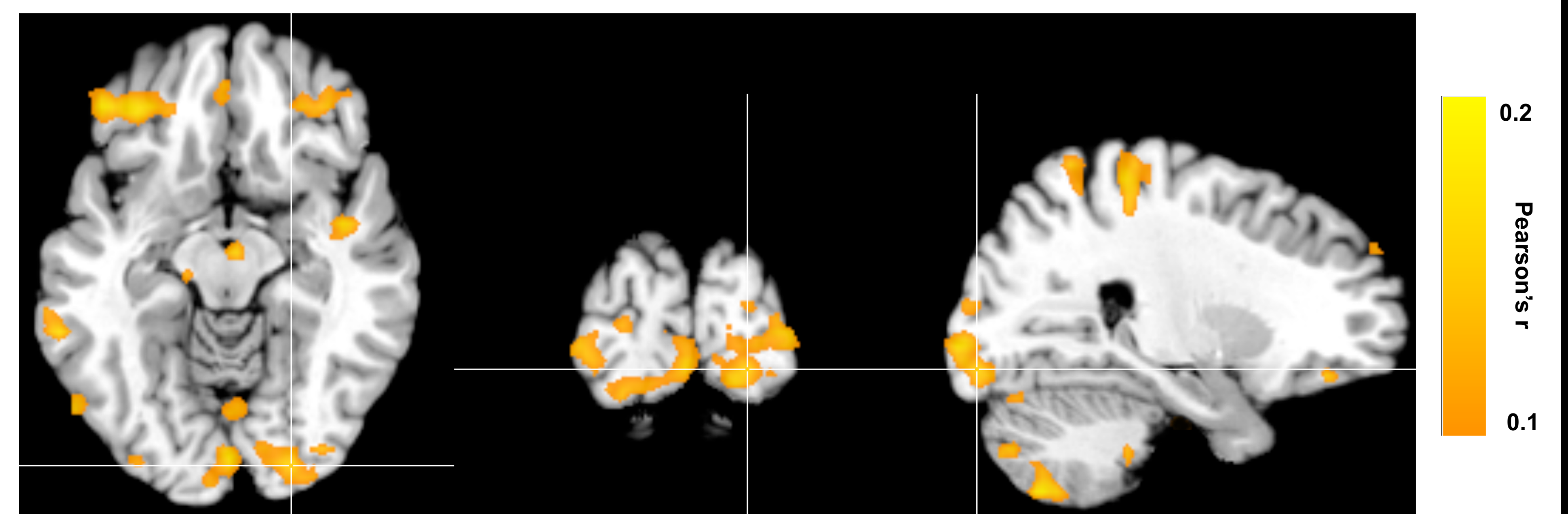


TR-by-TR correlation: Throughout the experiment, activity in the alpha-band sees a decrease as BOLD percent change increases in the regions involved with the reading task

However, this negative correlation is **not** maintained on a trial-by-trial basis



Trial-based analysis



Trial-by-trial correlation: Activity in the alpha-band increases from a pre-trial baseline in tandem with hemodynamic activity within regions associated with visual script-driven mental imagery: visual cortex, frontal cortex, cerebellum

Conclusions

- The visual script-driven mental imagery task results in alpha blocking during the reading period and alpha enhancement during the imagery period, relative to the pre-trial baseline
- BOLD effects of emotional mental imagery were replicated with activity in the prefrontal cortex and precuneus
- Across the experiment, a negative correlation of BOLD and alpha-band activity is seen in visual and language areas
- Trial-based analyses reveal the negative BOLD-alpha relationship associated with a reading task is not sustained within a trial. Instead, alpha-band increases are associated with higher BOLD activity in visual cortex, ventral frontal cortex, and the cerebellum during mental imagery