

BEHAVIORAL AND ELECTROPHYSIOLOGICAL DIFFERENCES WHEN VIEWING ARTISTIC AND MATHEMATICAL FRACTAL IMAGES

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INTRODUCTION

- **Fractals** are repeating patterns at increasingly fine magnifications
- Complexity of fractals is measured on dimension D , ranging from 1 (least complex) to 2 (most complex) – $D = 1.3$ is most prevalent in nature.
- Fractals are prevalent in nature, but can also be computer-generated.
- Research has shown that the poured patterns of American abstract painter Jackson Pollock are also fractal.
- Previous electrophysiological studies have shown that viewing fractal patterns of differing dimensions in natural scenery and in computer-generated fractals leads to differences in brain activity.
- To our knowledge, no study has investigated electrophysiological brain activity in human-generated artistic fractals of varying dimensions.

GOAL OF THE PRESENT STUDY

Investigate behavioral and electrophysiological differences when viewing artistic vs. computer-generated fractals

METHODS

$n = 32$ undergraduate students (19 male, 13 female)
 $M_{age} = 19.55$, $SD_{age} = 1.93$

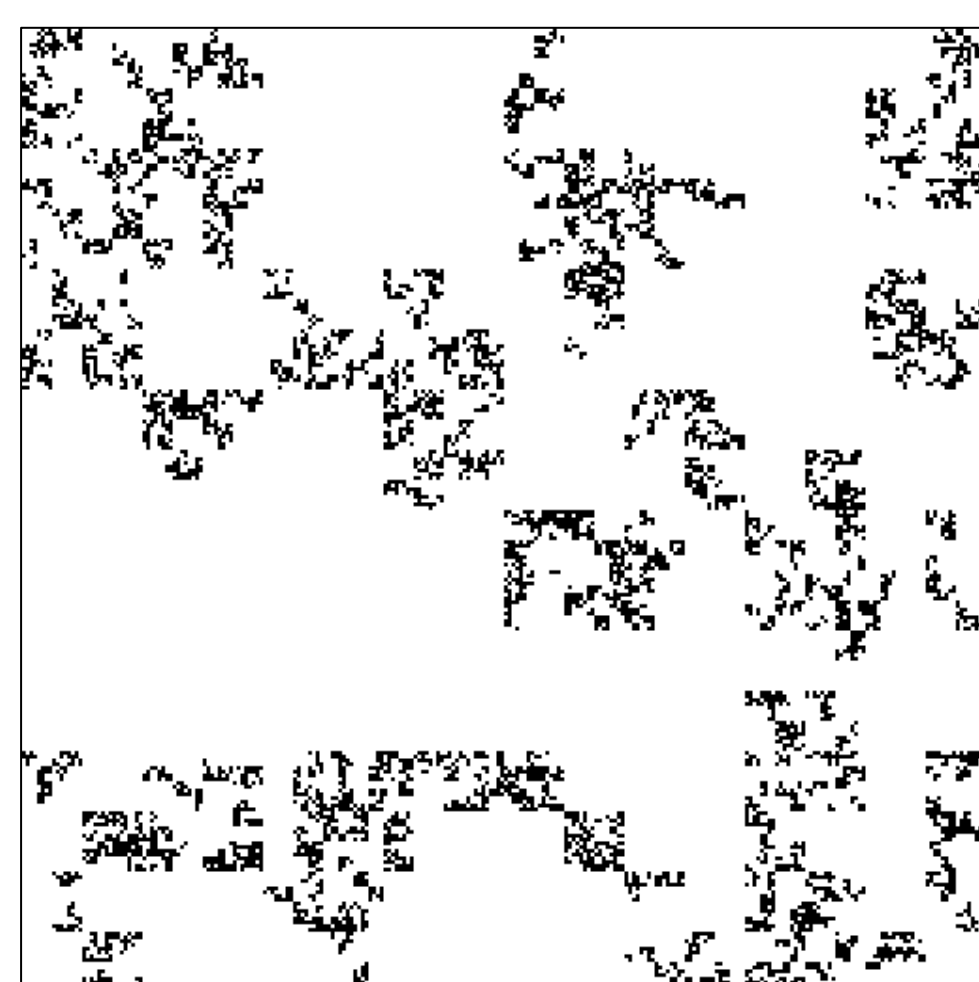
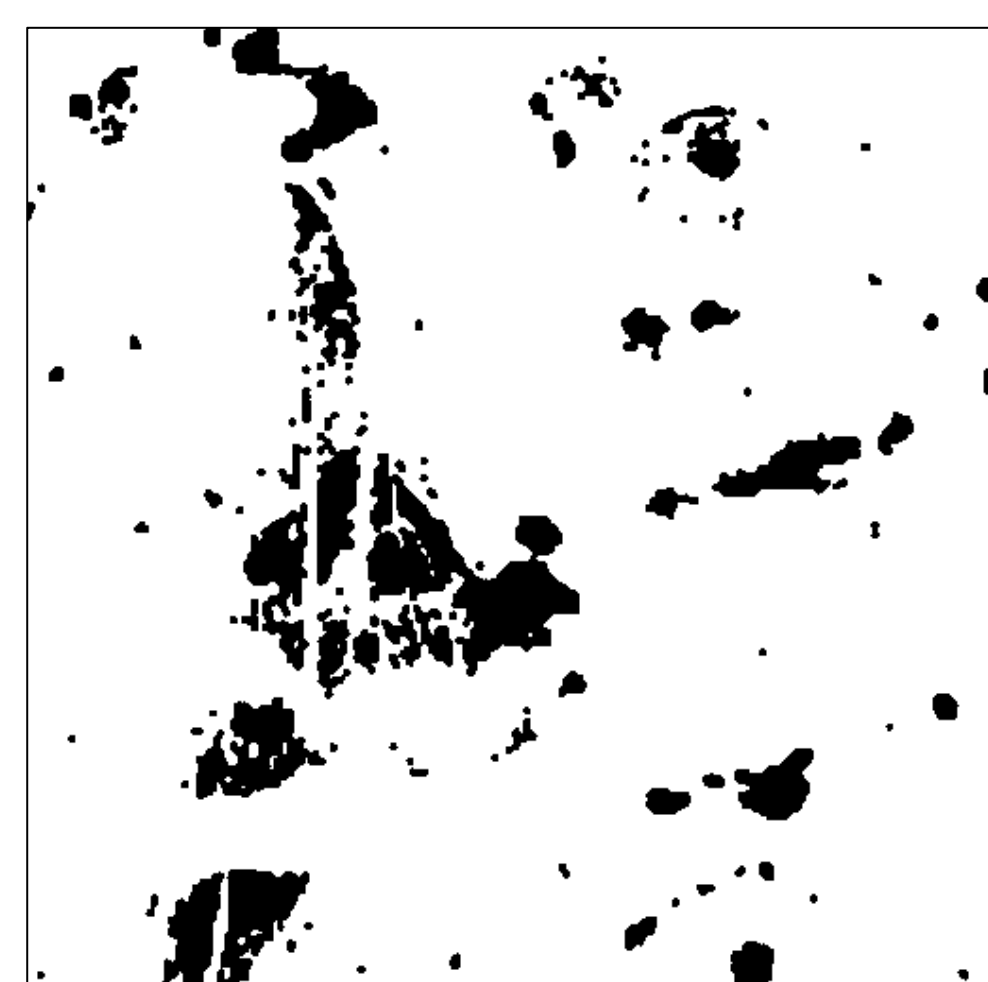
Fractal Task

Artistic fractal stimuli consisted of Jackson Pollock white layers and each artistic fractal had a mathematical twin (random Cantor set) with the same dimension.

Recorded 64-Channel continuous EEG while participants viewed sets of randomly presented fractal images with dimensions between 1.12 and 1.98, and rated how much they liked each image.

Jackson Pollock white layer

Mathematical "Twin" (Control)



Ratings

"How much do you like this image?"

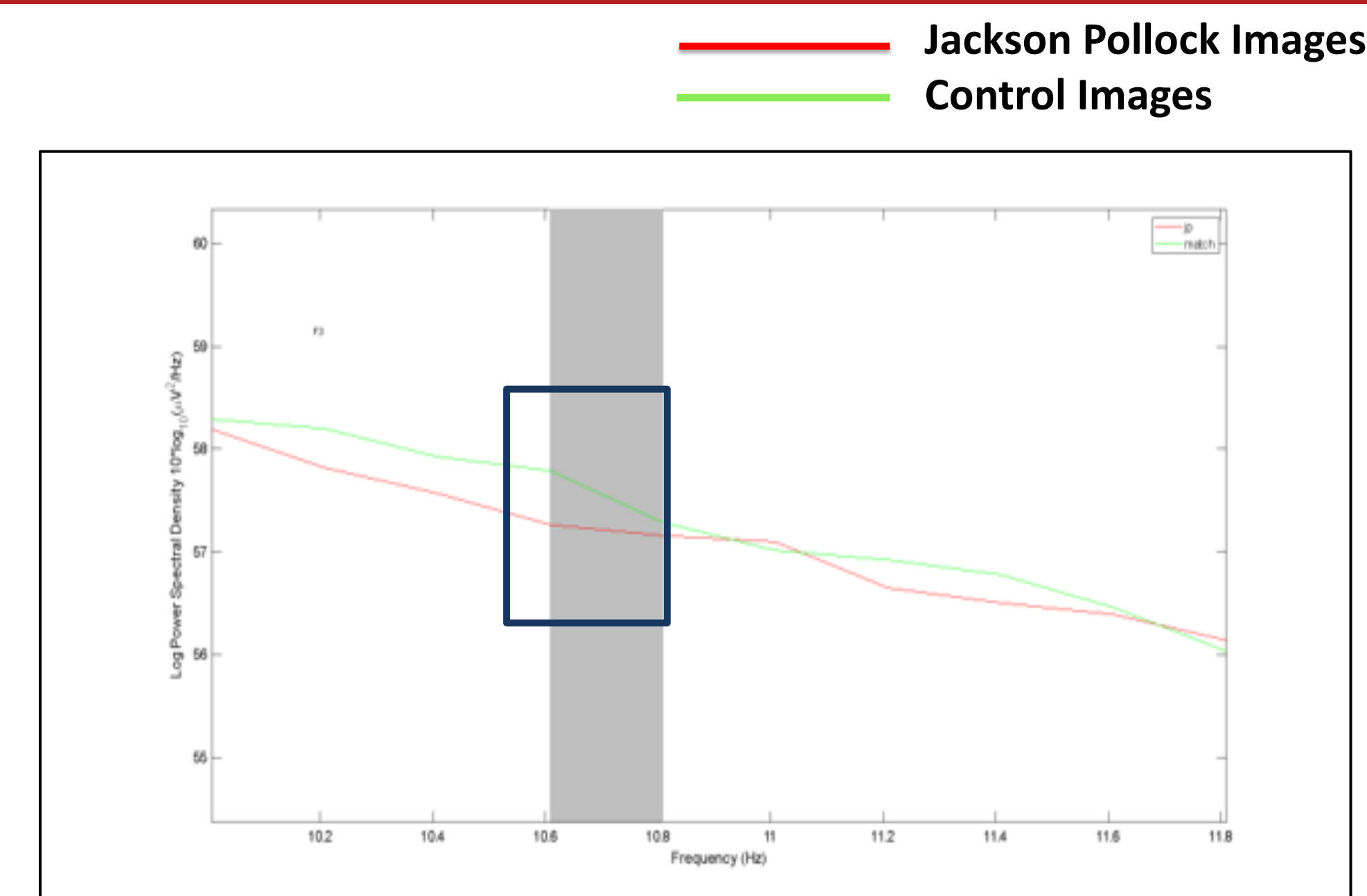
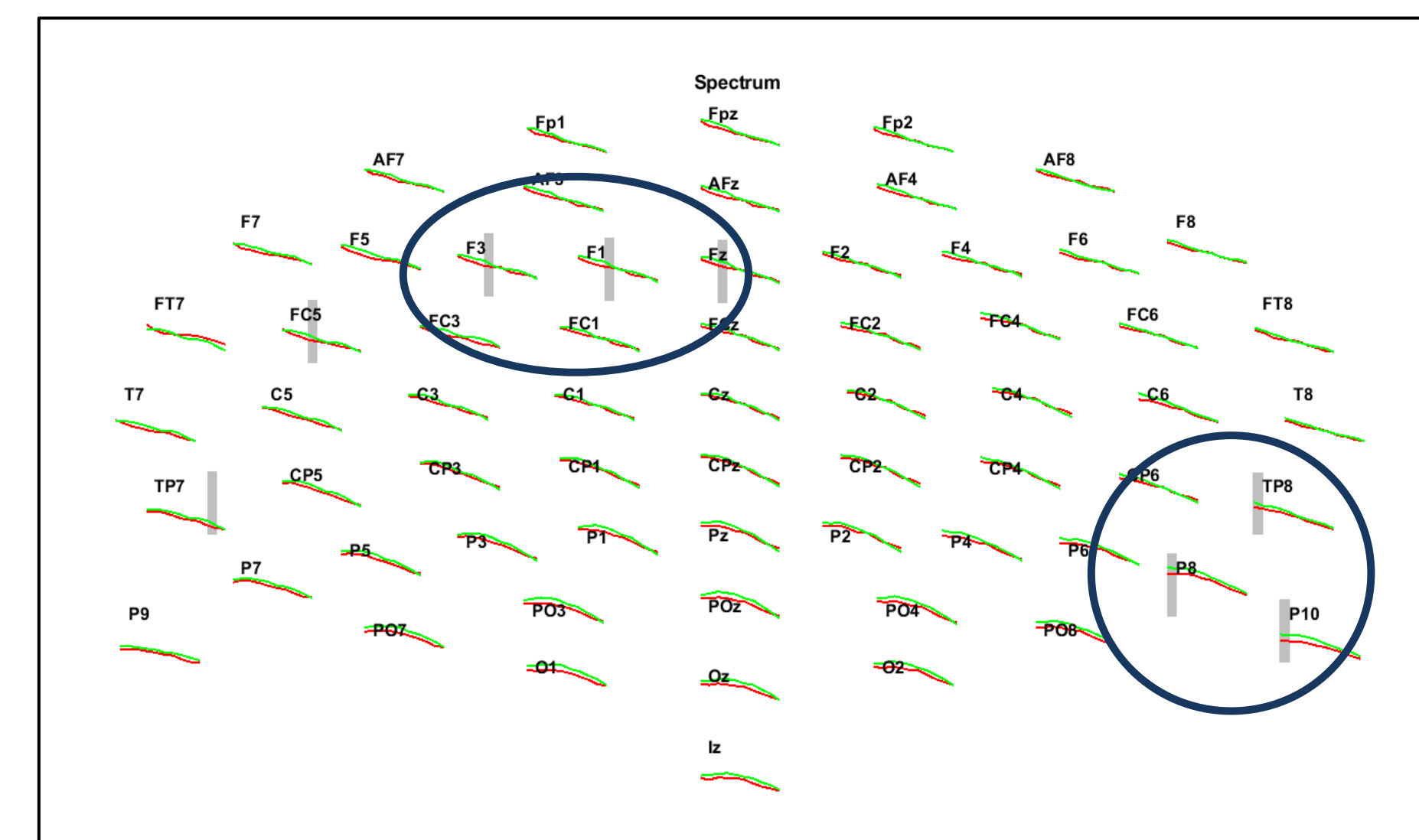
"How creative do you think this image is?"

"To what degree do you see any shapes or patterns in this image?"

"If you see any shapes or patterns, what do you see?"

RESULTS

EEG

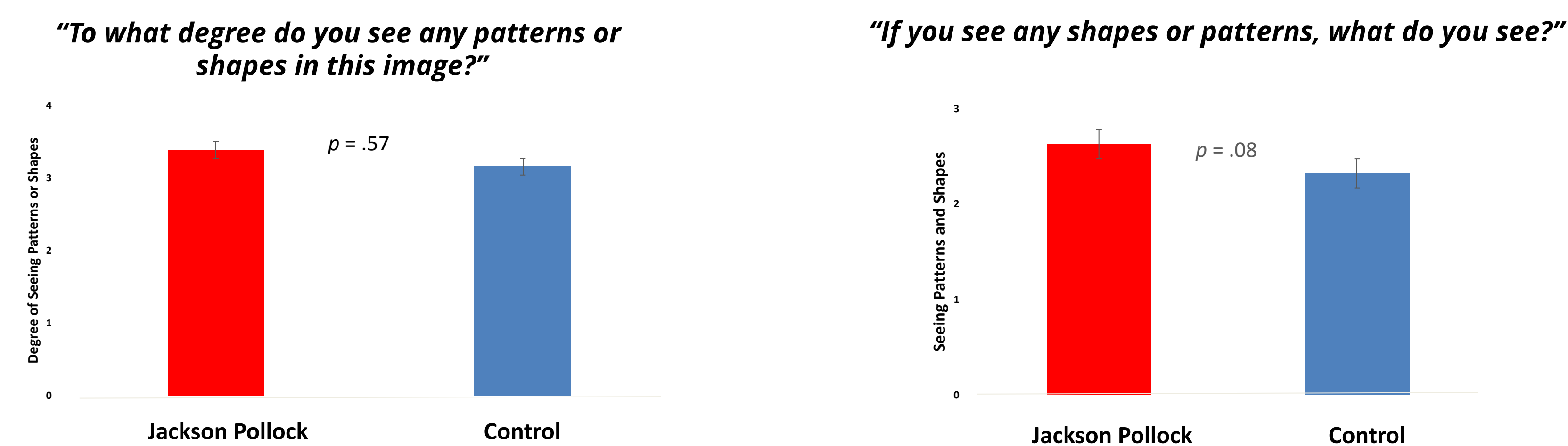


Between-condition differences in two areas: **dorsal frontal** (Fz, F1, F4) and **right parietal** (P8, P10, TP8).
Higher alpha power in Control condition than for Pollock condition.
Alpha waves are neural oscillations in the frequency range of 8-12 Hz.

JACKSON POLLOCK VS CONTROL



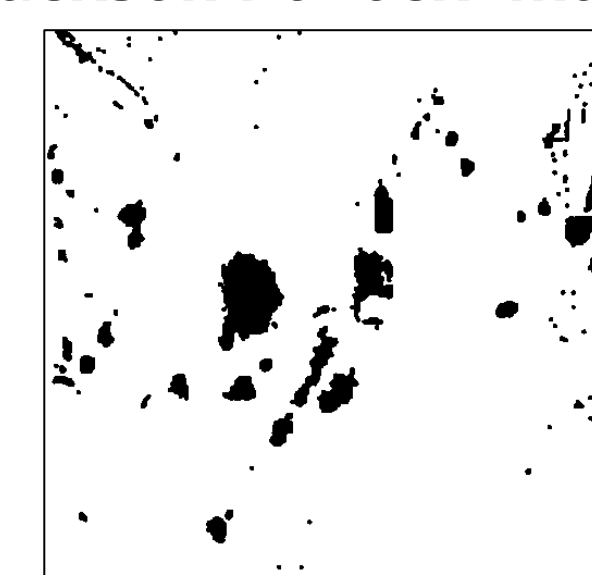
Participants preferred artistic images over mathematical control images ($p < .001$);
Participants found artistic images to be more creative than control images ($p = .007$)



Participants did not see more (or less) images in art vs. control images, but interestingly, if they did see patterns, they tended to see more creative shapes in art images.

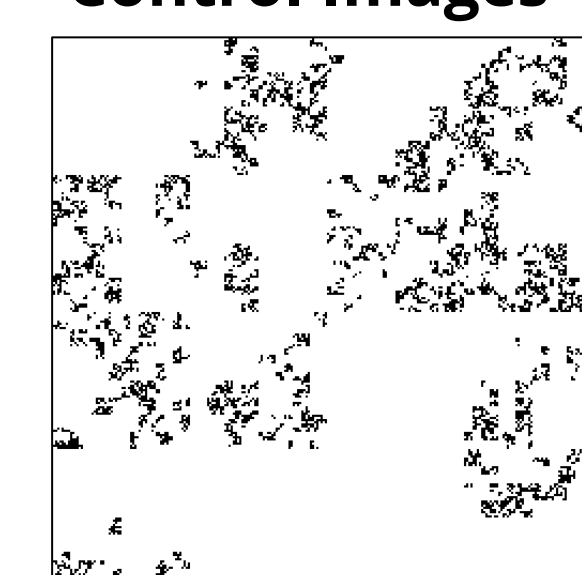
SAMPLE FRACTAL FREE-RESPONSES

Jackson Pollock Images



"I see a British soldier wearing a big fuzzy hat."

Control Images



"This is the outline of a raccoon digging through garbage."

CONCLUSIONS

- Prior evidence suggests that alpha power increases as internal attentional demands increase.
- In this study, higher alpha activity in the frontal region may indicate less active engagement with the control images.
- Prior evidence suggests that higher alpha power in the right parietal region corresponds to a deactivation of the right temporoparietal junction, which might reflect an inhibition to reorient to the task stimuli in this study.
- Participants preferred the art images over the control images.
- Participants also rated the Jackson Pollock white layers as more creative than the control image.

FUTURE DIRECTIONS

- Investigate differences by mechanism and by brain region to track complexity of artistic and mathematical fractal patterns
- Investigate transient brain states via EEG microstate analysis when viewing fractal patterns

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