Psilocybin Drives Idiosyncratic Brain Responses to Movies

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Background and Questions

- Ingestion of psilocybin ("magic mushrooms") causes changes to perception[1], emotion[2], memory[3], reasoning[4], and more[5]
- To what extent are such changes similar or idiosyncratic across subjects?
- Where in the visual processing pathway are perceptual changes associated with altered neural representations?
    - As early as V1, or only in higher-order regions?
- How does psilocybin alter encoding and memory of narrative information?
- How does psilocybin alter large-scale brain activity during naturalistic perception, and how does this differ from alterations during task and task-free conditions?

Methods

- 13 participants (of a planned 30) received 10mg/70kg psilocybin or placebo on separate visits
- Beginning ~60 minutes post-dose, participants watched one hour of short audiovisual movies during fMRI
- Movies were segmented into events by human raters
- Intersubject brain similarity during movie watching was measured via:
    - Intersubject pattern correlation (pISC), i.e. ISC of parcel-wise multivoxel patterns averaged over movie events[6] (Fig. 1)
    - Temporal intersubject correlation (tISC), i.e. ISC of each voxel's timeseries[7] (Fig. 2)
    - Inter-regional brain coupling was assessed via intersubject functional connectivity analysis (ISFC), i.e. tISC between brain regions[8] (Fig. 3)
- Coupling of visual brain activity to stimulus was assessed by fitting a model of low-level visual features to predict voxel timeseries

Bonus Materials and Contact

Figure captions

Movie stimuli

References

Twitter

Lab Website

Results

Figure 1— Psilocybin reduces intersubject pattern correlations (pISC) across cortex

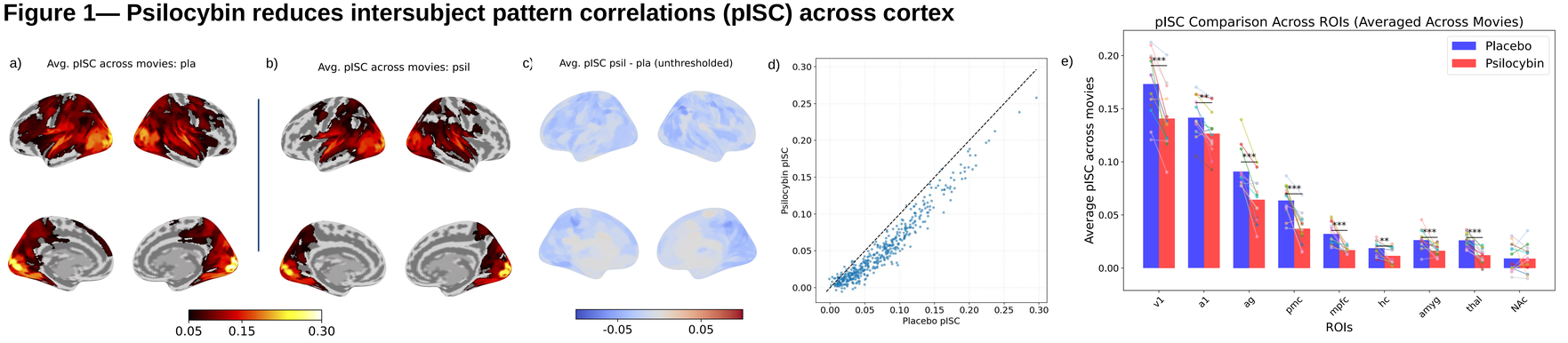
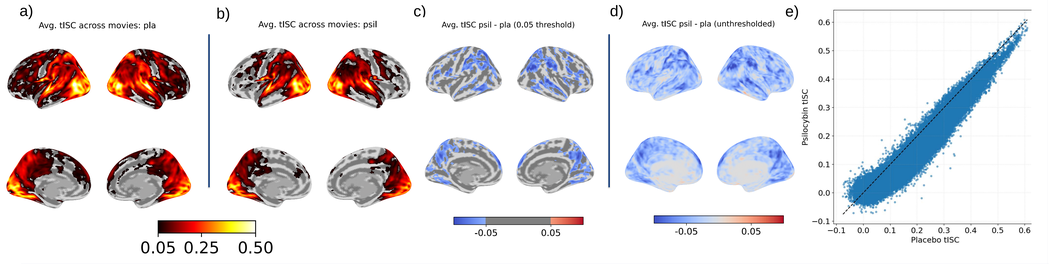


Figure 2: Psilocybin reduces temporal intersubject correlations (tISC) across cortex



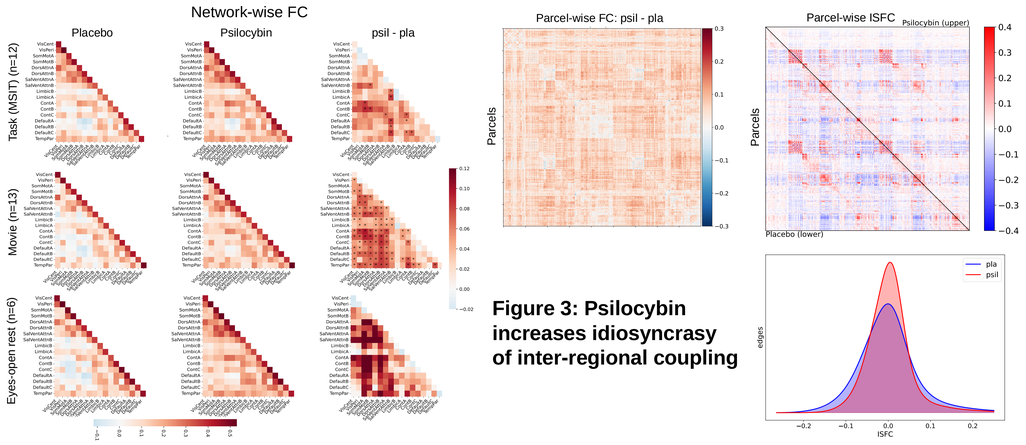
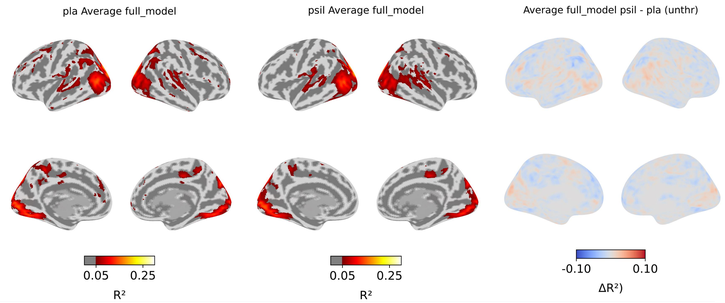


Figure 3: Psilocybin increases idiosyncrasy of inter-regional coupling

Figure 4: Low-level visual stimulus features predict visual responses equally across drugs



Conclusions

- Psilocybin reduced temporal, spatial, and interregional ISC across the whole brain, likely reflecting idiosyncratic changes to perceptual and cognitive representations of audiovisual narratives
- Despite reduced ISC in V1, a model of low-level visual features predicted visual responses equally across drug conditions, raising questions about top-down influence on sensory processing in the production of illusions and hallucinations
- Psilocybin increased FC between most brain regions and networks but caused ISFC to move towards 0 (uncorrelated). This may suggest psilocybin causes spatially widespread effects that are consistent across subjects but unrelated to the stimulus