Breaking Through the Veil of Perception:
Image Reconstruction of DMT Induced Psychedelic States

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Background

N,N-Dimethyltryptamine (DMT) is a psychedelic compound that produces profound alterations to consciousness.

- DMT creates "breakthrough" experiences, where users report encountering other-than-self social agents and entering vivid immersive 'worlds' (Michael, Luke, & Robinson, 2021)
- Theorized that the 'breakthrough' immersion is physiologically similar to dreaming during REM sleep (Timmermann et al. 2019).
- Neuroimaging data cannot account for complex subjective experiences alone.

Image reconstruction uses neuroimaging data and deep neural networks to create high-fidelity images of what a person is seeing. (Li 2024)

- Bayesian estimation reconstructions produce more coherent images of mental imagery from partial or abstract brain data. (Koide-Majima, Nishimoto, & Majima, 2024)

Using Bayesian Estimation, image reconstruction can provide a method to validate and quantify shared phenomenological elements reported in DMT experiences.

Method

Participants

Twenty healthy adults (50% male, 50% female) aged 24 to 37 (M_{Age} = 30.5, SD = 3.73), all with prior experience with psychedelic substances, were selected.

Research Design

This study follows a within-subjects design using the methods of Timmermann et al. (2023) with modifications to evaluate the subjective experience through image reconstruction.

Procedure

Participants received either 20 mg of DMT in 10 mL saline or 10 mL saline placebo intravenously while lying in an fMRI scanner with EEG monitoring. Post-session, participants completed the Mystical Experience Questionnaire (MEQ-30) to assess the intensity and quality of the psychedelic experience.

Results

Repeated Measures ANOVA: Evaluated differences in brain activity between DMT and placebo conditions. Found significant differences in global brain connectivity between the two conditions, $F(1, 19) = 15.62$, $p < .001$
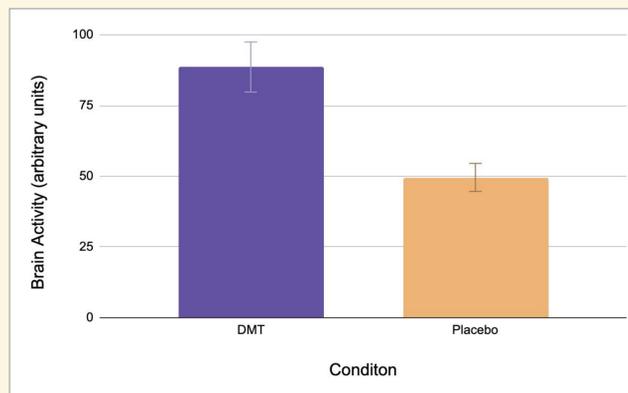

Linear Regression: Assessed the correlation between brain activity and the visual quality of the reconstructed images. Indicates a positive linear relationship with a significant correlation coefficient ($p < .05$).
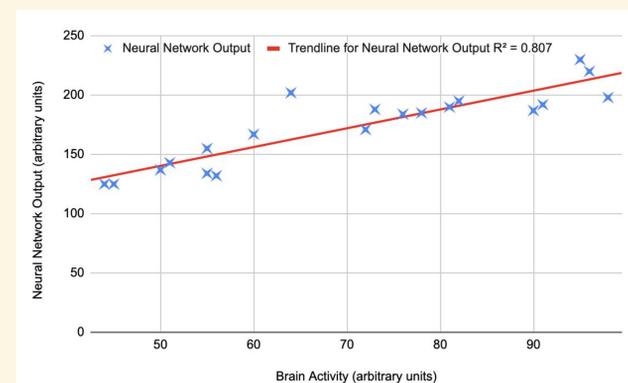
Pearson Correlation: Aimed to determine if higher MEQ-30 scores were correlated with more vivid or coherent reconstructed imagery. Results indicated a moderate positive correlation $r(18) = .837$, $p < .01$

Reconstruction

V1   V2   V3

V4   HVC
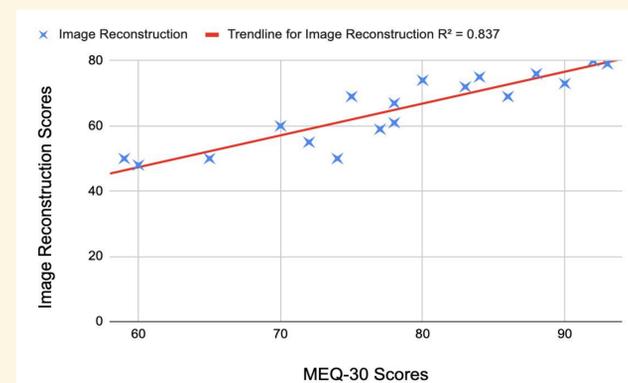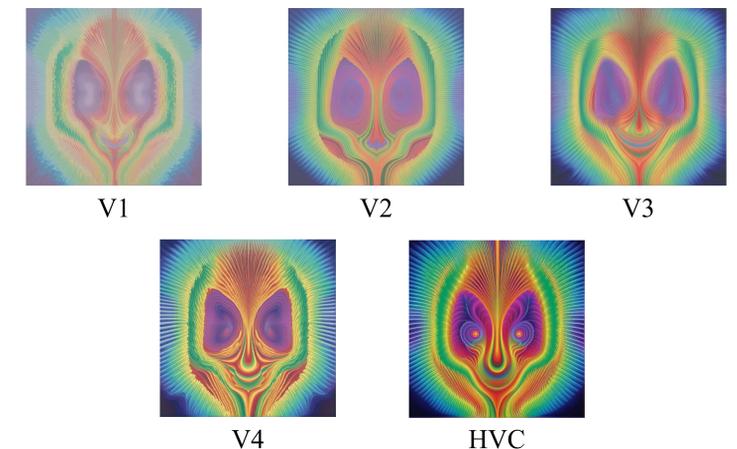
Conclusion

- Image reconstructions using Bayesian estimation can capture the semantic qualities of DMT experiences, such as the silhouettes of the 'entities' and geometric patterns.
- Bridges the gap between quantitative and qualitative measures
- Provides efficacy that Bayesian estimation image reconstruction can be a suitable method to apply to mental imagery of psychedelic experiences.
- Image reconstruction model needs to be refined in order to be more effective when validating the mental imagery.

References

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IMPORTANT NOTE: This study was not conducted and the data are fabricated.

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