May 2nd, 12:00 AM

Brain Connectivity Pattern Changes Associated With Psychedelic-Assisted Psychotherapy

Prince Patel
Rowan University

Samrat Gollapudi
Rowan University

Brian Joseph Mathew
Rowan University

Bhaumik Patel
Rowan University

ROWAN-VIRTUA
School of
Osteopathic Medicine

Brain Connectivity Pattern Changes Associated With Psychedelic-Assisted Psychotherapy

Prince Patel (OMS-II), Samrat Gollapudi (OMS-II), Brian Mathew (OMS-II), Bhaumik Patel (OMS-IV)

Background

- In recent years, psychiatric disorders (including depression, anxiety, post-traumatic stress disorder, schizophrenia, etc.) have become increasingly prevalent, posing a significant challenge for global healthcare.[8,10,11]
- Conventional treatment options , including pharmacotherapy and psychotherapy, often have limitations in efficacy, tolerability, and long-term sustainability.[8,10,11]
- Psychedelic-assisted psychotherapy (PAP) has resurfaced, after its classification as an illicit substance, and has shown promising therapeutic benefits in a growing body of research and are being investigated for their ability to induce profound transformative psychological experiences in controlled settings.
- There is little consensus, however, on the mechanism by which psychedelics provide this therapeutic effect.
- Investigating the specific alterations in brain connectivity associated with PAP is a crucial avenue for understanding its correlation with therapeutic outcomes such as enhanced emotional processing, increased introspection, and shifts in one sense of self and reality.[8,10,11,19,20]
- Neuroimaging studies via functional MRI (fMRI), have revealed insight into these changes.

Significance

- This data holds significant promise in optimizing the therapeutic potential of psychedelics for varying conditions, and in limiting the potential risks involved.
- This information serves to bridge the gap between neurobiological research and the practical implementation of these therapies.

Methods

- The “PubMed” and “Google Scholar” databases were searched for peer-reviewed studies using the following terms: “Psychedelic and connectivity”, “Psychedelic and therapy and connectivity”, “Psychedelic and fMRI”, “Psilocybin and connectivity”, “Psilocybin and therapy and connectivity”, “Psilocybin and fMRI”.
- The search was performed on 12/1/23
- Only studies involving the following major classes of psychedelics were included: lysergic acid diethylamide (LSD), psilocybin, and ayahuasca.
- Outcomes were measured via fMRI in all included studies.

Results

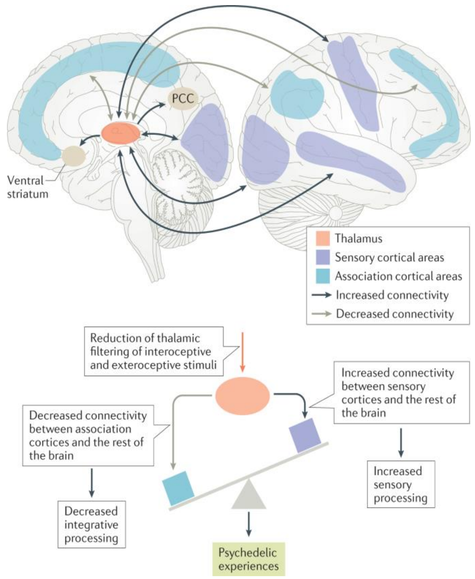

Figure 4: One proposed mechanism for the action of psychedelics involving the cortico-striato-thalamo-cortical loop. (Vollenweider et al. 2020)

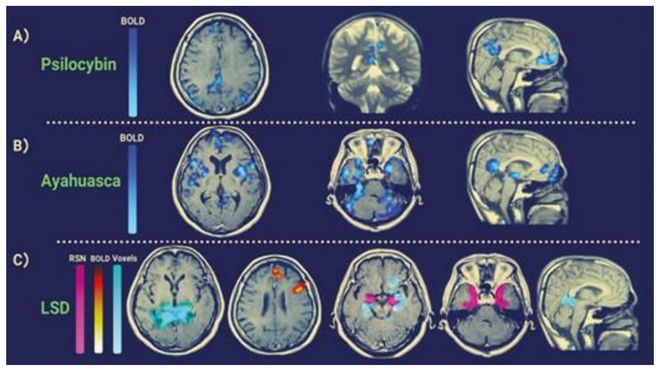

Figure 1: fMRI activity patterns of the various psychedelics on regions of the DMN. Orange represents increases in FC between the seed at the parahippocampus, and cyan/blue signifies decreases. Pink is a mask of the parahippocampal gyrus. (A) Blue BOLD signals represent significant brain deactivations after psilocybin compared with placebo. (B) Significant BOLD decreases of the DMN after the ingestion of Ayahuasca. (C) Between-group differences (LSD vs placebo) in the FC between a key DMN node (bilateral hippocampal seed) and the rest of the brain. Blood-oxygen-level-dependent (BOLD), Default mode network (DMN), Functional connectivity (FC). (Gattuso et al. 2023)

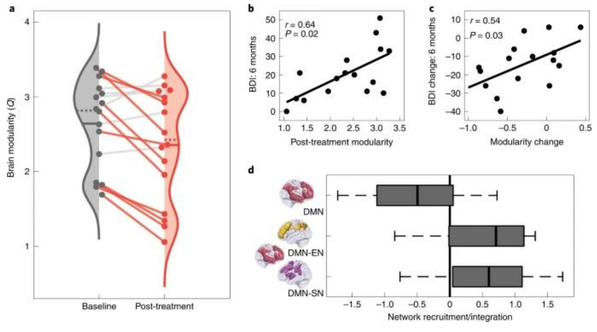

Figure 2: LSD significantly increased functional connectivity (FC) between the left or right thalamus and 104 of 130 investigated regions of interest (ROI) relative to placebo. Positive FC is shown in red, negative rFC is shown in blue. (Muller et al. 2017)

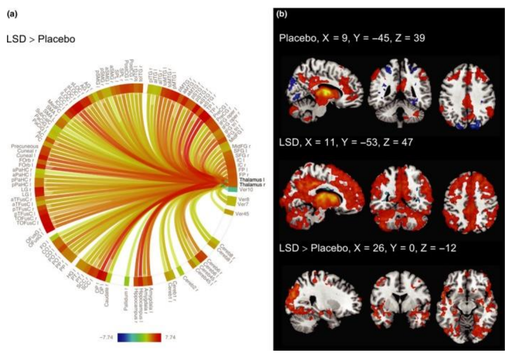

Figure 1: Brain modularity significantly reduced, indicating a global increase in brain network integration following psilocybin therapy in patients with treatment resistant depression. Post-treatment change in brain modularity significantly correlated with treatment response. Default mode network (red) recruitment decreased and its between-network integration with the executive network (gold) and salience (purple) increased following psilocybin therapy. (Daws et al. 2022)

References:

Discussion

Based on the evidence, a clear association can be made between psychedelic use and the following:

- Significantly increased global brain functional connectivity.[5,15,16,18]
- Significantly decreased functional connectivity of the DMN with a simultaneous increase in between-network connectivity with the rest of the brain.[8,13,17]
- Significant reduction in thalamic gating (filtering) of the flow of internal and external sensory and cognitive information from the thalamus to the cortex.[6, 13, 15, 19]

- These results point towards a unique shift in neural networking following psychedelic use. The results reflect a shift from a modular, segmented brain to a more fluid and interconnected one.
- According to the proposed CSTC model, the reduction of thalamic filtering may lead to an increase in sensory processing that is not counterbalanced by integrative processing in association cortices. This increase in inter-network sensory processing with a contrary decrease in associative processing with other networks could explain the unique psychedelic state defined by heightened sensation, hallucination, and ego dissolution.

Limitations & Future Directions

- A major limitation of these results is that there is currently no standardized guidelines for clinical practice of psychotherapy accompanied by psychedelic medications. Variables such as time, dosage, and associated guided psychotherapy were not standardized amongst the studies.
- Future studies can further evaluate specific differences between the major psychedelics for varying conditions with the goal of tailoring therapy to best optimize outcomes and ultimately the development of a standardized therapy.