



# DECREASED MENTAL TIME TRAVEL TO THE PAST CORRELATES WITH DEFAULT-MODE NETWORK DISINTEGRATION UNDER LSD

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## BECKLEY / IMPERIAL RESEARCH PROGRAMME

### What is this study about?

Mental time travel refers to the ability to think about future or past, to recollect aspects of past autobiographical episodes or imagine future experiences. This study is part of a larger study using brain imaging to give us the first insights into what happens to the brain to produce LSD's psychedelic (and possible therapeutic) effects.

### Why did we do this study?

- Spontaneous mental time travel (happening during mind wandering) has been previously linked to an activity in a particular brain network – the Default Mode Network (DMN).
- Our research has shown that both psilocybin and LSD decrease the activity of the DMN. This effect is a key factor in the ability of these substances to induce “ego dissolution,” an experience of the loss of the sense of self.
- Research has shown that people with greater connectivity in the DMN tend to reflect on the past more, engage in more ruminative thought, and suffer from depression and general low mood.
- We hypothesised that if LSD reduces mental time travel, through reducing the connectivity within the DMN, it could potentially help people suffering from depression.
- **Here we wanted to know: How do psychedelics affect mental time travel? Does this relate to changes in the connectivity within the DMN?**

### What did we do?

- We gave 19 people either **LSD** (75µg intravenous) or **placebo** (saline) on 2 separate days.
- On each day, they then completed brain imaging (**fMRI**) to measure activity during eyes-closed **rest**.
- After brain imaging participants answered the questions: ‘What was it like in the scanner?’, ‘Did you daydream in the scanner, and if so, what did you daydream?’, ‘Was the experience dreamlike at all, and if so, how?’, ‘Did you experience any personal thoughts or feelings at any point?’).
- The transcripts of their answers (**mentation reports**) were scored to calculate all the instances referring to the past, present or future, taking into account both grammar and semantics. All 38 reports were scored by independent raters who did not know who or under what drug condition the report had been done.

### About the research team

Amanda Feilding is the founder and director of the Beckley Foundation. She and David Nutt are Co-Directors of the Beckley/Imperial Research Programme. Robin Carhart-Harris is the Programme's lead investigator. Jana Speth is a researcher at Dundee University who collaborated with our Research Programme.

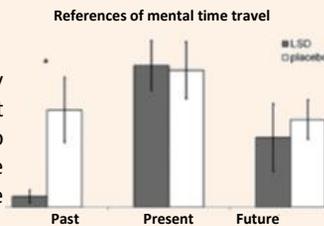
### What did we find?

#### 1. Reports after LSD were longer.

In general, participants delivered longer reports (in terms of word count) after LSD.

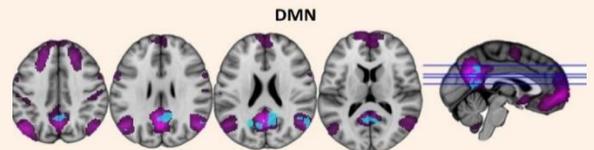
#### 2. Mental time travel to the past was reduced.

- There were significantly fewer references to the past after LSD, compared to placebo – but no difference in terms of references to the future or present.



#### 3. Decreased mental time travel to the past correlated with change in the DMN connectivity.

- After LSD, **DMN integrity** (connectivity within network) was **reduced** (in blue).



- Resting state Default Mode Network integrity correlated with the number of references to the past. I.e. the stronger was disintegration within the DMN, the fewer instances of mental time travel to the past were recorded.

### Why is this important?

- These outcomes shed light on the cognitive effects of LSD and specifically a decomposition of the ‘narrative-self’ or ‘narrative identity’, which is strongly associated with thinking about one’s own past.
- The ability of LSD to act on the DMN – a key neural circuit in depression - could represent a major opportunity for therapists looking for novel methods of combating depression. At present, several mindfulness-based treatments for depression encourage patients to adopt a more present-focused mode of thinking, and the capacity of LSD to inhibit the DMN could potentially help more patients achieve this.
- In future we need to investigate how long after the acute effects of the drug wear off the decrease in mental time travel and effects on the DMN persist.