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Psychedelic discourse: a neurolinguistic approach to LSD and psilocybin

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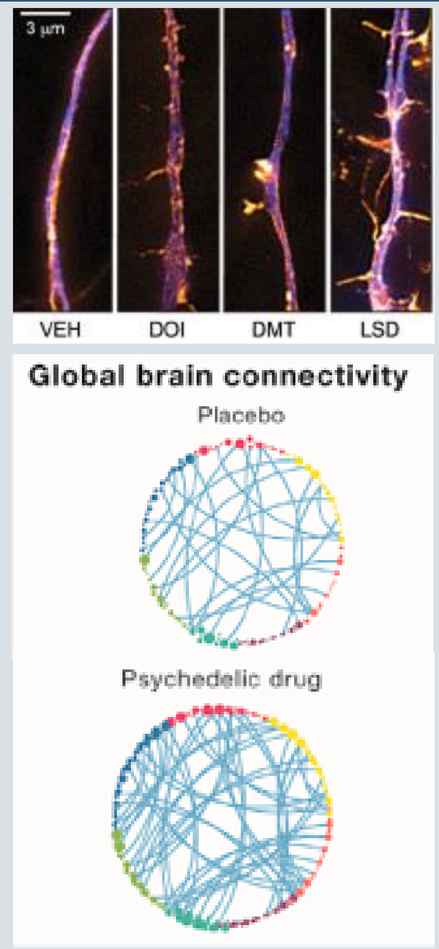
Background & Objective

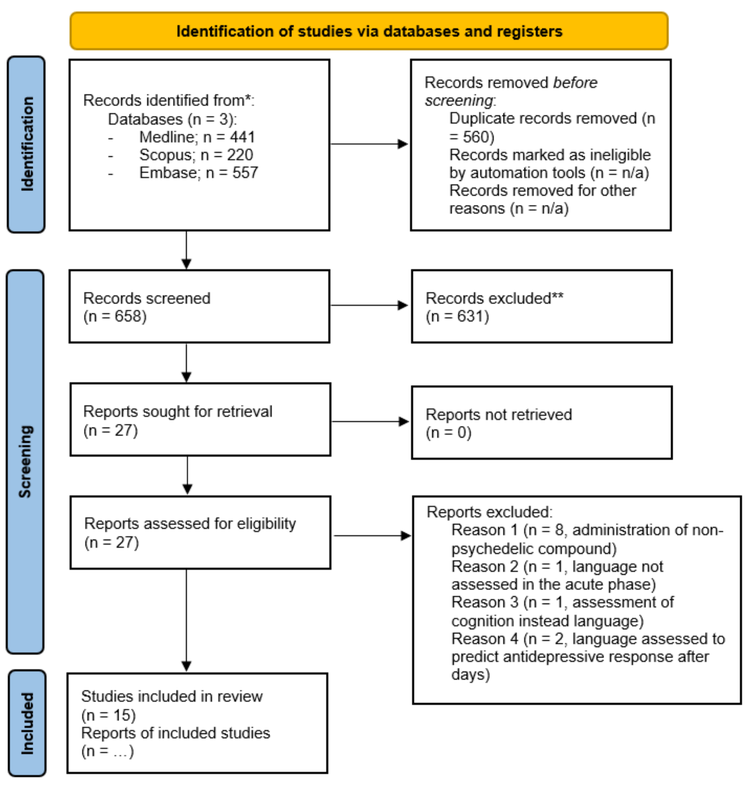
Psychedelics can induce long-lasting neuroplasticity (sprouting of new dendrites, spinogenesis and synaptogenesis) particularly in the V layer of the cortex populated by projecting neurons.
The macroscopic counterpart is the rearrangement of brain networks and circuits with an overall reduction of direct functional connectivity (FC) and an increase of indirect FC in the whole-brain, which highlights a pattern of hyper-connectivity and increased entropy.

Language is instantiated in the brain and the interdependence of multiple regions is crucial to the elaboration of different linguistic dimensions (syntax, semantics, pragmatics etc.).
Therefore, psychedelics should have an impact on the different linguistic categories, despite little is known up to date due to the sparse and conflicting findings.

Given these premises the current review aims at identifying different patterns of alterations under the effect of psychedelic compounds, depending on the specific linguistic category. This may provide evidence on the specific impairment of some linguistic categories over others, thus pave the way for the assessment of such alterations of language within the context of clinical trials on psychedelics.



Methods



Key words:
(LSD OR (lysergic AND acid) OR psilocybin OR DMT OR dimethyltryptamine OR mescaline OR psychedelic* OR hallucinogen*)
AND
(language OR linguistic* OR speech OR semantic* OR synta* OR discourse OR vocabulary OR phonem* OR phonology OR pragmatic* OR metaphor* OR irony)

Inclusion criteria:
- Studies written in English assessing language production under the effect of any psychedelic compound

Exclusion criteria:
- Studies on written reports or speech samples collected after the psychedelic experience or on memories related to the experience
- Intake of other substances (MDMA, ketamine) or other compounds inappropriately called psychedelics.

Results

Reference	Participants	Dose	Task	Speech			Lexical					Semantics - Pragmatics				
				Vocalization	Pause	Turn	N.of words	Word frequencies	Type/Token	Pos	Text content	Priming	Distance	Content	Graph	Metaphor
Amarel et al., 1965	10 alcohol addicted	LSD 100-200 µg	Asked to talk about - themselves - their family - the group				↓ volubility – sum of words						↑ cloze probability			
Gouzoulis-Mayfrank et al. 1998	12 healthy physicians	0.2 mg/kg psilocybin vs placebo, on two sessions	Lexical decision task									↑ indirect				
Jaffe et al., 1972	7 participants in psychotherapy	50-120 µg LSD, and a matching placebo. Each subject received each drug 7 times.	Conversatinos with psychoterapist	= monologues	↑ monologues											
Jaffe et al., 1973	7 participants in psychotherapy	50-120 µg LSD, and a matching placebo. Each subject received each drug 7 times.	Conversatinos with psychoterapist	= dialogues	↑ dialogues											
Landon and Fischer, 1970 [written texts]	2 university instructors	Psilocybin 80 µg/kg	Asked to recall and describe previous more intense experiences (160 µg/kg)							↑ Coordinates ↓ Embedding	↑ Concrete					
Martindale and Fischer, 1977 [written texts]	1 participant under psicoloc ybin	4 sessions, different doses: -160 µg -80 µg -80 µg -200 µg	Different tasks in each session								↑ Primary process content LWIC-like					
Natale, 1979a	7 neurotic depressives participants	50-100mg LSD, and a matching placebo. Each subject received each drug 7 or 8 times	5 minutes to talk about any topic that came to mind								↓ Non personal reference = Negators = Qualifiers = Retractors ↓ Explaning = Expresssions of feeling ↓ Evaluators					
Natale, 1979b	7 neurotic depressives participants	120 µg of LSD or placebo	Transcript of sessions of psychotherapy			↑ Matching of speech rhythm										
Natale et al 1978b	3 male psychoanalitic patients	LSD 50-100 µg vs placebo 7 times (21 experiments)	Transcript of sessions of psychotherapy													↑ Novel metaphors
Sanz et al., 2021	20 healthy participants	LSD 75 µg ev vs placebo	Subjects asked to report spontaneous thoughts and feelings after infusion.				↑ Word Count		↑ Shannon's Information Entropy	= Number of different PoS words	= Semantic similarity with "visual", "pattern", "relax", "listen", "mood", "stimulate", "normal", "ego", "fear", "reality"		↑ Semantic Variability		↓ Global* ↑ Local*	
Sanz et al., 2022	34 healthy participants	Psilocybin microdoses (0.5 g of psilocybin mushrooms)	Subjects asked specific questions on their mood and feelings				↑ Verbosity				↑ Sentiment Analysis		= Variability			
Spitzer et al., 1996	8 healthy participants	0.2 mg/kg psilocybin vs placebo, on 2 different sessions	Semantic priming									↑ indirect				
Wießner et al. 2023	24 healthy volunteers	50 µg LSD vs placebo	-Experience reporting: "how are you feeling today?" -1 min storytelling				↓ Word Count				LIWC		↓ creative storytelling = experience reporting		↓ Global** ↓ Local**	

Conclusion

The most replicated findings, with exceptions likely due to the usage of different doses and routes of administration were:

-Decrease of the number of words spoken
- Semantics: increased spread of semantic activation
- Pragmatics: production of metaphors denoted by a greater novelty
- Syntax was simplified as the use of coordinated increased and the number of embedded clauses was reduced with an overall reduction in length of clauses and T-units
- The use of concrete words and words pertaining to the categories of primary process thinking was predominant.