Trauma, neuro-inflammation and psychedelic neuromodulation: the path forward

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Abstract

Trauma can cause both physical and psychological damage, followed by repair via inflammatory responses. In a normal setting acute inflammation induces healing, both physically and psychologically. Depending on genetic, epigenetic and microbiome factors this inflammatory process can become chronic, resulting in only partial healing with persistence of trauma associated symptoms. This chronic inflammation will alter the activity but especially connectivity within and between the three canonical cognitive networks in the brain. The triple network becomes dysfunctional, generating cognitive and autonomic symptoms and the emotional network becomes engaged at a resting state level, generating emotional problems.

Treatments exist, consisting of psychotherapy, EMDR and medication, yet sometimes these provide insufficient benefit. Non-invasive neuromodulation is a novel treatment approach that can target the triple network and has anti-inflammatory effects. Extending trauma treatment with psychedelics to disrupt pathological connectivity within and between the brain networks, and subsequently rebuilding the networks with neuromodulation such as transcranial magnetic stimulation and transcranial electrical stimulation may be the path forward.

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Biography of the Author

Dirk De Ridder, MD, PhD, is professor of Neurosurgery at the Dunedin School of Medicine, University of Otago in New Zealand and runs a private clinic in Belgium. He is also associated with Manipal University in India, and teaches at the University of Bonn in Germany.

His research is based on 2 pillars: 1. Network science, in which any symptom is the emergent property of a changed network, and 2. the Bayesian brain concept, i.e. considering the brain as a predictive machine that updates its predictions by active exploration of the environment through the senses, as a way to reduce the inherent uncertainty in a changing environment. Phantom percepts are seen as a maladaptive network phenomenon due to deficient updating resultant from sensory deafferentation. Trauma and PTSD can be approached from a Bayesian perspective.

His main research interest is the understanding and treatment of phantom perceptions (tinnitus, pain), especially by use of functional imaging navigated non-invasive (TMS, tDCS, tACS, tRNS, LORETA neurofeedback) and invasive (implants) neuromodulation techniques.

The approach to unravel phantom percepts is by developing an understanding of commonalities in different diseases such as in thalamocortical dysrhythmias (pain, tinnitus, Parkinson disease, depression, slow wave epilepsy) and reward deficiency syndromes (addiction, OCD, Personality disorders, …). This has led to novel treatment approaches for neurological and psychiatric disorders.

He has developed "burst" and "noise" stimulation as novel stimulation designs for implants, and is currently working on multifocal or network stimulation, as well as reconditioning stimulation. Burst stimulation is commercialized by Abbott as BurstDR = Burst D(e)R(idder) stimulation.

Recently he has embarked in collaboration with the Departments of information Sciences and Computer Science at the University of Otago on artificial intelligence approaches for large scale pattern recognition of EEG brain signatures for pain, tinnitus and obesity.

He has written 40 book chapters and more than 300 pubmed listed journal articles. More than 170 articles relate to network approaches for brain disorders. This has resulted in a Google Scholar H-index of 74, with more than 20,000 citations and an i10 index of 249.