Cognitive network

- Capturing the Electrical Activity of all Cortical Neurons: Are Solutions Within Reach?
- PCSK9 expression and cancer survival: a prognostic biomarker at the intersection of oncology and geroscience
- Brain Structural Correlates of EEG Network Hyperexcitability, Symptom Severity, Attention, and Memory in Borderline Personality Disorder
- Biomarker changes associated with fornix deep brain stimulation in Alzheimer's disease
- The CAIDE dementia risk score indicates elevated cognitive risk in late adulthood: a structural and functional neuroimaging study
- Inflammatory, White Matter, and Neurodegenerative Mechanisms in Fluid Ability Decrements in Chronic Mild-to-Moderate Traumatic Brain Injury
- Regional free-water diffusion is more strongly related to neuroinflammation than neurodegeneration
- Theta bursts in patients with sleep-related hypermotor epilepsy: potential marker of impaired inhibitory control and its mitigation through musical stimulation

A cognitive network is a network that utilizes cognitive processes to improve its performance by adapting to environmental conditions and user needs. It incorporates intelligence into the network, enabling it to dynamically learn, optimize, and respond to changes in its environment. Cognitive networks are often associated with advanced telecommunications, computer networks, and artificial intelligence systems.

Key Features

Learning and Adaptation:

The network learns from historical data and real-time feedback.

It adapts its parameters, configurations, or behavior to optimize performance under varying conditions.

Decision-Making:

Uses algorithms to decide the best course of action for routing, resource allocation, or security. Decisions are made based on a combination of user needs, environmental constraints, and system performance. Awareness:

The network has awareness of its internal state (e.g., bandwidth, latency) and the external environment (e.g., interference, congestion). Autonomy:

Operates with minimal human intervention by automating processes such as troubleshooting, scaling, and optimization. Feedback Mechanism:

Collects and analyzes feedback to refine its operations over time. Applications of Cognitive Networks: Telecommunications: Dynamic spectrum allocation in cognitive radio networks. IoT: Managing large-scale IoT devices by optimizing network resources. Security: Identifying and mitigating cybersecurity threats in real-time. Cloud Computing: Optimizing workloads across distributed systems. Cognitive Network Architecture: Typically, a cognitive network includes:

Sensing: Collects data on network conditions, user demands, and external environments. Analysis: Processes the data using machine learning and data analytics. Decision-Making: Determines the optimal action based on the analysis. Action: Implements the decision to improve network performance. Learning: Updates models and policies based on outcomes and feedback. Cognitive networks represent the convergence of networking and AI, aiming to make networks smarter, more efficient, and better suited to modern applications.

Observational studies

A study attempted to elucidate whether deep brain stimulation for Parkinson's disease alters the functional connectivity pattern of cognitive networks.

The study obtained fMRI and cognitive scale data from 37 PD patients before and after the DBS surgery. Seed-based FC analysis helped demonstrate the FC changes of the default mode network (DMN), executive control network (ECN), and dorsal attention network (DAN).

PD patients indicated significant network connectivity decline in DMN [such as in right precuneus, left angular gyrus, and left middle frontal gyrus (MFG)], ECN [such as in left inferior parietal gyrus, left MFG, and left supplementary motor area (SMA)], and DAN [such as in left inferior frontal gyrus and left MFG] post-DBS surgery. The phonemic fluency score was positively associated with the FC value of the right precuneus and left angular gyrus in DMN before DBS.

The general reduction in FC in the major cognitive networks after DBS surgery depicted the presence of the corresponding network reorganization. Further research can help explore the mechanism of impaired cognitive function post-DBS [1)]

This study provides meaningful insights into the effects of DBS on cognitive network connectivity in PD, highlighting significant FC declines in major networks during the microlesion period. However, the small sample size, absence of a control group, and limited cognitive assessments constrain its conclusions. Further research with more robust designs and longer follow-ups is essential to deepen our understanding of DBS-induced cognitive changes and their clinical implications.

1)

Luo B, Zou Y, Yan J, Sun J, Wei X, Chang L, Lu Y, Zhao L, Dong W, Qiu C, Yan J, Zhang Y, Zhang W. Altered Cognitive Networks Connectivity in Parkinson's Disease During the Microlesion Period After Deep Brain Stimulation. CNS Neurosci Ther. 2024 Dec;30(12):e70184. doi: 10.1111/cns.70184. PMID: 39722165.