Reasoning

Reasoning is the cognitive process of thinking logically, drawing conclusions, and making decisions based on available information, evidence, and principles. It involves the ability to analyze and evaluate information, identify patterns and relationships, and apply logical and critical thinking to reach logical and well-supported conclusions.

Reasoning can be categorized into different types, including deductive reasoning and inductive reasoning:

Deductive Reasoning: Deductive reasoning starts with a general premise or set of principles and uses logical steps to reach a specific conclusion. It follows the pattern of moving from the general to the specific. For example:

All men are mortal. Socrates is a man. Therefore, Socrates is mortal. Inductive Reasoning: Inductive reasoning starts with specific observations or evidence and uses them to draw general conclusions. It follows the pattern of moving from the specific to the general. For example:

Every cat I have seen has fur. Therefore, all cats have fur. Reasoning involves the use of critical thinking skills, such as analyzing information, recognizing biases, evaluating arguments, and identifying logical fallacies. It requires the ability to consider different perspectives, weigh evidence, and make informed judgments.

Effective reasoning relies on accurate and relevant information, as well as a solid understanding of logical principles and principles of inference. It is an essential skill in problem-solving, decision-making, scientific inquiry, and many other aspects of life.

Executive functions (collectively referred to as executive function and cognitive control) are a set of cognitive processes that are necessary for the cognitive control of behavior: selecting and successfully monitoring behaviors that facilitate the attainment of chosen goals. Executive functions include basic cognitive processes such as attentional control, cognitive inhibition, inhibitory control, working memory, and cognitive flexibility. Higher-order executive functions require the simultaneous use of multiple basic executive functions and include planning and fluid intelligence (i.e., reasoning and problem-solving).

Executive function in people with depression is linked to the integrity of white matter fibers in the brain. Ma et al. hypothesized that the maze tests in neuropsychological tests assessed reasoning and problem-solving abilities dependent on the integrity of brain white matter fibers, and assessed this relationship using diffusion tensor imaging (DTI) in depressed patients and healthy controls.

Participants aged from 18 to 50 years were recruited from Zhumadian Second People's Hospital from July 2018 to August 2019. The sample included 33 clinically diagnosed individuals with major depressive disorder (MDD) and 24 healthy volunteers (HVs). All subjects underwent Neuropsychological assessment battery (NAB) maze tests and DTI. Tract-based spatial statistics technology in FSL software was used to process DTI data, and threshold-free cluster enhancement (TFCE) was used to perform multiple comparison corrections. The fractional anisotropy (FA) of white matter fibers in the MDD group and HVs group were compared and extracted. Pearson correlation was used to analyze the relationship between FA and NAB scores and HAMD scores.

The mean NAB maze test score for the MDD group was lower than the HVs group, and the difference was statistically significant ($F = 11.265$, $p = .037$). The FA value of the body of corpus callosum and cerebral peduncle right in the depression group was lower than that in the healthy control group, and the difference was statistically significant ($p < .05$). FA value of the body of corpus callosum was positively correlated with NAB score ($r = 0.400$, $p = .036$), but not with the HAMD score ($r = 0.065$, $p = .723$).

The decreased ability of reasoning and problem-solving in MDD may be due to the decreased integrity of the white matter fibers of the body of the corpus callosum [1].

Rapid and flexible learning during behavioral choices is critical to our daily endeavors and constitutes a hallmark of dynamic reasoning. An important paradigm to examine flexible behavior involves learning new arbitrary associations mapping visual inputs to motor outputs. We conjectured that visuomotor rules are instantiated by translating visual signals into actions through dynamic interactions between visual, frontal and motor cortex. We evaluated the neural representation of such visuomotor rules by performing intracranial field potential recordings in epilepsy subjects during a rule-learning delayed match-to-behavior task. Learning new visuomotor mappings led to the emergence of specific responses associating visual signals with motor outputs in 3 anatomical clusters in frontal, anteroventral temporal and posterior parietal cortex. After learning, mapping selective signals during the delay period showed interactions with visual and motor signals. These observations provide initial steps towards elucidating the dynamic circuits underlying flexible behavior and how communication between subregions of frontal, temporal, and parietal cortex leads to rapid learning of task-relevant choices [2].

[1]
Ma R, Luo Y, Liu S, Wang X, Guo H, Zhao M, Chen N, Liu P, Shi J, Li Y, Tan Y, Tan S, Yang F, Tian L, Wang Z. White matter abnormalities are associated with the declined ability of reasoning and problem-solving in major depressive disorder. Brain Behav. 2023 Jun 5:e3047. doi: 10.1002/brb3.3047. Epub ahead of print. PMID: 37278139.
[2]
Madhavan R, Bansal AK, Madsen JR, Golby AJ, Tierney TS, Eskandar EN, Anderson WS, Kreiman G. Neural Interactions Underlying Visuomotor Associations in the Human Brain. Cereb Cortex. 2018 Dec 27. doi: 10.1093/cercor/bhy333. [Epub ahead of print] PubMed PMID: 30590542.