Executive function

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.

Methods: 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.

Results: 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)].

Executive, emotional and social (EES) functions have likewise evolved during human development from contributing to primitive behaviors during infancy and childhood to being able to modulate complex actions in adults.

Beuriat address how the importance of the cerebellum in the processing of EES functions might change across development. This evolution is driven by the macroscopic and microscopic modifications of the cerebellum that are occurring during development including its increasing connectivity with distant supra-tentorial cortical and sub-cortical regions. As a result of anatomical and functional changes, neuroimaging and clinical data indicate that the importance of the role of the cerebellum in human EES-related networks shifts from being crucial in newborns and young children to be only supportive later in life. In early life, given the immaturity of cortically mediated EES functions, EES functions and motor control and perception are more closely interrelated. At that time,

the cerebellum due to its important role in motor control and sequencing made EES functions more reliant on these computational properties that compute spatial distance, and motor intent, and assist in the execution of sequences of behavior related to their developing EES expression. As the cortical brain matures, EES functions and decisions become less dependent upon these aspects of motor behavior and more dependent upon high-order cognitive and social conceptual processes. At that time, the cerebellum assumes a supportive role in these EES-related behaviors by computing their motor and sequential features. We suspect that this evolving role of the cerebellum has complicated the interpretation of its contribution to EES computational demands [2)].

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2)
Beuriat PA, Cristofori I, Gordon B, Grafman J. The shifting role of the cerebellum in executive, emotional and social processing across the lifespan. Behav Brain Funct. 2022 Apr 28;18(1):6. doi: 10.1186/s12993-022-00193-5. PMID: 35484543.