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Age-related changes in cognitive flexibility: fMRI meta-analysis

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Abstract

To examine neural mechanisms underlying cognitive flexibility changes with ageing, we synthesized findings from 87 fMRI studies, comprising 120 experiments with 2308 adult participants distributed across young, middle-age, and older groups. Our meta-analysis was focused on rule-retrieval and rule-discovery processes, assessed with Task-Switching Paradigm and Wisconsin Card Sorting Test, respectively. Activation Likelihood Estimation analyses revealed age-related decreases in brain activation related to general switching ability, particularly in posterior regions, alongside an anterior shift in older adults, consistent with the Posterior-Anterior Shift in Aging (PASA) model. Rule-retrieval tasks consistently engaged left-lateralized frontoparietal regions across all age groups, with middle-age adults additionally recruiting the right cerebellum and medial-frontal gyrus. For rule-discovery tasks, age-related decline was observed in bilateral frontoparietal regions, while older adults also showed unique activation in the left inferior-frontal gyrus. These findings highlight differential ageing trajectories for rule retrieval and rule discovery, potentially reflecting compensatory neural mechanisms and dedifferentiation processes.

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