MORE EFFICIENT MODULATION OF MIDFRONTAL THETA AND POSTERIOR ALPHA DURING THE CONSTRUCTION AND ELABORATION OF AUTOBIOGRAPHICAL MEMORIES IN INDIVIDUALS WITH HIGHLY SUPERIOR AUTOBIOGRAPHICAL MEMORY

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Background: Individuals with highly superior autobiographical memory (HSAM) represent a rare population with the exceptional ability to recall autobiographical information with remarkable precision and detail. While research has begun to explore the neural mechanisms underlying this extraordinary memory performance, the role of brain oscillations has not yet been investigated in HSAM individuals. Autobiographical memory retrieval involves a construction phase linked to strategic search and midfrontal control and an elaboration phase associated with perceptual reliving and posterior cortical activity, with theta oscillations potentially supporting construction and posterior alpha oscillations possibly contributing to sensory inhibition and visual imagery during the elaboration.

Aims: Here, we examined whether HSAM individuals exhibit distinct oscillatory signatures during AM retrieval, focusing on the flexible engagement of theta and alpha oscillations as a function of memory remoteness.

Methods: Three HSAM individuals and sixteen control participants retrieved older and newer autobiographical memories during EEG recording. Participants pressed a button to indicate memory access, marking the transition between construction and elaboration phases. We analyzed midfrontal theta oscillations during construction and posterior alpha oscillations during elaboration.

Results: Both groups showed increased theta during construction, but HSAM individuals exhibited a selective theta enhancement for older versus newer memories, indicating a more flexible and strategic engagement of retrieval control mechanisms for remote events. During elaboration, controls showed a transient posterior alpha increase followed by a decline, consistent with early sensory inhibition. In contrast, HSAM participants displayed no initial alpha enhancement, suggesting reduced reliance on inhibitory sensory gating.

Conclusions: These findings indicate that HSAM is associated with optimized oscillatory dynamics during AM retrieval. HSAM individuals flexibly recruit theta activity when required for strategic access to remote memories and show reduced alpha modulation during elaboration, possibly reflecting more automatic and vivid memory imagery. This distinct oscillatory profile shed light on the unique neural dynamics underlying HSAM individuals and offer new insights into how this phenomenon may be supported by highly efficient neuro-cognitive processes.

Keywords: Autobiographical memory, Retrieval, Theta power, Alpha power, Electroencephalography

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