Journal Club

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Distinct Neural Networks Support Autobiographical and Episodic Remembering

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Review of Chen et al.

Our memories for personally relevant events are extremely evocative and can transport us to our most cherished moments from the past. Consider, for example, the memory of visiting an amusement park as a young child. Multiple elements—the smell of fresh cotton-candy rolls being spun, the sounds of children screaming with joy in the bouncy house, the bright neon lights surrounding the arcade games, and the rush you experienced during your first roller coaster ride—all coalesce to create a memorable and vivid experience. Measuring and controlling for these experiential elements during the assessment of autobiographical memory, however, proves extremely challenging in the laboratory setting. Researchers therefore, opt for experimental testing paradigms that are thought to converge in principle with autobiographical remembering while ensuring adequate control over the strength of memories. Nevertheless, meta-analyses of functional neuroimaging data (Gilboa, 2004; McDermott et al., 2009) indicate that performance on these two types of tests recruit distinct neural regions. Therefore, a critical question emerges: do such dif-

ferences in neural network engagement reflect methodological differences across studies or are episodic and autobiographical memory fundamentally distinct constructs?

A recent study by Chen et al. (2017) addresses this important question. The authors sought to control for methodological differences between autobiographical and episodic remembering by using an elegant experimental design. In the study phase of their first experiment, young, healthy participants were asked to classify scenes as indoor or outdoor while in the scanner. The chosen scenes were familiar ones, such as a lecture hall or an airport, and were selected to induce vivid remembering of distinct memories. During retrieval, however, the authors altered the instructions to induce either self-generated autobiographical events or episodic retrieval of the stimulus attributes. Specifically, in the autobiographical retrieval condition (“life memory task”) for each scene, participants were instructed to remember a specific event from their past situated within a distinct spatiotemporal context. The airport scene for example, could cue the retrieval of a specific autobiographical experience such as going on a vacation. In the episodic retrieval condition (“picture memory task”), participants had to remember whether they had seen the scene during the study phase and to recall specific details about the stimulus. The emphasis placed on vivid remembering

ensured that the authors could later localize brain regions and networks that uniquely modulate the rich recall of information. In an important step, the authors further sought to control for the possibility that autobiographical memories, given their rich nature, could potentially elicit more vivid re-experiencing. A second experiment tackled this question by modifying mainly the response patterns at test to standard remember/know/new judgments from memory for both conditions. More specifically, instead of being asked to vividly recall a distinct spatiotemporal context associated with the stimulus, participants were now asked to make “remember” judgments when recollection was accompanied by details, “know” judgments when they had a gut feeling of familiarity, and “new” responses when scenes could not be recounted from memory.

The neuroimaging findings strongly suggested that dissociable neural networks are involved in the two memory types. In particular, autobiographical retrieval appeared to uniquely engage regions of the default-mode network, a distributed network comprising prefrontal, lateral parietal, cortical midline, and medial temporal regions implicated in internally directed cognitive activities such as remembering one's past, evaluating oneself, or envisioning one's future (Buckner et al., 2008). The distinct engagement of this network, however, could not be attributed

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solely to rich recollection of one's past, because results from the second experiment suggested that participants made significantly fewer remember responses on the autobiographical memory task. In contrast, successful retrieval on the picture memory task appeared to uniquely correlate with regions of the parietal memory network (medial parietal and intraparietal areas) and an anterior section of the frontoparietal control network (anterior prefrontal regions and middle frontal gyrus). These networks have been previously implicated in vivid memory recollection (Gilmore et al., 2015) and rapid adaptation and control based on task requirements (Vincent et al., 2008), respectively. The overlap of activated regions across autobiographical and episodic memory measures remained limited (to regions such as the middle frontal and medial parietal cortex) even when items with identical history (i.e., old scenes) and responses (i.e., remember) were contrasted. Moreover, an independently validated whole-brain network parcellation map applied to the dataset confirmed that activated regions mapped on to the respective networks.

Does the engagement of a distinct brain network equate to unique neurocognitive resources required for autobiographical retrieval? Some important clues emerge from the neuroimaging and neuropsychological literature on memory recollection. First, parts of the prefrontal cortex, such as the ventromedial prefrontal cortex, have been suggested to confer a self-referential stamp (Northoff and Bermpohl, 2004) and intuitive "feeling-of-rightness" (Gilboa, 2004), possibly bolstering the ability to recall events from our personal past. This may allow for a relatively automated search for memory, guided by a feeling of personal re-experiencing. Successful retrieval on standard episodic memory tasks, by contrast, appears to require greater control over monitoring and verification of information and engages lateral prefrontal regions (Gilboa, 2004). On the other hand, the lateral parietal cortex is located at the intersection of the default-mode, frontoparietal, and the parietal memory networks. Although its exact role in memory retrieval remains elusive, some hints that it subserves memory for contextual details come from its scaling involvement with the amount, strength, vividness, and duration over which recollected information is maintained in mind (Vilberg and Rugg, 2008, 2014). Strikingly, however, lesions to this region do not affect objective per-

formance on laboratory-type episodic retrieval tasks (Berryhill et al., 2009; Simons et al., 2010) but affect performance on complex memory tasks such as autobiographical retrieval (Berryhill et al., 2007). A consistent finding in patients with lateral parietal lesions is the reduction in subjective aspects of recollection such as confidence and vividness in memories (Simons et al., 2010). This suggests that the lateral parietal cortex may supply subjective aspects to our recollective endeavor based on stored mnemonic evidence.

The strong connectivity between the lateral parietal, prefrontal regions and the medial temporal lobes (Makris et al., 2005; Ranganath and Ritchey, 2012) allows one to speculate about how these regions of the core recollection network interact during successful autobiographical remembering. Because both regions were implicated in the life memory task, one possibility is that memory for contextual details convolved with a personal feeling of re-experiencing from lateral inferior parietal and medial prefrontal regions are layered on to the retrieved memory to enhance subjective recollection. This output may then pass through a thresholding mechanism facilitated by the medial prefrontal cortex to verify if it "feels right," resulting in an accurate memory for our personal past.

Further evidence in favor of a dissociation between autobiographical and episodic memory comes from the study of individuals with highly superior autobiographical memory (HSAM; LePort et al., 2012). These individuals can vividly recall minor details from their most remote memories as well as recall remote events that happened on specific dates, as long as they experienced a personally significant event on that date. Surprisingly, HSAM individuals show average or below average performance on standard episodic memory tests, suggesting distinct underlying cognitive mechanisms supporting these types of memories. Superior autobiographical performance in these individuals appears to be coupled with morphological changes in the middle temporal gyrus and temporal pole. Regions in the lateral temporal cortex that were implicated in the life memory task in the study by Chen et al. (2017) may therefore be crucial to autobiographical remembering in HSAM. As memories are continually rehearsed, they gradually undergo a process of semanticization, becoming abstracted and overgeneral representations divested of their rich recollective experience (for review, see Irish and Piguet, 2013). Inter-

estingly, some of these regions show hypoactivation in individuals with severely deficient autobiographical memory who exhibit abnormally low performance on autobiographical memory tests, despite average episodic memory performance (Palombo et al., 2015).

Of further relevance to this debate is the study of SuperAgers, healthy individuals who are ≥ 80 years old and have unusually high age-related performance on standard episodic memory tasks like word-list learning compared with middle-aged control subjects (Gefen et al., 2015). Indeed, compared with age-matched or middle-aged control subjects, SuperAgers tend to show greater thickness in cingulate regions (Gefen et al., 2015), which form an essential part of the parietal memory network uniquely implicated in the standard episodic memory condition in the study by Chen et al. (2017). An interesting question to explore then is whether unusually superior episodic memory in SuperAgers comes at a cost to autobiographical remembering; this would confirm differences at a construct level.

In conclusion, the findings by Chen et al. (2017) deepen our understanding of the underlying brain networks that mediate distinct aspects of human declarative memory. An important question to address in future studies is the extent to which recency effects potentially influence performance on the autobiographical component of this task, as such effects are well documented in studies of autobiographical memory in healthy and clinical populations (Irish et al., 2017). Refining our understanding of the neural substrates of episodic and autobiographical memory carries important clinical implications for the early diagnosis of neurodegenerative disorders, as episodic memory performance is often used as a gold standard cognitive marker in diagnostics.

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