Region-Educational Research and Reviews, 2024,Volume 6, Issue 6
DOI:10.12238/rerr.v6i6.2237
ISSN Online:2661-4634
ISSN Print:2661-4626

The Subjective Experience and Neural Mechanisms of Memory from Different Cultural Backgrounds

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Abstract: This study investigated cross-cultural differences in memory retrieval processes, focusing on the role of the parietal and angular gyrus (AG) in shaping the subjective experience of recall. By exploring how cultural context affects the relevant dynamic neural mechanisms, the study centred on Chinese and British subjects. The study used a mixed factorial design with 20 participants recruited from each cultural group. Functional magnetic resonance imaging (fMRI) captures blood oxygen level-dependent (BOLD) signals in memory tasks, revealing unique patterns of AG activity. The study combines three well-established fMRI paradigms - picture-word pairs, scenes, and autobiographical events - enhancing experimental validity and providing a comprehensive analysis of cultural memory differences. This multi-paradigm research approach deepens the understanding of how cultural influences manifest themselves in a variety of memory retrieval contexts. It is expected that the findings will make an important contribution to the ongoing debate about the universality versus cultural specificity of memory processes. Beyond shedding light on the cultural shaping of memory phenomenology, the study aims to provide valuable insights into the potential applications of these findings. Understanding the interplay between culture and memory processes has implications for diverse fields, including psychology, neuroscience, and clinical practices. This research not only expands our theoretical understanding of cross-cultural memory differences but also offers practical implications for tailoring memory interventions and rehabilitation practices to accommodate diverse cultural backgrounds.

Keywords: cross-cultural, angular gyrus, fMRI, subjective experience, memory paradigms

1. Introduction

1.1 Background

Memory is a complex cognitive process supported by distributed brain networks encompassing medial temporal, prefrontal, and parietal regions[1]. While the medial temporal lobe subserves encoding and storage, regions like the angular gyrus (AG) in the parietal cortex are thought to be involved in memory retrieval - the subjective experience of remembering the details of a prior event[2]. Despite evidence implicating the AG in retrieval success[3], precisely how this region contributes to the phenomenology of remembering remains unclear. Additionally, little is known regarding how the underlying neural mechanisms of retrieval in regions like AG may be modulated by an individual's cultural background.

Culture fundamentally shapes what events are attended to and subsequently encoded into memory[4]. Furthermore, how memories are subjectively constructed and retrieved likely differs across cultural contexts that promote variable styles of thinking and remembering[5]. Initial evidence indicates East Asian groups utilize more detail-oriented, visuospatial

processing during recollection, whereas Western groups take a more self-referential approach[6]. Such cross-cultural differences raise important questions about whether the recruitment of memory-related brain regions during retrieval systematically differs depending on one's cultural upbringing.

1.2 Motivation

No study has investigated the potential cultural sensitivity of parietal regions supporting the subjective experience of recollection. Elucidating cross-cultural dynamics in AG contributions to retrieval may clarify longstanding debates concerning the universality versus cultural specificity of memory processes and content. In this study, we aim to address critical gaps around whether and how AG facilitates the phenomenology of remembering differently among Chinese versus British individuals.

1.3 Research questions

1. What is the role of the parietal lobe and angular gyrus in cross-cultural differences in memory processes across cultural backgrounds?

2. How do these cultural influences on memory retrieval mechanisms affect the subjective experience of memory?

2. Literature review

2.1 Theoretical models of memory

Seminal models have outlined various processing stages supporting memory encoding through retrieval. Atkinson and Shiffrin's modal model proposes sensory information passes through short-term storage into long-term storage[7]. Baddeley's working memory model updated this framework, positing distinct verbal and visual buffers actively manipulate information before consolidation[8]. Craik and Lockhart's levels of processing work suggests durable memories depend on meaning-based, elaborative encoding[9]. While these frameworks differ in specifics, all indicate memory emerges from dynamic transformations across processing components. The modal model situated retrieval as a simple activation of dormant memory traces. Yet contemporary models recognize recollection as an active, constructive process engaging distributed networks extending well beyond the medial temporal lobe (MTL) memory system[10]. Regions like the parietal cortex and prefrontal cortex reconstruct memories by integrating features stored in MTL structures.

2.2 Parietal cortex contributions to memory

The parietal lobe encompasses the angular gyrus (AG), supramarginal gyrus, and adjacent cortical areas along the banks of the intraparietal sulcus. This heterogeneous region participates in diverse functions like attention, visual-spatial processing, concept representation, and social cognition[11]. Parietal areas are extensively interconnected with medial temporal structures, and neuropsychological evidence indicates parietal damage can mimic hallmark amnesic deficits associated with MTL lesions[12]. In particular, the AG has shown specificity to successful memory retrieval in fMRI studies, with activation predicting correct recognition[2][3]. Manipulations disrupting AG functioning via TMS can selectively impair context retrieval and feelings of recollection, without affecting item recognition accuracy[13][14].

These findings have fed theoretical proposals that the AG acts as a key posterior hub integrating distributed memory features into a coherent representation supporting the experience of remembering an episode[1][15]. However, precisely how AG contributes to subjective mnemonic phenomenology remains ambiguous. Competing accounts respectively emphasize AG roles in accumulating evidence, reconstructing contextual details, evaluating retrieval outcomes, or binding reactivated content[13]. Clarifying the specific computations implemented in AG stands as an important goal for models explicating the quality and accuracy of recollection.

2.3 Cultural shaping of memory processes

A fundamental debate in the field concerns whether memory processes take universal or culture-specific forms. Studies have documented cultural variability in what events individuals attend and subsequently encode into long-term stores[4][16]. European-Americans show superior memory for objects whereas East Asians have higher recognition of

background scenes[17]. Relatedly, East Asian groups preferentially process relational context, employing more holistic recall strategies relative to Western individualistic cultures[5]. Overall, existing work indicates culture helps shape both the content and subjective experience of recollection via commonalities as well as variation in the underlying neurocognitive substrates.

2.4 Gaps identified

While emerging evidence points to cultural influences on medial temporal contributions to retrieval, no study has addressed whether parietal regions implicated in subjective remembering demonstrate similar cross-cultural dynamics. This represents a critical gap given theoretical proposals that AG integrates memory features in a culturally-relative manner. Deconstructing AG computational contributions within each cultural framework would significantly advance models describing diversity in the phenomenology and accuracy of recollection.

3. Methodology

3.1 Research design

A mixed factorial design will compare neural activity and subjective memory experiences between 20 British and 20 Chinese participants. The between-subjects factor is cultural group (British vs. Chinese) while the within-subjects factor is memory task with three levels (picture-word pairs, scenes, autobiographical events).

Functional magnetic resonance imaging (fMRI) will measure blood-oxygen-level dependent (BOLD) signals during each retrieval task targeting distinct memory processes. Multi-voxel pattern analysis will also compare cultural differences in AG activity patterns predicting retrieval success.

3.2 Participants

The study will recruit 20 healthy British participants from a university in the UK and 20 demographically matched Chinese participants from a university in China. Inclusion criteria entail right-handedness, normal vision, no history of neurological disorders, no MRI contraindications, and English fluency. Groups will be matched on key variables like age (18-25 years), education, and basic cognitive functioning, given the known impacts of such factors on fMRI activations and potential cultural differences in age-related memory trajectory. Matched sampling will ensure observed neural differences stem from cultural influences rather than confounds.

3.3 Materials

The experiment will use three established fMRI paradigms assessing memory retrieval:

1.Picture-word pair associate learning and recall, including rearranged lures[2].

2.Scene recall with buildings, landscapes, etc.[18]

3.Autobiographical memory narratives of personal events

Employing the three paradigms will strengthen experimental validity, analytic depth, and alignment to existing ethnographic evidence of where cultural memory differences manifest.

3.4 Procedure

The tasks will be completed in a fixed order during one-hour fMRI sessions with the experimenter blind to cultural groups. Picture-word pairs will be intentionally encoded and then recalled. Scene recall will involve incidental encoding during an animacy judgement task followed by recognition testing. Lastly, cued autobiographical events will be described aloud by participants in the scanner.

Participants will make remember/know judgments to distinguish recollection and familiarity. Confidence ratings will index retrieval vividness. False alarm rates to rearranged pairs and source errors will also be quantified. Subjective descriptions of memory experiences will be coded for qualitative analysis.

3.5 Data analysis

BOLD activity in AG will be compared between cultural groups and memory tasks using ANOVA in SPM. PPI analyses will clarify AG functional connectivity patterns during successful retrieval. Multi-voxel decryption will decode culture and memory type based on AG activity signatures. Relationships between AG activations, connectivity, and decoding outcomes with memory performance and phenomenology measures will be analyzed within each cohort using regression approaches. Subjective memory data will be qualitatively synthesized to extract cultural commonalities and variations in recollection experiences across the experimental tasks.

4. Ethical considerations

University ethics boards will review protocols ensuring informed consent and confidentiality. Participants can exit anytime without penalty. Potential risks are minor given controlled experiment parameters. MRI safety guidelines are implemented to minimize hazards.

5. Expected outcomes

This project promises to significantly advance models of diversity in the subjective qualities and accuracy of memory by clarifying the precise contributions of the angular gyrus to recollection across Chinese and British cultural frameworks. Identifying systematic variation in AG recruitment and relationships to behavioural outcomes will elucidate neural mechanisms behind cultural influences on memory phenomenology. Findings stand to inform philosophical debates concerning universal attributes of memory processes versus culturally specific forms of remembering. On a practical front, characterizing the impacts of enculturation on AG functioning may guide clinical efforts to tailor memory rehabilitation practices for diverse populations. Moreover, the research entails methodological innovation through the novel application of a paired associate fMRI paradigm combined with fine-grained characterization of memory experiences to address cross-cultural research questions that have substantial theoretical and applied implications. Analyses will clarify boundaries on the generalizability of conclusions by assessing convergence with other cultural cohort comparisons reported in the literature.

Conflicts of interest

The author declares no conflicts of interest regarding the publication of this paper.

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