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The role of autobiographical memory in empathy: A perspective from memory disorders

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ABSTRACT

Empathy, the capacity to understand and share others' emotions, relies on two complementary components: cognitive empathy, involving perspective-taking and inferential understanding, and affective empathy, grounded in bodily resonance with others' states. Both depend on the ability to maintain a clear boundary between self and other because, when this is blurred, individuals might experience emotional contagion, a simpler form of emotional engagement with the other. Evidence suggests that autobiographical memory supports cognitive empathy by enabling individuals to simulate others' experiences through recollection, while interoceptive processes contribute to affective empathy by providing access to internal bodily representations that are appraised and interpreted based on first-hand previous experiences. We propose that memory and empathy are interconnected through a shared mechanism of self–other distinction, primarily mediated by the precuneus and its interactions with hippocampus, anterior insula and cingulate cortex. Damage to these networks may differentially impair empathic components, depending on whether memory-based self-referential processes or bodily self-representations are compromised. We suggest that the weakening of self–other distinction may represent a key mechanism linking memory loss to empathy impoverishment. Future studies should explicitly investigate this relationship by integrating assessments of memory, interoception, and self–other distinction—using approaches such as virtual reality, lesion mapping, and neuromodulation—to clarify how memory deficits affect empathy. Understanding these processes may reconcile inconsistent findings in the literature and advance models of social cognition across aging and disease.

1. Introduction

Empathy is the capacity to perceive another person's emotional state and represent it within oneself (Bird and Viding, 2014). It emerges through two primary mechanisms: (1) the internal resonance of another person's emotion, experienced as if it were one's own (affective sharing), and (2) mentalizing, that is the cognitive understanding of what another is feeling, based on contextual cues and perspective taking (Decety and Jackson, 2004; Zaki and Ochsner, 2012). Crucially, empathy remains distinct from first-hand emotional experience, or emotional contagion, i.e., the pure synchronization with another's emotional state, because we accurately attribute the source of the emotion to the other person, maintaining a clear boundary between self and other. Along this line, a recent redefinition by Quesque et al. (Quesque et al., 2024) proposes that a key dimension of empathy is *self-other distinction*, i.e., the capacity to differentiate between one's own and another's emotional experience. This refinement reflects a growing recognition that empathic processes are fundamentally anchored in the ability to preserve the boundary between self and other.

Recent research suggests that empathy partly relies on the recollection of personal experiences, specifically autobiographical memories (Meconi et al., 2021). This raises an important and timely question: does

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impaired memory diminish empathic capacity? A better understanding of this relationship is important because empathy is fundamental to effective social interaction engagement (Bechara et al., 2000; Montagrin et al., 2018; Peeters et al., 2020; Porcelli et al., 2019; Santangelo et al., 2020). In turn, social interaction promotes well-being (Sun et al., 2020), particularly among individuals facing physical or mental health challenges. Conversely, social isolation and loneliness, both increasingly prevalent, are themselves recognized risk factors for physical and mental illness (Brandt et al., 2022; Holt-Lunstad, 2021).

Despite increasing interest in this topic, the mechanisms linking memory and empathy remain poorly understood. Converging evidence suggests that empathic responses draw on two complementary mechanisms: memory-based *self-referential processes*, which recruit autobiographical recall to understand others' emotions, and *bodily perception processes*, which ground others' states in one's own interoceptive and previously experienced somatosensory representations (Ianì, 2019). Both rely on an intact self–other distinction, allowing understanding and resonance, respectively, without self–other blurring.

A robust body of evidence shows that the precuneus plays a central role in implementing this distinction, integrating signals from the insula and anterior cingulate cortex during bodily perception and from the hippocampal network during autobiographical memory retrieval. This region may thus mediate the interaction between mnemonic and empathic processes. Impairment of the neural network supporting self–other distinction would be expected to selectively disrupt empathy while leaving more basic forms of emotional engagement, such as first-hand emotional experience or emotional contagion, relatively preserved, as these do not require self-other differentiation. Fig. 1 shows a graphic representation of the link between parietal regions and both cognitive and affective empathy.

Memory impairments are common across neurological and psychiatric conditions and are strongly associated with age (Berna et al., 2016; Desaunay et al., 2020; Gur and Gur, 2013; James et al., 2021; Nyberg, 2017). Given the rapid aging of the global population, such deficits represent an urgent public health concern. Understanding whether and how memory loss contributes to reduced empathy is therefore of major scientific and clinical importance, with direct implications for social functioning and mental health in older and clinical populations.

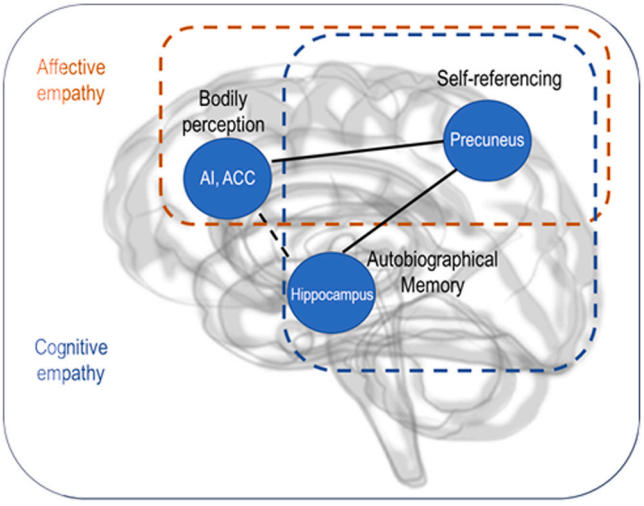


Fig. 1. Graphical representation of the proposed framework. Parietal regions, including the precuneus, are involved in cognitive empathy via a network including the hippocampus. Parietal regions, including the precuneus, are involved in affective empathy via a different network including Anterior Insula (AI) and Anterior Cingulate Cortex (ACC). Solid lines represent established links between brain areas within the relevant network. Dashed line represents a link that requires further investigation within the relevant network.

We seek to advance current understanding by examining the interdependence of memory and empathy through mechanisms more intricate than simple co-occurrence. Only a handful of studies have directly investigated empathy in individuals with memory impairments, yielding inconsistent findings (Beadle et al., 2013; Rabin et al., 2012; Rosenbaum et al., 2007; Sawczak et al., 2019; Staniloiu et al., 2013). Some studies show marked empathic reductions, whereas others do not, highlighting the need to identify the underlying neural and cognitive determinants. We propose that one pathway through which memory deficits may reduce empathy is because the neurological conditions that cause memory deficits, such as hippocampal damage or Alzheimer's disease, may also compromise the ability to distinguish self from other, a function subserved by the precuneus and its associated networks.

2. Empathy and memory interplay

2.1. What enables cognitive empathy? The role of episodic memory recall

Cognitive empathy, or mentalizing, refers to the capacity to understand what another person is thinking or feeling (Apperly, 2010). It involves inferential processes through which we represent others' internal states such as thoughts (cognitive states) or feelings and emotions (affective states). From an anatomical perspective, cognitive empathy relies upon a network of fronto-parietal brain regions, including medial and dorsolateral prefrontal cortices, temporal poles, posterior cingulate, temporoparietal junction and precuneus (Lamm et al., 2011; Molenberghs et al., 2012, 2016) and has a late processing time-course indicated by its modulation of the P300 event-related potential (ERP) component (Y. Fan and Han, 2008; Meconi et al., 2018; Palmieri et al., 2021; Sessa, Meconi, Castelli, et al., 2014; Sessa, Meconi, and Han, 2014).

Empirical studies indicate that healthy adults draw on either general semantic knowledge (Pehrs et al., 2017) or personal past experience (Gaesser, 2020; Gaesser et al., 2019; Meconi et al., 2018; Mitchell et al., 2005) when engaging in cognitive empathy. Compelling evidence suggests that the imagination of oneself within a specific time and place, a process central to episodic memory, may be essential for cognitive empathy. The construction, maintenance, and visualization of complex scenes (scene construction) underlie both the imagination of fictitious experiences and episodic recollection. When participants are asked to imagine future interpersonal interactions, repeated mental simulation increases the plausibility and vividness of the imagined scenario, enhancing emotional arousal and facilitating subsequent simulation (Szpunar and Schacter, 2013). Both younger and older adults show greater empathy and willingness to help when they are prompted to mentally simulate or recall episodes of others' suffering, an effect mediated by the vividness of mental imagery (Gaesser, 2020).

Neuroimaging evidence further supports the overlap between episodic memory and cognitive empathy. Studies comparing these processes, both within the same participants (Spreng and Grady, 2009; Spreng and Mar, 2012) and across studies (Rabin et al., 2009; Spreng and Grady, 2009), reveal a shared network of fronto-parietal regions, as well as the hippocampus (Buckner and Carroll, 2007). Perry and colleagues (Perry et al., 2011) provided converging evidence for the modulatory role of the medial temporal lobe (MTL) in cognitive empathy: MTL activation was greater when participants had previously experienced events similar to those described in the experimental vignettes, and when the vignette's character was perceived as more similar to the self. The authors proposed that participants projected their own experiences and self-representations onto the vignette's character. Meta-analytic evidence further supports that remembering the past and simulating possible events rely on overlapping mechanisms (Benoit and Schacter, 2015). The neural regions implicated in episodic memory and mental simulation—specifically the MTL and medial prefrontal cortex (mPFC)—also contribute to prosocial cognition and behavior (Gaesser et al., 2019).

We recently extended this line of research using electroencephalography (EEG) and fMRI in two independent samples (Meconi et al., 2021). Participants rated their empathy for individuals described in various situations, some of which they had personally experienced and others they had not. EEG analyses revealed spontaneous memory reactivation during empathic judgments, while fMRI showed that autobiographical situations elicited stronger activation in regions implicated in cognitive empathy—including the superior frontal gyrus, posterior cingulate cortex, superior parietal lobule, a portion of the temporoparietal junction (TPJ), and the precuneus—compared to non-autobiographical situations. Although none of these studies establishes a causal relationship between memory and empathy, the converging evidence consistently points to the engagement of episodic memory processes in cognitive empathy.

2.2. What enables affective empathy? The role of first-hand experiences and interoception

Affective empathy entails embodiment of others' inner states exploiting resonance mechanisms so that others' states are vicariously experienced in the self (Rütgen et al., 2015; Wagner et al., 2020). Affective empathy entails also emotional contagion, which is the tendency automatically to mimic and synchronize with the emotional state of another person, it is the simplest state of emotional sharing (Hatfield et al., 1994) but does not require awareness, regulation and self-other distinction that are instead necessary in the empathic experience. For example, watching videos of someone immersing their hands in cold water affects the temperature of the observer's hands, which become significantly colder. This phenomenon has been named "thermal contagion" (Cooper et al., 2014) and shows how self-other boundaries can become blurred. From an anatomical perspective, affective empathy is subserved by the somatosensory areas and the human mirror neuron system (Frith and Frith, 2003; Lamm et al., 2019; Rütgen et al., 2015, 2021; Samson et al., 2005; Zaki et al., 2016). It has an earlier processing time-course than cognitive empathy, mainly modulating ERP components within 250 ms (Fan and Han, 2008; Meconi et al., 2018; Palmieri et al., 2021; Sessa et al., 2014a; Sessa et al., 2014b).

Whilst a link between cognitive empathy and autobiographical memory has some experimental support, affective empathy seems less immediately related to memory. It draws upon the perception of internal bodily states and internal representations of what the other should be feeling (Terasawa et al., 2014). This may happen when we observe someone in a similar experience by reinstating the bodily and perceptual features of that event or when we experience the associated internal state by anticipating the possible consequences of that event. Several studies have shown how sharing others' physical pain is grounded in the first-hand experience of internal body states (Corradi-Dell'Acqua et al., 2011; Keysers et al., 2004; Zaki et al., 2016). Neuropharmacological studies have provided causal evidence that empathy for pain depends upon similar neural mechanisms as the first-hand experience of pain. Rütgen and colleagues administered participants with an inert substance promoted as a painkiller to test whether the induced placebo analgesia concomitantly reduced empathy for others' pain (Rütgen et al., 2015). The authors observed a decrease in neural activity in the anterior insula and the anterior midcingulate cortex associated with reduced explicit judgements of both pain perception and empathy for pain, but not with domain general unpleasant touch (Rütgen et al., 2021). When the analgesic effect was subsequently counteracted by an opioid antagonist, i.e., naltrexone, normal pain perception and empathy for pain were restored but not the reaction to unpleasant touch. These studies show that we catch what the other is feeling as if it were our own as a consequence of the fact that we have a first-hand bodily representation of such emotion. Therefore, the perception of the internal bodily signals, usually referred to as interoception (Craig, 2002), tags the emotive state and should be crucial for empathising to occur as long as the boundary between the self and the other is preserved. The handful of studies on this show that individuals' interoceptive accuracy predicts sensitivity to others' emotions (Terasawa et al., 2014), even though it is not emotion-specific (Dirupo et al., 2020). In other words, interoceptive accuracy does not allow a differentiation between emotions. Still, it supports a general capacity to perceive another's emotional state as we can perceive our own internal states. In a similar vein, Grynberg and Pollatos (2015) showed that participants with greater interoceptive accuracy reported higher levels of feelings for others' pain and greater estimates of others' pain perception. Ondobaka et al., proposed that knowledge about one's own physiological state in emotional contexts mediates the understanding of others in similar contexts (Ondobaka et al., 2017). Using a predictive coding framework, Ondobaka et al. hypothesise that empathising individuals predict the emotional context and formulate an appropriate response to it based on previous knowledge acquired in similar context. Thus, accurate appraisal of the interoceptive state in the current context is also refined by past experiences in analogous situations (Monzel et al., 2025). Whether such past experiences need to be accessible to episodic memory to serve interoception in human emotional contexts has yet to be clarified (Section 2.3).

2.3. Hippocampal involvement in empathy via interoception and emotion processing

The Embodied Predictive Interoception Coding account (Barrett and Simmons, 2015) suggests that the perception of our bodily sensations and past experiences are a prior facilitating the evaluation of current contexts and allowing us to react appropriately. Interoceptive signals allow central regulation to maintain balance and respond to external demands in an adaptive manner (Tsakiris and Critchley, 2016). An emerging body of research shows that the hippocampus plays a crucial role in associating correct information to interoceptive signals, allowing accurate appraisal of the internal signals and context-appropriate predictions to be made (Kleckner et al., 2017). Thus, previous experience supports the appraisal of concomitant bodily signals (Quigley et al., 2021; Seth, 2013).

Emotion recognition is thought to arise from a similar mechanism: individuals formulate hypotheses about what potentially causes current interoceptive signals associated with an emotional state in such a way that alexithymia, the inability to recognise one's own emotion, is inversely related to interoceptive awareness (Brewer et al., 2016; Herbert et al., 2011). Memory, therefore, may play a crucial role in generating predictions that allow appropriate understanding of the context.

However, only a handful of studies have directly investigated the role of memory in interoception. Dudley and Stevenson (Dudley and Stevenson, 2016) tested healthy young adults in three interoceptive tasks and in one learning and memory task that required hippocampal involvement. They showed that poorer interoceptive performance was associated with poorer performance at the learning and memory task. Edwards-Duric and colleagues administered healthy participants with neuropsychological measures including a verbal learning test and two tasks that tested interoception. In the first task, participants had to imagine a series of interoceptive situations, such as drinking, eating, hunger, boredom, etc. and predict how they would feel in each situation. In the second task, each interoceptive situation was physically experienced and participants reported how they actually felt. Results showed that the participants who were able to make more accurate interoceptive predictions were those who performed better in the memory test (Edwards-Duric et al., 2020). Studies also suggest that damage to the medial temporal lobes, especially the hippocampus, can cause interoceptive deficits. In a lesion study combined with fMRI, MRI and high-density EEG data, Garcia-Cordero and colleagues showed that patients with Alzheimer's disease (AD) manifested specific impairment in cardiac interoceptive learning, compared to healthy controls (Garcia-Cordero et al., 2016).

Although direct investigation on the topic is still limited, existing evidence suggests that memory processes are correlated with

interoception. Therefore, in people with memory deficits resulting from hippocampal damage, cognitive empathy may be disrupted because they cannot rely on their own past experiences, or affective empathy may be disrupted because interoceptive signals are poorly contextualized.

Importantly, hippocampal damage can also cause emotion dysregulation (Argyropoulos et al., 2020; Bernardi and Salzman, 2019; S.-J. Fan et al., 2018; Franca, 2019; Heller, 2020; Montagrin et al., 2018). Neuropsychological studies have shown that hippocampal sclerosis impairs the ability to recognise emotions in other faces (Hlobil et al., 2008; Monti and Meletti, 2015). Hippocampal damage can cause long-lasting emotional contagion induced by emotional movie clips even after having lost explicit memory of them (Feinstein et al., 2010). Recently, a neuroimaging study showed that patients with autoimmune limbic encephalitis showed pathological tearfulness associated with a brain network of emotion regulation that includes changes in the volume of the anterior hippocampus and its resting-state functional connectivity (Argyropoulos et al., 2020). Therefore, patients with memory deficits that experience enhanced emotional contagion might report intact affective empathy because of a general increase in emotional engagement but reduced cognitive empathy because of a lack of recollection of one's own past memories. Patients might also show impaired affective empathy because of an emotional dysregulation often associated with hippocampal damage. This leads to the consideration that using self-report to evaluate empathy abilities may be misleading, as this method of assessment might not be optimal to disentangle whether there are difficulties in detecting empathy or whether it is rather absent.

2.4. Clinical evidence on the relationship between memory impairment and empathy disruption

Neuropsychological studies investigating empathy in a variety of neurological disorders associated with memory impairment have reported generally convergent results showing impoverished empathic abilities. In the majority of these studies, empathy has been investigated through self-reported questionnaires and only occasionally through empathy inducing procedures. Empathy deficits have been observed in patients with AD (Moreau et al., 2013; Ramanan et al., 2017); Korsakoff's syndrome (Drost et al., 2019; Oosterman et al., 2011); mild cognitive impairment (Moreau et al., 2015); Parkinson disease (Monetta et al., 2009; Pell et al., 2014; Xi et al., 2015), and semantic dementia (Duval et al., 2012).

Cognitive and affective empathy may be differentially affected by neurological changes. In healthy aging, the affective side of empathy seems to decrease with age (Chen et al., 2014; Duval et al., 2011; Ze et al., 2014). The most common neurological disorder associated with memory impairment, AD, is typically characterised by early deficits in episodic memory and navigation alongside degeneration of the medial temporal lobe and associated brain regions, particularly within the default mode network. As the disease progresses, other brain regions become affected and other cognitive functions decline. People with AD experience impaired episodic memory retrieval and mental state attribution but show warmth, enhanced emotional contagion end engagement in mutual gaze, which are aspects of the affective empathy (Zhou and Seeley, 2014). A recent meta-analysis on empathy and theory of mind abilities in people with AD confirmed that they have relatively spared affective empathy but reduced cognitive empathy and theory of mind (Demichelis et al., 2020).

Most of the research to date investigating memory deficits and empathy impoverishment does not provide clear evidence of a causal link between the two, since the patients involved had neurodegenerative diseases that affect multiple cognitive functions beyond just memory. Hippocampal amnesic patients have focal memory loss and therefore can offer more direct insight into how autobiographical memory retrieval contributes to empathy. However, only a very few studies have assessed empathic abilities in hippocampal amnesic patients. One study addressed this question in three patients and three matching control participants (Beadle et al., 2013). Participants were asked to complete a series of online empathy eliciting tasks that provided participants' empathy ratings and measures of prosocial behaviour. Participants also completed a series of self-report questionnaires that measured cognitive and affective empathy traits. The results showed that patients with hippocampal amnesia seemed insensitive to empathy induction tasks and reported low scores of cognitive empathy. Self-reported scores of affective empathy were more variable (Beadle et al., 2013). It is important to notice that self-report accuracy may itself be affected by brain injury. In contrast, other studies in hippocampal amnesics have shown preserved (Rabin et al., 2012; Rosenbaum et al., 2007) or only mildly impaired cognitive empathy in tasks that require reasoning about others (Staniloiu et al., 2013). However, these investigations involved a limited cohort of patients, i.e., one to three patients in the studies mentioned. Sawczak and colleagues tested a larger cohort of patients with medial temporal lobe damage ($N = 16$) and showed that patients did not show similar cognitive empathy increases to healthy participants when prompted to build specific representations of others' suffering (Sawczak et al., 2019).

Taken together, the literature suggests that patients with memory impairment as part of more global cognitive decline (such as AD) tend to show impairment of cognitive empathy with relatively spared affective empathy. However, studies of patients with focal hippocampal damage, which could provide clearer evidence for a causal relationship between memory deficits and empathy impoverishment, are too few to reach conclusions.

3. Wider brain networks involved in episodic memory processes

Understanding the role of the hippocampus in memory processes is essential if hippocampal amnesia could indicate a risk for empathic difficulties. While hippocampal damage has traditionally been associated with severe memory impairments, growing evidence highlights that the extent and nature of these deficits often depend on dysfunction across a broader network of functionally connected regions (Aggleton et al., 2010). Studies in healthy individuals show that autobiographical memory (AM) retrieval engages a distributed network that includes the hippocampus, ventromedial prefrontal cortex (vmPFC), and posterior parietal regions such as the angular gyrus and precuneus (Bonnici et al., 2018; Greenberg and Rubin, 2003; Hebscher et al., 2020; Moscovitch et al., 2016). Lesion evidence backs up the claim that such extra-hippocampal regions are necessarily involved in autobiographical memory. For instance, in posterior cortical atrophy (PCA)—an atypical variant of AD characterized by parieto-occipital atrophy—impaired memory retrieval appears to stem from disrupted visual imagery due to damage in visual processing areas (Ahmed et al., 2018; Crutch et al., 2012). These patients struggle to access memories because of reduced ability to retrieve visual cues. Notably, higher vividness of mental imagery has been linked to higher empathy and prosocial tendencies (Gaesser, 2020; Sawczak et al., 2019).

Further evidence underscores the role of posterior parietal regions in self-referential memory. For example, theta burst stimulation of the angular gyrus reduces the ability to recognize self-related memories as real, suggesting this region contributes to the sense of agency over remembered experiences (Kwon et al., 2022). Similarly, transcranial magnetic stimulation of the precuneus impairs egocentric retrieval of autobiographical memories, indicating that parietal damage may distort how individuals experience themselves in memory (Hebscher et al., 2018, 2020). Lesions to the vmPFC can also disrupt autobiographical memory recollection (McCormick et al., 2018). Evidence suggests a dynamic interaction between the vmPFC and hippocampus, with the vmPFC driving hippocampal activity during scene construction, a process thought to underlie mental simulation (Barry et al., 2019; Monk et al., 2021). The involvement of this broader network has been further validated in a large study of patients with autoimmune limbic encephalitis. Among 38 individuals with focal hippocampal damage, memory

deficits were associated not only with hippocampal atrophy but also with structural and functional abnormalities in the thalamus, entorhinal cortex, posteromedial cortex, and inter-hippocampal connectivity (Argyropoulos et al., 2019).

Together, these findings indicate that hippocampal damage alone does not account for all memory impairments. Instead, the hippocampus functions as part of a broader memory network that includes the vmPFC, precuneus, and thalamus. Predicting empathy reductions in the context of memory deficits will therefore depend not just on the presence of hippocampal damage, but on how disruptions across this network impair the memory processes that support empathic abilities.

4. The self-other distinction: parietal involvement in memory, interoception, and empathy

Posteromedial parietal regions, particularly the precuneus, have been extensively identified as key hubs for self-processing (Cavanna and Trimble, 2006), and for mediating the interplay between AM retrieval and perspective-taking. Supporting its role in self–other distinction (Northoff et al., 2006), theoretical models of spatial cognition suggest that the precuneus enables the transformation of allocentric (third-person) spatial memories into an egocentric (first-person) perspective, allowing individuals to re-experience events from their own viewpoint (Burgess, 2008; Chen and Crawford, 2020). Empirical studies reinforce this notion. Freton and colleagues, using AM retrieval tasks and structural MRI in healthy participants, found that greater grey matter volume in the precuneus correlated with a higher tendency to spontaneously recall memories from a first-person, as opposed to a third-person, perspective (Freton et al., 2014). This relationship between the precuneus and egocentric memory recall has also been confirmed by transcranial magnetic stimulation studies, which showed that disrupting activity in the precuneus selectively impairs the retrieval of memory details associated with a first-person perspective (Hebscher et al., 2018, 2020).

Extending this to bodily self-awareness, Babo-Rebelo and colleagues proposed that self–other distinction may also be supported by the brain's monitoring of internal bodily signals—such as heartbeats—during the imagination of oneself or another person. This interoceptive monitoring is indexed by heartbeat-evoked potentials (HEPs), transient changes in brain activity time-locked to heartbeats. HEPs are enhanced when individuals imagine themselves in a scenario compared to imagining a friend in the same situation. Notably, the source of these HEPs has been localized to the precuneus (Babo-Rebelo et al., 2019; Babo-Rebelo, Richter, et al., 2016; Babo-Rebelo, Wolpert, et al., 2016), suggesting that the precuneus could also contribute to self–other distinction through bodily self-representation.

Rich bodily perception—resulting from the integration of internal and external sensory information—is associated with greater affective empathy, likely by enhancing the accuracy of perceiving others' internal states. Supporting this, an fMRI study by Oosterwijk et al. showed that the precuneus is actively involved when individuals imagine themselves or others in various scenarios, particularly during perspective switching from a first-person to an observer's viewpoint (Oosterwijk et al., 2017). Taken together, these findings highlight the pivotal role of the precuneus in self–other distinction, both in the context of bodily perceptions and autobiographical memory retrieval.

5. New perspectives on empathy impoverishment after memory loss

We propose a theoretical framework delineating potential pathways that link AM deficits to impairments in empathy. Evidence reviewed above suggests a close association between AM and cognitive empathy, supporting the expectation that impairments in recollection should co-occur with reduced cognitive empathy. However, memory loss is often complex and multifaceted, arising from pathology in regions far beyond the hippocampus. In this context, the precuneus and broader parietal network emerge as critical structures, as they support self–other distinction both in self-referential processes and in bodily perception. Because maintaining a clear boundary between self and other is fundamental for empathic experience, disruption of this distinction may represent a key mechanism linking memory and empathy deficits.

From a psychological standpoint, AM retrieval, cognitive empathy, and affective empathy all involve references to the self. In AM retrieval, events are recalled from an egocentric perspective and support cognitive empathy because perspective is shifted from self to other; in affective empathy, the internal model of the other is grounded in first-hand experience, which constitutes a model of the self, and it is supported by interoceptive processes that enable accurate inferences about others' affective states. Within this mechanism, self-other distinction is fundamental to maintain the clear boundary between the emotional state of the self and of the other and prevent pure emotional contagion. Anatomically, the self-other distinction is underpinned by the precuneus and is necessary for us to use memory retrieval and bodily perception in the service of empathy.

Our model therefore predicts that different patterns of brain injury or disease may yield distinct forms of empathy impoverishment. Damage to the hippocampus or its associated memory network, including the precuneus, may compromise cognitive empathy, because impaired recollection from an egocentric perspective and scene construction limits the ability to simulate others' experiences. In contrast, interoceptive context integration deficits and self-other blurring following parietal dysfunction, particularly within the precuneus, may compromise affective empathy. Affective empathy may nonetheless appear preserved, as emotional contagion can remain intact, fostering patients' feeling of emotional engagement, despite reduced self–other differentiation. Yet divergent findings across studies suggest that these relationships are not uniform and may depend on the specific neural substrates affected.

The fact that emotional contagion may persist even when empathy is impaired underscores the need for implicit, empathy-inducing paradigms to disentangle genuine empathic processing from automatic affective resonance. Critically, investigating whether and how a weakening of self–other distinction contributes to empathy impairments following memory loss constitutes a novel and promising research question and may help reconcile inconsistent findings in the literature and illuminate the shared neural architecture underlying memory and empathy. Fig. 2 represents a decision tree based on the proposed theoretical framework showing prediction of empathy impairment in an individual with memory deficits.

6. Semantic memory

In this theoretical framework, we have focused on autobiographical memory as the repository of personally experienced past events from which individuals can draw when engaging in empathic processing, if self-other distinction is preserved. However, recent models emphasize a dynamic interplay between episodic, autobiographical, and semantic memory (Irish and Vatansever, 2020; Renoult et al., 2019) proposing that these forms of memory lie along a continuum rather than constituting discrete systems. Within this continuum, semantic knowledge acquired through personal experience can facilitate the retrieval of autobiographical memories (Sheldon et al., 2020) and episodic memories can in turn enrich or constrain semantic knowledge (Renoult et al., 2015; Westmacott and Moscovitch, 2003). Personal semantics refer to conceptual knowledge that is personally meaningful but does not retain information about the specific time and place in which it was acquired. This category includes both context-independent knowledge (e.g., stable preferences or self-beliefs such as "I do not enjoy taking exams") and context-dependent knowledge derived from repeated experiences that preserve a degree of situational structure (e.g., "When I take an exam, I always feel unprepared"). Context-dependent personal semantics are thought to be more closely aligned with episodic memory, with neural

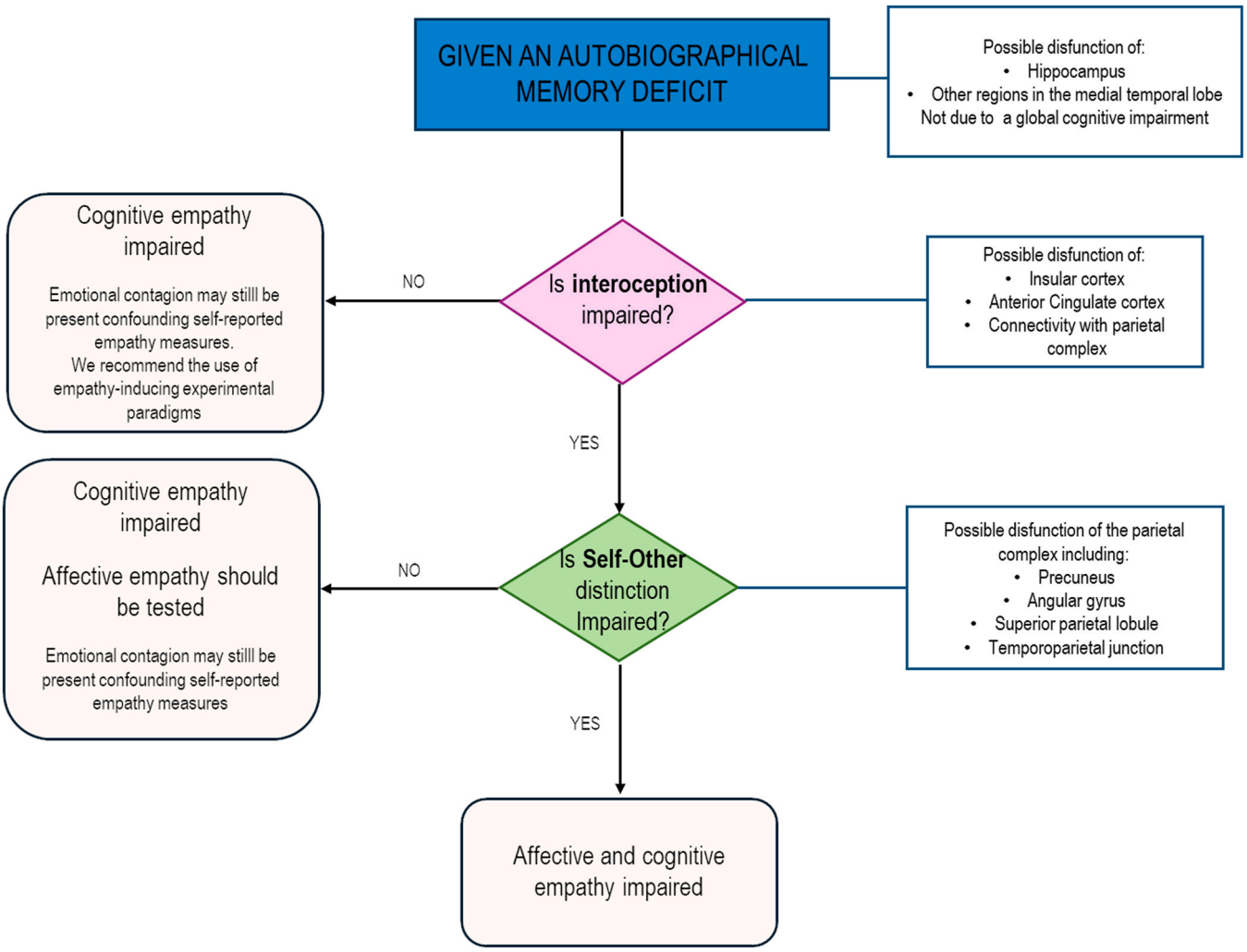


Fig. 2. Decision tree derived from the proposed theoretical framework linking autobiographical memory (AM) deficits to selective empathy impairments. This schematic is intended as a testable model for future empirical work integrating lesion mapping, interoceptive assessment, and measures of self–other distinction.

underpinnings overlapping within the autobiographical retrieval network, including hippocampus and parietal regions (Renoult et al., 2019). Clinical evidence from semantic dementia aligns with this view. Patients with semantic dementia show relatively preserved recent autobiographical recall but impaired access to remote memories (Hodges and Patterson, 2007). This pattern reflects the fact that recent memories still rely on episodic details supported by medial temporal and posterior midline regions, whereas remote memories become increasingly semanticized and depend on anterior temporal lobe structures, including the temporal poles, as well as posterior temporal and ventromedial prefrontal regions where context-independent personal semantics are organized. Thus, atrophy of the anterior temporal lobes observed in semantic dementia can disrupt access to semanticized, context-independent knowledge, while sparing more recent memories that are still rich in episodic details and can still be accessed through episodic, rather than semantic, retrieval (Graham et al., 1999; Irish et al., 2011, 2014, 2014).

Furthermore, context-dependent personal semantics can more effectively prime access to specific autobiographical episodes, as shown by Sheldon et al. (2020). Such evidence is relevant because it demonstrates how accessing autobiographical experiences can be triggered by situations that share contextual features even when they do not perfectly overlap (Fenneman et al., 2025; Fenneman and Lamm, 2026). From this perspective, empathic understanding does not require having lived the exact same event as another person. Rather, repeatedly experiencing a similar situation, such as the anxiety associated with exam sessions, provides a reservoir of context-dependent personal knowledge that can be generalized to infer what another individual might feel in an analogous circumstance. By contrast, context-independent personal semantics constitute more abstract knowledge about the self and rely more heavily on ventromedial prefrontal and anterior temporal regions, alongside posterior parietal areas including the precuneus. Such traits, beliefs, or stable self-representations can still guide or shape how we understand another person's internal state, even when no specific episodic memory is reinstated. Crucially, both forms of personal semantics depend on maintaining a clear self-other distinction: knowing how we typically respond to general or specific contexts allows us to draw on autobiographical knowledge, or to use self-representations as a heuristic, while keeping them sufficiently separate to appreciate the other's perspective without projecting mismatching emotional states. We highlighted that this self–other distinction is supported by the precuneus, a core hub functionally connected both to medial temporal regions underpinning episodic and autobiographical memory and to prefrontal and anterolateral temporal regions supporting semantic knowledge about the self (Buckner et al., 2008). This reinforces our proposal that when long-term memory fades, empathy impoverishment may emerge if the mechanisms sustaining self–other distinction are also compromised.

7. Roadmap and future directions

The present paper highlights the complex interplay between empathy and memory processes, focusing particularly on the important mediation of the self-other distinction. However, several research questions need to be answered about the dependencies of this three-way relationship.

First, neuropsychological studies on larger cohorts of patients with different forms of amnesia are needed to generalize existing evidence. Such studies would need to test both affective and cognitive empathy and provide precise profiles of memory impairments. Often, lesion studies have tested empathy with self-report questionnaires. Questionnaires in these cases can be problematic because they rely also on preserved verbal abilities and the ability for patients to recognize and reason on their own abilities. Therefore, other methods such as virtual reality (VR) environments should be explored. VR has already been used to test empathy in healthy populations (Patil et al., 2018). It offers the advantage of examining natural empathic responses in realistic contexts without requiring participants to explicitly judge their feelings or reactions.

Second, neuromodulation could be employed to test causal relationships between specific kinds of memory and empathy. Whilst transcranial magnetic stimulation (TMS) could be used to test the cortical nodes of the memory network, deeper brain structures, such as the hippocampus, could be more precisely targeted by novel forms of non-invasive neuromodulation such as focused transcranial ultrasound stimulation (TUS) (Blackmore et al., 2023; Kubanek, 2018) or temporal interference stimulation (Esmaeilpour et al., 2021; Grossman, 2018).

Third, the link between precuneus and empathy should be further explored in the absence of memory loss, since the self-other distinction might be impaired even without memory deficits. This could be investigated with TMS protocols on the precuneus in tasks testing self-other distinction in empathy and autobiographical memory retrieval during empathic experiences.

Fourth, the links between memory and interoceptive processes should be clarified by defining whether and how memory structures are included in the interoception brain network. In this manuscript, we have highlighted that interoception is vital to self-awareness as it builds the perception of the self and its boundaries, and that self-other distinction is crucial for empathy. Further studies investigating interoceptive accuracy and empathy could provide much needed insight into this unexplored link. Crucianelli and colleagues confirmed that interoceptive accuracy might coordinate the process of integration of interoceptive and exteroceptive signals in relation to body perception (Crucianelli et al., 2018) and recently proposed a theoretical framework on how memory processes can more intrinsically support the perception of bodily signals (Bischoff et al., 2026). The rubber hand illusion (Botvinick and Cohen, 1998) is a well-established tool for testing the boundaries of body ownership. Studies using this illusion show that those with lower perception of internal signals experience a stronger illusion of body ownership towards the rubber hand, suggesting greater self-other blurring (Crucianelli et al., 2013; Tajadura-Jiménez and Tsakiris, 2014). This provides a basis for further research into the relationship between the perception of the self and the perception of the other. Few studies in clinical populations with cognitive decline have examined the strength of the rubber hand illusion (Ding et al., 2017, 2018) and its potential as a diagnostic tool (Ryu and Seo, 2021; Chan et al., 2015). Studying the rubber hand illusion in hippocampal amnesia may provide further clarification of how self-other distinction mediates the relationship between memory deficits and empathy.

Lastly, the specific mechanisms through which the interplay between episodic memory processes, interoception and self-other distinction occurs need to be targeted. We highlight three plausible alternatives that are compatible with our proposal.

H1. "Memory first". Witnessing another person undergoing a familiar situation may automatically trigger the recollection of one's own past experiences that share contextual features with the observed event—such as the anticipated emotional state, the situational constraints, or the expected consequences. This recollection may occur through spontaneous memory reactivation or through a deliberate search of episodic memories, and potentially relevant semantic knowledge, aimed at guiding prosocial behavior. In both cases, self–other distinction mechanisms are required to prevent self-projection from dominating empathic inference. This hypothesis applies to the domain of cognitive empathy and accommodates the possibility that similar experiences may be associated with different affective responses, allowing self–other distinction processes to guide the empathic response. The hypothesized sequence of process to be tested would therefore be: perception of a familiar situation → memory retrieval/reactivation → self–other distinction → empathic inference.

H2. "Emotion detection first". When interacting with another person, we observe the physiological and behavioral manifestations of their emotional state, whether subtle or overt. Empathic responses may increase when the emotional state displayed by another person diverges from the emotional state we typically experience in similar circumstances. Detecting a discrepancy between one's own perceived interoceptive state and the physiological expression of the other's emotion may enhance self–other distinction, thereby making it more likely that the other's internal state becomes an object of attention. This hypothesis pertains to the domain of affective empathy and its interaction with interoceptive processing. The hypothesized sequence of processes to be tested would therefore be: perception of the other's emotional expression → comparison with one's own interoceptive state → self–other distinction → empathic response.

H3. "Self first". Self–other distinction may emerge only after bodily signals have been reinstated or a memory has been recollected. In this view, interoceptive reactivation, episodic retrieval or both concurrently, provide the raw material for an appraisal process that subsequently differentiates between self-generated and other-generated states, enabling accurate empathic understanding. This hypothesis accommodates the co-occurrence of the affective and cognitive components of empathy whereby all the information associated with one's own experience can be used to generate an empathic response. The hypothesized sequence of processes to be tested would therefore be: reinstatement of self-related bodily and/or mnemonic information → appraisal and self–other distinction → empathic response.

8. Conclusions

Studies in healthy populations clearly support the proposal that empathy draws upon past personal experiences. However, clinical studies that have investigated empathy abilities in patients with autobiographical memory impairment are less clear about the interplay between these cognitive processes.

We argued that advancing the field requires a stronger focus on self–other distinction and, in particular, on how the self is referenced, through bodily perceptions and autobiographical experiences, as a model for understanding others, a process heavily dependent on parietal regions.

Declaration of Generative AI and AI-assisted technologies in the writing process

F.M. wrote the original draft of the manuscript. Only after the first draft was written the author used ChatGPT in order to improve the grammar and readability of the original text. After using this tool, the authors reviewed and edited the content as needed. F.M. takes full responsibility for the content of the published article.

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Declaration of Competing Interest

The authors declare no competing interests.

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