CORTEX 50 (2014) 32–44

Available online at www.sciencedirect.com

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Journal homepage: www.elsevier.com/locate/cortex

Research report

Impaired emotional memory enhancement on recognition of pictorial stimuli in Alzheimer's disease: No influence of the nature of encoding

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ARTICLE INFO

Article history:
Received 29 April 2013
Reviewed 4 July 2013
Revised 14 July 2013
Accepted 9 October 2013
Action editor Michael Kopelman
Published online 24 October 2013

Keywords:
Emotional memory enhancement
Positivity effect
Encoding conditions (intentional *vs* incidental, low *vs* high resources)
Mild AD patients
Healthy older adults

ABSTRACT

Objectives: There is some discrepancy in the results regarding emotional enhancement of memory (EEM) in Alzheimer's disease (AD). Some studies report better retrieval of emotional information, especially positive, than neutral information. This observation is similar to the positivity effect reported in healthy older adults. It was suggested that this effect is due to privileged, deeper and more controlled processing of positive information. One way of testing this is to control both the intention to encode the information and the cognitive resources involved during encoding. Studies investigating EEM in AD patients did not systematically control the nature of encoding. Consequently, the purpose of our study was to examine EEM in AD while manipulating the nature of encoding.

Methods: Two experiments were conducted. In Experiment 1 the intention to encode stimuli was manipulated by giving or not giving instructions to participants about the subsequent retrieval. In Experiment 2 cognitive resources involved during encoding were varied (low *vs* high). In both experiments participants performed immediate recognition task of negative, positive and neutral pictures. 41 mild AD patients and 44 older healthy adults participated in Exp. 1, and 17 mild AD patients and 20 older healthy adults participated in Exp. 2.

Results: AD patients did not present EEM. Positivity effect, better performance for positive than neutral and negative pictures was observed with older healthy adults.

Conclusion: The data suggest that EEM is disturbed in mild AD patients, with respect to both negative and positive stimuli, at least concerning laboratory, not real-life material. They also suggest there is a positivity effect in healthy older adults and lend support to the idea that this effect is due to preferential cognitive processing of positive information in this population.

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http://dx.doi.org/10.1016/j.cortex.2013.10.001

1. Introduction

Numerous studies have described better declarative memory for emotional stimuli (negative and positive) than for neutral stimuli in healthy young and older participants (see Reisberg & Heuer, 2004, for review). According to the evidences from both studies involving patients with amygdala lesions and neuroimaging studies, emotional enhancement of memory (EEM) is particularly reliant on the amygdala (Cahill et al., 1996, Kensinger & Schacter, 2006). It has been suggested that EEM is based on not only the modulation the amygdala exerts on hippocampal memory consolidation processes, but also on the interaction between the amygdala and other brain regions (for review, see Canli, Zhao, Brewer, Gabrieli, & Cahil, 2000; McGaugh, 2000; Vuilleumier, Richardson, Armony, Diver, & Dolan, 2004). Accordingly, it has been proposed that EEM may be based on two different mechanisms, one related to the influence of the amygdala on consolidation processes (consolidation-mediation hypothesis) and the other based on how the amygdala influences attention processes (attention-mediation hypothesis) (Talmi, Anderson, Riggs, Caplan, & Moscovitch, 2008). The latter hypothesis is particularly relevant when retrieval occurs immediately after encoding.

EEM was also investigated in patients with Alzheimer's disease (AD), given the neuropathological changes in the medial temporal lobes, including the amygdala, observed in the early stages of the disease. However, data regarding the presence of EEM in AD patients are fairly inconsistent (e.g., Kazui, Mori, Hashimoto, & Hirono, 2003; Kensinger, Brierley, Medford, Growdon, & Corkin, 2002). In the present study we investigated if encoding conditions may influence presence of EEM in AD patients, in immediate picture recognition task. In particular, we were interested in the influence of the intention to encode or not to encode the material and of the cognitive resources involved during encoding.

1.1. *EEM in normal ageing*

During normal ageing the amygdala is relatively spared, although some studies have identified a linear decline in the volume of the amygdala with age (Allen, Bruss, Brown, & Damasio, 2005; Salat et al., 2004). The amygdala's response to emotional stimuli has been reported to be very similar in both young and older adults (Mather et al., 2004). Older adults' electrodermal responses to emotional stimuli and subjective emotional valence and arousal are also similar to those of young adults (Denburg, Buchanan, Tranel, & Adolphs, 2003; Kensinger & Corkin, 2004), although older adults present a positivity bias as regards processing emotional stimuli. On the behavioural level, they spend more time exploring positive stimuli and less time exploring negative stimuli than young adults (Knight et al., 2007; Mather & Carstensen, 2003). Some authors have suggested that this positivity effect may be related to greater cognitive control of positive stimuli processing (Knight et al.., 2007; Leclerc & Kensinger, 2011).

Like in young adults, EEM was frequently reported in older adults, in spite of the episodic memory decline observed in normal ageing (Comblain, D'Argembeau, Van der Linden, & Aldenhoff, 2004; Denburg et al., 2003; Kensinger & Schacter, 2006). In fact, EEM was reported after both long-term and immediate memory, and for different kinds of stimuli such as words (Kensinger, 2008; Thomas, 2006), images (Kensinger, Piguet, Krendl, & Corkin, 2005; Waring & Kensinger, 2009; Yang & Ornstein, 2011), faces (Denburg et al.., 2003; Mather & Carstensen, 2003), and public events (Kensinger, 2006; Petrican, Moscovitch, & Schimmack, 2008). In some studies EEM was shown after intentional encoding (Kensinger et al., 2005) and in other studies after incidental encoding (Kensinger et al., 2005; Mather & Carstensen, 2003; Mather & Knight, 2005; Thomas, 2006; Yang & Ornstein, 2011). To the best of our knowledge, one study investigated EEM after both intentional and incidental encoding (Kensinger et al., 2005), although it used only negative and neutral stimuli.

Interestingly, some studies observed the positivity bias with respect to memory performance in older adults. Contrary to young adults, who tend to be better at retrieving negative than neutral and positive stimuli, older adults are better at remembering positive stimuli than neutral and negative stimuli (Charles, Mather, & Carstensen, 2003; Mather & Carstensen, 2003; Mather & Knight, 2005; Ochsner, 2000; Thomas, 2006). However, other studies did not observe this positivity effect (Comblain et al., 2004; Denburg et al., 2003; Emery & Hess, 2008).

According to some authors, this pattern of results is due to the fact that there is no difference between older and young adults in their retrieval of positive stimuli, and that older adults do not perform as well as young adults when it comes to retrieving negative stimuli (Mather, 2006). To explain the positivity bias, it was proposed that older adults are more inclined to regulate their goals according to their emotions and to maintain positive affect (Mather & Carstensen, 2003). To do so, they spontaneously focus their attention on pleasant, positive information and process it in a more self-referential way (Yang & Ornstein, 2011; see Murphy & Isaacowitz, 2008, for review). In fact, in most studies the encoding of the stimuli was incidental and was not focused on the emotional aspects of the stimuli. Emery and Hess (2008) attempted to establish whether the encoding conditions might provide an explanation for the positivity effect by focussing, or not, participants' cognitive resources on the emotional aspect of the stimuli. They failed to demonstrate a positivity effect, independently of this manipulation. As far as we know, no study has investigated the influence of encoding instruction (intentional *vs* incidental).

Recently, Addis, Leclerc, Muscatell, and Kensinger (2010) proposed that the positivity effect observed in older adults may be due to age-related changes in the interactions between brain regions that process emotion (ventromedial prefrontal cortex and amygdala) and the hippocampus during encoding of positive information.

1.2. *EEM in AD*

AD is a progressive disorder in which the main early feature is memory impairment due to the pathological changes in the medial temporal lobe. Memory loss in the early stages of AD is well documented and numerous studies have shown explicit memory to be severely disturbed. Recently questions have been raised about the impact of AD on EEM, insofar as the neuropathological changes in AD also cause damage to