Effect of Emotion on Memory in Alzheimer’s Disease and its Relationship with Mediotemporal Atrophy

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Background

Effect of Emotion on Memory (EEM): In normal young participants, memory is usually better for emotional than for neutral information (La Bar & Cabeza, 2006). This emotional enhancement of long-term memory is supposed to be due to the influence of the amygdala on memory consolidation (McGaugh, 2004) but the mechanisms of emotional enhancement of immediate memory are less clear. Some authors suggested that amygdala response to emotional stimuli may also support enhanced attention towards these stimuli and, therefore, improve their encoding, resulting in a better retrieval (Talma et al., 2007).

EEM in aging and Alzheimer’s disease: During normal aging, the EEM is broadly preserved, though it is classically more noticeable on positive items (Talma et al., 2004). Results are less consistent concerning Alzheimer’s disease. Some authors observed preserved EEM (e.g. Boller et al, 2002) while others concluded to an impairment of this effect (e.g., Kensinger et al., 2002) especially with explicit, episodic memory tests. Because the neuropathological changes in AD typically involve early mediotemporal atrophy (Chan et al., 2001) it has been suggested that EEM loss in patients could be related to pathological amygdala alteration.

Objectives:

(1) Investigate the emotional enhancement effect on memory in Alzheimer’s disease;
(2) Precise the involvement of mediotemporal atrophy (amygdala and hippocampus) in EEM.

PART I. Behavioural study

Methods

Participants: Results were analysed on a set of 15 AD patients (mean MMS=22.9, SD=2.3; mean age=83.4, SD=4.6) and 20 control participants (mean MMS=28.4, SD=1.8; mean age=77.8, SD=7.5).

Stimuli: 60 pictures including 20 negative, 20 neutral and 20 positive items.

Procedure: Participants performed an encoding phase (living/nonliving categorisation task) followed by an Old/New retrieval phase (5 min delay).

Encoding (Living/Nonliving)

Retrieval (Old/New)

Results

Correct recognitions (% per stimulus type)

• ANOVA revealed a significant group effect (F(1,33)= 22.1, p<0.001) and a group x emotion interaction (F(2,66)=4.8, p<0.05).

Discussion

Our results replicate preserved EEM in normal aging controls, with a trend towards positivity effect which supports recent theories of emotional aging. However, no EEM was found across all AD patients, indicating a vulnerability of this process to AD.

PART II. Neuroimaging study

Methods

Participants: 15 AD patients (mean MMS=22.9, SD=2.3; mean age=83.4, SD=4.6) and 20 healthy participants (mean MMS=28.4, SD=1.8; mean age=77.8, SD=7.5).

MRI acquisition: Brain imaging consisted of millimetric resolution sagittal 3D T1 sequences in both groups (AD: Philips 1.5T; H. HP: Brucker 3T).

Data analysis: Volumetric segmentation was performed using Freesurfer stable release 5.0.0 (see Fischl et al., 2002, 2004). This technique allows precise measurement of gray matter structures volume, with minor effects of various field strength: sequence and machine type (see Han et al., 2006).

Automated analysis of a brain volume using Freesurfer, with grey and white matter segmentation labels (left and cortical surface parcellation (right))

Results

Healthy participants

Recognition of neutral stimuli was found to correlate positively with both hippocampus size (r=0.43, p<0.05). However, the correlation between the emotional enhancement effect and amygdala volume was found non-significant (r=0.32).

AD participants

No positive correlation was found between hippocampus nor amygdala and recognition performance. However, the correlations for emotional enhancement effect were significantly positive for the right amygdala (r=0.47; p<0.08) and both hippocampus (L: r=0.48; p<0.05 ; R: r=0.69, p<0.01)

General Discussion

Our results indicated an overall loss of EEM in Mild to moderate AD, which may therefore not be a good target for cognitive remediation in patients.

However, the loss of this effect appears strongly correlated to mediotemporal atrophy (non amygdala-specific) in this disease.

EEM testing may therefore be useful for neuropsychological assessment in the early stages of Alzheimer’s disease, in order to provide an index of progressive mediotemporal structures alteration.

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Image 1: Parcellation and resolution MRI acquisition:

Participants

Methods

Stimuli

Procedures

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Retrieval (Old/New)

Correct recognitions (% per stimulus type)

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