Effect of emotion on immediate explicit and implicit memory in Alzheimer’s disease: correlation with amygdalar volume.

H. Chainay¹, L. Landré¹, P. Krolak-Salmon², G. Michael¹, R. Versace¹ & A. Krainik³
1. EMC, University Lyon 2, France
2. Geriatric Hospital of Charpennes, France
3. Department of Neurology, CHU of Grenoble, France

Background

Effect of Emotion on Memory (EEM): In normal participants, memory for emotional information is usually better than for neutral information (La Bar & Cabeza, 2006). The emotional enhancement of long-term memory is supposed to be due to the influence of the amygdala on memory consolidation (McGaugh, 2000) but the mechanisms of emotional enhancement of immediate memory are less clear. Some authors suggested that amygdala response to emotional stimuli may result in enhanced attention towards these stimuli and, therefore, ameliorates their encoding (Talmi et al., 2007). Better encoding of the stimulus may increase mnemonic resolution and consequently improve subsequent immediate retrieval.

EEM in Alzheimer’s disease: Numbers of studies have shown impairment of explicit memory in the early stages of Alzheimer’s disease (AD), yet results are less consistent concerning implicit memory. Because the neuropathological changes in AD also involve amygdala (Chan et al., 2001) it was suggested that EEM should be impaired in AD. However, inconsistent results have been reported. Some authors observed impaired long-term EEM (e.g., Kensinger et al., 2002) especially of explicit memory, while others observed its preservation (Boiler et al., 2000). However, few very studies examined emotional enhancement on both implicit and explicit immediate memory in AD.

Objective:

Our objective is double: (1) investigate effects of emotional enhancement on immediate memory in AD; (2) investigate involvement of amygdala in this enhancement.

PART I. Behavioural study

Methods

Participants: 28 AD patients (mean MMSE=23.7, SD=2.2; mean age=81.4, SD=4.9) and 28 Controls (CP) (mean MMSE=29.1, SD=0.8; mean age=75.4, SD=8.1).

Stimuli: Two lists of 60 stimuli, each including 20 negative, 20 neutral and 20 positive.

Tasks: Categorisation (living vs non-living), Recognition (old, new).

Procedure: Participants performed two encoding phases (categorisation task) each followed by immediate retrieval phase (5 mins delay). One half of AD patients and Controls performed explicit encoding, they were asked to memorise pictures. The other half performed implicit encoding (were not asked to memorize). Each encoding phase was followed by either intentional (recognition task) or incidental retrieval (categorization task).

All participants performed both retrieval conditions. All conditions and order of less were counterbalanced between participants.

Hypothesis:

(1) CP better recognition and faster categorisation than AD; (2) CP & AD better recognition for emotional than neutral stimuli after incidental encoding; (3) CP & AD faster categorisation of emotional than neutral stimuli.

Results

Recognition:

Effect of Group (p<0.001) and interaction Group*Encoding (p<0.001) on % of correct recognition and d’, Effect of Emotion on response criterion (C).

Categorization:

Effect of Group (p<0.005) on RT. Priming effect - faster RT for old than new items (p<0.003), Effect of Emotion (p<0.001), Interaction Group*Encoding*Emotion*Item (p<0.009).

Discussion

Recognition of old items were less accurate for AD than Controls only after intentional encoding. Their discrimination between old and new items was also lower, as indexed by d’. Effect of Emotion was observed only for Controls on response criterion, as indexed by C, with more liberal criterion for positive items.

Categorization of items into KingmanKramer was faster for Controls than AD. Both groups categorized faster old than new items. Effect of Emotion on categorisation of old items were observed for AD (intentional encoding) and Controls (incidental encoding) with slower categorization of positive items.

PART II. Neuroimaging study

Methods

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

Procedure: The procedure was similar than above, with twice more stimuli for healthy participants.

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

Data analysis: Volumetric segmentation was performed using Freesurfer stable release 5.0.0 (see Fischl et al. 2002, 2004).

Healthy participants

Behavioural results: Data indicate an emotional enhancement effect, with both negative (t(19)=2.2, p<0.05) and positive (t(19)=6.3, p<0.001) items being better recognized than neutral ones (positive=negative tendency: t(19)=1.9, p=0.08).

Correlation analysis: Neural recognition scores only were 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).

Results

AD participants

Behavioural results: No emotional enhancement effect was found for negative nor positive items as compared to neutral ones.

Correlation analysis: No positive correlation was found between hippocampus nor amygdala and any recognition performance. However, the positive correlations for emotional enhancement effect were significant for the right amygdala (r=0.47, p<0.05) and both hippocampi (L: r=0.68, p<0.05 ; R: r=0.69, p<0.01).

General Discussion

- Our results tend to confirm an alteration of the effect of emotion on memory in Alzheimer’s disease, as compared to normal ageing.
- However, the degree of emotional memory enhancement was found to correlate with amygdala and hippocampal volumes in patients only.
- These observations support the differential implication of the rate of mediotemporal atrophy in the loss of emotional enhancement effect in AD.

Laboratoire d’Etude de Mécanisme Cognitif, Université Lyon 2
5, avenue Pierre Mendès France, 69676 Bron, France
hanna.chainay@univ-lyon2.fr

Work supported by Agence Nationale de Recherche
Grant number ANR-09-JCJC-0144