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Recognition memory for emotional pictures in Alzheimer's patients

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Objective – The purpose of the present study was to examine whether Alzheimer's Disease (AD) patients can benefit from the emotional content of visual stimuli in a picture recognition test. *Method* – Sixteen patients with AD and 19 normal controls matched for age and years of education, were studied. Sixteen pictures (with varying emotional contents) were presented to each participant. Thirty minutes later, a recognition test was applied with the target-pictures mixed among 34 others of similar content. The subjects were instructed to rate them as pleasant, unpleasant or indifferent. *Results* – The total of pictures correctly recognized by the AD patients (75.4% of the target-pictures) was smaller than that of the controls (96.4%). Controls recognized more emotional pictures than indifferent pictures. *Conclusions* – Emotional content enhanced recognition of pictures in normal subjects, whereas for the Alzheimer's subjects the emotional significance attached to the pictures was of no benefit to enhance recognition.

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Emotionally meaningful events as a general rule are more easily remembered than events devoid of emotional content. One explanation for this is that the amygdala is activated. This mesial structure of the temporal lobe seems to regulate the affective component of memory, bringing forth emotional significance to episodes to be remembered (1). Several lines of evidence point to this direction: results, both from animal experiments and human studies, implicate the amygdala in anxiety processes and conditioned fear (for a review, see 2); recently, it was reported that an Urbach–Wiethe disease patient with bilateral amygdaloid damage showed no evidence of enhanced memory after the introduction of emotional events (3); a functional imaging study (4) confirmed that amygdala activation is involved in this phenomenon. In addition, a number of studies have shown that the amygdala is involved in the recognition of emotions in facial expressions (5–8; but see 9).

Neuropathological alterations have been found in the amygdala of patients with dementia of the Alzheimer type (AD), including the presence of neurofibrilary tangles and neuritic plaques, the characteristic histologic features of the disease (10, 11). Amygdala atrophy was detected in autopsied patients with advanced AD (12), and also *in vivo* in patients in the early phase of the disease (13).

Given the pathological alterations seen in the amygdala of AD patients, some kind of emotion processing impairment is to be expected in these patients. Indeed, some authors have demonstrated a defective processing of emotional cues in AD patients, including an impairment in the processing of facial expressions (14–16). On the other hand, it was shown that AD patients living in Kobe when the earthquake happened were able to remember this experience with a strong emotional content (17). However, the literature on the processing of emotional information of AD patients has generally overlooked the effects of emotional content of stimuli on memory.

In this study we examined whether AD patients can benefit from the emotional content of visual stimuli in a picture recognition test. In normal subjects it was expected that affectively loaded pictures would be recognized better than neutral stimuli, but in AD patients, on the contrary, the affective content of stimuli should not facilitate

their performance because the amygdala is presumably affected.

Materials and methods

Subjects

Sixteen patients (males = 43.7%) with a diagnosis of probable dementia of the Alzheimer type and 19 healthy subjects (males = 36.8%) were evaluated. They were paired according to age and educational level (Table 1). The patients had a history of cognitive decline and memory problems, but normal consciousness. The diagnosis of probable Alzheimer's disease was made according to the criteria of the National Institute of Communication Disorders and Stroke–Alzheimer Disease and Related Disorders Association (NINCDS-ADRDA) (18). The patients were also submitted to the Mini-Mental State Examination (MEEM) adapted to Portuguese [18]. All patients lived with their families and required no special care. Patients with other specific causes for dementia, brain lesions, delirium and depression were excluded.

Material

Fifty slides with varied emotional content were prepared. The pictures were taken from books and magazines and showed, for instance, landscapes, sexual exposure, love scenes, lovely children, mutilated people or accidents, and also geometric pictures, among other themes. In a pilot study, emotional content was determined by asking volunteers (University students) to rate each picture as indifferent, pleasant or unpleasant.

Procedure

The test of emotional memory was applied individually in one single session. It consisted of the recognition of pictures with varied emotional contents. Initially, each subject was presented with a set of 16 target-pictures, each one projected on a white screen for 6 s. The instructions specified that the subject should carefully look at each picture without making any comments about it. After the presentation of the last slide, a distracting task lasting 30 min was given. After this period, the recognition (yes-no) of the target-pictures was carried out. The 16 target-pictures were presented within a set of 50 pictures of compatible emotional content. The subject had to say if each of the stimuli had or had not been presented before. Every time a subject recognized (either true or false recognition) a picture, he/she was asked to identify it (describe what it depicted) and classify it as pleasant, unpleasant or indifferent.

The results obtained did not fit the requirements for parametric statistical analyses. Therefore, Mann–Whitney U-test and Wilcoxon t-test were employed for comparisons between and within groups, respectively.

Results

The total number of pictures correctly recognized by the AD patients (75.4% of the target-pictures) was smaller than that of the controls (96.4%) (Mann–Whitney: $U = 57.0$; $P < 0.001$). In spite of this memory impairment, the patients did not differ from controls regarding the ability of categorizing the pictures as indifferent (Mann–Whitney: $U = 132.5$; $P = 0.52$), pleasant (Mann–Whitney: $U = 116.0$; $P = 0.23$) or unpleasant (Mann–Whitney: $U = 139.5$; $P = 0.68$, see Table 2). However, there was some variation among the participants (both controls and patients behaving similarly in this respect) in their classification of pictures as indifferent, pleasant or unpleasant. Therefore, for each subject, we calculated a ratio of remembered pictures within each category, as defined by his/her own categorization of each picture (Fig. 1). This value was used for the statistical analysis. Within both groups there were no differences in the number of remembered pictures between the pleasant and unpleasant categories. Therefore these two categories were combined into a single one (emotional pictures) for further analysis. Controls recognized more emotional pictures than indifferent pictures (Wilcoxon: $t = 0.0$; $P < 0.01$). The same was not true for the AD patients, who recognized a similar number of emotional and indifferent pictures (Wilcoxon: $t = 55.5$; $P = 0.79$). Across group compar-

Table 1. Demographic characteristics and scores of MEEM express in means and standard deviations[a]

	Controls ($n = 19$)	Alzheimer's ($n = 16$)
Age	67.4 ± 6.7	70.2 ± 6.8 NS
Education	11.3 ± 4.1	10.3 ± 5.0 NS
MEEM	28.9 ± 1.1	19.9 ± 4.6*

[a] t-test student for unequal samples; NS = not significant; * $t = 7.78$; $P < 0.0001$.

Table 2. Percentage of the 16 target-pictures pictures classified as indifferent, pleasant and unpleasant. Differences between patients and controls were not significant (Mann–Whitney)

	Controls ($n = 19$)	Alzheimer's ($n = 16$)
Indifferent	28.0	31.3
Pleasant	41.1	36.3
Unpleasant	30.9	32.4

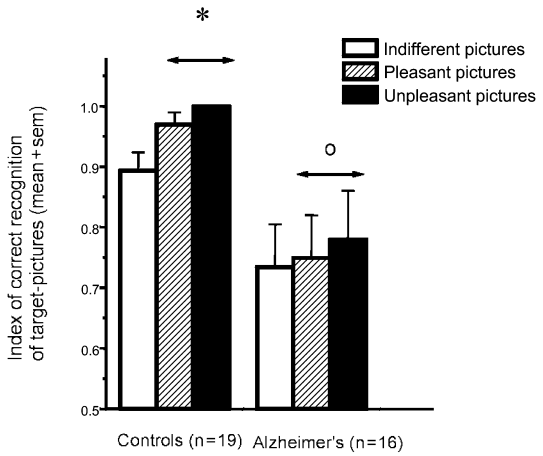

Fig. 1. Percentage of correctly recognized target-pictures of controls and Alzheimer's patients. °$P < 0.05$ (Mann–Whitney): Alzheimer's vs Controls. *$P < 0.05$ (Wilcoxon): Controls. Emotional vs indifferent pictures. Pleasant and unpleasant pictures (not significantly different from each other) were grouped together.

ison showed that AD patients recognized fewer emotional pictures than did controls (Mann–Whitney: $U = 51.5$; $P < 0.001$). The difference between patients and controls in recognizing indifferent pictures did not reach statistical significance (Mann–Whitney: $U = 113.0$; $P = 0.19$).

Discussion

Using an exposure time of 6 s for each target-stimulus, the task appeared to be very easy for normal subjects, who presented a high index (89.4%) of recognition of indifferent pictures. In spite of this high level of performance, significant enhancement of recognition was observed in this group when viewing emotionally laden images. That is, pictures with emotional content were more easily recognized than emotionally indifferent pictures. Both pleasant and unpleasant pictures equally enhanced recognition.

In the AD patients group, recognition of pictures devoid of emotional content was lower (73.6%), although not statistically different from controls. In this group we observed no enhancement of recognition of emotional pictures, whether the emotional content was positive or negative, meaning that, while the controls benefited from the affective content of the stimuli, the Alzheimer's patients did not.

It is important to note that the AD patients did not lose their capacity to attribute emotional content to the images, behaving similarly to the control group. The patients could identify the pictures and interpret their meaning as well as the controls. But this can be accomplished by other means besides emotion processing (for instance, regarding the different pictures as examples of cognitively based classes of situations) and does not imply that they 'comprehend the emotional states of others using facial cues or speech intonation as clues, and communicate their own emotional states via facial expressions and vocal prosody', one possible definition for the term *emotion processing* (16).

On the other hand, failure to comprehend the emotional states of others and failure to expressively communicate their own emotions does not mean an incapacity of these patients to *feel* emotions when confronted with provoking situations.

The main finding of this study points to an inability of Alzheimer's patients to benefit from the emotional content of stimuli, even in mild to moderate stages of the disease. This stands in contrast with the intact emotional enhancement of memory observed in amnesic patients of aetiologies diverse of AD (20).

The presumed damage to the amygdala of the AD patients may explain the present results, as Cahill et al. (3, 4) have demonstrated that the amygdala is critically involved in the emotional enhancement of memory. Thus the lack of memory enhancement in our AD patients may be because of a failure in arousal mechanisms that modulate declarative memory (20).

Our data are in disagreement with those of Ikeda (17). These authors investigated the memory of AD for the Kobe earthquake. The AD patients remembered the earthquake more than a neutral posterior event. It is important to note that the emotionally charged pictures used in the present investigation were not a personal experience of each subject. Personally lived experiences (like the earthquake in Kobe) and situations witnessed without a personal participation are presumably different things. Another hypothesis to explain this difference could be the uneven intensity of emotional contents in these two experiments, one of them involving threat to patients' own life, and the other mere disgusting or enjoyable. More studies are needed to clarify these hypotheses.

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