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Remembering versus knowing during face recognition in unilateral temporal lobe epilepsy patients with or without hippocampal sclerosis

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ABSTRACT

Recognition memory involves knowing an item was learned (familiarity) and remembering contextual details about the prior learning episode (recollection). We tested three competing hypotheses about the role of the hippocampus in recollection and familiarity. It mediates either recollection or familiarity, or serves both processes. We further tested whether the left temporal lobe mediates recollection and the right temporal lobe familiarity (modes of processing view), or whether the two temporal lobes mediate remembering material specifically (material specificity view). We investigated 24-h face recognition using the "remember-know" procedure. We studied 23 left and 24 right temporal lobe epilepsy (LTLE/RTLE) patients with and without hippocampal sclerosis (HS+/HS−) and 31 healthy participants. HS+ patients made fewer know responses than HS− patients or healthy participants. RTLE was related to fewer remember responses than LTLE. Our results suggest the hippocampus has a critical role in familiarity. Further, our findings support the material specificity hypothesis of laterality.

1. Introduction

Recognition is the ability to judge an event or information as having been encountered or learned before. This ability is widely viewed as consisting of the two mental states familiarity, i.e., knowing that the information was learned, and recollection, i.e., remembering specific contextual details about the situation in which the information was learned (Mandler, 1980). Recognition can also be based on familiarity, alone, for example, when we meet a person and are sure we saw the person before, but still cannot retrieve any contextual information about where or when this occurred or who the person is. Another example for the isolated feeling of familiarity is a certain form of déjà vu experience relatively often experienced by patients with medial TLE (Wild, 2005). Déjà vu is related with the erroneous and subjectively inappropriate impression of familiarity of a present experience without being able to explain the familiarity or to pinpoint its source (Neppe, 1983; Spatt, 2002).

Recollection is based on the episodic memory system, and familiarity is based on the semantic memory system (Gardiner & Java, 1990; Tulving, 1985). Disagreement exists about the neural representation of recollection and familiarity. A number of studies suggest, that the hippocampus is necessary for recollection but not familiarity (for reviews see Brown & Aggleton, 2001; Eichenbaum, Yonelinas & Ranganath, 2007). Other studies suggest that the hippocampus mediates both recollection and familiarity (for review see Squire, Wixted & Clark, 2007). A third, less accepted theory states that the hippocampus' dominant role in recognition is to signal familiarity of a percept, while recollection during recognition is mediated by the re-activation of a widespread cortical trace already involved in the conscious perception and encoding of the information (Milner, 1989). According to this model, familiarity is only another qualifying feature of a percept, like color or loudness.

Recollection and familiarity are often investigated with the "remember-know" paradigm (Gardiner & Java, 1990; Tulving, 1985). In the "remember-know" paradigm participants first identify items that they previously studied. If an item is identified, the participants are asked to distinguish whether they can remember details or aspects of the original presentation of the identified item (remember response) or whether they know that the item was on the study list, but are unable to remember any experience associated with its original presentation (know response; Knowlton, 1998).

In the present study, we investigated remember and know responses during recognition in patients with unilateral TLE. Unilateral TLE is related to material specific memory deficits. The material specificity hypothesis claims that the left temporal lobe is superior in encoding and retrieval of verbal information, and the right temporal lobe is specialized in remembering certain nonverbal information, e.g., faces (Ladavas, Umilta & Provinciali, 1979; Milner, 1975; Bengner et al., 2006a).

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There is ongoing debate whether memory differences between the two temporal lobes are based on material specificity, only, or whether the two temporal lobes also differ in how information is processed (e.g., Dobbins, Kroll, Tulving, Knight & Gazzaniga, 1998; Kennepohl, Sziklas, Garver, Wagner & Jones-Gotman, 2007). To our knowledge, only two studies to date have analyzed hemispheric differences of remembering versus knowing responses in TLE (Blaxton & Theodore, 1997; Moscovitch & McAndrews, 2002). The results of the first study strongly suggest a "modes of processing" view of laterality, namely that the left temporal lobe mediates remembering, whereas the right temporal lobe mediates know responses (Blaxton & Theodore, 1997). Whereas participants in the Blaxton and Theodore (1997) paper studied abstract line drawings, a second study tested recognition of words and faces. This second study found convincing support for a "material specificity" view of laterality, namely that the left temporal lobe mediates remembering of verbal information, while the right temporal lobe mediates remembering of nonverbal information (Moscovitch & McAndrews, 2002). Both cited studies investigated patients with either hippocampal sclerosis or anterior temporal lobe resection, and so it was not possible to draw any firm conclusions about the specific role of the hippocampus in recollection and familiarity during recognition.

In this study, we therefore tested remember and know responses during 24-h face recognition in left and right TLE patients with and without hippocampal sclerosis. A first aim was to test whether the hippocampus was more relevant for recollection or familiarity during recognition. If the hippocampus was more relevant for recollection than for familiarity, then TLE patients with hippocampal sclerosis should show fewer remember (but not fewer know) responses than healthy controls or TLE patients without hippocampal sclerosis. If, on the other hand, the hippocampus was more relevant for familiarity than for recollection, then TLE patients with hippocampal sclerosis should show fewer know (but not fewer remember) responses than healthy controls or TLE patients without hippocampal sclerosis. If the hippocampus was relevant for both recollection and familiarity, then both remember and know responses should decrease in TLE patients with hippocampal sclerosis.

A second aim of this study was to test whether the modes of processing view or the material specificity view holds the better explanation for the result pattern of the different patient groups. According to the material specificity hypothesis of laterality, right TLE patients with hippocampal sclerosis should show fewer remember responses to face items than left TLE patients or right TLE patients without hippocampal sclerosis. According to the modes of processing hypothesis of laterality right TLE patients should exhibit fewer know responses than left TLE patients or healthy participants. On the other hand, left TLE patients should show fewer remember responses than right TLE patients or healthy participants.

In this paper, we further studied the influence of proactive interference (PI) on recollection and familiarity. In PI, previously learned information impairs learning or remembrance of more recent information. Experimentally, PI is usually induced by one or more distracter lists of information that are learned before the acquisition of a similar target list. The distracter lists can be presented all at once right before the target list or distributed over days (compare Underwood & Ekstrand, 1966). PI decreases contextual distinctiveness of items in episodic long-term memory (Briggs, 1954; Wixted & Rohrer, 1993), and leads to long-term memory deficits (Underwood, 1957). While PI decreases the contextual distinctiveness of memory items, the medial temporal lobe memory system limits interference between representations by separating patterns of similar representations (McClelland, McNaughton & O'Reilly, 1995; Squire, Cohen & Nadel, 1984). In a recent related study we could show that distributed PI decreases 24-h long-term face recognition in TLE patients (Bengner et al., 2006b). As recollection is supposed to depend on the episodic memory system and includes remembering contextual details, we hypothesized that PI leads to a decrease in remember responses but leaves know responses unaffected. In this study, PI was induced by a list of 20 faces learned 24 h prior to a second list of 20 faces. We tested immediate and 24-h recognition of both lists. Using this paradigm, our study participants had already looked at 100 photographs of 60 different faces before studying the second list of faces (compare Bengner et al., 2006b). To our knowledge, this study is the first to test the effect of proactive interference on episodic memory with the remember-know paradigm.

2. Methods

2.1. Participants

Participants were 31 healthy participants and 47 consecutive unilateral TLE patients of the Epilepsy Center Hamburg (24 right and 23 left TLE). This study received prior approval by the ethics committee of the Protestant Hospital Alsterdorf and has therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki. Each participant gave informed consent to the study. All patients underwent a diagnostic workup with 24–72 h video-EEG-monitoring and structural magnetic resonance imaging (MRI) investigations between June 2004 and February 2007. The samples described here partly overlap with samples described in related studies (Bengner et al., 2006a, 2006b, 2006c; Bengner & Malina, 2007). A number of TLE patients described in two of the earlier studies (Bengner et al., 2006a, 2006c) could not be tested for face recognition under PI, because they did not stay long enough in the video-EEG unit. They could thus not be included in the present study. Further more, only patients with either a negative MRI finding or hippocampal sclerosis as the only finding were included in the present study. On the other hand, we included further consecutive TLE patients between January 2006 and February 2007, not yet included in Bengner and Malina (2007).

TLE diagnosis was based on seizure semiology (e.g., epigastric or déjà vu aura, alimentary or hand automatisms, dystonic arm posturing during seizures; duration of seizures 1 to 5 min.; gradual termination; postictal confusion, amnesia or partial amnesia) and interictal or ictal EEG abnormalities (see below for details on video-EEG). Auras and seizure semiology were documented either as reported by the patient, observers or during video-telemetry or video-EEG monitoring (Luders et al., 1998; Manford, 2001; Rosenow et al., 2001). TLE patients were grouped as left or right TLE according to unilateral interictal or ictal EEG abnormalities and lateralizing ictal signs (e.g., Serles et al., 1998). A number of patients had to be assigned to the left or right TLE groups according to seizure semiology and interictal epileptic abnormalities alone, as they did not have any seizures during video-EEG monitoring (see Table 1). This might partly be due to the fact that antiepileptic medication was not lowered during monitoring. However, unilateral interictal epileptic abnormalities were recently found to be an excellent lateralizing feature of the epileptogenic region in MRI negative TLE, proven by postoperative seizure freedom (Holmes et al., 2000; Sylaja, Radhakrishnan, Kesavadas & Sarma, 2004). This way of assignment is not the gold standard of determining TLE or seizure focus lateralization, leading some authors to use terms like "apparent" or "probable" TLE for similarly defined patient groups (compare for Sylaja et al., 2004; Arfanakis et al., 2002; but see also Giovagnoli, Casazza & Avanzini, 1995). Hippocampal sclerosis was always ipsilateral to the hemisphere where EEG abnormalities had been detected (for details about structural MRI see below).