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Brief Communication

Arousal in response to neutral pictures is modified in temporal lobe epilepsy

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ABSTRACT

The objectives of the present study were to (i) better characterize visual emotional experience in patients with temporal lobe epilepsy (TLE), (ii) identify clinical risk factors that might be predictive of a change in emotional experience, and (iii) study the relationships between emotional experience and psychobehavioral/quality-of-life factors. Fifty patients with TLE and fifty matched controls evaluated the emotional content of unpleasant, pleasant, and neutral pictures with respect to their valence (unpleasant-to-pleasant) and arousal (low-to-high) levels. Demographic, cognitive, and psychobehavioral data were recorded for all participants, and clinical data and factors related to quality of life were also collected for patients with TLE. There were no significant differences between the group with TLE and the control group in terms of valence evaluations. However, arousal scores for neutral pictures were significantly higher in patients with TLE than in controls. There was also a non-significant trend towards lower arousal scores for pleasant pictures in patients with TLE than in controls. Although none of the recorded clinical factors were found to be related to emotional experience, the level of apathy was predictive of greater arousal experience for neutral pictures in patients with TLE. In conclusion, emotional experience appears to be modified in TLE and might be related to apathy. Changes in emotional experience should be taken into account in studies in which neutral stimuli are used to establish a baseline level when assessing emotional and cognitive processing.

1. Introduction

A growing number of studies have highlighted emotional processing disorders in patients with temporal lobe epilepsy (TLE), with a current focus on the patients' ability to recognize emotional stimuli (such as emotional faces and prosodic sentences) [1,2]. However, the emotional experience of patients with TLE has been investigated much less extensively [3,4]. Nevertheless, it is important to consider this aspect because it is likely to be related to the psychological well-being and quality of life of patients with TLE. In fact, patients with TLE frequently exhibit social and psychobehavioral difficulties (such as depression often with concomitant anxiety) and poor quality of life [5–8]. Several researchers have hypothesized that social cognition disorders in patients with TLE (emotional processing and the attribution of mental states, i.e., theory of mind) are related to psychological well-being and quality of life [1,9,10]. However, social and psychobehavioral disturbances in epilepsy are often atypical and, thus, difficult to assess with conventional nosological tools [11]. This might explain the failure of two recent, large studies to find associations between self-reported depression and quality of life on the one hand, and performances in emotion recognition tasks on the other [1,9]. We have suggested that a more specific, comprehensive assessment of psychobehavioral disturbances and quality of life might be able to detect this type of association [12].

One of the most widely used methods for assessing emotional experience in healthy controls and patients with neuropsychiatric disorders involves the evaluation of emotional content (notably emotional pictures taken from the International Affective Picture System (IAPS)) [13]. Indeed, many neurophysiological and neuroimaging studies have shown that exposure to IAPS pictures induces emotions. The IAPS is based on a model in which emotions are defined according to two main dimensions: (i) valence, which is the level of pleasantness associated with an emotional experience (ranging from unpleasant to pleasant) and (ii) arousal, which indexes the intensity of an emotional

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experience (ranging from low to high). To the best of our knowledge, only one study (Batut et al. [3]) has investigated emotional experience in a sample of patients with mesial TLE using the IAPS. The results did not support a change in emotional experience in patients with mesial TLE (relative to controls). However, Batut et al. only evaluated picture valence. Furthermore, the pictures' arousal levels were not controlled for in the experiment and were not evaluated by the participants. In a task requiring evaluation of fearful faces only, Labudda et al. [4] did not find any change in arousal experience in patients with mesial TLE.

The primary objective of the present study was to better characterize emotional experience in patients with TLE (compared with controls), as judged by the valence and arousal in response to pictures from the IAPS. The study also investigated clinical risk factors capable of modifying emotional experience and assessed the relationships between emotional experience and psychobehavioral/quality-of-life factors.

2. Material and methods

2.1. Participants

The data presented here were collected as part of a larger study of social cognition disorders in patients with TLE [12]. The study protocol had been approved by the local investigational review board (CPP Nord Ouest IV, Lille, France; reference: 2012-A00339-34).

Fifty patients with TLE seen in consultation at Lille University Medical Center's Epilepsy Unit (Lille, France) were consecutively recruited on the basis of clinical evaluation, electroencephalographic monitoring (an interictal EEG record and an ictal video/EEG record), neuropsychological data, and neuroimaging results. The inclusion criteria were as follows: (i) unilateral TLE and (ii) right-handedness (according to the Edinburgh Handedness Inventory) [14]. The exclusion criteria were as follows: (i) impaired intellectual capacity (an intellectual quotient below 75, according to a French adaptation of the National Adult Reading Test: fNART) [15] or nonverbal reasoning (according to Raven's Coloured Progressive Matrices: PM-47) [16]; (ii) significant amnesia or a marked impairment of instrumental capacities (agnosia, aphasia, apraxia, alexia, or agraphia); (iii) a history of neurological disease other than epilepsy; (iv) a history of psychiatric disease (other than depression or anxiety disorders); and (v) a seizure in the 24 h preceding the experimental session.

The control group included 50 right-handed participants (according to the Edinburgh Handedness Inventory), each of whom was matched for demographic characteristics (age, gender and educational level) with a patient with TLE. The exclusion criteria for controls were as follows: (i) impaired intellectual capacity (an intellectual quotient below 75, according to the fNART) or nonverbal reasoning (according to the PM-47) and (ii) a history of neurological or psychiatric disease.

The patients with TLE and controls underwent the Montreal Cognitive Assessment (MoCA) [17], which assesses a number of cognitive domains (attention, executive function, memory, language, visuoconstruction skills, conceptual thinking, calculation, and orientation).

The clinical characteristics of patients with TLE were recorded as follows: the presence of febrile seizures, age of the first seizure, age at onset of epilepsy, duration of epilepsy, seizure frequency, laterality of epilepsy (right, left), type of epilepsy (mesial, lateral), and the presence of hippocampal sclerosis (HS; classified as “with HS”, “with no brain lesions” or “with other lesions”). The presence of HS was established from structural neuroimaging results (3 Tesla MRI datasets). The diagnostic criteria for HS included a volume decrease on T1-weighted images and high signal intensity in fluid-attenuated inversion recovery images.

In patients with TLE and controls, self-reporting was used to estimate psychobehavioral disturbances such as (i) depression (according to the Beck Depression Inventory (BDI)) [18] and anxiety (according to the State–Trait Anxiety Inventory (STAI)) [19]; (ii) disturbances of affective regulation commonly associated with mood disorders, such as apathy (according to the Lille Apathy Rating Scale (LARS)) [20], alexithymia (according to the Toronto Alexithymia Scale (TAS)) [21,22], and anhedonia (according to the Physical Anhedonia Scale (PAS) and Social Anhedonia Scale (SAS)) [23]; for all the abovementioned instruments, the higher the score, the more intense the psychobehavioral factor; (iii) positive and negative affective states experienced (according to the Positive and Negative Affect Schedule (PANAS)) [24]; and (iv) impaired empathy (according to the Interpersonal Reactivity Index (IRI)) [25]; the higher the score, the more intense the positive or negative affectivity and empathy. In patients with TLE, quality of life was also estimated (according to the Quality of Life Inventory in Epilepsy (QOLIE-89)) [26]. We calculated the overall score and the social subscores for role limitations-emotional, emotional well-being, social support, social isolation, and work/driving/social function; the higher the score, the better the quality of life.

Demographic, cognitive, and psychobehavioral characteristics of patients with TLE and controls and clinical characteristics of patients with TLE are presented in Table 1.

2.2. Assessment of emotional experience

2.2.1. Stimuli

Sixty pictures of animals, landscapes and objects (including representations of people in context, body parts and whole bodies) were selected from the IAPS [13] (20 unpleasant pictures, 20 pleasant pictures and 20 neutral pictures) (Supplementary data—Supplementary material). For ethical reasons and in order to avoid possible ceiling effects in evaluations of emotional content, pictures featuring physical violence or sexual scenes were not selected. As in previous studies of controls [27] and patients with epilepsy [28], we controlled for the emotional parameters of the selected pictures. Indeed, standardized IAPS ratings for valence and arousal were compared in a contrast analysis (Supplementary data—Table 2). Unpleasant and pleasant pictures differed in terms of valence and had higher arousal ratings than neutral pictures (all $p < .0001$). Again in terms of valence, neutral pictures were considered to be more pleasant than unpleasant pictures and more unpleasant that pleasant pictures (all $p < .0001$). The pictures were presented centrally (with a horizontal visual angle of 12° and a vertical visual angle of 8°) on a black background. Pictures were homogenized (using Image J Software, http://imagej.nih.gov/ij/) in terms of their major physical characteristics (luminance, spatial frequencies and color saturation levels).

2.2.2. The test procedure

Using a computerized interface, each picture was presented (one at a time) for 500 ms in pseudorandom order (i.e., no more than two pictures of a particular valence were presented successively). After the presentation of each picture, the participants were instructed to evaluate the emotional content on a valence scale (ranging from 0, very unpleasant, to 9, very pleasant) and on an arousal scale (ranging from 0, very calm, to 9, very arousing). The participants were told to respond as quickly as possible and were not given any feedback on their performance levels.

2.3. Data analysis

All statistical analyses were performed with SAS software (version 9.3, SAS Institute Inc., Cary, NC, USA). The threshold for statistical significance was set to $p < .05$. Parametric tests were used for normally distributed datasets; otherwise, nonparametric tests were applied. Scores are reported as the median and mean $\pm$ standard deviation.

Controls and patients with TLE were compared in terms of their demographic characteristics (age, gender, and educational level) and cognitive characteristics (the MoCA score). Patients with TLE were then classified according to the laterality of epilepsy (right, left) and compared in terms of their demographic, cognitive, and clinical parameters: