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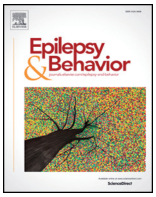

Experiences of self-conscious emotions in temporal lobe epilepsy

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ABSTRACT

Self-conscious emotions (SCEs) with a negative valence (such as shame and guilt) or a positive valence (such as pride) are moral emotions that emerge from self-reflection and self-evaluation processes in social contexts. In some neurologic and psychiatric disorders, experiences of SCEs are dysregulated. The objectives of the present study were to (i) evaluate whether patients with temporal lobe epilepsy (TLE) experience SCEs in the same way as nonclinical (control) participants and (ii) probe the relationships between experiences of SCEs on the one hand and the psychological symptoms frequently diagnosed in patients with TLE (anxiety and depression), the patients' clinical characteristics, and their functional outcomes in everyday life on the other.

Sixty-one patients with TLE and 61 matched controls completed a self-questionnaire (the Positive and Negative Affect Schedule (PANAS)) that enabled us to evaluate the extent to which they experienced shame, guilt, and pride. Demographic data, cognitive data, the severity of anxiety symptoms, and the severity of depressive symptoms were recorded for all participants. In patients with TLE, data of clinical characteristics and quality of life were also evaluated.

Relative to controls, patients with TLE were more likely to experience negative-valence SCEs to a higher extent and positive SCEs to a lesser extent. The patients who experienced negative-valence SCEs to a higher extent (rather than to a lesser extent) had a higher frequency of seizures, more severe anxiety and depressive symptoms, and a greater prevalence of anxiety and depressive disorders. Furthermore, patients who experienced positive-valence SCEs to a lesser extent (rather than to a higher extent) displayed a higher level of anxiety. Lastly, differences in experiences of SCEs by patients with TLE were associated with a lower quality of life.

In conclusion, experiences of SCEs can be dysregulated in patients with TLE. This dysregulation is linked to the patients' clinical and psychological symptoms and quality of life. In this context, SCEs might be a target of interest in the management of epilepsy.

1. Introduction

Shame, guilt, embarrassment, and pride are referred to as self-conscious emotions (SCEs, a subset of moral emotions) [1]. An individual's experience of SCEs emerges from self-reflection and self-evaluation processes [2]. Self-conscious emotions motivate individuals to defend and enhance their self-representations, produce behaviors that are socially valued, and inhibit those that are socially disapproved [3]. In this respect, SCEs differ from nonmoral emotions (e.g., basic emotions like joy, fear, anger, and disgust). This difference might also explain why experiences of SCEs are thought to appear later in a child's development than experiences of nonmoral emotions (for an example of an experiment on the developmental trajectory of pride, see [4]). However, the link between SCEs and nonmoral emotions remains poorly understood and requires further exploration. On a behavioral level, experiences of SCEs and experiences of basic emotions may differ in their neural basis; Gilead et al. showed that SCEs recruited more frontal areas (such as the medial prefrontal cortex) whereas basic emotions recruited "relatively phylogenetically-ancient" areas of the cortex [5].

The dysregulation of experiences of SCEs has been documented in some psychiatric disorders [6]. Perturbed experiences of negative-valence SCEs (such as shame and guilt) are frequently observed; for example, exaggerated feelings of shame have been observed in anxiety disorders in general [7] and social anxiety in particular [8]. It may also be the case that people having depression are more prone to experiences of guilt [9]. Moreover, combinations of contrasting changes in experiences of SCEs have also been described; people with borderline personality disorders may experience shame to a higher extent but guilt to a lesser extent [10]. Nevertheless, more intense experiences of positive-valence SCEs (such as pride) might also be associated with

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psychopathology, just as more intense experiences of pride might be observed in narcissism [11] or schizophrenia [12]. Although neurologic conditions have been studied less extensively, differences in modifications of experiences of SCEs have also been highlighted in neurologic conditions. For example, diminished experiences of SCEs have been reported following an orbitofrontal lesion [13] and in patients with frontotemporal dementia [14,15]. It is noteworthy that both of these neurologic disorders are known to have an impact on the patients' social behavior. It is now well established that patients with TLE are exposed to a risk of extensive structural and functional alterations in both temporal regions and extratemporal structures (such as the lateral temporal, temporoparietal, frontal and occipitotemporal neocortices) [16,17]. These changes encompass regions involved in SCE processing and might thus, account for disturbances in patients with TLE.

A growing number of studies of patients with temporal lobe epilepsy (TLE) have highlighted emotional processing disorders, with a current focus on the ability to recognize basic emotional stimuli on the basis of facial and vocal emotional expressions [18,19]. However, some aspects of emotional processing have not been extensively explored in patients with TLE; one such aspect is emotional experience [20–22]. In previous work, we found that experiencing the emotional valence of pictures (ranging from very unpleasant to very pleasant) might be – in contrast to the arousal experience – unaffected in patients with TLE [22]. However, the way in which patients with TLE experience SCEs has not previously been investigated. We therefore decided to establish whether or not patients with TLE report differences in experiences of SCEs. To this end, we applied the Positive and Negative Affect Schedule (PANAS), a self-questionnaire that enables an individual to rate the extent to which he/she experiences a number of SCEs, including shame, guilt, and pride [23]. We focused on TLE because psychological symptoms have been described in this context. Indeed, depressive disorders are frequently encountered in TLE [24] and are often associated with anxiety disorders [25]. Furthermore, the relationship between epilepsy and psychological symptoms is thought to be bidirectional, since the presence of depression and anxiety appears to be a risk factor for certain clinical characteristics of TLE [26], and is predictive of the patients' quality of life [27]. Consequently, a better understanding of psychiatric disorders in TLE might have major clinical implications.

2. Material and methods

2.1. Participants

Sixty-one patients with TLE consulting at Lille University Medical Center's Epilepsy Unit (Lille, France) were consecutively recruited on the basis of a clinical evaluation, a video-electroencephalographic recording, neuropsychological data, and neuroimaging results. The inclusion criteria were (i) unilateral TLE and (ii) right-handedness (according to the Edinburgh Handedness Inventory) [28]. The main exclusion criteria were (i) impaired intellectual capacity (an intellectual quotient below 75, according to a French adaptation of the National Adult Reading Test: fNART) [29] or impaired nonverbal reasoning (according to Raven's Colored Progressive Matrices: PM-47) [30]; (ii) significant amnesia or a marked impairment of instrumental capacities (agnosia, aphasia, apraxia, alexia, or agraphia); (iii) a history of neurologic disease other than epilepsy; (iv) a history of psychiatric disorders (other than depression or anxiety); and (v) a seizure in the 24 h preceding the experimental session.

The control group included 61 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. The exclusion criteria for controls were (i) impaired intellectual capacity (an intellectual quotient below 75, according to the fNART) or impaired nonverbal reasoning (according to the PM-47) and (ii) a history of neurologic or psychiatric disorders.

The study protocol had been approved by the local investigational review board (CPP Nord Ouest IV, Lille, France) and was performed in accordance with the tenets of the Declaration of Helsinki. All participants gave their written, informed consent to participation in the study.

2.2. Measures

2.2.1. Experiences of SCEs

The participants' experiences of SCEs were measured using items from the PANAS, which has been found to have good item validity [23,31]. Participants were requested to respectively report on the extent to which they experienced ten negative affects (including shame and guilt) and ten positive affects (including pride) during the past few weeks, on a 5-point Likert scale (1: "very slightly or not at all"; 2: "a little"; 3: "moderately"; 4: "quite a bit"; 5: "very much"). Only the data on shame, guilt, and pride were specifically analyzed.

2.2.2. Clinical characteristics

The following characteristics of patients with TLE were recorded: age at onset of epilepsy, duration of epilepsy, seizure frequency (per month, over the previous three months), and laterality of epilepsy (right, left). The presence or absence of a brain lesion was established from structural neuroimaging results (3-Tesla Magnetic Resonance Imaging (MRI)) and classified as "hippocampal sclerosis", "no lesion", or "other temporal lesions" (focal gliosis, focal atrophy, or focal dysplasia). The diagnosis of hippocampal sclerosis was based on a volume decrease on T1-weighted images and a high signal intensity on fluid-attenuated inversion recovery images.

2.2.3. Cognitive function

The patients with TLE and the controls underwent the Montreal Cognitive Assessment (MoCA) [32], which assesses a number of cognitive domains (attention, executive function, memory, language, visuoconstructional skills, conceptual thinking, calculation, and orientation).

2.2.4. Psychological symptoms

Self-reports by the patients with TLE and the controls were used to estimate the severity of depressive symptoms (according to the Beck Depression Inventory (BDI)) [33] and anxiety symptoms (according to the trait version of the State–Trait Anxiety Inventory (STAI-T)) [34].

2.2.5. Functional outcomes

In patients with TLE, quality of life was estimated using the Quality of Life Inventory in Epilepsy-89 (QOLIE-89) [35].

2.3. Data analysis

All statistical analyses were performed with Statistical Analysis Software (SAS) (version 9.3, SAS Institute Inc., Cary, NC). The threshold for statistical significance was set to $p < .05$. Quantitative variables were expressed as the median and the mean ± standard deviation (SD), and qualitative variables were expressed as the frequency (%). Parametric tests were used for normally distributed datasets; otherwise, nonparametric tests were applied.

Patients with TLE and controls were compared in terms of their cognitive functioning (MoCA score) and psychological symptoms (STAI-T and BDI scores), using the Mann–Whitney U test or Student's t test. To estimate the prevalence of depression and anxiety disorders, we considered the corresponding cut-off scores (i.e., a BDI score ≥ 12, and a STAI-T score ≥ 39) and the results of a structured interview.

Based on the PANAS score, the participants (i.e., both patients with TLE and controls) were classified according to the extent ("high" or "low") to which they experienced each SCE. Participants with a self-reported PANAS item score of 3, 4, or 5 for the SCE were considered to have experienced that SCE to a high extent. Conversely, participants

Table 1
Characteristics of patients with TLE and the statistical significance of intergroup comparisons (p-values).

	Controls n = 61	Patients with TLE n = 61	p-Value
Demographic characteristics			
Age[a] in years	41.53; 42.81 ± 12.15	42.40; 42.19 ± 11.30	p = .7697
Gender (% male)	49.18	49.18	p = 1.00
Educational level (≥12 years of full-time education, %)	47.54	47.54	p = 1.00
Clinical characteristics			
Age of onset[a] in years		20.00; 21.10 ± 14.55	
Duration of epilepsy[a] in years		18.59; 21.00 ± 13.68	
Seizure frequency[a] per month		2.96; 4.33 ± 4.40	
Laterality (right, %)		49.18	
Brain lesion (HS/no lesion, %)		49.18/27.87	
Cognitive functioning			
MoCA score[a] (from 0 to 30)	28.00; 28.20 ± 1.38	26.00; 25.52 ± 2.41	p < .0001
Psychological symptoms			
BDI score[a] (from 0 to 63)	3.00; 5.20 ± 6.31	14.00; 15.59 ± 10.10	p < .0001
STAI-T score[a] (from 20 to 80)	34.00; 35.11 ± 8.94	48.00; 49.26 ± 11.00	p < .0001
Functional outcomes			
QOLIE-89 score[a] (from 0 to 100)		61.59; 60.08 ± 13.84	

Abbreviations: TLE: temporal lobe epilepsy; HS: hippocampal sclerosis; MoCA: Montreal Cognitive Assessment; BDI: Beck Depression Inventory; STAI-T: trait version of the State–Trait Anxiety Inventory; QOLIE-89: Quality of Life Inventory in Epilepsy-89.

[a] Data are expressed as the median; mean ± standard deviation.

with a self-reported PANAS item score of 1 or 2 for the SCE were considered to have experienced that SCE to a low extent. Comparisons of the proportion of individuals experiencing each SCE (for patients with TLE vs. controls) were performed using a chi-squared test or (when the expected cell frequency was <5) Fisher's exact test.

To better characterize the experiences of each SCE in patients with TLE, patients experiencing the SCE to a high extent and those experiencing the SCE to a low extent were compared in terms of demographic, cognitive, and clinical characteristics and psychological symptoms. These comparisons were performed by using the Mann–Whitney U test or Student's t test for quantitative variables and a chi-squared test or Fisher's test for qualitative variables.

Lastly, patients in the “high” and “low” groups for each SCE were compared in terms of the functional outcome (quality of life, according to the QOLIE-89), using Student's t test.

3. Results

3.1. Demographic, cognitive, and psychological characteristics of patients with TLE

The mean MoCA score was lower in patients with TLE than in controls (Table 1). Relative to controls, patients with TLE had higher scores for depression (according to the BDI) and anxiety (according to the STAI-T). Among the patients with TLE, 60.66% ($n = 37$) met the clinical criteria for depression, and 85.25% ($n = 52$) met the clinical criteria for anxiety.

3.2. Experiences of SCEs in patients with TLE

Relative to controls, the proportion of patients experiencing shame and guilt to a high extent was greater, and the rate of patients experiencing pride to a high extent was lower (Table 2).

Table 2
Prevalence (%) of experiencing self-conscious emotions to a high extent among controls and patients with TLE and the statistical significance of intergroup comparisons (p-values).

Type of self-conscious emotion	Controls n = 61	Patients with TLE n = 61	p-Value
Shame (negative affect)	4.92	32.79	p < .0001
Guilt (negative affect)	18.03	36.07	p = .0250
Pride (positive affect)	80.33	44.26	p < .0001

3.3. Characterization of the experiences of SCEs in patients with TLE

3.3.1. Relationships with demographic characteristics

There were no differences in demographic characteristics between patients experiencing SCEs to a high extent and those experiencing SCEs to a low extent (Table 3).

3.3.2. Relationships with clinical characteristics

Seizures were more frequent in patients experiencing shame to a high extent than in patients experiencing shame to a low extent (Table 3). There were no other differences in clinical characteristics with regard to the extent to which SCEs were experienced.

3.3.3. Relationships with cognitive characteristics

There were no differences in cognitive characteristics between patients experiencing SCEs to a high vs. a low extent (Table 3).

3.3.4. Relationships with psychological symptoms

When compared with patients who experienced shame to a low extent, patients who experienced shame to a high extent had higher depression scores (according to the BDI score) and were more likely to meet the clinical criteria for depression (48.78% vs. 85%, respectively; $p = .0066$). Likewise, patients who experienced shame to a high extent had higher anxiety scores (according to the STAI-T) and were more likely to meet the clinical criteria for anxiety (100% vs. 78.05% of the patients who experienced shame to a low extent; $p = .0242$).

Relative to patients who experienced guilt to a low extent, patients who experienced guilt to a high extent had higher depression scores (according to the BDI) and were more likely to meet the clinical criteria for depression (48.72% vs. 81.82%, respectively; $p = .0110$). Likewise, patients who experienced guilt to a high extent had higher anxiety scores (according to the STAI-T) and were more likely to meet the clinical criteria for anxiety (100% vs. 76.92% of the patients who experienced guilt to a low extent; $p = .0203$).

When we compared patients who experienced pride to a low with those to a high extent, there were no significant differences in terms of depression (according to the BDI scores and the prevalence of depression, 70.59% and 48.15%, respectively; $p = .0748$). Relative to patients who experienced pride to a high extent, patients who experienced pride to a low extent had higher anxiety scores (according to the STAI-T); however, there was no significant difference between these

Table 3

Demographic, cognitive, and clinical characteristics of patients with TLE experiencing self-conscious emotions (shame, guilt, and pride) to a high vs. a low extent.

Dependent variables	Type of self-conscious emotion and the extent to which it was experienced								
	Shame			Guilt			Pride		
	Low n = 41	High n = 20	p-Value	Low n = 39	High n = 22	p-Value	Low n = 34	High n = 27	p-Value
Demographic characteristics									
Age[a] in years	41.80; 43.86 ± 10.81	38.10; 38.77 ± 11.80	p = .0994	41.80; 43.10 ± 11.39	41.53; 40.58 ± 11.23	p = .4086	44.78; 42.81 ± 9.15	41.33; 41.40 ± 13.69	p = .6477
Gender (% male)	46.34	55.00	p = .5254	48.72	50.00	p = .9234	41.18	59.26	p = .1606
Educational level (≥12 years %)	51.22	40.00	p = .4101	48.72	45.45	p = .8064	44.12	51.85	p = .5480
Clinical characteristics									
Age of onset[a] in years	20.00; 21.32 ± 14.57	20.50; 20.65 ± 14.88	p = .8536	14.00; 20.33 ± 15.47	23.00; 22.45 ± 13.00	p = .4212	22.50; 20.68 ± 12.80	14.00; 21.63 ± 16.75	p = .8959
Duration of epilepsy[a] in years	18.59; 22.51 ± 14.73	17.03; 17.90 ± 10.93	p = .3217	21.18; 22.66 ± 14.18	14.97; 18.05 ± 12.53	p = .1913	20.16; 22.04 ± 13.72	16.49; 19.69 ± 13.78	p = .4120
Seizure frequency[a] per month	2.96; 2.68 ± 2.35	8.57; 7.72 ± 5.62	p = .0010	2.96; 3.29 ± 3.09	2.98; 6.17 ± 5.70	p = .0751	2.96; 4.49 ± 4.64	2.96; 4.13 ± 4.16	p = .9825
Laterality (right, %)	43.90	60.00	p = .2378	51.28	45.45	p = .6620	50.00	48.15	p = .8857
Brain lesion (HS/no lesion, % (n)[b])	63.64/36.36 (33)	64.29/35.71 (14)	p = .9662	71.88/28.12 (32)	46.67/53.33 (15)	p = .0936	66.67/33.33 (27)	60/40 (19)	p = .6381
Cognitive function									
MoCA score[a] (from 0 to 30)	26.00; 25.44 ± 2.41	26.50; 25.70 ± 2.45	p = .6082	25.00; 25.49 ± 2.34	26.50; 25.59 ± 2.58	p = .7042	25.00; 25.18 ± 2.44	26.00; 25.96 ± 2.33	p = .2431
Psychological symptoms									
BDI score[a] (from 0 to 63)	11.00; 12.63 ± 8.52	20.50; 21.65 ± 10.58	p = .0014	11.00; 12.59 ± 8.22	18.50; 20.91 ± 11.09	p = .0040	15.50; 17.53 ± 10.79	11.00; 13.15 ± 8.75	p = .0926
STAI-T score[a] (from 20 to 80)	44.00; 46.41 ± 10.55	54.00; 55.10 ± 9.72	p = .0030	43.00; 46.03 ± 11.23	57.00; 55.00 ± 7.96	p = .0008	51.00; 52.91 ± 10.21	43.00; 44.67 ± 10.37	p = .0029
Functional outcome									
QOLIE-89 score[a] (from 0 to 100)	63.45; 63.64 ± 13.01	46.69; 52.78 ± 12.87	p = .0032	63.45; 63.34 ± 13.04	54.54; 54.30 ± 13.61	p = .0130	55.45; 56.67 ± 13.34	67.21; 64.37 ± 13.49	p = .0297

Abbreviations: TLE: temporal lobe epilepsy; HS: hippocampal sclerosis; MoCA: Montreal Cognitive Assessment; BDI: Beck Depression Inventory; STAI-T: trait version of the State–Trait Anxiety Inventory; QOLIE-89: Quality of Life Inventory in Epilepsy-89.

[a] Data are expressed as the median; mean ± standard deviation.

[b] Patients considered in this analysis.

"high" and "low" groups in terms of the proportion of participants meeting the clinical criteria for anxiety (74.07% vs. 94.12%, respectively, $p = .0646$).

3.3.5. Relationships with functional outcomes

Relative to patients who experienced shame and guilt to a low extent, patients who experienced shame and guilt to a high extent had a worse quality of life (according to the QOLIE-89, Table 3). Relative to patients who experienced pride to a low extent, patients who experienced pride to a high extent had a better quality of life.

4. Discussion

Our study provided insights into how patients with TLE experience SCEs, relative to nonclinical controls. More specifically, patients with TLE showed specific patterns of change in their experience of SCEs; they were more likely than controls to experience the negative-valence SCEs of shame and guilt and less likely to experience the positive-valence SCE of pride. Our observation of this specific pattern suggests that experiences of moral emotions can be dysregulated in patients with TLE [22,36].

From a developmental perspective, one can also hypothesize that SCEs are experienced to a lesser extent by patients with TLE because experiences of these emotions (e.g., pride) develop later in childhood than experiences of nonmoral emotions (e.g., joy) [4]. However, we found that experiences of SCEs were not associated with the clinical characteristics of TLE, such as the age of onset and even the duration of epilepsy. Furthermore, a relationship between age of onset and experiences of SCEs would have not explained why our patients with TLE experienced negative-valence SCEs to a higher extent than controls did.

However, on the clinical level, we observed a specific, positive relationship between experiences of shame and the frequency of seizures in patients with TLE. This relationship might be linked to a direct (i.e., neurophysiological) effect of seizures on experiences of SCEs. As indicated in the Introduction, it has been well established that patients with TLE are at risk of alterations in the temporal and extratemporal structures involved in SCE processing (such as the temporal and frontal neocortices, [16,17]). These alterations might therefore, account for disturbances of SCE experiences in patients with TLE.

Nevertheless, an indirect effect of seizures (such as stigma) can also be envisaged [37]. Indeed, patients with TLE might feel more shame in daily life because they may experience seizures in social contexts. This uncertainty about having a seizure in the presence of other people and the latter's reactions to these seizures might be involved in the higher extent to which the patient in the present study experienced feelings of shame. A longitudinal study might be needed to explore these hypotheses; in particular, it could explore the relationships between seizure frequency, the feeling of stigma, and experiences of SCEs, as well as changes over time in these relationships. Other ictal and interictal clinical parameters (such as the frequency and location of interictal abnormalities, and seizure length and severity) also merit further investigation. Indeed, these parameters are already known to be associated with cognitive impairments and might therefore, also be linked to disturbances in SCE processing [38,39].

Dysregulated experiences of SCEs might be also a result from the psychological symptoms frequently encountered in patients with TLE. Depression and anxiety were highly prevalent in our group of patients with TLE. A high prevalence of psychiatric disorders has been documented by many other studies of epilepsy [40], suggesting that this co-occurrence warrants further investigation. In our patients with TLE, experiencing negative-valence SCEs to a high extent (vs. a low extent) was found to be associated with higher levels of anxiety and depressive symptoms and a higher prevalence of anxiety and depressive disorders. Shame and guilt have been frequently associated with psychiatric conditions [41], and might thus, be potential targets for psychotherapy [6]. Longitudinal studies might be of great interest to establish whether changes in the psychological status of patients with TLE have repercussions on their experiences of SCEs. It might be worth testing specific therapies aimed at working on the exacerbated feelings of shame and guilt experienced by patients with TLE. It would also be interesting to observe whether therapeutic interventions (whether pharmacological or not) for anxiety and depression in TLE are associated with changes in the expression of shame and guilt.

The relationship between our patients' experiences of positive-valence SCEs on the one hand and depressive and anxious symptoms on the other was less clear. Indeed, only the anxiety score (and not the prevalence of a clinical anxiety disorder) was significantly associated with the extent to which the positive-valence SCE pride was experienced. However, it is possible that the extent to which pride is experienced has a less direct impact on the psychopathological status of patients with TLE. Relationships between some aspects of pride and self-esteem have been observed [11] whereas low self-esteem is associated with depression and anxiety [42].

Focusing on experiences of SCEs in TLE might not only provide a better understanding of anxiety and depressive symptoms but could also have consequences on the epilepsy itself and associated manifestations. The relationship between depression and epilepsy is thought to be valid in both directions [43]: patient with epilepsy have a greater risk of developing depression, and people having depression are more at risk of developing epilepsy [44]. Moreover, the presence of depression in patients with epilepsy in TLE affects the clinical symptoms by increasing the subsequent risk of generalized seizures [45]. It is noteworthy that in the present study, the patients' experience of shame was associated with the frequency of seizures. Thus, it would be interesting to explore the bidirectional nature of the relationships between experiences of SCEs and clinical symptoms in epilepsy — as already suggested above.

Lastly, experiences of SCEs were also related to our patients' quality of life. Patients who experienced negative-valence SCEs to a high extent and/or positive-valence SCEs to a low extent had a lower quality of life. This finding is in line with literature data showing that elevated negative affectivity of valence and decreased positive affectivity were predictive of a worse quality of life and emotional and psychosocial maladjustments in patients with epilepsy [27]. Moreover, relationships between quality of life and the extent to which SCEs are experienced have been documented in populations with psychiatric disorders [12].

The present study had several limitations. Firstly, we documented SCE experiences by asking participants to report (via the PANAS) the extent to which they had experienced a given emotion over the past few weeks, without contextualization. Thus, despite the PANAS' good item validity [23,31], this was a subjective evaluation of SCE experiences. In future studies, it would be interesting to consider whether experiences of SCEs change when a patient with TLE is faced with specific situations. For example, the patient could be asked to state what he/she would feel in particular scenarios [46]. Another avenue of investigation would be to identify a more objective marker of SCE experiences, such as changes in neurophysiological variables like (for example) the autonomic activity reflected by the skin conductance response. The latter is reportedly a reliable indicator of arousal experience [47]. Lastly, the present work focused on patients with TLE; we cannot say whether the changes observed here are specific to this epileptic syndrome or are applicable to all kinds of epileptic disorder.

In conclusion, our present results suggest that experiences of SCEs can be dysregulated in patients with TLE; more specifically, patients can experience negative-valence SCEs to a higher extent and positive-valence SCEs to a lower extent (relative to nonclinical subjects). These dysregulations appear to be associated with the patients' clinical and psychological status, i.e., the frequency of seizures and the severity and prevalence of depressive and anxious disorders. Importantly, these dysregulations of experiences of SCEs appear to have a functional impact on the patients' daily life by significantly influencing the quality of life. Consequently, experiences of SCEs in epilepsy should be investigated more extensively because this aspect might be worth considering in the management of patients.

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Disclosure of conflicts of interest

None.

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