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Published in:
Epilepsy & Behavior

DOI:
10.1016/j.yebeh.2020.107121

2020

Link to publication

Citation for published version (APA):
Cardeña, E., Pick, S., & Litwin, R. (2020). Differentiating psychogenic nonepileptic from epileptic seizures: A mixed-methods, content analysis study. *Epilepsy & Behavior*, *109*, Article 107121. https://doi.org/10.1016/j.yebeh.2020.107121

Total number of authors:
3

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Epilepsy & Behavior 109 (2020) 107121

Contents lists available at ScienceDirect

Epilepsy & Behavior

journal homepage: www.elsevier.com/locate/yebeh

Differentiating psychogenic nonepileptic from epileptic seizures: A mixed-methods, content analysis study

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ARTICLE INFO

Article history:
Received 20 February 2020
Accepted 12 April 2020
Available online xxxx

Keywords:
Epileptic seizures
Nonepileptic seizures
Functional neurological disorder
Mixed-methods
Content analysis

ABSTRACT

Background: Identification of clinical features that might distinguish psychogenic nonepileptic seizures (PNES) from epileptic seizures (ES) is of value for diagnosis, management, and understanding of both conditions. Previous studies have shown that patients' descriptions of their seizures reflect differences in content and delivery. We aimed to compare verbal descriptions of PNES and ES using a mixed-methods approach.
Methods: We analyzed data from semi-structured interviews in which patients with video-electroencephalography (EEG)-confirmed ES (n = 30) or PNES (n = 10) described their seizures. Two masked raters independently coded the transcripts for relevant psychological categories and discrepancies that were noted and resolved. Additional analyses were conducted using the Linguistic Inquiry and Word Count system. The identified phenomena were descriptively compared, and inferential analyses assessed group differences in frequencies. A logistic regression analysis examined the predictive power of the most distinctive phenomena for diagnosis.
Results: As compared with ES, PNES reported longer seizures, more preseizure negative emotions (e.g., fear), anxiety symptoms (e.g., arousal, hyperventilation), altered vision/olfaction, and automatic behaviors. During seizures, PNES reported more fear, altered breathing, and dissociative phenomena (depersonalization, impaired time perception). Epileptic seizures reported more self-injurious behavior. Postseizure, PNES reported more fear and weeping and ES more amnesia and aches. The predictive power when including these variables was 97.5%. None of the single predictor variables was significant. The few but consistent linguistic differences related to the use of some pronouns and references to family.
Conclusions: Although no single clinical feature definitively distinguishes PNES from ES, several features may be suggestive of a PNES diagnosis, including longer duration, negative emotion (i.e., fear) throughout the events, preseizure anxiety, ictal dissociation, and postseizure weeping. Fewer reports of ictal self-injury and postseizure amnesia and aches may also indicate the possibility of PNES.
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1. Introduction

Reliable identification of individuals with psychogenic nonepileptic seizures (PNES) and epileptic seizures (ES) requires electroencephalography (EEG) and videotape recordings (CCTV/EEG), which is resource demanding and not available in nonspecialized clinics. Thus, more accessible ways to assist in diagnosis are important and may also help elucidate the etiology and dynamics of both conditions. Some years ago, two of the authors [1] published a study in which 10 PNES and 31 ES were administered an interview schedule on dissociative disorders, a hypnotizability test, and questionnaires assessing dissociation and absorption. A logistic regression equation using sex, years of recurrent seizures, and duration of sexual abuse provided an excellent classificatory ability for the two diagnoses. Also, although not statistically significant probably because of limited power, 80% of PNES could have received a dissociative disorder diagnosis as compared with 45% of ES. Reported trauma and/or serious adversities [2–5] and dissociative experiences have since then been shown to be robust predictors of PNES [2–4,6,7] although potentially traumatizing events are not causally necessary nor sufficient [8]. Furthermore, pathological dissociative reactions among ES may occur [9] (code F44.9, dissociative and conversion disorder, unspecified, World Health Organization, 2017). Nonetheless, the co-occurrence of a history of trauma, psychoform dissociation, and functional symptoms in PNES provides a rationale to consider them a dissociative disorder [10].

Masked interviews on the phenomenology of the seizure experience were also conducted with our previous sample but were not reported in the original manuscript. A subsequent study conducted a systematic content analysis exclusively of partial ES noting various alterations of

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https://doi.org/10.1016/j.yebeh.2020.107121
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consciousness [11]. More relevant to our study, linguistic analyses of encounters between patients and their neurologists differentiated with good, but not perfect, sensitivity and specificity PNES from ES [12] (perfect prediction based on conversation analysis was reported by Schwabe, Howell, & Reuber [13] with 11 patients). When describing their seizures, relative to patients with ES, those with PNES are more likely to describe contextual details rather than subjective seizure symptoms, provide less detail, use more negation, resist focusing on individual seizures, differ in the metaphors to describe their seizures, and use unclear descriptions of unconsciousness and amnesia [14,15]. To extend these findings, we analyzed closely using qualitative and quantitative analyses the content of our existing interviews using a grounded theory approach [16] to determine, without a priori hypotheses, the similarities and differences in how PNES and ES described their seizures.

2. Method

2.1. Participants

Forty participants, 10 with a PNES and 30 with ES diagnoses, were recruited by the center's neuropsychologist (the group of individuals with a PNES diagnosis will be identified henceforth as PNES and those with an ES diagnosis as ES). This study contained 17 individuals with a confirmed temporal lobe focus and 13 with either a nontemporal or unknown focus. In the previous study measures [1], there were no significant differences between ES temporal and nontemporal foci so they were also combined for this study. The interview of one patient with ES with temporal lobe focus was lost from the original sample as well as the groups' demographic information, but the analyses for the original sample (i.e., this sample plus one with ES) likely remain almost the same: nonsignificant differences between PNES and ES for age, M_{age}30.5 (9.9) versus ES 35.2 (8.9), $p = .17$, or percentages of employment, marital status, or education, $p > .26$ for all analyses. There was, however, a sex difference in that 100% of PNES were female compared with 45% of ES. Participation was voluntary and unpaid, and exclusionary criteria included progressive neurological conditions, intellectual disability, and side effects from anticonvulsant medications or treatment. The interviewer was a male doctoral student who was otherwise not involved in the treatment of the participants. The original study was reviewed and received ethics approval from the Northern California Comprehensive Epilepsy Center and the University of California Medical Center where it was conducted.

2.2. Measures

Semi-structured interviews were conducted by the last author, who was masked at that point as to the diagnoses of the participants, and later transcribed from audio recordings. The interviews were conducted in an open-ended, nonjudgmental manner, focusing on the individual's experience of the seizure, including experiences of the body and self, emotions, sensory experience, behavior, and thinking, with follow-up questions as necessary until the participant stated that she/he had nothing to add. A few times when the participant stated that she/he was completely unconscious and could not recollect anything about the experience but was accompanied by a companion, the latter supplemented the answers as relevant. Participants also filled out questionnaires and were measured for hypnotizability; data reported elsewhere [1]. Eventually, participants' diagnoses were established through simultaneous EEG and videotape recordings (CCTV/EEG).

2.3. Procedure

2.3.1. Qualitative/quantitative analysis

The interviews were independently read by the first two authors who were masked to the participants' diagnoses. They annotated all units of meaning for each interview and then used them with all other interviews, in an iterative fashion, until there were no more statements uncategorized (i.e., saturation) [16]. They then consulted with each other to compare their list of categories and organize them. They arrived to the following general categories:

- background factors,
- type of seizure,
- triggers to the seizure,
- aura/prodromal phenomena,
- seizure phenomena, and
- postseizure phenomena.
- overall impression of whether a particular interviewee was likely to be a PNES or ES.

After deciding on a comprehensive list to cover all meaningful statements, they went back to each interview to score it according to them. After correcting typos, they disagreed in less than 0.1% of the classifications and, after communicating about them, arrived to a complete agreement, at which point they lifted the mask as to diagnosis and dichotomized the data into the two groups.

2.3.2. Computerized analysis

We also conducted a computerized content analysis using the Linguistic Inquiry and Word Count: LIWC2015 [17], probably the most commonly used top-down computerized program in psychology. It contains a vast dictionary encompassing dozens of categories including summary dimensions (e.g., word count), grammatical dimensions (e.g., pronouns), punctuation (e.g., commas), affective processes (positive or negative), social processes (e.g., family), cognitive processes (e.g., insight), perceptual processes (e.g., seeing), biological processes (e.g., sex), drives (e.g., affiliation), time orientation, relativity (e.g., time), personal concerns (e.g., work), and informal categories (e.g., "fillers"). We compared the transcribed interviews of ES and NES in all variables except those for punctuation given the nature of transcriptions.

2.4. Statistical analyses

The qualitative analysis of interviews provides primarily descriptive information, but in some instances, we could also conduct frequency analyses comparing the two groups. Fisher's exact test was used, with odds ratio (OR) as a measure of effect size. Spearman correlations were used for bivariate correlations as well as a logistical regression analysis with "enter" to determine which variables might increase statistical prediction. For the LIWC, independent sample *t*-tests were conducted, with corrections whenever a variable had significant inequality of variance according to Levene's text. Following the American Statistical Association guidelines [18], we are not employing $p < .05$ as the sole determinant of results worth paying attention to, so we report results with OR greater than 2.5 in the case of quantitative analyses derived from the qualitative evaluation. For the LIWC, we report results $p < .05$, with Hedges' *g* as a measure of effect size given the unequal number in the groups. SPSS version 21 was used for statistical analyses. This was an exploratory study so no specific hypotheses were proposed beforehand and all quantitative analyses were two-tailed.

3. Results

3.1. General clinical impression

The first two authors independently and before lifting the mask tried to determine which of the participants have PNES. Both concluded correctly that 4 of the PNES were PNES (one of us also chose a fifth one correctly), or true positives, and that 4 ES were PNES, or false positives. The

Table 1
Overall predictive value of raters' general clinical impressions.

Sensitivity	40.00%
Specificity	86.67%
Positive predictive value	50.00%
Negative predictive value	81.25%

reasons that we noted for our choices were "unusual content (e.g., talk of demonic possession)," "verbose," "vague," and/or contradictory. Table 1 shows the predictive value of our general impression.

3.2. Content analysis

3.2.1. General seizure characteristics

Similar percentages in both groups reported having multiple types of seizures (40% of PNES vs. 34% of ES, e.g., "grand mal and petit mal"), and in those cases, we focused on the most severe type of seizure. More PNES than ES stated that the attacks lasted more than 2 min (60% versus 23%; $p = .052$, OR = 4.93). Various differing triggers for the seizures (e.g., being stressed/upset, sleepy/exhausted, being emotional, sounds, seeing child abuse, menstruation) were reported by 40% of the PNES and 33% of the ES.

3.2.2. Auras/prodromal phenomena

With respect to auras/prodromal phenomena (see Table 2), similar percentages mentioned having hunches of the impending seizure (40% of ES vs. 30% of PNES; e.g., ES44: "Kind of like a funny sensation, like a 'this is it'"; PNES6: "I have an aura, I feel really distant, I lose my depth perception"). Prodromal negative emotions, particularly fear (40% vs. 20%; $p = .19$, OR = 2.67), were more often reported by PNES.

Various somatic sensations (sweating, breathing, gastric sensations, being hungry/thirsty, feeling hot/cold) were mentioned by both groups, with paresthesias being the most commonly reported (53% of ES and 40% of PNES; e.g., ES45: "tickling feeling… like floating in water"; PNES33: "this tingling in my body"). Psychogenic nonepileptic seizures reported more numbness (30% vs. 7%; $p = .09$, OR = 6.00) and autonomic arousal and fast breathing (20% vs. 7%; $p = .55$, OR = 3.50) than ES.

There were four types of sensory phenomena mentioned, with PNES reporting more impaired vision (50% vs. 20%; $p = .10$, OR = 4) and unusual smells than ES (20% vs. 3%; $p = .15$, OR = 7.25).

Alterations of consciousness (feeling dreamlike/distant, mind blank, *déjà vu*, being confused) were infrequently reported, with lightheadedness being the most common (30% of PNES vs. 13% of ES; $p = .34$, OR = 2.78). Unusual behaviors were rarely reported by either group, with major/minor automatisms being more frequent among PNES than ES (30% vs. 7%; $p = .09$, OR = 6.00; e.g., ES28: "eye blinking"; PNES20: "my arm swinging").

3.2.3. Seizure phenomena

Table 3 displays the phenomena reported during seizure events in the two groups. Only small minorities of both groups reported some specific emotion or no emotion during seizures, with fear being more prevalent among PNES (20% vs. 3%; $p = .15$, OR = 7.25). Unusual sensations and physiological reactions were mentioned rarely, with quick breathing (20% vs. 3%; $p = .15$, OR = 7.25) and sphincter loss more common among PNES than ES (20% vs. 7%; $p = .55$, OR = 3.50). Few respondents mentioned changes in the senses, with PNES reporting more impaired hearing than the ES (30% vs. 10%; $p = .15$, OR = 3.85).

Few people in either group reported changes in consciousness or cognition with the exception of being unconscious during the attack

Table 2
Aura/prodromal phenomena.

Type	ES (%)	PNES (%)
Hunch	40	30
Emotions		
Fear	20	40
Anger	0	10
Embarrassment	3	10
Escape/paranoia	10	20
Sensations/physiology		
Arousal	7	20
Sweating	0	10
Fast breathing	7	20
Heart/chest	10	20
Gastrointestinal	20	30
Hunger/thirst	3	10
Hot/cold	13	30
Numb	7	30
Paresthesias	53	30
Rigid/weak body	7	10
Senses		
Smell	3	20
Impaired vision	20	50
Hallucinations	0	10
Impaired hearing	3	10
Consciousness		
Lightheaded	13	30
Dreamlike	10	0
Distant/dissociative	20	10
Mind blank	7	0
Déjà vu	7	0
Confusion	7	10
Control		
Let go	0	10
Loss of control	13	20
Seek help/prevent	33	20
Behavior		
Aware, cannot respond	7	10
Major/minor automatisms	7	30
Speech/vocalizations	30	20
Complex/simple behaviors	16	0

Table 3
Seizure phenomena.

Type	ES (%)	PNES (%)
Emotions		
No emotion	20	10
Fear	3	20
Anger/frustration	7	0
Sensations/physiology		
Freezing	10	0
Sphincter loss	7	20
Fast breathing	3	20
Sweating	7	10
Rigid/weak body	10	0
Senses		
Impaired vision	23	30
Impaired hearing	10	30
Visual hallucination	3	10
Auditory hallucination	3	10
Taste/smell	3	10
Consciousness/cognition		
Impaired thinking	13	20
Unconscious	67	50
No loss of awareness	17	30
Aware/unresponsive	13	20
Intermittent unawareness	7	20
Memory loss	30	10
Depersonalization	7	20
Altered sense of time	7	20
Behavior		
Major/minor automatisms	60	70
Fixed stare	23	10
Self-injurious behavior	37	10
Coordinated/complex behavior	43	30
Attack self or someone	10	10
Scream/vocalization	10	0
Inability to speak	10	20

(67% of ES versus 50% of PNES), which was consistent with the smaller fraction mentioning either no loss of awareness, intermittent unawareness, or being aware but unresponsive. Depersonalization and an altered sense of time were mentioned by more PNES than ES (20% vs. 7%; $p = .55$, OR = 3.50; e.g., ES9: "Time seems to go by slower"; PNES39: "it's like when you experience fear, everything slows down").

As far as unusual behaviors, majorities of both PNES and ES (70% versus 60%) mentioned having major or minor motor automatisms, with substantial percentages also reporting coordinated or complex behaviors (ES = 45% versus PNES = 30%; e.g., 21ES: "I've been in a seizure where I've been able to talk with someone"; PNES6: "I can respond and talk while it is happening") and ES reporting more self-injurious behavior (SIB) than PNES (37% vs. 10%; $p = .23$, OR = 5.21; e.g., ES28: "I fall and get black and blue marks"; 19PNES: "my head went straight through the glass on the stove").

3.2.4. Postseizure reactions

Table 4 details the postseizure phenomena reported by the groups. The majority of both ES and PNES (67% versus 60%) reported exhaustion/sleepiness after a seizure and sizeable numbers also mentioned being disoriented (43% versus 30%). Epileptic seizures mentioned more often than PNES partial or partial/total amnesia for the seizure (37% vs. 10%; $p = .23$, OR = 5.21). Emotions such as embarrassment, anger, depression, or relief were rarely reported by PNES or ES; fear and weeping were reported exclusively by PNES (for both, 30% vs. 0%; $p = .01$, OR cannot be calculated; e.g., PNES43: "then I wake up crying, to just make sure someone is here"). Postseizure aches were more common among ES than PNES (30% vs. 10%; $p = .40$, OR = 3.86; 47% of those who endorsed SIB mentioned postseizure aches). A few other reactions (e.g., gastric sensations/hunger, sensory experiences, derealization, religiosity) were very rarely mentioned by either group.

In sum, no variable was reported by all members of either group but there are similarities and differences of interest, and we chose variables with an OR of 2.5 or larger as worthy of comment. Psychogenic nonepileptic seizures reported seizures of longer duration, and in the aura/prodromal phase, they tended to report negative emotions (particularly fear) and indicators of anxiety (sensations of arousal, fast breathing, lightheadedness, and numbness) in addition to impaired vision, smells, and automatic behaviors. Sizeable minorities of both groups mentioned hunches. Similar to the prodromal phase, for the seizure itself, PNES reported more fear and unusual breathing. They also mentioned more often sphincter loss, depersonalization, and an altered sense of time. In contrast, ES reported more often SIB. After the seizure, majorities of both groups reported exhaustion/sleepiness. Psychogenic nonepileptic seizures mentioned more fear and weeping and ES more amnesia and aches.

Table 4
Postseizure phenomena.

Type	ES (%)	PNES (%)
Emotions		
Embarrassment	7	0
Anger	10	10
Depressed	7	0
Fear	0	30
Relief	3	0
Weeping	0	30
Sensations/physiology		
Gastrointestinal/hunger	7	0
Aches	30	10
Senses		
Impaired vision	0	10
Taste/smell	3	10
Consciousness		
Exhausted/sleepy	67	60
Derealization	7	10
Disoriented	43	30
Amnesia	37	10
No amnesia	3	10
Regain awareness	23	10
Aware, nonresponsive	3	10

3.2.5. Logistic regression analysis

Correlation analyses using variables with OR greater than 3 show that a PNES diagnosis was moderately correlated with longer duration of the seizure, feeling numb, and having automatisms before the seizure, as well as fear and crying postseizure. There were weaker correlations with other variables, particularly impaired vision and sensing smell before the seizure, not having SIB and experiencing fear during the seizure, and not reporting amnesia or aches after it. A logistic regression to classify participants as NES or ES revealed that the predictive power when including these variables went from 75% to 97.5% with a Nagelkerke $R^2 = 0.89$ and a Hosmer and Lemeshow test = 0.98 ($\chi^2 = 1.06$). None of the single predictor variables was significant, and running other regressions with a smaller set of variables did not improve predictive power.

3.3. Linguistic Inquiry and Word Count (LIWC) analysis

There were very few noticeable differences between the two groups. None of the four summary variables (analytic, clout, authentic, and tone) revealed a significant difference. The few and consistent differences (listed as percentage of total words) had to do with the use of other pronouns and references to family. As compared with NES, ES used more often "we" ($M = 0.12$, standard deviation [SD] = 0.23 vs. $M = 0.02$, $SD = 0.06$, $t = .2.13$, $p = .04$, $g = 0.49$), she/he ($M = 0.39$, $SD = 0.48$ vs. $M = 0.10$, $SD = 0.18$, $t = .2.74$, $p = .009$, $g = 0.67$), and family ($M = 0.24$, $SD = 0.38$ vs. $M = 0.06$, $SD = 0.12$, $t = .2.31$, $p = .03$, $g = 0.53$).

4. Discussion

First, the overall clinical impression of the first two authors of which interviews corresponded to which diagnostic group had very unreliable predictive value. Considering that one author is an expert on PNES and the other on dissociation, this result militates against relying solely on a clinical impression although it must be qualified by the fact that these evaluations were based purely on transcriptions of interviews conducted by someone else, thus missing elements of a conversation. Nonetheless, it seems that using some type of linguistic diagnostic coding is more promising than a general impression [12].

The qualitative/quantitative content analyses were more promising and revealed that both PNES and ES were heterogeneous groups, with no item being reported by all members of a group. There were some commonalities and differences. With respect to the former, substantial proportions in both groups mentioned having a presentiment or hunch of the incoming seizure and paresthesias and automatisms during the prodromal phase. Both groups also mentioned often being unconscious, enacting automatic and coordinated behaviors during the seizure, and being exhausted or sleepy after the seizure.

As far as differences, ES tended to report more often SIB and greater postseizure amnesia and aches. In contrast, PNES' seizures tended to last longer than 2 min and to be preceded by numbness, sensory alterations, arousal/palpitations, and more automatisms. They also tended to mention more often fear before, during, and/or after a seizure along with more reports of sphincter loss and depersonalization and time alterations during the seizure and weeping after it. A logistic regression with variables with OR greater than 3 greatly increased correct classification over a prediction without variables.

Some of these findings are in accord with previous studies. The lack of variables that were generally endorsed and differentiated between the groups concurs with Pick, Mellers, and Goldstein's [5] conclusion that PNES includes individuals with distinct dynamics and predictors. It also supports the conclusion of Avbersek and Sisodiya's literature

review [19] that there is not a single sign/symptom that can reliably differentiate between PNES and ES. Nonetheless, some of the variables mentioned more often by PNES support their review: 1) seizures of long duration, 2) automatisms, 3) crying, and 4) memory recall. The somewhat greater mention of arousal/heart palpitations prodromally and depersonalization during the seizure replicates some previous findings (somatic symptoms of anxiety and dissociation) [2,4,6,7] and greater emotionality (particularly fear) [2]. In contrast with Hendrickson et al. [7], paresthesia did not clearly differentiate between the groups, being often reported by both. Also, although numbness tended to be more commonly reported by PNES than ES, it was mentioned only by a minority of the former. The tendency by a minority of PNES to report more often sphincter loss deserves to be investigated further. The LIWC analysis revealed few significant differences, but the ones found replicate previous findings that use of other pronouns than the first person suggests better psychological health and social affiliation [20].

The pattern of findings is consistent to an extent with proposals that PNES may follow the occurrence of overwhelming dysphoric emotions (e.g., fear/anxiety) and/or elevated autonomic arousal [6,8,21,22]. These processes may be followed by somatoform and psychoform types of dissociation characterized by alterations in the state of consciousness (e.g., depersonalization) and somatic loss of control (e.g., automatisms) although with enough awareness to avoid injury (notice the higher percentage of SIBs among the ES). This sequential dynamic in the context of a cognitive-affective dysregulation has been reported for posttraumatic conditions [23] with lack of mental control being a core component [24]. Yet, the heterogeneity among PNES, as well as among other forms of somatization, also indicates strongly that no single simple mechanism or precursor should be assumed to cover all or perhaps even most cases.

This study has various strengths and limitations. Among the former, the semi-structured form of interviewing permitted participants to mention aspects that might have been lost by using structured forms of evaluation. The design, including meaning-based qualitative and quantitative assessments, allowed us to compare generic/clinical with more statistical forms of classification. However, the openness of the inquiry did not facilitate an exhaustive evaluation of the phenomena mentioned so it is likely that their incidence is understated, but it approximates what might be presented by patients in a thorough clinical interview. Another limitation is the modest sample sizes, particularly for the group with PNES, and the description of seizures vary in other cultures [25].

A number of areas for further inquiry present themselves when considering the findings of this study. One would be, in the case of patients diagnosed by CCTV/EEG, to have them watch a seizure and explicate their experience (Experiential Analysis Technique), a type of approach that has been used fruitfully in the case of hypnosis [26]. Another would be to conduct through phenomenological interviews after the initial reporting of ES and PNES phenomena. And although no single variable differentiated between ES and PNES, it would be useful to create a questionnaire with the phenomenal variables in this study along with other background predictors and conversation markers that have differentiated the groups and evaluate its diagnostic sensitivity and specificity against CCTV/EEG diagnosis.

5. Conclusions

No single clinical feature definitively distinguished PNES from ES, but several patient-reported features were suggestive of a PNES diagnosis, including longer duration, negative emotion (particularly fear) throughout the events, preseizure anxiety, ictal dissociation, and postseizure weeping. Fewer reports of ictal self-injury and postseizure amnesia and aches may also indicate the possibility of PNES. The presence of these features may aid diagnosis in combination with clinical observations and/or relevant test results (e.g., video-EEG), when available. These findings also have implications for contemporary accounts of PNES, supporting the proposal that, in at least some instances, PNES represent a dissociative response to unpleasant or intolerable negative emotion or autonomic arousal.

Funding

EC, SP, and RL did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors for this project.

Declaration of competing interest

EC, SP, and RL do not report any conflict of interest (COI).

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