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Theory of mind and its relationship with alexithymia and quality of life in patients with psychogenic nonepileptic seizures: Comparisons with generalised epilepsy and healthy controls

Süha Can Gürsoy [a,*], Serhat Ergün [a], İpek Midi [b], Volkan Topçuoğlu [a,1]

[a] Marmara University Pendik Education and Research Hospital, Department of Psychiatry, Fevzi Çakmak, Muhsin Yazıcıoğlu Cd No:10, 34899 Pendik/İstanbul, Turkey
[b] Marmara University Pendik Education and Research Hospital, Deparment of Neurology, Fevzi Çakmak, Muhsin Yazıcıoğlu Cd No:10, 34899 Pendik/İstanbul, Turkey

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ABSTRACT

Objective: Psychogenic nonepileptic seizures (PNES) are associated with high alexithymia, social cognition problems and low quality of life (QoL). Theory of Mind (ToM) has been studied in several conditions as a significant predictor of QoL. We aimed to assess the relationship between ToM abilities, alexithymia and subjective QoL in PNES patients and compare with generalised epilepsy (ES) patients and healthy controls.
Method: Patients with PNES ($n = 28$), ES ($n = 28$) and healthy volunteers ($n = 28$) were evaluated for alexithymia and quality of life (QoL) with Toronto Alexithymia Scale-20 (TAS-20) and Short Form-36 (SF-36). Reading the Mind in the Eyes test was used for assessment of affective ToM and Hinting Task and Strange Stories tests for cognitive ToM abilities.
Results: Analyses revealed lower SF-36 scores and poorer ToM performance in the PNES group compared to healthy group and poorer cognitive ToM performance than ES group. Cognitive ToM performance was inversely correlated with TAS-20 "difficulty identifying feelings" subscale and "physical functioning" subscale of SF-36 in the PNES group.
Conclusion: These results are consistent with previous research on PNES and other somatoform disorders and suggest that PNES is associated with impaired ToM task performance. ToM task performance might be related to specific aspects of alexithymia and QoL.

1. Introduction

Psychogenic nonepileptic seizures (PNES) are paroxysmal events characterised by alterations in motor and sensory experience that resemble epileptic seizures (ESs) but are unrelated to electrical discharge activity. PNES is classified under dissociative and conversion disorders in psychiatric nosology. Various distinct domains, such as history of trauma, neuropsychological profiles, family relations and emotion regulation, have been studied for years, but no single disorder model is considered sufficient by itself. Brown and Reuber identified four main tenets in the PNES literature: PNES as a dissociative phenomenon, as a psychological defence, as a learned behaviour and as a startle reflex [1]. All these research foci have empirical support but also have shortcomings, contradicting evidence and unexplained exceptions. More recently, integrative frameworks capturing the main findings have been proposed to provide a valid disorder model [1,2].

One common area of interest among these approaches is problems of identifying, expressing and regulating emotions. Defined as the inability to identify and express emotions, alexithymia and its related constructs have been subjects of interest for aetiology, pathogenesis, clinical characteristics and low quality of life (QoL) [3]. Accordingly, many studies have demonstrated high alexithymia and an association of alexithymia with symptom severity and QoL in PNES patients [4–6]. The ratio of participants with 'high alexithymia' in the PNES samples of such studies was around one third, higher than the healthy population but comparable to the ES patients. In their study, Brown et al. observed two subtypes differing in their alexithymia: one characterised by more psychopathology, somatisation, alexithymia and deficits in goal-directed behaviour, and the other by somatisation and depression but relatively normal emotion regulation compared to the ES sample [4]. These

* Corresponding author.
E-mail address: cangursoy@gmail.com (S.C. Gürsoy).
[1] Current affiliation: Bayburt State Hospital, Psychiatry Unit, Şingah, İbni Sina Cd. No:20, 69000 Bayburt Center/Bayburt – Turkey

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findings suggest that alexithymia is common but not always prominent in PNES and that there may be different clusters of patients for which the presence or absence of alexithymia is a significant marker.

Theory of mind (ToM) is defined as the capacity to attribute intentions and emotional and mental states to others. ToM has long been a common research domain for cognitive science, developmental psychology and clinical psychopathology as a significant component of social cognition [7]. The term 'ToM abilities' refers to a set of capacities ranging from discriminating between intentional and unintentional behaviour in early life to the understanding of subtle social nuances (e.g. irony, white lie) in adulthood. Cross-cultural studies indicate that the sequence of developing certain ToM abilities may vary among different cultural settings, but the development generally follows a path from simpler to more complex abilities, and overall mastery appears to be universal in adulthood [8]. These abilities are also often divided into two distinct categories: affective and cognitive. Affective ToM is the capacity to attribute emotional states to others (e.g. 'she must be feeling this way'). This aspect, also called social-perceptual, is thought to be related more to the recognition of emotions and their implications within a social context. Cognitive ToM, also called social-cognitive, is the capacity of epistemic reflection, the ability to reason within a perspective-taking context (e.g. 'she must be thinking this way'). It has been proposed that these two aspects have distinct neuroanatomical correlates and developmental processes, which may be significant for various conditions [9,10].

Clinical studies have shown that the ToM abilities are affected in many disorders [11–13]. In addition, ToM task performance has been observed to be related with QoL as a distinct factor [14–17]. Studies with epilepsy patients showed impaired ToM task performance predominantly in samples with focal lesions in localisations that accord with the proposed neuroanatomical correlates of ToM [18–22]. In their systematic review and meta-analysis, Stewart et al. reported that adults with temporal or frontal focal epilepsy and children with generalised epilepsy were associated with poor ToM task performance while adults with generalised epilepsy performed more poorly than the healthy controls did, with much smaller effect sizes [23].

The ToM abilities have also been thought to be a relevant research subject in populations with high alexithymia because alexithymia implies insufficient or inappropriate attribution of emotional states. Accordingly, several studies using contemporary measures of ToM depicted associations between ToM task performance and alexithymia in healthy volunteer groups [24–26]. Studies on disorders such as fibromyalgia, somatisation disorder and chronic pain also reported poorer performance of people with such disorders than the healthy controls, further strengthening the association between mentalisation and alexithymia [27–32].

While the ToM abilities appear important in patient populations with high alexithymia, the data on PNES patients are scarce. Studies on facial emotion recognition tasks showed the PNES groups' association with more threat avoidance, emotion regulation problems and less reactivity towards positive emotions [33–35]. Schönenberg et al. reported that PNES was associated with poorer cognitive ToM task performance in their study, and that the performance was correlated with the perceived stress levels and the alexithymia scores [36]. A more recently published study that compared PNES patients with healthy volunteers reported no statistically significant difference between the two groups with regard to affective ToM, but the PNES group showed less empathy especially with regard to positive emotions [37]. These findings suggest that similar to other functional disorders, PNES may also be associated with impaired emotional regulation and social cognition task performance.

In this cross-sectional study, we aimed to extend the aforementioned findings by testing the ToM abilities, assessing their relationships with alexithymia and QoL in PNES patients and comparing PNES patients with generalised epilepsy (ES) and healthy control (HC) groups with similar age, sex and education level distributions. We followed Shamay-Tsoory et al.'s framework, which differentiates affective ToM with cognitive ToM [9,10], and aimed to determine whether:

1. PNES patients would perform more poorly on ToM tasks;
2. ToM task performance would show associations with alexithymia and
3. QoL scores would be associated with ToM task performance.

2. Materials and method

2.1. Participants and procedure

A-priori sample size calculations yielded a result of 25 participants per group. For the PNES group, at least one seizure in the previous year and a history of evaluation by a psychiatrist and a neurologist with video-electroencephalography assessment were defined as the study's inclusion criteria. The ES group consisted of control patients diagnosed with idiopathic generalised epilepsy in an outpatient epilepsy clinic, with similar sociodemographic characteristics. The participants' age range was 18–65. Current or past history of a psychotic disorder, bipolar disorder, substance use disorder or pervasive developmental disorder or a family history of any of these disorders was defined as an exclusion criterion for all the groups. For the PNES and ES groups, comorbidity of both conditions was also excluded, and for the HC group, any current Axis-I disorder was defined as an exclusion criterion.

A total of 65 patients were approached in the Marmara University Hospital psychiatry and epilepsy outpatient clinics within the period from January to May 2019. Six participants were excluded due to violation of the exclusion criteria (suspected PNES-ES comorbidity, suspected psychotic disorder in a first-degree relative), and three dropped out during the study. Healthy volunteers were recruited among the hospital personnel, with similar sex, age and education level distributions. Twenty-eight PNES patients, 28 ES patients and 28 healthy volunteers were included in the final analysis.

Ethical approval was obtained from the Marmara University Ethics Committee (Document No. 09.2018.656). All the participants were informed about the procedure and signed a written informed-consent form for participation in the study.

The procedure began with Structured Clinical Interview for DSM-IV (SCID-I) and then moved on to self-report questionnaires and ToM task tests, all conducted by the authors. The participants were encouraged to ask for assistance if needed whilst completing the questionnaires. Short breaks were allowed after SCID-I and the self-report questionnaire sections. The same author conducted all the interviews, and the whole procedure took 40–60 min per participant.

2.1.1. Demographic and clinical measures

The participants filled out a clinical and sociodemographic data form that had been prepared by the researchers. The clinical section of this form included the participant's age at first seizure, seizure frequency and current and past antiepileptic drug (AED) used. The 'duration of illness' value was set and defined as the difference between the age at the procedure and the age at first seizure.

The Turkish version of Beck Depression Inventory (BDI) was used to assess the symptoms of depression [38]. BDI was developed by Beck et al. to determine the presence and severity of depressive symptoms for the last 2 weeks, with 21 questions and four options [39]. The score range is 0–63.

All the participants were screened for Axis-I psychiatric disorders with SCID-I [40]. SCID-I is a semi-structured interview for assessing the presence of Axis-I disorders in DSM-IV.

The Turkish version of Short Form-36 (SF-36) was used to assess the QoL [41]. SF-36 does not have a total score but consists of eight subscales: physical functioning (PF), physical role functioning (PRF), bodily pain (BP), general health perception (GHP), vitality (V), social role functioning (SRF), emotional role functioning (ERF) and mental health (MH). The score range for each is 0–100, with higher scores meaning

better QoL.

Toronto Alexithymia Scale-20 (TAS-20) was used to assess alexithymia [42]. TAS-20 has 20 questions and a total score range of 20–100, with higher scores indicating higher alexithymia. TAS-20 also has three subscales that are considered to reflect distinct aspects: difficulty identifying feelings (DIF; range = 5–25), difficulty expressing feelings (DEF; range = 7–35) and externally oriented thinking (EOT; range = 8–40). The reliability and validity of the Turkish version have been established [43].

2.1.2. Theory of mind tests

2.1.2.1. Reading the mind in the eyes test (RMET). This forced-choice test consists of 36 photos of models with only their eye regions visible and four words placed around as options [44]. The participant is asked to choose the word that best describes the state of the model. It is considered to pertain to the affective ToM abilities. A validation study for the Turkish version has been conducted, and four questions were discarded [45]. The number of correct answers constitutes the total score (range = 0–32).

2.1.2.2. Hinting task (HT). Developed for the assessment of cognitive ToM, this test consists of short vignettes in which a character implies something to another character [12]. The participant is asked to explain the implication. A correct answer is given 2 points. If the correct implication is not described, a further hint is introduced, and the participant is again asked to explain the implication. If the correct answer is given, the participant gets 1 point. We used the four-question version, which was used in several studies (range = 0–8) [11,46].

2.1.2.3. Strange stories task (SST). This vignette-based test consists of short stories with social situations of higher complexity than HT, such as a white lie, a double bluff and a faux pas [47]. After reading each story, the participant is asked to explain the situation. Similar to HT, a correct answer that acknowledges the main aspect of the question (e.g. a white lie) gets 2 points. If an incorrect answer is given, a further hint is presented, and if the correct answer is given, the participant gets 1 point. We used the eight-question version, which was also used by White et al. (range = 0–16) [48].

2.2. Statistical analyses

Analyses were carried out using the IBM® SPSS® Statistics v20.0 software. Continuous variables were assessed for normal distribution with the Shapiro-Wilk test. Transformation methods (i.e. square root and logarithm) were used where applicable for data that did not exhibit normal distribution. For non-continuous data, the chi square and Fisher exact tests were used. For group comparisons, the *t*-test and analysis of variance (ANOVA) test with Bonferroni correction were used for continuous data, and the Mann-Whitney U and Kruskal-Wallis H tests were used for non-continuous data. Correlation examinations were done with the Pearson and Spearman tests. The statistical significance level was set to 5% ($p < 0.05$).

For the analysis, the sum of the HT and SST scores was designated as the 'total cognitive ToM' (TcToM) score (range = 0–24), and the RMET score constituted the affective ToM score. Multivariate ANOVA (MANOVA) was used to assess the general ToM performance, with the RMET and TcToM scores as the two dependent variables.

3. Results

3.1. Demographic and clinical variables

The demographic data and the clinical scale scores are summarised in Table 1. In the PNES group, six patients had major depressive disorder (MDD), six had anxiety disorder (three, panic disorder; two, specific phobia; one, general anxiety disorder) and one had an eating disorder. In the ES group, two had MDD and four had an anxiety disorder (a specific phobia).

The clinical data for the PNES and ES groups are summarised in Table 2. The ES group's seizures were mostly under control as 71.4% had no seizures in the last 6 months; as for the PNES group, more than half reported more than two seizures per month for the last 6 months. The AED use also differed significantly as 46.6% in the PNES group had never used AEDs while all the participants in the ES group had used

Table 1
Demographic and clinical scale data.

		PNES (n = 28) $\bar{x} \pm$ SD or n (%)	ES (n = 28) $\bar{x} \pm$ SD or n (%)	HC (n = 28) $\bar{x} \pm$ SD or n (%)	P
Age		36.86 ± 8.39	34.04 ± 8.88	35.11 ± 7.19	.432*
Gender	Male	6 (21.4%)	9 (33.3%)	8 (28.6%)	.658+
	Female	22 (78.6%)	19 (66.7%)	20 (71.4%)	
Education (years)		9.79 ± 3.604	10.21 ± 3.28	10.32 ± 3.56	.831*
Current Axis-I disorder	∅	16 (57.1%)	23 (82.1%)	28 (10.0%)	**.000**+
	≥1	12 (42.9%)	5 (17.9%)	0 (0.0%)	
BDI		20.48 ± 13.92	9.04 ± 6.91	7.00 ± 4.99	**.000***
TAS-20 Total		56.29 ± 1.37	52.79 ± 11.71	44.50 ± 8.46	**.000***
TAS-20 DIF		20.46 ± 5.19	17.11 ± 7.20	14.14 ± 4.37	**.001***
TAS-20 DEF		14.14 ± 4.34	13.79 ± 4.83	11.71 ± 2.23	.123*
TAS-20 ET		21.68 ± 3.74	21.89 ± 3.51	19.00 ± 4.56	**.012***

BDI = Beck Depression Inventory; TAS-20 = Toronto Alexithymia Scale – 20; DIF = difficulty identifying feelings; DEF = difficulty expressing feelings; EOT = externally oriented thinking.
* One-way ANOVA.
+ Chi-squared test.

Table 2
Clinical varibles of PNES and ES groups.

		PNES (n = 28) $\bar{x} \pm$ sd or n (%)	ES (n = 28) $\bar{x} \pm$ sd or n (%)	P
Age at first seizure		24.93 ± 9.64	19.64 ± 1.76	.058*
Duration of illness		12.00 ± 8.82	14.93 ± 9.95	.249*
Seizure frequency (mean per month / last 6 months)	0	3 (10.7%)	20 (71.4%)	.000+
	1 – 2	12 (42.9%)	8 (28.6%)	
	3 – 4	6 (21.4%)	0 (0.0%)	
	5 – 9	4 (14.3%)	0 (0.0%)	
	≥ 10	3 (10.7%)	0 (0.0%)	
Number of current AED	∅	16 (%57.1)	0 (%0)	.000+
	1–2	11 (%39.3)	26 (92.9%)	
	≥3	1 (%3.6)	2 (7.1%)	
Lifetime AED (years)	∅	13 (46.6%)	0 (0.0%)	.000+
	0 – 2	4 (14.3%)	1(3.6%)	
	3 – 4	4 (14.3%)	5 (17.9%)	
	5 – 9	5 (17.9%)	7 (25.0%)	
	≥ 10	2 (7.1%)	15 (53.6%)	

*t-test.
+Chi-squared test.

AEDs and more than half had used them for 10 or more years.

3.2. Theory of mind and quality of life

3.1.1. ToM task performance and SF-36 scores

The results of the comparison of the ToM task and SF-36 scores are summarised in Table 3. MANOVA using the RMET and TcToM scores revealed statistically significant differences between the groups with regard to general ToM task performance ($F[4160] = 6.381$; $p < 0.0005$; Wilk's $\Lambda = 0.744$; partial $\eta 2 = 0.138$). Separate evaluations (ANOVA) showed statistically significant differences in the ToM tasks other than HT in all the groups (RMET: $F[2,81] = 5.624$; $\eta 2 = 0.122$; $p = 0.005$; TcToM score: $F[2,81] = 12.490$; $\eta 2 = 0.230$). After Bonferroni correction, the PNES group had significantly lower scores than the HC group in all the tests. Compared to the ES group, the PNES group's TcToM scores were lower, but the difference was not statistically significant for the RMET scores.

The groups also differed with regard to their SF-36 scores, with the PNES group generally having lower scores. Separate comparisons showed that the difference between PNES and HC was statistically significant for all the subscales. The PNES-ES difference was significant for the PF, PRF, BP, SERF and ERF subscales while the ES-HC difference was significant only for the GHP and MH subscales.

3.1.2. Correlation analyses

The correlation coefficients between the ToM scores and the clinical variables are summarised in Table 4. The TcToM score showed a statistically significant correlation with education in all the groups while RMET did only in the HC group. In the PNES group, the TcToM score was correlated with the DIF subscale of TAS-20. When the non-alexithymic (total TAS-20 score < 51) participants were excluded, the RMET scores also showed a statistically significant correlation with DIF ($n = 20$; $r = -0.459$; $p = 0.021$).

The correlation coefficients between the SF-36 subscales and the ToM test scores in the PNES and ES groups are summarised in Table 5. In the PNES group, the cognitive ToM scores showed a statistically significant correlation only with the PF subscale while the HT scores also showed a statistically significant correlation with the SF subscale. The HT-SF correlation remained significant after adjusting for the education, TAS-20 total and BDI scores (rho $= 0.462$; $p = 0.020$), and the PF relationship remained significant for the SST and TcToM scores after adjusting for the same parameters (for the FF-SST score: $r = 0.466$, $p = 0.019$; for the FF-TcToM score: $r = 0.486$, $p = 0.014$), but not for the HT score (rho $= 0.308$, $p = 0.134$).

Univariate linear regression analyses were carried out for the two parameters that had exhibited a statistically significant correlation with SF-36 PF. The results showed that 21.7% of the variance in SF-36 PF was attributable to the SST score ($F[1,26] = 7.222$; $p = 0.012$; $R^2 = 0.217$) and 26.2% was attributable to the TcToM score ($F[1,26] = 9.245$; $p = 0.005$; $R^2 = 0.262$).

Table 3
ToM task and SF-36 scores.

	PNES ($n = 28$) $\bar{x}$ ± sd or M (IQR)	ES ($n = 28$) $\bar{x}$ ± sd or M (IQR)	HC ($n = 28$) $\bar{x}$ ± sd or M (IQR)	P
RMET	20.71 ± 4,15	21.75 ± 3.74	23.86 ± 2.66	**.005**[*]
HT	8.0 (1.0)	8.0 (0.0)	8.0 (0.0)	**.115**[+]
SST	12,5 (8:16)	15 (8:16)	15 (12:16)	**.000**[+]
TcToMs	20.18 ± 2.07	21.93 ± 2.62	22.94 ± 1.36	**.000**[*]
SF-36 PF	60.0 (41.3)	95.0 (30.0)	95.0 (15.0)	**.000**[+]
SF-36 PRF	37.5 (75.0)	75.0 (50.0)	75.0 (43.8)	**.001**[+]
SF-36 BP	52.0 (19.8)	77.0 (35.5)	79.0 (10.0)	**.000**[+]
SF-36 GHP	41.0 (32.0)	52.0 (38.0)	68.5 (23.8)	**.012**[+]
SF-36 V	40.0 (28.8)	55.0 (17.5)	65.0 (18.8)	**.000**[+]
SF-36 SRF	50.0 (34.4)	81.0 (37.5)	75.0 (21.9)	**.000**[+]
SF-36 ERF	33.3 (66.7)	66.7 (66.7)	66.7 (66.7)	**.011**[+]
SF-36 MH	42.0 (51.0)	68.0 (24.0)	84.0 (20.0)	**.000**[+]

RMET = Reading the Mind in the Eyes Test; HT=Hinting Task; SST=Strange Stories Task; TcToMs = Total cognitive ToM score SF-36 = Short Form-36; PF = physical functioning. PRF = physical role functioning; BP=bodily pain; GHP = general health perception; V = vitality; SRF = social role functioning; ERF= emotional role functioning; MH = mental health.

[*] One-way ANOVA.

[+] Kruskal-Wallis H test.

4. Discussion

In this study, we aimed to compare the ToM task performances of PNES patients with those of generalised ES patients and healthy controls, and to assess the relationships among ToM task performance, alexithymia and QoL.

Overall, the MANOVA results implied significant differences between the groups with regard to the general ToM task performance, with a notable effect size. The PNES group performed worse in all the tests, and the ES group performance was between those of the PNES and HC groups. This is consistent with the reported data showing adult idiopathic generalised ES patients having relatively preserved ToM task performance compared to focal epilepsy patients.

Regarding affective ToM performance, our findings showed statistically significantly lower scores in the PNES group compared to the HC group, but not to the ES group. This seems to partially contradict the prior findings. In Schönenberg et al.'s study, the comparison of the PNES group with the HC group on recognising facial emotions revealed no significant difference, and this was discussed as preserved affective ToM performance [36]. Also, Irorutola et al. reported no statistically significant difference between the mean RMET scores of the PNES and HC groups [37]. The performance of our PNES group was comparable to that in previous studies on other functional disorders, and that of our HC group was comparable to that in the Turkish validation study of RMET, suggesting that our results were not likely to have been driven by the extraordinary performance of these groups. While we did not observe an affective ToM–alexithymia correlation in the whole PNES group, the scores did show a correlation with the DIF subscale of TAS-20 when the analysis included only the participants with high alexithymia scores (i.e. TAS-20 score > 50; $n = 20$). This indicates that a higher alexithymic subgroup may be more relevant for our hypothesised ToM–alexithymia correlation and may also explain the discrepancy between the results of different studies. Future studies with greater sample sizes that allow studying these clusters are needed to determine if this observed affective ToM impairment is driven by a distinct subgroup.

With regard to the cognitive ToM scores, the groups differed, with larger effect sizes. The difference between the PNES and ES groups was also significant. Neither the HT nor the SST scores were as low as those of the psychotic-disorder samples in the literature, suggesting that the impairment was mild compared to such populations. This finding is also consistent with that of Schönenberg et al. Another interesting concurrence of our study's results with the results of Schönenberg et al.'s study was the correlation between the TcToM score and only the DIF subscale of TAS-20. In contrast to affective ToM, this correlation was not limited only to a high alexithymic subgroup. This indicates that in PNES, 'higher-order' social cognition abilities (i.e. attributing cognitive states to others) are more prone to be affected by defective emotional processes compared to lower-order abilities. This may be due to the fact that there are more steps in social-cognitive reasoning, which causes a minor defect in the lower steps to translate into more pronounced problems in the higher steps. Another possibility is that the dysfunction is confined within the cognitive processes (i.e. faulty inference). Categorisations of error types could be useful for investigating these possibilities. Some of the previous studies utilised instruments that divide cognitive ToM

Table 4
Correlations between clinical measures and ToM scores.

		Education	Seizure freq.	Lifetime AED	BDI	TAS-20 Total	TAS-20 DIF	TAS-20 DEF	TAS-20 EOT
RMET	PNES	.308	−0.090	.146	−0.053	−0.002	−0.104	.007	.204
	ES	.292	.010	−0.008	−0.042	−0.183	−0.082	−0.134	−0.239
	HC	**.498**	–	–	.081	.020	−0.121	.007	.101
HT	PNES	.225	−0.273	.283	−0.213	−0.094	−0.348	−0.085	.221
	ES	**.440**	−0.529	−0.023	−0.264	−0.296	−0.215	−0.293	.086
	HC	.177	–	–	−0.374	−0.158	−0.209	−0.051	−0.043
SST	PNES	**.515**	−0.306	−0.005	−0.019	−0.079	−0.289	−0.189	−0.008
	ES	.358	−0.180	.012	−0.135	**−0.393**	−0.177	**−0.399**	−0.136
	HC	**.405**	–	–	−0.146	−0.082	−0.254	−0.077	.159
TcToMs	PNES	**.517**	**−0.406**	.121	−0.070	−0.071	**−0.389**	.105	.113
	ES	**.380**	−0.220	.018	−0.162	**−0.406**	−0.191	**−0.418**	−0.114
	HC	**.394**	–	–	−0.163	−0.097	−0.264	−0.082	.153

RMET = Reading the Mind in the Eyes Test; HT=Hinting Task; SST=Strange Stories Task; TcToMs = Total cognitive ToM score; BDI = Beck Depression Inventory; TAS-20 = Toronto Alexithymia Scale – 20; DIF = difficulty identifying feelings; DEF = difficulty expressing feelings; EOT = externally oriented thinking.
Values with $p < 0.05$ are shown in bold.

Table 5
Correlations between SF-36 subscales and ToM task scores.

		SF-36 PF	SF-36 PRF	SF-36 BP	SF-36 GHP	SF-36 V	SF-36 SRF	SF-36 ERF	SF-36 MH
RMET	PNES	.292	−0.185	.084	−0.142	−0.171	.280	−0.138	.026
	ES	.241	−0.093	**.485**	−0.048	.099	.142	−0.078	−0.115
TcToMs	PNES	**.512**	.08	−0.013	.126	.243	.190	−0.041	.217
	ES	.107	−0.180	.163	.029	.098	.029	.071	.009
HT	PNES	**.401**	−0.005	−0.052	.129	.081	**.426**	.111	.199
	ES	.233	−0.091	.227	.348	.344	.137	.298	.302
SST	PNES	**.466**	−0.040	−0.016	.149	.303	.077	−0.101	.152
	ES	.098	−0.190	.154	.004	.064	.010	.034	−0.025

RMET = Reading the Mind in the Eyes Test; HT=Hinting Task; SST=Strange Stories Task; TcToMs = Total cognitive ToM score; SF-36 = Short Form-36; PF = physical functioning. PRF = physical role functioning; BP=bodily pain; GHP = general health perception; *V* = vitality; SRF = social role functioning; ERF= emotional role functioning; MH = mental health.
Values with $p < 0.05$ are shown in bold.

errors into 'undermentalising' and 'overmentalising'. Undermentalising refers to the insufficient attribution of emotional or cognitive states whereas overmentalising refers to inappropriate attribution (i.e. 'over-reading' a situation). Schönenberg et al. reported that the DIF subscale scores in their study were correlated specifically with 'under-mentalisation', and that the perceived stress levels were correlated with 'overmentalisation' errors. It would be interesting to also examine these categories in our sample because they imply different defective processes. However, only the correct answers are scored in HT and SST, and the wrong answers are not subgrouped. Nonetheless, these findings suggest that in PNES, the capacity to identify and attribute cognitive states to others (i.e. 'higher-order' social cognition) is more significantly affected and related to defective emotional processes than 'lower-order' abilities are.

The DIF subscale of TAS-20 may have further significance in this context. It has been argued that DIF may predict the development of persistent posttraumatic symptoms after stressful events [49]. The view that PNES is a dissociative phenomenon suggests that seizures can be formulated as somatic flashbacks of traumatic scenes. Although our sample did not include participants with clinical posttraumatic stress disorder, such predictive potential may also be relevant for mentalisation problems given the association of social cognition problems with trauma [50]. Studies with more sophisticated measurements of emotional processes and stressful life events are needed to establish this speculated relevance. This will also provide empirical data that can be used to come up with therapeutic strategies such as focusing on trauma and emotion regulation.

Taken together, the aforementioned study results suggest that ToM difficulties, especially the cognitive aspect, may have clinical relevance to PNES that is distinct from epilepsy. Social cognition problems are expected to be related to more psychosocial conflicts. As the level of impairment is not severe, these conflicts are likely to manifest subtly rather than overtly, especially in an alexithymic background. Speculatively, such conflicts may cause psychosocial stress, which then results in seizures. This will partially explain the absence of obvious anxiogenic seizure triggers in PNES. The relationship between the TcToM score and the reported seizure frequency supports this hypothesis. Suggesting specificity, no such relationship was present in the ES group, which is consistent with the previously reported data [23]. Future studies with more detailed accounts of seizure onset and designs that allow establishing causal relationships between ToM deficits and psychosocial conflicts will provide valuable insight on this observation. If established more robustly, this finding can also indicate therapeutic domains to focus on for clinical improvement.

The PNES group had lower QoL scores, with mean scores and effect sizes comparable with the results of previous studies that utilised SF-36 [51,52]. Two subscales exhibited statistically significant correlations with the ToM task scores. The correlation between social role functioning and the HT scores in the PNES group remained significant after adjusting for the education, depression and alexithymia scores. However, the interpretation of this specific finding is greatly limited by the ceiling effects in the HT scores (the percentages of participants who obtained the highest scores in the PNES, ES and HC groups were 67.9%, 82.1% and 89.3%, respectively). The other correlations were between physical functioning and other cognitive ToM scores (i.e. the SST and TcToM scores). It may appear counterintuitive that a subscale for a physical function rather than for a social or emotional function showed this correlation. However, in a highly alexithymic population with a functional disorder diagnosis, it is not contradictory that the degree of impairment in social cognition reflects on the severity of subjective physical complaints. The relationships between somatisation, medically unexplained fatigue and social cognition have reportedly been demonstrated in the literature [29–32]. Future studies with both subjective and objective measurements of QoL will be beneficial to determine the

overall impact of ToM difficulties on general QoL.

Another important factor to consider is the fact that the literature predominantly focuses on the Western countries while the present study was carried out in a Turkish sample. As briefly mentioned in the Introduction section, the available data suggest that the sequence of acquisition of ToM abilities can vary among different cultures whereas the overall ToM mastery does not. Significant discrepancies due to ethnic-cultural differences are therefore not expected in an adult sample. Supporting this idea, the reliability and validity study of the Turkish version of RMET did not report major differences from other versions. Unfortunately, no such validation data exist for HT and SST. However, our results do not indicate unexpectedly poorer or better performance compared to those reported in the literature, suggesting that cultural differences did not have a major impact on the measurements.

Cross-cultural comparisons indicate relatively more significant differences for PNES. The prevalence of PNES appears to be much higher in Turkey than in many Western countries, and seizures seem to be the most common complaint of patients with conversion disorder [53]. Various hypotheses, such as a special familial role, inter-generational trauma and societal customs discouraging verbal expressions of distress, have been put forward [54]. These may also imply differences in the relationship between social cognition and PNES. Although neither our study nor the currently available literature presents sufficient data to draw firm conclusions, the replication of Schönenberg et al.'s observation that difficulty identifying feelings is correlated with cognitive ToM task performance can be regarded as indicative of a universal association.

Our study had several significant limitations that need to be taken into consideration. Despite the fact that adequate evaluation by a neurologist and a psychiatrist was an inclusion criterion, the diagnoses of PNES were mostly 'possible' or 'probable' according to the proposed levels of diagnostic certainty [55]. the reported prevalence of PNES patients who receive epilepsy diagnoses during follow-up is small in the literature. As the mean duration of illness in our sample was 12.0 years and most of the participants had been regularly followed up at an epilepsy clinic, the potential percentage of patients with comorbid epilepsy will probably not be substantial. Another significant limitation of our study was the exclusion of certain conditions and ES comorbidity to obtain a 'pure PNES' group. This can be said to limit the generalisability of the study findings to the clinical population because comorbidity in PNES is rather common [56,57]. Apart from the particular limitations of our study, there are theoretical concerns regarding the concept of social cognition and its measurements. It has been argued that because ToM is very loosely defined, even the most frequently used tests may not actually be testing the capacity to attribute mental states per se [58]. There is also evidence of poor internal consistency and different associations among different patient populations between ToM tests [45,59,60]. Similar arguments have also been made for alexithymia, arguing that different scales may capture distinct aspects of the emotional process deficits pertaining to ToM [25,61]. As such, the incorporation of the ToM abilities into the disorder models requires further research taking these commensurability and validity issues into consideration.

Despite the foregoing, we believe that social cognition and its relationship with emotional processes are clinically significant aspects in PNES, with the potential to provide novel ways of understanding the nature of the disorder and how to improve a low QoL. The reported successes of various psychotherapeutic interventions may be related to these domains because no matter how different they are in their theoretical assumptions, they have a common emphasis on identifying, distinguishing and working between emotions, thoughts, states and events [62–66]. Longitudinal studies examining social cognition will have the potential to provide data that can help clinicians find the answers to the question of which approach should be adopted for whom.

5. Conclusion

This study provided further evidence of poor ToM task performance in PNES patients and of the correlation of cognitive ToM task performance with a specific aspect of alexithymia: difficulty identifying feelings. This association may assume specific significance as it has been previously reported and was not observed in the ES patients or healthy volunteers in this study. Additionally, some aspects of subjective QoL in PNES patients may be associated with these defective mentalisation processes. These results point to the potential characteristics, predictive factors and therapeutic targets for improving the clinical course and QoL in PNES. Further research is needed to establish the clinical significance and generalisability of our study's findings.

Declaration of Competing Interest

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. Authors confirm that they do not have any conflict of interest to disclose.

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