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Differences Between Trauma Experience, Perceived Stress, and Effort Testing in Patients with Psychogenic Nonepileptic Seizures and Epilepsy

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DIFFERENCES BETWEEN TRAUMA EXPERIENCE, PERCEIVED STRESS, AND EFFORT TESTING IN PATIENTS WITH PSYCHOGENIC NONEPILEPTIC SEIZURES AND EPILEPSY

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Dissertation Approval

This is to certify that the thesis presented to us by Anthony D. Fatzinger JR on the 9th day of May, 2017, in partial fulfillment of the requirements for the degree of Doctor of Psychology, has been examined and is acceptable in both scholarship and literary quality.

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Abstract

The present study attempted to identify predictors that would differentiate psychogenic non-epileptic seizures (PNES) from epilepsy, examine individual strength of predictors, and, in a separate analysis, examine the relationship between perceived stress and effort testing. A common experience that differentiates PNES patients from epilepsy patients is a traumatic experience, specifically childhood sexual abuse. The Adverse Childhood Experiences (ACE) scale has never been used to see if it differentiates PNES and epilepsy samples, despite its focus on abuse, neglect, and household dysfunction. The ACE was combined with other previously researched predictors. Results of the logistical regression were insignificant and the model was not able to accurately predict the two groups. A second analysis conducted through means of a point-biserial correlation failed to identify a relationship between perceived stress and performance on effort testing in a PNES sample. Both analyses were likely impacted by a lower than anticipated sample size. Future research should attempt to examine other possible predictors, such as the presence of functional somatic syndromes (fibromyalgia), substance abuse, and other measures of stress and worry

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Chapter 1: Introduction

Statement of the Problem

Psychogenic non-epileptic seizures (PNES) occur in approximately 5% to 20% of patients in epilepsy clinics (Tojek, Lumley, Barkley, Mahr, & Thomas, 2000). Patients who suffer from PNES exhibit symptoms similar to patients with epilepsy; however, there are no neurological underpinnings to their symptoms. The standard of care in differentiating epilepsy from PNES is video-electroencephalogram (EEG) monitoring in a comprehensive epilepsy center (Bowan & Coons, 2000). Patients with PNES show no epileptiform activity during an event, in contrast to most forms of epilepsy. There are also differences in seizure presentation between these patients that can elucidate diagnosis. Typically, patients with PNES are able to recall the events of their episodes, are more likely to have their seizures witnessed by others, and their seizures tend to occur in doctors' offices (Lee, 2010). More often, patients with PNES also tend to close their eyes during an event, experience a rapid post-ictal recovery, and exhibit unsynchronized limb movement and pelvic thrusting, all of which are not typical in epilepsy. PNES patients tend to overestimate cognitive deficits when compared to epilepsy patients, and tend to fail effort testing at a higher rate (Drane, Coady, Williamson, Miller, & Benbadis, 2011). In sum, there are many differentiating aspects between patients with PNES and epilepsy that are imperceptible to a layperson.

Given the difficulty distinguishing PNES and epilepsy events in community medical settings, PNES patients are often treated with antiepileptic drugs (AEDs), many of which can impact cognition negatively (Drane et al., 2011). Misdiagnosis has been linked to increased spending of healthcare dollars. In 1995, it was estimated that the lifetime equivalent of treating a PNES patient was similar to an epilepsy patient, approximately $230,000 (Begley et al., 2000). Identifying and treating PNES earlier would reduce unnecessary medication usage and healthcare spending. A proposed way to assist in reducing healthcare spending would be identifying PNES earlier through use of a measure that has the ability to differentiate between PNES patients and epilepsy patients.

A hallmark difference between PNES patients and epilepsy patients is a higher incidence of trauma experiences, including sexual abuse. They experience posttraumatic stress disorder (PTSD) at a significantly higher rate than those with epilepsy (Lee, 2010). A study conducted in 1997 examined the relationship between traumatic experiences as a child and later health outcomes. The study used a 10-item questionnaire known as the Adverse Childhood Experience (ACE) scale, which examines areas of abuse, neglect, and household dysfunction (Felitti et al., 1998b). Results from this study showed a relationship between high ACE scores and health conditions, including heart disease, cancer, chronic lung disease, skeletal fractures, and liver disease. Elevated ACE scores have also been linked to other conditions, including diabetes, sleep disturbances, and frequent headaches (Anda, Tietjen, Schulman, & Croft, 2010; Chapman et al., 2011; Lynch, Waite, & Davey, 2013). To date, no study has investigated ACE scores within a PNES sample.

The present study examined whether the ACE score predicts seizure status (PNES or epilepsy) and compared this measure's strength against other predictors used in past studies. This study also aimed to contribute to the growing literature on PNES and explore the relationship between perceived stress and effort testing in a PNES sample.

Often, patients suffering from this condition do not receive the care they need and are treated like epilepsy patients, which, ultimately, does not improve their conditions. By making accurate diagnoses faster, PNES patients can receive the treatment they need and have a better chance for successful outcomes.

Purpose of the Study

The present study examined the differences between scores on a measure of adverse childhood experiences and trauma in patients with PNES and patients with epilepsy. Although there is evidence to suggest that trauma is linked to PNES, research has not been conducted using the ACE scale with a PNES population. If differences are found between PNES and epilepsy patients showing that PNES patients tend to have higher ACE scores, this scale could be utilized as a screening measure in epilepsy centers, thus reducing likely exposure to unneeded medication and decrease overall spending of healthcare funds for these patients. PNES patients would be referred to the treatment they need earlier, typically psychotherapy and use of proper psychotropic medication, and have a better chance for remission of symptoms (LaFrance & Devinsky, 2004). Due to the brevity and ease of use of the ACE, this measure could also serve as a means for physicians to obtain sensitive yet important data. Additionally, this study aimed to investigate whether the presence of high levels of perceived stress has a relationship with PNES patients' performance on effort testing, since little has been offered as a possible explanation as to why they perform differently than epilepsy patients.

Research Questions

1. Do certain self-report measures differentiate PNES patients from epilepsy patients?
2. Does the ACE have higher power in predicting group membership (PNES or epilepsy) than the Personality Assessment Inventory (PAI)?
3. Does perceived stress impact PNES patients' performances on tests of effort?

Chapter 2: Literature Review

Psychogenic Nonepileptic Seizures

Psychogenic nonepileptic seizures (PNES) have been recognized and described for more than 300 years, and were first recognized as "hysterical seizures" in 1730 (Krebs, 2007). The condition has also been referred to as pseudoseizures, spells, and attacks, but current preferred terminology is PNES (LaFrance, Reuber, & Goldstein, 2013). Inaccurate diagnosis of an epilepsy disorder can cost medical centers thousands of dollars per patient, expose the patient to unnecessary medication that often has harsh side effects, and delays the patient from receiving the treatment he or she requires (Binder & Salinsky, 2007). It is estimated that it takes 7 to 16 years to receive an accurate diagnosis of PNES (Lee, 2010). When treated correctly, approximately 75% to 95% of patients display improvement (Drane et al., 2011). Additionally, a standardized treatment manual has been published recently using cognitive behavioral therapy techniques (LaFrance & Wincze, 2015).

There are several ways to differentiate PNES from epilepsy. The standard of care for PNES diagnosis is continuous video-EEG monitoring (Lee, 2010). A patient with epilepsy will display epileptoform activity during a seizure, whereas a PNES patient will have an event with no corresponding changes in EEG patterns. This has been the standard of diagnosis since the introduction and growth of video-EEG in the 1980s (LaFrance & Devinsky, 2004).

PNES patients also differ in seizure presentation when compared to patients with epilepsy. During a PNES event, an alteration of consciousness or motor, sensory, or autonomic functioning occurs (Griffith & Szaflarski, 2010). A PNES presentation can include any of the following symptoms: asynchronous limb movement, clear provocation by stress, pelvic thrusting, crying, eye closure, responsiveness during the event, longer than 5-minute duration, and rapid postictal recovery (Lee, 2010). Oral laceration is associated with PNES, whereas incontinence and tongue biting are more indicative of epilepsy (Sahaya, Dholakia, & Sahota, 2011). Attempts at classification have identified atonic and hypermotor subtypes (Griffith & Szaflarski, 2010). The hypermotor subtype presents in a thrashing or convulsive manner, whereas the atonic subtype appears motionless and more closely resembles catatonia.

PNES patients tend to have a more prominent psychiatric history than patients with epilepsy. Turner et al. (2011) found that 48% of their epilepsy sample had a diagnosable psychiatric issue, whereas 100% of their PNES sample had a diagnosable condition other than conversion disorder. Another hallmark of the PNES diagnosis is a history of trauma, most commonly childhood sexual abuse. Physical abuse, neglect, and recent traumatic experiences can also put patients at risk (LaFrance & Devinsky, 2004). Personality disorders are also more prevalent in PNES patients. On the Minnesota Multiphasic Personality Inventory-2 (MMPI-2), hysteria and hypochondriasis are scales with the most common elevations. On the Personality Assessment Inventory (PAI), somatization is the most commonly elevated scale (Testa, Lesser, Krauss, & Brandt, 2011; Testa, Schefft, Szaflarski, Yeh, & Privitera, 2007).

Several pathogenic models for the manifestation of PNES have been offered. Bodde et al. (2009) presented a five-level model on the formation and prolongation of PNES. Level 1 is typically a psychological etiology or event, which in most cases is trauma. Level 2 relates to vulnerability, with factors including personality, gender, neuropsychological impairments, and age. Level 3 includes shaping factors that lead to the formation of PNES. Common shaping or symptom modeling includes having a relative or friend with epilepsy, or having had an epileptic event in the past. Level 4 describes triggering factors, or situations in which an event is brought on. Lastly, level 5 involves prolongation factors, which explain why the condition persists and whether PNES is a coping strategy or induced for some other potential gain. The first three levels are considered to be the development of PNES, and the latter two act as provocation and prolongation of the disorder. A separate model proposed by Baslet (2011) stated that those who have difficulties in areas of adaptive functioning are more prone to developing PNES. Essentially, combinations of excessive emotionality, excessive selective focus, hypervigilance, cognitive inflexibility, decreased sensitivity, dissociative tendencies, alexithymia, cognitive deficits, limited volitional control, and/or suggestibility can contribute to a predisposition for developing PNES (Baslet, 2011).

PNES is a cross-cultural phenomenon. PNES has been studied in South Africa, various part of South America, and Iran (Alessi & Valente, 2013; Asadi-Pooya & Sperling, 2015; Pretorius & Sparrow, 2015). PNES differs in presentation across cultures. For example, in an Iranian sample, childhood physical and sexual abuse were weaker indicators when compared to religious factors, including extra-marital affairs (Asadi-Pooya & Sperling, 2015).

Psychiatric comorbidity in PNES. PNES patients often report more psychiatric symptoms than both the general population and epilepsy patients (Drane et al., 2011). The most common comorbidities include PTSD, panic disorder with and without agoraphobia, other anxiety disorders, depressive disorders, and personality disorders.

Some have suggested that psychiatric disturbances within the PNES population may be sufficient to create cognitive impairments that are seen in epilepsy (Binder & Salinsky, 2007; Locke, Berry, Fakhoury, & Schmitt, 2006). It is important to note that depression and anxiety are also present in epilepsy patients, however, they are often comorbid to a lesser extent, and the presentation of symptoms of these disorders varies between the two groups (Filho & Caboclo, 2007; Testa et al., 2011). PNES patients tend to experience higher levels of physiological symptoms of anxiety and depression versus epilepsy patients.

Asmussen, Kirlin, Gale, and Chung (2009) compared self-reported depressive symptoms of PNES patients and epilepsy patients. Measures included the PAI and the Beck Depression Inventory-II (BDI-II). No statistical difference was found between the two groups on the BDI-II; however, PNES patients expressed a significantly higher amount of physiological symptoms of depression, with female PNES patients expressing the highest amount of somatic symptoms of depression.

Adverse Childhood Experiences and Disease/Illness

In the late 1990s, Felitti et al. (1998b) examined the long-term impact of childhood experiences on adult health. The ACE scale was based on several previous questionnaires, and is a 10-question self-report measure examining abuse, neglect, and household dysfunction. Data were collected in conjunction with a standardized medical questionnaire that gathered demographic information, biopsychosocial information, review of organ systems, previous diagnoses, and family medical history. Participants were 9,500 health maintenance organization (HMO) members living on the west coast of the United States. The findings suggested a strong relationship between number of exposures to adverse childhood experiences and risk factors for disease. Conditions including ischemic heart disease, various cancers, chronic lung disease, skeletal fractures, and liver disease were found to have a graded relationship to the amount of adverse childhood exposures. Additionally, those who reported four or more adverse childhood experiences were significantly more likely to demonstrate risky health behaviors, including current tobacco use, being overweight, a higher rate of sexual partners, and higher rates of sexually transmitted diseases. A model was developed that spans from birth to death, beginning with adverse childhood experiences that lead to social, emotional, and cognitive impairment. The individual then adopts health-risk behaviors, which lead to acquired disease, disability, social problems, and a potential early death. Although this study reported on some aspects of mental health (e.g., increased depression and suicide attempt), it was focused largely on physical health and well-being. A major weakness of that study was that it relied on a self-reported medical history in which participants' diagnoses could have either been over or under reported. The present study verified the participants' diagnostic statuses through review of their electronic medical records (Filitti et al., 1998).

The ACE scale has since been used to investigate early childhood experiences in a variety of medical conditions. A partial replication of the ACE study found that those who report four or more ACEs were 1.6 times more likely to have type 2 diabetes (Lynch et al., 2013). Participants were primarily a low-income minority population and the rate of trauma in this population was much higher than the original ACE study, with approximately 50% of the sample reporting four or more adverse experiences. A higher rate of ACEs was also related to sleep problems. In a sample of approximately 17,000 participants, those who reported an ACE score of 5 or higher were 2.1 more times likely to report trouble falling asleep and staying asleep than those who reported 0 ACEs (Chapman et al., 2011). Self-reported sleep disturbances appeared to have a graded relationship with the number of ACEs present. Anda et al. (2008) investigated the relationship between ACEs and chronic obstructive pulmonary disease (COPD) and asthma. Participants who reported five or more ACEs (compared to those who reported no ACEs) were 2.6 times more likely to have COPD, 2 times more likely to have incident hospitalizations, and had 1.6 times the rate of prescription drug usage. Higher rates of ACEs were also related to the presence of asthma.

The presence of adverse experiences in childhood has been linked to a variety of medical conditions and health behaviors that have poor outcomes. Additionally, there appears to be a graded relationship between higher amount of ACEs present and presence of a medical condition. This scale has not been applied as extensively to psychiatric status, and has not been used to differentiate between PNES and epilepsy patients.

Adverse Childhood Experiences and Psychiatric Status

Several studies investigating ACEs and the presence of psychiatric illness have been conducted. Chapman et al. (2004) examined the relationship between ACE scores and rate of depression. Results from approximately 9,500 participants showed that women who experienced childhood emotional abuse were 2.7 times more likely to experience depressive symptoms, and men were 2.5 times more likely to experience depression than those who did not experience childhood emotional abuse. The number of ACEs in this study was found to have a graded relationship to both lifetime and current depressive symptoms.

Masuda et al. (2007) investigated intra- and extra-familial adverse experiences and the presence of childhood psychosomatic disorders, including non-ulcer dyspepsia, peptic ulcer, headaches, irritable bowel syndrome, autonomic nervous dysfunction, and ulcerative colitis. This study examined the impact of domestic violence, physical violence, emotional abuse, illness in the household, divorce, level of affection from parents, and overall family dysfunction on rate of developing a psychosomatic condition. Females were at a higher risk of developing somatic disorders than males, and those who had experienced emotional abuse were 1.9 times more likely to experience a somatic disorder than those who did not. Those who had ill relatives living in their households were 1.7 times more likely to experience psychosomatic disorders. When a participant reported three intra-family adverse experiences and two or more extra-familial adverse experiences, he or she was 3 times more likely to experience a psychosomatic disorder, providing strong evidence that psychosomatic disorders are associated ACEs.

Imbierowicz and Egle (2003) examined the link between adverse experiences in childhood and fibromyalgia, a condition with high comorbidity in PNES (Drane et al., 2011). Fibromyalgia patients were compared with somatoform pain disorder patients and a control group that had medically verifiable reasons for experiencing pain. The measure used to obtain information about adverse experiences in childhood was a structured interview containing questions about parental relationships, violence, lack of physical care, sexual abuse, and mental illness or addiction of parents. Of the three groups examined, those who were diagnosed with fibromyalgia had the highest relative frequency of reported adverse experiences, followed by patients with somatoform pain disorder. Patients with fibromyalgia and somatic pain syndrome did not differ significantly in presence of ACEs, but fibromyalgia patients had significantly higher level of adverse experiences when compared to the control group (*p* = < .005). Although this study was able to identify a relationship between adverse childhood experiences and conversion disorders, it used an instrument that required a costly amount of time for the examiner and participants that is unlikely to be used in primary care or neurologist visits. The present study attempted to improve upon this by using a more concise and efficient measure that takes far less time than the ones used in this study.

Stone, Sharpe, and Binzer (2004) examined the presence of adverse childhood experiences in a PNES sample. Data were gathered using the Structured Clinical Interview for Diagnostic and Statistical Manual for Mental Disorders (SCID), SCID-II for DSM-IV Axis II Personality Disorders, the global assessment of functioning (GAF) scale, a "My Memories of Upbringing" self-rating inventory, and a life events review from the past 12 to14 months. Data were examined against a psychogenic movement disorders comparison group. PNES patients were significantly more likely to experience incest, have less emotional warmth from their parents, and experience rejection from their fathers when compared to patients with a motor conversion disorder. This preliminary study investigated adverse childhood experiences, Axis-II status, and sequence of events 12 to 14 months prior to admission. In contrast to this explorative approach, the present study aimed to make meaningful distinctions with a simple screening method.

Although some studies have been completed examining the presence of ACEs in psychiatric-related illnesses and conversion disorders, few have used the ACE scale, which has been able to predict the presence of a variety of conditions. Most of the studies reviewed in this section used several lengthy measures, which are not likely to be used in a primary care or neurologist visits due to administration time and the knowledge base necessary to score and interpret these measures. The ACE scale is much shorter and focused in content, and if found to differentiate patients with epilepsy from PNES, could aid greatly in preliminary differential diagnosis for neurologists in the community.

Personality Measure Use in Differentiating PNES and Epilepsy

Since the ACE measure has never been used to differentiate PNES from epilepsy, a means for comparison is needed. The PAI has been used extensively in epilepsy and PNES research, with each having a typical profile. One drawback to the PAI is that it is a lengthy self-report measure that requires specialized software to score and interpret. Subsequently, an instrument like the PAI is unlikely to be administered at a primary care doctor's office or during a neurologist visit. If the ACE scale were found to have stronger predictive power than the PAI, healthcare professionals would have a questionnaire that takes less than 10 minutes to complete and is very easy to score to help them with differential diagnoses.

Wagner, Wymer, Topping, and Pritchard (2005) investigated the use of the PAI as a differential diagnosis tool between epilepsy and PNES. The PAI has a fourth grade reading level, non-overlapping scales, and fewer items in comparison to the MMPI. Past studies have also found MMPI and MMPI-2 specificity and sensitivity in prediction of PNES to be as low as 37%. Results showed that participants in the PNES sample reported impairment related to neurologically based symptoms, whereas the epilepsy sample did not. Although the two groups did not differ on the Somatization scale, those in the PNES sample reported significantly higher levels of conversion disorder on a subscale. The PNES sample also endorsed a higher level of depression overall, particularly physiological symptoms of depression. They created a PNES indicator by subtracting two of the subscales (Conversion-Health Concerns = PNES indicator) from the Somatization scale. Positive scores were associated with PNES, and negative scores were associated with epilepsy. Their PNES indicator scale was found to have 84% sensitivity and 73% specificity. This PNES indicator appears to be a helpful tool in discerning an accurate diagnosis, but requires replication.

Thompson, Hantke, Phatak, and Chaytor (2010) sought to replicate the findings of Wagner et al. (2005) by tripling its sample size. Although their PNES sample had significantly higher conversion, somatic, and physiological signs of depression, there was no significant difference in their level of health concerns when compared to an epilepsy sample. This finding challenges the usefulness of the PNES indicator that was used in the previous study, as the indicator did not predict seizure status in this study accurately. Additionally, the conversion subscale in their sample only had 58% sensitivity and 83% specificity in differentiating PNES from epilepsy.

Testa, Lesser, Krauss, and Brandt (2011) attempted to clarify the results of the previous two studies, and added a neurologically normal sample for an additional means of comparison. Both the PNES and epilepsy samples endorsed clinically significant rates of somatic complaints, anxiety, depression, and borderline features when compared to the control group. Differences emerged at the subscale level between the PNES and epilepsy samples, with the PNES sample reporting higher levels of physical symptoms of depression, conversion symptoms, and somatization. Although overall scores of anxiety and depression were similar, the PNES and epilepsy samples experienced their problems in different ways. They were unable to replicate the clinical utility of the PNES indicator (from Wagner et al. [2005]). The conversion subscale alone accurately diagnosed 7 out of 10 PNES patients, and was consistent with previous findings.

Although better than the MMPI, there is mixed evidence whether the PAI can be used to differentiate PNES from epilepsy accurately. Even if strong evidence was found to differentiate the two populations, the PAI is still a lengthy measure that takes specialized training to score and interpret. Although Wagner et al. (2005) make the point that a clinical interview and administration of the PAI is more cost effective than an epilepsy monitoring unit (EMU) stay, it is unlikely that most PNES patients will have this referral early in their care. Nevertheless, if the ACE scale is found to differentiate PNES patients and epilepsy patients, it is more likely that the ACE scale would be used in a typical doctor or neurologist visit, due to its easy and quick administration and simple interpretation.

Perceived Stress and PNES

Stress has been characterized as an unpleasant emotional response to a threatening event (Lazarus, 1966). LaFrance and Bjornaes (2010) describe PNES as a maladaptive coping mechanism to perceived stress. A person with PNES's brain perceives a stressful event, which elicits physiological and behavioral changes. It is then reinforced through repeated presentation of stress and accumulation of these responses, ultimately allowing PNES to emerge as a coping mechanism for stress. In part, this is why therapy has success in seizure reduction, as the individual is introduced to more adaptive means of coping.

Tojek, Lumley, Barkley, Mahr, and Thomas (2000) compared a sample of PNES patients to an epilepsy sample on several measures focused on life events, current symptoms, illness concerns, bodily awareness, and alexithymia. Findings suggested that those with PNES have a higher number of stressful events and rate their events as more highly stressful. They noted that although the predominant cause of PNES is a history of abuse, other causes varied, and ranged from troubled childhood or troubled current relationships, family problems, or illness or loss of a close friend. PNES patients were also more aware of bodily sensations, which corroborates the heightened stress response theory in PNES patients. This study demonstrates that PNES patients react differently to stress than epilepsy patients and adds support to the model discussed above.

Testa, Krauss, Lesser, and Brandt (2012) expanded upon the work of Tojek et al. (2000). They compared PNES patients, epilepsy patients, and a healthy control group on measures of positive and negative stressful events and coping styles toward stress. Counter to their hypothesis, they found no differences between frequency of stressful events and perceived severity of stressful events; however, when a stressor was present, it caused greater distress to PNES patients compared to epilepsy patients and control subjects. In line with Tojek et al. (2000), they found that PNES patients have an exaggerated stress response compared to those with epilepsy and healthy controls.

PNES is a maladaptive coping mechanism and response to a stressful event. Tojek et al. (2000) demonstrated that PNES patients experience more stressful events and believe them to be more severe when compared to an epilepsy sample. Testa et al. (2012) added to this research by distinguishing that a PNES patient does not necessarily experience a greater amount of stressful events, but that a stressful event is perceived as more distressing when compared to the stress response of an epilepsy patient or healthy control. Little research has been conducted on the effect of stress on a PNES patient's cognitive performance on neuropsychological tests, in which there is often a great deal of variability in cognitive energy expenditure.

Effort Testing

Performance validity tests help neuropsychologists determine whether the person being evaluated put forth sufficient and consistent effort during his or her evaluation. To be able to draw accurate interpretations from testing data, it is imperative to have measures to ensure that the data collected are valid (Lezak, Howieson, Bigler, & Tranel, 2012). Several freestanding and embedded measures of effort are included in a typical neuropsychological evaluation (Walter, Morris, Swier-Vosnos, & Pliskin, 2014). These measures are not sensitive to cognitive impairment and are designed so that both intact and impaired patients should achieve a passing score (Tombaugh, 1997). For example, even those with genuine neurological concerns (e.g., TBI, aphasia, cognitive impairment, and dementia) have been shown to achieve a passing score. A failing score is a reflection of suboptimal, insufficient, or inconsistent effort and not cognitive impairment. Failure on multiple performance validity measures invalidates testing.

The literature on performance validity measures and rate of failures in PNES samples is mixed. Cragar, Berry, Fakhoury, Cibula, and Schmitt (2006) compared epilepsy patients and PNES patients on four measures of effort tests, including the Test of Memory Malingering (TOMM). Results showed that 20% of their sample failed one or more effort measures. The TOMM was failed at a significantly higher rate by PNES patients when compared to the other two groups; however, a small portion of the PNES sample failed. Overall, when all four measures of effort were taken into account, failure rate was not significantly different across the three groups, potentially a result of small sample size. The present study aimed to build upon this research by examining performance on the TOMM in PNES patients and epilepsy patients in a larger sample to determine whether differences exist.

Drane et al. (2006) investigated performance on effort testing in a PNES sample compared to an epilepsy sample. They hypothesized that patients with PNES would fail measures of symptom validity at a higher rate than those with epilepsy, and that PNES patients who pass effort testing would outperform patients with epilepsy and the PNES patients who failed effort testing. Measures for this study included the Green Working Memory Test and the Neuropsychological Battery for Epilepsy. Results showed that the PNES sample failed effort testing approximately 50% of the time, significantly more than the epilepsy sample.

Dodrill (2008) called the results of Drane et al. (2006) into question and replicated the study. Dodrill (2008) stated that the previous study used overly stringent parameters of inclusion and exclusion criteria. Drane et al.'s (2006) exclusions included previous epilepsy surgery, English as a second language (ESL), recent epileptic seizure, apparent cognitive deficits, incomplete testing, and patients who were not seen by full-time neuropsychologists. Inclusion criteria for Dodrill (2008) included proficiency in English and completing at least the Green Word Memory Test. If an epilepsy patient had a seizure during the testing, an unspecified break was given, and no patient was permitted to resume testing if there was a belief that lingering cognitive deficits were present. Results from this study were unable to replicate the results found in Drane et al. (2006), and found no significant difference in performance on effort testing between epilepsy and PNES patients. The failure rate for the epilepsy sample was 25%, whereas the failure rate for the PNES sample was 28%. Dodrill (2008) concluded that they were unable to replicate the findings due to sample selection criteria.

One possible explanation as to why PNES patients perform worse on effort testing when compared to epilepsy patients is their mood states. Some have suggested that the presence of anxiety, depression, PTSD, or other psychological states impacts effort testing in PNES patients (Drane et al., 2011). Nevertheless, when pure samples of depression with varying severity, anxiety, and somatoform disorders are used to examine whether these symptoms have an impact on measures of effort, a systematic review suggested that these populations tend to achieve acceptable scores on measures including the TOMM and Reliable Digit Span (RDS; Boone, 2007). PNES patients have also been found to overestimate their levels of cognitive impairment, which leads to lower task engagement and subsequent failure of validity testing (Myers, Lancman, Laban-Grant, Matzner, & Lancman, 2012). Because there is usually little financial incentive, PNES patients are not likely to be malingering when compared to other clinical populations.

Drane et al. (2011) summarized several hypotheses regarding why PNES patients perform poorly on measures of validity and suggested that it was most likely due to poor task engagement, but did not offer an explanation for what is contributing to this. The present study intended to expand upon the literature by examining whether the presence of ACEs or high levels of perceived stress impact a patient’s performance on effort testing.

Chapter 3: Hypotheses

Hypothesis I

It was hypothesized that seizure status would be predicted by higher ACE scores, Perceived Stress Scale (PSS-10) score, elevated PAI conversion and somatization scale scores, BDI-II score, and Beck Anxiety Inventory (BAI) score.

Rationale. Elevated ACE scores have been associated with a myriad of physical and mental health concerns (Felitti et al., 1998b). Although the ACE has never been investigated in a PNES sample, it was predicted that the PNES sample would have a higher score when compared to epilepsy patients and serve as a predictor of PNES when placed in a logistical regression. The PAI has also been found to be a significant predictor of PNES, specifically in the somatization and conversion subscales (Testa, Krauss, Lesser, & Brandt, 2012). Additionally, PNES patients generally have been found to have higher rates of psychiatric illness; thus, it was hypothesized that scores on the BDI-II and BAI would be more elevated in a PNES sample when compared to an epilepsy sample.

Hypothesis II

It was hypothesized that the ACE score would have stronger predictive power than PAI subscales in differentiating PNES from epilepsy patients.

Rationale. Previous studies have found the PAI to have modest sensitivity and specificity in differentiating PNES from epilepsy patients, whereas others have been no better than chance (Testa et al., 2011). Although the ACE has never been used to differentiate these two populations, PNES patients were hypothesized to score higher on this measure due to its content focusing on various forms of abuse and neglect, which are major distinguishing factors when differentiating between PNES and epilepsy (Drane et al., 2011).

Hypothesis III

It was hypothesized that PSS-10 scores would have a negative relationship with measures of effort and performance (RDS and TOMM) in a PNES sample.

Rationale. The research is mixed on whether patients with PNES perform more poorly on measures of effort when compared to epilepsy patients (Dodrill, 2008; Drane et al., 2006). Further, when differences have been found, there has been little explanation regarding why. It was hypothesized that PSS-10 scores would have a negative relationship with performance on tests of effort in a PNES sample.

Chapter 4: Method

Research Design

This study used retrospective quasi-experimental design to determine whether a diagnosis of PNES could be predicted through a set of variables' scores (PAI subscales, BDI-II, BAI, PSS-10, and ACE), and whether certain predictors are more powerful (i.e., ACE scores) than other self-report measures through use of a binary logistic regression. It also examined whether there was a relationship between perceived stress and performance on measures of effort in a PNES sample through use of a point-biserial correlation.

Inclusion/Exclusion Criteria

Inclusion criteria for the study included those with a diagnosis of PNES or epilepsy. All participants had a comprehensive epilepsy evaluation and diagnosis was made by means of continuous video-EEG monitoring.

Participants were excluded if they had a diagnosis of both PNES and epilepsy. Participants who were diagnosed under the age of 18, were in the acute phase of concussion (less than 30 days post injury), or had any intellectual/developmental disabilities were also excluded. Participant status was determined through review of electronic medical records and review of the attending neuropsychologists' reports. Additionally, participants were excluded if they produced invalid scores on the PAI.

Measures

The measures used for this study included the ACE scale, PAI, BDI-II BDI-II, BAI, PSS-10, TOMM, and RDS.

Adverse Childhood Experiences (ACE) scale. The ACE scale consists of 10 yes or no questions, as well as some items' additional sub-questions (Felitti et al., 1998a). There are two domains measured by this scale: abuse and household dysfunction. The abuse domain contains two questions on psychological abuse, two questions on physical abuse, and four questions on sexual abuse. The household dysfunction domain contains two questions on substance abuse, two questions on mental illness, four questions on how the participant was treated by his or her mother, and one question on criminal behavior in the household. The ACE has never been used in a PNES sample, and past research did not establish cutoffs for significance; however, higher amounts of ACEs typically relates to poorer prognosis and outcome.

Personality Assessment Inventory (PAI). The PAI is a 344 item self-report questionnaire designed to gather a personality profile (Morey, 2007). Each question is answered using a 4-point Likert scale, with options including *false*, *slightly true*, *mainly true*, and *very true*. The PAI is comprised of four validity scales (Inconsistency, Infrequency, Positive Impression Management, and Negative Impression Management), 11 clinical scales (Somatization, Anxiety, Anxiety Related Disorders, Depression, Mania, Paranoia, Schizophrenia, Borderline Features, Antisocial Features, Alcohol Problems, and Drug Problems), five treatment scales (Aggression, Suicidal Ideation, Stress, Nonsupport, and Treatment Rejection), and two interpersonal scales (Dominance and Worth). Participants record their responses on record forms, which are then entered into a computer manually. After the data are entered, a scoring program computes *t*-scores for each of the scales and determines whether the profile is valid. Participants with invalid profiles were excluded from the study.

The PAI used several normative samples totaling approximately 3,600 participants. Samples included a U.S. census-matched group, a group of individuals seen in a variety of clinical settings, and a college student group (Morey, 2007). The PAI is appropriate for most populations aged 18 and older, and has a slightly easier readability in comparison to the MMPI-2 (fourth grade reading level versus fifth). There has also been a steady growth in research using the PAI with PNES and epilepsy populations, with certain scales being used as predictors of PNES.

Although the PAI is considered to be a fairly new measure when compared to other measures in the field (the PAI was published in 1991 versus the MMPI's introduction in 1943), it is a widely used scale with comparable reliability and validity (Wise, Streiner, & Walfish, 2010). Busse, Whiteside, Waters, Hellings, and Ji (2014) investigated reliability and validity of the PAI within a neuropsychological sample. Reliability full-scale coefficients ranged from .72 to .94, whereas subscale coefficients ranged from .60 to .90. Although subtle, small differences existed between the original PAI sample and their current sample, and the authors concluded that it was a reliable and valid measure for use in a specialized neuropsychological sample. *T*-scores of 70 or higher on PAI scales and subscales indicate clinical significance and were used for this study.

Perceived Stress Scale (PSS-10). The PSS-10 is a 10-item questionnaire examining how often a person experiences different aspects of stress, as well as perceived self-efficacy (Cohen, Kamarck, & Mermelstein, 1983). Responses are given using a 5-point Likert scale ranging from 0 (*never*) to 4 (*very often*). Taylor (2015) investigated the PSS-10's reliability and validity. In his sample of 1,236 participants, it was found to have a reliability of .82. An analysis using item response theory investigated each item in relation to either perceived stress or perceived self-efficacy. It was found that the reliability of the measure for perceived stress diminished if perceived helplessness was low and self-efficacy was high. Taylor (2015) concluded that this is a valid and reliable measure of perceived stress as long as this rule is followed. There are no established cutoffs or classification designations for the PSS-10, but the measure is useful for general comparisons (Cohen & Janicki-Deverts, 2012). For the purpose of this study, higher perceived stress was defined as having a statistically higher mean score on the PSS-10.

Beck Depression Inventory-II (BDI-II). The BDI-II is a 21-question self-report measure assessing depression in adolescents and adults (Beck, Steer, & Brown, 1996). Interpretation of this measure is as follows: 0-13 minimal, 14-19 mild, 20-28 moderate, and 29-63 severe depression. Each question is rated by circling one of four answers that best applies a given depression symptom. It is a very commonly used measure of depression, has been found to have reliability coefficients ranging from .84 to .93, and was found to be a useful tool in discriminating depressed from non-depressed individuals (Strauss, Sherman, & Spreen, 2006). In the present study, the presence of higher depression scores in a PNES sample compared to an epilepsy sample was determined by comparing group means for statistical significance.

Beck Anxiety Inventory (BAI). The BAI is similar to the BDI-II, in that it has 21 self-report questions and it uses a Likert type scale, with each item representing a symptom of anxiety rated from *not at all* to *severely* (Beck & Steer, 1993). Interpretation of this measure is as follows: 0-9 minimal, 10-16 mild, 17-29 moderate, and 30-63 severe anxiety. Reliability coefficients for this measure range between .85 and .94, with good test-retest reliability, which has been found to be .75 over 1 week (Beck, Epstein, Brown, & Steer, 1988). Additionally, it was found to have factorial, convergent, and discriminant validity. In the current study, the presence of higher anxiety scores in a PNES sample compared to an epilepsy sample was determined by comparing group means for statistical significance.

Test of Memory Malingering (TOMM). The TOMM examines an individual's ability to retain 50 line drawn pictures, each presented for 3 seconds over the course of two trials (Tombaugh, 1997). Following each of the learning trials, the individual is then asked to pick the line drawing from a distractor for 50 trials. The TOMM was normed using cognitively intact and cognitively impaired samples. Both samples performed well, and a criterion cutoff score of 45 on the second trial was established as a passing score (Tombaugh, 1997). Following this, Rees, Tombaugh, Gansler, and Moczynski (1998) investigated the validity of the TOMM over several experiments. Across the experiments, they found convergent results that the TOMM more than adequately was able to distinguish malingering from non-malingering individuals. The cutoff score of 45 or more correct responses was used to determine whether adequate effort was put forth in the present study.

Reliable Digit Span (RDS). RDS is calculated using the Digit Span subtest of the Wechsler Adult Intelligence Scale (Wechsler, 2008). It is calculated by summing the number of digits repeated by an individual correctly for an item without error for digits forward and backward (Schroeder, Twumasi-Ankrah, Baade, & Marshall, 2012). A meta-analysis evaluated the use of RDS as a means of detecting poor effort (Jasinski, Berry, Shandera,

& Clark, 2011). A cutoff score of greater than or equal to 6 was be used for this study, with scores below that indicating poor effort (Schroeder et al., 2012).

The cutoff score of 6 has been researched widely. This score has been found to have a sensitivity of 30% to 35% and specificity of approximately 96% to 97%, and is deemed to be effective in most clinical samples (Schroeder et al., 2012). When a cutoff score of 7 was used, it achieved higher sensitivity, but at the cost of specificity, and was, therefore, not encouraged. A separate meta-analysis found that RDS was sensitive to differentiate people who were malingering versus honest by more than one standard deviation (Jasinski et al., 2011).

Procedure

During their stay at the hospital, patients are connected to constant video-EEG monitoring. In addition, they undergo a comprehensive neuropsychological evaluation. Typically, this evaluation takes place as part of patients' hospital course, but occurs occasionally on an outpatient basis. For all of the patients who participated in the current study, either a trained psychometrist or a pre-doctoral trainee who has a focus area in neuropsychology conducted the neuropsychological testing.

After the evaluation was complete, the examiner then scored the collected data and entered it into a customized database that uses Microsoft Office's Access, a program that is used primarily to store data. Basic patient information (name, date of birth, testing dates, and diagnosis) and testing data (domain of the test, name of the test/subtest, raw score, normalized score, percentile, and qualitative descriptor) were stored in the database. The data were then pulled into a spread sheet and transferred to statistical software. Once the data were pulled and placed into a spreadsheet, information was de-identified to maintain confidentiality of the participants.

Chapter 5: Results

Three hypotheses were tested through use of a binary logistic regression analysis and a point-biserial correlation. The analyses were conducted using Statistical Package for Social Sciences, version 24 (SPSS 24.0).

Sample Demographics

The initial data pull revealed 139 participants; however, after examining for diagnosis (eliminated ambiguous or dual diagnosis of epilepsy/PNES), completeness of data (missing two or more predictor variables), and validity concerns (PAI validity scales rendering the measure uninterpretable), 71 participants remained ($N = 71$). The mean age was 39 (range = 18-74; $SD = 14.5$), with 20 participants (28%) diagnosed with PNES and 51 (72%) diagnosed with epilepsy. The sample was predominately female (47, 66%) with only 24 males (34%). Of the PNES sample, 75% were female ($n = 15$). Participants for this study were seen at a large hospital undergoing comprehensive evaluation for a more detailed diagnosis of epilepsy or PNES.

Hypothesis I

Seizure status was predicted by higher ACE scores, higher PSS-10 scores, elevated PAI conversion and somatization scale scores, BDI-II score, and BAI score. Seizure status was a dichotomous variable with two values (PNES and epilepsy). ACE, PSS-10, the three subscales that make up the clinical scale somatization (SOM) from the PAI (somatization [SOM], conversion [CON], and health concerns [HCON]), BDI-II, and BAI scores are continuous variables. Table 1 displays descriptive statistics for each of the variable listed above. It was found that the PNES sample had, on average, mild-moderate depression (BDI-II = 19.75) and moderate anxiety (BAI = 19.90), and all three of the subscales of the SOM scale of the PAI (SOM, CON, and HCON) were just below clinical significance of 70. The PNES samples' ACE score (2.95) was slightly below the cutoff for significance as well. The epilepsy samples scores were generally lower than the PNES sample, with minimal-mild depression (BDI-II = 13.37) and mild anxiety (BAI = 14.84), and the three PAI subscales were well below the clinical significance cutoff point. The epilepsy sample's ACE mean score was lower than the PNES sample's mean score (ACE = 1.57).

Hypothesis I was tested using a binary logistical regression. A logistical regression was chosen because it examines the relationship between an outcome variable (seizure status) and predictor variables that are either continuous or categorical. From the scores listed above, a prediction was made whether it is more likely for an individual to be in a PNES group or an epilepsy group. A logistical regression uses an *R*-statistic, which is a partial correlation between the outcome variable and each of the predictor variables (Field, 2009). A Wald statistic was then calculated to determine the contribution of each of the predictor variables. The Wald statistic determines whether the *b* coefficient is significantly different from 0 (Field, 2009). A main assumption of logistic regression is that there should be no perfect linear relationship between two or more of the predictor variables, known as multicollinearity (Field, 2009). A variance inflation factor (VIF) was examined as an effort to avoid multicollinearity. Logistic regression does not make many of the key assumptions of linear regression and general linear models that are based on ordinary least squares algorithms, particularly regarding linearity, normality, homoscedasticity, and measurement level. There should also be independence of errors in logistical regression. This ensures that overdispersion is avoided, meaning the variance size is not larger than what was expected from the model (Field, 2009).

Table 1

Descriptive Statistics for Variables in Regression Model

	PNES (*n* = 20)		Epilepsy (*n* = 51)	
	Mean	SD	Mean	SD
ACE	2.95	2.395	1.57	1.769
PSS	22.5	8.593	18.47	6.736
BDI-II	19.75	11.064	13.37	10.093
BAI	19.90	12.161	14.84	10.843
CON	68.80	15.797	59.37	12.414
SOM	66.30	11.193	56.94	11.905
HCON	68.20	12.866	66.86	10.153

Each variable was examined to ensure it did not exceed a correlation of .70 (Field, 2009). The highest correlation was found to be .68, just below the recommended cutoff (Table 2). SPSS collinearity diagnostics were also used to determine the presence of multicollinearity among the predictor variables. Tolerance levels and VIFs were examined to determine whether multicollinearity was present, which is indicated by tolerance levels less than 0.1 and/or a VIF above 10 (Field, 2009). Tolerance levels ranged from .366 to .657 and VIFs ranged from 1.52 to 2.16, both within acceptable ranges, suggesting that multicollinearity was not present.

Table 2

Intercorrelation of Variables in Logistic Regression

	1	2	3	4	5	6	7	8
1. Diagnosis	-	.306*	.244*	.270*	.201	.305*	.343*	.056
2.ACE		-	.404*	.520*	.395*	.470*	.451*	.314*
3.PSS			-	.680*	.561*	.378*	.419*	.227
4.BDI-II				-	.651*	.502*	.532*	.337*
5.BAI					-	.501*	.397*	.236*
6.CON						-	.606*	.546*
7.SOM							-	.483*
8.HCON							-	

* Correlation is significant at the .05 level (2-tailed)

To ensure that the linearity of the logit between the dependent variable and each predictor is not in violation, a separate logistical regression was used with predictors that are interactions between the predictor and the log of itself (Field, 2009). After the regression was run, there was no indication of a violation in linearity, which would have been found by significance at the $p = .05$ level (Field, 2009).

Goodness of fit was also assessed using the Hosmer-Lemeshow test. Unlike most statistical tests, a significant finding means that the model does not fit the data (Field, 2009). The Hosmer-Lemeshow test was not significant (p = .955), meaning the model does fit the data. Case-wise residual sizes were also reviewed to determine whether any outliers were present. Field (2009) stated that approximately 5% of cases should fall outside of +/- 1.96 and only 1% are outside of +/- 2.58. Scores beyond 3 are typically concerning. None of the standardized residuals surpassed 3 (the highest recorded was 2.1).

The first hypothesis of this study examined the ability of a model composed of data from several self-report measures in identifying seizure status. A binary logistic regression was performed through SPSS. All predictor variables were entered in one step (ACE, PSS-10, BAI, BDI-II, and the SOM, CON, and HCON subscales from the PAI). Coefficients of determination for this model included the Cox and Snell R^2 of .179 and the Nagelkerke R^2 of .258 (Table 3). Nagelkerke's R^2 is a value ranging from 0 to 1; values approaching 1 indicate increased strength of the relationship between predictors and grouping. A Nagelkerke's R^2 of .258 is considered to be a small relationship between predictors and grouping, and was not found to be significant (p = .051). The Wald statistic was not significant for any of the predictors, meaning that none of the b-coefficients of predictors were statistically significant from 0.

Table 3

Logistic Regression Model Statistics

Model	χ^2	*df*	-2LL	Cox & Snell R	N[1] R	H & L[2] Test
1	14.017	7	70.408	.179	.258	.955

[1] Nagelkerke's R
[2] Homer and Lemeshow Test
p = .051

Hypothesis II

The ACE score was predicted to have stronger predictive power than PAI subscales in differentiating PNES from epilepsy patients. This was tested by examining beta weights of the ACE and PAI subscales from the logistic regression described in hypothesis I. Beta weights are standardized coefficients that allow one to compare strength of prediction among several variables and, thus, determine which is the strongest predictor (Nimon & Reio, 2011).

Interpretation of the beta weights from the logistic regression was not possible due to the model itself not being significant. Therefore, no distinction can be made regarding strength of individual predictors (Table 4).

Table 4

Logistic Regression Analysis Model/Step 1

	B (SE)	Wald	P	Exp (B)
ACE	.166	1.265	.261	1.206
PSS	.060	.233	.629	1.029
BDI-II	.045	.005	.945	1.003
BAI	.036	.209	.647	.984
CON	.029	1.408	.235	1.036
SOM	.031	2.590	.108	1.052
HCON	.033	2.588	.108	.948
Constant	2.163	2.561	.110	.031

Note: All variables were entered on step 1: ACE, PSS, BDI-II, BAI, CON, SOM, HCON
R^2= .179 (Cox and Snell), R^2 =.258 (Nagelkerke)
p = .051

Hypothesis III

PSS-10 scores were hypothesized to have a negative relationship with measures of effort and performance in a PNES sample. Descriptive statistics for both samples can be found in Table 5. Performance on the TOMM and RDS were dummy coded as pass/variable. A point-biserial correlation was used for this analysis. Assumptions for this type of correlation include that one of the variables is dichotomous and that the data are normally distributed (Field, 2009). A coefficient of determination, R^2, was examined to determine how much of the variability is accounted for by PSS-10 scores.

A point-biserial correlation was used to determine whether the level of perceived stress (PSS-10) had a relationship with level of effort in a PNES sample (N= 20). A point biserial correlation was chosen because one of the variables (effort) is dichotomous (1 = pass, 2 = variable). No significant relationship was found in the PNES sample (r_{pb} = .044, *p* = .855).

Table 5

Descriptive Statistics for Effort Measures

	PNES (*n* = 20)		Epilepsy (*n* = 51)	
	Mean	SD	Mean	SD
RDS	7.75	2.22	8.59	2.128
TOMM	46.56	8.191	49.02	2.589

Chapter 6: Discussion

The present study attempted to identify variables that assist in the differential diagnosis of PNES versus epilepsy. Previous research had investigated using lengthy personality measures (e.g., PAI, MMPI-2) for differential diagnosis (Testa et al., 2001; Thompson, Hantke, Phatak, & Chayto 2010; Wagner et al., 2005). MMMPI and MMPI-2 scales that are most commonly elevated are content scales 1 (Hypochondriasis) and 3 (Hysteria; Boone, 2007). Nevertheless, studies using the MMPI and MMPI-2 have indicated specificity and sensitivity in identifying PNES has been as low as 37% (Wagner et al., 2005). The PAI's Somatization scale has been the most prominently researched in terms of differential diagnosis. PNES patients typically have higher *t*-scores on the Conversion subscale and lower t-scores on the Health Concerns subscale, which led to the development of a PNES indicator (Conversion-Health Concerns = PNES indicator). Initial research supported 84% sensitivity and 73% specificity in differential diagnosis of PNES when the value of the indicator was positive. Additional research was unable to support these findings, indicating instead that the Conversion subscale alone accurately diagnosed 7 out of 10 patients (Testa et al., 2011). Measures such as these are unlikely to be used in a neurologist's or epileptologist's office due to the time and specialized training required to interpret these measures. The ACE is a short 10-question measure that examines childhood abuse, neglect, and household dysfunction. This measure has been found to predict a myriad of health problems in adulthood, including ischemic heart disease, various cancers, chronic lung disease, skeletal fractures, and liver disease (Felitti et al., 1998b). Additionally, the ACE has been found to predict higher rates of depression, psychosomatic disorders, and conversion disorders (Chapman et al., 2004;

Imbierowicz & Egle, 2003; Masuda, et al., 2007). The ACE has never been investigated as a possible predictor of PNES when compared to an epilepsy population, despite strong evidence that childhood sexual abuse is a common part of PNES patients' histories (Lee, 2010). The ACE, along with previously researched predictors and common measures of psychopathology, were entered into a regression model to determine whether these measures could accurately differentiate the two diagnoses, and to examine which predictor had the most strength in the model.

The relationship between perceived stress and performance on effort testing in a PNES sample was investigated. PNES has been characterized as a maladaptive coping mechanism to a stressful event (LaFrance & Bjornaes, 2010). Research on PNES patients' performance on effort measures is mixed, with some suggesting lower performance and other research stating no difference from the performance epilepsy patients (Dodrill, 2008; Drane et al., 2011). There has also been conflicting research on whether mood symptoms have an impact on effort (Boone, 2007; Drane et al., 2011; Myers et al., 2012). To date, perceived stress level and performance on effort measures have not been studied directly in a PNES sample.

Review of Findings

Diagnostic predictors. The ACE, PSS-10, SOM, CON, and HCON subscales of the PAI clinical scale SOM, BDI-II, and BAI were entered into a logistical binary regression to predict diagnostic status of either PNES or epilepsy. The model did not present concerns for multicollinearity, overdispersion, or violation of linearity. Results for the model were not significant, indicating that the selected variables were not able to accurately identify a differential diagnosis. Subsequently, due to the lack of significant findings, no further determination of strength of individual predictors could be rendered.

Stress and effort. The relationship between perceived stress (PSS-10) and performance on effort measures (pass or variable) in a PNES sample was examined. Results were unable to identify whether there was a relationship between level of perceived stress and performance on measures of effort. A commonly used statistical tool (G-Power) was used to determine the adequate sample size for this procedure. Calculations suggested that 64 participants would be required at a power level of .80. Failure to reject the null hypothesis in this analysis is likely due to low sample size (n = 20) versus lack of a relationship between these variables, as stress is considered a core component of PNES symptomology.

Strengths

A particular strength of this study was having access to both populations. The present study relied on the gold standard for diagnosis of PNES, video-EEG monitoring, and allowed for accurate classification of the comparison groups. Much of the research in the field of psychology is based on self-report measures from participants versus a clinical diagnosis and is a practice that can lead to misleading results and poor generalizability of findings. This study used a sample of participants who had their diagnoses thoroughly documented through a facility that offers exceptional services through use of a multidisciplinary team. Additionally, PNES patients have been the focus of an increased research effort and are deserving of continued attention. When an accurate diagnosis is made and proper treatment provided, 75% to 95% of patients with

PNES show improvement in overall functioning and 19% to 52% have their symptoms remit entirely (Drane et al., 2011).

The design for this study was also a strength, as it specifically incorporated previously supported predictors of PNES (Thompson et al., 2010; Wagner et al., 2005) with unstudied predictors that, conceptually, would seem to predict PNES patients. This study also attempted to look at a specific cause (stress) as an explanation for questionable effort in a PNES sample, versus general mood concerns that were not well defined.

Limitations

The primary limitation to this study was sample size. Unfortunately, due to a variety of reasons, the number of participants was greatly reduced. Since data were gathered through use of clinical work and not a research protocol, pieces of data were likely omitted due to time constraints, irrelevance, and various other circumstances. There was also a large imbalance in the two diagnostic groups, with epilepsy patients making up approximately 72% of the sample. Nevertheless, the percentage of PNES patients included in this study was slightly higher than what is generally estimated in previous research, with PNES patients comprising 5% to 20% of most epilepsy centers (Tojek et al., 2000). If the study had run longer, it would have accumulated additional participants and results may have been different.

Although the ACE is a fast and easy way to gather sensitive data, there is still a chance of under-reporting, as is the case with any self-report measure. Patients from either diagnostic group may not have felt comfortable disclosing aspects of their past that pertain to stressful events, such as childhood sexual abuse. Even if significant findings for the regression equation found the model to have predictive power and indicated the

ACE as a strong predictor of PNES, this measure could not be used alone as a diagnostic indicator. The patient would likely still need at least EEG monitoring, if not an inpatient evaluation in an EMU.

The examination of the relationship between perceived stress and performance on effort measures also had limitations. The PSS-10 scale may have been a poor choice for a measure of stress, as there are no established cutoffs for what indicates a high level of perceived stress. Rather, the higher the score, the higher the stress level is presumed. Additional measures of stress reaction and experience of stress may have been utilized. Other options include the Stress and Worry scale from the PAI (Morey, 2007) or the Stress Appraisal Measure (Peacock & Wong, 1990). Different effort measures other than RDS and the TOMM could have also been included in the analysis. Past research using PNES samples have also examined the embedded measure in the California Verbal Learning Test (CVLT), Portland Digit Recognition Test, and the Word Memory Test (Boone, 2007).

Future Research

Future studies are encouraged to use the ACE as part of a regression model in a larger, more evenly distributed sample of PNES and epilepsy patients. Conceptually, patients with PNES should score higher on the ACE than epilepsy patients, and verification of this through significant findings would demonstrate its utility as a quick and simplified way of gathering important data for differential diagnosis (LaFrance & Devinsky, 2004). Additionally, a review of the descriptive for the measures used for the regression show that the PNES sample appeared to suffer more psychological distress when compared to the epilepsy sample, which is consistent with the literature. Future research on these populations should continue to explore other measures with a focus on history of abuse and neglect (specifically childhood sexual abuse) to see whether these can be used in a regression analysis that accurately differentiates the two populations. The present study only examined the effects of perceived stress on measures of effort testing. Future research could investigate whether stress impacts performance on other areas of cognitive functioning, particularly timed tests, when a high level of perceived stress is present.

Other predictors outside of the ACE could be incorporated into a regression model to see whether different variables accurately differentiate PNES from epilepsy. Collecting data on additional risk factors may have helped with building a successful model. For example, including a fibromyalgia diagnosis into a regression model may be useful, as PNES patients tend to have functional somatic syndromes, such as fibromyalgia, at a higher rate than epilepsy patients (Benbadis, 2005). Another risk factor that could have been used in a regression model is the presence of substance abuse. A meta-analytic review of comorbidities found the rate of substance abuse within PNES populations to be as high as 29.5% (Diprose, Sundram, & Menkes, 2016). Variables such as the Alcohol (ALC) and Drug (DRG) scales from the PAI could have been used in the regression model.

There has been an increase in attention to PNES with regard to both research and clinical work. An evidenced based treatment manual with corresponding patient workbook has been published recently to aid in effective treatment for PNES patients. Core aspects of the treatment include getting a better understanding of the seizures, taking control of the events, identifying triggers, relaxation training, coping with stress, personal wellness, and additional techniques such as yoga and meditation (Reiter, Andrews, Reiter, & LaFrance, 2015). Additionally, the therapist manual educates and prepares clinicians to give these patients techniques that have been found to be effective for a PNES population. Any future research in this area is likely to increase access to appropriate care and, thus, increase the frequency and availability of validated treatment.

Summary and Conclusions

PNES occurs in approximately 5% to 20% of patients in epilepsy clinics and can take upwards of 16 years to receive an accurate diagnosis, costing hundreds of thousands of dollars in unnecessary medical treatment (Begley et al., 2000; Lee, 2010; Tojek et al., 2000). The ACE has been successful in identifying various health problems related to early childhood abuse, neglect, and household dysfunction. Childhood sexual abuse is a common element of PNES, and it was believed that the ACE may help with differential diagnosis of PNES versus epilepsy and could be used by other medical professionals, such as neurologists. This study attempted to identify a series of predictors that would differentiate PNES from epilepsy to determine whether shorter and easier to use screening instruments, such as the ACE, had higher predictive power over previously researched predictors. Results of the model were insignificant and no distinction on strength of individual predictors could be determined. Exploration as to whether level of perceived stress is related to performance on effort measures in a PNES sample was also unfounded. Future research in this area should include predictors such as the ACE and attempt to gather a larger sample size with more equally distributed groups (PNES group versus epilepsy group). Despite lack of findings, continued research in this population is strongly encouraged as a means to decrease misdiagnosis and achieve quicker access to care that will be beneficial instead of potentially harmful.

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