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Social Skills and Executive Functioning in Children with Epileptic and Non-Epileptic Seizures

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ABSTRACT

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Prior studies have demonstrated that a sizeable percentage of children presenting to the epilepsy monitoring unit for evaluation of paroxysmal events (seizures) are found to have non-epileptic seizures (NES) (Asano et al., 2005). The importance of identifying NES cannot be overstated since misdiagnosis often leads to treatment with antiepileptic drugs, which may have side effects that may negatively impact cognition (Chen, Chow, & Lee, 2001) and perhaps even cognitive development. While studies in adults with epilepsy or NES have demonstrated impaired executive functioning and social outcome compared to healthy peers, less work is present among pediatric populations (Cragar, Berry, Fakhoury, Cibula, & Schmitt, 2002; Rantanen, Eriksson, & Nieminen, 2012). Furthermore, research is void of information regarding social skills between these pediatric groups. The aims of this study were to examine group differences between social skills and executive functioning between pediatric epileptic and NES patients, determine if social skills predict diagnostic classification, and examine correlations between executive functioning and social skill measures.

This study was conducted on the epilepsy monitoring units (EMU) at Phoenix Children's Hospital and Primary Children's Medical Center. The parent/caregiver of patients admitted to the EMU for video-EEG diagnosis of seizures was approached regarding study participation. A total of 43 children and parent/caregiver participated in this study. The NES group consisted of 15 participants (67% female; M age at testing = 12.62, SD = 3.33), and the epilepsy (ES) group consisted of 28 participants (50% female, M age at testing = 11.79, SD = 3.12). Both the parents and children completed brief questionnaires measuring executive functioning and social skills. These measures included The Behavior Rating Inventory of Executive Functioning, The Behavioral Assessment System for Children, Second Edition, and the Social Skills Improvement System Rating Scales. Binomial logistic regression analysis showed social skills did not significantly predict diagnostic group. No group differences were found between children with epilepsy and NES on measures of executive functioning or social skills. Parents of both groups rated their children as having below average social skills, while children rated their social skills in the average range compared to healthy peers. Both children and parents of both groups rated their executive functioning within the average range. Executive functioning scores and social skill scores significantly correlated and regression analyses indicated that the Behavioral Regulation Index on the BRIEF significantly predicted Social Skills on the SSIS. Interpretation of results, limitations, and future directions are discussed.

Keywords: children, pediatric, epilepsy, non-epileptic seizure, executive functioning, social skills

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Non-epileptic seizures (NES) have been defined as paroxysmal involuntary events (seizures) characterized by movements, sensations, behaviors, or cognitive processing that resemble epileptic seizures, but are not associated with abnormal brain activity (Baslet, 2011; Verrotti et al., 2009). While there are multiple medical conditions that may mimic epileptic seizures (e.g. cardiac events), the underlying cause in a substantial number of these cases is purportedly psychogenic (Baslet, 2011).

A substantial percentage of children presenting to the epilepsy monitoring unit for evaluation of paroxysmal events are found to have NES (Asano et al., 2005; Montenegro et al., 2008). Estimates of the frequency of NES in children with paroxysmal events vary, but studies utilizing video-EEG to diagnose these events have suggested the percentage with NES ranges from approximately 15-45% (Asano et al., 2005; Bye, Kok, Ferenschild, & Vles, 2000; Montenegro et al., 2008). In adults, NES may be present in 5-33% of outpatient epilepsy populations and as much as 50% in inpatient and comprehensive epilepsy care centers (Bowman, 1998; Bowman & Markand, 1996; Charbolla, Krahn, So, & Rummans, 1996). A further complication is the comorbidity of NES and epilepsy, which is estimated to occur in 10-73% of NES patients (Benbadis, Agrawal, & Tatum, 2001; Bowman, 1998). Currently, video-EEG is the only diagnostic tool able to differentiate NES from epileptic seizures; however, it remains costly and time-consuming (Asano et al., 2005). Since pediatric NES is frequently mistaken for epilepsy at onset (Martin, Gilliam et al. 1998), it is imperative that inexpensive screening tools are developed that better differentiate those children at risk for NES who would benefit from earlier evaluation using video-EEG. Poor differentiation and misdiagnosis creates a significant

economic, familial, and an individual quality of life burden since the correct diagnosis of NES in children ranges anywhere from three weeks to four years (Kotagal, Costa, Wyllie, & Wolgamuth, 2002). Furthermore, misdiagnosis often leads to treatment with antiepileptic drugs, which may have side effects that negatively impact cognition and neural development (Chen et al., 2001). Proponents of using other techniques and screeners in addition to video-EEG, suggest that this combination may improve diagnostic accuracy, thereby shortening hospital stays and resulting in more effective interventions (Cragar, Berry, Fakhoury, Cibula, & Schmitt, 2002). With the profound cost associated with misdiagnosis or delayed diagnosis, most studies have focused on identifying the clinical differences (i.e., psychopathology and neuropathology) between epileptic seizures and NES to alleviate the proportion of incorrect diagnoses made, although no reliable markers have been detected (Cragar et al., 2002) . One area of functioning that has received very little attention is possible variations in social skills between individuals with epilepsy and individuals with NES. Identifying differences in social skills between these populations could aid in developing earlier, briefer, and more specific screening instruments, thereby increasing differential diagnostic accuracy, as well as assist in developing early interventions for these populations. Therefore, the present study looks at social skill ratings in pediatric NES and epileptic populations and examines how well these correlate with executive functions. Such a comparison provides information regarding the functional impact of executive functioning on social outcome. The analyses of this study aid in identifying group differences between children diagnosed with NES and epilepsy.

Review of Literature

Social Functioning in NES and Epileptic Populations

Research on social variables in NES populations across the lifespan is sparse, but consistently demonstrates poor social outcomes, with only 16% of adult patients in long-term employment and/or attending school (Reuber et al., 2003), and 35.3% of children seizure free and attending school regularly (Sri, Prahbhjot, Pratibha, & Sudesh, 2008). These findings indicate a significant problem related to social outcome, but research has failed to clearly define the contributing factors to poor social outcome or potential differences in these factors between NES and epileptic populations. Additionally, the vast majority of research in this field has been carried out in adults.

Similarly, while research in pediatric epilepsy demonstrates poor social outcomes, including reduced cognitive and social functioning as compared to healthy peers and children with other chronic illnesses (La Greca, 1990), the specific social skills that contribute to poor social outcome remain unclear. For example, a 2012 meta-analysis of social outcome in children with epilepsy found that 76% of the articles reviewed focused solely on intelligence quotient (IQ), educational attainments, age, and seizure manifestation as indicators of outcome (Rantanen, et al., 2012). In contrast to pediatric epilepsy research, there has been little research in any area of social outcome for children with NES compared to children with epilepsy or healthy controls, and what few pediatric NES outcome studies that have been done, focused only on measures of outcome such as IQ, educational attainments, and seizure manifestation as factors predicting long-term outcome (Reuber et al., 2003). Thus, the majority of the current literature continues to identify deficiencies in these outcomes (i.e., lower IQ and decreased academic achievements) rather than identifying other facets of social outcome. Studying other dimensions such as social

skills (i.e., ability to perceive and interpret social situations) (Cavell, 1990) may reveal specific deficits that require amelioration and in addition may potentially increase diagnostic accuracy between NES and epileptic populations.

Neuropsychological Findings in NES and Epileptic Populations

Research comparing adults with epilepsy, NES, and adults with comorbid presentation of ES and NES, found no significant group differences between groups on measures of attention, memory, executive functioning, and verbal and/or visuospatial abilities (Cragar et al., 2002; Turner et al., 2011). Although there was no differentiation between groups, both epileptic and NES patients performed worse on neuropsychological measures when compared to healthy controls (Cragar et al., 2002; LaFrance, 2008; Strutt, Hill, Scott, Uber-Zak, & Fogel, 2011). Neuropathology, psychopathology, and amount of effort are comparable between epilepsy and NES populations and specific factors purported to contribute to cognitive impairment, such as the acute effects of epileptic activity, neuropathology, effects of anti-epileptic drug treatment, psychological co-morbidity, poor effort on cognitive testing, or psychosocial factors (Baslet, 2011; Cragar et al., 2002; Fargo et al., 2004), do not predict unique neuropsychological findings that aid in differential diagnosis between groups (Dodrill, 2008; Locke, Berry, Fakhoury, & Schmitt, 2006). One variable, seizure semiology, may predict association with NES groups, with cognitive profiles in these populations remaining heterogeneous based upon semiological category (Hill & Gale, 2011). However, the overall cognitive profile for adults with NES and adults with epilepsy seems to be similar; with no reliable variable predicting differences between groups.

Although research in adult populations is continuing to evolve, the cognitive literature on pediatric NES populations and those with concomitant NES and epilepsy are scarce. Cognitive

difficulties in children with epilepsy include impairments in memory, attention, and executive functioning (Hernandez et al., 2002; Schoenfeld et al., 1999; Semrud-Clikeman & Wical, 1999), with a dearth of research comparing children with epilepsy to those with NES.

Executive Functioning and Social Functioning Association

Thus far, the research has shown deficits in social outcome in children with NES and reduced social outcome and executive dysfunction in children with epilepsy. Difficulties with attention and executive functioning (e.g., planning, problem solving, and multitasking) have been hypothesized to adversely affect peer relationships (Nassau & Drotar, 1997; Semrud-Clikeman & Wical, 1999), highlighting the dynamic interplay between executive and social dysfunction in this population.

Prior work has suggested that individuals with limited attention and executive capacities may develop adjustment difficulties (Matthews, Coyle, & Craig, 1990; see Hocking, 2011). To elaborate, it may be that children who have difficulty in planning or inhibiting behaviors will also have trouble in areas such as responding to instruction, which contributes to poorer social functioning (Baum et al., 2010). This position is supported by prior research, which has indicated that executive attention problems are highly associated with social outcome and peer relations, thus supporting the notion that higher attentional control is necessary for successful social function (Gomes, Spencer-Smith, Jacobs, Coleman, & Anderson, 2012). Indeed, inattentive behaviors are related to difficulties with peers for epileptic children ages 8-15 (Drewel, Bell, & Austin, 2009), and those who scored lower on measures of executive abilities had worse social behavioral outcomes as measured by the Child Behavior Checklist (CBCL) teacher-report form three years after seizure onset (Baum et al., 2010).

Additionally, it has been suggested that limited attention regulation and executive functioning may influence the choice of coping strategy in children, who are more likely to be avoidant (Baslet, 2011; LaFrance, 2008; Uliaszek, Prensky, & Baslet, 2012). When compared to patients with epilepsy, adults with NES frequently present as emotionally avoidant (Uliaszek et al., 2012). Since research shows higher levels of avoidance in adults with NES compared to individuals with epilepsy, it is thought that NES is an expression of an avoidance tendency in order to cope with internal experiences or emotions that may be aversive (Baslet, 2011). Avoidant coping strategies may be linked to impaired attention and executive abilities, as processing both emotional and cognitive information requires intact sustained attention and executive abilities (Baslet, 2011). Interestingly, in one study NES patients performed worse on measures of attention and concentration (i.e., Digit Span) while epilepsy patients performed worse on executive measures (i.e., Controlled Oral Word Association Test) (Risse, Mason, & Mercer, 2000). These findings may support the theory that NES patients have poorer attention, which may relate to less effective coping strategies for social interaction. Similarly, social functioning in children with epilepsy is affected by neuropsychological deficits, especially in attention and cognitive processing (Drewel et al., 2009; Rantanen et al., 2012; Schoenfeld et al., 1999). Taken together, these findings suggest a relationship between neuropsychological abilities (especially executive abilities) and social functioning, illustrating the need for increased understanding of differences between NES and epileptic populations, providing the impetus for the future exploration of empirically supported treatments.

Significance of Study

To summarize, adults with NES and adults with epilepsy have deficits in executive and attentional functioning compared to healthy controls, but this line of research has been quite

limited in pediatric populations. Furthermore, deficits in social functioning have been demonstrated in both children with NES and children with epilepsy. Although much of the research has focused on measures of outcome such as IQ and achievement outcomes, little research has identified the contributing factors such as poor social skill development (i.e., executive functioning and ability to perceive and interpret social situations) that likely influence long-term social outcome. Therefore, it is important to assess this social skill component and concordant executive functioning deficits in children with seizure disorders, both epileptic and non-epileptic, because 1) social skills deficits may be recognized earlier than emerging behavioral problems, which could enable earlier identification of skill deficits and subsequent intervention, and 2) examining social skills and executive functioning may provide us with insight into differential diagnosis. Therefore, this study focused on the relationship between executive functioning and social skill abilities both within and between groups of children with either epilepsy or NES.

The first aim of the study was to predict group membership (i.e., NES or ES) based on social skill scores. The hypothesis was that measures of social skills scores would predict group membership (i.e., NES or ES) on the SSIS Social Skills Scale, BASC-2 Adaptive Skills Composite (ASC), and BASC-2 Interpersonal Relations Scale. The second aim of the study was to identify group differences between children with NES and ES on measures of social skills and executive functioning. There were two hypotheses for this; first, children with NES would demonstrate lower social skill scores than children with epilepsy as measured by the SSIS Social Skills Scale, BASC-2 ASC, and BASC-2 Interpersonal Relations Scale. Second, that children with NES would demonstrate lower executive functioning than children with epilepsy as measured by the BRIEF Metacognition Index (MI) and BRIEF Behavioral Regulation Index

(BRI). The final aim of the study was to determine if social skills were related to executive functioning scores. It was hypothesized that executive functioning (as measured by the BRIEF MI and BRI) would be positively correlated with social skills scores on the SSIS Social Skills Scale, BASC-2 ASC, and BASC-2 Interpersonal Relations Scale.

Study Design and Procedure

Inclusion Criteria

Patients were eligible for enrollment if they were between the ages of 6 and 18 and if it was determined by the attending physician that they had epileptic, non-epileptic, or mixed events via video-EEG. The inclusion of video-EEG results was included since this is currently considered the most accurate method of diagnosis (Cragar et al., 2002). Furthermore, participants were included if they were available for evaluation prior to titration of seizure medication(s).

Exclusion Criteria

Participants were excluded from the study if they had a non-diagnostic EMU stay, if they were found to be psychotic, if there was a recognized paroxysmal disorders such as parasomnias or extrapyramidal movement disorders (i.e. non-psychogenic NES), if there was a previous diagnosis of Intellectual Developmental Disorder, if they did not speak English, if there was evidence of invalid test results (e.g., the parent or child answered true to every question), if the child was under the age of 6 or over the age of 18, and if there was suspected malingering or factitious disorder.

Consent

Consent was obtained from the legal guardian of each child. For those children ages 12-17 an assent form was also given. All participants were allowed to withdraw at any time without

negative consequence; however, an incentive of one $25 gift certificate was given per family after the packet of questionnaires was completed by the child and parent/caregiver. Participants were required to sign the consent form prior to participation and received a copy of the signed consent form.

Recruitment and Study Duration

This study was conducted on the Epilepsy Monitoring Unit (EMU) at Primary Children's Medical Center (PCMC) in Salt Lake City, Utah. Data was also collected at Phoenix Children's Hospital (PCH) in Phoenix, Arizona. The parent/caregiver of all patients admitted to the EMU for video-EEG (VEEG) diagnosis of seizures was approached regarding study participation. Individuals were recruited for this study from January 2014-January 2015.

Participant Demographics

The total number of participants recruited was 44, with one dropping out before completion (final N=43). The NES group consisted of 15 participants (67% female; M age at testing = 12.62, SD = 3.33), and the epilepsy (ES) group consisted of 28 participants (50% female, M age at testing = 11.79, SD = 3.12). There were no significant group differences between gender, age at testing, age at onset, ethnicity, handedness, socioeconomic status, or diagnosis of learning disability, attention deficit hyperactivity disorder or other psychological diagnoses. For a complete summary of demographic variables, see Table 1.

Each patient's final EMU report was reviewed for final diagnosis. The following data was collected from the medical records: developmental history, neurological or psychological diagnoses, medications, results from neuroimaging or prior EEG, and medical diagnoses that have been associated with potential non-epileptic paroxysmal events (e.g. sleep disorder, headache, cardiomyopathy, etc.). Upon review of participant's medical records, there were three

participants whose medical history indicated abnormal video-EEG results although their current video-EEG results on the EMU were negative, and they were subsequently diagnosed with non-epileptic seizures. Due to the possibility that these children were part of a population with mixed epilepsy and NES, data analyses were run both including and excluding them in the NES group. They were included in the NES group for summary of demographic variables (N = 15).

Table 1

Demographics for Groups

Demographic	NES (*n*=15)	ES (*n*=28)	F/χ^2	*p*
Gender (Female)	10 (66.7%)	14 (50%)	1.10	.294
Age at testing	12.62 (3.3)	11.79 (3.1)	43.00	.266
Age at onset	10.10 (4.7)	5.32 (4.4)	27.74	.116
Handedness (Right)	14 (93.3%)	20 (71.4%)	3.22	.358
Ethnicity			6.00	.199
Caucasian	13 (86.7%)	18 (64.3%)		
Hispanic	1 (6.7%)	6 (21.4%)		
Native American	0	1 (3.6%)		
Mixed	0	3 (10.7%)		
Other	1 (6.7%)	0		
Socioeconomic			3.38	.642
$35,000 <	8 (53.3%)	13 (46.4%)		
40-75,000	3 (20%)	4 (14.3%)		
80-100,000	1 (6.7%)	5 (17.9%)		
110-150,000	0	3 (10.7%)		
150,000 >	2 (13.3%)	2 (7.1%)		
Learning Disability	4 (26.7%)	12 (42.9%)	1.29	.256
ADHD	2 (13.3%)	7 (25%)	.803	.370
Mood Disorder	7 (46.7%)	9 (32.1%)	.882	.348

Note. Sample size smaller for socioeconomic measures due to missing data

Assessment Battery

The neuropsychological testing aimed to be completed within 1-3 days following admission to the unit. Also, attempts were made to complete testing prior to diagnosis by the attending physician. Total testing time for the child was approximately 30-40 minutes and approximately 40-50 minutes for the parent/caregiver. The following measures were used for this evaluation:

Social Skills Measures

The *Behavior Assessment System for Children, Second Edition (BASC-2)* is a questionnaire designed to facilitate and identify differential diagnosis and classification of emotional and behavioral disorders in children. This measure was designed as a screening tool and is useful with younger pediatric patients who are more likely to have difficulties with verbalization of symptoms (Vega, 2011) making it relevant for pediatric non-epileptic patients. Clinical subscales help identify possible difficulties in the areas of aggression, anxiety, learning problems, conduct problems, and attention problems compared to a normative sample. This measure is comprised of 176 True/False questions. This test takes 10-15 minutes to complete. We will administer both the self-report form and the parent/caregiver form (Chee Soon Tan, 2007).

Current research has linked internalizing problems commonly seen in children with NES (i.e., Depression, Anxiety) with the Behavioral Symptoms Index of the BASC-2. In a study with children with Neurofibromatosis-1 (NF1), school-related events were related to worse scores on the parent BASC-2 Internalizing Problems composite and Behavioral Symptoms Index (Martin et al., 2012). Furthermore, they found that school events were also positively correlated with the Depression, Anxiety, and Aggression subscales and negatively correlated with the Adaptability

subscale on the BASC-2 (Martin et al., 2012). There was also evidence that these events were correlated with worse scores on the Attention Problems subscale (Martin et al., 2012). This provides further support for the link between cognitive and social-emotional functioning. A current study used the BASC-2 as a screening and identification measure of psychological symptoms in a pediatric epilepsy population (Guilfoyle, Wagner, Smith, & Modi, 2012). They identified that children with chronic epilepsy had higher depressive and withdrawal symptoms, as well as lower activities of daily living as measured by the BASC-2 (Guilfoyle et al., 2012). There are no known studies utilizing the BASC-2 in pediatric NES populations. There has been research demonstrating the BASC-2 as a well-established assessment tool with reliability and validity in pediatric epilepsy populations (Allison Bender, Auciello, Morrison, MacAllister, & Zaroff, 2008; Guilfoyle et al., 2012). However, one study showed the BASC-2 to be better in identifying attention problems than internalizing problems compared to the CBCL among children with epilepsy; indicating that each test may provide unique diagnostic utility for assessing behavior problems (Allison Bender et al., 2008).

The BASC-2 scales that were included in data analyses include the Adaptive Skills Composite (ASC) on the BASC-2 Parent Form, and the Interpersonal Relations Scale on the BASC-2 Self-Report form. The ASC includes the following scales from the BASC-2 Parent Form: Adaptability, Activities of Daily Living, Functional Communication, Social Skills, Leadership, and Study Skills (Reynolds & Kamphaus, 2006). This composite was chosen as a measure of social skills due to its comprehensiveness in identifying areas impacting social functioning. As outlined in Reynolds & Kamphaus (2006), this composite successfully "summarizes appropriate emotional expression and control, daily living skills inside and outside

the home, and communication skills as well as prosocial, organizational, study and other adaptive skills" (p. 67). The scales that comprise this composite are briefly outlined below.

The Adaptability scale assesses one's ability to adjust to change, or shift from task to task (Reynolds & Kamphaus, 2006). The Activities of Daily Living scale assesses adaptive-behavior deficits (e.g., acting in a safe manner, organizing tasks, performing simple daily tasks) (Reynolds & Kamphaus, 2006). The Functional Communication scale assesses one's ability to communicate and express ideas clearly to others (Reynolds & Kamphaus, 2006). The Social Skills scale measures interpersonal social functions (e.g., complimenting others, offering assistance, saying "please" and "thank you") (Reynolds & Kamphaus, 2006). The Leadership scale assesses competencies in the community and school settings (e.g., joining clubs, participating in extracurricular activities, giving good suggestions, making decisions) (Reynolds & Kamphaus, 2006). Finally, the Study Skills scale assesses school adaptation (e.g., analyzing a problem before solving it, ability to take notes, achievement motivation) (Reynolds & Kamphaus, 2006).

On the BASC-2 Self-Report Form, the Interpersonal Relations scale was used as a measure of social skill. This scale assesses an "individual's reports of success in relating to others and the degree of enjoyment derived from this interaction" (Reynolds & Kamphaus, p. 78). Children who score low on this scale exhibit problems in relating to others and developing social skills (Reynolds & Kamphaus, 2006).

The *Social Skills Improvement Scale (SSIS)* provides a broad, multi-rater assessment of student social behaviors that can affect teacher-student relations, peer acceptance, and academic performance. The SSIS assesses the domains of social skills, problem behavior, and academic competence. Teacher and parent forms are available for three developmental levels: preschool,

Grades kindergarten through 6, and Grades 7 through 12 and takes 10-25 minutes to complete (Crowe, Beauchamp, Catroppa, & Anderson, 2011). A previous version of the SSIS, The Social Skills Rating System (SSRS), was created to address social skills and was standardized for a sample of over 4000 children without disabilities (Gresham, Elliott, & Kettler, 2010). This social skills measure has good reliability and validity as a comprehensive assessment tool for measuring social skills (Gresham et al., 2010). It covers social behaviors such as cooperation, assertion, responsibility, self-control, and empathy (Gresham et al., 2010). It is also one of the most popular measures in comparison to other social skills assessments available for use with school-aged populations because of its comprehensive nature and user-friendly format (Crowe et al., 2011). While this measure has not been used in pediatric non-epileptic seizures, the SSRS version was used in pediatric epilepsy populations which showed children with epilepsy to have poorer SSRS total scores compared to healthy controls but not to children with other chronic diseases (Hamiwka, Hamiwka, Sherman, & Wirrell, 2011).

The scales of interest to be included in data analyses include the Social Skills Scale on the Parent and Student Forms. Similar to the BASC-2 Parent Adaptive Skills Composite, this Scale is a combination of multiple subscales which address a wide variety of social skills. On both the Parent and Student forms this Social Skills Scale includes the following subscales: Communication (i.e., ability to interchange thoughts, opinions, information with others), Cooperation (i.e., willingness to work or acting together for a common goal), Assertion (i.e., the ability to stick up for oneself or for what is right), Responsibility (i.e., the ability to make moral or rational decisions alone), Empathy (i.e., the ability to identify or understand another's feelings, thoughts, motives, etc.), Engagement (i.e., involvement in an activity with others), and Self-Control (i.e., the control of one's actions or feelings) (Gresham & Elliott, 2008).

Executive Functioning Measure

Executive functioning consists of cognitive and behavioral skills that are responsible for purposeful, goal-directed activity that includes social interaction (Hocking et al., 2011). One theory of executive function states that behavioral inhibition underlies executive functioning, thus the development of behavior inhibition is necessary for neuropsychological abilities to function properly (Barkley, 1997).

The *Behavior Rating Inventory of Executive Function (BRIEF)* is an 86-item questionnaire which assesses executive functions such as planning and organization, initiation, attention, problem-solving, and skills related to emotional regulation. Both the self-report form as well as the parent/caregiver form was administered. This measure takes 10-15 minutes to complete (Gioia, 2000). Research has shown that the BRIEF can identify individuals with behavioral difficulties in addition to deficits in executive functioning with high validity and reliability (Gioia, 2000). Studies utilizing the BRIEF have suggested a substantial portion of children with epilepsy have greater executive difficulties compared to their healthy peers (Parrish et al., 2007; Slick, Lautzenhiser, Sherman, & Eyrl, 2006). No known research has examined the BRIEF in a pediatric NES population. In adult epileptic and non-epileptic patients, there are no differences between the subjective measure of the BRIEF and objective assessment of attention, concentration, or executive ability ($p=.93$) (Fargo et al., 2004). This study will utilize the BRIEF to measure executive abilities, including attention, in children with non-epileptic seizures compared to children with epilepsy. Specifically, data analyses utilized the Behavioral Regulation Index (BRI) and the Metacognition Index (MI) on parent and self-report. The BRI measures one's ability to "shift and modulate emotions and behaviors through appropriate inhibitory control" (Gioia, 2000, p. 20). The MI measures one's ability to self-manage tasks;

reflecting an ability to monitor oneself and actively problem solve in multiple contexts (Gioia, 2000).

Data Analysis

Data Screening/Cleaning

Data was screened for invalid responses including overly negative or inconsistent responses, along with missing values and data entry errors. There were six variables of interest to be explored out of 43 cases. Out of those 43 total cases, 12 cases were missing measures of the BASC-2 Self Report Interpersonal Relationships, 20 cases were missing both from the BRIEF Self-Report Behavioral Regulation Index and Metacognition Index, and 11 were missing from the SSIS Student-Form Social Skills Scale. After physically examining the data, it was determined that these cases were not missing due to data entry errors. Notably, the high rates of missing scores were all in self-report measures. There are several potential reasons for the high rate of missing self-report measures including fatigue or drowsiness due to medications, an inability to complete the forms before discharge, lack of motivation, or an inability to comprehend directions. Although there were several missing cases, when a missing value analysis was run using SPSS, Little's MCAR test indicated $p = .471$. (chi-square = 34.934, df = 35). Since $p > .05$, it can be concluded that the data missing was at random; however, since N was small, it was decided that pairwise deletion would be the best option in order to include as many cases as possible.

Next, tests of normality were run. Due to the small sample size, the distribution shape via histograms was not relied upon, as this is often not a good approximation to normal in small samples (Warner, 2008). Instead, normality was determined from the Shapiro-Wilk Test, which showed that the assumption of normality was not violated for the variables of interest in the

epilepsy group; however, the assumption of normality was violated in the NES group for the BRIEF Self-Report Behavioral Regulation Index (p = .017) and BRIEF Self-Report Metacognition Index (p = .045). Then, both NES and ES groups were screened for outliers. The ES group had one outlier (>3 SD below) on the BASC-2 Self-Report Interpersonal Relations. In the NES group, one individual was greater than three standard deviations below on the BRIEF Self-Report BRI and the BRIEF Self-Report Metacognition Index. A winsorized variance approach was implemented on the data, as it is more resistant to outliers than the variance is (Erceg-Hurn & Mirosevich, 2008) and unlike trimming, it would preserve more cases. After winsorizing was completed, the tests of normality were again run. This time, the assumption of normality was met for both ES and NES groups (p > .05). The winsorized data was used in all subsequent data analyses.

Results

The first aim of the study was to determine if diagnosis could be predicted by social skill measures. In order to evaluate how well a diagnosis of epilepsy or NES could be predicted from social skills, a binomial logistic regression was performed. Since it is recommended to have approximately 50 cases per predictor in logistic regression (Warner, 2008), the original hypotheses consisting of four measures of social skills was not used. When a correlation was completed, it showed that the subscales of interest on the BASC-2 (i.e., Adaptive Skills Composite and Interpersonal Relations) were significantly correlated with the SSIS Social Skills scores (p < .05). In addition, the Social Skills scores on the parent and student forms were significantly correlated (p < .001). This was an important consideration because 25.6% of the SSIS Student-Form Social Skills scores were missing compared to 2.3 % from the SSIS Parent-Form. Based on the results of the correlation in conjunction with the number of missing cases

among measures, it was decided to run two regression analyses, one with only the SSIS Parent-Form Social Skills scores and gender and one looking at the BASC-2 Parent-Form Adaptive Skills scores and gender. In the first regression looking at the SSIS Social Skills and gender, a test of the full model against a constant only model was not statistically significant, indicating that the predictors as a set did not reliably distinguish between epileptic and non-epileptic seizures ($\chi^2(2) = .966$, $p = .617$). Nagelkerke's R^2 of .032 indicated a weak relationship between prediction and grouping. Prediction success overall was 66.7% (100% for epilepsy and 0% for NES). The Wald criterion demonstrated that neither gender nor SSIS Social Skills scores made a significant contribution to prediction ($p > .05$). In the second regression looking at the BASC-2 Adaptive Skills and gender, a test of the full model against the constant only model was also not statistically significant, indicating that these predictors as a set did not reliably distinguish between epileptic and non-epileptic seizures ($\chi^2(2) = 2.265$, $p = .322$). Nagelkerke's R^2 of .074 indicated a weak relationship between prediction and grouping. Prediction success overall was 58.5% (80.8% for epilepsy and 20% for NES). The Wald criterion demonstrated that neither gender nor BASC-2 Adaptive Skills scores made a significant contribution to prediction ($p > .05$).

The second aim of the study was to determine if there were group differences on social skill and executive measures between children diagnosed with epilepsy and children diagnosed with NES. To test for group differences, data was first analyzed using independent t-tests to identify mean differences between children with NES and ES on measures of social skills (i.e., SSIS Social Skills Scale on the parent and student form, BASC-2 Adaptive Skills Composite, and BASC-2 Interpersonal Relations Scale). As previously mentioned, data was first screened and outliers were winsorized. For all measures, the assumption of homogeneity of variance indicated

no significant violation of the equal variance assumption as assessed by the Levene test ($p > .05$). Analyses used pairwise deletion in order to preserve as many cases as possible. Results indicated the mean scores did not differ significantly on any of the social skills measures between groups; however, the effect size for this analysis was of moderate size for Adaptive Skills ($d = .334$) and even larger for Interpersonal Relations ($d = .725$) based on Cohen's standard (See Table 2) (Warner, 2008). Post-hoc analysis was also run excluding the three possible "mixed" NES children, and results remained non-significant between groups ($p > .05$). These results suggest that select measures of social skills may not differ for children diagnosed with epilepsy compared to children diagnosed with non-epileptic seizures.

Although there were no significant group differences, in comparison to normative data the epilepsy group social skills were rated in the below average range on the BASC-2 and SSIS on parent-report forms while children with epilepsy reported their social skills to be in the average range on the BASC-2 and SSIS. In contrast, both parent and self-report on the BASC-2 for children with NES indicated average range of functioning, but on the SSIS the parents of children with NES rated their children in the below average range for social skills while the children rated themselves in the average range.

Table 2

Independent T-test Results and Effect Sizes for Social Skills

	N		Mean (SD)					
	ES	NES	ES	NES	*t*	df	*p*	*d*
Measure								
Parent Ratings								
Adaptive Skills[1]	26	15	39.54(14.08)	43.87(11.72)	-4.328	39	.321	.334
Social Skills[2]	28	14	81.18(21.03)	83.36(20.33)	-2.179	40	.751	.105
Child Ratings								
Interpersonal[1]	22	9	49.59(9.42)	42.00(11.42)	7.591	29	.065	.725
Social Skills[2]	22	10	91.55(15.52)	93.50(11.61)	-1.955	30	.725	.142

Note. N=sample size; SD= standard deviation; [1]=T-score; [2]=standard score; ES=epilepsy diagnosis; NES= non-epileptic seizure diagnosis; p values for Equality of Mean is two-tailed; Adaptive Skills=Adaptive Skills Composite on BASC-2 Parent Form; Social Skills= Social Skills Score on the SSIS Parent and Student From respectively; Interpersonal= Interpersonal Relations T-score on the BASC-2 Self-Report Form

Next, data was analyzed using independent t-tests to identify mean group differences between children with NES and ES on measures of executive functioning (i.e., the BRIEF Metacognition Index and Behavioral Regulation Index). Results showed all scores to be within the average range with no significant mean differences between epileptic and NES groups (See Table 3). Even though there were no significant differences between groups, the effect sizes for the BRI (d = .352) and MI (d = .582) on the BRIEF Self-Report were found to correspond to Cohen's convention for a moderate effect (Warner, 2008). Results also remained non-significant

when the three possible “mixed” NES children were excluded in analyses ($p > .05$). Therefore, the hypothesis that children with NES would have lower social skill and executive functioning scores than children with epilepsy was rejected.

Table 3

Independent T-test Results and Effect Sizes for Executive Functioning

	N		Mean (SD)					
	ES	NES	ES	NES	*t*	df	*p*	*d*
Measure								
BRIEF Parent								
BRI	26	14	65.08(15.43)	62.79(13.51)	2.291	38	.643	.158
MI	26	14	61.88(11.94)	59.71(10.82)	2.170	38	.575	.190
BRIEF Self								
BRI	14	9	60.29(10.99)	63.44(6.27)	-3.159	21	.444	.352
MI	14	9	57.21(8.91)	61.67(6.16)	-4.452	21	.206	.582

Note. N=sample size; SD= standard deviation; ES=epilepsy diagnosis; NES= non-epileptic seizure diagnosis; p values for Equality of Mean is two-tailed *BRI*= Behavioral Regulation Index; *MI*= Metacognition Index; All scores for BRI and MI are T-scores.

The final aim of the study was to determine if social skills were associated with executive functioning. In order to test the hypothesis that social skills would correlate with executive functioning, a correlation was performed between executive functioning measures (i.e., the BRIEF Metacognition Index and Behavioral Regulation Index), and social skills scores (i.e., SSIS Social Skills Scale, BASC-2 Adaptive Skills Composite, and the BASC-2 Interpersonal Relations Scale). Parent ratings of executive functioning were first examined. Results showed the BRI from the BRIEF Parent-Form significantly correlated with the Social Skills Scale on the SSIS Parent-Form (r = -.54, p = .000), the ASC (r = -.59, p = .000), and the Interpersonal Relations Scale (r = -.44, p = .017). It did not significantly correlate with the Social Skills Scale

form the SSIS Student-Form (r = -.31, p = .098). Similarly, the MI from the BRIEF Parent-Form significantly correlated with the Social Skills Scale on the SSIS Parent-Form (r = -.41, p = .008), the ASC (r = -.62, p = .000), and the Interpersonal Relations Scale (r = -.39, p = .036), but it did not significantly correlate with the Social Skills Scale on the SSIS Student-Form (r = -.14, p = .461). These findings show parent ratings of executive functioning are significantly correlated with social skills measures, except with child-rated social skills as measured by the SSIS.

Second, child's ratings of executive functioning were correlated with social skill measures. The BRI from the BRIEF Self-Report form significantly correlated with the Social Skills Scale on the SSIS Parent-Form (r = -.45, p = .033), the SSIS Student-Form (r = -.43, p = .043), and the Interpersonal Relations Scale (r = -.63, p = .001), but not with the ASC (r = -.39, p = .078). The MI from the BRIEF Self-Report form significantly correlated with the ASC (r = -.43, p = .051) and the Interpersonal Relations Scale (r = -.47, p = .023), but not on either parent or student form of the SSIS (p > .05). Overall, results indicated differences between self-reported executive functioning, with the BRI but not the MI correlating to social skills, as measured by the SSIS.

Further analyses were done between executive functioning and social skills measures as broken down by NES or epilepsy diagnosis. Results are outlined in Table 4 and 5. Results showed that the Behavioral Regulation Index (BRI) on the parent form of the BRIEF significantly correlated with ASC and parent-rated Social Skills for both epileptic and NES groups (p < .05). Specifically, for the epilepsy group there was a strong, negative correlation (r = -.55, p = .006) between BRI and ASC, suggesting that worse executive functioning (i.e., behavioral regulation), correlates with fewer reported adaptive social skills. In the epilepsy group, there was also a moderate, negative correlation (r = -.44, p = .026) between BRI and Social Skills, suggesting that worse behavioral regulation is correlated with worse social skills.

Similarly, for the NES group, there was a significant (p = .005) strong, negative correlation (r = -.70) on BRI and ASC and a significant (p = .001) strong, negative correlation (r = -.78) on BRI and Social Skills, indicating that regardless of diagnosis, worse executive functioning correlates with worse social skills.

Another aspect of executive functioning (i.e., self-monitoring) was examined through the Metacognition Index (MI) on the BRIEF. The MI on the BRIEF Parent-Form significantly correlated with ASC (p = .001) and Social Skills (p = .019) on the parent rating forms for the epileptic group, but only the ASC for NES group (p = .026). These were all strong, negative correlations (r = -.50 or greater), suggesting that worse self-monitoring also correlates with worse social skill abilities. In contrast, when children completed the BRIEF, MI only significantly correlated with parent's ratings of ASC (p = .048) and self-rated Interpersonal Relations (p = .035) for children with a diagnosis of epilepsy, but not NES.

Overall, both measures of social skills (i.e., BASC-2 and SSIS) indicated a significant correlation with executive functioning, where parent reports of poor behavioral regulation correlated with parent reports of fewer social skill abilities in children with epilepsy and NES. Interestingly, neither the BRI nor the MI on both parent and self-report forms significantly correlated with the SSIS student ratings of social skills for ES or NES groups (p > .05). This stands in contrast to correlations found between parent ratings of executive functioning and parent ratings of social skills on the SSIS in ES and NES groups, therefore suggesting differences between child and parent observations.

Table 4

Correlations between Executive Functioning and Social Skills Measures for Epilepsy Group

	BRIEF Parent						BRIEF Self					
	BRI			*MI*			*BRI*			*MI*		
	N	*r*	*p*	N	*r*	*P*	N	*r*	*p*	N	*r*	*p*
Parent Rating												
Adaptive Skills	20	-.55	.006**	24	-.64	.001**	12	-.55	.063	12	-.58	.048*
Social Skills	26	-.44	.026*	26	-.46	.019*	14	-.45	.110	14	-.44	.120
Child Rating												
Interpersonal	29	-.44	.017*	20	-.47	.037*	14	-.62	.017*	14	-.57	.035*
Social Skills	30	-.31	.098	20	-.17	.474	14	-.40	.153	14	-.44	.118

Note. * $p < .05$; ** $p < .01$; *BRI*=Behavioral Regulation Index; *MI*=Metacognition Index; BRIEF = Behavioral Rating Inventory of Executive Function; Adaptive Skills=Adaptive Skills Composite on BASC-2 Parent Form; Social Skills= Social Skills Score on the SSIS Parent and Student From respectively; IP Relation= Interpersonal Relations T-score on the BASC-2 Self-Report Form. Parent and child Social Skill scores are standard scores; all other scores are T-Scores.

Table 5

Correlations between Executive Functioning and Social Skills Measures for Non-Epileptic Group

	BRIEF Parent						BRIEF Self					
	BRI			*MI*			*BRI*			*MI*		
	N	*r*	*p*	N	*r*	*P*	N	*r*	*p*	N	*r*	*p*
Parent Rating												
Adaptive Skills	14	-.70	.005**	14	-.59	.026*	9	-.22	.570	9	-.42	.236
Social Skills	14	-.78	.001**	14	-.29	.309	9	-.62	.078	9	-.083	.831
Child Rating												
Interpersonal	9	-.53	.139	9	-.30	.433	9	-.66	.054*	9	-.15	.698
Social Skills	10	-.18	.612	10	-.06	.862	9	-.64	.064	9	-.039	.921

Note. * $p < .05$; ** $p < .01$; *BRI*=Behavioral Regulation Index; *MI*=Metacognition Index; BRIEF = Behavioral Rating Inventory of Executive Function; Adaptive Skills=Adaptive Skills Composite on BASC-2 Parent Form; Social Skills= Social Skills Score on the SSIS Parent and Student From respectively; IP Relation= Interpersonal Relations T-score on the BASC-2 Self-Report Form. Parent and child Social Skill scores are standard scores; all other scores are T-Scores.

Thus, although significant correlations existed between executive functioning (i.e., BRIEF) and social skills measures (i.e., SSIS and BASC-2) confirming the study's hypothesis, distinctions were apparent when results were evaluated based on diagnostic group. Since executive functioning and social skills were correlated, further analyses were done to examine if social skill scores predicted executive functioning scores. Initial variables of interest included the SSIS Parent-Form Social Skills Scale predicting executive functioning as measured by the BRIEF Parent-Form (i.e., BRI and MI indices), while controlling for demographic variables such as age and gender; however, when a correlation was conducted, gender was not correlated with the other potential explanatory variables ($p > .05$), therefore it was not included in the regression model. Table 6 summarizes the descriptive statistics and analysis results. The multiple regression model with all three predictors produced $R^2 = .422$, $F\ (3, 36) = 8.76$, $p < .001$. As can be seen in Table 6, the BRI had significant negative regression weights, indicating children with higher scores on this scale (i.e., worse behavioral regulation) had lower SSIS Social Skill scores (i.e., worse social skills), after controlling for the other variables in the model. Age of the child at time of testing had a significant positive regression weight, indicating older children were expected to have greater social skill scores. The Metacognition Index was the only variable that did not significantly contribute to the model ($p = .884$).

Table 6

Summary Statistics, Correlations and Results from Regression Analysis Predicting SSIS Social Skills

Variable	Mean	SD	B	*p*
BRIEF BRI	64.28	14.65	-.412	.037*
BRIEF MI	61.13	11.47	-.027	.884
Age	6.99	5.02	.374	.008**

Note. Behavioral Regulation Index (BRI), Metacognition Index (MI)
* $p < 05$, ** $p < .01$

Discussion

The intention of this study was to examine and describe relationships between social skills and executive functioning among children with epileptic or non-epileptic seizures (NES). Video-EEG (V-EEG) is the current diagnostic gold standard in diagnosing epilepsy and NES (Cragar et al., 2002). Unfortunately, V-EEG is often unable to distinguish between epilepsy and NES due to uncaptured spells or interictal abnormalities while the patient is being monitored (Cragar et al., 2002). While V-EEG may correctly classify upward to 73% of patients (Mohan, Markand, & Salanova, 1996), there remains a possibility of epilepsy existing despite normal EEG recordings and NES existing despite the presence of abnormal EEG recordings (Boon & Williamson, 1993; Cragar et al., 2002). In addition, V-EEG is more costly, labor intensive, and not always widely available in clinical settings (Cragar et al., 2002). Due to the limitations associated with obtaining a diagnosis of epilepsy or NES through video-EEG, research has sought to identify additional measures that may assist in reliably distinguishing between these groups. Prior research has attempted to identify the utility of different techniques in discriminating between groups, including Single Photon Emission Computed Tomography

(SPECT) and seizure semiology classification (Cragar et al., 2002). Although seizure semiology studies show individuals with NES to typically have longer spells accompanied by pelvic thrusting and closed eyes, methodological concerns, such as lack of blind and multiple raters and differences between studies in definitions of behavioral characteristics of interest, exist (Cragar et al., 2002; DeToledo & Ramsay, 1996; Devinsky et al., 1996; Hill & Gale, 2011). SPECT studies also suggest differences between NES and epilepsy populations, with NES patients rarely having abnormal ictal SPECT results; however, the cost and the use of radioactive materials are significant weaknesses associated with this procedure (Cragar et al., 2002; Ettinger et al., 1998; Varma et al., 1996). Potential differences in factors between groups including neuropathology, psychological co-morbidity, poor effort on cognitive testing, and cognitive testing profiles have also been examined, but have not assisted in differential diagnosis between epileptic and NES populations (Baslet, 2011; Cragar et al., 2002; Dodrill, 2008; Fargo et al., 2004). An area that has lacked attention is group differences in social skills, which was the focus of this study. Although research has shown both NES and epilepsy populations have worse social outcome compared to healthy individuals (LaGreca, 1990; Reuber et al., 2003; Sri et al., 2008), the possibility that social skills may differentiate between these groups has not been previously researched. Thus, this study attempted to predict diagnosis based on social skill measures using the BASC-2 and SSIS. Unfortunately, results from the regression analyses did not show social skills to be a useful predictor of epilepsy or NES diagnosis.

Although group membership could not be predicted, it was still hypothesized that differences may exist on social skills and executive functioning measures between children with epileptic or non-epileptic seizures. It has been speculated that patients with epilepsy will have greater cognitive dysfunction on neuropsychological measures due to the organic underpinnings

of their disorder compared to patients with non-epileptic seizures (NES), which may have greater psychological components (Cragar et al., 2002). This study sought to evaluate cognitive dysfunction using the Behavior Rating Inventory of Executive Functioning (BRIEF), a survey of executive functioning. Although it was hypothesized that children with epilepsy would have worse reported executive functioning, data analysis revealed that there were no significant group differences between epileptic and NES groups. Previous research on executive functioning is mixed, with some studies showing epileptic patients perform worse on executive functioning measures compared to NES patients (Dodrill & Holmes, 2002), while others show no significant differences in adult populations (Binder et al., 1998; Cragar et al., 2002; Smith, Saykin, Riordan, Flashman, & Williamson, 1997). Despite mixed results between groups, the majority of studies illustrate impaired executive functioning for NES and epileptic adult populations when compared to healthy controls (Cragar et al., 2002; LaFrance, 2008; Strutt et al., 2011). Notably, these comparison studies use neuropsychological batteries, such as the Halstead-Reitan Test Battery, Trailmaking Test, and Wisconsin Card Sorting Test, to measure executive dysfunction. This study contributes to research by exploring performance on a survey measure of executive functioning, which can be completed quickly by the patient or their parent/caretaker without formal neuropsychological testing. Results obtained from the survey of executive functioning were consistent with results from studies using neurocognitive batteries, namely that neuropsychological performance does not distinguish between epileptic and NES groups (Cragar et al., 2002). However, caution should be taken when interpreting the current results due to the small sample size, which limited power. Notably, there were moderate effect sizes on the BRI and MI of the BRIEF Self-Report with children diagnosed with NES reporting worse behavioral regulation and self-monitoring than children diagnosed with epilepsy. Thus, with a larger

sample size, it is possible that group differences will be detected on this executive functioning measure.

Notably, unlike findings from neuropsychological batteries measuring executive functioning (Cragar et al., 2002; Parrish et al., 2007; Slick et al., 2006), the results from the BRIEF did not show clinical impairment for either the NES or epileptic group; instead, both parent and self-report measures placed children with NES or epilepsy within the average range of functioning. Although some research has concluded that no differences exist between the BRIEF and other neuropsychological assessments of executive functioning in adult epileptic and non-epileptic patients (Fargo et al., 2004), the reliance on observation and subjective judgment required by surveys may explain these results. Future research could include cognitive tests with surveys to better evaluate the presence of executive functioning impairment and detect any inconsistencies between measures.

Executive functioning specifically between pediatric epileptic and NES populations has not been previously explored. Developmental factors associated with pediatric populations may contribute to our lack of evidence for group differences or clinical impairment on executive functioning. Plasticity is the ability of a developing brain to adapt to demands or circumstances by adjusting and reorganizing neural networks to restore functioning after these systems have been disrupted (Stiles, Reilly, & Trauner, 2012). Children with epilepsy can have subtle changes in their brains including thickening of cortical gray matter, non-uniform density of cortical regions, and unclear distinctions between gray and white matter (Sarnat & Flores-Sarnat, 2013, Chapter 44). More microscopic cortical architectures cannot be detected by neuroimaging and are only confirmed by neuropathological examination of resected brain tissue (Sarnat & Flores-Sarnat, 2013, Chapter 44). Even when notable lesions and cortical changes are detected and

epilepsy surgery is performed in children, not all children retain or regain functioning (Roulet-Perez et al., 2010). Thus, it is possible that children with seizures and interictal discharges may incur undetectable damage in brain structures and neural networks that prompts a functional re-organization of cortical systems to adapt to impaired systems (Roulet-Perez et al., 2010). This adaptation may not be developmentally uniform, making it difficult to determine its potential effect on cognitive performance in this population.

Another area of functioning that was not previously researched was social functioning in pediatric NES and epileptic populations. Results from this study did not show significant group differences on social skills; however, there were moderate effect sizes for Adaptive Skills and Interpersonal Relations. Furthermore, even though Interpersonal Relations did not reach statistical significance ($p = .065$), it did show a trend for children with NES to report more strain in interacting with peers than children with epilepsy, which is consistent with research showing children at NES to be particularly at risk for interpersonal stressors (Reilly, Menlove, Fenton, & Das, 2013). Therefore, given the moderate effect size and near statistically significant result, it is likely that increasing the sample size would result in statistical significance. Notably, both parents of children with epilepsy and parents of children with NES, rated their children as having below average social skills, while children perceived their social skills as average compared to their peers. This finding replicates previous research that found parents of children with epilepsy rated their child's social skills on the SSIS as lower than their healthy siblings, while children with epilepsy rated their own social skills in the average range (Tse, Hamiwka, Sherman, & Wirrell, 2007). This may indicate a lack of awareness over social deficits among children with epilepsy and NES. Future research is needed to replicate these findings. In addition, it would be beneficial to include observational ratings and other measures of social skills by an examiner in

addition to parent and child reports. Doing so may reveal common and specific social skill deficits that can then be addressed through intervention. Replicating the differences between child and parent behavior survey responses would also give further credence to the idea that children may be less aware or able to perceive their deficits compared to their parents.

Finally, this study was interested in associations between executive functioning and social skills. The findings supported the initial hypothesis that these two domains (i.e., executive functioning and social skills) significantly correlate. Specifically, for children diagnosed with epilepsy, both parent and self-reports on the BRIEF Metacognition Index, a measure of self-monitoring, significantly correlated with BASC-2 Adaptive Skills scores (i.e., behaviors including emotional expression and control, daily living and communication skills in and outside of the home). The same correlation existed for children with NES among parental ratings of executive functioning and Adaptive Skills. Additionally, both parent and self-reports on the BRIEF Behavioral Regulation Index (BRI), a measure of inhibitory control and ability to shift, significantly correlated with parental SSIS Social Skills scores for both epileptic and NES groups; however, this was not found for student SSIS Social Skills scores for both groups. As previously mentioned, the differences between self-reported executive functioning and social skills and parental reports of executive functioning and social skills may suggest differences in observational abilities or awareness. Nevertheless, overall results showed an association between executive functioning and social skill measures. This finding is supported by previous research that reveals an adverse relationship between impaired executive functioning and peer relationships (Nassau & Drotar, 1997; Gomes et al., 2012; Semrud-Clikeman & Wical, 1999). The deleterious relationship between lower executive functioning and social functioning has been specifically shown in children with epilepsy (Baum et al., 2010; Drewel et al., 2009),

although the research on pediatric NES populations is lacking. For these reasons, this study examined whether executive functioning scores predicted social skill scores. Results of the analyses indicated that children with higher scores on the BRI (i.e., worse behavioral regulation) had lower SSIS Social Skill scores, but MI was not a significant predictor of social skills. Abilities covered by the BRI include shifting and regulating emotions and behaviors, specifically through inhibitory control (Gioia, 2000). In comparison, the MI mainly measures an ability to self-manage tasks (Gioia, 200). It should not be assumed based on the results that self-management does not play a role in social functioning. Indeed, self-management and monitoring are arguably important abilities needed to productively and efficiently engage in tasks and relationships. But, MI may impact fewer social skill domains than BRI. The Social Skill scale utilized in this study was from the SSIS, which includes numerous social domains including Communication, Cooperation, Assertion, Responsibility, Empathy, Engagement, and Self-Control scores. Perhaps the findings showed behavioral regulation to predict social skills because it encompasses a broader range of executive ability, including self-monitoring aspects, which affect more of these domains than self-monitoring alone does.

Limitations

Due to this study's small sample size, results should be interpreted with caution and replication studies should be completed. Although the overall N for this study is small, this number is consistent with prior research, which typically uses sample sizes of 20 patients for NES and epilepsy groups; furthermore, many have published results with as few as 10 participants per group (Cragar et al., 2002). Since no similar studies were conducted looking at group comparisons on social skills and executive functioning in children with epilepsy and NES, there was no known population effect size. For the present study to have a power of .80, it

would require approximately 17 participants in each group giving us a population effect size of .20 (η = .20) (Cohen, 1977). Maintaining an estimated η = .20, the 15 participants in our NES group corresponds to power of .75 (Cohen, 1977). It will be beneficial for future research to include a larger sample size of epileptic and NES groups in order to increase statistical power and decrease the risk of committing a Type II error.

In addition, a larger sample size will provide the ability to examine group differences on various levels not explored in this study. This could help identify if the existence of variations within groups, such as seizure type and semiology, influence cognitive or social functioning. One study showed children with generalized seizures had significantly more behavioral problems as reported on the CBCL than children with focal seizures, of either the simple partial or complex partial type (Moci, 2007). In addition, children with intractable epilepsy had lower levels of intellectual functioning that was significantly associated with behavioral problems (Moci, 2007). Consequently, depending on the type of epileptic seizure, different brain regions may be affected which may potentially contribute to diverse outcomes. For the present study, the most frequent seizure type was generalized (N=12) followed by complex partial (N=5), but several participants within these groups also experienced absence seizures or co-morbid presentations. Still, the more populous generalized seizure type within this study could have contributed to the markedly below average social skills scores on the SSIS noted by parents.

Similarly, medication amount and AED side effects may also influence neuropsychological findings and should be included as a co-variable of interest in future research. There is conflicting research on group differences between epileptic and NES patients in regard to the amount of AED's patients are on, although generally it is expected that NES patients are on fewer AED's that epileptic patients (Cragar et al., 2002; Szaflarski, Ficker, Cahill,

& Privitera, 2000). Even if there are no significant group differences on the amount of AEDs, the presence of AEDs is common among both populations (Cragar et al., 2002). This is important since antiepileptic drugs can cause numerous side effects such as drowsiness, reduced vigilance, and psychomotor slowing which could affect cognitive testing (Chen et al, 2001; Cragar et al., 2002). Specific types of AED's may also create more adverse cognitive effects than others. For example, phenobarbital and benzodiazepines appear to have the most cognitive side effects among AED's (Loring & Meador, 2001). Compared to older AEDs such as carbamazepine, phenytoin, and valproate, newer AEDs such as gabapentin, lamotrigine, and tiagabine, show fewer cognitive side effects and minimal effects when compared with placebo (Loring & Meador, 2001). Therefore, it is important to note the medication status of participants in future research since cognitive side effects may alter neuropsychological results, blurring possible group differences when this is not factored in. Thus, a larger sample size would assist in parsing out within and between group differences on medication type and status.

In addition to obtaining larger sample sizes, methodological improvements could be made by identifying an additional comparison group of children with epilepsy plus NES. In this study, data was conservatively analyzed by comparing results when three children with possible co-morbid epilepsy and NES were included and excluded from the NES group. Although the results did not change with the inclusion of these participants, future research would ideally separate patients experiencing comorbid epilepsy and NES and run comparison analyses to children diagnosed only with epilepsy or with NES.

Conclusion

Cognitive and behavioral difficulties exist within pediatric epileptic and NES populations. It is important to understand when these problems occur and if there are

distinctions between groups in order to target treatment. This study found that social skills and executive functioning measures did not distinguish between groups, nor were social skills able to predict diagnostic group. But, interestingly, children in both ES and NES groups rated their social skills within the average range while their parents rated their social skills as impaired. It is possible that behavioral difficulties are more likely to be identified by parents, making it important to include parental behavioral ratings in neuropsychological batteries. Another contribution of this study was the recognition of positive correlations between executive functioning and social skill scores, and the finding that behavioral regulation significantly predicted social skills. As a result, it may be beneficial to include social skill measures when examining pediatric epileptic and NES populations as well as be cognizant of potential difficulties with skills such as interpersonal communication and cooperation, engagement in activities or with others, and ability to control emotions, when executive functioning is impaired.

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