University of Cincinnati

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I, Shawna N Jacob M.A., hereby submit this original work as part of the requirements for the degree of Doctor of Philosophy in Psychology.

It is entitled:

Neurocognitive Functioning and Coping in Patients with Epilepsy

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Neurocognitive Functioning and Coping in Patients with Epilepsy

A dissertation submitted to the Graduate School

of the University of Cincinnati

in partial fulfillment of the

requirements for the degree of

Doctor of Philosophy

in the Department of Psychology

of the College of Arts and Sciences

by

Shawna N. Jacob, M.A.

University of Cincinnati, 2013

Committee Chair: Paula K. Shear, Ph.D.
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Abstract

The goal of this study was to investigate the cognitive, disease, and demographic predictors of the coping strategies employed by patients with epilepsy. It was hypothesized that poorer executive functioning would predict less frequent use of engagement and more frequent use of disengagement coping strategies, even after accounting for the prominent memory deficits that are common in patients with epilepsy. Additionally, we hypothesized that greater seizure severity, longer disease duration, and the presence of abnormal interictal EEG activity would predict less engagement and more disengagement coping strategies. Finally, females were expected to report lower reliance on engagement coping relative to their male counterparts. Participants were 46 inpatients and outpatients with neurologist-confirmed epilepsy, recruited from the Cincinnati Epilepsy Center at the University of Cincinnati Medical Center. Participants were recruited through two streams. First, individuals referred for clinical neuropsychological evaluation were either re-contacted and completed the Coping Strategies Inventory- Short Form (CSI-S) over the phone or were approached at the time of their clinical evaluation and completed the questionnaire in person. The second recruitment stream consisted of individuals who were recruited from the Cincinnati Epilepsy Center outpatient clinic who had not been referred for clinical neuropsychological assessment, and they completed a brief battery of neuropsychological tests and the CSI-S during a single study visit. When the entire sample was considered together, the main hypothesis was not confirmed. However, in the subset of patients with temporal lobe epilepsy (n = 31), better executive functioning was a significant predictor of the increased use of active, problem focused coping, independent of the contributions of memory, disease-related variables, and use of other coping strategies (all p < .05). In addition to the relationship between executive functioning and problem focused engagement coping, visual
learning and memory was a significant predictor of increased emotion focused engagement coping, above and beyond executive functioning, disease variables, and use of other coping strategies (all $p < .05$). Poorer executive functioning was not related to increased reliance on disengagement coping ($p < .05$). The second hypothesis was partially confirmed in the entire sample in that women reported significantly more reliance on emotion-focused engagement and problem focused disengagement coping ($p < .05$) than men. Seizure severity, disease duration, and the presence of interictal EEG activity were not significant predictors of coping in patients with epilepsy (all $p > .05$).
Acknowledgements

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Chapter 1: Introduction

Epilepsy affects approximately two million individuals in the United States and is associated with a $15.5 billion annual cost of care (Centers for Disease Control and Prevention, 2011). In addition to seizures, patients with epilepsy face a number of disease-related and psychosocial stressors that impact their daily lives, such as seizure worry and limitations on employment and driving (Jehi, Tesar, Obuchowski, Novak, & Najm, 2011), and they are at disproportionate risk to experience cognitive dysfunction. There is limited but provocative evidence within the epilepsy literature that the quality of psychosocial outcomes in this population is related in part to the presence of specific coping strategies (Goldstein, Holland, Soteriou, & Mellers, 2005; Krakow, Buhler, & Haltenhof, 1999; Livneh, Wilson, Duchesneau, & Antonak, 2001; Oosterhuis, 1998; Piazinni, et al., 2007; Westerhuis, Zijmans, Fischer, van Andel, & Leijten, 2011; Upton & Thompson, 1992). In addition, research in other populations suggests that the presence of cognitive deficits may interfere with one’s ability to implement positive coping strategies. The present study is the first to examine the cognitive, disease-related, and demographic predictors of coping strategies among patients with epilepsy. This introduction will provide a brief background on coping research in general and then describe the literature on coping in patients with epilepsy and on the relationship between cognitive functioning and coping.

Coping Theory

Coping has been studied extensively for the past several decades. A challenge in summarizing this literature is that researchers have proposed a large number of different theories, several of which overlap conceptually and yet use differing terminology. Early coping research
was centered on an ego psychology perspective, which emphasized the role of unconscious processes in coping with stress (e.g., Valliant, 1977). This perspective focused mainly on the use of psychological defenses to reduce emotional distress but did not take into account the role of more conscious processes, such as problem solving, in coping with stress (Folkman & Lazarus, 1980). Other researchers hypothesized that coping is more of a dispositional or trait-dependent construct (Carver, Scheier, & Weintraub, 1989), an approach that does not account for the possibility that an individual’s coping response could be in part dependent on the situation at hand.

Early work by Richard Lazarus and Susan Folkman conceptualized coping from a cognitive and behavioral perspective. These authors theorized that coping reflects the individual’s appraisal of the situation, appraisal of his or her own ability to cope with the situation, and actual response to the situation (Folkman & Lazarus, 1980; Lazarus and Folkman, 1984). Later theories have focused on an individual’s ability to modify coping responses according to specific situational demands (Lester, Smart, & Baum, 1994). A related theory of coping that has been applied often in populations with chronic illness is the “goodness of fit hypothesis.” This hypothesis suggests that problem-focused coping strategies (i.e., those that directly address the problem that is causing distress) are preferred when stressors are appraised as controllable, whereas emotion-focused strategies (i.e., those that are directed towards palliating negative emotions) may be preferable in managing uncontrollable stressors (Conway & Terry, 1992).

Many coping researchers have acknowledged that labeling coping as adaptive or maladaptive is too simplistic, and they have studied coping from problem/emotion-focused perspectives (e.g., efforts to problem solve versus efforts to palliate emotional responses) and
approach/avoidant perspectives (e.g., addressing the stressor head on versus avoiding thinking about the situation); however, such dichotomies may not capture all of the relevant aspects of the construct. In developing the Coping Strategies Inventory, which was applied in the present study, Tobin, Reynolds, & Wigul (1989) theorized that, at the simplest level, coping strategies can be characterized as engagement (efforts to actively address aspects of the stressful situation) or disengagement (efforts to disengage from or draw attention away from the stressor); each of these factors may include both problem and emotion focused strategies. For example, engagement coping can be problem focused (e.g., problem solving in a stressful situation) or emotion focused (e.g., intentional emotional expression to reduce stress). Similarly, disengagement coping can be problem focused (e.g., trying to push aside thoughts about the stressful situation) or emotion focused (e.g., self-criticism, social withdrawal). Working within this framework, the different coping strategies are not mutually exclusive; for example, one can implement both problem and emotion focused strategies in dealing with the same stressor.

There is extensive research on the coping strategies that individuals with chronic illness use when dealing with stressors that are illness-related (e.g., symptoms) or more general in nature (e.g., work). For example, patients with multiple sclerosis who applied problem focused coping to deal with stress that they perceived as being outside of their control exhibited significantly more symptoms of depression and anxiety than those who used meaning-focused coping (acceptance; looking for the good in the situation), consistent with the predictions of the goodness of fit hypothesis (Roubinov, Turner, & Williams, 2015). Other research has focused on comparisons between patient populations and healthy controls. In one study, patients with irritable bowel syndrome demonstrated a tendency to use both problem-focused and avoidance coping more often than healthy controls (Stanculate, Matu, Pojoga, & Dumitrascu, 2015). In the
same sample, increased use of avoidance was associated with poorer health related quality of life. The authors proposed that patients might increase their use of avoidant strategies to cope with uncontrollable symptoms, but that these same avoidant strategies can have negative implications for quality of life outcomes. For example, in those with irritable bowel syndrome, avoiding social situations alleviates stress related to experiencing symptoms in public but also limits healthy social interactions.

**Coping Strategies and Outcomes in Patients with Epilepsy**

Patients with focal epilepsy who rely more heavily on passive coping reactions (e.g., feeling discouraged and overwhelmed, withdrawing, escaping in fantasies) have been shown to have poorer self-reported mental components of quality of life (emotional role functioning, mental health, social functioning; Westerhuis, et al., 2011). Similarly, those with focal epilepsy who show increased use of denial and detachment coping strategies have significantly poorer psychosocial adjustment (Piazinni et al., 2007). Conversely, in the same sample, increased problem solving and efforts to seek social support are associated with better psychosocial adjustment (Piazinni, et al., 2007). Across studies including individuals with a range of epilepsy diagnoses and seizure types and frequencies, the use of more active, problem-focused coping is related to decreased levels of depression and anxiety and better social adjustment, while the use of more avoidance, wishful thinking, and detachment is related to more psychological complaints and poorer adjustment (Goldstein, et al., 2005; Krakow, et al., 1999; Oosterhuis, 1998; Snyder, 1991; Upton & Thompson, 1992). In sum, coping strategies that require active engagement with the stressor and associated emotions seem to be more adaptive in terms of quality of life and psychosocial outcomes. In contrast, reliance on disengagement from the stressor and associated emotions seem to increase risk for poorer quality of life and psychosocial outcomes.
Among patients experiencing seizure frequencies that were classified by the authors as low (generalized seizures once every six months to once a year) and medium (generalized seizures ranging from once per month to once every six months with relatively few absence seizures every day), those who were more resourceful [better able to self-regulate internal responses to stress such as emotions, pain, and cognitions, as measured by Rosenbaum’s Self-Control Schedule (Rosenbaum, 1980)], reported less depression and anxiety than their less resourceful counterparts (Rosebaum & Palmon; 1984). The more resourceful patients who experienced high frequencies of seizures (generalized seizures occurring once per week to once per month, with daily absence seizures) did not differ from their less resourceful counterparts in terms of anxiety or depression. This pattern suggests that, in the presence of frequent seizures, better ability to self-regulate internal responses to stress may not be a protective factor against depression and anxiety. Although causality cannot be inferred based on these findings, this study does illustrate the need for further investigation into the role of disease-related variables (e.g., seizure frequency) in coping with stress.

**Predictors of Coping Styles in Patients with Epilepsy**

The research on predictors of coping strategies in patients with epilepsy is limited, and the findings are not entirely consistent across studies. Krakow and colleagues (1999) investigated coping strategies, specifically in response to illness, in a sample of inpatients on an epilepsy unit with medically intractable partial and primary generalized epilepsy. Longer duration of epilepsy was related to lower levels of active and problem focused coping, and higher seizure frequency predicted lower levels of active, self-affirming coping and increased depressive coping (Krakow, et al., 1999). However, because the measure of coping used in this study was restricted to
response to illness, one cannot be sure that these findings would generalize to coping strategies in response to more general life stressors such as family conflict or workplace stress.

A related line of evidence is that, in coping with illness-related stressors, patients with intractable focal epilepsy were more likely to use denial and detachment coping strategies than their counterparts with well-controlled seizures (i.e., seizure-free for at least two years; Piazinni, et al., 2007). Furthermore, patients with well-controlled seizures tended to use more problem solving coping strategies than those with intractable epilepsy. These findings suggest that the presence of ongoing seizures predicts more disengagement coping strategies; however, the frequency of seizures in the intractable patient group ranged from two to 30 per month and was not taken into consideration, precluding inference regarding the relationship between frequency of seizures and coping in this sample (Piazinni, et al., 2007).

The findings that seizure frequency and disease duration were predictive of coping strategies in patients with intractable focal and primary generalized epilepsy were not replicated in studies that included patients with more varied diagnoses and degrees of seizure control (Bautista, et al., 2013, Mirnics, Bekes, Rozsa, & Halasz, 2001; Snyder, 1991; Upton & Thompson, 1992). Further, it is not clear whether other variables might be contributing to reduced coping abilities in these patients. Of particular interest for the present study was whether variables that change in the presence of ongoing and frequent seizures, such as cognitive functioning, are related to coping strategies.

Gender differences in coping with stress have been studied widely in healthy individuals. It has been suggested that men use more problem focused coping strategies, while women use more social support and emotion focused coping strategies (e.g., Ptacek, Smith, & Dodge, 1994). However, a meta-analytic review of 50 studies concluded that women actually used both
problem focused and emotion focused coping strategies more than their male counterparts (Tamres, Janicki, & Helgeson, 2002). Gender differences in coping strategies have also been demonstrated in patients with epilepsy. In a sample of inpatients on an epilepsy unit with intractable seizures, women with epilepsy were more likely than their male counterparts to report active, problem focused coping on a measure of coping with chronic illness (Krakow, et al., 1999). Taking a different approach, two studies compared the coping strategies in response to general life situations (i.e., not illness specific coping) of outpatients with epilepsy to those of the normative sample from the questionnaire manual. Men with epilepsy were more likely than the reference population of men to use more avoidant and palliative coping (e.g., seeking diversion, relaxing, trying to feel better by using substances), but they were also more likely than the reference population to use comforting thoughts and social support (Oosterhuis, 1998; Westerhuis, et al., 2011). Women with epilepsy were less likely than the reference population of women to use an active, problem solving coping strategies, but more likely to use palliative reactions, reassuring thoughts, avoidance, and depressive reactions (i.e., focusing on the negative, being helpless; Oosterhuis, 1998; Westerhuis, et al., 2011). In both of the aforementioned studies, there were no differences between men and women in coping strategies. The authors interpreted the finding of a difference between patients with epilepsy and the general population as evidence that individuals may have adapted or changed coping strategies in the face of epilepsy.

**Neurocognitive Functioning in Patients with Epilepsy**

Patients with epilepsy often demonstrate prominent neuropsychological deficits, which are known to impact QOL and psychosocial functioning (Breier, et al., 1998; Giovagnoli & Avanzini, 2000; Perrine, et al., 1995; Gois, et al., 2011). These deficits are related to seizure
type, etiology, lateralization, and localization and are often material-specific. For example, there is strong evidence that patients with left temporal lobe epilepsy perform more poorly on verbal learning, verbal memory, and expressive language tasks than do patients with right temporal lobe epilepsy and healthy controls, (Loring, 1997; Moore & Baker, 2002). Patients with frontal lobe epilepsy tend to demonstrate impairments in executive functioning, working memory, and attention (Lee, 2010); however, as a group, patients with temporal lobe epilepsy are also more likely than the general population to experience impairments in executive function and working memory (Oyegbile, et al., 2004; Stretton & Thompson, 2011).

**Neurocognitive Functioning and Coping Strategies**

Research in other neurologic and neuropsychiatric populations has demonstrated a relationship between cognitive abilities and the coping strategies that individuals apply. Among patients recovering from traumatic brain injury and those with schizophrenia, better executive functioning predicts increased use of active, problem solving coping strategies (Krpan, Levine, Stuss, & Dawson, 2007; Wilder-Willis, Shear, Steffen, & Borkin, 2002). Better performance on measures of executive functioning has also been found to predict decreased use of more passive, avoidant coping strategies in patients recovering from traumatic brain injury and in patients with HIV (Krpan, Levine, Stuss, & Dawson, 2007; Banerjee, Ironson, & Levin, 2016).

The relationship between cognitive functioning and coping in patients with multiple sclerosis has been given frequent attention, with consistent evidence that poorer executive functioning predicts more avoidant coping and better executive functioning predicts greater problem-focused coping (Goretti, et al., 2009; Montel, Spitz, & Bungener 2012). Further support for the relationship between cognitive function and coping is that performance on a summary cognitive index (combined speeded attentional, working memory, and planning task indices)
mediated the relationship between a composite coping index (difference between active and avoidant coping) and depression among a sample of patients with multiple sclerosis (Rabinowitz and Arnett, 2009), which the authors interpreted as evidence that cognitive functioning is a coping resource. A related line of evidence using the same composite coping index in patients with multiple sclerosis demonstrated that lower executive functioning, in particular, mediated the relationship better adjustment (i.e., as measured by self-reported depression, anxiety, and stress) through use of more active coping strategies (Grech et al., 2016). Conversely, poorer executive functioning was related to less favorable adjustment through increased use of behavioral and mental disengagement strategies. Interestingly, patients who exhibited poor executive function achieved better adjustment through use of more acceptance based coping strategies and efforts to find meaning in the situation with a focus on personal growth (Grech et al., 2016).

In a heterogeneous sample of patients with acquired brain injury (e.g., traumatic brain injury, vascular infarct, and tumor), problem-focused engagement coping mediated the relationship between self-reported executive functioning and quality of life, in that problem-focused coping was more adaptive for individuals who reported better executive functioning in their daily activities, but less adaptive for those who reported poorer executive functioning (Wolters, et al., 2015). However, in the same study, performance on neuropsychological measures of executive functioning was not related to coping (Wolters, et al., 2015). Studies in patients with PTSD and in a separate heterogeneous sample of patients with acquired brain injury also failed to find a relationship between performance on neuropsychological measures of executive functioning and coping (Martindale, et al., 2016; Wolters, et al., 2011). It is possible that these discrepant findings are related to sampling differences. There was a range of diagnoses (and therefore suspected cognitive and psychosocial outcomes) in the acquired brain injury
samples, and patients with PTSD without neurologic illness may have more complicated psychiatric/stress responses and less significant cognitive vulnerability than the samples of patients with traumatic brain injury, multiple sclerosis, schizophrenia, and HIV.

There is also evidence for a role of verbal memory in coping styles, as Martindale and colleagues (2016) found that among patients with PTSD, the relationship between delayed verbal recall and quality of life was mediated by action-focused coping, even after taking into account combat exposure, PTSD, and probable TBI (i.e., head impact accompanied by alteration in consciousness, loss of consciousness, or posttraumatic amnesia). Similarly, in individuals with schizophrenia, poorer verbal recognition memory performance predicted decreased use of self-initiated, proactive problem solving coping strategies (Wilder-Willis, Shear, Steffen, & Borkin, 2002).

To our knowledge, the relationship between cognitive functioning and coping strategies among patients with epilepsy has not been studied. This gap in the literature is particularly important to address given the disproportionate rates of depression and anxiety in patients with epilepsy compared to the general population of healthy individuals (for review see Jackson & Turkington, 2005), as well as the known diminished quality of life, even in patients who experience seizure freedom (Theodore, et al., 2006; Jehi, et al., 2011). The demonstrated relationships between coping strategies and outcomes among patients with epilepsy, and the relationship between cognitive skills and coping that has been demonstrated in other neurological populations, provide further support for increasing our understanding of the relationship between cognitive functioning and coping among patients with epilepsy. For the present study we focused on the cognitive domains of executive functioning and memory given evidence from research in other populations of their relevance to coping strategies and due to the common deficits in these
area in patients with epilepsy (e.g., Lee, 2010). There are also limited and mixed findings regarding the relationship between demographic and illness-related variables and coping styles in patients with epilepsy. The goal of the present study was to investigate the cognitive, disease-related, and demographic predictors of coping strategy use among patients with epilepsy. An understanding of the predictors of coping strategies might allow clinicians and treatment providers to identify individuals who are at risk for maladaptive responses to stress and those that might be more resilient to illness-related and other types of stressors. A better understanding of coping among patients with epilepsy will lay a foundation for the development of interventions aimed at improving coping skills and tailored to the needs of patients with epilepsy.

Hypothesis 1: Poorer executive functioning was expected to predict less engagement and more disengagement coping strategies, even after accounting for the prominent memory deficits that are common in patients with epilepsy.

Hypothesis 2: Greater seizure severity, longer disease duration, and the presence of abnormal interictal EEG activity were expected to predict less engagement and more disengagement coping strategies. Consistent with previous gender research, females were expected to use less engagement coping strategies.

Chapter 2: Method

Participants

A total of 46 participants with epilepsy were drawn from inpatients and outpatients treated at the Cincinnati Epilepsy Center within the University of Cincinnati Medical Center. Participants were required to be between the ages of 18 and 65, with neurologist- and EEG-confirmed diagnoses of epilepsy. Diagnostic information (e.g., localization/lateralization, age of onset) was derived from patient medical records. Prospective participants were excluded for a
history of a current and progressive neurologic disorder other than epilepsy that would be expected to impact cognition, bipolar or psychotic disorder, current substance use disorder, serious developmental disability, or verified non-epileptic seizures. All aspects of this study were approved by the University of Cincinnati Institutional Review Board.

Procedure

Participants were recruited through two streams (see Table 1). The first stream involved recruitment of individuals who were referred for clinical neuropsychological evaluation. Individuals with confirmed epilepsy who had completed neuropsychological testing in the past three years were contacted by phone, and those who were new referrals for neuropsychological testing were approached in person at the time of their clinical neuropsychological evaluation or contacted by phone after their clinical evaluation and invited to participate. The majority of those in this recruitment stream had medically refractory seizures and were examined as part of their evaluations for possible epilepsy surgery; a few \( n = 6 \) were post-surgical. Participants completed the study questionnaire, and neuropsychological test scores were retrieved from the clinical record. Post-surgical patients were only included if they had received neuropsychological testing after their lobectomies; in other words, pre-surgical neuropsychological data were never used in conjunction with post-surgical coping data.

The second recruitment stream included individuals who had not been referred for clinical neuropsychological evaluation; they had heterogeneous seizure classifications and a wide range of seizure frequencies. These individuals were contacted via telephone, and if they agreed to participate, they completed a single in-person study session, during which they were administered the battery of neuropsychological tests and the study questionnaire. All participants
provided verbal (if completed via telephone) or written (if completed in person) informed consent.

<table>
<thead>
<tr>
<th></th>
<th>Stream 1</th>
<th>Stream 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Targeted for recruitment</td>
<td>115</td>
<td>61</td>
</tr>
<tr>
<td>Reached via phone/in person</td>
<td>84</td>
<td>34</td>
</tr>
<tr>
<td>Declined participation</td>
<td>18</td>
<td>12</td>
</tr>
<tr>
<td>Ineligible</td>
<td>32</td>
<td>4</td>
</tr>
<tr>
<td>Cancelled/No Showed</td>
<td>--</td>
<td>6</td>
</tr>
<tr>
<td>Completed participation</td>
<td>34</td>
<td>12</td>
</tr>
</tbody>
</table>

The study questionnaire began with demographic information (age, gender, education, race and ethnicity) and information related to the participant’s diagnosis of epilepsy (current anti-epilepsy medications, current seizure types, current seizure frequency). Finally, participants were asked about the ways in which they tend to cope with stress using the Coping Strategies Inventory - Short Form (CSI-S; Tobin, 1995). In its original form, the CSI-S is intended to be a paper and pencil instrument; therefore, the researchers obtained permission from the CSI-S author (D. Tobin, personal communication, November 17, 2014) to adapt the measure to be administered orally so that it could be administered via telephone. In order to maintain consistent administration, the CSI-S was also administered orally to individuals who completed the questionnaire in person.

**Measures**

**Coping Strategies Inventory – Short Form.** The Coping Strategies Inventory (CSI; Tobin et al., 1989) was derived from the Ways of Coping Checklist (Folkman & Lazarus, 1980), and the factor structure is empirically supported through hierarchical factor analysis (Tobin, et al., 1989). The 32-item Coping Strategies Inventory – Short Form (Tobin, 1995) was developed as an abbreviated form of the 72-item full version of the CSI. Participants are asked to generate a
A description of a specific stressful event and then are asked to indicate the extent to which they used specific coping responses, using a 5-point Likert format. In the present study, the stressful event could be epilepsy-related or not. The CSI-S consists of eight subscales. These eight primary subscales load onto four secondary subscales and two tertiary subscales (see Figure 1). For the purposes of the current study only the secondary subscales were used, but all subscales are included here to facilitate an understanding of the factor structure of the CSI-S. After completing the CSI-S, participants were asked to think of a situation that recently made them happy, to induce a positive mood. Once the positive situation was described, participants were asked several questions about how they reacted in that situation. This information was not used in data analysis and was solely for the purposes of ending the study session on a positive note.

*Figure 1. Subscales of the Coping Strategies Inventory-32 Item version. The secondary subscales (shaded in the figure) were analyzed in the present study.*

**Neuropsychological measures.** All of the neurocognitive measures are standardized, norm-based tests that are known to be sensitive to neuropsychological deficits in patients with epilepsy.

Executive functioning was measured using the following neurocognitive measures: The Inhibition subtest of the Color-Word Interference Test presents participants with color names printed in a discordant color of ink and requires participants to name the ink color and ignore the
conflicting word (Delis, Kaplan, & Kramer, 2001). The raw score is recorded in seconds and the standard scores are age-corrected scaled scores. The Trail Making Test – B (TMT-B) is a sequencing task which requires the individual to connect encircled numbers and letters in alternating order (e.g., connecting 1 to A to 2 to B and so on; Lezak, Howieson, & Loring, 2004). Performance on the TMT-B is measured in seconds to complete the task and it produces age-, education-, gender-corrected T scores (Heaton, Miller, Taylor, & Grant, 2004). The Letter-Number Sequencing (LNS) subtest of the Wechsler Adult Intelligence Scale – 4th Edition (WAIS-IV; Wechsler, 2008) produced age-corrected scaled scores and measures working memory by presenting participants with a sequence of numbers and letters, and the participant is required to recall the numbers in ascending order and the letters in alphabetical order.

Verbal learning and memory were assessed with the California Verbal Learning Test, Second Edition (CVLT-II; Delis, et al., 2000). Participants are read a list of words and are asked to recall them across several trials and again after short and long delay intervals. Standardized scores for the CVLT-II are age and gender-corrected; T-scores are produced for the immediate learning trials and Z-scores for the delayed recall trials. The Brief Visuospatial Memory Test – Revised (BVMT-R; Benedict, 1997) was used to assess visual memory. During this test, participants are shown a series of figures and are asked to recall and draw the figures across three trials and after a brief delay interval. Raw scores from the BVMT-R are converted to age-corrected T-scores.

Measures of language and visual spatial functioning were included in the study in order to ensure that any measured memory and executive impairments were not due entirely to deficits in these primary cognitive domains. They were also of interest in order to demonstrate specificity of executive functioning and memory in predicting coping styles. Confrontation naming was
assessed with the Boston Naming Test-Second Edition (Kaplan, Goodglass, & Weintraub, 1983); participants are shown a series of pictures and are asked to produce the correct name. This task produces age, gender, and education-corrected T-scores (Heaton, Miller, Taylor, & Grant, 2004). Visual-perceptual ability was assessed using the raw scores from the Judgment of Line Orientation Task (JLO; Benton, Varney, & Hamsher 1978), which requires participants to accurately perceive the positions of lines. Finally, academic achievement, as measured by the Word Reading subtest of the Wide Range Achievement Test (WRAT-IV; Wilkinson & Robertson, 2006), was used to estimate verbal intellectual ability and produces age corrected standard scores.

**Statistical Analyses**

All data distributions were examined for normality. The BVMT-R T-scores were not normally distributed, as the lowest possible T-score on this task is 20, which can result from a range of raw scores. The T-scores are used in the analyses below, but significance was also confirmed using raw scores. T-tests were run in order to confirm that there were no differences in demographics and coping between administration groups (i.e., phone vs. in-person administration) and to compare coping styles between men and women with epilepsy. Pearson correlation coefficients were calculated to investigate the relationships between the CSI-S and cognitive, disease, and demographic variables. Data reduction techniques were applied to reduce the number of variables included in the multivariate models. Separate multiple regression analyses were completed to predict secondary coping styles (i.e., problem focused engagement, emotion focused engagement, problem focused disengagement, and emotion focused disengagement) from executive functioning after accounting for (1) memory, (2) disease-related variables, and (3) use of other coping styles. Although the original design for this study called for
the recruitment of a heterogeneous group of patients, the sampling strategy (drawing first on presurgical patients who had already had neuropsychological testing and then on general clinic patients) resulted in a majority of the sample carrying a diagnosis of temporal lobe epilepsy and having medically refractory seizures, and therefore, coping and cognition was ultimately investigated separately in this sample.

All analyses were conducted using SPSS Statistics version 23 (IBM corp, 2015).

Chapter 3: Results

Sample Characteristics

A total of 46 participants completed the study (see Table 2 for demographic and disease information). The mean age of the sample was 40.39 years, approximately half of the participants were female, and the majority were white. The sample consisted largely of patients with TLE, and other diagnoses included frontal lobe and primary generalized epilepsy. Two participants had neurologist-confirmed seizures based on long-term video-EEG monitoring, but the seizures could not be localized. Six of the participants had undergone anterior temporal lobectomy for treatment of epilepsy, and they did not differ significantly from the rest of the group in terms of disease characteristics, demographics, cognitive performance, or self-reported coping (all $p > .05$). There were no differences in self-reported coping between the 34 individuals who were administered the questionnaire over the phone and the 12 who were administered the questionnaire in person ($p > .05$).

When the participants were considered as one group, mean standard scores on neurocognitive tests did not fall within the clinically impaired range (see Table 3). Earlier age of epilepsy onset was associated with poorer age-corrected T-scores on measures of immediate
verbal \((r(44) = .30, p < .05)\) and visual memory \((r(44) = .31, p < .05)\) and confrontation naming \((r(44) = .41, p < .05)\).

### TABLE 2
Sample Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Full Sample (N = 46)</th>
<th>Temporal (n = 31)</th>
<th>Frontal (n = 5)</th>
<th>Generalized (n = 8)</th>
<th>Other (n = 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>40.39 (11.74)</td>
<td>42.61 (11.4)</td>
<td>31.00 (5.52)</td>
<td>37.00 (13.73)</td>
<td>43.00 (12.73)</td>
</tr>
<tr>
<td>Education</td>
<td>13.93 (2.51)</td>
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<tr>
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<td>Age at onset</td>
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<td>GTC (seizures)</td>
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*Note: \(M(SD)\)*
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<td>22.80 (5.54)</td>
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<td>24.48 (6.23)</td>
<td>25.38 (6.29)</td>
<td>24.20 (5.97)</td>
<td>21.38 (5.97)</td>
<td>23.50 (7.78)</td>
</tr>
<tr>
<td>EFD</td>
<td>21.22 (7.69)</td>
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<td>16.40 (2.70)</td>
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<tr>
<td>LNS (scaled)</td>
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<td>TMT-B (T-score)</td>
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<td>42.41 (14.38)</td>
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<td>38.88 (14.27)</td>
<td>40.00 (8.49)</td>
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<td>CW Inhibition (scaled)</td>
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<td>9.17 (3.85)</td>
<td>9.00 (3.39)</td>
<td>11.50 (2.33)</td>
<td>10.50 (3.54)</td>
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<td>40.88 (12.88)</td>
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<td>CVLT-II Delay (Z-score)</td>
<td>-0.94 (1.26)</td>
<td>-1.13 (1.37)</td>
<td>-0.50 (1.17)</td>
<td>-0.63 (.92)</td>
<td>-0.25 (.35)</td>
</tr>
<tr>
<td>BVMT-R Total (T-score)</td>
<td>36.20 (12.60)</td>
<td>34.83 (14.01)</td>
<td>37.80 (9.36)</td>
<td>41.75 (14.51)</td>
<td>31.00 (15.55)</td>
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<tr>
<td>BVMT-R Delay (T-score)</td>
<td>39.17 (15.37)</td>
<td>35.84 (14.78)</td>
<td>44.20 (13.29)</td>
<td>47.38 (15.75)</td>
<td>45.50 (23.33)</td>
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<td>BNT (T-score)</td>
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<td>JoLO (raw)</td>
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<td>24.0 (2.94)</td>
<td>24.88 (5.64)</td>
<td>18.00 (9.90)</td>
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</tbody>
</table>

Notes: *Tertiary (max score = 80) and secondary (max score = 40) scales

Pearson correlations among the four self-reported coping styles (problem focused engagement, emotion focused engagement, problem focused disengagement, emotion focused disengagement) ranged from .02 to .28. There were no significant relationships between coping styles, although there were trends toward associations between the two engagement coping styles (problem focused and emotion focused engagement; \( r(44) = .26, p = .09 \)) and between the two disengagement coping styles (problem focused and emotion focused disengagement; \( r(44) = .28, p = .06 \)).

**Disease and Demographic Predictors of Coping**
Women with epilepsy ($M = 26.73, SD = 6.08$) reported significantly more frequent use of problem focused disengagement coping than men with epilepsy ($M = 21.55, SD = 5.22$), $t(44) = -3.04, p < .05$. There was also a trend for women ($M = 28.35, SD = 7.12$) to use emotion focused engagement coping more frequently than men ($M = 24.3, SD = 6.49$), $t(44) = -1.98, p = .05$. No significant relationships existed between any of the other disease or demographic related variables and coping (all $p > .05$).

**Neurocognitive Function and Coping in the Full Sample**

There were no significant relationships between executive functioning and engagement coping in the entire sample, nor did performance in other cognitive domains predict problem focused engagement coping. Turning to the relationships between memory and coping style, poorer visual learning was significantly related to increases in both emotion focused engagement coping ($r(44) = -.38, p < .05$) and problem focused disengagement coping ($r(44) = -.34, p < .05$). Similarly, poorer visual delayed memory was significantly related to increased emotion focused engagement ($r(44) = -.36, p < .05$) and problem focused disengagement coping ($r(44) = -.39, p < .05$). Finally, poorer verbal delayed memory was significantly related to increased use of problem focused disengagement coping, $r(44) = -.38, p < .05$.

**Neurocognitive Functioning and Coping in Temporal Lobe Epilepsy**

Given that the sample was made up primarily of patients with temporal lobe epilepsy (TLE), a series of secondary analyses were conducted to evaluate only this subset of participants. Separate multiple regression analyses were used to investigate the unique contribution of cognition in predicting coping. More specifically, for each predictor of coping that was found to be significant in prior analyses, three separate regressions were run that included the following variables: (1) memory (if executive functioning was the predictor of interest) or executive
function (if memory was the predictor of interest), (2) disease related variables, and (3) the three coping strategies that were not the outcome variable of interest. A regression analysis was also run with seizure lateralization included in the model; because there was no significant lateralization effect, this variable was not included in subsequent analyses given the small sample size. There were no significant relationships between disease variables and coping in the patients with TLE (all $p > .05$).

**Engagement coping.** Pearson correlations revealed that better cognitive set shifting ($r(29) = .44, p < .05$), cognitive inhibition ($r(29) = .39, p < .05$), and inhibition/switching ($r(29) = .37, p < .05$) significantly predicted increased use of problem focused engagement coping (see figure 2). In order to confirm that executive functioning contributed unique and significant variance to the use of problem focused engagement coping, separate multiple regression analyses were performed. The first set of models each included visual and verbal delayed memory in addition to the executive variable of interest. Cognitive set-shifting (see Table 4) and inhibition (see Table 5) each contributed unique and significant variance to the use of problem focused engagement coping, above and beyond memory ($p < .05$). Inhibition/switching (see Table 6) was no longer a significant independent predictor of problem focused engagement coping when memory was taken into account ($p > .05$). The second set of models looked at the unique contribution of executive functioning to the use of problem-focused engagement coping above and beyond disease duration and complex partial seizure frequency. Again, set-shifting (see Table 4) and inhibition (see Table 5) were unique predictors of problem focused engagement coping above and beyond disease related variables. Inhibition/switching (see Table 6) also remained a significant unique predictor when disease related variables were taken into account, and frequency of complex partial seizures was also a significant predictor of problem focused
engagement coping. Finally, the third set of models took into account whether the significant relationships between cognition and coping method remained significant after account for the other measured coping styles. Cognitive set-shifting (see Table 4) was a significant and unique predictor of problem focused engagement coping even after accounting for other coping styles. Better inhibition (see Table 5) and inhibition/switching (see Table 6) remained significant independent predictors of greater problem focused engagement coping after accounting for other coping styles, with higher emotion focused engagement coping having an independent and additive contribution to problem focused engagement.

Figure 2. Relationships between (a) inhibition, (b) inhibition/switching, and (c) cognitive set shifting and problem focused engagement coping.
### Table 4

Three separate regression models each including Trails B with problem focused engagement coping as the outcome variable

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
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<td>.95</td>
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<td>.29</td>
<td>.03</td>
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<td>Disease duration</td>
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<td>.10</td>
<td>.10</td>
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<tr>
<td>Emotion Disengagement</td>
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</table>

**Notes:** *p < .05

### Table 5

Three separate regression models each including inhibition with problem focused engagement coping as the outcome variable

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<th></th>
<th>Model 1</th>
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<td>.30</td>
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<tr>
<td>Disease duration</td>
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<td>Problem Disengagement</td>
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**Notes:** *p < .05
Table 6

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<tr>
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<td>$B$</td>
<td>$SE$</td>
<td>$\beta$</td>
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<td>.35</td>
<td>.35</td>
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<tr>
<td>Switching</td>
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<tr>
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</table>

Notes: *$p < .05$

Pearson correlations revealed a significant relationship between poorer visual learning ($r(29) = -.53, p < .05$) and delayed memory ($r(29) = -.57, p < .05$) and increased use of emotion focused engagement coping (see Figure 3). Visual learning (see Table 7) and memory (see Table 8) were each unique predictors of emotion focused engagement coping above and beyond disease duration and seizure frequency, and use of other coping strategies. When the latter were taken into account, problem focused engagement coping was also an independent and significant predictor of emotion focused engagement coping.

![Figure 3. Relationships between memory and emotion focused engagement coping.](image-url)
Table 7

Two separate regression models each including visual learning with emotion focused engagement coping as the outcome variable

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<td>β</td>
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<td>SE</td>
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Notes: *p < .05

Table 8

Two separate regression models each including visual memory with emotion focused engagement coping as the outcome variable

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Notes: *p < .05

Disengagement coping. Our second hypothesis, that poorer executive functioning would be related to increased use of disengagement coping, was not confirmed. There was, however, a trend towards an association between increased problem focused disengagement coping and poorer verbal delayed memory ($r(29) = -.35, p = .05$) and visual learning ($r(29) = -.33, p = .07$). Increased use of problem focused disengagement coping was also significantly related to poorer auditory working memory $r(27) = -.47, p < .05$ (see Figure 4). Although this relationship was no longer significant when two outliers were removed, it is an intriguing finding to consider as both outliers were at the extreme low end in terms of working memory performance and at the
extreme high end in terms of reliance on problem focused disengagement coping, suggesting that with minimal working memory they are making frequent use of coping strategies that involve disengaging from the stressor. With the outliers included, the association remained significant after accounting for disease variables and other coping styles ($p < .05$), but was no longer significant when memory was taken into account ($p > .05$). There were no significant relationships between emotion focused engagement coping and cognitive or disease related variables.

![Graph](image)

*Figure 4. Relationship between working memory and problem focused disengagement coping.*

**Chapter 4: Discussion**

This study is the first to report a significant relationship between neurocognitive functioning and coping styles in patients with epilepsy. The present emphasis on cognitive functioning is particularly relevant in this population given these patients’ well documented cognitive deficits (e.g., Lee, 2010) and these findings are consistent with evidence from other populations that neurocognitive functioning is related to coping (Krpan, Levine, Stuss, & Dawson, 2007; Wilder-Willis, Shear, Steffen, & Borkin, 2002; Grech, et al., 2016; Rabinowitz & Arnett, 2009).
Our first hypothesis was partially confirmed, in that executive functioning was a significant and unique predictor of problem-focused engagement coping in patients with TLE, above and beyond memory, disease related variables, and use of other coping strategies. Although the current study was designed to include all epilepsy diagnoses, exploratory analyses revealed that the relationship between executive functioning and coping was significant only in the patients with TLE. Given the growing evidence of executive deficits in many patients with TLE (Oyegbile, et al., 2004; Stretton & Thompson, 2011), the relationship between executive dysfunction and coping is particularly relevant to treatment in those with this specific syndrome. The finding that executive functioning predicts problem focused engagement coping is in line with research in patients with schizophrenia, traumatic brain injury, HIV, and multiple sclerosis showing that better executive functioning is related to increased use of active problem solving coping strategies (Wilder-Willis, Shear, Steffen, & Borkin, 2002; Krpan, Levine, Stuss, & Dawson, 2007; Rabinowitz & Arnett, 2009; Grech, et al., 2016; Banerjee, Ironson, Levin, 2016). Implementing active coping such as problem solving and cognitive restructuring requires cognitive flexibility, for example being able to see the problem from someone else’s point of view and changing one’s thoughts about the situation. Additionally, one’s ability to inhibit more automatic responses (e.g., avoid stressful stimuli, strategies to palliate the emotions) may play a role in the ability to implement more problem focused coping.

Although our hypothesis that poorer executive functioning would predict increased use of emotion focused engagement coping was not confirmed, we did find that individuals with poorer visual learning and memory reported increased use of emotion focused engagement coping. This learning and memory finding was independent of disease variables and other coping styles. This result is consistent with previous findings that poorer verbal recognition memory predicted less
use of active coping strategies in patients with schizophrenia (Wilder-Willis, Shear, Steffen, & Borkin, 2002) and that the relationship between delayed verbal memory and quality of life was mediated by active coping strategies in patients with PTSD (Martindale, et al., 2016). It is not surprising that individuals with poorer memory functioning would tend to rely more on coping strategies that aim to palliate difficult emotions as opposed to turning to those which require memory for the details of the stressor such as problem solving or cognitive restructuring. It is possible that the lack of a significant relationship between executive functioning and emotion focused engagement coping (social contact, expressing emotions) may in part be related to the measures of executive functioning that were included in this study. More specifically, the measures of inhibition and set shifting better align with coping strategies such as cognitive restructuring and problem solving than with the more emotion focused engagement strategies (i.e., seeking social support and expressing emotions). In contrast, seeking social support and expressing emotions may involve aspects of social cognition (e.g., emotional problem solving, affective processing) that were not measured in the current study.

This study also sought to add to the literature on demographic and disease related predictors of coping in patients with epilepsy. Our second hypothesis was partially confirmed, as women with epilepsy reported using emotion focused engagement and problem focused disengagement coping more than men with epilepsy. This finding is inconsistent with a previous report that women with epilepsy were more likely to report active, problem focused coping than their male counterparts (Krakow, et al., 1999), although the latter study only looked at coping in response to illness related stress. The finding that women use more emotion-focused coping is, however, consistent with findings in the general population (Ptacek, Smith, & Dodge, 1994).
Disease characteristics including interictal EEG activity, age of onset, and frequency of seizures with loss of awareness (i.e., complex partial and generalized tonic clonic) did not predict coping styles, and there was no difference between patients with and without abnormal interictal EEG. Previous research is mixed regarding the relationship between disease related variables and coping in patients with epilepsy, and our negative findings are consistent with the research in patients with varied diagnoses and degrees of seizure control (Bautista, et al., 2013, Mirnics, Bekes, Rozsa, & Halasz, 2001; Snyder, 1991; Upton & Thompson, 1992). The finding that disease characteristics did not predict coping in our sample of patients with TLE is in contrast to prior findings in patients with intractable epilepsy (Krakow, et al., 2009; Piazinni, et al., 2007). It is notable that the patients in the aforementioned studies were asked specifically about coping with illness related stressors, whereas our sample was asked to think about any life stressor in their responding.

One limitation of the current study was the sampling strategy. The findings are largely dependent on the TLE participants, who differ from the rest of the sample both in seizure location and seizure severity; therefore, it is not clear how well the results generalize to patients with other types of epilepsy or to patients with TLE with well-controlled seizures. The coping findings in patients with epilepsy have varied depending on the subtypes of epilepsy included in the samples, and therefore, future studies should aim to study more homogeneous groups of patients with epilepsy, especially considering the very different clinical presentations and neurological impact of differing epilepsy diagnoses. Another limitation was the lack of a healthy control group, without which we cannot make conclusions about the degree to which the coping strategies reported in our sample may have differed from those of the general population. Coping was assessed by self-report and may not be entirely reflective of how an individual copes with
situations more objectively. Additionally, we did not assess perceived control of the stressful event, which may have implications for how adaptive different coping strategies would have been in a given situation. Finally, given that psychiatric diagnoses or measurement of symptoms of depression and anxiety were not included in this study, we cannot make inferences about whether the use of certain coping strategies in this population was related to positive or negative emotional functioning or outcomes. Although the relationships between coping and outcomes were not investigated in this study, the literature suggests that more active coping is related to more positive psychosocial and emotional outcomes in patients with epilepsy. An understanding of this relationship would be especially relevant in light of provocative longitudinal evidence that maladaptive coping styles precede the onset of depression in patients with multiple sclerosis (Rabinowitz and Arnett 2009).

These data have several implications for psychological interventions with TLE patients. They suggest that certain aspects of neurocognitive functioning are related to the coping styles that patients with TLE use regardless of how early they were diagnosed with epilepsy and how frequently they experience seizures. The existing literature suggests that depression and anxiety are common in those with epilepsy, even when they are seizure free (Theodore, et al., 2006; Jehi, et al., 2011). Although emotional functioning was not directly measured in the current study, our data suggest that coping ability, an important predictor of emotional resilience, is closely related to the cognitive dysfunction in patients with TLE that persists even after seizure remission (e.g., Lee, 2010). Additionally, engagement and disengagement coping strategies were not correlated, suggesting that use of more engagement coping does not necessarily mean less disengagement coping, and vice versa. Psychotherapeutic interventions designed to assist those with epilepsy to alter coping strategies will need to take into consideration that these patients may have a
cognitive vulnerability to rely more heavily on certain coping strategies. Treatment targets may not only involve teaching cognitive restructuring and problem solving skills, but also taking into consideration that these strategies may be difficult for certain individuals to implement, and therefore targeting strategies that may be more accessible. For example, Grech and colleagues (2016) suggested that less cognitively demanding adaptive strategies might be important for individuals who experience executive dysfunction. In our sample, poorer executive functioning was related to decreased use of active problem focused coping strategies, but not increased active emotion focused coping. Therefore, in addition to interventions aimed at improving active problem focused strategies, increased engagement in adaptive emotion focused strategies could also be a treatment target. Although causality cannot be inferred, the current study provides a foundation for our understanding of how cognitive functioning may impact coping in patients with epilepsy and evidence for the importance of considering cognitive strengths and weaknesses when tailoring psychotherapeutic interventions to best treat our patients.

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