2014

Moderation And Mediation Of Headache-Related Disability: The Roles Of Self-Efficacy And Headache Diagnosis

Kelly Peck
University of Mississippi

Moderation and Mediation of Headache-Related Disability: The Roles of Self-Efficacy and Headache Diagnosis

A Thesis
presented in partial fulfillment of requirements
for the degree of Master of Arts
in the Department of Psychology
The University of Mississippi

By

KELLY R. PECK

November 2013

ABSTRACT

Primary headache disorders such as migraine and tension-type headache are some of the most frequently-diagnosed health disorders in the world and can be extremely disabling. However, disability resulting from these disorders varies substantially across individuals. Although headache severity has been identified as the strongest predictor of headache-related disability, the relationship between the two variables is non-linear, suggesting that other mechanisms may be involved. Self-efficacy mediates relations between pain and impairment associated with other chronic pain conditions, but this relationship has not been evaluated in a sample of individuals with primary headache disorders. Therefore, the present study sought to examine whether headache self-efficacy acts as a mediator between headache severity and disability. The potential for moderated mediation by diagnostic status was also evaluated.

The sample consisted of 822 college students with a mean age of 19.03 years (SD = 2.19), with 378 participants (46 %) meeting *International Classification of Headache Disorders, 2nd Edition* diagnostic criteria for ETTH, 363 (44.2%) for episodic migraine, and 81 (9.9%) for chronic migraine. Headache severity and disability were strongly associated, $r(818) = .61$, $p < .01$. Self-efficacy mediated the association between pain severity and disability for the sample as a whole (95% confidence interval [CI]: .12 to .33), although the clinical significance of this effect may be rather modest. Moreover, the mediation effect was moderated by headache diagnosis such that mediation was strongest for individuals suffering from episodic migraine (95% CI = .12 to .43). Overall, the results indicate that both pain severity and self-efficacy

contribute to the extent to which an individual is disabled by their headaches. A strong belief in one's own ability to manage, function in spite of, and cope with pain may protect against disability resulting from headache pain. The present findings build upon and extend previous research that has focused primarily on individuals diagnosed with chronic and/or severe musculoskeletal pain and extend prior findings to the cyclical pain characteristic of migraine. There is a need for longitudinal studies, particularly among diverse populations, assessing the role that headache-management self-efficacy and other potential mediators play in the experience of headache.

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INTRODUCTION

Headache Disorder Diagnoses

According to the *International Classification of Headache Disorders, 2nd Edition* (ICHD-II; Headache Classification Subcommittee of the International Headache Society [IHS], 2004), headaches not attributable to identifiable organic pathology are classified as "primary" headaches; these headaches comprise the large majority of headaches experienced by the population. Both migraine and tension-type headache (TTH) are included under the category of primary headache disorders, which also includes less common headache subtypes such as cluster headache. Migraine is as a common neurological disorder characterized by recurrent severe episodes of headache and associated symptoms typically lasting between 4 to 72 hours. Associated symptoms of migraine are unilateral location, pulsating quality, moderate to severe intensity, aggravation by routine physical activity, nausea, and photophobia (sensitivity to light) and phonophobia (sensitivity to sound). In a significant minority of cases, migraine attacks are preceded by aura, a constellation of temporary focal neurological symptoms that are most commonly visual in nature (e.g., seeing spots or zigzag lines, blurry vision). Aura symptoms usually develop gradually over 5-20 minutes and last for less than 60 minutes, after which time the head pain begins (Lipton, Scher, Silberstein, Liberman, & Bigal, 2008). Among 2-3% of the population, migraine becomes a very frequent condition characterized by headaches on 15 or more days per month (i.e., chronic migraine). The rare occurrence of migraine progression from an episodic (< 15 days/month) to chronic (≥ 15 days/month) form, or headache "chronification," is associated with older age, female gender, significant life stressors, and overuse of acute or abortive headache medications (Lipton & Bigal, 2005).

Like migraine, TTH varies widely in frequency and duration. Tension-type headaches may last anywhere from 30 minutes to 7 days and occur an average of 1 day or less per month (infrequent episodic TTH, or ETTH), 1-14 days per month (frequent ETTH), or 15 or more days per month (chronic TTH or CTTH). Unlike migraine, the pain of TTH is typically bilateral, dull and non-throbbing, pressing or tightening in quality, of mild to moderate severity, and not worsened by routine activity (Rasmussen, Jensen, Schroll, & Olesen, 1991). Nausea is not typically associated with TTH, but photophobia or phonophobia (not both) may accompany these headaches, although they are typically of lesser severity compared to that observed in migraine (ICHD-II; Jensen, 2003). Due to frequent comorbidity and some overlap of symptoms, it has been suggested that migraine and TTH are actually variants of a single underlying disorder, existing at two different points on a continuum (Leston, 1996). However, the two headache forms differ in gender ratio, age distribution, and clinical presentation (Rasmussen, 1996; Rasmussen et al., 1991b), in turn suggesting they are in fact different disorders but with some similarities in presentation.

Headache Disorder Epidemiology

Migraine affects 12% of the population (Lipton et al., 2007) and is three times more common among women than men (18% vs. 6%; Fukui et al., 2008; Jelinski et al., 2006; Lipton, Stewart, Diamond, Diamond, & Reed, 2001; Lipton, Stewart, & Simon, 1998). In U.S. samples, migraine is more prevalent among Caucasian individuals than among minorities, with 20.4% of Caucasian women experiencing migraine in comparison to 16.4% of African-American and 9.2% of Asian-American women. A similar trend was found among men (8.6%, 7.2%, and 4.2%, respectively; Stewart, Lipton, & Liberman, 1996). Additionally, an inverse relationship has been established between the incidence of migraine headache and socio-economic status (SES; Lipton et al., 2001; Stang & Osterhaus, 1993). Migraine affects individuals of all ages, however; it is most prevalent between 25 and 50 years of age (Lipton et al., 2001; Jette, Patten, Williams, Becker, & Wiebe, 2008; Victor, Hu, Campbell, Buse, & Lipton, 2010).

Tension-type headache is the most common of the primary headache disorders, affecting up to 78% of the population and being slightly more prevalent among women (42%) than men (36%; Jensen, 2003; Schwartz, Stewart, Simon, & Lipton, 1998). Like migraine, TTH is more prevalent in Caucasians than in African-Americans among both women (46.8% versus 30.9%) and men (40.1% versus 22.8%; Schwartz et al., 1998). An interesting difference between migraine and TTH is that while migraine prevalence decreases with increased SES, TTH prevalence increases with SES (Schwartz et al., 1998), further supporting the notion that migraine and TTH are in fact distinct disorders. The onset of TTH typically occurs between 20 and 30 years of age (Gobel, Petersen-Braun, & Soyka, 1994; Rasmussen et al., 1991b; Schwartz et al., 1998), and prevalence peaks between 30-39 years age for both males and females (Schwartz et al., 1998). Tension-type headache is equally prevalent in boys and girls during school years. However, like migraine, TTH becomes more prevalent in females during adolescence (Laurell, Larsson, & Eeg-Olofsson, 2003; Milovanovic, Jarebinski, & Martinovic, 2007).

Impact of Primary Headache Disorders

Migraine is among the 20 leading causes of disability worldwide and the 12th leading cause of disability among women (Leonardi, Steiner, Scher, & Lipton, 2005; World Health Organization, 2001). Disability is a construct defined by the effect of an illness on an individual's ability to function at work as well as in other areas such as home, social, and familial settings (Ferrari, 1998). Studies in North America, Japan, and Europe have shown that during a migraine attack, individuals report a reduced ability to function (Holmes, MacGregor, & Dodick, 2001). During a migraine attack, approximately half of individuals are disabled to the point that they will require bed rest (Hu, Markson, Lipton, Stewart, & Berger, 1999; Lipton et al., 2001). However, functioning is not only impaired during the headache attack but also interictally (Clarke, MacMillan, Sondhi, & Wells, 1996; Solomon, Skobieranda, & Graff, 1993; Stronks, Tulen, Bussmann, Mulder, & Passchier, 2004).

As such, migraine affects multiple aspects of an individual's life and confers significant direct and indirect costs to society as a whole (Edmeads & Mackell, 2002; Holmes et al., 2001; Lipton et al., 2003b; Stewart, Lipton, & Kolodner, 2003). The indirect costs of migraine are much higher than that of direct costs, such that indirect costs exceed $13 billion and direct costs $1 billion (Hu et al., 1999). As a result of indirect costs such as missing work and diminished productivity, many migraineurs are fearful of losing their jobs or being denied promotion (Clarke et al., 1996). Individuals with severe migraine have a two to four time higher rate of unemployment than the general population (Von Korff, Ormel, Keefe, & Dworkin, 1992). In addition to being less productive at work, migraineurs report that their headaches negatively affect their productivity at home as well as their relationships (Clarke et al., 1996; Smith, 1996), such that their headaches contribute to being argumentative and less involved with their partners and children (Lipton et al., 2003a). The negative impact of migraine extends also to school-age children, who miss approximately twice as many school days compared to children without migraine (Abu-Arefeh & Russell, 1994). Migraineurs also utilize health care services with greater frequency, have higher medical costs, and miss more work for health-related reasons than individuals without migraine (Edmeads & Mackell, 2002; Von Korff, Stewart, Simon, & Lipton, 1998). Finally, the impact and management of migraine is often complicated further by the presence of comorbid psychiatric disorders such as major depressive disorder, bipolar disorder, and various anxiety disorders (e.g., panic disorder, social phobia, generalized anxiety disorder; Baskin, Lipchik, & Smitherman, 2006; Breslau & Davis, 1993; Breslau, Lipton, Stewart, Schultz, & Welch, 2003; Hamelsky & Lipton, 2006; Jette et al., 2008; Oedegaard et al., 2006; Smoller et al., 2003; Stewart, Schechter, & Lipton, 1994). Comorbid psychiatric disorders may complicate differential diagnosis and are associated with reductions in quality of life and the effectiveness of treatment (Baskin et al., 2006; Jette et al., 2008; Lipton, Hamelsky, Kolodner, Steiner, & Stewart, 2000; Radat & Swendsen, 2004).

Although ETTH is not as severe or debilitating as migraine or CTTH, its impact on quality of life is still significant due to its high prevalence. The direct costs of TTH are lower than those of migraine, as individuals with TTH are less likely to seek medical attention (Rasmussen, Jensen, & Olesen, 1992). Like migraine, the treatment and management of this condition can be complicated by the presence of other disorders. Anxiety disorders, depressive disorders, and to a lesser degree somatoform disorders, are commonly comorbid with TTH (Heckman & Holroyd, 2006; Puca et al., 1999). The prevalence of TTH is greatest during adults' peak productive years, and thus resulting disability is often significant. Approximately 8% of those with ETTH report missing work due to headache and 44% report being less effective at home, work, or school due to headache (Schwartz, Stewart, & Lipton, 1997). Schwartz and colleagues (1997) found that while migraine patients have higher rates of absenteeism from work, TTH accounts for a higher proportion of reduced productivity at work. Like migraine, the impact of TTH extends beyond work and into school performance as well, as university students with ETTH experience an average of 2.3 days of pain per month and greater impairment than those without headache (Bigal, Bigal, Betti, Bordini, & Speciali, 2001).

Impact of Pain Severity on Disability

As in other chronic pain conditions, significant variability exists in the extent to which an individual is disabled by headache (Lipton et al., 2002). In order to understand why pain causes greater impairment in some individuals than others, identifying the factors that are most strongly associated with pain-related disability is imperative. Not surprisingly, pain severity has been found to be one of the strongest predictor of disability in a variety of chronic pain conditions including headache (Arnstein, 2000; Arnstein, Caudill, Mandle, Norris, & Beasley, 1999; Ford, Calhoun, Kahn, Mann, & Finkel, 2008; Leonardi, Raggi, Bussone, & D'Amico, 2010; Levin, Lofland, Cassisi, Poreh, & Blonsky, 1996; Magnusson & Becker, 2003; Rejeski, Craven, Ettinger Jr., McFalane, & Shumaker, 1996). In a study examining the effects of headache severity and frequency on disability experienced by migraineurs, pain severity was a stronger predictor of headache-related disability than headache frequency (Magunusson & Becker, 2003). Though pain severity is a strong predictor of disability, other factors are likely involved. Indeed, regression analyses have shown that the relationship between pain severity and pain-related disability is non-linear, suggesting that other contributing factors may affect disability associated with chronic pain (Magnusson & Becker, 2003; Rucker & Metzler, 1995; Serlin, Mendoza, Nakamura, Edwards, & Cleeland, 1995; Stewart et al., 2003). A considerable body of research supports Magnusson and Becker (2003) in their assertion that psychosocial factors such as self-efficacy beliefs likely contribute to the disability experienced by chronic pain sufferers (Ciccone, Just, & Bandilla, 1996; Nicholson, Hursey, & Nash, 2005; Turk, Okifuji, Starz, & Sinclair, 1996).

The Role of Self-Efficacy in Headache

Broadly, self-efficacy is defined as an individual's perception of (or confidence in) his or her ability to perform specific behaviors in certain contexts (Bandura, 1977a; Bandura, 1977b). Social learning theory asserts that individuals are more likely to engage, persist, and endure in behaviors that they believe will be successful (Bandura, 1977b). When applied to the management and prevention of pain, individuals with high self-efficacy are most likely to be confident in their ability to engage in adaptive coping skills. These individuals will subsequently be less likely to utilize pain-management and prevention skills they have acquired and to persist in their efforts to cope with their pain. Meanwhile, those who have lower levels of self-efficacy are less likely to be confident in their ability to manage their pain and subsequently cease pain management attempts in the absence of quick results, instead relying more readily upon medication for management of their condition (Bandura, O'Leary, Taylor, Gauthier, & Gossard, 1987; O' Leary, 1985).

As in other pain conditions, successful management and treatment of headache is dependent upon the patient's level of self-efficacy (Holroyd, Penzien, Rains, Lipchik, & Buse, 2008; Martin, Holroyd, & Rokicki, 1993; Nicholson et al., 2005). Using a cold-pressor task, Litt (1988) found that perceived level of self-efficacy affected pain tolerance and was predictive of how an individual would respond in the presence of aversive stimuli. Furthermore, increased self-efficacy predicts improved outcomes in a variety of chronic pain conditions. Self-efficacy is correlated with the increased efficacy and utilization of pain-coping skills, as well as increased physical and emotional functioning in individuals suffering from chronic joint pain disorders (Lefebvre et al., 1999; Rejeski et al., 1996; Sharma, Cahue, Song, Hayes, Pai, & Dunlop, 2003). In patients suffering from chronic pain in the lower back or limbs, self-efficacy is correlated with improved functioning, improved treatment outcomes, lower levels of pain, and lower ratings of disease severity (Kores, Murphy, Rosenthal, Elias, & North, 1990; Lacker, Carosella, & Feuerstein, 1996; Levin et al., 1996). Finally, in treating fibromyalgia patients, pre-treatment ratings of self-efficacy and changes in pre- to post-treatment self-efficacy were found to be predictive of better outcomes, as increased self-efficacy was associated with reduced disease severity, and pain intensity and increased physical ability (Buckelew et al., 1996).

Self-efficacy has been established as a reliable predictor of headache-related outcomes (Martin, Holroyd, & Rokicki, 1993; Nicholson et al., 2005). Self-efficacy also appears to underlie the efficacy of behavioral headache interventions. One of the most historically effective treatments of TTH is electromyographic (EMG) biofeedback training. The traditional explanation for the effectiveness of these procedures attributed decreased headache activity to physiological mechanisms involving relaxation of the pericranial muscles, prolonged contractions of which were implicated in causing TTH (Budzynski, Stoyva, Adler, & Mullaney, 1973). This physiological explanation, both for the efficacy of biofeedback and the mechanism of TTH, has since been discredited by studies showing that improvement in TTH via EMG biofeedback training alone or in combination with relaxation is mediated by changes in levels of self-efficacy (Blanchard, Kim, & Cu, 1993; Holroyd et al., 1984; Rokicki et al., 1997). In the Holroyd et al. study, self-efficacy predicted improvements in TTH even among patients who were trained to actually increase (versus decrease) their muscle tension during EMG biofeedback. In essence, the improvements resulting from EMG biofeedback were found to be the product of the cognitive changes stemming from performance feedback (of success) rather than changes in EMG activity.

Similar results have been found in other treatment studies of TTH. Holroyd and colleagues (2009) reported that the significant improvements in headache activity resulting from stress-management therapy alone or in combination with antidepressant medication were fully mediated by headache self-efficacy, regardless of headache severity. In addition, self-efficacy change resulting from the use of antidepressant medication alone had little role in the reduction of headache, providing evidence that the purported self-efficacy mediation was not simply the result of reduced headache frequency and intensity. Contrary to these findings, Seng and Holroyd (2010) found that the use of a beta-blocker for migraine prophylaxis was associated with increases in self-efficacy regardless of headache severity, although there were no significant differences between the changes in headache self-efficacy associated with the use of a beta-blocker versus use of a placebo. One proposed explanation for this finding is that the effectiveness of pharmacological migraine treatments results more from the act of taking medication rather than the medication's pharmacological effects. Seng and Holroyd (2010) found that behavioral therapy increased self-efficacy more than medication and the greatest increases in self-efficacy were attained when behavioral treatment was combined with medication. These studies support Bandura's assertion (1977a) that changes resulting from psychological (and perhaps medication) treatments are largely dependent on the procedure's ability to alter an individual's level of self-efficacy.

Headache, Self-Efficacy, and Disability

Given the number of studies highlighting the associations between high self-efficacy and reductions in pain-related impairment, as well as strong evidence that behavioral headache treatments are effective because they strengthen self-efficacy beliefs, potential interactions between headache severity and headache self-efficacy should be examined. The present model hypothesizes that the relationship between headache pain and headache disability is mediated by self-efficacy. If this model holds true, it would provide an explanation as to why headache treatments that increase self-efficacy levels are also effective in reducing headache-related disability, regardless of the pain severity experienced by the patient. Moreover, if confirmed, this model would provide support for a mechanism by which headache pain affects disability (MacKinnon, Fairchild & Fritz, 2007).

This basic model has been validated in several studies among samples of chronic pain patients. Self-efficacy has been found to act as a mediator between pain severity and disability in two studies of the physical and psychosocial components of pain (Arnstein et al., 1999; Arnstein, 2000). More recently, this mediational relationship has been confirmed in a sample of chronic low-back pain patients (Costa, Maher, McAuley, Hancock, & Smeets, 2011). These findings yield support for the proposed relationships between pain severity, self-efficacy, and disability resulting from pain. Furthermore, they imply that low self-efficacy contributes to disability even in the presence of only mild to moderate pain. However, most participants in previous studies have reported suffering from pain in the lower back, extremities, or midsection. Therefore, further research is needed to understand whether this model applies specifically to individuals suffering from primary headache disorders.

Preliminary support for the application of this model to those with primary headache disorders was provided when French and colleagues (2000) observed that headache self-efficacy was negatively correlated with both headache-related disability and headache severity among a sample of 329 CTTH sufferers. Though their study did not directly address the mediational model proposed by Arnstein and colleagues (1999 & 2000), it does confirm the basic premises that pain severity and self-efficacy are predictive of disability among headache patients. Their findings do not address temporal relations among the variables, nor the applicability of these findings to other headache diagnoses; thus, the extent to which this model holds across different primary headache diagnoses remains unknown. Headache diagnosis may moderate the degree to which self-efficacy mediates the relationship between pain severity and disability, given differences in severity, symptomatology, and disability among ETTH, episodic migraine (EM; with and without aura), and chronic migraine (CM).

Aims of the Present Study

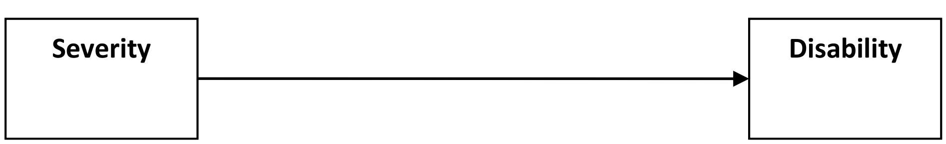
The principal goal of the present study is to examine whether headache self-efficacy mediates relations between pain severity and headache-related disability in a non-clinical sample of young adult headache sufferers. The present study also seeks to examine whether the strength of the proposed mediational role of self-efficacy differs by headache diagnosis. College students serve as an ideal population in which to assess these variables because of their high prevalence of headache (25% migraine prevalence: Smitherman, McDermott, & Buchanan, 2011; 33% ETTH: Bigal et al., 2001) and because their relatively short headache histories rarely are complicated by medication overuse or chronification.

Goals & Hypotheses

The following study goals and hypotheses are proposed:

Study Goal 1: To examine whether headache pain severity is associated with headache-related disability across diagnoses.

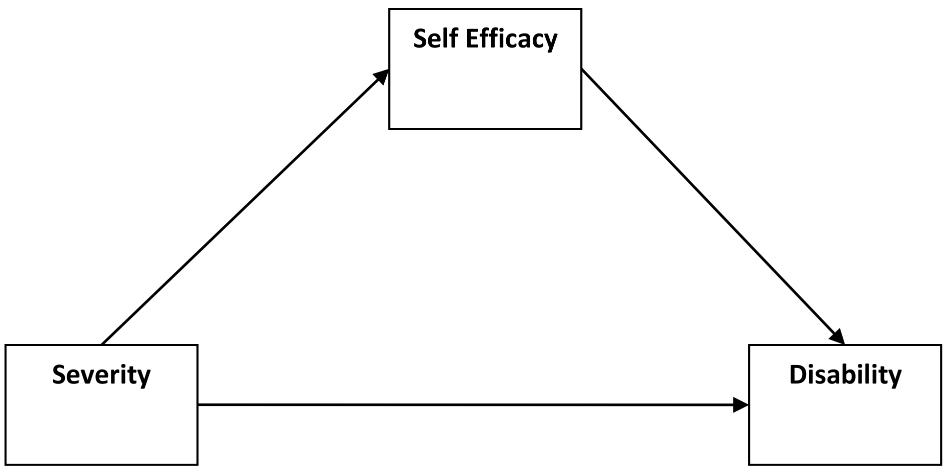
Figure 1: Proposed direct relationship between headache severity and headache disability.



Hypothesis 1: Headache severity will be significantly and positively correlated with disability regardless of headache diagnosis.

Study Goal 2: To examine whether headache self-efficacy acts as a mediator between headache severity and headache-related disability.

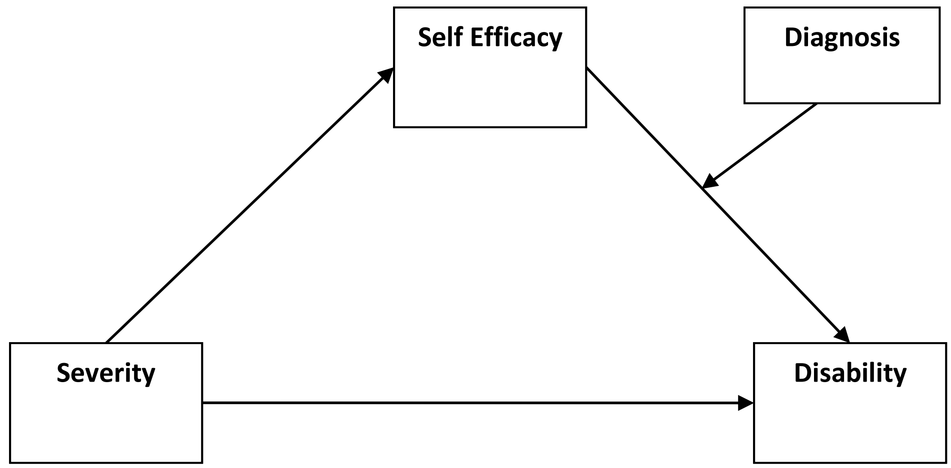
Figure 2: Proposed mediational model with headache self-efficacy as the mediator.



Hypothesis 2: Self-efficacy will at least partially mediate relations between pain severity and headache-related disability.

Study Goal 3: To examine whether headache diagnosis moderates any observed mediation effect of self-efficacy.

Figure 3: Proposed moderated-mediation model with headache diagnosis as the moderator.



Hypothesis 3: The strength of the relationship between headache self-efficacy and headache disability is moderated by headache diagnosis, such that the meditational role of self-efficacy will be strongest in individuals with CM, followed by EM and finally ETTH.

METHODS

Participants

Participants were undergraduate students enrolled in introductory psychology courses. Students were eligible if they were 18 years of age or older and fulfilled ICHD-II diagnostic criteria for CM, EM (with or without aura), or ETTH. ICHD-II criteria were followed strictly with the one exception that the minimum required duration of migraine was shortened from 4 hours to 2 hours in light of data showing that younger adult migraineurs often experience otherwise prototypical migraine attacks that are shorter than 4 hours (Rains, Penzien, Lipchik & Ramadan, 2001; Rasmussen, Jensen, & Olesen 1991). Assuming a moderate effect size ($f^2 = 0.15$), a power level of 0.8, and an alpha level of 0.05, a total sample size of 148 was required (Fritz & MacKinnon, 2007).

Materials

Demographic Questionnaire. Participants provided information pertaining to age, gender, marital status, race, employment status, level of education, income, religion, Greek status, relationship status, as well as mother and father's level of education.

Structured Diagnostic Interview for Headache – Revised. The Structured Diagnostic Interview for Headache – Revised (SDIH-II) is a structured headache diagnostic interview that assesses the presence of primary headache disorders in strict accordance with ICHD-II criteria. The 17 items inquire about headache type, frequency, pain severity, and other diagnostic characteristics and symptomatology. The instrument also provides information about the experience of aura symptoms and cluster headaches and can be used to rule out secondary causes such as post-traumatic headache (i.e., directly attributable to a head injury) and medication overuse. The original SDIH has been found to accurately identify migraine in both clinical and non-clinical populations (Andrew, Penzien, Rains, Knowlton, & McAnulty, 1992) and was modified slightly for the present study to adhere to ICHD-II diagnostic criteria and to be administered in a computerized format. This measure can be found in Appendix A.

Headache Management Self-Efficacy Scale-25. The Headache Management Self-Efficacy Scale-25 (HMSE-25; French et al., 2000) is a self-report instrument that quantifies an individual's perceived ability to prevent or manage her headaches. The scale is made up of 25 questions that are rated on a 7-point Likert-type scale with responses ranging from "strongly disagree" to "strongly agree". Nine of the items are reverse-scored. Higher scores are indicative of higher levels of self-efficacy. Scores range from 25 to 175. The HMSE has demonstrated excellent internal consistency ($\alpha = .90$) and construct validity via a positive correlation with Headache Specific Locus of Control Scale (HSLC; Martin, Holroyd, & Penzien, 1990) Internal Subscale ($r = 0.40$) and a negative correlation with the HSLC Chance subscale ($r = -0.64$) (French et. al, 2000). These findings suggest that individuals who score high on the HMSE are confident in their ability to manage and prevent their headaches and are less likely to believe their headaches are the result of chance (French et. al, 2000). This measure can be found in Appendix B.

Headache Impact Test-6. The Headache Impact Test-6 (HIT-6; Kosinski et al., 2003) is a 6-item self-report measure of the impact of headache on an individual's functioning. The instrument addresses how social functioning, cognitive functioning, and psychological distress are affected by headache. Each question requires the respondent to provide an estimate of frequency of impairment (over the last 4 weeks) on a 5-point Likert-type scale ranging from "never" to "always". Scores range from 36 to 78. This score provides a basis for organizing respondents into 4 levels of severity ranging from little or no impact to very severe impact. Headaches are seen as having little impact on an individual who scores 49 or less, some impact on those scoring 50-55, substantial impact on those scoring 56-59, and a very severe impact on those scoring 60 or more. The HIT-6 has shown good internal consistency (α= 0.90) and test-retest reliability (r = 0.78; Kosinski et al., 2003) as well as discriminant validity across headache diagnostic groups. This measure can be found in Appendix C.

Procedure

The aforementioned measures were included as part of a larger online survey battery. Students completed the online battery over three consecutive semesters and received modest course credit for their participation.

Statistical Analyses

Statistical analyses were conducted for participants who had complete data for all variables of interest. Before beginning the primary analyses, bivariate correlations between measures were tested using Pearson correlation analyses. The primary analyses were then conducted in three steps. First, the effects of headache severity on headache disability through self-efficacy were assessed, both directly and indirectly using standard path-analytic approaches described by Preacher and Hayes (2004, 2008) and MacKinnon (2008). Second, given the presence of a mediation effect, the extent to which the effect of self-efficacy on disability was moderated by headache diagnosis was estimated using a moderated ordinary least-squares (OLS) regression analysis (Hayes, 2013; Hayes & Mathes, 2009). Finally, mediation and moderation results were combined by estimating the conditional indirect effects of severity on disability through self-efficacy as a function of headache diagnosis, using the moderated-mediation approach (Hayes, 2013; Preacher, Rucker, & Hayes, 2007). Because the proposed moderator (headache diagnosis) was categorical, two dummy variables were created in order to code for the three-category diagnostic group variable. Gender was included as a covariate in the model due to findings suggesting that women report greater pain severity and disability scores than men (Bayliss et al., 2003; Stewart et al., 1994). The required criterion for statistical significance for each analysis was $p < .05$.

Preacher and Hayes' (2004, 2007, & 2008) approaches were chosen because they utilize a bootstrapping approach. Briefly, bootstrapping is a procedure that takes a predetermined number of samples from the original data set via random sampling with replacement. The indirect effect of each of the bootstrap samples is computed and tests of significance are conducted using a percentile-based confidence interval (95% CI) computed around these estimates of the indirect effect. To date, no consensus has been reached regarding the optimal number of bootstrap samples that should be generated. According to Preacher and Hayes (2008), 5,000 samples should be used for final reporting. Although it is likely that fewer samples would have been sufficient, for the purpose of this study, 5,000 were generated in order to minimize sampling variance.

RESULTS

Participant Demographics and Headache Diagnosis Prevalence

A total of 3613 students participated. Two-hundred eighty-one failed to complete the entire battery, 533 did not complete the headache-specific items necessary to render a valid headache diagnosis, and 323 evidenced suspect effort by taking less than 30 minutes to complete the 600+ items in the battery (i.e., ≥ 90th percentile of completion time speed; see Meade & Craig, 2012 and Smitherman & Kolivas, 2013). These participants were excluded from analyses, as were students who denied headache (n = 644), reported symptoms indicative of probable migraine (n = 426) or probable TTH (n = 356), or reported suffering from CTTH (n = 26), cluster headache (n = 31), or secondary headache attributable to head injury or medication overuse (n = 95). Finally, 76 participants were missing subscale scores on at least one of the measures of interest. As is standard in the estimation of path analytic models, these participants were also excluded from analyses (Chen, Aryee, & Lee, 2005; Preacher & Hayes, 2004) based on the reasoning that it would be misleading to present a "directional" model based on analyses of paths that were derived from different subsets of the data.

Table 1 presents the demographic characteristics of the sample. The sample consisted of 822 college students (71.2% female) with a mean age of 19.03 years (*SD* = 2.19). The majority (78.7%) of the sample was Caucasian, 16.1% were African-American, 2.4% were Hispanic/Latino, 1.6% were Asian, 0.9% identified as multiracial, and 0.3% were Native American/Pacific Islander. With regard to headache diagnosis, of the retained sample 378 participants (46 %) met ICHD-II diagnostic criteria for ETTH, 363 (44.2%) met the diagnostic criteria for EM (252 (30.7%) without aura and 111 (13.5%) with aura), and 81 (9.9%) met the criteria for CM. Participants reported experiencing headache 6.55 days per month (*SD* = 5.08), and average headache severity for the sample was 4.84 out of 10 (*SD* = 1.76). Participants reported a mean self-efficacy score of 111.10 (*SD* = 20.60) on the HMSE-25 and a mean score of

Table 1

Demographic Characteristics of the Sample

Variable	**% or Mean *(SD)***
Gender (% Female)	71.2
Mean Age (SD)	19.03 *(2.19)*
Race (% Caucasian)	78.7
Marital Status (% Never Married)	97.9
Education (% Some college)	55.6
Employment (% Unemployed)	77.2
Income (% >$50,000)	38.3
Greek (% Greek)	32.0
Religion (% Protestant/Evangelical)	55.8
Relationship (% In Relationship)	38.5
Father's Education (% ≥ bachelor’s degree)	62.0
Mother’s Education (% ≥ bachelor’s degree)	61.0
Mean Headache Severity *(SD)*	4.84 *(1.76)*
Mean HMSE Score *(SD)*	111.10 *(20.60)*
Mean HIT-6 Score *(SD)*	53.10 *(9.13)*

53.10 (*SD* = 9.13) on the HIT-6. Although approximately 39% of the sample reported experiencing little to no disability as a result of their headaches, nearly 40% endorsed substantial to very severe headache disability.

Data Analytic Assumptions

Histograms, Q-Q plots, and descriptive statistics (i.e., skewness, kurtosis) were used to assess data analytic assumptions for the variables of interest (SDIH-II pain severity scale, HMSE-25, HIT-6) and found to be satisfactory. All participants were assessed for multivariate outliers on the main total scores of interest by using Mahalanobis distance; two multivariate outliers (both CM) were found using a conservative $p < .001$ cutoff and were removed prior to subsequent analyses.

Although the distributional assumptions of the data were found to be satisfactory, Preacher and Hayes' (2004, 2007, 2008) bootstrapping techniques differ from traditional methods of meditational analyses in that they do not impose assumptions of normality (MacKinnon et al., 2007). The percentile-based CIs used in bootstrapping are based on empirical estimations of the sampling distribution, rather than the traditional assumption that the sampling distribution is normal. Therefore, percentile-based CIs can be (and often are) asymmetrical. Bias-corrected and accelerated CIs are reported when possible based on the assertion by MacKinnon and colleagues (2004) that the percentile-based CI can be further improved through bias-correction and acceleration, which adjust for both bias and skew. Although it is beyond the scope of this paper, a detailed and technical account justification of these methods is provided by Efron (1987) and Efron and Tibishirani (1993).

Correlations among the Variables under Study

Significant correlations were found between each of the variables. Headache severity showed a moderate negative association with headache self-efficacy, $r(818) = -.30$, $p < .001$, and showed a strong positive correlation with headache-related disability, $r(818) = .61$, $p < .001$, providing preliminary support for the first hypothesis. Higher reported headache self-efficacy was associated with lower levels of headache-related disability, $r(818) = -.32$, $p < .001$. As to be expected in a mediational analysis, all of the variables were at least moderately correlated. Therefore, a large sample size was obtained to minimize the impact of conceptual overlap.

Mediation Analysis

Using the INDIRECT procedure for SPSS (Preacher and Hayes, 2008), the effect of headache severity on disability was assessed directly and indirectly through self-efficacy. Each path is represented in terms of an unstandardized OLS regression coefficient. As depicted in Table 2, after controlling for gender, a total effect of headache severity on headache disability was 3.07, $p < .001$, further confirming that headache disability is greater for individuals who experience more severe headache pain. For every one-point increase in headache severity, HIT-6 scores increased by more than three points on average. The direct effect of headache severity on headache disability was 2.85, $p < .001$. Holding self-efficacy constant, a one-unit increase in headache severity was associated with a 2.85 unit increase in disability (HIT-6 scores).

Most relevant to the mediation hypothesis was the estimate of the indirect effect of headache severity on disability through self-efficacy. This effect was quantified as the product of two OLS regression coefficients, one estimating self-efficacy from pain severity (path *a* in Figure 4) and the other estimating headache disability from self-efficacy controlling for severity (path *a* in Figure 4) and the other estimating headache disability from self-efficacy controlling

Table 2

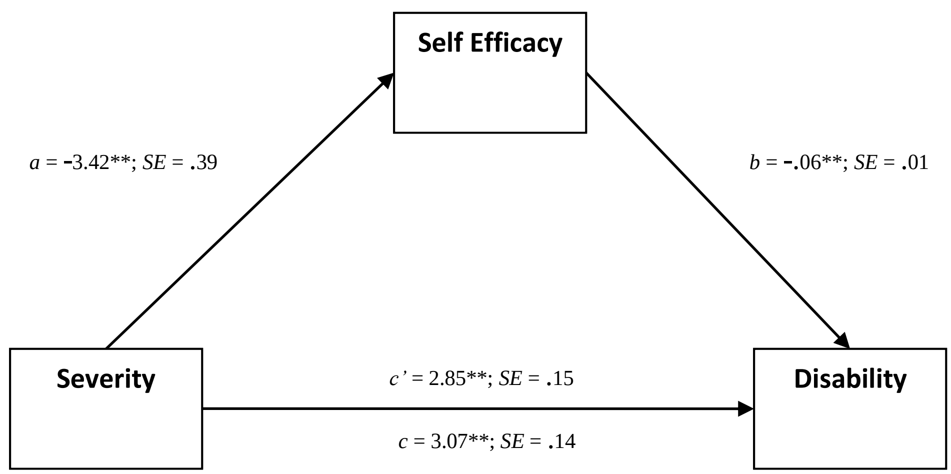
Regression results for indirect effect

						95% CI	
Predictor	**Pathway**	***B***	***SE***	***T***	***p***	***LL***	***UL***
Constants	I_M	130.96	3.02	43.29	<.01	125.02	136.89
	I_Y	42.54	1.99	21.38	<.01	38.64	46.45
HMSE on:							
Severity	*a*	-3.42	.39	-8.76	<.01	-4.18	-2.65
	R^2 = .09		-	-	<.01	-	-
Disability on:							
HMSE	*b*	-.06	.01	-4.96	<.01	-.09	-.04
Severity	*c'*	2.85	.15	19.29	<.01	2.56	3.14
Gender		2.18	.55	3.98	<.01	1.10	3.26
Indirect via:							
HMSE	*ab*	.22	.05	-	<.05	.12	.33
Total	*c*	3.07	.14	19.29	<.01	-	-
	R^2 = .41		-	-	<.01	-	-

**Note*. CI = confidence interval; LL = lower limit; UL = upper limit; HMSE = headache management self-efficacy.

for severity (path *b* in Figure 4). Path *a* indicates that a unit increase in headache severity was associated with a 3.42 unit decrease in self-efficacy (*a* = -3.42), and path *b* indicates that a unit increase in self-efficacy was associated with a reduction in disability of .06 units (*b* = .06). As reported in Table 2, the difference between the total and direct effects is the indirect effect through self-efficacy, which has a point estimate of .22 (95% CI = .12 - .33). As this bias-corrected and accelerated bootstrap CI did not include zero, the null hypothesis that the total indirect effect is zero was rejected, as the mediation effect was found to be significant at $\alpha < 0.05$. These results indicate that little of the variance in self-efficacy is explained by changes in headache severity ($R^2 = .093$); however, more than forty percent of variance in HIT-6 scores is accounted for by both self-efficacy and headache severity ($R^2 = .405$). These results provide support for the hypothesis that headache pain severity is associated with headache-related disability partially through headache self-efficacy.

Figure 4: Path coefficients for simple mediation analysis on headache-related disability



Note: c denotes the total effect while c' denotes the effect of headache severity on disability when self-efficacy is not included as a mediator. Gender was included as a covariate but is not represented here.
** $p < .01$

Moderation of the Effect of Self-Efficacy on Disability by Diagnosis

The mediation analysis provided evidence of a positive indirect effect of headache severity on disability through headache-management self-efficacy, with higher headache severity associated with lower self-efficacy, which in turn was related to a higher level of headache-related disability. Hypothesis 3 predicted that the indirect effect of headache severity would be moderated by headache diagnosis, such that any observed mediation via self-efficacy would be stronger for individuals with migraine than for those with TTH.

To test for moderation of the effect of self-efficacy on disability by headache diagnosis, an SPSS macro was utilized to generate an OLS regression model predicting disability from self-efficacy, headache diagnosis, and their products (along with gender as a control variable) using 5,000 bootstrapped estimates for the construction of a 95% bias-corrected CI coefficient (Hayes, 2013; Hayes & Mathes, 2009). This method produced calculations of the effect of self-efficacy on disability for individuals with specific headache diagnoses. Table 3 presents the results of an OLS regression model testing the hypothesis that the path between self-efficacy and disability (path *b* in Figure 4) was moderated by headache diagnosis.

As mentioned earlier, the three headache diagnoses were coded using two dummy variables. As depicted in Figure 5, when EM was coded as 1 and CM was coded as 0, a bootstrapped estimate of path b^4 was calculated for EM. When EM was coded as 0 and CM was coded as 1, a bootstrapped estimate of path b^5 was calculated for CM. When both variables were coded as 0, a bootstrapped estimate of path b^1 was calculated for ETTH. The regression coefficients for self-efficacy and diagnosis are conditional effects with their products in the model and can be found in Table 3. As expected, the interaction for individuals with ETTH was not significantly different from zero (b_1 = -.02, p = .18), indicating that when holding constant headache severity among individuals with ETTH, those with relatively low self-efficacy were no more disabled than those higher in self-efficacy. In contrast, the interaction for EM was significant (b_4 = -.054, p = .03) and accounted for .3% of the variance in disability. Last, the interaction for CM was non-significant (b_5 = -.035, p = .42), accounting for only .04% of the

Table 3

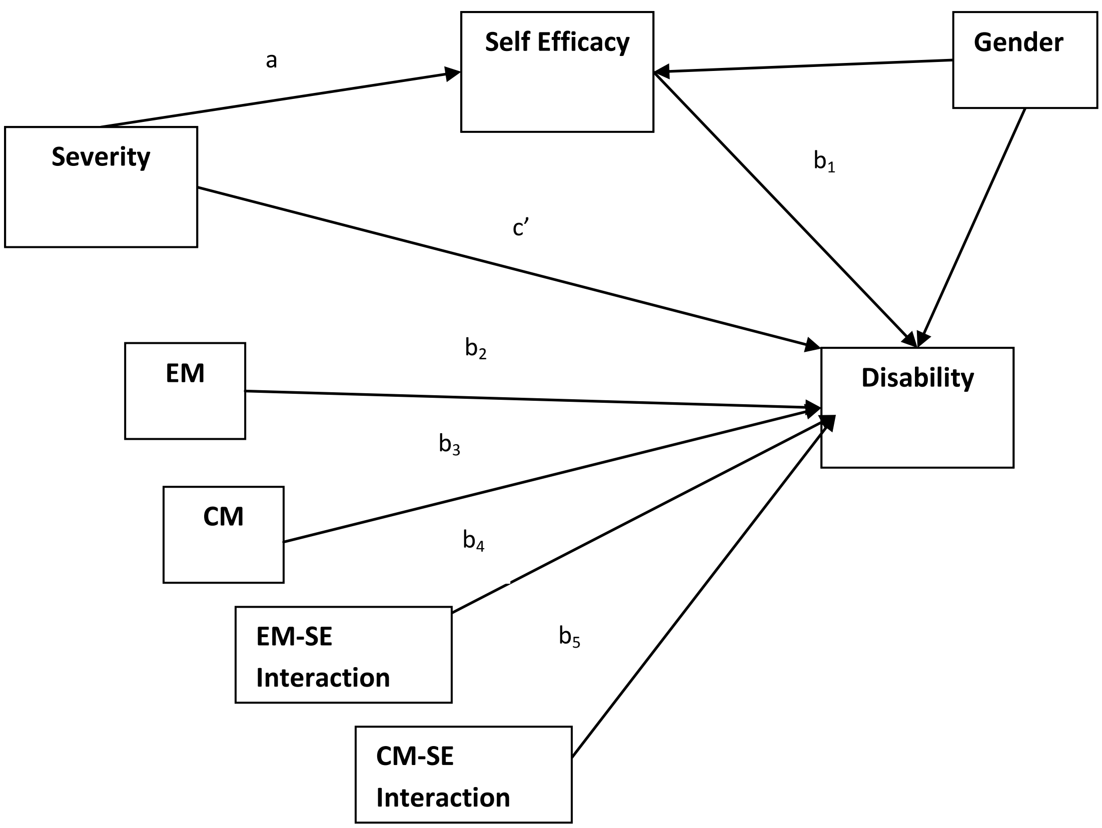
Regression results for conditional effect of self-efficacy on disability.

Predictor	Pathway	B	SE	T	p	95% CI LL	95% CI UL
Constants	*Iy*	40.13	2.39	16.80	<.01	35.44	44.82
HMSE	*b*	-.02	.02	-1.33	.18	-.06	.01
EM	b^2	10.85	2.92	3.71	<.01	5.12	16.59
CM	b^3	10.54	4.62	2.28	.02	1.47	19.61
Interaction 1 (EM)	b^4	-.05	.03	-2.12	.03	-.10	>-.01
Interaction 2 (CM)	b^5	-.04	.04	-.81	.42	-.12	.05
Severity	*c'*	2.03	.17	11.96	<.01	1.69	2.36
Gender		1.65	.53	3.11	<.01	.61	2.68
Effect of SE on Disability for:							
ETTH		-.02	.02	-1.33	.18	-.06	.01
EM		-.08	.02	-4.20	<.01	-.11	-.04
CM		-.06	.04	-1.46	.14	-.14	.02
Severity		2.03	.17	11.96	<.01	1.69	2.36
R^2 increase due to interactions:	R^2 change	*F*	*df1*	*df2*	*p*		
EM	.003	4.48	1	812	.03		
CM	.0004	.65	1	812	.42		
Both	.003	2.26	2	812	.10		

**Note.* Interaction 1 = HMSE x EM; Interaction 2 = HMSE x CM.

variance. These results indicate that the effect of self-efficacy on disability is negative and significant for those with EM (point estimate = -0.08, 95% CI = -0.11 – -0.04), whereas the effect of self-efficacy on disability is not significantly different from zero for individuals with CM (point estimate = -0.06, 95% CI = -0.14 – 0.02) and ETTH (point estimate = -0.02, 95% CI = -0.06 – 0.01).

Figure 5: Path coefficients for moderated mediation analysis on headache-related disability



Note, Conditional indirect effect of X on Y through M = $a(b_1+b_4V+b_5Q)$. Direct effect of X on Y = c'

The direct effect (*c*') quantifies how much two individuals who differ by one unit in headache severity are estimated to differ in disability when holding constant both self-efficacy and diagnosis. As displayed in Table 3, the direct effect was positive and significant (*c*' = 2.03, *p*

< .01). Thus, two individuals differing by one unit in headache severity but equal in headache self-efficacy and with the same diagnosis are expected to differ by 2.03 units on the HIT-6, such that higher headache severity is associated with greater disability.

Moderated Mediation

As evidenced previously, the simple mediation analysis established that headache severity was positively associated with disability through headache-management self-efficacy. Headache severity was associated with lower self-efficacy, which in turn was associated with higher disability scores. The moderation analysis showed that the effect of self-efficacy was contingent upon diagnosis, with the effect of self-efficacy being significant for those with EM only. Considered together, these findings provide evidence of moderated mediation. The indirect effect of headache severity on disability is contingent upon diagnosis. However, to this point, it is unclear whether the indirect effects differ from zero for individuals with differing headache diagnoses. In order to examine this interaction, indirect effects were calculated at specific values of the moderator using the methods outlined by Hayes (2013) and Preacher and colleagues (2007). The point estimates and 95% CIs for the conditional indirect effect can be found in Table 4. For individuals with ETTH, the conditional effect of self-efficacy on disability was not significantly different from zero (point estimate = .08, 95% CI: -.03 to .21). Differentially, for both EM (point estimate = .26, 95% CI: .12 to .43) and CM (point estimate = .20. 95% CI: .0009 - .43), the conditional indirect effect was significant. Thus, regardless of an individual's diagnosis, those with higher self-efficacy tended to be less disabled by their headaches, as the conditional effects for each diagnosis were all positive. However, this effect was statistically significant only for individuals with migraine, and the effect was largest for those with EM.

Table 4

Conditional indirect effect regression coefficients

						95% CI	
Indirect Effect for:	**Pathway**	**B**	**SE**	**T**	**p**	**LL**	**UL**
ETTH	ab^1	.08	.06	-	>.05	-.03	.21
EM	ab^2	.26	.08	-	<.05	.12	.43
CM	ab^3	.20	.11	-	<.05	<.01	.43
	R^2	.46	-	-	<.01	-	-

Given that the indirect effect was significantly different from zero for migraineurs but not for individuals with ETTH, a secondary analysis was implemented to examine whether the conditional indirect effect for one diagnostic group was statistically different from the conditional indirect effect for another diagnostic group. As shown at the bottom of Figure 5, the conditional indirect effect of headache severity is equal to $a(b_1+b_4V+b_5Q)$, where V = EM and Q = CM. For the purpose of this analysis, both diagnosis variables were dummy-coded; therefore V = 1 for individuals with EM and V = 0 for all other diagnoses. Similarly, Q = 1 for individuals with CM and Q = 0 for all other diagnoses. Thus, 95% confidence intervals can be calculated utilizing the following equations to determine whether statistically significant differences exist between each of the diagnostic groups in terms of the conditional indirect effect of headache severity on disability through self-efficacy:

Equation 1 = EM v. CM: $ab_1(0)+ab_4(1)+ab_5(0)$ - $ab_1(0)+ab_4(0)+ab_5(1)$

$$ab_4(1)+ab_5(0)- ab_4(0)+ab_5(1)$$

or

$$ab_4- ab_5$$

$$\text{Equation 2 = EM v. ETTH: } ab_1+ab_4(1)+ab_5(0)- ab_1(1)+ab_4(0)+ab_5(0)$$

or

$$ab_4- ab_1$$

$$\text{Equation 3 = CM v. ETTH: } ab_1+ab_4(0)+ab_5(1)- ab_1(1)+ab_4(0)+ab_5(0)$$

or

$$ab_5- ab_1$$

The indirect effect for the EM groups was slightly but not significantly greater than that of both the CM group, with a point estimate of .06 (95% CI = -.20 - .32), and the ETTH group (point estimate = .10; 95% CI = -.17 - .36). Further, the CM group was slightly but not significantly greater than the ETTH group (point estimate = .04, 95% CI = -.28 - .36). Although the indirect effect of headache severity on disability through self-efficacy differed significantly from zero for migraineurs, the indirect effect does not differ significantly between diagnostic groups. This finding is supported by the finding that R^2 changed only minimally when interactions between diagnosis and disability were added to the model (Table 3).

DISCUSSION

The present study sought to examine how headache severity is associated with headache-related disability. Although previous studies have examined this question in samples of chronic musculoskeletal pain patients (Arnstein, 2000; Arnstein et al., 1999; Costa et al., 2011), the present study extends these findings by examining the role of self-efficacy as a potential mediator among a sample of individuals suffering from headache disorders. Further, the present study builds upon previous research by examining whether the proposed mediational relationship differs as a function of headache diagnosis and by utilizing updated statistical methodology for assessing mediation.

Self-Efficacy as a Mediator

As hypothesized, a significant positive bivariate correlation was found between severity and disability. This finding is consistent with previous research (Arnstein, 2000; Ford et al., 2008; Leonardi et al., 2010; Magnusson & Becker, 2003) and indicated the presence of an effect to be mediated. Although these data were not collected among individuals who were presenting for headache treatment, a significant number were significantly impaired by their condition. Many individuals reported headache pain that interfered with home or family responsibilities, occupation, school, and social activities.

A mediation analysis showed that the positive association between headache severity and disability was driven in part by headache management self-efficacy. This finding is supported by previous cross-sectional and longitudinal studies of individuals with chronic muskuloskeletal pain (Arnstein et al. 1999; Arnstein, 2000; Costa et al., 2011). Individuals with higher self-efficacy scores were less disabled than individuals with lower self-efficacy scores, even if ratings of pain severity were held constant. Findings were significant even after controlling for gender, which was as a significant predictor of disability in this study as well as in previous research (Bayliss et al., 2003). This finding builds upon Bandura's theories (1977a; 1977b) and recent research indicating that a belief in personal efficacy is adaptive in coping with pain (Costa et al., 2011; Holroyd et al., 2008; Vancleef & Peters, 2011). These findings extend the conclusions of previous chronic pain studies by showing that headache sufferers, similar to individuals suffering from chronic musculoskeletal pain, may experience disability in part due to the belief that they can do little to prevent or reduce their pain.

Despite the statistical significance of self-efficacy as a mediator, the clinical significance of this mediation effect is questionable. Less than 10% of the variance in self-efficacy was explained by headache severity ($R^2 = .093$), whereas 41% of the variance in headache disability was accounted for by both self-efficacy and headache severity, similar to the results reported by Arnstein and colleagues (1999; 2000). However, there is a substantial amount of unexplained variance in disability that is attributable to some other processes or mechanisms not included in the model. According to Castien and colleagues (2012), a clinically significant reduction in HIT-6 scores is at least 8 points (on a total range of 42). Given the relatively modest indirect effect of headache severity on disability through self-efficacy, changes in self-efficacy resulting from changes in disability are not likely to produce clinically significant changes in headache disability. Therefore, clinically meaningful changes in disability may be attained more via interventions that influence pain severity directly or via interventions that influence pain severity's effect on disability through some mediator not included in the present model.

Despite the significant but rather modest meditational effects of self-efficacy in the present study, the development of self-efficacy remains a major component of behavioral headache interventions. Many headache patients benefit from behavioral treatments designed to increase self-efficacy, either as an alternative to or in conjunction with pharmacological treatments. Behavioral treatments of migraine have been shown to produce increases in self-efficacy and headache activity (Holroyd et al., 2008; Nestoriuc, Martin, Rief, & Andrasik, 2008) and may hold particular benefits for those who possess low levels of headache-management self-efficacy. Headache treatment studies examining self-efficacy frequently utilize headache activity, specifically frequency, severity, and duration as outcome variables. These studies show that improvements in self-efficacy frequently are associated with improvements in headache activity (Blanchard et al., 1993; Holroyd et al., 1984; Holroyd et al., 2009; Rokicki et al., 1997). Given that self-efficacy is associated with both headache activity and disability, an important empirical inquiry would be which outcome variable is most strongly associated with self-efficacy. Further, certain subgroups of headache sufferers may benefit from treatments that address psychological factors other than self-efficacy (Holroyd et al., 2009). Emotional distress, pain-related anxiety, depression, headache-related locus of control beliefs, and stress are associated with increased disability (French et al., 2000; Nash et al., 2006) and reduced response to headache treatments (Holroyd et al., 2009), although these variables were not assessed in the present study.

The modest role of self-efficacy conflicts somewhat with a large body of research asserting that self-efficacy is a very strong predictor of disability and other deleterious clinical outcomes resulting from primary headache disorders and other chronic pain conditions (Arnstein et al., 1999; Bandura, 1977a; Holroyd et al., 2009; Martin et al., 1993; Nicholson et al., 2005;

Somers, Wren, & Shelby, 2012). However, these findings are based on samples composed primarily of treatment-seeking patients, and few studies have examined the causal effects of self-efficacy on pain-related disability (Arnstein, 2000; Arnstein et al., 1999; Costa et al., 2011; Holroyd et al., 2008). As the present study examined a non-clinical sample of individuals primarily reporting episodic pain of mild to moderate severity (Hirschfeld & Zernikow, 2013), the role of self-efficacy was compared across headache diagnostic groups.

Headache Diagnosis as a Moderator

Individuals with TTH typically experience pain that is not as severe as that experienced by migraineurs (Lipton et al., 2008; Rasmussen et al., 1991). Further, in comparison to migraineurs, those with ETTH are not as disabled by their pain (Bigal et al., 2001; Fuh, Wang, Lu, Liao, Chen, & Yang, 2010). As self-efficacy is negatively correlated with both pain severity and disability (French et al., 2000; Nicholson et al., 2005), it was predicted that as a group individuals with ETTH would report higher self-efficacy than individuals with migraine and that self-efficacy beliefs would be less relevant among those with ETTH versus migraineurs.

Consistent with this hypothesis, after controlling for headache severity, self-efficacy was associated with disability for those with EM but not CM or ETTH. In contrast, a significant mediation effect was observed among individuals with both EM and CM such that higher headache severity was associated with lower disability via change in self-efficacy among individuals with migraine. Thus, while self-efficacy scores may be relatively high among individuals with ETTH, high self-efficacy does not appear to buffer them from the deleterious effects of headache pain. These findings extend prior research (French et al., 2000; Holroyd et al., 2009) by demonstrating that the association between self-efficacy and disability is not significant for all headache sufferers, indicating the need to consider not only how disability occurs, but also under what circumstances.

The finding of moderated mediation (i.e., that self-efficacy's effect on disability was contingent upon diagnosis) may be explained by reference to social learning theory (Soderlund & Asenlof, 2010). After repeated failures in their attempts, individuals with very frequent headache may come to believe that they can do little to prevent and manage their pain and thus fail to engage in necessary coping strategies (Bandura, 1977b). Therefore, self-efficacy may act as a buffer for those with EM but not CM. Finally, headache diagnosis may not be the most useful moderator variable, given overlap between diagnostic symptoms of migraine and TTH and frequent comorbidity between the two diagnoses (Marcus, 1992; Turkdogan, Cagirici, Soylemez, Sur, Bilge, & Turk, 2006). Variables such as headache frequency or the presence of psychopathology such as anxiety or depression, both of which are more common among individuals with more chronic headache conditions (Bigal Sheftell, Rapoport, Tepper, Weeks, & Baskin, 2003; Breslau & Davis, 1993; Lipton & Bigal, 2005; Swartz, Pratt, Armenian, Lee, & Eaton, 2000), may more strongly influence the relationship between self-efficacy and disability.

Limitations and Future Directions

Strengths of the current study included a large sample size composed entirely of primary headache sufferers and strong statistical methodology. However, some limitations are worth bearing in mind when drawing conclusions from the current study. The present study is cross-sectional; therefore, even significant associations among variables should be interpreted as correlational rather than causal due to uncertainty regarding the temporal ordering of the variables. For example, although it was assumed that reductions in self-efficacy lead to greater disability for headache patients, individuals with greater disability may perceive their actions as less effective. Despite uncertainty regarding the temporal ordering of the variables in the present study, hypotheses were based on well-established research suggesting that self-efficacy predicts pain-related disability (Lacker, et al., 1996; Sharma et al., 2003) and mediates important health outcomes (Bandura, 1977b, O'Leary, 1985; Holden, 1991). Nevertheless, until studies are completed where self-efficacy is experimentally manipulated, causality cannot be assumed. Although self-efficacy is significantly associated with headache disability, the magnitude of the relationship, which is critical to the evaluation of self-efficacy's theoretical and clinical utility, remains unclear and varies across studies. Studies implementing behavioral interventions designed to increase self-efficacy would be useful in examining whether changes in self-efficacy are able to produce clinically significant changes in disability per se. Future studies utilizing structural equation modeling or the longitudinal methods outlined by MacKinnon and colleagues (2007) are needed to establish the presence and direction of cause-effect relationships among the various interrelated facets of headache pain.

Second, though the sample was large, it was a convenience sample with limited diversity. While the finding that the majority of the sample was comprised primarily of women was expected (Fukui et al., 2008), diversity in race and age was limited. Nonetheless, the mean ratings of headache severity (M = 4.82), self-efficacy (M = 110.99), and disability (M = 53) obtained in the present study are consistent with previous studies of individuals diagnosed with primary headache disorders (Bayliss et al., 2003; French et al., 2000; Kosinski et al., 2003; Lipton et al., 2007 Rasmussen et al., 1991); therefore, conclusions drawn from this study are likely to be representative of primary headache sufferers as a population. However, replication with treatment-seeking samples and more diverse participants would further inform the proposed relationships, as these conclusions may not apply to treatment-seeking individuals. Future studies may also build upon the findings of the present study by examining individuals with primary headache diagnoses other than those examined here (e.g. CTTH, cluster headache).

Third, despite the fact that our mediation model was significant, future research is needed that examines other potential mediators and moderators of the relationship between severity and disability. Headache-related control beliefs, emotional distress, pain-related anxiety, and headache frequency are other variables that merit examination as potential mediators of the relationship between headache pain severity and disability. Headache-related locus of control, or the attribution of headaches and headache relief to oneself, health professionals, or chance, is associated with headache disability (Martin et al., 1990), as are negative affective states (French et al., 2000; Holroyd et al., 2009; Nash, Williams, Nicholson, & Trask, 2006; Trask, Iezzi, & Kreeft, 2001), with one study finding that that pain-related anxiety was a stronger predictor of headache disability than self-efficacy (Nash et al., 2006).

Significant advancements have been made in the area of statistical analyses for mediation and moderation but have yet to be regularly implemented in the field of chronic head pain. The tools and macros discussed in this article are freely available to researchers and allow for efficient analysis even when the model consists of a large number of variables. Therefore, in addition to examining new variables and how they contribute to headache disability, future research should employ new theoretical models such as those proposing multiple mediators (Preacher & Hayes, 2008). Such models may account for a greater amount of variability in disability than the present model and would afford comparisons between proposed mediators in terms of which variables contribute most heavily to headache disability.

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LIST OF APPENDICES

APPENDIX A: STRUCTURED DIAGNOSTIC INTERVIEW FOR HEADACHE-REVISED

Structured Diagnostic Interview for Headache – Revised

1. Do you ever get headaches?

   a. Yes   b. No

2. On average, how many DAYS PER MONTH do you have a headache?

   _____ days

3. How long have your headaches been occurring at this rate?

   _____ months   OR _____years

4. If 0 is no pain, 5 is moderate pain, and 10 is the worst pain imaginable, what is the average pain intensity of these headaches (*pick one number between 0 and 10*)?

   _____

5. If left untreated or unsuccessfully treated, about long would these headaches usually last?

   _____ hours

6. For approximately how long have you had these headaches?

   _____ months   OR   _____ years

7. About how many of these headaches have you had in your life?

   a. Less than 5

   b. 5 – 10

   c. 11 – 20

   d. More than 20

8. Which of the following best describes your pain?

   a. Pulsating/Throbbing b. Tight pressure (non-pulsating)

9. Is the pain typically experienced on one side or both sides of your head?

a. Typically one side   b. Typically both sides

10. Is the pain made worse by routine physical activities or cause you to avoid routine physical activities (like walking, bending over, or climbing stairs)?

a. Yes   b. No

11. Do you often feel nauseous or sick to your stomach during these headaches?

a. Yes   b. No

12. Do you often vomit or throw up during these headaches?

a. Yes   b. No

13. Are you often sensitive to light during these headaches?

a. Yes   b. No

14. Are you often sensitive to sound during these headaches?

a. Yes   b. No

15. Do you often experience any symptoms before the headache pain actually begins, such as changes in your vision (blurry vision, seeing spots or lines), changes in your sensation (numbness, tingling), or changes in your speech?

a. Yes

b. No

16. How many times have you experienced these symptoms before having a headache?

a. 1

b. 2 – 5

c. 6 – 10

d. More than 10

17. Do you use any medications to treat these headaches?

a. Yes

b. No

18. If you use medication, how many days per week do you use any type of medication to treat your headaches?

a. Less than 1 day per week

b. 1-2 days per week

c. 3 days per week

d. 4 or more days per week

19. How long have you been using these medications at this frequency?

a. 3 months or less

b. More than 3 months

20. Did your headache develop or get worse when you started using these medications at this frequency?

a. Yes

b. No

21. Did this headache develop shortly after a head injury or head trauma?

a. Yes

b. No

22. Have you ever been diagnosed with cluster headaches?

a. Yes

b. No

23. Do these headaches interfere with your work, school, or personal life?

a. Yes

b. No

24. Which of the following trigger (cause) your headaches? (*Select ALL that apply*)

a. Stress

b. Menstruation

c. Noise

d. Odors/smells

e. Not eating

f. Alcohol

g. Weather changes

h. Not getting enough sleep

i. Sleeping too much or too long

j. Exercise

k. Sexual activity

l. Smoking

m. None of these trigger my headaches

25. From the list of triggers below, which of the following is the MOST important in causing your headaches? (*Select ONLY one*)

a. Stress

b. Menstruation

c. Noise

d. Odors/smells

e. Not eating

f. Alcohol

g. Weather changes

h. Not getting enough sleep

i. Sleeping too much or too long

j. Exercise

k. Sexual activity

l. Smoking

m. None of these trigger my headaches

26. If you encountered this most important trigger, what are the chances (0 - 100% likelihood) that you would get a headache? (*pick one number between 0 – 100%)*

_____ %

27. In a typical 30-day month, on how many days would you usually encounter this most important trigger? (*pick one number between 0 and 30 days*)

_____ days

APPENDIX B: HEADACHE MANAGEMENT SELF-EFFICACY SCALE-25

HMSE-25

Instructions: You will find below a number of statements related to headaches. Please read each statement carefully and indicate how much you agree or disagree with the statement by circling a number next to it. Use the following scale as a guide:

Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree or Disagree	Slightly Agree	Moderately Agree	Strongly Agree
1	2	3	4	5	6	7

1)	I can keep even a *bad* headache from disrupting my day by changing the way I respond to the pain.	1	2	3	4	5	6	7
2)	When I'm in some situations, nothing I do will prevent headaches.*	1	2	3	4	5	6	7
3)	I can reduce the intensity of a headache by relaxing.	1	2	3	4	5	6	7
4)	There are things I can do to reduce headache pain.	1	2	3	4	5	6	7
5)	I can prevent headaches by recognizing headache triggers.	1	2	3	4	5	6	7
6)	Once I have a headache there is nothing I can do to control it.*	1	2	3	4	5	6	7
7)	When I'm tense, I can prevent headaches by controlling the tension.	1	2	3	4	5	6	7
8)	Nothing I do reduces the pain of a headache.*	1	2	3	4	5	6	7
9)	If I do certain things every day, I can reduce the number of headaches I will have.	1	2	3	4	5	6	7
10)	If I can catch a headache before it begins I often can stop it.	1	2	3	4	5	6	7

Please complete reverse side

Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree or Disagree	Slightly Agree	Moderately Agree	Strongly Agree
1	2	3	4	5	6	7

11)	Nothing I do will keep a mild headache from turning into a bad headache.*	1	2	3	4	5	6	7
12)	I can prevent headaches by changing how I respond to stress.	1	2	3	4	5	6	7
13)	I can do things to control how much my headaches interfere with my life.	1	2	3	4	5	6	7
14)	I <u>cannot</u> control the tension that causes my headaches.*	1	2	3	4	5	6	7
15)	I can do things that will control how long a headache lasts.	1	2	3	4	5	6	7
16)	Nothing I do will keep a bad headache from disrupting my day.*	1	2	3	4	5	6	7
17)	When I'm not under a lot of stress I can prevent many headaches.	1	2	3	4	5	6	7
18)	When I sense a headache is coming, there is nothing I can do to stop it. *	1	2	3	4	5	6	7
19)	I can keep a *mild* headache from disrupting my day by changing the way I respond to the pain.	1	2	3	4	5	6	7
20)	If I am under a lot of stress there is nothing I can do to prevent headaches.*	1	2	3	4	5	6	7
21)	I can do things that make a headache seem not so bad.	1	2	3	4	5	6	7
22)	There are things I can do to prevent headaches.	1	2	3	4	5	6	7

23)	If I am upset there is nothing I can do to control the pain of a headache.*	1	2	3	4	5	6	7
24)	I can control the intensity of headache pain.	1	2	3	4	5	6	7
25)	I can do things to cope with my headaches.	1	2	3	4	5	6	7

APPENDIX C: HEADACHE IMPACT TEST-6

HIT-6™
(VERSION 1.1)

This questionnaire was designed to help you describe and communicate the way you feel and what you cannot do because of headaches.

To complete, please circle one answer for each question.

HEADACHE IMPACT TEST™

1 When you have headaches, how often is the pain severe?

Never	Rarely	Sometimes	Very Often	Always

2 How often do headaches limit your ability to do usual daily activities including household work, work, school, or social activities?

Never	Rarely	Sometimes	Very Often	Always

3 When you have a headache, how often do you wish you could lie down?

Never	Rarely	Sometimes	Very Often	Always

4 In the past 4 weeks, how often have you felt too tired to do work or daily activities because of your headaches?

Never	Rarely	Sometimes	Very Often	Always

5 In the past 4 weeks, how often have you felt fed up or irritated because of your headaches?

Never	Rarely	Sometimes	Very Often	Always

6 In the past 4 weeks, how often did headaches limit your ability to concentrate on work or daily activities?

Never	Rarely	Sometimes	Very Often	Always

COLUMN 1 (6 points each)	+	COLUMN 2 (8 points each)	+	COLUMN 3 (10 points each)	+	COLUMN 4 (11 points each)	+	COLUMN 5 (13 points each)

To score, add points for answers in each column.

Please share your HIT-6 results with your doctor.

Total Score

Higher scores indicate greater impact on your life.

Score range is 36-78.

VITA

Kelly R. Peck
Curriculum Vitae

KRPeck@go.olemiss.edu
Room 205 Peabody Building
University, MS 38677
(901) 848-4275

EDUCATION

Louisiana State University, Baton Rouge, LA 2005-2006

University of Memphis, Memphis, TN 2007-2010
- -Degree: B.A., Magna Cum Laude
- -Major: Psychology

University of Mississippi, Oxford, MS 2011-Present
- -Expected 2016
- -Degree: M.A./ Ph.D.
- -Major Field: Clinical Psychology
- -Concentration: Behavioral Health and Pain Research
- -Mentor: Todd A. Smitherman, Ph.D.

AWARDS

-Second Place Winner in Social and Behavioral Sciences at the University of Memphis Student Research Forum for Peck, K.R., Buscemi, J., Murphy, J.G., *Exploration of Relations between Type of Residence and Alcohol Consumption in University of Memphis Students*. Presented on April, 5 2010.

RESEARCH EXPERIENCE

-Research Assistant- University of Memphis Psychotherapy Lab, August 2008-December 2008

-Research Assistant- Health and Addictive Behavioral Interventions Lab, January 2009–May 2010

-Research Assistant- University of Memphis School of Public Health, May 2010-June 2011

-Interviewer/ Research Assistant-University of Rochester- *New Mothers Study*- May 2010-August 2012

-Research Assistant-University of Mississippi -Behavioral Health and Headache Lab-August 2011-Present-St. Jude Research Hospital Psychology Department September 2012- Present

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EDITING AND REVIEWING

Ad Hoc Reviewing

- •Behaviour Research and Therapy
- •Cephalalgia
- •Headache
- •Pediatric Blood and Cancer
- •Book Chapters for forthcoming *Assessment of Children: Behavioral, Social, and Clinical Foundations, Sixth Edition* text by Jerome Sattler

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POSTER PRESENTATIONS

Buscemi, J.**,** Murphy, J. G., Martens, M. P., McDevitt-Murphy, M. E., Pederson, A. A., Skidmore, J. R., & Peck, K. R. *Help-Seeking for Alcohol Use in College Students: Correlates and Preferred Methods*. Presented at the 2009 annual convention of the Association of Behavioral and Cognitive Therapies, Addictive Behaviors SIG, New York, NY.

Ehrentraut, J. H., Jurbergs, N., Peck, K. R., Canavera, K., & Willard, T. (2013, October). Treatment Acceptability of a Brief, Single-Session Workshop for Families of Children with Chronic Pain. Poster presented at the International Forum on Pediatric Pain, Nova Scotia, Canada.

Peck, K.R., Buscemi, J., Murphy, J.G., Martens, M.P. McDevitt-Murphy, M.E., Pederson, A.A., Skidmore, J.R. *Characteristics of College Students Who Seek Help for Alcohol Problems.* Presented at the 2009 convention of the Tennessee Psychology Association, Nashville, TN.

Peck, K.R., Buscemi, J., Murphy, J.G., *Exploration of Relations Between Type of Residence and Alcohol Consumption in University of Memphis Students.* Presented at the 2010 University of Memphis Student Research Forum, Memphis, TN.

Peck, K. R. *Center for Epidemiologic Studies Depression Scale (CES-D) and Middle-Eastern Populations.* Presented at the 2012 convention of the Mississippi Psychological Association , Gulfport, MS.

Peck, K.R., Nicholson, J., & Tyc, V.L. *Parent-Reported Exposure to Second-Hand Smoke in Motor Vehicles for Children on Treatment for Cancer.* Presented at the 2013 National Conference in Pediatric Psychology, New Orleans, LA.

Peck, K.R., Nicholson, J., & Tyc, V.L. *Mediation and Moderation of Secondhand Smoke Exposure (SHSe): The Role of Self-Efficacy (SE) and Perceived Vulnerability in Parents of Pediatric Cancer Patients.* To be presented at the 2013 annual convention of the Association of Behavioral and Cognitive Therapies, Addictive Behaviors SIG, Nashville, TN.

Peck, K.R., Moynahan, V.L., & Smitherman, T. A. *Relationships between Self-Efficacy, Headache Diagnosis, and Impairment.* To be presented at the 2013 annual convention of the Association of Behavioral and Cognitive Therapies, Addictive Behaviors SIG, Nashville, TN.

PUBLICATIONS

McDermott, M. J., Peck, K. R., Walters, A. B., & Smitherman, T. A. (2013). Do migraineurs selectively attend to headache-related visual stimuli? *Headache*, *53*, 356-364*.* doi: 10.1111/head.12011

Peck, K. R., Smitherman, T. A., & Baskin, S. M. (In Press) Traditional and Alternative Treatments for Depression: Implications for Migraine Management.

Davis, R. E., Peck, K. R., Hamer, J. D., & Smitherman, T. A. (2013) Relations between alcohol use and migraine among young adults. [Published abstract]. *Cephalalgia, 33*(Suppl.1), 266.

Peck, K.R., Tyc, V. L., Huang, Q., & Zhang, H. (in preparation) Secondhand Smoke Exposure in Cars of Children with Cancer

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PRESENTATIONS

Peck, K. R. *Parent-Reported Secondhand Smoke Exposure in the Car: Trends and Predictors.* Presented at Psychology Rounds on July 29, 2013, St. Jude Children's Research Hospital, Memphis, TN.

Peck, K.R. *Aberrant Opioid-Associated Behavior among Adolescents and Young Adult Hematology and Oncology Patients.* To be presented at the University of Mississippi Conference on Psychological Science on April 11, 2014, University of Mississippi, University, MS.

ASSESSMENT INSTRUMENTS ADMINISTERED

Asperger Syndrome Diagnostic Scale (ASDS)

Barkley ADHD Self-Report, Childhood, and Other Symptoms Scales

Beck Anxiety Inventory (BAI)

Beck Depression Inventory II (BDI-II)

Beck Youth Inventory (BYI-II)

Behavior Assessment System for Children – Second Edition (BASC – II)

Child Depression Inventory (CDI)

Conners' Continuous Performance Test – II (CPT – II)

Kaufman Brief Intelligence Test, Second Edition (KBIT-II)

Learning and Study Strategies Inventory – Second Edition (LASSI – 2)

Mini-Mental State Examination, 2nd Edition (MMSE-2)

Minnesota Multiphasic Personality Inventory – 2 Restructured Form (MMPI – 2 RF)

Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4)

Structured Diagnostic Interview for Headache – Revised (SCID-R)

Wechsler Adult Intelligence Scale-IV (WAIS-IV)

Wechsler Individual Achievement Test - Third Edition (WIAT-III)

Wechsler Intelligence Scale for Children - Fourth Edition (WISC-IV)

Woodcock Johnson III - Tests of Achievement (WJ III-ACH)

Woodcock Johnson III - Tests of Cognitive Skills (WJ III-COG)

MISCELLANEOUS

Data Collector. *Community Assessment for Public Health Emergency Response (CASPER) after the Gulf Coast Oil Spill.* Centers for Disease Control and Prevention, National Center for Environmental Health, Division of Environmental Hazards and Health Effects (August, 2011)