Pain-Related Fear and Cognitive Performance in Recurrent Headache

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Abstract

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Pain-Related Fear and Cognitive Performance in Recurrent Headache

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The present study examined the relationship between pain-related fear and avoidance behavior and the role that psychological variables, such as depression, play in the relationship between pain-related fear and cognitive performance in recurrent headache. The concept of cogniphobia (i.e., fear of cognitive exertion) was adapted from kinesiophobia (i.e., fear of physical movement) to describe the relationship between pain-related fear and cognitive performance in headache. Prior research testing the construct of cogniphobia has been extremely limited. In the current study, 70 individuals with two or more headaches per month were recruited from an undergraduate population. Assessment included measures of attention, memory, pain-related fear (including cogniphobia), effort, avoidance, pain, depression, anxiety, locus of control and self-efficacy. As expected, cogniphobia was significantly related to self-reported avoidance, psychological variables, other pain-related fear measures, pain catastrophizing, pain experience, and pain cognition variables such as self-efficacy and locus of control. Cogniphobia was related to poorer performance on an attention measure, but not after controlling for depression. While these findings suggest that cogniphobia mirrors kinesiophobia in many ways, findings from this study also suggest that cogniphobia may play a different or more nuanced role in relation to cognitive performance than kinesiophobia plays with physical performance.

Approved: 

Julie A. Suhr

Professor of Psychology
Dedication

To my beautiful wife, Amanda B. Spickard
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Introduction

The Department of Mental Health and Substance Dependence of the World Health Organization has classified headaches among the most pervasive international public health disorders, contributing significantly to disability throughout the world (World Health Organization, 2004). It is estimated that, worldwide, two to three percent of the population has a current chronic headache disorder (McFate & Scher, 2009). Although 14 headache types have been classified in detail by the International Headache Society, the causes and consequences of recurrent headaches are only partly documented. A large body of research has explored the physical and psychological consequences of headache pain; however research has been inconsistent regarding the relationship between headaches (e.g., migraine and tension-type headaches) and cognitive functioning. While many researchers have failed to find a significant relationship between headaches and cognitive functioning (e.g., Bell, Primeau, Sweet, & Lofland, 1999; Burker, Hannay & Halsey, 1989; Gaist et al., 2005; Jellicic, Van Boxtel, Houx, & Jolles, 2000; Leijdekkers, Passchier, Goudswaard, Menges, & Orlebeke, 1990; Pearson, Chronicle, Maylor, & Bruce, 2006), other researchers have identified changes in cognitive functioning (e.g., attention, memory) in headache patients compared to controls (e.g., Ardila & Sanchez, 1988; Farmer, Cady, Bleiberg, & Reeves, 2000; Hooker & Raskin, 1986; Le Pira et al., 2000; Le Pira et al., 2004; Mulder, Linssen, Passchier, Orlebeke, & De Geus, 1999). Non-headache pain studies have also yielded inconsistent objective evidence for poorer cognitive functioning in individuals experiencing acute and/or chronic pain (Eccleston, 1995; Eccleston & Crombez, 1999; Farmer et al., 2000; Hart, Martelli, & Zasler, 2000; Martelli, Zasler, Bender, & Nicholson, 2004; Martelli, Grayson, & Zasler, 1999; Martelli, Zasler, Grayson, & Liljedahl, 1999; Meyer, Thornby, Crawford, & Rauch, 2000).
There are differing theories suggesting causal linkages between recurrent or chronic pain and cognitive performance in headache and non-headache pain populations. Biologically-based theories suggest that pain causes a disruptive physiological effect on brain functioning that interferes with cognitive functioning. Physiological mechanisms potentially related to cognitive functioning include alteration of neurotransmitters (Hart et al., 2000; Myer et al., 2000), increases in systemic and central glucocorticoid production, (deQuervin, Roozendaal, & McGraugh, 1998), differences between patients with chronic pain and normal controls in regard to blood flow in certain brain regions (DiPiero et al., 1991; Martelli et al., 1999; Mountz et al., 1995; Mountz, Bradley, & Alarcon, 1998), and structural brain abnormalities (Scherer, Bauer, & Baum, 1997; Schmitz et al., 2008; Yunus, Young, Saeed, Mountz, & Aldag, 2004).

While it is important to consider physiological processes related to cognitive performance in pain patients, there are three limitations of the existing literature. First, many of these studies rely heavily on individuals’ self-report to assess cognitive performance. Due to inherent limitations of self-report as a measure of cognitive performance, studies using self-report to attribute poorer cognitive performance to organic/physiological changes in the brain may be misleading. Second, even studies using neuropsychological measures to evaluate cognitive performance may be limited by their disregard of the role that effort may play in performance on cognitive tasks. Several studies examining the specific role that effort plays in cognitive performance have found that chronic pain patients may exert diminished effort during cognitive test batteries (Gervais, Rohling, Green, & Ford, 2004; Meyers & Diep, 2000; Meyers & Volbrecht, 2003; Suhr, 2003; Suhr & Spickard, 2007). These findings suggest a fundamental flaw in studies using cognitive test batteries to measure cognitive performance without consideration of effort, as these studies may inaccurately assert that cognitive test results are true indicators of an individual’s cognitive ability, rather than a reflection of the participant’s exerted effort. Third, many biological theories disregard psychological factors that may contribute to suboptimal
cognitive performance. Research suggests that psychological factors may relate to poorer cognitive performance either directly or indirectly through poor effort and/or avoidance behaviors. These include stress, expectation of pain, catastrophizing, anxiety, negative expectations (Levy, Hausdorff, Hencke, & Wei, 2000), depression (e.g., Hart, Wade, & Martelli, 2003; Iezzi, Archibald, Barnett, Klinck, & Duckworth, 1999; Suhr, 2003; Tucker, Luu, Friskhoff, Quiring, & Poulsen, 2003), and diagnosis threat (Spickard, 2005; Suhr & Gunstad, 2002, 2005). Many of these psychological mechanisms have been shown to be related to cognitive performance in a number of medical conditions, including non-headache pain disorders (e.g., fibromyalgia, chronic back pain). However, existing literature has not clearly linked these psychological processes, particularly those related to pain-related fear, to cognitive performance in headache.

Over the last three decades, researchers have studied the role that pain-related fear plays in the development of maladaptive pain behaviors. Studies exploring the mechanisms of pain-related fear have found that fear plays a significant role in behaviors that contribute to the development and maintenance of disability and chronic pain (Keefe, Rumble, Scipio, Giordano, & Perri, 2004; Lethem, Slade, Troup, & Bentley, 1983; Vlaeyen & Linton, 2000). It is well established that chronic pain involves not only physical and psychological but also behavioral components. Kinesiophobia, defined as an unreasonable or irrational fear of pain and/or painful re-injury due to physical movement, is the focus of much pain-related fear research in non-headache pain (Kori, Miller, & Todd, 1990; Lethem et al., 1983; Vlaeyen, Kole-Snijders, Boeren, & van Eek, 1995). Martelli, Zasler et al. (1999) explain kinesiophobia as “phobic responses to pain,” which are exacerbated by unhealthy habits (e.g., avoidance) that perpetuate pain and often contribute to pain-related disability. Kinesiophobia research has found that, in clinical pain samples, expectations and/or hypervigilance about pain are often related to poor behavioral performance (McCracken, Zayfert, & Gross, 1992; Crombez, Vlaeyen, Huets, & Lysens, 1999).
independent of pain severity. Avoidance behaviors, such as completely avoiding regular daily activities and/or decreasing effort on tasks or activities believed to initiate pain, may be related to disuse and disability.

Pain-related fear research has focused predominately on non-headache pain and the resulting kinesiophobia literature has yielded important insights in the relationships between pain-related fear, avoidance and behavioral (physical) performance. However, very little research has been conducted to understand the relationships between pain-related fear of cognitive exertion, a term labeled *cogniphobia* by Todd, Martelli, & Grayson (1998), and cognitive performance. Cogniphobia was conceptualized in relation to, and adapted from, the concept of kinesiophobia. Thus it may be expected that, paralleling the relationship between kinesiophobia and poorer performance on physical activities, cogniphobia would have a similar relationship with poorer performance on cognitive activities as measured through neuropsychological tests. As with kinesiophobia, in the context of cogniphobia, poorer performance on cognitive tasks may be reflective of avoidance behavior (e.g., diminished effort) associated with pain-related fear. The basic premise for both cogniphobia and kinesiophobia is the same. That is, as a result of pain-related fear, individuals may avoid tasks that they believe may potentially trigger pain. Where cogniphobia diverges from the construct of kinesiophobia is in the potential consequences of avoidance and poorer behavioral performance. In regard to kinesiophobia, avoidance of behavioral and physical activity leads to disuse, physical degeneration, and/or disability. In contrast, there is no evidence indicating that avoidance of cognitive activity related to cogniphobia would lead to physical/neurological degeneration. Instead cognitive avoidance (e.g., diminished effort on cognitive tasks) may result in invalid cognitive test results. In addition, while poor performance on cognitive tests may not accurately reflect actual brain functioning, individuals may falsely attribute poorer cognitive performance to neurological dysfunction, which might have further consequences (e.g., development of avoidance behaviors impacting daily
functioning, such as avoidance of more complex cognitive tasks at work, or avoidance of social interactions).

While research on cogniphobia is limited, one measure, the Cogniphobia Scale, was introduced to measure pain-related fear of cognitive exertion. Adapted from the Tampa Scale of Kinesiophobia, the Cogniphobia Scale was designed to address cognitive deficits in chronic pain individuals, accounting for the role of pain-related fear in the avoidance of cognitive exertion (Todd et al., 1998). Although the Cogniphobia Scale is considered a clinically useful instrument in the measurement of avoidant behavior in chronic pain (Martelli et al., 2004), it has been utilized in only two studies, one of which used an adapted version of the Cogniphobia Scale to examine chronic stress complaints, rather than cognitive performance, in an exploratory pilot study of cogniphobia (Schmidt, 2003). To date no studies have examined the relationships between cogniphobia and cognitive performance among headache samples. Despite the limited number of cogniphobia studies, findings from existing cogniphobia, headache, and non-headache studies illuminate the importance of three key mechanisms in understanding the potential relationships between cogniphobia and cognitive performance in headache populations. These key mechanisms include pain related fear, avoidance, and cognitive performance, as discussed below. The literature also suggests that a number of psychological variables (e.g., depression, anxiety, and catastrophizing) play important roles in relation to pain-related fear, avoidance and cognitive performance; these findings are also discussed.

**Pain-Related Fear and Avoidance**

A number of headache and non-headache pain studies illuminate the relationship between fear of pain and avoidance behavior. Although some studies use self-reported avoidance behavior, which may be less accurate than more objective measures of behavioral performance (e.g., lifting tasks), they still contribute insight into the relationship between pain-related fear and avoidance. For example, Norton and Asmundson (2004) studied the relationships between pain-related fear,
self-reported avoidance behavior and anxiety sensitivity in chronic headache, and found that fear of pain (as measured by the Pain Anxiety Symptom Scale, McCracken et al., 1992) had a strong direct loading on self-reported pain-related avoidance behavior, as measured by the escape/avoidance subscale of the Pain Anxiety Symptom Scale. Several studies utilizing tasks measuring actual behavioral avoidance (e.g., physical tasks) have also found that pain-related fear is significantly related to avoidance in non-headache pain (i.e., Crombez, 1999; Swinkels-Meewisse, Roelofs, Oostendorp, Verbeek, & Vlaeyen, 2006; Thomas & France, 2007; Van den Hout, Vlaeyen, Houben, Soeters, & Peters, 2001; Vlaeyen et al., 1995).

In a broader body of literature examining cognitive performance in pain, avoidance behavior has also been conceived as “diminished effort” (e.g., Gervais, Rohling, Green, & Ford, 2004; Meyers & Diep, 2000; Meyers & Volbrecht, 2003; Suhr, 2003) and findings from several seminal studies are discussed below. A study by Suhr (2003) addressed the role of diminished effort in chronic pain patients not reporting pending litigation. Out of 55 chronic pain patients, 10 (five with chronic pain and five with fibromyalgia) failed an effort measure, while no individuals in the healthy control group failed the measure. The group of 10 individuals who failed the effort measure was not significantly different from the other three groups (i.e., remaining chronic pain, remaining fibromyalgia, and controls) in regard to age, education, gender, or estimated intellect. Yet, their performance on psychomotor speed tasks was significantly worse than individuals in the control group, highlighting the effect of effort on neuropsychological performance in chronic pain patients not clearly motivated by secondary gain. Research studies have also examined the relationship between diminished effort and cognitive performance in chronic pain patients who are potentially motivated by secondary gain (Gervais et al., 2004; Meyers & Diep, 2000; Meyers & Volbrecht, 2003). For example, two studies estimated that 26 to 29 percent (Meyers & Diep, 2000; Meyers & Volbrecht, 2003) of chronic pain patients receiving neuropsychological assessment for litigation/compensation purposes failed two or more indicators of poor effort.
embedded in a battery of neuropsychological tests. Although cogniphobia literature is limited, Todd et al. (1998) examined cogniphobia in a post-traumatic headache sample and found that, shortly after experiencing head trauma and/or whiplash, a high percentage of individuals failed a measure of poor effort. They also found that those who failed the task had much higher scores on the Cogniphobia Scale than those who did not, suggesting that pain-related fear was related to patients’ effort on neuropsychological tasks. Studies examining the relationship between pain-related fear and avoidance behavior or effort highlight the significant role that thoughts, beliefs, and feelings about pain can have on an individual’s behaviors.

**Psychological Variables and Pain-Related Fear**

Research also demonstrates a strong relationship between several psychological variables and pain-related fear. Pain-related fear studies suggest that depression and anxiety may have an important and positive relationship to pain-related fear in headache samples (Hursey & Jacks, 1992; Norton and Asmundson, 2004) as well in non-headache chronic pain samples (Crombez et al., 1999; Vlayen et al., 1995). Hursey and Jacks investigated the role of fear of pain, as measured by the Fear of Pain Questionnaire, in 76 individuals suffering from at least five or more headaches per month of at least moderate severity. The study included a control group of 58 participants, matched for gender. Results indicated that headache participants reported higher pain-related fear, and fear of pain was correlated with depression, as measured by the Beck Depression Inventory, and anxiety, as measured by the State Trait Anxiety Inventory. The Norton and Asmundson (2004) study discussed above used the Anxiety Sensitivity Index to examine the role of anxiety sensitivity, described as the fear of anxiety-related sensation, in relation to fear and avoidance behavior in chronic headache. They found that anxiety sensitivity had a direct and significant relationship to fear of pain, as measured by subscales of the Pain Anxiety Symptoms Scale (i.e., cognitive anxiety symptoms subscale, physiological anxiety symptoms subscale, and fearful appraisal subscale).
Pain-related fear in non-headache patients has also been shown to be significantly and positively correlated with pain catastrophizing (George, Wittmer, Fillingim, & Robinson, 2006; George, Wittmer, Fillingim, & Robinson, 2007; Picavet, Vlaeyen, & Schouten, 2002; Swinkels-Meewisse et al., 2006; Turner, Jensen, & Romano, 2000; Vlaeyen et al., 1995). Several studies have found that pain-related fear and catastrophizing are not only directly related to each other, but they are also correlated with psychological variables (e.g., depression, anxiety) and avoidance behaviors (Crombez et al., 1999; George, Dannecker, & Robinson, 2006; George et al., 2007; Picavet et al., 2002; Swinkels-Meewisse et al., 2006; Thomas & France, 2007; Turner et al., 2000; Van den Hout et al., 2001; Vlaeyen et al., 1995). Although cogniphobia research is limited, one study (Schmidt 2003) used an adapted version of the Cogniphobia Scale to examine chronic stress complaints in an exploratory pilot study of cogniphobia. They found that participants who were referred for psychological assessment and vocational rehabilitation due to chronic work-related stress problems scored significantly higher on the adapted measure of cogniphobia when compared with a control group of actively working employees. This is the only study since the creation of the Cogniphobia Scale to examine the relationship between cogniphobia and psychological characteristics. Schmidt’s study found that individuals experiencing self-reported psychological difficulties exhibited higher levels of cogniphobia than the control group. Schmidt’s study is consistent with previous pain-related fear research in regard to the connection it demonstrates between psychological variables and pain-related fear. It should be highlighted that the Schmidt study did not examine causal direction in the relationship between pain-related fear and cognitive performance. It is possible that psychological variables may play a confounding role in the relationship between pain-related fear and cognitive performance, leading to higher reported pain-related fear and poorer cognitive performance. However, one could also speculate that psychological variables mediate the relationship between pain-related fear and cognitive performance, such that higher pain-related fear could lead to higher levels of anxiety.
and/or depression when faced with stressful cognitive tasks, which in turn could lead to poorer cognition. Without examining the direction of relationships between psychological variables and both pain-related fear and behavioral performance, the research in this area, as well as the clinical implications of the research, are significantly limited. Much of the pain-related fear literature has shown strong correlations among pain-related fear, avoidance behavior, catastrophizing and other psychological variables (e.g., depression, anxiety). However, most existing studies do not include experimental methods that would allow for the examination of causation among these variables. Until research studies assess the direction of these relationships, we can only speculate as to the etiology of pain-related behaviors.

**Psychological Variables related to Avoidance and Behavioral Performance**

Studies also suggest that avoidance and behavioral performance in headache and non-headache pain samples are related to psychological variables, including emotional distress (Hart et al., 2003; Iezzi et al., 1999) and depression (Philips & Jahanshahi, 1986; Suhr, 2003). A study conducted by Philips and Jahanshahi (1986) provides evidence of an important relationship between depression and avoidance, which may play a key role in pain processes among headache patients. The study assessed 267 chronic headache sufferers and conducted a factor analysis of the Pain Behavior Checklist (Zarkowska, 1981) in order to explore components of pain behavior. One major component they identified was avoidance behavior. The authors found that when dividing participants into high and low avoider groups based on the factor analytically derived scores, the chronic avoider group had significantly higher depression scores on the Wakefield Depression Inventory (Snaith, Ahmed, Melita, & Hamilton, 1971) than the low avoider group. Suhr (2003) found that, even after controlling for effort, decline in cognitive performance in fibromyalgia patients was related to both level of pain and depression severity. This supports the above findings that behavioral performance, in this case performance on memory tests, is related to psychological variables (i.e., depression severity) in a chronic pain sample. However, as with
previously discussed studies, the study does not examine what role depression might play in regard to behavioral performance; that is, whether depression is directly associated with pain-related fear and thus poorer cognitive performance, whether depression mediates the relationship between pain-related fear and cognitive performance, or whether both depression and pain-related fear are independently associated with cognitive performance.

Negative expectations have also been linked to cognitive performance (Desrichard & Kopetz, 2005; Hess, Auman, Colcombe, & Rahhal, 2003; Hess, Hinson & Statham, 2004; Kit, Tuokko, & Mateer, 2008; Kvavilashvili & Ellis, 1999; Levy, 1996; Levy et al., 2000; Levy & Langer, 1994; Rahhal, Hasher, & Colcombe, 2001; Steele, 1997; Suhr & Gunstad, 2002; Suhr & Gunstad, 2005; Suhr & Spickard, 2006; Tindale, Kulik, & Scott, 1991). The concept of stereotype threat proposed by Steele (1997) suggests that a member of a particular group, when faced with a cognitive task thought to be poorly performed by members of that group, will face the threat of being judged by stereotypes about that group’s inferiority on the task. This threat is thought to interfere with his/her individual performance through either increased anxiety or decreased effort. Existing stereotype threat literature highlights evidence that even “normal” populations have been found to be vulnerable to the effects of expectations on cognitive performance (Kit et al., 2008; Kvavilashvili & Ellis, 1999; Tindale et al., 1991) and there may be important relationships between expectations, effort and performance. Several researchers have suggested that negative expectations create a state of learned helplessness, resulting in individuals believing that they have little or no control over future performance outcomes (Kit et al., 2008; Steel, 1997). It is hypothesized that learned helplessness may result in decreased motivation and poorer performance on future cognitive/intellectual tests. Individuals may feel that regardless of the effort they exert, their performance on neuropsychological/cognitive tasks will be inadequate; this feeling of learned helplessness may be intensified when negative stereotype conditions exist.
A small body of research has looked at the influence that negative expectations has on cognitive performance in headache. Results of this research reflect findings from non-headache pain-related fear research in medical samples (e.g., Ozen & Fernandes, 2011; Suhr & Gunstad, 2002; Suhr & Gunstad, 2005), in which negative expectations have been found to influence cognitive performance. One study examined diagnosis threat in chronic headache (Spickard, 2005). Diagnosis threat refers to an effect originally observed in individuals with a history of head injury, where negative expectations based on injury/diagnosis negatively affected neuropsychological test performance. Individuals with a history of chronic headaches were randomly assigned to receive either neutral instructions (i.e., control group) or to have attention called to literature suggesting that chronic headaches can have a negative impact on cognitive performance (i.e., diagnosis threat group). Depressive symptoms were measured at baseline while ratings of effort and state anxiety were completed after a battery of neuropsychological tests. Consistent with previous studies, the diagnosis threat group performed worse on delayed memory relative to controls. As demonstrated in non-headache studies, findings from the above study suggest that negative expectations can play a significant role when assessing performance on cognitive/neuropsychological tests in a headache sample. As discussed above, it is not clear whether psychological symptoms, such as depression and anxiety, act as mediators or are confounds in the relationship between pain-related fear and cognitive performance. However, it is still important to consider that depressive symptoms, anxiety and other psychological variables may be associated with negative expectations and the development of learned helplessness, all of which may play key roles in cognitive performance.

**Present Study**

While headache and non-headache pain literature, discussed above, provide findings instrumental in beginning to understand the relationships between pain-related fear, avoidance and cognitive performance in headache, there remain gaps in the existing literature. The purpose
of the present study was to begin filling these gaps by examining the relationship between pain-related fear and avoidance of cognitive exertion (as measured by self-reported avoidance, neuropsychological measures and tests of effort) and considering the potential roles that psychological variables (i.e., depression and anxiety) may play in these relationships. Building on the expansive pain-related fear research, this study was designed to examine whether cogniphobia is related to avoidance and cognitive performance in individuals with recurrent headache, similar to the way that kinesiophobia (pain-related fear of movement) has been found to relate to avoidance and performance on physical tasks in non-headache pain. Based on findings from headache and non-headache pain literature, we also examined the relationships between a number of psychological variables (e.g., depressive symptoms, anxiety, and catastrophizing) and pain-related fear, avoidance and cognitive performance.

The present study had three primary aims. First, we examined whether cogniphobia was related to avoidance behavior in headache. We hypothesized that higher levels of cogniphobia would be associated with lower scores on measures of effort (i.e., Word Memory Test immediate recall) and self-reported avoidance (i.e., Pain Anxiety Symptom Scale avoidance subscale). In addition, we hypothesized that higher levels of cogniphobia would be associated with poorer performance on cognitive tasks (i.e., Rey Auditory-Verbal Learning Test delayed recall, Paced Auditory Serial Addition Task trial 4). We also examined whether effort and/or avoidance mediated the relationship between the cogniphobia and performance on attention and memory measures. We hypothesized that effort and/or avoidance (as measured by the Word Memory Test immediate recall and the Pain Anxiety Symptom Scale avoidance subscale) would act as mediators in the relationship between cogniphobia and cognitive performance.

Our second aim was to explore the relationships between psychological variables (i.e., depressive symptoms, change in state anxiety) and cogniphobia, cognitive performance, and avoidance/effort. We hypothesized that symptoms of depression and change in state anxiety
would be related to cogniphobia, cognitive performance, and both effort and avoidance. Finally, we explored the relationship between cogniphobia and cognitive performance on attention and memory tests, after controlling for psychological variables. We hypothesized that cogniphobia would have a significant relationship with cognitive performance even after controlling for psychological variables.
Methods

Participants

Participants were recruited through an on-line electronic screening procedure for undergraduate students enrolled in psychology courses at a mid-size Midwestern University. Recruitment occurred from spring 2008 through spring 2010. As part of the on-line screening, students completed a self-report headache screener and an adapted form of the Cogniphobia Scale. Individuals were selected based on the following criteria: (1) report of a history of headaches (i.e., two or more per month) on the headache screener; (2) and scoring in the top one-third or bottom one-third on the Cogniphobia Scale for the entire sample for that academic quarter. Participants were then able to view the description of the study and enroll if they were interested in participating. Each participant provided informed consent to participate in the study, and all participants received extra credit points in their psychology classes.

Eighty-six individuals met initial criteria for inclusion and signed up to participate in the current study. When participants reported to the laboratory for their individual sessions, the headache screener was repeated and eight students were excluded from the present analyses due to reporting fewer than two headaches per month. An additional eight individuals were excluded from the analysis due to reporting a current headache of greater than a 5 rating on a visual analogue scale of current headache pain, with 10 indicating the worst pain imaginable. Thus, a total of 70 participants were included in the final analyses. The sample was comprised of 53 females and 17 males; 89 percent of participants reported Caucasian as their race. Participants ranged in age from 18 to 23 years old, with an average age of approximately 19 years ($M = 19.07$, $SD = 1.1$). Participants’ self-reported level of education ranged from first year to fifth year of college, with an average level of education at the freshman level.
Participants’ self-reported headache characteristics (Table 1) indicated that, on average, participants experienced approximately seven headaches per month ($M = 7.1, SD = 5.8 (2-30)$) for approximately 25 months ($M = 24.6, SD = 33.1 (0-144)$), and they rated severity of a typical headache as approximately a 3 ($M = 2.9, SD = .9 (0-5)$) on a scale of 0-10, where 10 is the most severe level of headache pain. Level of headache at the time of the study fell between 1 and 2 ($M = 1.5, SD = 1.5 (0-5)$) on a 0-10 visual analogue scale, where a 0 rating indicated no pain at all and a 10 rating indicated worst pain imaginable.

Based on answers on the headache questionnaires, participants were generally classified into three types of headaches (i.e., migraine, tension-type headaches, mixed headaches). Approximately 30 percent of the sample reported characteristics consistent with migraine headaches, while approximately 40 percent of the sample reported headache characteristics consistent with tension-type headaches and 23 percent of the sample reported a combination of migraine and tension-type headache characteristics.

**Measures**

The current study used a number of pain-related fear, headache, pain, anxiety, depression, cognition/coping, neuropsychological, and effort measures, which are briefly summarized below. See Appendix A for detailed discussion of psychometric properties for each measure.

**Cogniphobia.** The Cogniphobia Scale (Todd et al., 1998) includes 17 items used to assess fear-avoidance behavior in regard to cognitive performance. The original Cogniphobia Scale was developed in order to assess pain-related fear in patients with severe chronic pain conditions and was therefore adapted in this study to better assess a sample of college students with recurrent headache. Specifically, two items were added and one item was altered in the adapted Cogniphobia Scale used in this study (i.e., hereafter referred to as the C-Scale; see Appendix C). In the current study sample, item 5 of the C-Scale showed a negative corrected item-total correlation of -.09 and item 13 showed a low corrected item-total correlation of .14.
These items referred to relieving headaches by practicing concentration exercises ("My pain would probably be relieved if I practiced concentration exercises") and believing that increased mental activity would be positive ("Although my condition is painful, I would be better off if I were more mentally active"). There was no difference in results when testing the study hypotheses with or without these items. These items were not included in the final analyses, and, after removing them, the Cronbach’s α for the C-Scale increased from .87 to .88.

**Pain-Related Fear Measures.** The Fear of Pain Questionnaire (McNeil, Rainwater, & Aljazireh, 1986) was used to measure fear of painful stimuli. The questionnaire consists of 30 items with three subscales and participants rate their level of fear on a scale from 1 (not at all) to 5 (extreme). The Fear of Pain Questionnaire has been shown in previous studies to be a reliable and valid measure of pain-related fear (Roelofs, Peters, Deutz, Spijker, & Vlaeyen, 2005). The total score was used in the current study, and the instrument showed strong internal consistency (α = .94).

The Pain Anxiety Symptom Scale (McCracken et al., 1992) is a well-validated 40-item measure of pain-related fear and anxiety. The total score has been used as a measure of pain-related fear in previous research and shows strong correlations with other pain-related fear measures (Roelofs et al., 2005). The total score was used in the present study to measure pain-related fear in general and the Pain Anxiety Sensitivity Scale total score had strong internal consistency in the present study (α = 0.93).

**Psychological Measures.** The Beck Depression Inventory (Beck, Steer, & Brown, 1996) is a well-validated measure of self-reported depressive symptoms that asks participants to rate their experience over the past two weeks. The Beck Depression Inventory showed good internal consistency in the current study (α = .87).

The Spielberger State Trait Anxiety Inventory-State (Spielberger, 1983) is a 20-item self-report scale that assesses symptoms of anxiety at a particular moment in time, and was
administered at the beginning and at the end of the current study. The first administration of the State Anxiety Inventory assessed was administered prior to the administration of neuropsychological measures in an effort to assess state anxiety prior to cognitive exertion. In exploratory analyses, a change score between State Trait Anxiety Inventory time 1 and time 2 was used to explore whether a change in state anxiety during the study was related to cogniphobia and neuropsychological performance. The state scale showed strong internal consistency in the current study for time 1 ($\alpha = .89$) and time 2 ($\alpha = .90$).

**Cognitive Measures.** The purpose of the Rey Auditory-Verbal Learning Test is to assess verbal learning and memory and consists of two lists of 15 nouns. The first list (List A) is presented verbally for five consecutive trials, and a free-recall test is given for each trial. List B is given verbally as an interference list after the completion of trial five of List A, and a free-recall test is given for List B. Recall of the first list immediately follows the free-recall test for List B. After a 20-minute delay period, the participant is required to recall words from List A. Participants’ scores on the 20-minute delayed recall were used in this study as a measure of memory; data shows this score has one of the most reliable test-retest reliabilities (Schmidt, 1996) and overall the Rey Auditory-Verbal Learning Testis strongly related to other measures of learning and memory (Crossen & Wiens, 1994; Johnstone, Vieth, Johnson, & Shaw, 2000; Stallings, Boake, & Sherer, 1995).

The Paced Auditory Serial Addition Task (Gronwall, 1977) is a measure of information processing and sustained attention and was used as a measure of attention in the current study. The test presents, via audiotape, a random series of numbers from 1 to 9. The subject must consecutively add pairs of numbers so that each number is added to the number presented immediately before it. This pattern is sustained over several items and this process is repeated over several trials with an increase in the speed of stimulus input and a decrease in the available time for each response (Strauss et al., 2006). Only the fourth (1.2 second) trial was used in the
current analyses. Existing reliability and validity data are strong for the Rey Auditory-Verbal Learning Test (McCaffrey et al., 1995; Strauss, Sherman, & Spreen, 2006).

**Avoidant/Effort Measures.** The Pain Anxiety Symptom Scale escape/avoidance subscale was used in the present study to measure self-reported avoidance behavior. The internal consistency of the escape/avoidance subscale produced a Cronbach’s $\alpha$ of .74 in the present study. In the current study sample, item 3 of the Pain Anxiety Symptom Scale escape/avoidance subscale showed a low corrected item-total correlation of .14, well below the accepted level of .30. This item refers to staying as still as possible when feeling pain and was determined to be less relevant to this non-chronic pain, undergraduate sample in comparison to pain populations. This item was excluded in the final analyses; when removing the item from the subscale, the Cronbach’s $\alpha$ for the Pain Anxiety Symptom Scale escape/avoidance subscale increased from .73 to .74.

The Word Memory Test is a well-validated computerized measure of effort on cognitive tasks (Green, Allen, & Astner, 1996; Green, 2003) including seven primary subscales. For the purposes of the present study, effort was assessed utilizing only the immediate recall subscale of the Word Memory Test.

**Headache Severity Measures.** The Headache Questionnaire (Asmundson, Norton, & Veloso, 1999) consists of questions regarding distinct aspects of the individual’s experience with headaches (e.g., severity of typical headache, nature of headaches, and restriction of lifestyle), and was used in the current study to obtain additional headache characteristics of the participants. Psychometric properties of the questionnaire are not yet available.

A visual analogue scale was utilized in the current study in order to measure pain levels. Participants reported pain levels on a scale from 1 to 10 (1 representing no pain at all and 10 representing the worst pain imaginable). Visual analogue scales have been shown to possess adequate reliability and validity (Jensen & Karoly, 1992) and high test–retest reliability (Kahl &
Cleland, 2005). Individuals reporting greater than 5 on this measure (N = 8) were excluded from the present analyses.

**Supplemental Pain Measures.** A modified version of Lipchick et al.’s (1996) Headache Screening Questionnaire was used to measure self-reported headaches (e.g., frequency, duration). The questionnaire was used as the on-line screener to determine whether individuals qualified for this study and was repeated during the study session. The questionnaire has been used as a reliable measure for recent headache-related research and has shown high reliability in regard to separate reports over a two week span (Kappa’s from .82 to .98; Lipchik et al., 1996).

The Headache Self-Efficacy Scale (French et al., 2000) is a 25-item instrument designed to assess individuals’ agreement with statements regarding their ability to cope with their headaches. The Headache Self-Efficacy Scale has shown good construct validity (French et al., 2000) and showed strong internal consistency in the current study (α = .88).

The Headache Specific Locus of Control Scale is a 33-item instrument used to assess the extent to which individuals believe that factors influencing their headaches are related mainly to external or internal forces (Martin, Holroyd & Penzien, 1990). The Headache Specific Locus of Control Scale has been shown to have adequate test–retest reliability and good construct validity (Martin et al., 1990). Internal consistency of the scale in this study was adequate (α = .76).

The Pain Catastrophizing Scale (PCS; Sullivan, Bishop, & Pivic, 1995) is a commonly used self-report measure designed to assess catastrophizing and consists of 13 items describing different thoughts and feelings that individuals may experience when they are in pain. The Pain Catastrophizing Scale showed high internal consistency in this study (α = .93).

**Procedure**

All testing was conducted by trained graduate students and advanced undergraduate students with experience in testing under the supervision of a licensed clinical psychologist. Participants were asked to participate in one individually-administered session lasting
approximately two hours. Table 2 outlines the order in which tests were administered. As
indicated, students completed the Headache Screening Questionnaire and the Cogniphobia-Scale
as part of the on-line screening. These measures were utilized to select individuals with five or
more headaches a month scoring within the top or bottom one-third on the Cogniphobia-Scale.
Ultimately, self-report was inconsistent between the initial screening and study sessions, with the
mean number of reported headaches being much lower when assessed at the time of the study. In
addition, scores on the C-Scale were less extreme when administered at the time of the study. As
a result, we changed the study design from an extreme group comparison (i.e., comparing
participants who scored in the top or bottom one-third on the C-Scale) to a continuous variable
analysis. At the study session, participants were asked to complete an informed consent form (see
Appendix C). Each participant then completed psychological and headache-related self-report
questionnaires (Table 2) followed by neuropsychological measures as well as additional pain-
related questionnaires. Participants then completed a measure of pressure pain threshold, which
was not part of the current study’s main hypotheses, prior to completing pain-related fear
questionnaires including the Cogniphobia-Scale. After completion of all measures, participants
were debriefed regarding the study and provided contact information for resources to address
concerns they might have had about headaches and/or psychological issues.
Results

Prior to conducting statistical analyses, exploratory analyses were conducted to assess for normality, linearity, homoscedasticity, and the presence of outliers. Of note, differences in sample size emerged due to incomplete data on certain measures (e.g., Pain Anxiety Symptom Scale) and discontinuance on some measures (e.g., Paced Auditory Serial Addition Task), and thus sample sizes for individual analyses are noted below. In addition, results of the Word Memory Test immediate recall were significantly negatively skewed and there were a number of extreme outliers; after log10 transformation, the distribution looked more normal and there were no longer outliers. The transformed value was used in subsequent analyses. Two outliers were also identified on the Paced Auditory Serial Addition Task trial 4, but were retained. This decision was based on the facts that the outliers identified were not substantially different from the remaining distribution, and the 5 percent trimmed mean was very close to the mean for this variable (18.39 and 18.47, respectively). Bivariate correlations are presented in Table 3 and means, standard deviations, and ranges for primary variables of interest are presented in Table 4.

Relationship between Cogniphobia and Other Pain-Related Fear Measures

Consistent with our hypothesis that cogniphobia would be related to other measures of pain-related fear, the Cogniphobia-Scale was significantly and positively related to both the Pain Anxiety Symptom Scale, $r(65)= .60, \ p < .001$, and the Fear of Pain Questionnaire, $r(70) = .39, \ p = .001$. Exploratory analyses were conducted to further examine relationships among cogniphobia, pain-related variables, and other pain-related fear measures (see Appendix B for details). Consistent with previous literature showing that pain-related fear is significantly related to pain severity, duration of pain symptoms, and disability, individuals with elevated cogniphobia scores reported significantly more severe headaches, higher levels of distress related to headaches, more frequent headaches, and reported that their lifestyle was significantly more
restricted by their headaches. In addition, consistent with existing studies showing that high levels of pain-related fear are related to lower locus of control and lower self-efficacy, high cogniphobia scores in the present study were related to less headache locus of control related to chance and to lower self-efficacy in regard to managing headaches. Finally, consistent with the kinesiophobia literature, participants with higher scores on the C-Scale (i.e., higher pain-related fear) reported higher levels of pain catastrophizing.

**Relationship between Cogniphobia and Avoidance**

We hypothesized that higher levels of cogniphobia would be associated with lower scores on the effort and the avoidance measures. Contrary to hypotheses, the Cogniphobia-Scale was not significantly related to the effort measure, $r(70) = .13, p = .28$, but it was significantly and positively related to self-reported avoidance, $r(65) = .51, p < .001$. It should be noted that, based on standard clinical norms for the effort measure, no participants were classified as “poor effort.”

Exploratory analyses were conducted to explore whether other measures of pain related fear and pain catastrophizing would be related to avoidance. Consistent with the Cogniphobia-Scale, the Fear of Pain Questionnaire and the Pain Anxiety Symptoms Scale were not significantly related to effort, but both were significantly and positively related to self-reported avoidance. In addition, pain catastrophizing was not related to effort or self-reported avoidance. (See Appendix B for details.)

**Relationship between Cogniphobia and Cognitive Performance**

We also hypothesized that higher levels of cogniphobia would be associated with poorer cognitive performance. Cogniphobia was not significantly related to memory, $r(70) = .16, p = .18$, but it was significantly and negatively related to attention, $r(64) = -.30, p = .02$.

Exploratory analyses were conducted to explore whether other measures of pain-related fear and pain catastrophizing would be related to cognitive performance. Consistent with the general lack of significant results between cogniphobia and cognitive performance,
participants scoring higher on pain-related fear and pain catastrophizing did not perform significantly worse on neuropsychological measures (see Appendix B for details).

**Role of Effort/Avoidance as Mediator**

In order to examine whether effort/avoidance mediated the relationship between cogniphobia and performance on attention and memory measures, mediation models were planned. The following conditions must exist to completely satisfy the mediator model: 1) the main effect (i.e., association between cogniphobia and cognition) must be significant; 2) the independent variable (i.e., cogniphobia) and the mediator (i.e., effort/avoidance) must be significantly associated; and 3) the association between the mediator (i.e., effort/avoidance) and the dependent variable (cognition) must be significant, with the main effect (i.e., association between cogniphobia and cognition) no longer showing significance.

As reported above, condition 1 (i.e., relationship between cogniphobia and cognition) was satisfied for attention, \( r(64) = -0.30, p = 0.02 \), but not memory, \( r(70) = 0.16, p=0.18 \). Condition 2 (i.e., relationship between cogniphobia and avoidance/effort) was satisfied for self-reported avoidance, \( r(65) = 0.51, p = 0.00 \), but not for effort, \( r(70) = 0.13, p = 0.28 \). Therefore, a mediator model including cogniphobia, self-reported avoidance, and attention was further explored. Despite the fact that effort was significantly related to memory, \( r(70) = -0.34, p = 0.004 \), a mediator model including cogniphobia, effort and memory was not explored because neither condition 1 nor condition 2 were satisfied.

Condition 3 was tested for the mediator model that included cogniphobia as the independent variable, attention as the dependent variable, and self-reported avoidance as the possible mediator. Regression analyses were conducted in order to provide appropriate statistics for a Sobel test, utilized to test our mediator model. According to the first regression analysis, the relationship between cogniphobia and avoidance was significant, \( beta = 0.51, p = 0.00 \). The second regression included attention as the dependent variable and both cogniphobia and avoidance as
predictors. Neither the contribution of cogniphobia, $\beta = -.22, p = .13$, nor the contribution of avoidance, $\beta = -.13, p = .36$, were significant. Based on the results of the above regression analyses, the Sobel test statistics were not significant, test statistic = -0.91, $SE = 0.09, p = .36$. Therefore, condition 3 was not satisfied and avoidance (as measured by the Pain Anxiety Symptom Scale escape/avoidance subscale) cannot be considered a mediator between cogniphobia and attention. It should be noted that self-reported avoidance was related to attention in the expected direction, although the relationship was not significant, $r (60) = -.24, p = .07$.

**Relationship between Cogniphobia and Psychological Variables**

As hypothesized, higher levels of depressive symptoms were significantly and positively related to higher levels of cogniphobia, $r (70) = .33, p = .005$, and lower scores on attention measures, $r (64) = -.33, p = .008$. However, depressive symptoms were not significantly related to memory, $r (70) = .22, p = .070$, effort, $r (70) = .10, p = .399$, or avoidance, $r (65) = .21, p = .10$. Contrary to expectations, larger differences in the change in anxiety scores between the first and second administration of the State-Anxiety Inventory were not significantly related to cogniphobia, $r(70) = .03, p = .81$, attention, $r(64) = -.14, p = .28$, memory, $r(70) = -.07, p = .56$, effort, $r(70) = .15, p = .22$, or avoidance, $r(65) = .11, p = .39$.

Finally, we hypothesized that cogniphobia would still have a significant relationship with cognitive performance, even after controlling for psychological variables. As noted above, the correlation between cogniphobia and memory was not significant, and therefore only attention was used in the regression model. Also, change in state anxiety was not considered as a control variable due to the lack of significant relationship of anxiety change to any variables of interest. Specifically, hierarchical multiple regression was used to assess the amount of variance in attention performance that was accounted for by cogniphobia, after controlling for the influence of depressive symptoms. A measure of depressive symptoms was entered on Step 1, and
explained 11 percent of the variance in performance on the test of attention, $F(1, 62) = 7.64, p = .008$. After entry of the cogniphobia measure at Step 2, cogniphobia explained an additional 3.9 percent of the variance in performance on attention, $R^2$ change = .04, $p = .10$. 
Discussion

The purpose of the present study was to examine the relationship between pain-related fear and avoidance of cognitive exertion, as measured by self-reported avoidance, neuropsychological measures and tests of effort, and to consider the potential roles that depressive symptoms and anxiety may play in these associations. This study advances the literature on pain among individuals who report recurrent headaches by exploring a largely untested concept (i.e., cogniphobia) and implementing a novel measure of pain-related fear (i.e., the Cogniphobia-Scale). We sought to understand the role of cogniphobia in maladaptive behavior change in a sample of individuals reporting recurrent headaches based on existing pain-related fear literature, including studies examining kinesiphobia.

Cogniphobia Scale as a Measure of Pain-Related Fear

Although we did not conduct a formal validation of the Cogniphobia-Scale, the adapted form of the scale was found to have good internal consistency (α = .88), and results documented significant associations between the C-Scale and factors shown to be associated with pain-related fear, including the Pain Anxiety Symptom Scale and the Fear of Pain Questionnaire, two well validated pain-related fear measures. Data also indicated that the C-Scale was significantly related to other pain-related measures, including a measure of pain catastrophizing. Higher levels of cogniphobia were associated with more severe headache pain, higher levels of headache-related distress, higher frequency of headaches, a more restricted lifestyle due to headaches, less personal control of headaches (i.e., more headache locus of control related to chance) and lower self-efficacy in regard to managing headaches. It should be noted, however, that because the present study did not assess whether headaches were related to alcohol use among this college sample, assessments of headache frequency and severity and number of headaches may be inflated. Nonetheless, it was not surprising that individuals experiencing more severe and
frequent headaches, those that attribute their headaches to chance, and those who report low self-efficacy in managing headaches would report a higher fear of pain. Findings that participants exhibiting more severe headache pain characteristics also scored higher on the C-Scale are especially notable given that most pain-related fear measures, including the Fear of Pain Questionnaire and the Pain Anxiety Symptom Scale, have been studied with medical samples (e.g., chronic back pain) and therefore, may not be sensitive to a healthier sample. Given that the present study did not examine causal directions between pain-related fear and headache characteristics, it is also possible that individuals with high pain-related fear are more likely to perceive greater or more severe pain characteristics, and have lower headache locus of control and/or self-efficacy. More broadly, these associations suggest that the C-Scale is consistent with other pain-related fear measures in its association to key variables that previous research has consistently shown to be related to pain-related fear, suggesting it as a valid measure of the cogniphobia construct. Future studies might further examine the causal directions between pain-related fear and headache characteristics in order to clarify how cogniphobia is related to headache characteristics and related variables.

**Cogniphobia and Avoidance/Effort**

In order to explore the consequences of fear of cognitive exertion among individuals reporting recurrent headaches, we first examined whether cogniphobia was related to avoidance behavior. As hypothesized, higher levels of cogniphobia were associated with self-reported avoidance. The fact that cogniphobia was related to avoidance is significant, given the importance of behavior change in pain-related fear literature. For example, if an individual fears that engaging in cognitive activities will increase the severity of their headaches, it is possible that they may report a tendency to want to escape or avoid such activities. This is consistent with prior pain-related fear research suggesting that individuals who report higher levels of kinesiophobia report avoidance of physical activity. Supporting this finding, higher levels of
pain-related fear via other pain-related fear measures used in this study were also related to self-reported avoidance.

Contrary to expectations, cogniphobia was not related to lower scores on a measure of effort, and pain-related fear via alternate measures was not related to lower scores on the same measure of effort. It is important to note that the effort measure used in the present study (i.e., the Word Memory Test) is most often used to assess effort as it relates to malingering behavior, and was designed to be especially sensitive to poor effort as seen in those consciously malingering cognitive impairment (i.e., noncredible performance). Specifically, the measure was created so that a high rate of correct responses (greater than or equal to 90 percent correct) would be obtained by most individuals, even those with severe brain injury diagnoses; therefore, in a non-treatment seeking sample, the measure may be insensitive to slightly diminished effort. In fact, no individuals in the sample scored lower than the conservative cutoff score of 85, and most participants exceeded a score of 90. As such, it is possible that the utilization of a non-treatment seeking sample with no obvious reasons to exhibit noncredible effort may have contributed to the lack of association between cogniphobia and effort. Of note, however, even in the limited cogniphobia research, noncredible effort has been linked with cogniphobia in a treatment-seeking sample. During the development of the Cogniphobia-Scale, Todd et al. (1998) found that cogniphobia was related to noncredible effort in a post-traumatic headache sample after a high percentage of individuals failed a measure of effort included in a battery of neuropsychological tests. The avoidance behavior that we might have expected to detect in our sample may be more subtle given the demographics of our non-treatment seeking sample and might not have been detected by a measure (i.e., the Word Memory Test) created to detect more pronounced noncredible effort. Nonetheless, use of the Word Memory Test as a measure of avoidance behavior departs from other studies that use self-report measures only to assess avoidance behavior, and its use may be more effective if utilized in a treatment-seeking sample. Inclusion
of the objective measures of effort may strengthen inferences drawn in future research regarding the role of avoidance and effort in behavioral performance, such that significantly poorer performance on a test of effort might indicate an observable attempt, whether conscious or not, to avoid a potentially pain-inducing task.

**Cogniphobia and Cognitive Performance**

We also hypothesized that higher levels of cogniphobia would be associated with poorer performance on cognitive tasks. This hypothesis was only partially supported; high cogniphobia scores were not related to lower scores on a test of memory, but were related to lower scores on a test of attention. High pain-related fear scores, as per alternate measures utilized in this study, and high catastrophizing scores were not related to lower scores on a test of memory and were not related to lower scores on a test of attention.

The attention measure used in the present study is a considerably more difficult and stressful cognitive task than the memory measure, and while speculative, it may be that individuals who report high pain-related fear of cognitive exertion are less likely to persist on tasks such as the Paced Auditory Serial Addition Task that are considered to be aversive (Lejuez, Kahler, & Brown, 2003, Johnston, Vieth, Johnson, & Shaw., 1997) and require a greater amount of effort. Since the measure consists of four progressively more difficult trials, data indicating that only trial 4 was negatively related to the Cogniphobia-Scale may suggest a possible lack of persistence of individuals reporting high pain-related fear. The use of the Paced Auditory Serial Addition Task allows for direct observation of avoidance behavior on a difficult or aversive task, which aligns with kinesiphobia studies that include the direct observation of behavioral performance as measured through physical tasks (e.g., Crombez, 1999; Swinkels-Meewisse et al., 2006; Thomas & France, 2007; Van den Hout et al., 2001; Vlaeyen et al., 1995). It could be argued that the Paced Auditory Serial Addition Task is the cognitive equivalent to physical tasks in the kinesiphobia literature that require an effortful performance. Hence, while the Word
Memory Test effectively measures nonvalid responding, the Paced Auditory Serial Addition Task might be more effective in detecting diminished cognitive effort, related to higher levels of cogniphobia. In other words, perhaps cogniphobia is related to diminished performance rather than invalid performance.

**Effort and Avoidance as Mediators**

Analyses also examined the hypothesized mediation of effort and avoidance measures in the relationship between cogniphobia (independent variable) and attention (dependent variable). Based on the three conditions for mediation, only one model met the first two conditions and was further explored (i.e., testing avoidance as a mediator). Although, avoidance trended towards a negative association with the measure of attention ($p = .065$), the model did not satisfy the third condition for mediation. Perhaps this mediator model would be satisfied in future research with a larger sample providing for greater power. Utilization of a non-treatment seeking sample with no obvious reasons to exhibit poor effort may have also contributed to this marginally significant association.

**Role of Psychological Variables**

When we examined the role that psychological variables (i.e., symptoms of depression, change in state anxiety) played in the relationship between cogniphobia and cognitive performance, we found that change in state anxiety during the study did not show any significant associations with primary variables, but depressive symptoms assessed at the beginning of the study were significantly related to cogniphobia and to attention. We further considered the relationship that psychological variables have with cogniphobia and cognitive performance by looking at the significant relationship between cogniphobia and attention while controlling for depressive symptoms. As indicated above, when accounting for depressive symptoms, we found that cogniphobia was no longer significantly related to attention. These findings suggest that depressive symptoms may potentially mediate the relationship between cogniphobia and
cognitive performance. Two factors in our study design limited our ability to formally test depressive symptoms as a mediator, which may have yielded a more robust understanding of the role that depression may play in relation to pain-related fear and cognitive performance. First, depressive symptoms were only measured near the beginning of the study (i.e., prior to the administration of the cognitive measures and the Cogniphobia-Scale). Second, depression is a state variable and our study did not measure participants’ change in depressive symptoms over time. As such, future studies should be designed to test for depressive symptoms both prior to the administration of the Cogniphobia-Scale and again following the administration of neuropsychological tests. Through careful study design, future research may begin to tease out whether psychological variables, such as anxiety and depression, play a confounding role in the relationship between pain-related fear and cognitive performance (i.e., leading to higher reported pain-related fear and poorer cognitive performance) or potentially mediate the relationship between pain-related fear and cognitive performance, in which case higher pain-related fear would be expected to lead to higher levels of anxiety and/or depression when faced with stressful cognitive tasks and, in turn, lead to poorer cognition. It would be beneficial for future research to examine the role of depressive symptoms or diagnosis in a clinical or treatment-seeking sample, thus addressing some of the present study’s aforementioned sample limitations. By building a mediation model into the study design and examining the role of depression in a clinical sample, future research may shed more light on key relationships among pain-related fear, depression, and behavioral performance and enhance the generalizability of research findings to individuals reporting pain.

Despite the significant role depressive symptoms appear to play, our findings show a significant lack of association between psychological variables and other primary variables considered in our study. That is, depressive symptoms were not related to memory, effort, or avoidance, and the change in state anxiety during the study was not related to cogniphobia, the
avoidance measures, or the cognitive measures. The lack of association between psychological variables and pain-related fear, avoidance, and cognitive measures may be due to the use of a relatively healthy sample. For example, the mean score on the Beck Depression Inventory-II was 9.6 (SD=7.1). More specifically, approximately 76 percent (53 participants) scored within the cutoff for no to minimal depression, 16 percent (11 participants) scored within the mild range of depressive symptoms, and only 7 percent fell within the moderate range. It is possible that this ceiling effect precluded full examination of the role of depressive symptoms in tests of memory and avoidance. Future studies can further examine the role of psychological variables and their relationship with pain-related fear, avoidance and cognitive measures by looking at a more general community sample or targeting a clinical sample, where participants would be expected to exhibit a wider range of depressive symptoms and anxiety.

Limitations

It is likely that important limitations of our study design may have contributed to our findings about the general lack of relationship between cogniphobia and cognitive performance, and some have been previously mentioned. There are additional key limitations to consider in more detail. One key limitation of the study relates to the ordering of tests, specifically the effect that exposure to the neuropsychological tests might have had on participants’ endorsement of pain-related fear or avoidance behavior. Individuals completing a neuropsychological test battery that includes an aversive task, such as the Paced Auditory Serial Addition Task, might endorse higher levels on pain-related fear measures. It should be noted, however, that if the order of measures was reversed (i.e., pain-related fear measures were administered prior to neuropsychological measures) participants’ exposure to pain-related fear items may lead to increased hypervigilence or avoidance and potentially poorer cognitive performance. In order to address the potential impacts of order effects, it may be necessary for future study designs to include two separate test batteries, where one group would complete neuropsychological tests
prior to self-report measures of pain-related fear and a comparison group would complete pain-related fear measures prior to neuropsychological tests.

A second key limitation of our study relates to the study sample; participants included in the study were generally healthy and limited in regard to their race and age. Possibly due to the relatively healthy status of our sample in comparison to a general community or treatment-seeking sample, we observed a narrower and milder level of depressive symptoms and anxiety which might have affected results. It might be expected that level of education might also be an important limitation. Specifically, the study sample was enrolled in a university and would therefore perform better on cognitive tests than other samples; resulting in a stronger relationship between pain-related fear and cognitive performance. However, our sample in fact performed worse than general community, medical, and psychiatric samples based on existing normative data for the attention and memory measures. The reason for this is unclear. Perhaps our study sample’s relatively poorer performance could be attributed to a lack of perceived urgency to perform well on neuropsychological measures given that the study may have had relatively little perceived importance for them personally other than providing class credit in exchange for their participation. This is in contrast to a treatment seeking/patient sample that may have more motivation to engage on tests that they perceive to be important in relation to their presenting health issues. Second, we were not looking at a chronic pain or disabled sample and thus some characteristics of our sample are substantially different than samples targeted in most pain-related fear studies, which have often examined treatment-seeking samples and/or samples exhibiting significant and/or chronic pain issues. The sample examined in this study reported relatively lower levels of pain intensity (severity of typical headache; $M = 2.9, SD = .9$), and relatively lower frequency of headaches per month ($M = 7.1, SD = 5.8$), again most likely due to the fact that the participants were not a patient sample. The fact that our study focused on a relatively healthy, non-clinical sample, along with the relatively low mean age of the sample in comparison
to the general population, contributes to the possibility that this sample simply has had a shorter and less extensive experience with pain, providing less time to develop long-term associations with pain and/or consequent maladaptive behavioral patterns.

Finally, procedural limitations of our study may have also decreased the generalizability of the study findings. Participants for the present study were selected through an on-line recruiting system in a university Psychology Department and was recruited based on specific criteria (i.e., five or more headaches per month, high or low scores on the Cogniphobia-Scale). However, upon further inquiry at the time of the study, many reports were inconsistent regarding the participants earlier self-reported frequency of headaches. This might be due to the lack of reliability in regard to self-report and/or the large number of measures that students were required to complete in the university’s mass screening procedures. Due to the discrepancy in reported headaches, the number of headaches required to be included in the data analysis was reduced to two or more headaches per month. The fact that the study sample exhibited less frequent headaches than anticipated may have contributed to the dilution of the relationships between pain-related fear and other variables (e.g., cognitive performance) that were examined in this study.

Summary

Despite study limitations, the present results advance pain-related fear research by addressing a gap in existing literature regarding cogniphobia and its influence on cognitive performance. While the present findings suggest that cogniphobia mirrors kinesiophobia in many ways, they also suggest that cogniphobia may play a different or more nuanced role in relation to cognitive performance than kinesiophobia plays in regard to physical performance. While the impact of kinesiophobia may be clearly observed through measurements of physical performance and an individual’s decline in physical health, the results of cogniphobia may not be as apparent. Rather, an individual’s fear of cognitive exertion may have a more subtle and less observable
impact on cognitive performance, resulting from a reduction in effort and avoidance behaviors, which may require more sensitive scales and measures to assess. Further research on the impact of cogniphobia on cognitive performance in a treatment-seeking sample could provide more definitive evidence regarding relationships between pain-related fear and attention and memory among individuals who report recurrent or chronic headaches.
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Appendix A. Study Instruments and Psychometric Properties

Assessment of Pain-Related Fear

**C-Scale.** An adapted form of the Cogniphobia Scale (C-Scale; Todd et al., 1998) was used in the current study to assess fear-avoidance behavior in regard to cognitive performance. According to Martelli, Zasler, et al. (1999), the C-Scale is designed to assess anxiety-based avoidant behavior regarding cognitive exertion in a chronic pain population. Cogniphobia was an extension of kinesiophobia to post traumatic headache in response to the observation of poor effort on cognitive tests by patients after whiplash and head trauma. Suboptimal performance on neuropsychological tests was found to be a result of phobic responses to the possibility that headaches would occur or that current headache pain would increase when completing a cognitively challenging task (Martelli et al. (1999). Psychometrics are limited for the C-Scale. As the C-Scale was adapted from the Tampa Scale of Kinesiophobia (TSK), psychometrics for the TSK will be cited, as well as unpublished pilot data.

In a sample of 200 chronic pain patients in a study by French, France, Vigneau, French & Evans (2007), internal consistency was high across items in the TSK ($\alpha = 0.84$). Item-total correlations for all 17 items ranged from $r = 0.29$ to $r = 0.69$. TSK scores are significantly correlated with other measures of fear-avoidance beliefs (e.g., Fear Avoidance Beliefs Questionnaire, Waddell, Newton, Henderson, Somerville, & Main, 1993; Pain Catastrophizing Scale), measures of self-reported disability (e.g., Million Visual Analogue Scale, Million et al., 1982; the Quebec Back Pain Disability Scale, Kopec et al., 1995), and self-reported pain intensity. The TSK has also been found to have a relationship with measures of general negative affect (i.e., higher levels of kinesiophobia associated with higher depression scores as measured by the BDI), as well as with measures of state anxiety (i.e., higher levels of kinesiophobia...
associated with higher trait anxiety scores as measured by the State-Trait Anxiety Inventory; French, France, Vigneau, French, Evans, 2007).

The original Cogniphobia Scale was developed in order to assess pain-related fear in patients with severe chronic pain conditions and was therefore adapted in this study to better assess a sample of college students with recurrent headache. Specifically, two items were added and one item was altered in order to obtain the adapted Cogniphobia Scale (Appendix C) used in this study. Preliminary internal consistency analysis of the adapted form of the C-Scale produced a Cronbach’s α of .77 in a non-specific sample of approximately 800 undergraduate college students. In the current study sample, item 5 of the Cogniphobia Scale showed a negative corrected item-total correlation of -.09 and item 13 showed a low corrected item-total correlation of .14. These items referred to relieving headaches by practicing concentration exercises (“My pain would probably be relieved if I practiced concentration exercises”) and believing that increased mental activity would be positive (“Although my condition is painful, I would be better off if I were more mentally active”). There was no difference in results when testing the study hypotheses with or without these items. These items were not included in the final analyses, and, after removing them, the Cronbach’s α for the C-Scale increased from .87 to .88. In the current study, the C-Scale was significantly and positively related to both the PASS, \( r(65)= .61, p < .001 \), and the FPQ, \( r(70) = .39, p = .001 \).

FPQ. The Fear of Pain Questionnaire (FPQ; McNeil et al., 1986) was used to measure fear of painful stimuli. The FPQ consists of 30 items with three subscales for minor pain, severe pain, and medical pain. For each described painful situation on the FPQ, participants rate their level of fear on a scale from 1 (not at all) to 5 (extreme). According to previous research, the FPQ subscales have adequate internal consistency (α’s = 0.86 to 0.87) in a sample of headache patients (Hursey & Jacks, 1992), and adequate test-retest stability (α = .56) over a three-month interval in a non-clinical sample (Roelofs, et al., 2005). Roelofs et al. (2005) provided evidence
for construct validity, finding a correlation between FPQ and PASS to be significantly stronger than the correlation between FPQ and STAI-State. FPQ showed strong internal consistency in the current study ($\alpha = .94$) and was significantly related to both the C-Scale, $r(70) = .39, p = .001$ and the PASS, $r(65) = .40, p < .001$.

**PASS.** The Pain Anxiety Symptom Scale (PASS; McCracken et al., 1992) is a well-validated 40-item measure of pain-related fear and anxiety. The measure consists of four subscales measuring: cognitive anxiety, fearful appraisal, escape/avoidance, and physiological anxiety. The total score has been used as a measure of pain-related fear in previous research and was used in the present study to measure pain-related fear. This instrument has strong internal consistency ($\alpha = 0.94$; Roelofs et al., 2004). Correlations with pain-related measures have been found to be modest but similar to the PASS-20 (a 20-item questionnaire based off of the original PASS). Correlations of the PASS total score with pain-related measures were .59, .55, and .76 for the Pain Anxiety Symptoms Questionnaire, the Tampa Scale of Kinesiophobia, and the Pain Catastrophizing Scale respectively. The correlations for the PASS-20 were almost identical (.59, .54, .76 respectively; Roelofs et al., 2004). The total score was used in the present study to measure pain-related fear in general. The PASS total score showed strong internal consistency in the present study ($\alpha = 0.93$) and was significantly related to both the C-Scale, $r(65)= .61, p < .001$ and the FPQ, $r(65) = .40, p< .001$.

**Assessment of Depression**

**BDI-II.** The Beck Depression Inventory (BDI-II; Beck et al., 1996) is a measure of self-reported depression. It has been often used to differentiate chronic pain patients with and without significant depression. The BDI-II has participants rate their experience with each item from “not present” to “severe.” Consistent with DSM-IV criteria for a Major Depressive Episode (American Psychiatric Association [DSM-IV-TR], 2000), the BDI-II asks for ratings over the past two weeks. Psychometric properties of the BDI-II have been compiled in the Mental Measurements.
Yearbook database (Arbisi, 2007). Estimates of reliability for the BDI-II in outpatient and nonclinical samples ranged from $\alpha = .92$ to .93. In this same study, corrected item-total correlation for the outpatient sample ranged from $r = .39$ (loss of interest in sex) to $r = .70$ (loss of pleasure). For the nonclinical college sample, the lowest item-total correlation was $r = .27$ (loss of interest in sex) and the highest $r = .74$ (self-dislike). The test-retest reliability coefficient across the period of a week was quite high at $r = .93$. Evidence for concurrent validity comes from a correlation with the Hamilton Psychiatric Rating Scale for Depression utilized in a sample of psychiatric outpatients ($r = .71$). A relatively moderate correlation was found between the BDI-II and the Hamilton Rating Scale for Anxiety ($r = .47$), providing evidence for its discriminate validity. The BDI-II manual (Beck et al., 1996) reported mean scores for groups of psychiatric outpatients and college students. As expected, outpatients had higher score than college students. Further, individuals with mood disorders had higher scores than those individuals diagnosed with anxiety and adjustment disorders (Arbisi, 2007). The BDI-II showed good internal consistency in the current study ($\alpha = .87$).

**Assessment of Neuropsychological Performance**

**AVLT.** The purpose of the Rey Auditory-Verbal Learning Test is to assess verbal learning and memory. The measure is a brief pencil and paper test that is easily administered. The AVLT consists of two lists of 15 nouns. Both lists are read aloud with a one-second interval between each word. The first list is presented for five consecutive trials, and a free-recall test is given for each trial. List B is given as an interference list after the completion of trial five of List A, and a free-recall test is given for List B. Delayed recall of the first list immediately follows the free-recall test for List B. A 20-minute delay period is provided, after which the participant is required to recall words from List A. Finally, a list of 50 words is presented verbally to the participant containing all words from both lists plus an additional 20 words that are not on either
list. The participant is asked to identify those words contained in List A. For the present study the 20-minute delayed recall score was used as the measure of memory.

Test-retest reliability has been found to be fair to good, ranging from .12 to .86 (Schmidt, 1996). The most reliable scores have come from trial five and delayed-recall trials \((r = .60 \text{ to } .70; \text{ Mitrushina & Satz, 1991; Snow, Tierney, Zorzitto, Fisher, & Reid, 1988; Uchiyama et al., 1995})\). The AVLT has been found to correlate moderately with alternate measures of learning and memory (Crossen & Wiens, 1994; Johnstone et al., 2000; Stallings et al., 1995). According to factor analytic studies, the AVLT loads primarily with other verbal memory tests (Strauss et al., 2006).

**PASAT.** The Paced Auditory Serial Addition Task (PASAT; Gronwall, 1977) is a measure of information processing and sustained attention. The test presents a random series of numbers from 1 to 9. The subject must consecutively add pairs of numbers so that each number is added to the number presented immediately before it. This pattern is sustained over several items, and this process is repeated over several trials with an increase in the speed of stimulus input and a decrease in the available time for each response. The PASAT tests divided attention, sustained attention and working memory by requiring the individual to switch between two ongoing tasks over several trials (Strauss et al., 2006). In addition, the PASAT has been considered an aversive task and has been used in this capacity in research studies to induce stress and to increase fatigue (Johnston et al., 1997; Lejuez et al., 2003). Despite this, no clear evidence was found for fatigue effects on performance when the PASAT was administered four separate times during one testing session to both normal controls and patient groups (Strauss et al., 2006).

Instructions for the PASAT are provided on a tape that must be played at an audible level for each participant. To start, a practice trial is presented, followed by the first trial (2.4 seconds). Before each section the participant is warned that it will be faster than the one previous. Sixty seconds is provided between each section. The two faster rates (1.6 seconds and 1.2 seconds) are
only given if the participants meet a certain performance level during the first two slower rate versions (i.e., at least 20 items correct on the 2.0-second trial, or at least 40 correct on the 2.4-second trial). The test administration takes approximately 15 to 20 minutes (Strauss et al., 2006). All four trials were given in the present study, but only the fourth (1.2 second) trial was used in analyses.

Split half reliability for the four trials of the PASAT are high in adults (i.e., \( r = .96; \) Strauss et al., 2006). Test-retest correlations are very good (\( r > .90 \) after short rest intervals of 7-10 days (McCaffrey et al., 1995). Evidence has been provided for the construct validity of the PASAT. It is moderately correlated to other measures of attention including the Digit Span test, Auditory Consonant Trigrams, d2 Test, Trail Making Test, Visual Search and Attention Test, and Stroop test (Dyche & Johnson, 1991; Gronwall & Wrightson, 1981; MacLeod & Prior, 1996; O’Donnell, MacGregor, Dabrowski, Oestreicher, & Romero, 1994; Sherman, Strauss, & Spellacy, 1997). The test also loads with other attention/processing speed tests in factor-analytic studies (Strauss et al., 2006). Also, recent research has indicated that correlations of the PASAT with IQ and with mathematical ability appear to be at least in the moderate range (Strauss et al., 2006).

**Effort/Avoidance Assessment**

**WMT.** The Word Memory Test is a computerized measure of effort on cognitive tasks (WMT; Green et al., 1996). There are seven primary subscales of the WMT: immediate recall, delayed recall, recall consistency, multiple choice, paired associates, free recall, and long delayed free recall. For the purposes of the proposed study, effort was assessed utilizing only the immediate recall subscale. According to the authors, the WMT was created so that a high rate of correct responses (greater than or equal to 90% correct) would be obtained by most individuals, even those with 'severe' brain injury diagnoses. In fact, scores obtained from a sample of 'severe'
brain injury individuals exceeded 90% correct for measures of immediate recall, delayed recall, and recall consistency (Green et al., 1996).

In 1,207 consecutive outpatients, correlations were found to be high among the first three subtests and delayed recall \( (r = .88) \), multiple choice and paired associates \( (r = .90) \), and free recall and long delayed free recall \( (r = .86; \text{Green et al., 1996}) \). In regard to test-retest reliability, effort measures were found to correlate highly with one another (immediate recall and delayed recall \( r = .87 \) on initial testing and on retesting \( r = .94 \) a year or longer after the initial testing of 33 individuals (Green, 2003). Construct validity is evidenced through the comparison of the WMT with the Computerized Assessment of Response Bias, and with indicators of response bias from tests of memory (e.g., California Verbal Learning Test, Warrington Recognition Memory Test). In addition, as expected from a measure of effort, the WMT has been found to be sensitive to poorer effort from compensation-seeking individuals (e.g., Gervais et al., 2001; Green, Less-Haley, & Allen, 2002). Evidence supports the WMT authors’ intention that the test is very easy for those with significant neurological impairment (Green & Faro, 2003; Green, Iverson, & Allen, 1999; Green, Rohling, Lees-Haley, & Allen, 2001, Green et al., 2002; Williamson, Green, Allen, & Rohling, 2003), and it appears to be unrelated to age, reading ability, limited education or intellectual attainment (Green & Faro, 2003). Face validity is good and disguises the fact that effort is being tested (Green et al., 1996). No individuals in the current study’s participant sample scored lower than the conservative cutoff score for poor effort on the WMT of 85, and most participants exceeded a score of 90.

The PASS escape/avoidance subscale was used to measure self-reported avoidance behavior. The internal consistency for subscales of the PASS have been shown to have Cronbach’s \( \alpha \) coefficients ranging between .81 and .89 in previous studies and the escape/avoidance subscale produced a Cronbach’s \( \alpha \) of .74 in this study. In the current study sample, item 3 of the PASS escape/avoidance subscale showed a low corrected item-total
correlation of .144, well below the accepted level of .30. This item refers to staying as still as possible when feeling pain and may not be as relevant to this non-chronic pain, undergraduate population in comparison to pain populations. This item was excluded in the final analysis and when removing it from the subscale the Cronbach’s α for the PASS escape/avoidance subscale increased from .73 to .74. Overall, there were no negative corrected item-total correlations that suggest that a question is not properly measuring the purposed construct.

Assessment of Catastrophizing

PCS. The Pain Catastrophizing Scale (PCS; Sullivan et al., 1995) is a commonly used self-report measure designed to assess catastrophizing and consists of 13 items describing different thoughts and feelings that individuals may experience when they are in pain with scores ranging from 0 to 52, with higher scores indicating a higher level of pain catastrophizing. The PCS provides a total score, as well as subscale scores for assessing rumination, magnification and helplessness. Internal consistency has been shown to be adequate to excellent: total PCS (α = 0.87), rumination (α = 0.87), magnification (α = 0.66), and helplessness (α = 0.78; Sullivan et al., 1995). The PCS has shown good test-retest reliability (r = .75 at 6 weeks; r = .70 at 10 weeks). The PCS showed high internal consistency in this study (α = .93).

Assessment of Anxiety

STAI. The Spielberger State Trait Anxiety Inventory (STAI; Spielberger, 1983) is a 20-item self-report scale that assesses symptoms of anxiety. The four-point rating scale requires participants to indicate to what degree they feel each symptom generally. The choices include: (1) not at all, (2) somewhat, (3) moderately so, and (4) very much so. Total score on the STAI ranges from 20 to 80. The higher the scores are on the measure, the greater the symptoms of anxiety.

The STAI consists of two separate scales measuring state anxiety and trait anxiety (Spielberger, Gorsuch, & Lushene, 1969). The state scale was used in the current study and
consists of 20 statements that participants use to describe how they feel at that particular moment in time. As expected the state scale has a lower test-retest reliability than the Trait scale \((r = 0.32)\). Internal consistency for the state scale ranges from 0.92 to 0.93 (Spielberger, Gorsuch, & Lushene, 1969). According to Spielberger (1983), both scales on the STAI appear to have high discriminant and convergent validity with separate measures of anxiety as well as with other related constructs. As reported by Spielberger (1983) construct validity was demonstrated by finding higher stress in college students after testing and higher stress in military recruits after training. Concurrent validity was demonstrated in a neuropsychiatric patient population using the Cornell Medical index \((r = .70)\) and in a college student population seeking counseling using the Jackson’s Personality Research Form \((r = .61-.65; Speilberger, 1983)\). The STAI was given at the beginning and at the end of the current study. The first administration of the STAI was used in order to consider state anxiety before it is affected by the possible increase in stress related to engaging in cognitive activities. In the exploratory analyses, a change score between STAI time 1 and time 2 was used to explore the possibility of a mediating effect involving the change in state anxiety and its role in the relationship between cogniphobia and neuropsychological performance. The scale showed strong internal consistency in the current study \((\alpha = .89)\).

**Assessment of Headache Characteristics**

*Headache Screening Questionnaire.* A modified version of Lipchick et al.’s (1996) headache screening questionnaire was used to measure self-reported headaches (e.g., frequency, duration), and was used as the on-line screener and repeated during the study session. The questionnaire was developed in order to identify and categorize self-reported headaches, and has been used as a reliable measure for recent headache related research. This measure includes questions regarding pain quality, headache location, chronicity, frequency, duration, intensity, and associated symptoms. Data from this questionnaire was used in order to determine frequency of headaches and to determine if the individual was included in the study. This measure has been
shown to have high reliability over two weeks of reports (Kappa’s from .82 to .98; K. A. Lipchik et al., 1996).

**HQ.** The Headache Questionnaire (HQ; Asmundson et al., 1999) consists of questions regarding distinct aspects of the patient’s experience with headaches. Questions query the severity of typical headache (0=no headache to 5=extremely painful), the disturbing/distressing nature of headaches, and the degree to which headaches restrict or change one’s lifestyle. The HQ was developed by Asmundson et al. in order to obtain specific information regarding headache pain, and the psychometric properties of the questionnaire have yet to be addressed. The HQ was used in the current study to obtain additional headache characteristics of the participants not already addressed by the Headache Screening Questionnaire and was administered with other self-report measures in the first part of the testing session.

**VAS.** A visual analogue scale (VAS) was utilized in the current study in order to measure recent, current, and acute pain levels. Participants reported pain levels on a scale from 1 to 10 (1= no pain at all and 10= worst pain imaginable). Visual analogue scales are widely used measures of subjective pain and have been shown to possess adequate reliability and validity (Jensen & Karoly, 1992). Test–retest reliability has been reported to be high for the VAS \( r = 0.71 \text{ to } 0.99; \) Kahl & Cleland, 2005). The VAS demonstrates convergent validity when correlated with numeric pain rating scales and the McGill Pain Questionnaire \( r = .30 \text{ to } .95; \) Kahl & Cleland, 2005). Validity has been found to be moderate for the VAS \( r = 0.71–0.78 \) when compared with the NPRS (Kahl & Cleland, 2005). Overall, the VAS is considered a reliable and valid measure of pain intensity.

**Assessment of Self-Efficacy and Locus of Control**

**HSE.** The Headache Self-Efficacy Scale (HSE: French et al., 2000) is a 25-item instrument designed to assess individuals’ agreement with statements regarding their ability to cope with their headaches. The HSE uses a six-point Likert-type scale with anchors of 1 (strongly
disagree) and 7 (strongly agree). The HSE has been shown to have high internal consistency ($\alpha = 0.90$) and has shown good construct validity (French et al., 2000). Test-retest reliability across a three week period was $r = .67$ in a larger sample of college students (Martin, Holroyd, & Rokicki, 1993). In this same population, lower scores on the HSE were associated with higher depression scores on the BDI, higher anxiety scores on the Headache Specific Locus of Control-A, greater physical symptoms on the HSL-S, and use of disengaging coping strategies as measured by the Coping Strategies Index ($r = .48, .45, .42,$ and $.25$, respectively). The HSE showed strong internal consistency in the current study ($\alpha = .88$).

**HSLC.** The Headache Specific Locus of Control Scale (HSLC) is a 33-item instrument used to assess the extent to which individuals believe that factors influencing their headaches are related mainly to external (i.e., Health Care Provider subscale, Chance subscale) or internal forces (Martin et al., 1990). The HSLC uses a five-point Likert-type scale with anchors of 1 (strongly disagree) and 5 (strongly agree). The HSLC has been shown to have good internal consistency ($\alpha = 0.80–0.88$; Martin et al., 1990; VandeCreek & O’Donnell, 1992), adequate test–retest reliability (0.75) and has shown good construct validity (Martin et al., 1990). Van de Creek & O’Donnell (1992) found a significant difference in scores on the HSLC between patients and non-patients, indicating the scale’s ability to distinguish between individuals whose headaches are severe enough to seek treatment and those whose headaches are not severe enough to need physician’s care. The authors found significant differences for each loci of control. The largest difference they found was in the orientation toward health care professional control. Also, they found that headache patient scores were shifted away from internal control and into both health care professional and chance control. In addition, Van de Creek & O’Donnell found that those individuals that reported headaches while completing the HSLC were associated with having higher health care and chance orientation scores. Internal consistency of the scale in this study was adequate ($\alpha = .76$).
Pressure Pain Threshold Assessment

**PPT.** Although not part of the primary hypotheses of this study, the Wagner Instruments algometer was used to measure pain threshold. The device consists of a rubber tip attached to the pole of a pressure gauge, which displays values in kilograms. Pressure pain threshold (PPT) is defined as the minimum pressure that elicits discomfort or pain in the test site of the body being explored (Fischer, 1990). Consistent with the procedures in similar studies (Fernández-de-las-Peñas, Alonso-Blanco, Cuadrado, Gerwin, & Pareja, 2006), in the current study three successive measurements were taken at intervals of 30 seconds, and the mean was used in the analysis.

In healthy populations, inter-examiner reliability of the PPT has been found to be good, with a mean intra-class correlation coefficient (ICC) of 0.75 and 0.77 (Antonaci, Sand, & Lucas, 1998; Cathcart & Pritchard, 2006). Intra-examiner reproducibility has been found to be excellent (mean ICC=0.84; Antonaci et al., 1998). As expected, comparisons between groups have yielded significant differences between individuals with pain and controls without pain on pressure pain thresholds. In comparing a chronic pain group with a non-pain control group, Ohrbach and Gale (1989) found that chronic pain patients had significantly lower PPT than controls ($r = .75$). Other studies have also shown PPT differences between chronic headache patients and healthy controls (Bendtsen, Jensen, & Olesen, 1996; Bovim, 1992; Janke & Holroyd, 2002; Langemark, Jensen, Jensen, & Olesen, 1989; Schoenen, Bottin, Hardy, & Gerard, 1991).
Appendix B

Cogniphobia was significantly related to headache pain variables showing that high pain-related fear and self-report of negative headache characteristics are related (Table B.1) and was significantly and positively related to the severity of typical headache, $r(70) = .37, p = .002$, level of distress related to headaches, $r(70) = .40, p = .001$, restricted lifestyle due to headaches, $r(70) = .53, p < .001$, and frequency of headaches, $r(70) = .28, p = .019$. Cogniphobia was significantly and positively related to headache locus of control related to chance, $r(70) = .33, p = .005$. Headache Specific Locus of Control (chance) and cogniphobia have 11% shared variance. In addition, cogniphobia was significantly and negatively related to headache management self-efficacy, $r(70) = -.28, p = .02$. Headache management self-efficacy and the cogniphobia have 8% shared variance.

As expected, the C-Scale was significantly and positively related to both the PASS, $r(65) = .60, p < .001$, sharing 36% of variance, and the FPQ, $r(70) = .39, p = .001$, sharing 15% of variance. Cogniphobia was also significantly related to pain catastrophizing, $r(70) = .513, p < .001$, sharing 26% of variance (Table 3).

Exploratory analyses were conducted to explore whether other measures of pain related fear and pain catastrophizing would be related to avoidance (Table B.2). Consistent with the C-Scale, the Fear of Pain Questionnaire, $r(70) = -.01, p = .923$, and the Pain Anxiety Symptoms Scale, $r(65) = .22, p = .075$, were not significantly related to the effort measure, but both the Fear of Pain Questionnaire, $r(65) = .40, p < .001$, and the Pain Anxiety Symptoms Scale, $r(65) = .72, p < .001$, were significantly and positively related to self-reported avoidance. In addition, pain catastrophizing was not significantly related to the effort measure, $r(70) = -.02, p = .874$, and was not significantly related to self-reported avoidance, $r(65) = .17, p = .170$. 
Given the lack of consistent findings regarding cogniphobia’s relationship to neuropsychological variables, we examined how other measures of pain-related fear related to neuropsychological performance in the present study (Table B.2). Pearson product-moment correlation coefficients were calculated to investigate the relationship between neuropsychological measures and the other two measures of pain-related fear (i.e., FPQ, PASS). Consistent with the C-Scale, the FPQ and PASS were not significantly related to AVLT and PASAT performance. Also, similar to the pain-related fear measures, catastrophizing was not significantly related to the neuropsychological measures.
Appendix C

Instructions: Please respond to the following statements regarding how you feel about your current/recent headaches by marking the appropriate box. 1 = Strongly Disagree, 2 = Disagree, 3 = Agree, 4 = Strongly Agree

1. I'm afraid that I might make the cause of my head pain worse if I concentrate too much.
   - [ ] Strongly Disagree (1)
   - [ ] Disagree (2)
   - [ ] Agree (3)
   - [ ] Strongly Agree (4)

2. If I were to try to overcome it, my head pain would increase.
   - [ ] Strongly Disagree (1)
   - [ ] Disagree (2)
   - [ ] Agree (3)
   - [ ] Strongly Agree (4)

3. My head pain is telling me that I have something dangerously wrong.
   - [ ] Strongly Disagree (1)
   - [ ] Disagree (2)
   - [ ] Agree (3)
   - [ ] Strongly Agree (4)

4. I worry that when I have to think or concentrate too hard that I will bring on a headache.
   - [ ] Strongly Disagree (1)
   - [ ] Disagree (2)
   - [ ] Agree (3)
   - [ ] Strongly Agree (4)

5. My pain would probably be relieved if I practiced concentration exercises.
   - [ ] Strongly Disagree (1)
   - [ ] Disagree (2)
   - [ ] Agree (3)
   - [ ] Strongly Agree (4)

6. People aren't taking my headache pain seriously enough.
   - [ ] Strongly Disagree (1)
   - [ ] Disagree (2)
   - [ ] Agree (3)
   - [ ] Strongly Agree (4)

7. My headaches put my head & brain at risk for the rest of my life.
   - [ ] Strongly Disagree (1)
   - [ ] Disagree (2)
   - [ ] Agree (3)
   - [ ] Strongly Agree (4)

8. Headaches always mean I have an injury or have done something to make it worse.
   - [ ] Strongly Disagree (1)
   - [ ] Disagree (2)
   - [ ] Agree (3)
   - [ ] Strongly Agree (4)

9. I purposely avoid doing activities that might elicit a headache.
   - [ ] Strongly Disagree (1)
   - [ ] Disagree (2)
   - [ ] Agree (3)
   - [ ] Strongly Agree (4)

10. I'm afraid that I might make my headache pain worse by concentrating too much or being too mentally active.
    - [ ] Strongly Disagree (1)
    - [ ] Disagree (2)
    - [ ] Agree (3)
    - [ ] Strongly Agree (4)
11. Simply being careful not to concentrate too hard or too long is the safest thing I can do to prevent my pain from worsening.

☐ Strongly Disagree (1)  ☐ Disagree (2)  ☐ Agree (3)  ☐ Strongly Agree (4)

12. I wouldn't have this much pain if there weren't something potentially dangerous going on in my head.

☐ Strongly Disagree (1)  ☐ Disagree (2)  ☐ Agree (3)  ☐ Strongly Agree (4)

13. Although my condition is painful, I would be better off if I were more mentally active.

☐ Strongly Disagree (1)  ☐ Disagree (2)  ☐ Agree (3)  ☐ Strongly Agree (4)

14. Pain lets me know when to stop concentrating so that I don't injure myself.

☐ Strongly Disagree (1)  ☐ Disagree (2)  ☐ Agree (3)  ☐ Strongly Agree (4)

15. Performing a difficult cognitive task frequently brings on my headache pain.

☐ Strongly Disagree (1)  ☐ Disagree (2)  ☐ Agree (3)  ☐ Strongly Agree (4)

16. I can't do all the things normal people do because it's too easy for me to cause my headache pain to increase.

☐ Strongly Disagree (1)  ☐ Disagree (2)  ☐ Agree (3)  ☐ Strongly Agree (4)

17. Even though something is causing me a lot of head pain, I don't think it's actually dangerous.

☐ Strongly Disagree (1)  ☐ Disagree (2)  ☐ Agree (3)  ☐ Strongly Agree (4)

18. No one should ever concentrate on difficult mental tasks when he/she is in pain.

☐ Strongly Disagree (1)  ☐ Disagree (2)  ☐ Agree (3)  ☐ Strongly Agree (4)

19. Just because something aggravates my pain does not mean it's dangerous.

☐ Strongly Disagree (1)  ☐ Disagree (2)  ☐ Agree (3)  ☐ Strongly Agree (4)
### Study Tables

Table 1

*Headache Characteristics*

<table>
<thead>
<tr>
<th></th>
<th>$N$</th>
<th>Reported Range</th>
<th>$M$ (SD)</th>
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<tbody>
<tr>
<td>Number per Month</td>
<td>70</td>
<td>2 – 30</td>
<td>7.1 (5.8)</td>
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<tr>
<td>Months Recurrent</td>
<td>64</td>
<td>0 – 144</td>
<td>24.6 (33.1)</td>
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<tr>
<td>Typical Severity</td>
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<td>0 – 5</td>
<td>2.9 (0.9)</td>
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<tr>
<td>Headache Distress</td>
<td>70</td>
<td>0 – 4</td>
<td>2.2 (0.9)</td>
</tr>
<tr>
<td>Current Pain Level</td>
<td>70</td>
<td>0 – 5</td>
<td>1.5 (1.5)</td>
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</tbody>
</table>

*Note.* Number per Month=number of headaches per month; Months Recurrent=number of months experiencing recurrent headaches; Typical Severity=severity of participant’s most typical headache; Headache Distress=amount of distress caused by participant’s typical headache; Current Pain Level=pain level of participant’s headache at the time of the study; Pain Level of MostTypical = perceived pain level of participant’s most typical headache
Table 2

*Study Measures and Questionnaires in Order of Administration*

<table>
<thead>
<tr>
<th><strong>Self-Report Questionnaires:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics and History</td>
</tr>
<tr>
<td>Beck Depression Inventory-II</td>
</tr>
<tr>
<td>State Trait Anxiety Inventory – Form Y1</td>
</tr>
<tr>
<td>Headache Management Self-Efficacy Scale</td>
</tr>
<tr>
<td>Headache Specific Locus of Control</td>
</tr>
<tr>
<td>Pain Catastrophizing Scale</td>
</tr>
<tr>
<td>Headache Questionnaire</td>
</tr>
<tr>
<td>Visual analogue scale regarding current pain level</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Neuropsychological Measures:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Word Memory Test immediate trials</td>
</tr>
<tr>
<td>Rey Auditory-Verbal Learning Test learning trials</td>
</tr>
<tr>
<td>Paced Auditory Serial Addition Task</td>
</tr>
<tr>
<td>STAI (second time)</td>
</tr>
<tr>
<td>AVLT delayed recall</td>
</tr>
<tr>
<td>WMT delayed trials</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Pain-Related Fear Measures:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fear of Pain Questionnaire</td>
</tr>
<tr>
<td>Pain Anxiety Symptom Scale</td>
</tr>
<tr>
<td>Cogniphobia Scale</td>
</tr>
<tr>
<td>Headache Screening Questionnaire</td>
</tr>
</tbody>
</table>

Pressure pain threshold

*These tests require time delays between sections and are therefore listed twice.*
Table 3

*Pearson Product-Moment Correlations among Psychological, Pain-Related Fear, Neuropsychological, Effort and Avoidance Measures*

<table>
<thead>
<tr>
<th></th>
<th>Cs</th>
<th>STAI</th>
<th>BDI</th>
<th>AVLT</th>
<th>PASAT</th>
<th>FPQ</th>
<th>PASS</th>
<th>WMT</th>
<th>PASSsub</th>
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</thead>
<tbody>
<tr>
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<td></td>
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<td>1.0</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BDI</td>
<td></td>
<td></td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
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<td>FPQ</td>
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<td></td>
<td></td>
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<td>1.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PASS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WMT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>PASSsub</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td>1.0</td>
</tr>
</tbody>
</table>

*Note.* N = 60 - 70, *p* < .05, ** *p* < .01. C-Scale=Cogniphobia Scale revised; STAI=State Trait Anxiety Inventory (trial 2 - trial 1); BDI=Beck Depression Inventory-II; AVLT= Rey Auditory-Verbal Learning Test (delayed recall); PASAT=The Paced Auditory Serial Addition Task (trial 4); FPQ-III=Fear of Pain Questionnaire-III; PASS=Pain Anxiety Symptom Scale; WMT=Word Memory Test Immediate Recall; PASSsub=Pain Anxiety Symptom Scale escape/avoidance subscale
Table 4

Mean, Standard Deviation, and Range for Primary Variables of Interest

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean Score</th>
<th>SD</th>
<th>Range</th>
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</thead>
<tbody>
<tr>
<td>C-Scale</td>
<td>33.4</td>
<td>7.7</td>
<td>34</td>
</tr>
<tr>
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<td>21.4</td>
<td>98</td>
</tr>
<tr>
<td>PASS</td>
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<td>25.3</td>
<td>113</td>
</tr>
<tr>
<td>BDI</td>
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<td>7.1</td>
<td>30</td>
</tr>
<tr>
<td>STAI</td>
<td>7.1</td>
<td>8.8</td>
<td>43</td>
</tr>
<tr>
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<td>1.5</td>
<td>5</td>
</tr>
<tr>
<td>HAF</td>
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<td>5.8</td>
<td>28</td>
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<td>AVLT</td>
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<tr>
<td>PASAT</td>
<td>19.3</td>
<td>8.4</td>
<td>47</td>
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<tr>
<td>WMT</td>
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<tr>
<td>PASSsub</td>
<td>16.9</td>
<td>6.4</td>
<td>31</td>
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</table>

*Note. N = 64 - 70. C-Scale=Cogniphobia Scale revised; FPQ-III=Fear of Pain Questionnaire-III; PASS=Pain Anxiety Symptom Scale; BDI=Beck Depression Inventory-II; STAI=State Trait Anxiety Inventory (trial 2- trial 1); VAS= Visual Analogue Scale 0-10; HAF= Frequency of Headaches per Month; AVLT= Rey Auditory-Verbal Learning Test (delayed recall); PASAT=The Paced Auditory Serial Addition Task (trial 4); WMT=Word Memory Test Immediate Recall; PASSsub=Pain Anxiety Symptom Scale escape/avoidance subscale*
Table B.1

Pearson Product-Moment Correlations Among C-Scale, Headache Locus of Control, Headache Management Self-Efficacy, Headache frequency, Longevity, Severity, and Distress, Effect on Lifestyle

<table>
<thead>
<tr>
<th></th>
<th>CScale</th>
<th>HLC1</th>
<th>HLC2</th>
<th>HLC3</th>
<th>HME</th>
<th>HAS1</th>
<th>HQ1</th>
<th>HQ2</th>
<th>HQ6</th>
<th>HQ7</th>
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</thead>
<tbody>
<tr>
<td>CScale</td>
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<td>.08</td>
<td>.17</td>
<td>.33**</td>
<td>-.28*</td>
<td>.28*</td>
<td>.19</td>
<td>.37**</td>
<td>.39**</td>
<td>.53**</td>
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<tr>
<td>HLC1</td>
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<td>.06</td>
<td>.01</td>
<td>.15</td>
<td>-.20</td>
<td>-.09</td>
<td>.05</td>
<td>.10</td>
<td>.09</td>
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<td>.16</td>
<td>.13</td>
<td>.07</td>
<td>-.21</td>
<td>-.25</td>
<td>-.10</td>
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</tr>
<tr>
<td>HLC3</td>
<td>1.0</td>
<td>-.64**</td>
<td>.20</td>
<td>.16</td>
<td>.40**</td>
<td>.29*</td>
<td>.47**</td>
<td></td>
<td></td>
<td></td>
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<td>HMSE</td>
<td>1.0</td>
<td>-.11</td>
<td>-.06</td>
<td>-.39**</td>
<td>-.29**</td>
<td>-.33**</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>HAS1</td>
<td>1.0</td>
<td>.05</td>
<td>.16</td>
<td>.16</td>
<td>.25*</td>
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<td>HQ1</td>
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<td>HQ6</td>
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</tr>
<tr>
<td>HQ7</td>
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</tr>
</tbody>
</table>

*Note. N = 64 - 70, * p < .05, ** p ≤ .01. C-Scale=Cogniphobia Scale revised; PCS=Pain Catastrophizing Scale; HLC=Headache Specific Locus of Control Scale (1=, 2=, 3=); HMSE=Headache Management Self-Efficacy Scale; HAS1=how often do you experience headaches?, HQ1=number of months experiencing recurrent headaches; HQ2=severity of typical headache; HQ6=how distressing are headaches; HQ7=have headaches restricted lifestyle?
Table B.2

*Pearson Product-Moment Correlations Among Psychological, Pain-Related Fear, Effort/Avoidance, and Neuropsychological Measures*

<table>
<thead>
<tr>
<th></th>
<th>AVLT</th>
<th>PASAT</th>
<th>FPQ</th>
<th>PASS</th>
<th>PCS</th>
<th>WMT</th>
<th>PASSsub</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVLT</td>
<td>1.0</td>
<td>.01</td>
<td>.08</td>
<td>.04</td>
<td>.15</td>
<td>-.34*</td>
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</tr>
<tr>
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<td>-.25</td>
<td>-.22</td>
<td>-.22</td>
<td>-.24</td>
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<tr>
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<td>-.01</td>
<td>.40**</td>
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</tr>
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<td>.22</td>
<td>.72**</td>
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<td>-.02</td>
<td>.17</td>
<td></td>
<td></td>
<td></td>
</tr>
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<td></td>
<td></td>
<td>1.0</td>
<td>.29*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* N = 60 - 70, *p < .05, **p ≤ .01. C-Scale=Cogniphobia Scale revised; BDI=Beck Depression Inventory-II; STAI State=Spielberger Trait Anxiety Inventory-State (first administration); AVLT= Rey Auditory-Verbal Learning Test (delayed recall), PASAT=The Paced Auditory Serial Addition Task (trial 4); FPQ-III=Fear of Pain Questionnaire-III; PASS=Pain Anxiety Symptom Scale; WMT=Word Memory Test Immediate Recall; PASSsub=Pain Anxiety Symptom Scale escape/avoidance subscale