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Pain-Related Fear: Metacognitive and Health Belief Predictors of Cogniphobia

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Abstract

Individuals who have an unreasonable fear of headache pain or painful re-injury during cognitive exertion are said to suffer from a pain-related fear referred to as cogniphobia. Specifically, individuals high in cogniphobia avoid cognitive tasks in an attempt to reduce the risk of initiating or exacerbating headache-related pain. While health beliefs concerning pain-related fear have been examined through the concept of kinesiophobia, defined as the unreasonable fear of pain or painful re-injury during physical movement, little research has been done through a cognitive framework. The health anxiety beliefs, metacognitive factors, and negative thinking patterns related to cogniphobia remain unclear. This study presents an analysis of predictors of the development of cogniphobia and an analysis of the effects of self-reported traumatic brain injury (TBI) history on cogniphobia in two studies. Study One investigated these hypotheses in data from 620 participants from an internet sample. Study Two utilized data from a sample of 251 college students. An independent samples *t*-test was used to determine group differences between those with a self-reported history of TBI and those without on cogniphobia scores in both Study One and Two. Multiple regression analysis was used to examine the significance of metacognitive factors, health locus of control, and pain catastrophizing in predicting cogniphobia scores. These results highlight the role of TBI history on cogniphobia scores as well as the different health beliefs and pain attitudes that significantly impact pain-related fear. Additional implications for future clinical practice and research are discussed.

Keywords: cogniphobia, metacognition, pain-related fear, health locus of control, pain catastrophizing, traumatic brain injury, health anxiety, kinesiophobia

I. Overview of Literature Review

In 2017, TBIs contributed to about 30% of all injury deaths in the United States (Taylor, Bell, Breiding, & Xu, 2017). With such a high prevalence of head injuries in the United States, both sports-related and not, recovery protocols and guidelines have been reevaluated to reflect best practice for returning people as close to their baseline functioning as possible. Some symptoms that occur after head injuries, like headaches and anxiety, can be very debilitating, both physically and psychologically. Return to baseline functioning is a general goal for most people with these injuries, but there can be many obstacles to overcome in order to get there. One important factor to consider when treating someone with this kind of injury is their own personal perceptions of their recovery. Someone suffering from the effects of a head injury may behave in a certain way in academic, work-related, and cognitive-taxing environments out of fear or anxiety, which may shape the trajectory of their recovery. These issues were explored by evaluating the relative utility of a set of variables in predicting cogniphobia scores. The primary goal of this study was to determine what factors, physical and non-physical, were related to the avoidance of cognitive activities based on the fear of physical pain sensations.

1.1 Cogniphobia

The notion of pain-related fear being more disabling than experiencing the pain itself has been the focus of a specific field of research on pain beliefs (Crombez et al., 1999b; Waddell, Newton, Henderson, Somerville, & Main, 1993). There is some concern of this pain-related fear causing decreased performance within cognitive tasks as well as neuropsychological assessments (Suhr & Spickard, 2012). However, Crombez, Eccleston, Baeyens, van Houdenhove, and van den Broek (1999a) noted that this lowered performance may actually be a result of attentional resources being redirected from the actual cognitive task to the fear of physical pain sensations.

They have also suggested that this pain-related fear induces a sensitivity and hypervigilance to experiencing pain.

The concept of pain-related fear disabling someone from completing a task has been summarized through the study of kinesiophobia. Kinesiophobia is defined as the unreasonable or irrational fear of pain or painful re-injury during physical movement. It is a concept that was derived in response to observations by health care specialists of significant avoidant responses to physical movement during treatment of chronic back pain (Kori, Miller, & Todd, 1990). It has been shown to lead to self-reported avoidance of physical activities that might worsen pain, as well as decreased performance on physical tasks that are believed to cause pain. However, an important distinction should be noted in that kinesiophobia refers to the fear and perception that a physical activity might induce pain, not whether the physical activity actually causes pain.

Crombez at al. (1999b) examined kinesiophobia and its impact on the ability to complete tasks and perceived pain in a sample of chronic back pain patients. Results from their study included strong relationships between pain-related fear and self-reported disability and behavioral performance in a weight lifting test. Pain-related fear also proved superior in predicting self-reported disability and reduced weight lifting performance compared to pain intensity, pain duration, and negative affect. These results were consistent with previous research (Waddell et al., 1993) suggesting that pain-related fear or fear of re-injury may be more disabling than the actual pain itself. More recent work by Thomas et al. (2010) revealed that in a sample of chronic back pain patients, there was a significant relationship between pain and functional impairment as well as pain and depression, but not between pain and pain catastrophizing or kinesiophobia. They also found that degree of disability was correlated with both pain catastrophizing and kinesiophobia. It seems that the actual physical aspects of pain are not related to pain catastrophizing or pain-related fear. However, patient self-report of degree of disability correlated with pain catastrophizing and kinesiophobia, suggesting that as the degree to which patients' thought they were disabled increased, so did their self-belief of pain catastrophizing and kinesiophobia.

Further research by Martelli, Zasler, Grayson, and Liljedahl (1999) expanded the concept of kinesiophobia to cognitive performance in individuals suffering from headache, referred to as cogniphobia. Namely, those who display an unreasonable or irrational fear of headache pain or painful re-injury during cognitive exertion are said to suffer from cogniphobia. Just as in kinesiophobia, cogniphobia refers to the fear and perception that a cognitive task might induce pain, and not whether the cognitive task actually causes pain. While there has not been a consensus measure of cogniphobia to date, most studies use a variation or a modified version of the Cogniphobia Scale (C-Scale) developed by Martelli et al. (1999). There has been little research in the field of cogniphobia despite evidence of the impact of headache disorders, such as migraine, and brain injuries on cognitive abilities (Martins, Gil-Gouveia, Silva, Maruta, & Oliveira, 2012; Rabinowitz & Levin, 2014). However, there are several important studies related to cogniphobia worth mentioning.

Preliminary work with the construct of cogniphobia was conducted by Schmidt (2003) in an effort to further explore its connections to stress and cognitive performance. Results showed that a sample of chronically-stressed individuals on sick leave tended to avoid mental exertion significantly more than a group of employees actively working. They also reported a case study of an individual convinced that the chronic stress he had previously endured had damaged his brain, making it susceptible to new stress or stimulation that could then cause permanent damage. He was under the impression that engaging in too much thinking would be too big a risk for him and therefore should be avoided. Schmidt (2003) suggested that behaviors of cogniphobia may be exhibited in the form of avoiding activities that require long periods of concentration, such as reading, performing computer tasks, avoiding complex problem solving tasks that require mental exertion, and avoiding large groups of people or high sensory-stimulating situations.

Suhr and Spickard (2012) explored the psychological and cognitive correlates of cogniphobia in a sample of college students with frequent headaches. They found two different components of cogniphobia: headache dangerousness and fear/avoidance of headache pain. The headache dangerousness component was associated with high anxiety and depressive symptoms. The fear/avoidance component was associated with poor performance on the Paced Auditory Serial Addition Test, which measured sustained attention, the Word Memory Test, which measured symptom validity performance, and a low pressure-pain threshold measured with a hand-held analogue pressure algometer. The findings demonstrate that pain-related fear may be related to decreased effort on neuropsychological tasks.

Silverberg, Iverson, and Panenka (2017) expanded research on cogniphobia within a mild TBI sample suffering from post-traumatic headaches. Participants with more severe headaches endorsed higher levels of cogniphobia than participants with less severe headaches. Additionally, cogniphobia was associated with lower performance on memory testing after controlling for self-reported headache severity. Participants who were higher in cogniphobia also reported a tendency to avoid physical activity than participants who were lower in cogniphobia. Silverberg et al. (2017) suggests that cogniphobia may play a role in persistent cognitive difficulties after mild TBI, and that cogniphobia may be indicative of an avoidant coping style toward stress. Their findings have implications for connections to avoidant behaviors, including physical activity, and to performance on cognitive tests. It is possible that the decreased performance is connected to attentional resources being redirected from the actual memory testing to the fear of inducing a headache, as suggested by Crombez et al. (1999a). Some health beliefs may also be associated with the redirection of attentional resources from cognitive testing to pain-related fear as well.

1.2 Health Belief Systems

Different beliefs about health and illness recovery should be considered when analyzing any psychological distress or anxiety a patient may have in regard to their injury recovery. Strecher and Rosenstock (1997) described a conceptual model, labeled the Health Belief Model, as a general pathway of explaining why (or why not) people will take action to prevent, screen for, or control illnesses. The model categorizes individual beliefs into perceived disease susceptibility, perceived benefits (i.e., preventative measures saving on financial costs), perceived barriers (psychological costs), and perceived self-efficacy (confidence in one’s own ability to recover or take action). These beliefs then affect an individual’s health behavior going forward. Additional factors thought to modify the effects of health beliefs on action are age, gender, ethnicity, personality, socioeconomics, and knowledge (Strecher & Rosenstock, 1997). These beliefs play a role in a patient’s likelihood of seeking treatment or recovery assistance post-injury.

Moore and Stambrook (1995) outlined a model that explains differences in health beliefs and coping strategies between TBI patients. They hypothesized that cognitive, behavioral, emotional, psychiatric, and social effects post-TBI may encourage the development of ‘learned helplessness’ with deficits in positive coping strategies and a changed locus of control belief. Based on this hypothesis, they claim that TBI patients are at risk for developing self-limiting belief systems concerning their ability to control significant problems, such as symptom recovery and pain management, that may result in an overgeneralization of the effects that TBI has in their everyday lives (Moore & Stambrook, 1995). Unfortunately, this results in a negative feedback loop where their belief in being unable to influence their own life events is not challenged and quality of life can be reduced. Instead of utilizing positive coping mechanisms and reaching out for help concerning physical and cognitive rehabilitation, many people succumb to a belief system where they feel helpless to control the severity of their symptoms and then consider themselves doomed to suffer from a lifetime of disability or chronic post-TBI symptoms.

Health beliefs may vary across ages, genders, cultures, personalities, and level of education. Swift and Wilson (2001) investigated brain injury recovery beliefs through qualitative interviews in a sample of 22 brain-injured individuals. Participants appeared to endorse inaccurate and inadequate knowledge about brain injury, and noted how prevalent these misconceptions are among the general public. Several themes that arose during the interviews were inaccurate beliefs about length of recovery time, possible degree of recovery from brain injury, and lack of awareness of the variety of problems TBI can cause, particularly in behavioral and cognitive symptoms. Additionally, participants reported common misconceptions about the capabilities of brain-injured individuals depending on how visible their injuries or disabilities are, and misidentified brain-injured individuals as mentally ill or learning disabled (Swift & Wilson, 2001). These misconceptions, coupled with the trauma and pain of dealing with a TBI, may play a role in the negative cycle of beliefs that some brain-injured individuals suffer from. Further investigation into these misconceptions as well as attitudes surrounding recovery and pain is necessary in order to identify the factors that may be associated with fear-related cognitive task avoidance.

1.2.1 Pain Catastrophizing

One heavily studied health belief is pain catastrophizing. Pain catastrophizing has been defined as the exaggerated, negative consideration of a pain experience (Chaput, Lajoie, Naismith, & Lavigne, 2016; Sullivan, Bishop, & Pivik, 1995). In fact, several dimensions of pain catastrophizing have been suggested. Sullivan et al. (1995) identified magnification, rumination, and helplessness as three related but separate domains of negative appraisal within pain catastrophizing. The description of magnification included an amplification of the unpleasantness of pain situations and expectancies for negative outcomes, while rumination was described as persistent thoughts about pain, worrying, and an inability to inhibit pain-related thoughts. Helplessness was loosely defined as inability to deal with painful situations. Additionally, initial scale development showed a significantly strong correlation with the Pain Catastrophizing Scale and the Fear of Pain Questionnaire ($r = .80$; Sullivan et al., 1995). Although pain catastrophizing is more likely to be found in people who experience pain frequently, this concept can be demonstrated in both healthy and non-healthy populations. Previous literature has consistently established relationships between amplified pain and pain catastrophizing in both healthy individuals and those who suffer from a chronic disorder, even though these levels of pain catastrophizing may differ (Severeijns, Vlaeyen, van den Hout, & Weber, 2001; Sullivan et al., 1995).

The role of pain catastrophizing has been investigated in a variety of different populations. Chaput et al. (2016) investigated the link between pain catastrophizing and mild TBI outcome. Their findings included significant relationships between pain catastrophizing and pain severity, reported number of post-concussion symptoms, psychological distress, and functionality. These results show that higher levels of pain catastrophizing were related to worse outcomes in a mild TBI sample. Early detection of this exaggerated pain belief may help limit chronic pain issues (i.e., headaches) during TBI recovery. Carey, Naugle, Saxe, and White (2018) investigated the kinds of behavior that predict headache pain following mild TBI. They found that increased sedentary behavior, such as sitting, within two weeks post-injury predicted greater headache pain, and this relationship was mediated by pain catastrophizing. Further research in the TBI recovery domain is necessary to fully understand the psychological risk factors that can affect recovery outcomes.

Additionally, catastrophizing may be seen in populations of patients who are extremely sensitive to minor physical changes or have devastating beliefs about bodily sensations. Boone (2009) discussed the concept of neurocognitive hypochondriasis in that there is a fixed belief in cognitive abilities, or lack thereof, even though objective testing concludes otherwise. Hypochondriacal patients may engage in catastrophizing in response to minor physical symptoms, which can then extend to perceived cognitive dysfunction. Hadjistavropoulos, Hadjistavropoulos, and Quine (2000) identified situations in which health anxious individuals worried more about their injury during physical therapy and paid more attention to and catastrophically misconstrued bodily sensations more frequently compared to non-health anxious individuals. They suggested that paying attention to minor bodily sensations acted as a short-term anxiety reducing effect for health anxious individuals, whereas it caused more anxiety in the non-health anxious individuals.

Further research on the effects of pain-related fear and pain catastrophizing on disability and rehabilitation reveal just how incapacitating pain-related fear can be. Crombez, Vlaeyen, Heuts, and Lysens (1999b) investigated the disabling effect this fear can have. They found moderate to strong relationships for pain catastrophizing with fear of movement or reinjury (kinesiophobia), pain anxiety, negative affect, and weight lifting. Interestingly, as the amount of time participants spent weight lifting, pain catastrophizing reduced, indicating a moderate but negative relationship. Additional work by Vlaeyen, Kole-Snijders, Boeren, and van Eek (1995) found that pain catastrophizing was superior in predicting pain-related fear compared to biomedical status and pain severity, suggesting that catastrophic thinking about pain might be a precursor of pain-related fear.

Severeijns, Vlaeyen, van den Hout, and Weber (2001) also examined the relationships between pain catastrophizing and pain intensity, pain-related disability, and psychological distress after controlling for level of physical impairment in chronic pain patients. Overall, those who catastrophized more reported more pain intensity, felt more disabled by their pain problem, and experienced more psychological distress regardless of their physical impairment than those who did not report high levels of pain catastrophizing. Perhaps most importantly, Severeijns et al. (2001) demonstrated that there was little to no relationship between physical impairment and pain catastrophizing. Therefore, pain catastrophizing may be more related to cognitive attributes of a negative thought cycle and attitudes toward pain than physical impairment. Magnification of pain and certain health perceptions may point to a maladaptive coping style, such as avoidance of possible pain-inducing situations or stimuli.

1.2.2 Health locus of control

Health beliefs influence patients’ perceptions of their own health status and care. Health locus of control has been heavily studied and has been defined as the extent to which individuals believe their health status is a result of their own behaviors, chance, or the influence of others (Mercer et al., 2018). Strudler-Wallston and Wallston (1978) noted that locus of control is mainly relevant in health behaviors through seeking health information, taking medication, maintaining physician appointments, maintaining a diet, and giving up smoking. Those who generally believe their health is determined by their own behavior exhibit an internal health locus of control (Wallston, Strudler-Wallston, & DeVellis, 1978). Wallston et al. (1978) also broke down the external health locus of control category into two subtypes: chance and powerful others. Those who believe their health is out of their hands and is mainly determined by luck or chance are said to have a chance health locus of control, while those who seem to place their health status in the hands of others (doctors, family, etc.) are said to have a locus of control dependent on others. Strudler-Wallston and Wallston (1978) found evidence that internals generally show more positive health behaviors, such as those mentioned above.

Buckelew et al. (1990) investigated beliefs about locus of control in relation to persistent pain. Their main findings included differences between genders in the types of reported locus of control beliefs. Older male patients relied more heavily on both chance and powerful others subtypes, while the beliefs of women were broken down in relation to their use of different coping strategies. Women who had only high internal locus of control scores showed a preference for self-management of their health care, were more likely to seek health information, blame themselves, and minimize threats to their health compared to those who scored high on both external subtypes. Additionally, the patients who reported more reliance on medical professionals were more likely to have internalized fewer cognitive, and possibly helpful, adaptive coping strategies than patients who only viewed themselves as responsible for their own health status. These findings supplement those of Mcdonald-Miszczak, Maki, and Gould (2000) in that those higher in powerful others health locus of control were less likely to adhere to their medication routine than those lower in powerful others health locus of control. They suggested that self-reported medication adherence is primarily a belief-laden construct not influenced by actual health status. Although the gender differences do shed some light on the differences in health beliefs between men and women, Buckelew et al. (1990) have suggested that those with a high external locus of control dependent on others may not be utilizing effective coping strategies that could improve their health.

Further evidence of health locus of control's influence on health behaviors has been shown through studies of individuals suffering from a variety of medical issues (Caplan et al., 2015; Mercer et al., 2018). In a sample of patients with cardiovascular disease, those who were high in internal health locus of control were more likely to engage in physical activity at a leisurely level than those who were low in internal health locus of control (Mercer et al., 2018). Those who were high in chance health locus of control were less likely to engage in physical activity at a leisurely level and were more likely to be a smoker than those who were low in chance health locus of control. Those higher in powerful others health locus of control were less likely to be a smoker than those lower in powerful others health locus of control. In fact, AbuSabha and Achterberg (1997) noted that scoring higher in internal health locus of control was positively related to hypertension treatment compliance, breast self-exams, and precautionary behaviors in those suffering from immunodeficiency disorders. In a national survey of pain given within the United States, those with higher internal health locus of control were more likely to exhibit healthy behaviors, were less likely to have all kinds of pain (ranging from headaches to joint pain to dental pain), and had less severe pain on average than those with lower internal health locus of control (Sternbach, 1986). It seems that having a high internal health locus of control may be influential for maintaining treatment, reducing risky health behaviors, and having a lower likelihood of suffering from pain.

Health locus of control has also been evaluated within TBI samples. Caplan et al. (2015) found that for people three years post-TBI, their internal health locus of control and powerful others (physicians, in this case) health locus of control scores were significantly lower than the scores of healthy adults. People three years post-TBI also scored significantly higher than healthy adults on chance health locus of control. Moreover, chance health locus of control was inversely related to both self-reported total and psychosocial quality of life. Interestingly, those with higher chance health locus of control also showed a significantly longer duration of post-traumatic amnesia and length of hospital stay compared to internal and powerful others health locus of control patients.

These health control beliefs may even generalize to headache problems and pain relief. Martin, Holroyd, and Penzien (1990) examined health locus of control beliefs in relation to headache exacerbation, coping strategies, and psychological distress. Chance health locus of control surrounding headache problems was associated with depression, physical pain complaints, reliance on maladaptive pain coping strategies, and self-reported disability related to headache. Additionally, the belief that one’s headache problems and relief are mainly determined by the treatments given by health care professionals was associated with greater medication use and greater preference for medical treatment. Internal health locus of control regarding headache problems was associated with a preference for self-regulation treatment. It’s possible that adaptation to headache problems is not solely determined by physical sensations and is instead partially influenced by health locus of control beliefs.

Although these health locus of control beliefs have been shown to have some influence on general health behaviors, such as seeking health information, it is important to note that locus of control beliefs, or lack thereof, may also be guiding thoughts about avoiding tasks or avoidance behaviors. Moore and Stambrook (1995) proposed a conceptual model regarding cognitive, emotional, social, and psychological TBI sequelae and the link to poor coping skills and locus of control beliefs. Those with long-lasting symptoms may be at risk for developing self-limiting belief systems about their effectiveness in having control over their recovery and day to day lives. Post-TBI patients who failed to return to their pre-injury level of employment reported significantly lower internal health locus of control, higher powerful others health locus of control, and higher hopelessness scores compared to those patients who were able to return to work. Further, frequent use of positive reappraisal and self-regulating coping strategies along with low external health locus of control beliefs was associated with decreased mood disturbance and physical difficulties, as well as lower rates of depression compared to those not implementing these coping strategies. It appears that having a low internal health locus of control may be a risk factor for mood disturbance, poor coping skills, and self-limiting beliefs in patients suffering from symptoms post-TBI.

1.3 Traumatic Brain Injury

Traumatic brain injury (TBI) has become a serious public health issue over the past decade. According to the Centers for Disease Control and Prevention, TBI is defined as a bump, blow or hit to the head, penetrating or non-penetrating, that disrupts normal brain functioning (Centers for Disease Control and Prevention, 2017a). However, not all hits to the head result in a TBI. TBI severity may range from mild to severe depending on any changes in mental status, level of consciousness, or memory loss. Depending on the severity of the TBI and the situation in which the injury occurs, these injuries may cause permanent physical damage, impaired cognitive functioning, or death.

In 2017, 153 people in the United States died from injuries related to TBI every day. In 2013 alone, these injuries were responsible for approximately 2.5 million TBI-related emergency department visits, 282,000 TBI-related hospitalizations, and 56,000 TBI-related deaths in the United States (Taylor, Bell, Breiding, & Xu, 2017). The most common causes of these visits for all age groups were due to falls, being struck by or against an object, and motor vehicle crashes. Although the impact of the damage from a TBI varies from person to person, and could be due to many different factors, the mechanisms by which people tend to receive TBIs are applicable to all age groups. However, from 2006 to 2010, falls accounted for the majority (54.4%) of TBI-related deaths in adults aged 65 years and older in the United States (Centers for Disease Control and Prevention, 2017a). Additionally, motor vehicle accidents accounted for 55.8% of TBI-related deaths in adolescents aged 5-14 years and almost half of TBI-related deaths (47.4%) in young adults aged 15-24 years. The high prevalence of TBI-related injury and death in the United States highlights the need to evaluate recovery guidelines and helpful coping strategies for people healing from TBI.

1.3.1 History of Concussion Recovery Protocols

Criteria for TBI diagnoses have been proposed by several organizations. West and Marion (2014) provided a comparison of the TBI diagnosis and recovery guidelines proposed by the American Medical Society for Sports Medicine, the American Academy of Neurology, and the Zurich Consensus group. All three organizations stated that a clinical TBI diagnosis should be made by a licensed health care provider familiar with the signs and symptoms of TBI, including clinical symptoms, physical signs, cognitive impairment, neurobehavioral features, and sleep disturbance. They agreed that there is no single test that can be used to determine whether a concussion has occurred, but that graded and clinical symptom checklists can be useful, especially if there is an available baseline record of symptoms to be compared with post-injury results. In particular, the Zurich group identified the number, duration, and severity of symptoms as well as loss of consciousness and post-traumatic amnesia as useful indicators of TBI severity. Many physicians use information about duration of loss of consciousness, post-traumatic amnesia, and Glasgow-Coma scale scores to determine the severity of someone's injury. Post-traumatic amnesia is the duration of confusion or memory loss after the injury. The Glasgow-Coma scale is implemented immediately after injury by a trained medical professional and measures a patients' degree of consciousness through three types of response on a 15-point scale: eye opening, motor, and verbal response, where the lower the Glasgow-Coma scale score is, the more severe the injury was (Kervick & Kaemingk, 2005).

In 2016, the 5th international consensus meeting was held by the Concussion in Sport Group to aggregate current knowledge of sport-related concussion and identify areas of research in this topic that are lacking. Previous meetings outlined recovery strategies, rehabilitation goals, symptoms, and assessment tools all centered on sports-related concussion. Currently, the published guidelines listed by the 5th international meeting are the most up-to-date guidelines assembled by the most current research and expert opinions. Although sports-related concussion is considered just one type of TBI, these guidelines provide a helpful outline of suggested recovery strategies and timeline for those with brain injuries from other circumstances (e.g., motor vehicle accident, falls).

The suggested return-to-activity timeline assembled by the Concussion in Sport Group (McCrory et al., 2017) outlines several different stages meant to eventually reintroduce players to full gameplay. The first recommendation is symptom-limited activity, involving normal daily activities that do not provoke symptoms in order to foster gradual reintroduction of work or school activities. Once achieved, they recommend light aerobic exercise, such as walking or stationary cycling at slow pace in order to increase heart rate. The next several steps describe gradual contact/non-contact training until the player is cleared to return to their sport. McCrory et al. (2017) also recommended an initial period of 24 to 48 hours of both physical rest and cognitive rest before starting the return to play steps. Additionally, there should be at least 24 hours or longer between each step. If any symptoms worsen during exercise, the athlete should return to the previous step.

Although the steps are recommended for returning to play, they may also apply to people who suffer TBIs that were not acquired through sports. McCrory et al. (2017) also offered gradual return to school steps post-injury that may be applicable to returning to work. First, they suggested doing daily activities at home that do not give the person symptoms such as reading, texting, and screen time, as long as they do not provoke or worsen symptoms for 5 to 15 minutes at a time. Next, they recommended doing school activities, like homework, reading, or other cognitive activities, outside of the classroom in order to help increase the person's tolerance for cognitive work. After this is achieved, McCrory et al. (2017) recommended a gradual return to school part-time until a whole day can be tolerated, and then to return to school full time. These steps are merely guidelines for those who suffer TBIs and may need to be modified depending on injury severity and the person's pain tolerance level. Although the guidelines provide a basic outline of returning to sport/work/school after a TBI, the steps are not always laid out for those with TBI, especially if their primary care provider is not familiar with the recommendations.

When assessing cognitive functioning of someone before a TBI, neuropsychological assessments may be an informative way to test baseline functioning. However, in most cases, people who have sustained a TBI typically do not have a baseline measure of their normal cognitive functioning. McCrory et al. (2017) did not consider baseline neuropsychological testing as necessary, but it may be helpful when determining the degree of loss of cognitive function if a baseline happens to be available. Post-injury assessment may provide some insight into possible timing of implementing recovery strategies or cognitive activity, but physicians should also take symptom provocation and injury severity into account when making decisions.

McCrory et al. (2017) considered diagnosis of TBI to involve symptoms such as somatic, cognitive, and/or emotional symptoms; physical signs such as loss of consciousness, amnesia, and/or neurological deficits; balance impairment (e.g. unsteadiness); behavioral changes; cognitive impairment (e.g., slowed reaction times); and/or sleeping or waking disturbances (e.g., somnolence, drowsiness). TBI symptoms usually present differently in different people. For example, while some people may only experience physical pain, others may suffer from cognitive deficits, sleep issues, and memory problems. McCrory et al. (2017) also warned physicians of longer-lasting effects of head trauma in some, which may include depression, anxiety, and major or minor cognitive impairments that could persist for longer than a few weeks. However, pre-morbid factors like chronic migraines, anxiety, or other psychological disorders may play a role in the duration of these longer-lasting symptoms that were brought on by the TBI. McCrory et al. (2017) also suggested that a greater number of and severity of symptoms after TBI predict a slower recovery time. Additionally, post-injury clinical factors, such as the initial severity of cognitive deficits, development of post-traumatic headaches, dizziness, difficulties with oculomotor functioning, and symptoms of depression have all been associated with poor outcomes. The physical and psychological symptoms and limitations that people suffer post-TBI play an important role in their outcomes. However, another aspect that may be related to recovery outcomes is a person's pre-morbid attitudes, beliefs, and perceptions surrounding their health and their recovery after they receive a TBI.

1.3.2 Beliefs Surrounding Concussion Recovery

The previously mentioned prevalence rates indicate how common TBI-related injuries are among all age groups. Physical recovery from a TBI is typically the milestone by which many primary care physicians measure full recovery. However, previous research showed that a large portion of people who previously suffered a TBI also experience other emotional or cognitive symptoms post-injury. In a sample of patients 6 months post-TBI, 39% self-reported cognitive complaints, but these complaints were more strongly related to pre-injury characteristics, such as personality and emotional distress, than they were to actual cognitive impairment (Stulemeijer, Vos, Bleijenberg, & van der Werf, 2007). Further research assessed the differences in reporting between mild TBI (mTBI) groups and other injury groups. It seems that mild TBI patients tend to endorse ongoing symptomatic complaints much more frequently compared with controls (Stulemeijer, van der Werf, Bleijenberg, Brauer, and Vos, 2006; Heitger, Jones, Frampton, Ardagh, and Anderson, 2007).

Stulemeijer et al. (2007) noted that just as higher cognitive testing performance does not make patient complaints about ongoing symptoms any less real, poor cognitive test performance in itself is not direct evidence of impaired cognitive abilities, especially if performance validity, poor effort, and/or malingering are not controlled for. Instead, cognitive complaints should always be considered within the context of the patient's emotional and physical health, intellectual ability, and personality. Whether these symptoms are physical or psychological in nature, they can pose a real problem in recovery and treatment. Therefore, it may be important to consider both psychological and physical symptoms when deciding on treatment and recovery strategies for TBI patients.

1.3.2a Symptoms post-injury

One major issue that may impede post-TBI recovery is the types of symptoms that can appear post-injury. These symptoms can impact multiple domains of health including psychological, cognitive, oculomotor, sleep, fatigue, vestibular, emotional, and physical pain. Meehan, O'Brien, Geminiani, and Mannix (2015) found that patients symptomatic post-injury may have an increased risk of suffering from prolonged symptoms (greater than 28 days) compared to asymptomatic patients. It's possible that by being burdened with symptoms, patients may have more pain, stress, or anxiety about recovery than those unburdened with symptoms, which in turn prolongs the symptom duration. An analysis of patients suffering from varying degrees of severity of TBIs found that high levels of somatic, cognitive, and anxiety symptoms at three months post-injury, as well as short post-traumatic amnesia duration, were significant predictors of the severity of post-concussion syndrome symptoms at 12 months post-injury for all degrees of TBIs (Sigurdardottir, Andelic, Roe, Jerstad, & Schanke, 2009). Although the mild TBI group endorsed more post-concussive symptoms than the other two groups at three months post-injury, no differences were found on post-concussive symptoms between any of the three TBI groups one year post-injury. In terms of these post-concussive symptoms, TBI recovery may be affected by the presence of anxiety, somatic, and cognitive symptoms regardless of the severity of the initial injury.

Rimel, Giordani, Barth, Boll, and Jane (1981) identified further examples of self-reported post-TBI symptoms within a sample of 424 patients who had suffered mild brain injury. Of these patients, 79% reported persistent headaches, 59% endorsed memory problems, and 14% reported difficulty doing everyday tasks. Although post-TBI symptoms can range from physical to emotional to cognitive, most clinicians are forced to rely upon self-report of symptoms in order to gauge recovery. Additionally, it should be noted that current research and reports of post-TBI symptoms are based on responses from patients who have agreed to return to a clinic or a study either for treatment, follow-up, or participation in a study. Therefore, current research excludes any information from the patients who did not return for follow-up care.

In a comprehensive study of base rates of neuropsychological complaints, Lees-Haley and Brown (1993) investigated the prevalence of symptoms in a mild brain injury sample of 170 participants and compared these rates to those from a non-brain injury sample. The mild brain injury group were also filing claims for emotional distress or industrial stress, but none filed claims on a neuropsychological basis. This group was assessed two years post-injury, on average, for any symptoms they experienced over the last two years. The mild brain injury group were significantly more likely to endorse a symptom compared to the control group. The most common symptom reported by the brain injury group was anxiety or nervousness, with sleeping problems, depression, headaches, back pain, and fatigue following closely behind. Although litigation processes may have affected the high base rates within this sample, results provided a snapshot of the kinds of symptoms that are most common in a mild brain injury litigation sample. The findings concur with other studies of brain injury symptom rates (Rimel et al., 1981; Kreutzer, Seel, and Gourley, 2001).

Lannsjö, Geijerstam, Johansson, Bring, and Borg (2009) investigated symptom prevalence of 2523 patients who had visited the hospital in Sweden three months prior for a mild TBI. Out of the 2523 patients, 56% reported no remaining symptoms related to their TBI, while 24% reported three to six symptoms. When asked to rate the severity of their remaining symptoms, the most commonly reported severe symptoms were fatigue (23%), headaches (22%), dizziness (16%), poor memory (16%), and irritability (15%). A significant minority reported multiple symptoms persisting at least three months post-injury; the most commonly reported symptoms were similar to ones reported by patients from previously mentioned studies (Lees-Haley et al., 1993; Rimel et al., 1981).

In an attempt to further clarify the symptoms, Dikmen, Machamer, Fann, and Temkin (2010) investigated symptom endorsement by 603 patients at both one-month and one-year post brain injury. At one-month post-injury, the most commonly endorsed symptoms were fatigue (66%), headache (55%), dizziness (51%), memory problems (47%), trouble sleeping (45%), and trouble concentrating (44%). At one-year post-injury, the prevalence of reported symptoms appeared to decrease overall. At one year, the most frequently endorsed symptoms were memory problems (43%), fatigue (42%), irritability (36%), anxiety (30%), and headache (29%; Dikmen et al., 2010). Additionally, at one-month post-injury the mean number of symptoms reported was 4.8 for the brain injury group and 3.0 for a trauma control group. At one-year post-injury, the mean number of symptoms decreased to 3.5 for the brain injury group and 1.9 for the trauma control group. These findings allow for further comparison of the kinds of base rates typically seen in brain injury patients at several time points post-injury. While the types of symptoms tend to vary greatly, the most common range from physical (fatigue and headache) to cognitive (memory problems and trouble concentrating) to emotional (irritability and anxiety).

1.3.2b Psychological correlates following TBI

Symptoms that persist for months post-TBI have become an intense and controversial topic of inquiry in the form of post-concussion syndrome (PCS). PCS is seen as a group of physical, cognitive, and emotional symptoms that frequently occur following TBI and last for longer than a month or two, such as headache, dizziness, irritability, cognitive and memory problems, fatigue, sensitivity to noise, depression, and anxiety (Ryan & Warden, 2003). The definition of this group of symptoms has been under debate by both researchers and clinicians, but is listed in the Diagnostic and Statistical Manual of Mental Disorders as major or mild neurocognitive disorder (American Psychiatric Association, 2013).

One of the main characteristics of PCS is the duration of the symptoms post-injury. Although PCS typically resolves within a month or two, current research shows that PCS symptoms can occur for months or even years post-injury in many individuals post-TBI. Additionally, Lahz and Bryant (1996) found reports of chronic pain in 58% of those with mild TBI and 52% of those with moderate-to-severe TBI. Headaches were the most common complaint. Over half of TBI patients suffered from chronic physical pain post-injury. Although many patients suffer from headaches post-injury, PCS is often characterized as having an etiology based in psychological dysfunction. King (1996) examined predictors of persistent PCS in a sample of patients with head injuries and found that the strongest predictors of persistent PCS were patient level of anxiety and/or depression and stress following the head injury. Ryan and Warden (2003) suggested that multiple pre-morbid, injury-related, and post-injury neurological and/or psychological factors contributed to the development and persistence of PCS symptoms. It’s possible that head-injured patients with symptoms of PCS may endure a prolonged recovery and require a more psychologically-focused treatment approach than those suffering solely from physical symptoms.

Another factor affecting recovery and symptoms post-TBI is baseline health status. McLean et al. (2009) assessed a sample of emergency department patients over the course of a year on health status, post-concussion and cognitive symptoms, and injury information. Over time, baseline mental health status and physical health status were the strongest predictors of persistent symptoms. Interestingly, the presence of a head injury did not predict symptoms of persistent post-concussion syndrome. Being vulnerable to somatic symptoms or post-concussion symptoms before a head injury may put these patients at a disadvantage during recovery. McLean et al. (2009) suggested that symptom vulnerability is an individual constitutional characteristic and not necessarily brought on by the presence of a head injury. If someone's mental or physical health is already suffering prior to a head injury, findings suggest that they will also be more vulnerable to prolonged post-concussion symptoms.

Some patients may experience prolonged cognitive difficulties following a TBI, such as feeling in a fog or feeling cognitively 'slower.' However, when these self-reported complaints were addressed in the form of cognitive and neuropsychological testing six months after the initial injury, Stulemeijer, Vos, Bleijenberg, and van der Werf (2007) found that the complaints were unrelated to clinical indicators of injury severity and neuropsychological test performance. Instead, premorbid characteristics, such as proneness to focusing on internal sensations, and post-TBI emotional and physical status were strongly related to perceived cognitive inadequacy. Stulemeijer et al.'s (2007) findings mirror those of McLean et al. (2009) in that poor psychological and physical health are strong predictors of slow post-injury recovery. Additionally, the patients with cognitive complaints in the Stulemeijer et al. (2007) study showed stronger tendencies to inhibit the expression of emotions to avoid negative reactions from others as opposed to patients who did not report cognitive symptoms. Cognitive symptom complaints were also associated with strong awareness for experiencing internal bodily sensations. Awareness of internal bodily sensations and inhibiting expression of emotion may contribute to the perception of cognitive decline post-injury since there is a heightened awareness of the self or the patient is coping with symptoms in an avoidant manner.

Additional research has focused on the psychological correlates of head injury, both pre- and post-injury. Trahan, Ross, and Trahan (2001) investigated the relationship between head injury and psychological illness and found strong relationships between post-concussion symptoms, anxiety, and depression in a sample of young adults. Additionally, depressed individuals endorsed significantly more post-concussion symptoms and general health symptoms (i.e., getting lost, decreased reading comprehension, chest pains, slurred speech) than those without brain injury and those with neither depression nor brain injury. The authors suggested that depressed individuals may have their already compromised health symptoms exacerbated when their depression is coupled with a brain injury. Snell et al. (2018) also investigated the relationship between psychological distress and health conditions. Their sample consisted of participants with mild TBI, defined as a loss of consciousness less than 20-30 minutes, a Glasgow Coma Scale score less than or equal to 13, post-traumatic amnesia duration of less than 24 hours, and no significant injury findings on imaging, either through CT or MRI. They found that participants who had not yet recovered from a mild TBI and participants with chronic pain both expected to experience negative consequences of their health condition, engaged in limiting or avoidant coping behaviors in order to recover from their conditions, reported low quality of life, and endorsed high psychological distress and post-concussion symptoms. Levels of psychological distress and health recovery behaviors and expectations may be similar for those with mild TBI and chronic pain. Mapping out a pattern of psychological symptoms that both groups may suffer from may be helpful to do when developing treatment plans.

Kreutzer et al. (2001) investigated prevalence rates of depression in patients who had recently suffered a TBI. Of these 722 TBI patients, 42% met the criteria for a DSM-IV diagnosis of major depressive disorder (MDD). Among these patients, 46% reported fatigue, 41% reported feelings of frustration, 29% endorsed trouble falling asleep, 22% felt hopeless, and 38% reported poor concentration. These findings highlight the complexity of the psychological aspect of the TBI recovery process. Previous research has also shed some light on the prevalence of depression after TBI. Varney, Martzke, and Roberts (1987) found that 77% of the patients in a 120-person TBI sample met DSM-III criteria for MDD. Patients were interviewed at least two years after their injury and 46% of patients that met MDD diagnosis criteria reported that their depressive symptoms did not start until at least six months after their head injury. While the prevalence of the symptoms in this sample may reflect normal rates of depression in the general population, and there was no true baseline testing of depression before the injury, the findings do shed some light on similar symptoms between depression and the TBI recovery process. Another process thought to influence health beliefs is the role of metacognition.

1.4 Metacognition

Flavell (1979) defined metacognition as one’s beliefs or knowledge about cognitive processes and the approaches used to monitor and regulate cognition. Those with high levels of metacognition tend to be aware of their own capacities for memory, comprehension, and other cognitive processes. Although many people use their metacognitive skills to become more self-aware, this may sometimes backfire in those with psychological disorders and create more anxiety. The development of the Self-Regulatory Executive Functioning (s-REF) model highlighted the role of metacognition in psychological disorders (Wells & Matthews, 1996). The s-REF model integrates voluntary control of cognition and attention, stored knowledge and beliefs, and the interactions between different levels of information processing as well as the effects of cognitive bias (Wells & Matthews, 1996). The premise of the s-REF model was to illustrate how beliefs about the self, voluntary attention, active worrying, and external cognitive information affects emotion regulation and response to external stimuli. The s-REF model helps to explain how those with anxiety may find rumination to be a positive coping mechanism in order to predict dangerous or uncomfortable situations. Maladaptive metacognitive beliefs may determine if an individual responds to a cycle of negative thoughts or feelings (Grotte et al., 2016). The s-REF models the link between cognition and attention, referred to as a cognitive-attentional syndrome, which focuses on heightened, self-focused attention, decreased efficiency of cognitive functioning, activation of beliefs about the self, worrying, self-appraisal, attentional bias, and awareness of the capacity of one's limitations (Wells & Matthews, 1996). These processes can then lead to ruminative thinking, constant threat monitoring for psychological or physical harm, and maladaptive coping strategies.

Wells and Cartwright-Hatton (2004) have applied the s-REF model to populations of those with psychological disorders, such as obsessive-compulsive disorder. They found a significantly positive relationship between metacognitions and obsessive-compulsive symptoms. Further research into this connection resulted in general metacognitive beliefs predicting obsessive-compulsive symptoms in a non-clinical sample (Sica, Steketee, Ghisi, Chiri, & Franceschini, 2007). The link between metacognition and the ruminative, persistent negative thought cycle and maladaptive coping styles found in obsessive-compulsive symptoms provides support for a connection between metacognition and other persisting, anxiety-related psychological disorders.

In an effort to model the relationships between metacognition and specific emotional, anxiety, and obsessive-compulsive symptoms, processes, and disorders, Wells and Cartwright-

Hatton (2004) developed the Metacognitions Questionnaire-30 (MCQ-30). Exploratory analyses resulted in five major subscales within the instrument that break down distinct, but related, aspects of metacognition. The five constructs include positive beliefs about worry (PBW; the degree to which people think worrying is helpful), negative beliefs about worry (beliefs concerning uncontrollability and danger), cognitive confidence (assessing confidence in one's own attention and memory), need to control thoughts (negative beliefs about the consequences of not controlling one's own thoughts), and cognitive self-consciousness (CSC; the tendency to attend to one's thought processes).

Positive beliefs about worry and cognitive self-consciousness play a role in being aware of your own thoughts as well as reactions to these self-beliefs in non-clinical samples. In a study consisting of data from 80 undergraduate students, positive beliefs about worry predicted maladaptive coping styles, such as denial or rumination, while cognitive self-consciousness seemed to foster or facilitate adaptive coping styles (Sica et al., 2007). Both of these thought processes appeared to have an impact on coping styles, which may in turn influence one's actions when faced with anxiety-producing situations. Sica et al. (2007) suggested that having positive beliefs about rumination and considering it to be a helpful coping mechanism may interfere with the initiation of helpful coping behaviors, such as those that provide positive reinforcement and a sense of control over a situation or over one's thoughts. A lower degree of positive reinforcement and sense of control in an individual's life may then contribute to the development of learned helplessness. Janeck, Calamari, Riemann, and Heffelfinger (2003) also explored the connections between metacognitive intrusive thoughts and beliefs with cognitive thought processes in those with psychological disorders. There was a significant, positive relationship between CSC, anxiety, and depression. They also found that there were significant differences in CSC between a sample of obsessive-compulsive disorder patients and patients with other anxiety disorders, with OCD patients reporting higher levels of CSC (Janeck et al., 2003). They suggested that a tendency to constantly reflect on one's own cognitive processes might increase negative appraisals of persisting thoughts and emphasize negative self-beliefs. The process of constantly attending to one's own thoughts may also be the result of an over-allocation of attentional resources to these ruminative thoughts.

Grotte et al. (2016) discussed specific subcategories of metacognition in relation to obsessive-compulsive symptoms, emotional and psychological disorders, and anxiety. Their findings included a significantly positive relationship between PBW and CSC with obsessive-compulsive symptoms at both pre- and post- cognitive-behavioral therapy treatment. Additionally, out of the five subscales, CSC was the sole significant predictor of obsessive-compulsive symptoms, which is consistent with previous research (Janeck et al., 2003). It is possible that the belief of rumination and worrying as a positive coping mechanism and the allocation of attentional resources to one's thought processes leaves individuals vulnerable to a negative feedback loop of persistent, negative thoughts.

Based on the literature surrounding TBI recovery, metacognitive beliefs, health beliefs, and attitudes about recovery need to be investigated to get a better sense of the factors affecting recovery post-TBI. In order to evaluate the efficacy of metacognitive beliefs and TBI history in predicting cogniphobia scores, an initial study was conducted. Prior to this study, previous work surrounding cogniphobia had only been conducted using solely headache or TBI samples. Study One incorporated TBI history, cogniphobia, CSC, and PBW. While mainly exploratory, the results from this study informed further research examining the factors that predict cogniphobia.

II: Study One

The purpose of the initial study was to provide a better picture of the physical and metacognitive characteristics that are tied to cogniphobia. A comparison of cogniphobia scores between groups of people with a presence of a TBI history and those with no TBI history had not been conducted, so data from these two groups were examined together to determine whether cogniphobia scores differed depending on the presence of an injury history. Anstey et al. (2004) reported an association between having a history of TBI and increased psychiatric and mood disorder symptoms such as negative affect, depression, anxiety, and suicidal ideation. With this relationship in mind, and the worry and pain-related fear that encompass cogniphobia, I considered the idea that individuals with a presence of a history of TBI may have more anxiety about their cognitive abilities and level of exertion compared to those with no TBI history. Further, Crombez et al. (1999a) noted that decreased neuropsychological assessment performance may be a result of attentional resources being redirected from a cognitive task to a fear of the possibility of feeling pain. Additionally, they suggested that this pain-related fear causes a hypervigilance to experiencing pain. Silverberg et al. (2017) then suggested that cogniphobia may be a product of an avoidant coping style. Based on these findings, it seemed possible that metacognitive factors, such as the constant monitoring of or worrying about one’s own thoughts, play a role in the development of cogniphobia by driving attentional resources from a cognitive task to thoughts about experiencing pain.

The objectives of the first study were to investigate the relationship between a history of traumatic brain injuries and cogniphobia scores, as well as to look into metacognitive factors that may have an impact on this relationship. I was initially interested in this topic due to exposure to patients in clinic and hospital settings who were suffering from TBI but had already physically healed from their brain injuries. They reported that they were still suffering from the symptoms of their injury and did not want to continue with their daily, pre-injury routine of school, work, or any other cognitively-straining task. Previous studies provided a starting point for the initial study. The research questions related to Study One were:

1. Is there a significant difference in cogniphobia scores between people with a self-reported TBI history and people without a self-reported TBI history?
2. Do positive beliefs about worry and cognitive self-consciousness significantly predict cogniphobia scores?
3. Do stronger positive beliefs about worry and cognitive self-consciousness moderate the relationship between self-reported TBI history and cogniphobia?

Study One utilized self-report data from participants recruited from an internet sample to determine if metacognitive factors would buffer against an association between a self-reported history of TBI and higher cogniphobia scores. Cognitive self-consciousness and positive beliefs about worry were examined in relation to differences in metacognitive beliefs. In order to investigate the links between the findings of the research by Silverberg et al. (2017), Crombez et al. (1999a), and Anstey et al. (2004) as noted above, it was hypothesized that individuals who reported a history of TBIs would have higher cogniphobia scores compared to those who did not report a history of TBIs. Second, stronger metacognitive beliefs, categorized as cognitive self-consciousness and positive beliefs about worry, would both predict higher cogniphobia scores. Moreover, this positive association between self-reported history of TBI and cogniphobia would be stronger for individuals with greater cognitive self-consciousness scores as well as for those with greater positive beliefs about worrying scores than for individuals with lower cognitive self-consciousness and positive beliefs about worrying scores.

III: Study Two

Given the lack of research on cogniphobia's connection to metacognition and health beliefs, possible predictors of cogniphobia were explored in data from a student sample. Namely, these predictors included pain catastrophizing, health locus of control, positive beliefs about worry, and cognitive self-consciousness. The misconceptions about brain injury symptoms and recovery processes within the general public may pave the way for pain-related fear of exerting mental energy. Beliefs about head trauma and its recovery process may also play a role in a lack of exerting mental energy, even in populations of people without a history of head trauma. For example, someone may believe that the best way to recover from a TBI is to avoid mentally-exerting tasks like school and work so that they won't exacerbate their symptoms or make their injury worse. The TBI recovery process of limiting stimulation until all symptoms are gone has become popularized both as general knowledge and a recovery strategy among the public despite growing research that this is more harmful than helpful. Specifically, Silverberg and Iverson (2013) found that complete, uninterrupted rest exceeding three days is likely not helpful, gradual return to regular activities should start as soon as tolerated, even if symptoms are still present, and aerobic exercise may benefit patients who report persistent symptoms. McLean and Clauw (2004) found that adopting a sedentary lifestyle/recovery process after an injury or illness is one of the most consistent risk factors for chronic disability. The development of cogniphobia may not just be limited to those with headache disorders or a history of brain injury and may instead be a product of health anxiety and maladaptive pain beliefs. The examination of both this idea and the factors that predict the development of cogniphobia are therefore important to consider so that its detection becomes clearer.

3.1 Research Questions

1. Is there a significant difference in cogniphobia scores between people with a self-reported TBI history and people without a self-reported TBI history?
2. Do positive beliefs about worry, cognitive self-consciousness, pain catastrophizing, and internal, chance, and powerful others health locus of control significantly predict cogniphobia scores within the presence of each other?

3.2 Hypotheses

McLean et al. (2009) suggested that symptom vulnerability is not necessarily brought on by the presence of a brain injury, and is instead influenced by premorbid mental and physical health. Further, Severeijns et al. (2001) reported little to no relationship between physical impairment and pain-related fear. These findings provided support for the lack of association between injury history and cogniphobia. Therefore, it was hypothesized that there are no significant differences in cogniphobia scores between those with a self-reported TBI history and those without within a sample of college students.

There is little research within the field on direct, strong predictors of cogniphobia. Therefore, possible predictors of cogniphobia within a college sample were examined. The variables that served as predictors within this model were positive beliefs about worry, cognitive self-consciousness, pain catastrophizing, and three subgroups of health locus of control: internal, chance, and powerful others. Hypotheses of this model included stronger metacognitive beliefs about worrying (positive beliefs about worry and cognitive self-consciousness), higher levels of pain catastrophizing, lower levels of internal health locus of control and higher levels of external (chance and powerful others) health locus of control would predict higher cogniphobia scores.

Research by Crombez et al. (1999a) suggested attentional resources may be redirected from a cognitive task to a fear of the possibility of feeling pain, while Silverberg et al. (2017)

suggested that cogniphobia may be a product of an avoidant coping style. Both positive beliefs about worry and cognitive self-consciousness were also associated with poor coping strategies and ruminative thinking patterns. Based on these findings, it seemed possible that metacognitive factors aid in the development of cogniphobia by moving attentional resources from a cognitively-effortful task to thoughts about experiencing pain. Therefore, it was hypothesized that positive beliefs about worry and cognitive self-consciousness would both significantly predict cogniphobia scores. Additionally, pain catastrophizing has been shown to have little to no relationship with physical impairment and a strong relationship with kinesiophobia (Severeijns et al., 2001). Moreover, pain catastrophizing was superior in predicting pain-related fear compared to biomedical status and pain severity (Vlaeyen et al., 1995). Based on these findings, it was hypothesized that higher levels of pain catastrophizing would predict higher scores of cogniphobia. Examining health locus of control in the context of pain-related fear may shed light on another facet of cogniphobia development. Patients who reported more reliance on medical professionals for their health were more likely to have fewer adaptive coping strategies (Buckelew et al., 1990). Further, Martin, Holroyd, and Penzien (1990) found that chance health locus of control surrounding headache problems was associated with higher levels of depression, physical pain complaints, reliance on maladaptive pain coping strategies, and self-reported disability related to headache. With both chance and powerful others health loci of control predicting poor pain coping strategies, these beliefs may lead to increased avoidance of cognitive exertion in those who have increased pain-related fear. These findings led to a hypothesis of lower levels of internal health locus of control and higher levels of external (chance and powerful others) health locus of control predicting higher cogniphobia scores.

Since there is no previous research on identifying differences in cogniphobia and the hypothesized predictors between student samples and internet samples, a specific hypothesis as to whether the proposed relationships is stronger, weaker or the same between the two samples cannot be provided. However, the replication of these results in a different sample will strengthen the argument that cogniphobia more strongly related to psychological and health belief factors rather than physical injury history. While mainly exploratory, these hypotheses were partially guided by both literature in the field and the previously conducted initial study.

IV: Method

4.1 Study One

Survey responses were collected from 620 participants (308 males, 299 females, 6 other, and 7 prefer not to answer) through the crowd-sourcing site Amazon Mechanical Turk. Amazon Mechanical Turk is an open, online marketplace for task creation, worker recruitment, compensation, and data collection. Individuals register as either requesters or workers. Requesters can create and post their task that can be done at a computer by registered workers. Workers can browse available tasks and are paid after the successful completion of a task. This source was chosen for data collection in order to gather information from a non-clinical sample in an attempt to report inferences closer to that of the general public instead of a clinical sample consisting of just people who seek treatment for their head injury. Buhrmester, Kwang, and Gosling (2011) found that Amazon Mechanical Turk participants are significantly more diverse than typical American college samples and that the data obtained through the site are at least as reliable as those obtained from traditional methods, such as survey research and student samples. Behrend, Sharek, Meade, and Wiebe (2011) also studied differences in data quality between a college student sample and an Amazon Mechanical Turk sample and found slightly higher data quality for the Amazon Mechanical Turk sample in both quantitative and qualitative data. The survey included a modified version of the Cogniphobia Scale (CS-m), the Metacognitions Questionnaire-30 (MCQ-30), and the Texas Evaluation of Concussion History (TECH; Cartwright-Hatton & Wells, 1997; Todd, Martelli & Grayson, 1998).

Study One’s survey was posted on the site and workers completed it in exchange for 50 cents. Workers were not able to take the survey more than once. Initial data collection resulted in 891 participants but 129 participants were eliminated because they failed an in-survey attention check. This attention check consisted of a set of questions regarding the participants’ medical history, as well as an option for the participant to check that none of the medical history disorders/diseases applied to them. If a participant reported that they had a history of any of the disorders/diseases listed, and reported that none of these disorders/diseases applied to them, then the data from these participants were removed from the final data set since they reported two contradictory statements. From the pool of 762 participants, 142 more were eliminated because they either did not report English as their primary language, took less than 4.77 minutes to complete the entire survey (allotting 2 seconds for each item), or showed a response set pattern, such as responding with the same answer option, even for reverse-scored questions. Participants who did not report English as their primary language were removed to ensure they understood the questions in the survey. Most of these criteria overlapped with each other in some way (i.e., responding in all one option, thereby invalidating responses since there are four reverse scored questions on the survey, rapidly responding in under approximately four minutes, and/or spoke a language other than English as their first language). A cutoff time of completing the survey in under 4.77 minutes was used in an attempt to get rid of low effort responses. Insufficient effort in survey responding research suggested using a cutoff of two seconds for each item in the survey to get a minimum response time, and that any response below this total amount is likely the result of poor effort (Huang, Curran, Keeney, Poposki, & DeShon, 2012). After removing all invalid responses, there were 620 participants with usable data.

4.2 Study Two

The second study utilized participant pool data obtained at James Madison University, a public university located in Harrisonburg, Virginia. The total sample size included 235 students. The sample included students over the age of 18 with high levels of education and a variety of ethnicities, health histories, and histories of brain injury. As part of a course requirement, students enrolled in a general psychology class must complete three credits of participation in studies through the participant pool. Participation in this study was advertised as a one credit incentive. Students who indicated they were interested in the study were asked to complete a survey after agreeing to participate in the study. Surveys were administered through a secure online survey tool, Qualtrics. Qualtrics recorded the time for the overall test, so the researchers were able to calculate a minimum completion time to identify participants who quickly moved through the survey by randomly responding. Participants were not able to take the survey more than once.

Initial data collection resulted in 251 participants but two participants were removed because they failed to complete the survey. From that pool of 249 participants, 12 were eliminated (4.8%) because they either did not report English as their primary language, took less than 2.87 minutes to complete the entire survey (allotting 2 seconds for each item), or showed a response set pattern. Research on responses in survey data has shown that around 10-12% of undergraduate students completing a survey for course credit were screened and removed from the final data set based on similar criteria (Meade & Craig, 2012). Participants who did not report

English as their primary language were removed to ensure they understood the questions in the survey. Most of these criteria overlapped with each other in some way (i.e., responding in all one option, thereby invalidating responses since there are four reverse scored questions on the survey, rapidly responding in under approximately four minutes, and/or spoke a language other than English as their first language). A cutoff time of completing the survey in under 2.87 minutes was used in an attempt to get rid of low effort responses. Insufficient effort in survey responding research suggested using a cutoff of two seconds for each item in the survey to get a minimum response time, and that any response below this total amount is likely the result of poor effort (Huang et al., 2012). After removing all invalid responses, there were a total of 237 participants with usable data. The survey included a modified version of the Cogniphobia Scale (CS-m), the Metacognitions Questionnaire-30 (MCQ-30), the Texas Evaluation of Concussion History (TECH), The Pain Catastrophizing Scale (PCS), and The Multidimensional Health Locus of Control scale (MHLC; Wallston, Strudler Wallston, & DeVellis, 1978; Sullivan, Bishop, & Pivik, 1995; Cartwright-Hatton & Wells, 1997; Todd, Martelli & Grayson, 1998). On average, this survey took approximately 27 minutes to complete. Data collection was complete within one month.

4.3 Measures

The following are descriptions of measures used in Study One, Study Two, or in both studies

4.3.1 Cogniphobia Scale-modified (CS-m)

The modified version of the Cogniphobia Scale is a self-report measure of an unreasonable fear of head pain upon cognitive exertion (see Appendix). The original Cogniphobia Scale (Todd, Martelli & Grayson, 1998) was adapted from a measure of kinesiophobia designed to evaluate fear of reinjury or pain during physical movement. In the original measure, participants are asked to designate their degree of agreement or disagreement with 17 items on a 4-point Likert scale which can then be computed as a total score (Martelli, MacMillan, Zasler, & Grayson, 1999). The authors did not provide any psychometric information on of the scale in their original publication.

Further research with this scale by Suhr and Spickard (2012) revised the cogniphobia scale by increasing the total number of items to 19. Their version included three additional items to further represent constructs similar to kinesiophobia. They performed a principal components analysis based on data from a chronic headache sample that derived two subscales: avoidance of mental exertion labeled Cogniphobia-Avoidance (Cronbach's alpha=.83) and beliefs that mental effort is dangerous labeled Cogniphobia-Dangerousness (Cronbach's alpha=.86). Silverberg et al. (2017) also implemented this version of the scale in their study and found that the internal consistency (Cronbach's alpha) of the two subscales in their sample was 0.79 for Cogniphobia-Avoidance and 0.80 for Cogniphobia-Dangerousness.

Additional research within this construct investigated the psychometric properties of the 15-item Cogniphobia Scale for Headache Disorders (CS-HD; Seng & Klepper, 2017). Seng and Klepper (2017) developed this version, intended for those with headache disorders, through content analysis and patient evaluation. Their findings included support for using the CS-HD as a single component scale with its evidence for high internal consistency in this migraine sample (Cronbach's alpha=.94).

According to a review of the literature on this construct and the Cogniphobia Scale, there is no well-validated consensus measure of cogniphobia for the general population. For this both studies, the author implemented a modified version of the Cogniphobia Scale based on the original scale by Todd et al. (1998). The version of the scale from the Suhr and Spickard (2012) study could not be used since it was only applicable for people suffering from chronic headache or pain. The modified version includes 17 questions that are reworded from the initial scale to be more interpretable, generalizable, and to allow anyone to answer these questions instead of just those from a headache or chronic pain sample. While the modified version is the same scale as the original for the most part, with the exception of changing the target of the question from first-person to third-person and changing the word “condition” to head injury/illness in several questions, further research needs to be done in order to ensure the modified version of the Cogniphobia Scale is measuring the same construct as the original scale. This scale is intended to be used to interpret people’s beliefs about the impact of thinking or concentrating on cognitive tasks on those with head injuries or head pain. In Study One, the internal consistency (Cronbach’s alpha) of the modified version of the Cogniphobia Scale was 0.78, while it was 0.65 in the second study. The low reliability of the scores on this scale in Study Two may be due to the fact that the measure is not sensitive enough to people higher in cogniphobia since it was changed from first-person to third-person. Suhr and Spickard (2012) also tested the reliability of their measure on a sample of college students with chronic headaches, while the modified version used in Study One and Study Two was tested on a sample of college students with no specific criteria for head pain or injury. Further, the low reliability might be explained by the fact that the modified version of the scale was specific to head injury/head pain instead of headache or chronic pain like in sample from Suhr and Spickard (2012).

4.3.2 Texas Evaluation of Concussion History (TECH)

The TECH is a self-report questionnaire of concussion history. Participants answer questions about the duration, frequency, and characteristics of any previous head injuries. Additional questions include causes of the injury, symptoms, level of consciousness, and any previous psychological illnesses or diagnoses. The authors of this measure, Cullum, Rossetti, Wilmoth, and Didehbani have not yet published this measure or any of its psychometric properties; however, they have confirmed that its use may be for both clinical and research purposes. Participants were asked two questions in reference to their history of TBI:

- “Have you ever had a concussion or hit to your head that caused any of the following: Being knocked out or unconscious; headache; feeling lightheaded/dizzy; feeling sick/throwing up; feeling unsteady/off balance; changes with vision/eyesight; ringing in the ears; change in mood; difficulty paying attention, remembering, thinking clearly, or speaking clearly?”
- “Have you ever had a period of time in which you experienced multiple, repeated hits to your head (for example, in sports like soccer or football, or in military duty)?”

If participants answered yes to either of these two questions, they were considered to have a self-reported history of TBI.

4.3.3 Metacognitions Questionnaire-30 (MCQ-30)

The Metacognitions Questionnaire-30 is a self-report, short form version of the Metacognitions Questionnaire (Cartwright-Hatton & Wells, 1997) designed to measure metacognitive beliefs and attitudes toward metacognitive processes. It is given as a four-point Likert scale where higher scores indicate stronger levels of maladaptive metacognitions. Subscale scores are calculated by summing the six items on each subscale. The authors of the MCQ-30 (Wells & Cartwright-Hatton, 2004) proposed a five subscale measure: positive beliefs about worry, which measures the degree to which people think worrying is helpful; negative beliefs about worry, which measures beliefs about the dangers of worrying; cognitive confidence, which measures low confidence in one's own cognitive abilities; beliefs about the need to control thoughts, which measures negative beliefs about the consequences of not controlling one’s own thoughts; and cognitive self-consciousness, which measures the tendency to attend to one’s thought processes.

Research on the psychometric properties all provided support for a five-factor structure within the MCQ-30 (Wells & Cartwright-Hatton, 2004; Spada, Mohiyeddini, & Wells, 2008; Cook, Salmon, Dunn, & Fisher, 2014; Grotte et al., 2016). The given subscales also showed high internal reliability with Cronbach's alpha values ranging from .87 to .92 for positive beliefs about worry, .80 to .91 for negative beliefs about worry, .85 to .93 for cognitive confidence, .72 to .81 for need to control thoughts, and .79 to .92 for cognitive self-consciousness across the four previously mentioned psychometric studies. The cognitive self-consciousness and positive beliefs about worry subscales were used in this study. If someone frequently attends to their thought processes and their thinking patterns, they may be more aware of any situations that would require them to put forth mental effort or be more aware of their thinking patterns. Additionally, if they believe worrying is a helpful coping tool, they may be more concerned with worrying about their own health as a way to protect themselves from any damage or symptom exacerbation. In Study One, the internal consistency (Cronbach's alpha) of cognitive self-consciousness was 0.77 and 0.89 for positive beliefs about worry. In the second study, Cronbach's alpha for cognitive self-consciousness was 0.81 and 0.88 for positive beliefs about worry.

4.3.4 The Pain Catastrophizing Scale (PCS)

The Pain Catastrophizing Scale (PCS; Sullivan, Bishop, & Pivik, 1995) is a self-report measure of pain catastrophizing that includes subscales of Pain Magnification, Pain Rumination, and Helplessness (Osman, Barnos, Kopper, Hauptman, Jewell, & O'Neill, 1997; Sullivan et al., 1995). Previous research has shown good test-retest reliabilities with Cronbach's alpha=.75 at six weeks and .70 at ten weeks (Sullivan et al., 1995). Initial development of the PCS by Sullivan et al. (1995) revealed moderate internal consistency of the three subscales where Pain

Magnification Cronbach’s alpha = .60, Pain Rumination Cronbach’s alpha = .87, and Helplessness Cronbach’s alpha = .79. Suhr and Spickard (2012) found additional support for all three subscales in a headache sample showing adequate internal consistency (Pain Magnification: Cronbach’s alpha = .76, Pain Rumination: Cronbach’s alpha = .84, Helplessness: Cronbach’s alpha = .78). Osman et al. (1997) found high internal consistency for the PCS as a whole where Cronbach’s alpha = .93 within a college sample. The PCS has also shown adequate reliability in pain samples. Chaput et al. (2016) found a Cronbach’s alpha value of .87 within their TBI sample while Miró, Nieto, and Huguet (2008) found a value of .91 in a sample of chronic pain patients. While the PCS is broken down into three subscales, the current author used the total PCS score in this study based on the use of a total score in previous research surrounding pain catastrophizing. Sullivan et al. (1995) described the three subscales as dimensions that make-up the same pain-catastrophizing construct and, together, cover the breadth of the content of the construct. In Study Two, the internal consistency (Cronbach’s alpha) of the Pain Catastrophizing Scale was 0.94.

4.3.5 The Multidimensional Health Locus of Control (MHLC)

The Multidimensional Health Locus of Control scale (MHLC; Wallston, Strudler Wallston, & DeVellis, 1978) is a 36-item measure that evaluates beliefs about one’s health being determined by their behavior, chance, or the behavior of others. This scale was modified from the Health Locus of Control scale (HLC) developed by Wallston, Wallston, Kaplan and Maides (1976). The HLC is an 11-item measure where higher scores indicated an external health locus of control while lower scores indicated an internal health locus of control. Wallston et al. (1978) adapted this scale to create the MHLC, which has two forms. The authors constructed equivalent forms in such a way that the total scores of Form A and Form B were as identical as possible.

Form A and Form B both contain 18 items each and the authors suggested using either form or both forms together depending on the data collection situation. The current author used Form A based on the generally superior reliability of Form A over Form B found in previous studies, as discussed below.

For each form, three 6-item subscales make up the MHLC: Internal, Chance, and Powerful others (medical professionals, friends, family). These subscales assess the degree to which individuals believe sickness onset and development is mainly determined by one's own behaviors (Internal), by chance (Chance), or by the action or inaction of another person who has influence in their life (Powerful others). The MHLC is given as a six point Likert scale ranging from strongly disagree (scored as one) to strongly agree (scored as six). Subscale scores are calculated by summing the six items on each subscale, and can range from six to 36. Higher scores indicate stronger beliefs of sickness onset and development locus of control for that cause.

In the literature surrounding the development of the MHLC's psychometric properties, each subscale demonstrated moderate internal consistency for the internal subscale (Form A Cronbach's alpha=.767; Form B Cronbach's alpha=.710; Form A&B Cronbach's alpha=.859), chance subscale (Form A Cronbach's alpha=.753; Form B Cronbach's alpha=.691; Form A&B Cronbach's alpha=.841), and powerful others subscale (Form A Cronbach's alpha=.673; Form B Cronbach's alpha=.715; Form A&B Cronbach's alpha=.830; Wallston et al., 1978). More recently, several studies have used the MHLC and reported adequate internal consistency, reliability, and validity (Aflakseir, & Mohammad-Abadi, 2016; Caplan et al., 2015; Champagne, Fox, Mills, Sadler, & Malcarne, 2016; Keedy, Keffala, Altmaier, & Chen, 2014; Mautner et al., 2017).

One of the original authors of the MHLC (Wallston, 2005) published a more recent discussion of the validity evidence for the MHLC scores and made several points about the evidence discussed in the original article. Each of the scores from MHLC subscales correlated significantly and positively with its respective scale from another measure of health locus of control: Levenson’s generalized Internal (I-subscale), Powerful others (P-subscale) and Chance (C-subscale) subscales (Levenson, 1973). The Internal MHLC subscale correlated .57 with Levenson’s I-subscale, but -.12 with the P-subscale and -.14 with the C-subscale. The Internal and Powerful others MHLC subscales were weakly correlated with one another, and Powerful others MHLC and Chance MHLC were only weakly positively correlated. Internal MHLC and Chance MHLC were weakly negatively correlated, thus supporting the validity claim that these dimensions were related but not the same. Additionally, the Internal MHLC was moderately positively correlated and the Chance MHLC was negatively correlated with a measure of self-reported health status.

This MHLC scale was chosen as a way to measure multiple dimensions of health locus of control. With cogniphobia being the fear of taking action and putting forth effort in order to complete a task, different aspects of locus of control about health may play a role in the development of this fear. This scale is frequently used and allows researchers to assess different types of locus of control in one measure. Internal MHLC, a measure of the belief that someone has power over their health, seems to measure an internal belief of control compared to Powerful others MHLC and Chance MHLC, which describe health as being out of someone’s control. In the second study, the internal consistency (Cronbach’s alpha) of Internal MHLC was 0.80, 0.73 for Powerful others MHLC, and 0.71 for Chance MHLC.

V: Results

5.1 Study One Preliminary Analyses

Initial demographic descriptives showed that a majority of participants (72.1%) identified themselves as White, 15.3% as Asian, 8.4% as African-American, and 4.2% as being from other or mixed ethnic groups. The average age of the participants in the sample was 36 years old (*SD* = 11.92) and participants, on average, reported 14 years of schooling (*SD* = 4.01). Most participants self-reported a medium annual income at the time of the study. Almost half of the participants (41%) indicated they were in good health. An alpha level of .05 was used for all statistical tests. Tables 1 and 2 provide univariate statistics and intercorrelations between primary constructs and descriptive statistics for each construct.

5.2 Study One Primary Analyses

An independent samples *t*-test was conducted to determine if the cogniphobia scores of participants with a presence of TBI history and participants without a presence of TBI history were statistically significantly different. Cogniphobia scores did not significantly differ between those with a self-reported TBI history (*M* = 42.05, *SD* = 6.39) and those without (*M* = 41.43, *SD* = 6.19; *t*(618) = 1.216, *p* = .487, *d* = .01). Self-reported TBI history did not predict presence of cogniphobia, but two separate regression analyses showed that higher scores of CSC (Table 3; R^2 = .042, *F*(1, 618) = 27.02, *p* < .001) and PBW (Table 4; R^2 = .142, *F*(1, 618) = 101.893, *p*<.001) significantly predicted cogniphobia scores. The addition of an interaction term in both regressions did not explain a significantly greater amount of variance in cogniphobia than just the metacognitive factor.

5.3 Study Two Preliminary Analyses

Prior to main analyses for Study Two, all data were examined via descriptive analyses in SPSS for accuracy of data entry, missing values, and outliers. There were no missing data identified in the dataset. Initial demographic descriptives showed that a majority of participants (82.7%) identified themselves as White, 3.4% as Asian, 7.2% as Hispanic or Latinx, 5.5% as Black or African-American, and 0.8% as being from other or mixed ethnic groups. A majority of participants identified as female (84.4%), while two participants preferred not to provide their gender. The average age of the participants in the sample was 18.91 years old (*SD* = 1.34) and about half of the participants (49.8%) indicated they were in very good health. Out of the 237 participants, 52.7% self-reported a history of TBI.

An alpha level of .05 was used for all inferential statistical tests. A summary of demographic characteristics is presented in Table 5. Initial relationships between primary constructs are presented in Table 6.

5.3.1 Assumptions. All assumptions associated with both independent samples t-tests and multiple regression were tested and there was not evidence of assumption violation. Levene's test indicated equal variances (*F* = 1.606, *p* = .206), so the assumption of homogeneity of variance was likely not violated.

5.4 Study Two Primary Analyses

An independent samples *t*-test was conducted to determine if the cogniphobia scores of students with a presence of TBI history and students without a presence of TBI history were statistically significantly different. There were no significant differences in cogniphobia scores between students with a self-reported TBI history (*M* = 44.26, *SD* = 3.99) and those without (*M* = 44.18, *SD* = 4.70; *t*(235) = .146, *p* = .884, 95% CI [-1.04, 1.20], *d* = .02).

Multiple linear regression was conducted to predict cogniphobia scores based on positive beliefs about worry, cognitive self-consciousness, pain catastrophizing, and three subgroups of health locus of control: internal, chance, and powerful others. Table 6 presents intercorrelations between the predictors. Multicollinearity was not a major issue in this situation, as the predictors did not correlate very highly with one another. The set of six predictors did not statistically significantly predict cogniphobia ($R^2 = .053$, $F(6, 230) = 2.136$, $p = .0502$). Only powerful others health locus of control was a statistically significant predictor of cogniphobia in the presence of the other predictors ($b = .126$, $t(1) = 2.01$, $p = .046$, $sr^2 = .017$). Powerful others health locus of control explained 1.7% of the variance in cogniphobia scores while cognitive self-consciousness explained 1.4% of the variance in cogniphobia scores, and chance health locus of control, internal health locus of control, positive beliefs about worry, and pain catastrophizing explained less than 1% of the variance in cogniphobia scores. Table 7 presents regression coefficients as well as the efficacy of the six predictors in predicting cogniphobia scores.

VI: Discussion

6.1 Hypotheses

Results from Study One showed no significant differences in cogniphobia scores between the group with a TBI history and the group without a TBI history. The small effect size of $d = .01$ revealed very little practical significance as well. These results provide support for the lack of association between self-reported TBI history and cogniphobia. With no significant interaction between PBW and self-reported TBI history or CSC and self-reported TBI history, stronger metacognitive belief scores did not moderate the relationship between self-reported TBI history and cogniphobia. Although the presence of a history of TBI had no relationship with the cogniphobia scores of participants within this sample, PBW and CSC both significantly predicted cogniphobia scores. Further, positive beliefs about worry significantly explained 14.2% of the variance in cogniphobia scores, while cognitive self-consciousness significantly explained 4.2% of the variance in cogniphobia scores. These findings from Study One implied that if someone believes that worrying is beneficial to them, or if they constantly monitor their own thoughts, they may also be more cogniphobic.

The first objective of Study Two was to determine if the cogniphobia scores of students with a presence of self-reported TBI history and students without a presence of self-reported TBI history were statistically significantly different. There was no significant difference in cogniphobia scores between the group with a TBI history and the group without a TBI history. Not only was this difference not statistically significant, but its effect size of .02 revealed very little practical significance as well, according to Cohen's *d* guidelines (Cohen, 1992). Therefore, the results revealed support for the hypothesis that no significant differences in cogniphobia scores between those with a self-reported TBI history and those without within a sample of college students. These results are consistent with the findings in Study One in that there were no significant differences in cogniphobia scores between the two groups. Further, the findings are similar to those from Severeijns et al. (2001) where there was little to no relationship between physical impairment and pain-related fear. These findings provided further support for the lack of association between injury history and cogniphobia.

The second goal of Study Two was to identify which health-related behaviors and thought patterns were significant predictors of cogniphobia. Results from the multiple regression analysis did not show a statistically significant overall model. Further, the set of six predictors together only explained 5.3% of the variance in cogniphobia scores. A closer look at the individual predictors in the model identified one statistically significant predictor in the presence of five others: Powerful others health locus of control. However, this predictor only explained 1.7% of the variance in cogniphobia scores, which was not practically significant. Except for cognitive self-consciousness and internal health locus of control, all predictors in the model predicted cogniphobia in the direction hypothesized. Therefore, the set of predictors that included positive beliefs about worry, cognitive self-consciousness, pain catastrophizing, and three types of health locus of control: internal, chance, and powerful others did not explain much variance in cogniphobia scores within the presence of each other.

These six predictors did not serve as adequate predictors for cogniphobia because their correlations with cogniphobia were so low (Table 6). The highest correlation between one predictor and cogniphobia was with Powerful others health locus of control ($r = .169$). Since Powerful others had the strongest relationship with cogniphobia out of the set of predictors, it makes sense that it was the only statistically significant predictor in the regression equation. Further, Powerful others health locus of control predicted cogniphobia scores in the direction hypothesized. In this sample, as someone’s belief that their health status is dependent on others increased, so did their cogniphobia. There seems to be a link between external health locus of control and cogniphobia. People who shy away from mentally-exerting tasks that could give them a headache may also feel that other people, like medical professionals, have more influence over their own health than they do.

Cognitive self-consciousness was not a statistically significant predictor of cogniphobia, but had a squared semi-partial value close to that of Powerful others health locus of control ($sr^2 = .014$). While neither Powerful others health locus of control nor cognitive self-consciousness explained much variance in cogniphobia scores, they explained the most variance as individual predictors compared to the others in the model. Interestingly, cognitive self-consciousness did not predict cogniphobia scores in the direction hypothesized. In this sample, as someone's awareness of their own thoughts increased, their cogniphobia decreased. The effect size of this relationship is minimal at best, but the direction of the relationship is still important to note. Internal health locus of control also did not predict cogniphobia scores in the direction hypothesized. In this sample, as someone's belief that they are responsible for their own health increased, their cogniphobia increased as well. However, the practical significance of this relationship was miniscule, as Internal health locus of control only explained .4% of the variance in cogniphobia scores.

6.2 Comparison of Studies

A comparison of the general demographics between Study One and the Study Two showed several main differences. Study One participants were almost twice as old as Study Two's participants, on average. Study One's sample had a larger number of participants identifying as male compared to Study Two, and Study Two's participants reported higher cogniphobia than Study One's, on average. Study One participants reported higher positive beliefs about worry and cognitive self-consciousness compared to the second study's sample, on average. The majority of participants in Study One (41%) reported being in good health, while the majority of participants in Study Two (49.8%) reported being in very good health. The prevalence of self-reported TBI in both studies, however, was similar (Tables 1 & 3). Average overall cogniphobia scores in the samples for both studies were slightly higher than in Seng and Klepper (2017), although they used a slightly different version of the Cogniphobia Scale. Health locus of control subscale means and standard deviations in the second study were all similar to scores in a study measuring internal, powerful others, and chance health locus of control in a college sample (Roddenberry & Renk, 2010). Ranges and standard deviations for scores of the variables used in both studies were similar, indicating that although the demographics of the two samples were different in terms of age and gender, responses from participants in both samples on the survey measures were not restricted in range. Additionally, results from both studies showed a small, but significant, negative relationship between age and cogniphobia. Therefore, it seems that younger people may be more cogniphobic. Between the two studies, slight differences in results, such as a higher average cogniphobia score, may have occurred due to the demographic make-up of each sample.

The results from Study One were partially replicated in Study Two. In both studies, there was no significant difference in cogniphobia scores between the group with a TBI history and the group without a TBI history. The sample in Study One also reported lower cogniphobia scores (*M* = 41.71, *SD* = 6.29), on average, compared to the second study's college student sample (*M* = 44.26, *SD* = 4.37). However, in Study One, both positive beliefs about worry and cognitive self-consciousness were significant predictors of cogniphobia within the presence of each other. In Study Two, neither of the metacognitive factors were significant predictors of cogniphobia. When comparing the two studies, the Amazon Mechanical Turk sample reported stronger positive beliefs about worry (*M* = 13.57, *SD* = 4.40) and cognitive self-consciousness (*M* = 17.41, *SD* = 3.00) than the participant pool sample in Study Two (PBW *M* = 11.54, *SD* = 4.25; CSC *M*= 15.71, *SD* = 3.94). Both positive beliefs about worry and cognitive self-consciousness were more strongly correlated with cogniphobia in Study One than they were in Study Two, and were both significant predictors in Study One. Positive beliefs about worry explained of the 14.2% variance in cogniphobia scores in Study One, and .5% in the second study, while cognitive self-consciousness explained of the 4.2% variance in cogniphobia scores in Study One, and 1.4% in the second study. These weaker relationships with the dependent variable help explain why neither predictor was significant in Study Two. Further, the internal consistency of the modified version of the Cogniphobia Scale was higher in Study One (α = .78) than in the second study (α = .65). Therefore, the scores on the modified version of the Cogniphobia Scale were generally more reliable in Study One than in the second study. This unreliability in the scores from this scale in this study may explain why the regression model results were not replicated.

6.3 Limitations

Several limitations should be considered when interpreting these results. In Study Two, Cronbach's alpha for the modified version of the Cogniphobia Scale was .65. Reliability, therefore, was low for this scale, which could explain why the correlations between the predictors and dependent variable were so weak. Low reliability could be due to random measurement error or because the scale is actually multidimensional with weakly correlated factors. Therefore, some of the inferences made from this study were based on results from a scale with low reliability. Further work on the psychometric properties of the modified version of the Cogniphobia Scale needs to be done in order to make more reliable inferences based on results stemming from scores on this scale.

Further, the utility of the predictors as a set may have caused the lack of a statistically significant overall regression model. The overall model fit *F*-test is based on how well the predictors work together to explain the variance in cogniphobia scores, on average. By having many non-significant predictors in the model, excess degrees of freedom were burned. Since five of the six predictors were not significantly contributing to the model, the effect of Powerful Others Health Locus of Control on the model was washed out.

Another limitation within this study is that the data were collected in a self-report manner. Most of the constructs in the study were based on attitudes, opinions, and beliefs of the participants, so collecting self-report data made sense for these constructs. However, students were also asked to self-report their history of TBI. Since this was a non-clinical sample, medical records were not obtained in order to group students into those with a history of TBI and those without a history of TBI. Therefore, students were asked to determine if they had a head injury or not. As noted previously, they were asked two questions in reference to their history of TBI:

- "Have you ever had a concussion or hit to your head that caused any of the following: Being knocked out or unconscious; headache; feeling lightheaded/dizzy; feeling sick/throwing up; feeling unsteady/off balance; changes with vision/eyesight; ringing in the ears; change in mood; difficulty paying attention, remembering, thinking clearly, or speaking clearly?"
- "Have you ever had a period of time in which you experienced multiple, repeated hits to your head (for example, in sports like soccer or football, or in military duty)?"

Students answering these questions may not have considered any hits to the head that they had to be serious enough to consider them concussions. Also, there may have been some students who were hit in the head, but did not experience any of the symptoms listed above. On the opposite end of the spectrum, students may not have remembered having been hit in the head due to memory problems from a concussion. In fact, students in this sample may be considering every hit to the head that they have ever had to be a head injury. However, the majority of reports of TBI would be classified as "mild" by clinicians if participants sought medical attention for their injury (Kraus, 1993). Self-reported TBIs were also not verified through medical documentation or a clinician. Ideally, the self-reports of TBI in this sample would be corroborated against medical records, but with this being a non-clinical sample without access to medical records, this was not an option. On the other hand, some students may not have even seen a physician concerning their head injury, so there would not be a record of their TBI.

Although 52.7% of the students in Study Two's sample self-reported having a TBI, this distinction may not have been completely accurate. Based on reports from the Centers for Disease Control and Prevention (2017b), less than 1% of people in the 15–24 year old age group visited an emergency department because of a TBI in 2010. In this sample, therefore, 52.7% may be an over-estimate for the number of students reporting a head injury. However, less than 1% may not be a completely accurate estimate as well since it only includes people who actually went to an emergency room for their injury, while the sample in both studies include people who sustained a blow/repeated blows to the head in their lifetime. Additionally, a survey of college students in the United States resulted in 24% of men and 16% of women within the sample reporting that they had been "knocked out by a head injury" at some point in their lives (Crovitz, Horn, & Daniel, 1983).

Both samples in Study One and Two completed the survey on an online platform. It is possible that people who suffer from cogniphobia did not want to put themselves in a situation where they would have to exert cognitive effort, such as completing the survey or using the computer. If this were the case, then the samples in both studies may not have included people who are extremely cogniphobic and may not be representative of the true prevalence of high cogniphobia in these populations. Additionally, I was unable to control the conditions in which the participants filled out the survey. Participants received credit for taking part in the study, so they had some motivation to provide accurate responses on the survey. However, they were permitted to complete it on their own time and in whatever environment they chose, so a number of different factors could have influenced the scores on the survey. If someone's attentional resources were already being taken up by experiencing pain, anxiety, or other distractions, they may not have been able to put enough cognitive effort into the survey or to remember much about their TBI.

6.4 Potential Implications and Recommendations for Future Research

It is possible that health-related thinking patterns encourage the development of cogniphobia more so than actual injury history. Self-reported TBI history was not associated with cogniphobia scores, which is consistent with findings of Severeijns et al. (2001) in that there was little to no relationship between physical impairment and pain-related fear. An external locus of control surrounding health status could also play a role in pain-related fear. The belief that health status is dependent on others, such as doctors, friends, or family, seems to be another way of coping with poor health or fear of poor health. Depending on external sources to be responsible for your health is another way of avoiding possible health issues, and instead shifting that responsibility to someone else. This avoidant coping style may underlie both external health attitudes and avoidance of pain surrounding cognitive tasks.

In individuals suffering from prolonged recovery, such as those with post-concussion syndrome, treatment may center around promoting adaptive attitudes and health belief perceptions in order to reduce anxiety over lingering symptoms. Todd et al. (1998) suggested the use of combination therapies to reduce this anxiety. These techniques may include reeducation, anxiety reduction procedures that counter maladaptive phobic response, and promoting adaptive attitudes. Additionally, they suggested implementing graduated exposure to cognitive exertion, systematic desensitization, and reshaping adaptive attitudes and maladaptive thought cycles. Teaching active coping skills and discouraging both external dependence and avoidant behaviors may also be a helpful component of cognitive-behavioral therapy for people suffering from cogniphobia.

Reduced or invalid performance on neuropsychological assessments and cognitive testing may be an indirect result of cogniphobia (Suhr & Spickard, 2012). This decreased performance may be a result of attentional resources being redirected from the actual cognitive task to the constant rumination and self-awareness of physical pain sensations. It may be helpful for clinicians and neuropsychologists to be aware of possible reasons, like pain-related fear, for decreased or invalid performances. Patients may be so focused on their headache, or the possibility that they may develop one, that they are not directing their full attention to the task. These clients may avoid these cognitive tasks or not perform their best in an attempt to reduce the risk of developing a headache or making an existing headache worse. It could be helpful for clinicians to screen for these behaviors and/or attitudes before conducting full neuropsychological batteries to get a better idea of the patients' health-related beliefs and attitudes.

In order to provide a clearer picture of the construct of cogniphobia, more work on the psychometrics of the modified version of the Cogniphobia Scale needs to be done. In this study, internal consistency was weak, indicating that the items are not highly correlated. Therefore, the items on the scale need to be adjusted for clarity and evaluated for how well they explain the construct being measured. Additional work on the factor structure of the scale is also necessary to determine the possible components of cogniphobia. Previous studies have evaluated the psychometrics of the Cogniphobia Scale (Seng et al., 2017; Suhr et al. 2012; Todd et al., 1998), but all have used varying versions of the scale as well as different methods of evaluating the factor structure, so there is no consensus measure of cogniphobia to date.

Further investigation into the development of cogniphobia might include perceptions of pain, fear-avoidance coping styles, and relationships with anxiety, depression, obsessive-compulsive disorders, and post-concussion syndrome. Pre-morbid conditions, such as health anxiety, may increase feelings of worry and self-awareness of one's thoughts, so it could be helpful to investigate how big of a role anxiety plays on cogniphobia. Obsessive behaviors, such as rumination, may also be linked with the development of cogniphobia. Janeck et al. (2003) suggested that a tendency to constantly reflect on one's own cognitive processes might increase negative appraisals of persisting thoughts, which could be the result of an over-allocation of attentional resources to ruminative thoughts. To relieve these effects of rumination or maladaptive health beliefs, clinicians may focus on implementing targeted interventions of changing maladaptive health attitudes and beliefs through cognitive-behavioral therapy to reduce the client's belief that cognitive exertion is dangerous.

Table 1

Descriptive statistics of primary constructs for Study One (N = 620)

	M	*SD*	Min	Max
1. Age	36.07	11.92	18	82
2. Gender	49.68% male	--	--	--
3. Race	72.10% white	--	--	--
4. TBI History	45.65% yes	--	--	--
5. Positive Beliefs about Worry	13.57	4.40	6	24
6. Cognitive Self-Consciousness	17.41	3.00	7	24
7. Cogniphobia	41.71	6.29	25	64

Table 2

Intercorrelations between primary constructs for Study One (N = 620)

	1	2	3	4	5	6
1. Age	1.000					
2. Gender	.096*	1.000				
3. TBI History	.019	-.087*	1.000			
4. Positive Beliefs about Worry	-.246**	-.084*	.020	1.000		
5. Cognitive Self-Consciousness	-.205**	-.109**	.073	.302**	1.000	
6. Cogniphobia	-.189**	-.108**	.049	.376**	.205**	1.000

Note. **p* <.05, ***p*<.01.

Table 3

Regression Predicting Cogniphobia from TBI History, Cognitive Self-Consciousness and their Interaction for Study One

Step and Predictor Variable	R^2	ΔR^2	*b*	95% CI of *b*
Step 1	.042**	.042**		
Cognitive Self-Consciousness			.429**	.267 to .591
Step 2	.043**	.001		
Cognitive Self-Consciousness			.424**	.261 to .586
TBI History			.431	-.547 to 1.409
Step 3	.046**	.003		
Cognitive Self-Consciousness			.529**	.315 to .743
TBI History			4.75	-1.069 to 10.57
Interaction			-.247	-.576 to .081

Note. *p<.05, **p <.01.

Table 4

Regression Predicting Cogniphobia from TBI History, Positive Beliefs about Worry and their Interaction for Study One

Step and Predictor Variable	R^2	ΔR^2	*b*	95% CI of *b*
Step 1	.142**	.142**		
Positive Beliefs about Worry			.537**	.433 to .642
Step 2	.143**	.001		
Positive Beliefs about Worry			.536**	.432 to .641
TBI History			.520	-.403 to 1.444
Step 3	.146**	.003		
Positive Beliefs about Worry			.603**	.460 to .746
TBI History			2.475	-.517 to 5.467
Interaction			-.144	-.353 to .066

Note. **p*<.05, ***p* <.01

Table 5

Descriptive statistics of primary constructs for Study Two (N = 237)

	M	*SD*	Min	Max
1. Age	18.92	1.34	18	30
2. Gender	84.39% female	--	--	--
3. Race	82.70% white	--	--	--
4. TBI History	52.74% yes	--	--	--
5. Positive Beliefs about Worry	11.54	4.25	6	24
6. Cognitive Self-Consciousness	15.71	3.94	7	24
7. Cogniphobia	44.26	4.37	33	61
8. Pain Catastrophizing	20.89	12.37	0	50
9. Internal Health LOC	23.5	5.28	7	36
10. Powerful Others Health LOC	15.99	4.88	6	30
11. Chance Health LOC	16.69	5.02	6	32

Note. LOC=Locus of Control.

Table 6

Intercorrelations between primary constructs for Study Two (N = 237)

	1	2	3	4	5	6	7	8	9	10
1. Age	1.00									
2. Gender	-.192**	1.00								
3. TBI History	.086	.007	1.00							
4. Positive Beliefs about Worry	-.052	-.008	-.055	1.00						
5. Cognitive Self-Consciousness	.036	-.071	.038	.29**	1.00					
6. Cogniphobia	-.195**	.145*	-.01	.075	-.052	1.00				
7. Pain Catastrophizing	-.053	.094	.054	-.013	.172**	.079	1.00			
8. Internal Health LOC	-.055	-.005	.003	.192**	.261**	.098	.202**	1.00		
9. Powerful Others Health LOC	-.088	-.075	-.153*	.074	.125	.169**	.132*	.219**	1.00	
10. Chance Health LOC	-.001	-.053	-.072	.216**	.171**	.108	.214**	.086	.35**	1.00

Note. **p* <.05, ***p*<.01

Table 7

Predictors of Cogniphobia for Study Two (N = 237)

Predictor Variable	β	*b*	*t*	95% CI of *b*	sr^2
Positive Beliefs about Worry	.079	.081	1.145	-.059 to .221	.005
Cognitive Self-Consciousness	-.128	-.142	-1.841	-.294 to .010	.014
Pain Catastrophizing	.06	.021	.878	-.026 to .068	.003
Internal Health LOC	.07	.058	1.003	-.055 to .171	.004
Powerful Others Health LOC	.141	.126*	2.010	.003 to .249	.017
Chance Health LOC	.045	.039	.630	-.083 to .162	.002

Note. LOC=Locus of Control. *p<.05.

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Appendix A

Cogniphobia Scale-modified (CS-m)

1=Strongly Disagree, 2=Disagree, 3=Agree, 4=Strongly Agree

*=reverse scored

This scale is used to interpret people's beliefs about the impact of thinking or concentrating on mental tasks on people with head injuries or head pain.

Question	**Strongly Disagree**	**Disagree**	**Agree**	**Strongly Agree**
1. If someone concentrates too much, they could make the cause of their headache pain worse.				
2. If someone were to try to overcome his/her head pain, it would increase.				
3. Head pain tells someone that her/she has something dangerously wrong.				
4. Someone's head pain would probably be relieved if they practiced concentration exercises.*				
5. People aren't taking head injuries/illnesses seriously enough.				
6. Someone's injury/illness puts his/her head and brain at risk for the rest of his/her life.				
7. Headaches always mean someone has a head injury/illness or has done something to make the injury/illness worse.				
8. Just because something aggravates someone's head pain does not mean it's dangerous.*				
9. People with head injuries/illnesses should avoid activities that might make him/her think too hard.				
10. Being careful not to concentrate too hard or too long is the safest thing someone can do to prevent his/her head pain from worsening.				
11. Someone wouldn't have a lot of symptoms if there wasn't something potentially dangerous going on in his/her head.				
12. Even if someone's head injury/illness is painful, he/she would be better off if he/she were more mentally active.*				
13. Having head pain can let someone know to stop concentrating on a mental task so that he/she doesn't injure himself/herself.				

14. It’s really not safe for a person with a head injury/illness to engage in too much thinking and concentrating.				
15. People with head injuries/illnesses can’t do all the things normal people do because it’s too easy for them to cause harm to their condition.				
16. Even though something is causing someone a lot of head pain, I don’t think it’s actually dangerous.*				
17. No one should ever concentrate on difficult mental tasks when he/she is in pain.				

Appendix B

Description of Measures

Measures	Cronbach's Coefficient Alpha	Normative Scores/Cutoffs	Scale Range
Modified version of the Cogniphobia Scale (CS-m; adapted from Todd, Martelli & Grayson, 1998)	Cogniphobia (17 items) • Study 1: α = 0.78 • Study 2: α = 0.65	Cutoff of 37. Scores above 37 considered clinically significant levels of cogniphobia (Martelli et al., 1999)	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
Texas Evaluation of Concussion History (TECH; Cullum, Rossetti, Wilmoth, and Didehbani)	---	---	---
Metacognitions Questionnaire-30 (MCQ-30; Wells & Cartwright-Hatton, 2004)	Cognitive self-consciousness (6 items) • Study 1: α = 0.77 • Study 2: α = 0.81 Positive Beliefs about Worry (6 items) • Study 1: α = 0.89 • Study 2: α = 0.88	Scale development study reported scores of cognitive self-consciousness (*M* = 11.65, *SD* = 4.68) and positive beliefs about worry (*M* = 9.60, *SD* = 3.46) in data from a convenience sample of 182 university students and employees (Wells et al., 2004)	1 = Do not agree 2 = Agree slightly 3 = Agree moderately 4 = Agree very much
The Pain Catastrophizing Scale (PCS; Sullivan, Bishop, & Pivik, 1995)	Pain Catastrophizing (13 items) • Study 2: α = 0.94	Scale development study reported scores of pain catastrophizing (*M* = 20.90, *SD* = 12.50) in data from a convenience sample of mainly consisting of chronic pain patients (Sullivan et al., 1995)	0 = Not at all 1 2 3 4 = All the time (0 and 4 are anchor responses; no label given to 1-3 response options)
The Multidimensional Health Locus of Control scale (MHLC Form A; Wallston, Strudler-Wallston, & DeVellis, 1978)	Internal (6 items) • Study 2: α = 0.80 Chance (6 items) • Study 2: α = 0.71 Powerful Others (6 items) • Study 2: α = 0.73	Scale development study reported scores of internal LOC (*M* = 25.10, *SD* = 4.89), chance LOC (*M* = 15.57, *SD* = 5.75) , and powerful others LOC (*M* = 19.99, *SD* = 5.22) in data from a convenience sample consisting of people arriving at an airport (Wallston et al., 1978)	1 = Strongly Disagree 2 3 4 5 6 = Strongly Agree (1 and 6 are anchor responses; no label given to 2-5 response options)