Expanding the Fear of Loss of Vigilance Theory: Using Intolerance of Uncertainty, Responsibility for Harm, and Fear of Sleep to Predict Nocturnal Panic Attacks

Nicole S. Smith

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EXPANDING THE FEAR OF LOSS OF VIGILANCE THEORY: USING INTOLERANCE OF UNCERTAINTY, RESPONSIBILITY FOR HARM, AND FEAR OF SLEEP TO PREDICT NOCTURNAL PANIC ATTACKS

by

Nicole Simonne Smith

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Submitted to the Graduate School,
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and the School of Psychology
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for the Degree of Master of Arts

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ABSTRACT

Nocturnal panic involves experiencing panic attacks out of a sleeping state without obvious causes such as nightmares or loud noises. Roughly half of patients with panic disorder will experience nocturnal panic in addition to panic attacks while awake, or daytime panic. Like daytime panic, nocturnal panic also occurs in other disorders such as PTSD. The Fear of Loss of Vigilance theory is currently the only model available to explain nocturnal panic. It suggests that nocturnal panickers fear states in which they cannot easily react to or protect themselves from danger. Prior research using a self-report measure to differentiate nocturnal and daytime panickers has been unsuccessful. The current study sought to expand upon the existing theory by including constructs from the broader anxiety literature such as fear of sleep, intolerance of uncertainty, and responsibility for harm. Nocturnal panickers were expected to report higher scores on these measures when compared to daytime panickers and those without panic attacks. A sample of undergraduates (Nocturnal Panic \( N = 52 \); Daytime Panic \( N = 56 \); Without Panic \( N = 58 \)) completed self-report measures about panic attacks, fear of sleep, intolerance of uncertainty, responsibility for harm, and fear of loss of vigilance. Measures of fear of sleep and responsibility for harm successfully differentiated nocturnal from daytime panickers, whereas measures of intolerance of uncertainty and fear of loss of vigilance did not. These results provide partial support for the Fear of Loss of Vigilance theory. Modifications to the theory to incorporate additional constructs are suggested.
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DEDICATION

I would like to dedicate this paper to my family for their support throughout my lengthy pursuit of education. I would also like to thank my research family, who provided the perfect combination of encouragement and constructive criticism as this project progressed. Finally, thank you Brad for your constant love and patience through the chaotic days and sleepless nights. I couldn’t have done it without you.
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LIST OF ABBREVIATIONS

REM              Rapid Eye Movement
PTSD             Post-Traumatic Stress Disorder
FLOVQ            Fear of Loss of Vigilance Questionnaire
OCD              Obsessive-Compulsive Disorder
DSM-5            Diagnostic and Statistical Manual of Mental Disorders-5th Edition
FoSI-SF          Fear of Sleep Inventory-Short Form
IUS-12           Intolerance of Uncertainty Scale-12 item version
DOCS             Dimensional Obsessive-Compulsive Scale
ROC              Receiver Operating Characteristic
NP               Nocturnal Panic
DP               Daytime Panic
WP               Without Panic
AUC              Area Under the Curve
APA              American Psychiatric Association
CHAPTER I - INTRODUCTION

Panic attacks are a major public health concern, with 28% of people in the United States experiencing one in their lifetime (Kessler et al., 2006). Furthermore, roughly two-thirds of people who experience a panic attack will go on to experience recurring panic attacks (Jonge et al., 2016). In the United States, treatment costs for panic disorder range from $30,000 to $45,000 annually and individuals with panic disorder are more than twice as likely to experience work impairment and miss work days compared to those without panic (Bystritsky et al., 2010). Individuals who experience panic attacks without meeting criteria for a diagnosis of panic disorder contribute to societal costs as well. These individuals use more psychotropic medication, report more psychological help-seeking behaviors and more psychological impairment than do individuals without panic (Kessler et al., 2006). Indeed, panic attacks are associated with poorer treatment response and more severe symptomology within other psychological diagnoses, when compared to those same diagnoses without panic (Jonge et al., 2016).

1.1 Nocturnal Panic

Many who suffer from panic disorder experience panic attacks during sleeping states in addition to wakeful states (Craske, Lang, Tsao, Mystkowski, & Rowe, 2001). These nocturnal panic attacks begin while the individual is sleeping and result in awakening to a panic attack (Freed, Craske, & Greher, 1999). Nocturnal panic attacks comprise the same symptoms as panic attacks while awake (daytime panic), but occur during the transition from light to deep sleep (Craske & Rowe, 1997). Similar to unexpected daytime panic attacks, nocturnal panic occurs in the absence of an obvious trigger (Craske & Rowe, 1997). Nocturnal panic does not refer to being awoken by
environmental stimuli (e.g. alarms or thunder), nor does it refer to waking from sleep and panicking after a period time (Craske & Tsao, 2005). Specifically, nocturnal panic attacks occur between late stage II and early stage III sleep (Mellman & Uhde, 1989a). Since they do not occur during the REM sleep stage, nocturnal panic is not associated with dreams or nightmares (Craske & Rowe, 1997). Similarly, nocturnal panic is separate from night terrors, which occur in stage IV (Craske & Rowe, 1997).

Individuals who experience nocturnal panic do, however, experience more insomnia than those who experience daytime only panic (Mellman & Uhde, 1989b). Returning to sleep following a nocturnal panic attack is difficult, resulting in periods of wakefulness throughout the night. Frequent nocturnal panic often leads to a fear of sleep, resulting in avoidance behaviors such as attempts to delay sleep onset (Craske & Tsao, 2005). Chronic sleep loss can then lead to poorer mental and physical health, impaired work performance, and more frequent workplace accidents (Barnes & Drake, 2015).

1.2 Theoretical Foundations

Existing conceptual models of panic attacks, however, only address daytime panic and fail to account for nocturnal panic (Bouton, Mineka & Barlow, 2001). The body vigilance model, for example, suggests that individuals with panic disorder pay more conscious attention to internal physical sensations to detect potentially dangerous bodily fluctuations (Schmidt, Lerew, & Trakowski, 1997). Catastrophic misinterpretations of these bodily fluctuations (e.g., “My heart rate is too fast, so I must be having a heart attack”) then lead to increased anxious arousal and trigger panic attacks (Bouton et al., 2001). This model relies on conscious thoughts leading into the panic attacks, which would not occur during non-REM sleep when nocturnal panic attacks occur. The modern
learning theory of panic, conversely, suggests individuals become conditioned to associate internal anxious states leading up to a panic attack with the occurrence of full-blown panic attacks, but do not necessarily need to be consciously aware of those states for the conditioning to occur (Bouton et al., 2001). These internal states could then occur while an individual is sleeping, triggering a nocturnal panic attack. While this theory helps to explain how panic attacks could occur during sleep, it does not explain why some individuals experience nocturnal panic and others only experience daytime panic.

Craske and colleagues (Freed, Craske & Greher, 1999; Craske et al., 2001; Tsao & Craske, 2003a; Tsao & Craske, 2003b; Craske et al., 2005) are responsible for the bulk of the theoretical work on nocturnal panic. Early theories suggested individuals who experience nocturnal panic have more internal physiological fluctuations or body movement during sleep than those who experience daytime-only panic. The empirical findings, however, did not support this hypothesis. Studies failed to find any differences in respiratory activity (Craske & Barlow, 1990; Hauri, Friedman, & Raveris, 1989), cardiac activity (Craske et al., 2005), or body movements (Uhde, 1994) between nocturnal and daytime panic groups. Other theories proposed individuals who experience nocturnal panic represented a more severe form of panic disorder. Craske and colleagues (2002) found no differences between nocturnal and daytime panic groups in panic symptom severity, psychological comorbidity, anxiety symptom severity, or depressive symptom severity. Additionally, those who experience nocturnal panic were not found to be more aware of or more afraid of anxiety symptoms than those who panic only while awake (Craske et al., 2001). Where the groups differ is in reactivity to states that resemble sleep (Craske et al., 2005).
1.3 Fear of Loss of Vigilance Theory

Tsao and Craske (2003a) have suggested that individuals who experience nocturnal panic fear states of diminished vigilance such as meditation, hypnosis, and sleep. This fear of loss of vigilance theory proposes that individuals who experience nocturnal panic fear being unable to respond properly to threats and fear being unable to protect themselves because of decreased vigilance (Tsao & Craske, 2003a). Someone who experiences nocturnal panic may attempt to avoid or delay sleep for fear of having a heart attack or being attacked by an intruder while asleep. For these individuals, threats during sleep are particularly frightening because their ability to get medical help or defend themselves against attack is at its lowest while sleeping (Tsao & Craske, 2003b). Craske and Tsao (2005) have suggested that those who experience nocturnal panic may be conditioned to respond to internal cues with panic attacks, as suggested by the modern learning theory described above, but are also conditioned to react to the shift from light to deep sleep (semi-vigilance to non-vigilance) with heightened arousal, resulting in nocturnal panic attacks when the internal cues occur during the transitional period between stage II and stage III of sleep. Thus, the conditioned fear of loss of vigilance separates those who panic out of sleep from those who panic only while awake.

The results of several studies support the role of fear of loss of vigilance in nocturnal panic. Freed and colleagues (1999) suggested that a fear of loss of vigilance may result from past traumatic experience based on the similarities between those who experience nocturnal panic and those with post-traumatic stress disorder (PTSD). Both suffer from insomnia, hypervigilance, and sudden awakenings from sleep in a heightened state of arousal (Freed et al., 1999). Nocturnal panic has been observed in patients with
PTSD, but has been studied primarily in the context of panic disorder (Craske & Tsao, 2005). Traumatic experiences may increase the expectation of future threats, resulting in persistent hypervigilance (Freed et al., 1999). Non-vigilant states, such as sleep, would then produce more anxiety and distress because of the diminished ability to protect oneself from danger and result in frequent awakenings (Freed et al., 1999). Indeed, individuals who experienced nocturnal panic attacks were more likely to report traumatic experiences than those who experienced only daytime panic and those traumas preceded nocturnal panic onset (Freed et al., 1999).

Individuals who experience nocturnal panic have also shown increased anxiety and panic responses to meditative relaxation exercises (Craske et al., 2001). This research anticipated that those who experience nocturnal panic would be more reactive to cardiac and respiratory fluctuations than those who experience panic only while awake. They also predicted that the nocturnal panic group would be more reactive to a meditation exercise designed to resemble the diminished vigilance experienced during sleep (Craske et al., 2001). No differences were found for the cardiac and respiratory challenges, but the nocturnal panic group reported more anxious symptoms and panic attack symptoms during the meditative relaxation exercise. Those who experience nocturnal panic also reported more discomfort associated with trying to relax or “letting go” (Craske et al., 2001). In support of the fear of loss of vigilance theory, these results suggest that individuals who panic out of sleep differ from those who panic only while awake primarily in their reaction to states of decreased vigilance.

Similarly, Tsao and Craske (2003b) measured responses to imagery of traumatic experiences, panic attacks, and hypnosis in nocturnal and daytime panic groups. Once
again, the groups differed only in the condition targeted at decreased vigilance: hypnosis (Tsao & Craske, 2003b). The nocturnal panic group reported more panic symptoms and showed more physiological arousal in response to hypnotic imagery than did the daytime panic group (Tsao & Craske, 2003b). This study provided further support to the theory that those who experience nocturnal panic are specifically reactive to situations in which vigilance is diminished.

The Fear of Loss of Vigilance Questionnaire (FLOVQ) was designed to test the fear of loss of vigilance theory through self-report (Tsao & Craske, 2003a). The measure asks participants to rate the amount of fear and anxiety associated with fourteen different states of decreased vigilance (e.g. fatigue, daydreaming) on a scale from 0 (no fear or anxiety) to 8 (extreme fear or anxiety). Higher FLOVQ scores indicate more fear and anxiety associated with states of decreased vigilance while lower scores indicate less fear and anxiety associated with such states (Tsao & Craske, 2003a). The FLOVQ did not, however, differentiate between nocturnal and daytime panic groups as predicted (Tsao & Craske, 2003a). It is possible that the questionnaire did not differentiate the groups because the items asked about experiences of decreased vigilance, such as fatigue and drowsiness, but not complete loss of vigilance (e.g. during sleep) or more considerable losses of vigilance (e.g. meditation and hypnosis).

Craske and Tsao (2005) suggested that light sleep (stages I and II) represent semi-vigilant states, whereas deep sleep (stages III, IV, and REM) represent non-vigilant states. Nocturnal panic attacks occur exclusively during the transition from light sleep (semi-vigilance) into deep sleep (non-vigilance; Craske & Tsao, 2005). Therefore, states of somewhat decreased vigilance, like those referenced in the FLOVQ, may not activate
the anxiety needed to trigger a full-blown panic attack. For example, one item asks, “How much distress/anxiety/fear do you experience when experiencing fatigue from lack of sleep?” (Tsao & Craske, 2003a). Fatigue may represent a state of lessened vigilance, but one may feel able to respond to danger even when experiencing fatigue. Conversely, vigilance is lost completely during sleep, so fatigue may be preferable to the risk of harm associated with sleep for someone who fears loss of vigilance. If this is the case, then measures that address experiences of more complete loss of vigilance, more general feelings of vulnerability to danger, or an inability to act during non-vigilant states may better differentiate those who experience nocturnal panic from those who experience only daytime panic.

1.4 Additional Constructs

One construct that may be related to the fear of loss of vigilance theory is intolerance of uncertainty. Intolerance of uncertainty refers to fears of the consequences of uncertain situations and the inability to react to uncertain situations (Carleton, Norton, & Asmundson, 2007). Individuals who are intolerant of uncertainty experience uncertain situations as stressful, unfair, difficult or impossible to respond to, and something that should be avoided (Buhr & Dugas, 2002). For individuals who experience nocturnal panic, there may be excessive worry about the consequences of unforeseen events such as heart attacks or suffocation occurring during sleep. Worry about cardiac and respiratory disaster is common among patients with panic disorder (Craske et al., 2001), and sleep is a state in which it is more difficult to call for help or get to safety quickly. In addition to worry about internal threats, those who experience nocturnal panic may also worry about external threats such as natural disasters or home invasions (especially for those suffering
from PTSD). In these cases, individuals may also fear being harmed or killed before they awake. One prior study has compared intolerance of uncertainty in nocturnal panic, daytime panic, and no panic groups (Smith, Albanese, Schmidt, & Capron, 2019). Results indicated that individuals with nocturnal panic reported significantly higher intolerance of uncertainty than did those who panic only while awake and those who do not experience panic attacks (Smith et al., 2019). In sum, because sleep limits the capacity to deal with potential threats, elevated intolerance of uncertainty may exacerbate sleep-related fear, thereby contributing to nocturnal panic.

Another construct that is likely related to fear of loss of vigilance is responsibility for harm. Responsibility for harm refers to doubts about causing harm through actions or failing to prevent harm through inaction (Wheaton et al., 2012). For example, someone who feels strong responsibility for harm might be excessively preoccupied with worry about whether or not they left the stove on, potentially causing a fire (Wheaton et al., 2012). This thought pattern is commonly seen in individuals with obsessive-compulsive disorder (OCD) and can be accompanied by repeatedly checking for potential dangers (Abramowitz et al., 2010). Individuals who experience nocturnal panic may feel that they are failing to prevent harm by allowing themselves to sleep rather than taking steps to protect themselves. For these individuals, sleep may represent a context in which they are missing an opportunity to protect against an unforeseen internal (e.g., heart attack) or external (e.g., natural disaster) danger. Sleep avoidance and nighttime vigilance behaviors may be the nocturnal panic equivalent to compulsive checking behaviors observed in patients with OCD. Currently, only one study has compared responsibility for harm in nocturnal panic, daytime only panic, and no panic groups (Smith et al., 2019). Findings
showed that individuals who experience nocturnal panic report higher responsibility for harm than do those who experience only daytime panic and those who do not experience panic attacks (Smith et al., 2019). Therefore, because one cannot prevent potential harm while asleep, a strong sense of responsibility for harm may contribute to a fear of loss of vigilance and nocturnal panic attacks.

Fear of sleep has been discussed at length with regard to nocturnal panic, but few studies to date have explicitly measured the construct in patients with panic disorder. The PTSD literature, however, has repeatedly addressed fear of sleep in relation to sleep disturbances caused by trauma-related nightmares (Pruiksma et al. 2014). DeViva and colleagues (2004), for example, found that a measure of hypervigilance was unrelated to reports of insomnia in patients with PTSD. The authors suggested that fear of loss of vigilance related to sleep is more important to the etiology of trauma-related insomnia than is hypervigilance, which may occur in a variety of settings (DeViva et al., 2004). Furthermore, this theory has been supported in other research showing that fear of loss of vigilance was associated with sleep disturbances in veterans with PTSD (Pietrzak, Morgan, & Southwick, 2010). Pruiksma and colleagues (2014) proposed that fear of sleep, characterized by sleep avoidance, fear of loss of vigilance during sleep, and nighttime vigilant behaviors contribute to the fearful awakenings experienced by individuals with PTSD. This construct has not yet been examined in relation to nocturnal panic attacks, but may contribute to the increased arousal related to sleep that these individuals also experience.
1.5 Aims and Hypotheses

The current study aims to revise the existing fear of loss of vigilance theory to include (1) constructs related to the inability to respond to threats, (2) the urge to protect oneself from danger during non-vigilant states, and (3) fear of sleep. I propose that measures of intolerance of uncertainty, responsibility for harm, and fear of sleep will better differentiate individuals who experience nocturnal panic from individuals who experience daytime-only panic when compared to existing measures of fear of loss of vigilance. I predict that those who experience nocturnal panic will show greater intolerance of uncertainty, responsibility for harm, and fear of sleep compared to individuals who experience panic only while awake as well as compared to those who do not experience panic attacks. Further, I expect to replicate the findings of Tsao and Craske (2003a) and find no differences in FLOVQ scores among daytime and nocturnal panic groups. Thus, I expect that the revised fear of loss of vigilance theory proposed here will better characterize nocturnal panic than the existing theory, thereby adding to current knowledge about nocturnal panic attacks and providing directions for future research and treatment approaches.
CHAPTER II - METHODS

2.1 Participants

Participants (N = 166) were undergraduate students recruited to participate in a research study about anxiety and sleep disturbances. Participants were placed in groups based on self-report of panic attack history. Responses to the Daytime Panic Screen and the Nocturnal Panic Screen were used to determine group membership. The Nocturnal Panic Screen was used by Craske & Tsao (2005) to create similar groups. The Nocturnal Panic Screen was adapted in this study to create the Daytime Panic Screen. Participants were excluded if they did not answer the majority of items for one or more outcome measures for the study (N = 23), failed 25% or more of the 12 validation questions (N = 63), failed a panic attack definition check (N = 44), or endorsed panic attacks, but never experienced four or more panic symptoms simultaneously (N = 44). Recruitment flow is depicted in Figure 2.1.

Figure 2.1 Recruitment flowchart
Inclusion criteria required participants to be at least 18 years of age and current undergraduate students at the University of Southern Mississippi. Participants were also required to be able to read in English and provide informed consent. Participants ranged in age from 18 – 48 $M = 20.94$, $SD = 4.82$) and were mostly female ($N = 142$ female; 85.5%). Most participants identified their race as White (68.7%), with the rest of the sample made up of Black/African American (24.1%), Asian (1.8%), Latinx (1.8%), or Biracial (3.6%).

2.2 Procedure

Participants who met eligibility criteria completed self-report questionnaires online through the university’s SONA system. All study procedures were approved by the university’s Institutional Review Board, and informed consent was obtained from all participants prior to data collection.

2.3 Measures

2.3.1 Nocturnal Panic Screen

The Nocturnal Panic Screen (Craske & Tsao, 2005) is an 8-item measure used to record the frequency, symptom severity, timeline, worry, and behaviors associated with nocturnal panic attacks (e.g., *When did you first experience a panic attack out of a sleeping state for no apparent reason?*). The screener provides a detailed description of nocturnal panic attacks so that participants can distinguish them from awakenings due to nightmares or loud noises. In addition to providing information about lifetime history of nocturnal panic, participants also provide severity ratings for the 14 panic symptoms listed in the DSM-5 on a 5-point Likert scale ranging from *Not at all* (0) to *Extreme* (4).
The Nocturnal Panic Screen was designed to be administered in person but was adapted for a digital administration for this study.

2.3.2 Daytime Panic Screen

The Daytime Panic Screen (adapted from Craske & Tsao, 2005) was created for this study based on the structure and wording of the Nocturnal Panic Screen. The Daytime Panic Screen is also an 8-item measure used to record the frequency, symptom severity, timeline, worry and behavioral responses to panic attacks that occur while awake (e.g., Have you ever experienced a panic attack while you were awake?). The screener provides a detailed description of daytime panic attacks so that participants can distinguish them from other forms of anxiety or nervousness. The Daytime Panic Screen is identical to the Nocturnal Panic Screen with the exception of referring to panic attacks while awake rather than out of a sleeping state.

2.3.3 Fear of Sleep Inventory-Short Form (FoSI-SF)

The FoSI-SF (Pruiksma et al., 2014) is a 13-item measure of two aspects of fear of sleep: “fear of loss of control, and fear of darkness” (Pruiksma et al., 2014). Participants rate how often they experienced certain thoughts and behaviors related to sleep over the past month (e.g., I felt that it was dangerous to fall asleep) on a 5-point Likert scale. The scale ranges from Not at all (0) to Nearly every night (4). The FoSI-SF contains two items that reference bad dreams and nightmares. For the current project, two items were added to the FoSI-SF replacing “bad dream” and “nightmare” with “panic attack” (e.g., I avoided going to sleep because I thought I would have bad dreams became I avoided going to sleep because I thought I would have panic attacks). Both the original item and the panic item were included in the measure such that the version used in this
study had 15 total items instead of 13. Research has demonstrated strong psychometric properties for the FoSI-SF, including internal consistency, convergent validity and discriminant validity (Pruiksma et al., 2014). In this study, the 15-item FoSI-SF demonstrated excellent internal consistency (α = .91).

2.3.4 Intolerance of Uncertainty Scale (IUS-12)

The IUS-12 (Carleton et al., 2007) is a 12-item measure that assesses an individual’s ability to tolerate uncertainty in ambiguous situations. The scale has two subscales: prospective intolerance of uncertainty (i.e., worry related to the consequences of future uncertainty) and inhibitory intolerance of uncertainty (i.e., behavioral responses to uncertainty). Participants are asked to rate the extent to which each item is characteristic of them (e.g., I can’t stand being taken by surprise) on a 5-point Likert scale ranging from Not at all characteristic of me (1) to Entirely characteristic of me (5). The IUS-12 total score as well as the prospective and inhibitory subscales have demonstrated strong psychometric properties (Carleton et al., 2007). In the present study, the total, prospective, and inhibitory scores demonstrated good to excellent internal consistency (α’s = .91, .87, and .87 respectively).

2.3.5 Dimensional Obsessive-Compulsive Scale (DOCS) Responsibility for Harm and Mistakes Subscale

The DOCS (Abramowitz et al., 2010) is a 20-item measure that assesses the four dimensions of OCD symptoms that are most reliably found in the structural research of the disorder: contamination, responsibility for harm, unacceptable thoughts, and symmetry/completeness. Participants respond to each item based on their experience within the past month (e.g., To what extent has your daily routine (work, school, self-
care, social life) been disrupted by thoughts about harm or disasters and excessive checking or asking for reassurance?) using a 5-point Likert scale ranging from 0 to 4. The wording of the response options varies by item. Prior research indicates that the DOCS has good psychometric properties including test-retest reliability, validity, and diagnostic sensitivity (Abramowitz et al., 2010). In the current study, only the responsibility for harm subscale was used, which demonstrated good internal consistency (α = .88).

2.3.6 Fear of Loss of Vigilance Questionnaire (FLOVQ)

The FLOVQ (Tsao & Craske, 2003a) is a 14-item measure that assesses the amount of fear and anxiety experienced in situations that involve diminished vigilance (e.g., How much distress/anxiety/fear do you experience when you experience drowsiness?). Participants rate their distress on a 9-point Likert scale ranging from No distress/fear/anxiety (0) to Extreme distress/fear/anxiety (8). The FLOVQ has exhibited sound internal consistency and test-retest reliability (Tsao & Craske, 2003a). In the current sample, the FLOVQ demonstrated excellent internal consistency (α = .92).

2.4 Data analysis

Participants were separated into nocturnal panic (N = 52), daytime panic (N = 56), and without panic (N = 58) groups based on responses to the Daytime and Nocturnal Panic Screens. Participants were placed in the nocturnal panic group if they endorsed having a past nocturnal panic attack, had experienced four or more panic symptoms simultaneously during a nocturnal panic attack, and correctly identified the nocturnal panic attack definition after the detailed description was removed from view. Nocturnal panic group membership was determined regardless of past reported daytime panic
attacks. Forty-four of the 52 nocturnal panic group participants also endorsed a past
daytime panic attack with four or more panic symptoms occurring simultaneously.
Participants were placed in the daytime panic group if they endorsed having a past panic
attack while awake, had experienced four or more panic symptoms simultaneously during
a daytime panic attack, did not endorse any nocturnal panic attacks, and correctly
identified the daytime panic attack definition after the detailed description was removed
from view. Participants who did not endorse past nocturnal or daytime panic attacks were
placed in the without panic group.

Skewness and kurtosis were examined for all self-report measures. The FoSI-SF
was both positively skewed (1.87) and leptokurtic (3.67). This measure was rank-
transformed using Blom’s formula to more accurately estimate a normal distribution
(FoSI-SF ranged from -1.43 to 2.58; Blom, 1958). Transformed values were used in the
discriminant analyses. Two Receiver Operating Characteristic (ROC) curves were run for
each self-report measure, one comparing daytime and nocturnal panickers and one
comparing nocturnal and non-panickers. Transformed values were not used in the ROC
curve analyses, as ROC curves do not assume a normal distribution. The curves for each
self-report measure were then compared to one another using the method described by
is, curves discriminating between daytime and nocturnal panickers were compared to one
another and curves discriminating between nocturnal and non-panickers were compared
to one another. The DeLong method is used when comparing measures collected within
one participant sample (DeLong et al., 1988). Descriptive statistics, correlations, and
discriminant analyses were conducted using SPSS version 24. ROC curves and their
comparisons were conducted using the easyROC web-based program (Goksuluk et al., 2016).
CHAPTER III - RESULTS

3.1 Group comparisons across demographic variables

Nocturnal panic (NP), Daytime panic (DP), and Without panic (WP) groups were compared on demographic variables. Demographic data are shown in Table 3.1.

Table 3.1 Demographic Data by Group

<table>
<thead>
<tr>
<th></th>
<th>Nocturnal Panic Percentage</th>
<th>Daytime Panic Percentage</th>
<th>Without Panic Percentage</th>
<th>( \chi^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>90.4%</td>
<td>92.9%</td>
<td>74.1%</td>
<td>.009</td>
</tr>
<tr>
<td>Transgender</td>
<td>1.9%</td>
<td>0.0%</td>
<td>1.7%</td>
<td>.595</td>
</tr>
<tr>
<td>Sexual Orientation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterosexual</td>
<td>78.8%</td>
<td>83.9%</td>
<td>93.1%</td>
<td>.315</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>78.8%</td>
<td>69.9%</td>
<td>58.6%</td>
<td>.280</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>7.7%</td>
<td>3.6%</td>
<td>3.4%</td>
<td>.506</td>
</tr>
<tr>
<td>Marital Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never Married</td>
<td>86.5%</td>
<td>94.6%</td>
<td>93.1%</td>
<td>.220</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some College</td>
<td>61.5%</td>
<td>46.4%</td>
<td>48.3%</td>
<td>.515</td>
</tr>
<tr>
<td>Employment Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployed</td>
<td>53.8%</td>
<td>60.7%</td>
<td>67.2%</td>
<td>.393</td>
</tr>
<tr>
<td>Veteran</td>
<td>3.8%</td>
<td>0.0%</td>
<td>1.7%</td>
<td>.535</td>
</tr>
<tr>
<td>Disability</td>
<td>25.0%</td>
<td>3.6%</td>
<td>1.7%</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Age in years</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>21.9 (6.9)</td>
<td>20.5 (3.5)</td>
<td>20.5 (3.3)</td>
<td>ANOVA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>( p = .191 )</td>
</tr>
</tbody>
</table>

Note: Nocturnal Panic \( N = 52 \). Daytime Panic \( N = 56 \). Without Panic \( N = 58 \).

Chi-square analyses revealed significant group differences in biological sex and disability status, but no significant group differences in any other demographic variables. The NP and DP groups each had more female participants than did the WP group (90.4%,
92.9%, and 74.1% respectively). The NP group also had more participants with a
disability than the DP and WP groups (25.0%, 3.6%, and 1.7% respectively).

On the FoSI-SF, the NP and DP groups exceeded the non-clinical means reported
in the original normative data ($M = 4.80$; Pruiksma et al., 2014). None of the groups
exceeded the clinical means reported in the FoSI-SF normative data ($M = 17.90$;
Pruiksma et al., 2014), but the NP group closely approached the reported clinical means
(NP = 16.25). The NP and DP groups also exceeded the non-clinical means reported for
the IUS-12 Prospective and Inhibitory subscales ($M = 16.68$ and 9.17 respectively;
Carleton et al., 2007). The WP group exceeded the non-clinical mean for the Prospective
subscale by .04 points, which was not interpreted as a meaningful difference. All three
groups exceeded the non-clinical means for the DOCS Responsibility for Harm subscale
reported in the original normative data ($M = 2.86$), but only the NP group exceeded the
OCD group mean for the subscale ($M = 7.54$; Abramowitz et al., 2010). All three groups
also exceeded the non-clinical means reported in the original normative data for the
FLOVQ, which were reported for nocturnal panic, daytime panic, and no panic groups as
well ($M = 3.47-2.77$, $M = 3.16-1.93$, and $M = 2.50-1.44$, respectively; Tsao & Craske,
2003a). The original norms for the FLOVQ were collected across five studies of
undergraduate students, a population similar to the one used in the present study.
Nevertheless, the reported means were far lower than the means attained in this study
(NP = 43.31, DP = 30.64, WP = 17.10). See Table 3.2 for descriptive statistics and
Figure 3.1 for a visual representation of group means and reported means from the
normative data.
Table 3.2 *Descriptive Statistics for Measures by Group*

<table>
<thead>
<tr>
<th></th>
<th>Nocturnal Panic</th>
<th>Daytime Panic</th>
<th>Without Panic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>FoSI-Short Form</td>
<td>16.25</td>
<td>11.21</td>
<td>5.86</td>
</tr>
<tr>
<td>IUS-12</td>
<td>36.00</td>
<td>9.35</td>
<td>30.95</td>
</tr>
<tr>
<td>IUS-Prospective</td>
<td>23.40</td>
<td>5.62</td>
<td>20.02</td>
</tr>
<tr>
<td>IUS-Inhibitory</td>
<td>12.60</td>
<td>4.98</td>
<td>10.93</td>
</tr>
<tr>
<td>DOCS</td>
<td>8.15</td>
<td>4.52</td>
<td>4.71</td>
</tr>
<tr>
<td>FLOVQ</td>
<td>43.31</td>
<td>17.54</td>
<td>30.64</td>
</tr>
</tbody>
</table>

Figure 3.1 *Reported norms and observed group means by measure.*

Error bars represent standard error of the mean. The original norm sample for the FoSI-SF reported both non-clinical and clinical PTSD means. The original norm sample for the DOCS reported both non-clinical means and clinical OCD means. The original norm sample for the FLOVQ reported means for each of three panic groups (nocturnal panic, daytime panic, and non-panic). FoSI-SF = Fear of Sleep Inventory-Short Form. IUS-12 = Intolerance of Uncertainty Scale Total score. IUS-Prosp = Intolerance of Uncertainty Scale Prospective Subscale. IUS-Inhib = Intolerance of Uncertainty Scale Inhibitory Subscale. DOCS = Dimensional Obsessive-Compulsive Scale. FLOVQ = Fear of Loss of Vigilance Questionnaire.
3.2 Correlations

Overall means and correlations for each measure are reported in Table 3.3. The scores for each measure were moderately and significantly positively correlated with one another. These measures likely assess related, but separate constructs. The IUS-12 total score was most highly positively correlated with its subscales and the subscales were highly positively correlated with one another, reflecting the close association among facets of intolerance of uncertainty.
Table 3.3 *Means, Standard Deviations, and Intercorrelations for Included Measures*

<table>
<thead>
<tr>
<th>Measure</th>
<th>Mean</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. FoSI-Short Form</td>
<td>8.34</td>
<td>9.68</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. IUS-12</td>
<td>30.52</td>
<td>10.68</td>
<td>.49**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. IUS-Prospective</td>
<td>19.93</td>
<td>6.77</td>
<td>.48**</td>
<td>.95**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. IUS-Inhibitory</td>
<td>10.59</td>
<td>4.74</td>
<td>.44**</td>
<td>.90**</td>
<td>.71**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. DOCS</td>
<td>5.31</td>
<td>4.19</td>
<td>.57**</td>
<td>.53**</td>
<td>.46**</td>
<td>.54**</td>
<td></td>
</tr>
<tr>
<td>6. FLOVQ</td>
<td>29.88</td>
<td>20.07</td>
<td>.52**</td>
<td>.55**</td>
<td>.49**</td>
<td>.55**</td>
<td>.65**</td>
</tr>
</tbody>
</table>

*Note.* **p < .01. *p < .05. FoSI = Fear of Sleep Inventory. IUS = Intolerance of Uncertainty Scale. DOCS = Dimensional Obsessive-Compulsive Scale. FLOVQ = Fear of Loss of Vigilance Questionnaire.*
3.3 Receiver Operating Characteristic Curves

ROC curves were used to determine how well each measure 1) differentiated nocturnal panickers from daytime panickers and 2) nocturnal panickers from non-panickers. ROC curves plot the true positive rate versus the false positive rate for identifying nocturnal panickers in the participant sample. Because ROC curves require a dichotomous outcome (nocturnal panic versus no nocturnal panic) two sets of ROC curves were performed for each measure: one discriminating the NP group from the DP group and one discriminating the NP group from the WP group. The statistic of interest associated with ROC curves is the area under the curve (AUC), which represents the probability that a nocturnal panicker has a greater score (e.g., FoSI-SF, IUS-12, etc.) than an individual who does not experience nocturnal panic attacks. AUC values range from 0 to 1, with .50 representing chance levels (e.g., flipping a coin). AUC values are classified as “outstanding” (AUC = .90 – 1.0), “excellent” (AUC = .80 – .89), and “acceptable” (AUC = .70 – .79; Hosmer et al., 2013). AUC values below .70 are classified as “poor” and are not clinically useful. Statistically significant ROC curves are those which differ from .50. Statistically significant ROC curves may not represent clinically useful measures, however, so interpretations of the present results will focus on the AUC statistic.

3.3.1 Fear of Sleep

The AUC value for the FoSI-SF was in the excellent range (AUC = .83, 95% CI = .76 - .91, p < .001) when discriminating between the NP and DP groups. The AUC for the FoSI-SF was in the outstanding range (AUC = .90, 95% CI = .84 - .95, p < .001) when discriminating between the NP and WP groups. FoSI -SF ROC curves are depicted
in Figure 3.2. The FoSI-SF successfully differentiated the NP group from both the DP and WP groups at a clinically useful level.

Figure 3.2 Fear of Sleep Inventory-Short Form ROC curves
(a) Differentiating Nocturnal and Daytime panic groups and (b) Differentiating Nocturnal and Without panic groups. Diagonal green lines represent differentiation by chance.

3.3.2 Intolerance of Uncertainty

The AUC value for the IUS-12 total score was in the poor range (AUC = .64, 95% CI = .54 - .75, $p = .01$) when discriminating between the NP and DP groups and in the excellent range (AUC = .81, 95% CI = .72 - .89, $p < .001$) when discriminating between the NP and WP groups. The Prospective subscale was also in the poor range (AUC = .65, 95% CI = .54 - .75, $p = .01$) when discriminating between the NP and DP groups and in the excellent range (AUC = .80, 95% CI = .72 - .88, $p < .001$) when discriminating between the NP and WP groups. The Inhibitory subscale was in the poor range (AUC = .60, 95% CI = .49 - .71, $p = .08$) when discriminating between the NP and DP groups and in the acceptable range (AUC = .75, 95% CI = .66 - .85, $p < .001$) when discriminating between the NP and WP groups. Refer to Figure 3.3 for the IUS ROC
curves. The IUS total and subscale scores failed to differentiate between the NP and DP groups at a clinically useful level, whereas each score successfully differentiated between the NP and WP groups.
Figure 3.3 *Intolerance of Uncertainty ROC curves*

(a) IUS-12 differentiating Nocturnal and Daytime panic groups. (b) IUS-12 differentiating Nocturnal and Without panic groups. (c) IUS-Prospective differentiating Nocturnal and Daytime panic groups. (d) IUS-Prospective differentiating Nocturnal and Without panic groups. (e) IUS-Inhibitory differentiating Nocturnal and Daytime panic groups. (f) IUS-Inhibitory differentiating Nocturnal and Without panic groups. Diagonal green lines represent differentiation by chance.
3.3.3 Responsibility for Harm

The AUC value for the DOCS Responsibility for Harm subscale was in the acceptable range (AUC = .73, 95% CI = .63 - .82, p < .001) when discriminating between the NP and DP groups and in the excellent range (AUC = .81, 95% CI = .72 - .89, p < .001) when discriminating between the NP and WP groups. The DOCS ROC curves are shown in Figure 3.4. The DOCS Responsibility for Harm subscale successfully differentiated the NP group from both the DP and WP group to a clinically meaningful degree.

Figure 3.4 DOCS Responsibility for Harm ROC curves
(a) Differentiating Nocturnal and Daytime panic groups and (b) Differentiating Nocturnal and Without panic groups. Diagonal green lines represent differentiation by chance.

3.3.4 Fear of Loss of Vigilance

The AUC value for the FLOVQ was in the poor range (AUC = .69, 95% CI = .59 - .79, p = .001) when discriminating between the NP and DP groups and in the excellent range (AUC = .88, 95% CI = .81 - .94, p < .001) when discriminating between the NP and WP groups. FLOVQ ROC curves are depicted in Figure 3.5. The FLOVQ failed to
differentiate between the NP and DP groups at a clinically useful level but successfully differentiated between the NP and WP groups, replicating the pattern of results from the original study (Tsao & Craske, 2003a).

Figure 3.5 FLOVQ ROC curves
(a) Differentiating Nocturnal and Daytime panic groups and (b) Differentiating Nocturnal and Without panic groups. Diagonal green lines represent differentiation by chance.

3.4 ROC Curve Comparisons

ROC curves were compared using the DeLong et al. (1988) method for multiple measures taken from the same participant group. ROC curves differentiating between the NP and DP groups were compared to one another and ROC curves comparing the NP and WP groups were compared to one another. False positive rates were controlled for using the false discovery rate control method described by Glickman and colleagues (2014) to minimize type I error.

3.4.1 Differentiating Nocturnal Panic from Daytime Panic Groups

The FoSI-SF significantly outperformed the IUS-12 (adjusted \( p = .008 \)), IUS-Prospective subscale (adjusted \( p = .01 \)), and IUS-Inhibitory subscale (adjusted \( p = .003 \))
when differentiating between the NP and DP groups. Figure 3.6 shows the FoSI-SF, IUS-12, IUS-Prospective, and IUS-Inhibitory ROC curves displayed together. No other NP and DP group comparisons reached statistical significance after controlling for false positive rates.

![ROC curves](image)

Figure 3.6 Differentiating Nocturnal and Daytime panic groups ROC curves

Fear of Sleep Inventory-Short Form, Intolerance of Uncertainty-12 total score, Inhibitory subscale, and Prospective subscale ROC curves differentiating Nocturnal Panic and Daytime Panic groups. Diagonal dashed line represents differentiation by chance.

### 3.4.2 Differentiating Nocturnal Panic from Without Panic Groups

No significant differences emerged when comparing ROC curves differentiating the NP and WP groups (all adjusted $p$’s > .13). Each measure performed equally well at distinguishing nocturnal panickers from those without panic attacks. Figure 3.7 shows each measure together to depict the close clustering of ROC curves when comparing these groups.
Figure 3.7 Differentiating Nocturnal and Without Panic groups ROC curves

All measures differentiating Nocturnal Panic and Without Panic groups. Diagonal dashed line represents differentiation by chance.

3.5 Discriminant Analysis

A discriminant analysis was run to determine how well the measures collectively discriminate among the panic groups. A combination of measures may perform better at discriminating the groups than any one measure alone. Discriminant analyses are interpreted similarly to multiple regressions with the exception that the outcome variable is categorical as opposed to continuous. Discriminant analyses also allow all three groups to be compared at once, rather than comparing two groups at a time as was required for the ROC curves.

Due to high multicollinearity between the IUS-12 total score and its subscales, the total score was not included in the model. Biological sex and disability status were significantly different between the panic groups, so these variables were included in the model to account for any variability due to demographic differences. One individual in
the NP group declined to answer the demographic disability status question and was thus excluded from the model. Finally, the rank-transformed FoSI-SF measure was included in place of the original measure to address normality concerns. Functions 1 though 2 were significant, \(X^2 (14, N = 165) = 114.67, p < .001\). Function 2 was also significant, \(X^2 (6, N = 165) = 18.21, p = .006\). The Eigenvalue for Function 1 was .834 and the Eigenvalue for Function 2 was .121. Canonical correlation calculations revealed that the model explains 51% of the total variability (45% from Function 1 and 6% from Function 2). Standardized canonical discriminant function coefficients revealed that the FoSI-SF had the largest impact on Function 1 (.588) and the FLOVQ had the largest impact on Function 2 (-.681).\(^1\) Standardized canonical discriminant function coefficients for the remaining variables are found in Table 3.4.

Table 3.4 Standardized Canonical Discriminant Function Coefficients

<table>
<thead>
<tr>
<th>Measure</th>
<th>Function 1</th>
<th>Function 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>FoSI-Short Form (Transformed)</td>
<td>.588</td>
<td>.547</td>
</tr>
<tr>
<td>IUS-Prospective</td>
<td>.217</td>
<td>-.247</td>
</tr>
<tr>
<td>IUS-Inhibitory</td>
<td>-.267</td>
<td>-.187</td>
</tr>
<tr>
<td>DOCS</td>
<td>.209</td>
<td>.290</td>
</tr>
<tr>
<td>FLOVQ</td>
<td>.367</td>
<td>-.681</td>
</tr>
<tr>
<td>Biological Sex</td>
<td>-.005</td>
<td>.594</td>
</tr>
<tr>
<td>Disability</td>
<td>.391</td>
<td>.311</td>
</tr>
</tbody>
</table>

Note. FoSI = Fear of Sleep Inventory. IUS = Intolerance of Uncertainty Scale. DOCS = Dimensional Obsessive-Compulsive Scale.

FLOVQ = Fear of Loss of Vigilance Questionnaire.

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\(^1\) Removing demographic variables did not meaningfully impact the results. Functions 1 through 2 remained significant, \(X^2 (10, N = 166) = 97.58, p < .001\). Function 2 also remained significant \(X^2 (4, N = 166) = 11.38, p = .023\). The Eigenvalues for Functions 1 and 2 were .708 and .073. Canonical correlation calculations revealed that the model explained 45% of the total variability (41% from Function 1 and 4% from Function 2). Standardized canonical discriminant function coefficients revealed that the FoSI-SF had the largest impact on Function 1 (.653) and the FLOVQ had the largest impact on Function 2 (.794). Correct group membership was predicted for 59.6% of participants.
The model was then used to predict group classification for each participant using a leave-one-out approach. Each participant’s group membership was predicted based on functions derived from all of the other cases in the sample. Correct group membership was predicted for 63% of participants. The classification results are shown in Table 3.5.

Table 3.5 *Leave-one-out Classification Results*

<table>
<thead>
<tr>
<th>Actual Group Membership</th>
<th>Predicted Group Membership</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nocturnal Panic</td>
</tr>
<tr>
<td></td>
<td>N (%)</td>
</tr>
<tr>
<td>Nocturnal Panic</td>
<td>35 (68.6%)</td>
</tr>
<tr>
<td>Daytime Panic</td>
<td>8 (14.3%)</td>
</tr>
<tr>
<td>Without Panic</td>
<td>4 (6.9%)</td>
</tr>
</tbody>
</table>

*Note.* Each participant’s group membership predicted based on Functions derived from all other participants in the sample. Nocturnal Panic N = 51. Daytime Panic N = 56. Without Panic N = 58.
CHAPTER IV – DISCUSSION

Previous theories have proposed that fear of loss of vigilance, the fear of being unable to respond to or protect oneself from threatening situations during non-vigilant states, distinguishes individuals who experience panic attacks out of a sleeping state (nocturnal panic) from those who experience panic attacks only during wakeful states (Tsao & Craske, 2003a). Findings from the current study partially support the fear of loss of vigilance theory. Measures of responsibility for harm and fear of sleep successfully differentiated nocturnal and daytime panic groups. Measures of intolerance of uncertainty and fear of loss of vigilance, however, did not successfully differentiate the groups. As predicted, the nocturnal panic (NP) group reported more fear of sleep and responsibility for harm than did the daytime panic (DP) group, but reported similar levels of fear of loss of vigilance. Contrary to predictions, NP and DP groups did not differ in reported levels of prospective or inhibitory intolerance of uncertainty.

4.1 Fear of Sleep

The FoSI-SF was used to measure fears about not being in control of the environment and fear of darkness that are specifically associated with sleep (Pruiksma et al., 2014). As predicted, the NP group reported more fear of sleep than the DP group, supporting the idea that sleep may be interpreted as a threatening state for those who experience panic attacks out of sleep. Conversely, those who panic only while awake may consider sleep to be a relaxing and safe environment. This is the first study in which the FoSI-SF has been in relation to nocturnal panic. Previously, it has been used to measure fear of sleep in PTSD patients demonstrating nighttime vigilance behaviors such as sleeping with lights or televisions on and repeatedly checking locks on doors and
windows (Pruiksma et al., 2014). Freed and colleagues (1999) have suggested fear of loss of vigilance as a potential mediator for the relationship between traumatic experiences and nocturnal panic attacks observed in their study, regardless of a PTSD diagnosis. The current study did not include questions regarding prior traumatic experiences or PTSD symptoms. Future research should examine fear of sleep in the context of both nocturnal panic and traumatic experiences to determine if this effect is partially accounted for by higher reports of trauma in the NP group compared to the DP group.

4.2 Responsibility for Harm

NP group also reported more feelings of responsibility for harm than the DP group, replicating findings from previous research (Smith et al., 2019). Responsibility for harm, as measured by the DOCS subscale, refers to the extent to which individuals fear that a harmful event will occur due to failure on their part to prevent the event (Abramowitz et al., 2010). This measure is typically used to measure obsessive-compulsive symptoms related to excessive checking behaviors and obsessive thoughts about causing harm to oneself or someone else (Abramowitz et al., 2010). In the context of nocturnal panic, however, responsibility for harm may also encompass nighttime vigilance behaviors observed in nocturnal panickers such as delaying sleep onset for as long as possible, checking locks on doors and windows at night, and developing a sleep routine to ensure safety. In the current study, text responses to the item, “What do you typically do when you experience a sudden rush or intense fear or dread from a sleeping state?” indicated that much of the NP group had established routines for responding to nocturnal panic (e.g., watching a television show or video to prevent returning to sleep, calling a friend or family member, breathing exercises). This study did not ask about
preparations that nocturnal panickers took prior to sleep in order to avoid or prevent nocturnal panic attacks. Future research should examine responsibility for harm in relation to pre-bedtime rituals in nocturnal panickers.

4.3 Intolerance of Uncertainty

Contrary to predictions, neither the prospective or the inhibitory subscale of the IUS-12 differentiated the NP and DP groups. Prior research has indicated that nocturnal and daytime panickers report similar levels of prospective intolerance of uncertainty, suggesting that both groups strive to prepare in advance for uncertain situations (Smith et al., 2019). Conversely, nocturnal panickers reported higher inhibitory intolerance of uncertainty than daytime panickers in a previous study (Smith et al., 2019). Individuals with elevated inhibitory intolerance of uncertainty are unable to act in response to ambiguous situations, a characteristic that was proposed to relate to worry about the ability to take action in response to threats during sleep (Smith et al., 2019). The present results, however, suggest that nocturnal and daytime panickers freeze in response to uncertainty to the same extent. This discrepancy may be due to the fact that psychological diagnoses were accounted for by Smith and colleagues (2019) in their community sample high in psychopathology. The current study, conversely, used an undergraduate sample and did not assess for psychological diagnoses. Therefore, the contradicting inhibitory intolerance of uncertainty results may be due to the participant population and/or statistical approach used. Additionally, Carleton and colleagues (2014) have suggested that inhibitory (but not prospective) intolerance of uncertainty is related to uncued panic attacks and catastrophic cognitions about future panic attacks in panic disorder patients. The present results suggest that this relationship is not likely to be unique to nocturnal
panickers but may apply equally to uncued panic out of a sleeping state and wakeful state. This comparison may benefit from replications that account for the frequency of uncued panic attacks in DP group members.

4.4 Fear of Loss of Vigilance

In line with my hypothesis, the FLOVQ results replicated those found by Tsao and Craske (2003a), in which the measure successfully differentiated NP and WP groups, but did not successfully differentiate NP and DP groups. This result supports the notion that the examples of diminished vigilance that make up the measure do not constitute enough loss of vigilance to activate the fear response observed in nocturnal panickers in response to meditation (Craske et al., 2001), hypnosis (Tsao & Craske, 2003b), and sleep (Craske & Tsao, 2005). The FLOVQ means found in this study were much higher than previous samples. Means for the current sample ranged from 43.31 (NP) to 17.10 (WP) whereas the means from the original norm sample ranged from 3.12 (NP) to 1.97 (WP; Tsao & Craske, 2003a). It is unclear why such high scores were attained in this undergraduate sample compared to the undergraduate sample in the original study. This study is not the first, however, to report elevated means for this measure. Tsai and colleagues (2012) reported means ranging from 54.83 (PTSD patients) to 24.26 (non-PTSD) in a sample of military veterans. Proposed explanations for the elevated means were not reported (Tsai et al., 2012). Because the means reported by Tsao and Craske (2003a) were derived from over 1,000 participants across six studies, the results of the present study must be interpreted with caution until additional studies also replicate the elevated means found in this study and by Tsai and colleagues (2012).
4.5 Combination of Outcome Measures

A discriminant analysis using all of the measures together to predict group assignment was moderately successful. The model explained only 51% of the total variance, suggesting that additional constructs are necessary to fully understand what separates nocturnal panickers from daytime and non-panickers. Further, correct group membership based on the model well exceeded chance levels, at 63% correct group assignment. The FoSI-SF had the largest impact on the first function, suggesting as predicted, that fear of sleep play an important role in discriminating nocturnal from daytime panickers. The FoSI-SF is also used with patients with PTSD. Therefore, it may be useful to expand on the existing literature regarding prior traumatic experiences and PTSD symptoms in relation to nocturnal panic attacks (Freed et al., 1999). Including trauma related variables may help future models to better discriminate nocturnal from daytime panic attacks. The FLOVQ had the largest impact on the second function, which lends some support for the fear of loss of vigilance theory. The FLOVQ, however, was only able to reliably discriminate nocturnal from non-panickers according to the ROC curve. Therefore, the impact of the FLOVQ on the discriminant analysis may have been to separate the nocturnal and non-panickers as well.

Biological sex and disability status also impacted the model to a considerable degree. Biological sex was used to separate non-panickers from the NP and DP groups as there were fewer females in the group without panic attacks (74% in WP vs. 93% in both NP and DP). This difference is not surprising, however, due to higher reported prevalence rates for panic disorder and panic attacks more generally in females compared to males (APA, 2013). The DSM-5 estimates that females are twice as likely to have a lifetime
panic disorder diagnosis than males (APA, 2013). The prevalence of panic attacks without a panic disorder diagnosis is also higher for females, but the disparity is not as pronounced as it is for panic disorder (APA, 2013).

Disability status, conversely, contributed to the model’s ability to separate the NP group from the DP and WP groups. The NP group had far more participants with disabilities compared to the DP and WP groups (25% compared to 4% and 2%, respectively). According to the 2017 U.S. census data, roughly 5% of individuals ages 15 to 24 have a disability (U.S. Census Bureau, 2012). Therefore, the NP group in the current study was more than three times as likely to have a disability compared to same-aged peers nationally. This was an unexpected demographic difference that merits additional research to determine if and how disability status affects nocturnal panic attacks and fear of loss of vigilance.

4.6 Implications

Together, these results suggest that both fear of sleep and responsibility for harm are elevated in nocturnal panickers compared to daytime panickers. The improved discriminating ability of the FoSI-SF compared to the FLOVQ provide support for the proposed theory that losses of vigilance must reach a certain threshold before activating feelings of fear and anxiety for individuals who experience nocturnal panic attacks. The FLOVQ addresses only states of slightly diminished vigilance such as feeling fatigued or drowsy, which appear to be insufficient to reliably distinguish nocturnal from daytime panickers. Sleep, however, represents a state of total loss of vigilance that exceeds the theoretical threshold needed to elicit fear in nocturnal panickers. Responsibility for harm provides a potential rationale for the placement of that theoretical threshold on the
vigilance continuum. The threshold likely falls at the point at which nocturnal panickers no longer feel able to take action to prevent harmful events from occurring. For example, a nocturnal panicker who delays sleep onset for as long as possible to avoid the possibility of a heart attack during sleep may feel perfectly capable of calling for help while fatigued, but worry that they may not wake from a sleeping state in time to call for help before death or serious injury occur. Studies measuring fear of loss of vigilance in nocturnal panickers may attempt to remove the responsibility for harm factor experimentally (e.g., a sleep study in which the participants are closely monitored) to determine if the theoretical fear threshold can be moved or even removed completely.

The inability of intolerance of uncertainty to distinguish nocturnal and daytime panickers, then, may simply be due to differences in what is considered an uncertain state. Nocturnal and daytime panickers may experience the same levels of distress in response to ambiguity, but interpret what qualifies as an uncertain state differently. The NP group may have considered sleep to be a source of uncertainty while completing the IUS-12, whereas the DP may not have thought about sleep at all in the context of that measure. Generalizing already elevated levels of intolerance of uncertainty to non-vigilant states would support the fear of loss of vigilance theory, but would not inflate the scores on the IUS-12 beyond that of the DP group. Future research may find that intolerance of uncertainty specifically related to sleep may be elevated in nocturnal compared to daytime panickers. In general, the results of this study suggest that the loss of vigilance that nocturnal panickers fear may be more limited than what was originally suggested by Tsao and Craske (2003a). Therefore, a revision of the theory and what qualifies as a “loss of vigilance” is warranted.
In practice, the results of the present study indicate potential areas of improvement for therapeutic interventions for nocturnal panic. Cognitive behavioral therapy targeted specifically at reducing nocturnal panic has shown some success in decreasing the frequency of nocturnal panic attacks, reducing worry about future attacks, and improving sleep quality in general (Craske et al., 2005). Techniques such as exposure to relaxation in situations that increase physiological fluctuations (e.g., hot, stuffy rooms) added to the typical CBT for panic disorder protocol demonstrated promising results (Craske et al., 2005). Thus, the fear of loss of vigilance, like any other fear, can be targeted in therapy using exposure exercises. The results of this study suggest that targeting fear of sleep and fear of failing to prevent harm in therapeutic exposure may further improve treatment outcomes for nocturnal panicers.

4.7 Limitations

This study had several limitations. First, the data is cross-sectional, making causal inferences impossible. A longitudinal study showing the progression of fear of sleep and responsibility for harm before and after the development of nocturnal panic would clarify many questions about causation with regard to these variables. Additionally, the measures used in this study were entirely self-report and subject to biased reporting. Because none of the panic symptoms were directly observed or recorded in real time, it is possible that some participants over or underreported the nature of their panic. Wearable technology such as smartwatches with the ability to detect heartrate and sleep cycles in a naturalistic setting represent an exciting possible method of measuring the physiological symptoms of nocturnal panic in real time.
Finally, far more participants in the NP group identified as having a disability than the DP and WP groups. I did not anticipate this demographic difference to emerge when designing the study and therefore did not include additional questions about the nature of participants’ disabilities or their relation to nocturnal panic attacks. It is possible that physical or intellectual disabilities may be interpreted as impeding one’s ability to respond to threatening situations that occur during sleep, thereby increasing fear and anxiety associated with non-vigilance. Additional research is need to determine whether the presence of a disability impacts fear of loss of vigilance, or if this demographic difference was simply due to chance.

4.8 Strengths

The current study had a number of strengths as well. First, although this study used exclusively self-report measures, group assignment was determined based on responses to an extensive screening measure in combination with an item to verify that participants could correctly define both a nocturnal and daytime panic attack. This screening measure not only asked if participants had ever experienced a panic attack, but also asked participants to rate the intensity of their typical symptoms and verified that four or more symptoms had been experienced at once, per DSM-5 criteria for a panic attack (APA, 2013). Participants then had to choose the correct definition for daytime and nocturnal panic attacks from a list containing anxious experiences typically mistaken for panic attacks (e.g., “Nervousness and sweating related to speaking in front of a group of people”, “Waking up suddenly from a nightmare, with an intense sense of fear”). Forty-four individuals were excluded who endorsed experiencing daytime and/or nocturnal panic attacks, but had never experienced four or more symptoms at once. Another 44
individuals were excluded who endorsed daytime and/or nocturnal panic but were unable to choose the correct definition from the list of alternatives despite being provided with the correct definitions throughout the screening measures. This procedure improves upon prior research that based group assignment on individual items regarding nocturnal and daytime panic attacks (Smith et al., 2019; Tsao & Craske, 2003a; O’Mahoney & Ward, 2003). Had a single item been used for the NP and DP groups in this study, 88 individuals would have been incorrectly included in those groups, introducing a large amount of additional error into the analyses. Therefore, more reliable group assignment was achieved without requiring a time-consuming diagnostic interview.

Additionally, this study was the first to use the Fear of Sleep Inventory in the context of nocturnal panic. Prior studies suggested that fear of sleep was characteristic of nocturnal panickers, but none had employed a direct measure of the construct (Tsao & Craske, 2003a; Craske & Tsao, 2005; Freed et al., 1999). Finally, the majority of the foundational nocturnal panic research was limited to panic disorder patients despite the fact that nocturnal panic attacks are observed in the absence of a panic disorder diagnosis (Craske et al., 2001; Tsao & Craske, 2003b). The current study adds to the growing body of literature examining nocturnal panic attacks as a transdiagnostic construct (Freed et al., 1999; Smith et al., 2019).

4.9 Conclusions

The results of this study partially support the fear of loss of vigilance theory by demonstrating that the explicit fear of sleep and feelings of being responsible for preventing harm can be used to differentiate nocturnal from daytime panickers. The results also add to the theory by supporting the idea that not all losses of vigilance are
equally anxiety-provoking. There may be a threshold for the amount of vigilance that must be lost in order to activate the fear and panic unique to nocturnal panickers. This study’s results also highlight areas in need of future research, including the role of past traumatic experiences and disability status in nocturnal panic attacks. Further examination of the fear of loss of vigilance theory is warranted, especially with regard to factors that contribute to a threshold of loss of vigilance that separates nocturnal from daytime panickers.
NOTICE OF COMMITTEE ACTION

The project below has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services regulations (45 CFR Part 46), and University Policy to ensure:

- The risks to subjects are minimized and reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered involving risks to subjects must be reported immediately, but not later than 10 days following the event. Problems should be reported to ORI via the Incident template on Cayuse IRB.
- The period of approval is twelve months. An application for renewal must be submitted for projects exceeding twelve months.

PROTOCOL NUMBER: IRB-18-57

PROJECT TITLE: Thesis: Expanding the Fear of Loss of Vigilance Theory

SCHOOL/PROGRAM: School of Psychology, Psychology

RESEARCHER(S): Nicole Smith
              Daniel Capron

IRB COMMITTEE ACTION: Approved

CATEGORY: Expedited

PERIOD OF APPROVAL: November 28, 2018 to November 28, 2019

Edward L. Goshorn, Ph.D.
Institutional Review Board Chairperson
REFERENCES


