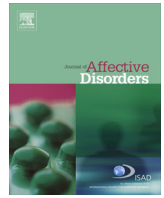




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Preliminary communication

## Sleep disorders and the interpersonal–psychological theory of suicide: Independent pathways to suicidality?

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### ABSTRACT

**Background:** Although sleep disorders are a risk factor for suicidal behavior little research has examined why sleep disorders confer suicide risk. The present study examined the relation between two sleep disorders, insomnia symptoms and nightmares, and suicide risk in the context of Joiner's interpersonal–psychological theory of suicide (IPTS).

**Methods:** The present study utilized two large samples ( $N=747$  and  $604$ ) recruited from two large public universities in the Southeast. Both studies included measures of insomnia symptoms, nightmares, depressive symptoms, and prior suicide attempts. In addition, study one contained a measure of suicide risk.

**Results:** In study 1, the relations between insomnia symptoms and both suicide risk and prior attempts were not significant after controlling for the IPTS. However, nightmares were related to both suicide risk and suicide attempts independent of the IPTS. Furthermore, nightmares nearly missed significance in the prediction of suicide risk ( $p=0.054$ ) and significantly predicted suicide attempts even after controlling for depressive symptoms. In study 2, both insomnia and nightmares were found to be significantly associated with prior suicide attempts after controlling for the IPTS and depressive symptoms.

**Limitations:** The study is limited by its use of a college sample and cross-sectional design.

**Conclusions:** These studies suggest that the IPTS may not explain the relation between sleep problems and suicidality. More research is needed to understand the mechanism by which sleep disorders confer suicide risk, which is clinically relevant as it may inform specific interventions to reduce the adverse effects of sleep disorders.

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## 1. Introduction

Suicide is a significant and growing problem in the United States. In 2010, suicide was the tenth leading cause of death in the United States, and the third cause of death among individuals age 15–24 years old, accounting for a total of 38,364 deaths (Centers for Disease Control and Prevention, 2012). Further, 2010 was also the fifth straight year that suicide rates increased in the United States (Centers for Disease Control and Prevention, 2012). Given that suicide rates continue to rise, there is an urgent need to identify risk factors that will help clinicians more accurately identify individuals who are at risk of suicide, as well as to help develop new treatments to prevent suicide.

### 1.1. Insomnia symptoms and suicidality

Insomnia symptoms have been found to be positively associated with suicidal ideation among children and adolescents (Barbe et al., 2005; Wong and Brower, 2012), college students (Cukrowicz et al., 2006; Nadorff et al., 2011, 2013b), Veterans (Pigeon et al., 2012; Ribeiro et al., 2012), adults (Bjørngaard et al., 2011; Krakow et al., 2011) and older adults (Nadorff et al., 2013a). Although several studies have found that the relation between current insomnia symptoms and suicidal ideation is mediated by depression (Cukrowicz et al., 2006; Nadorff et al., 2013a), there are several reasons to believe this relation is nonetheless important and that insomnia itself maintains a robust and unique relation with suicidal ideation. First, research indicates that individuals with persistent insomnia were six times more likely to develop a major depressive episode compared to those with no insomnia (Perlis et al., 2006), signifying that insomnia symptoms may be an important factor in the development of depression and potentially suicidal ideation. Further, a recent study found that the duration of

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insomnia is associated with suicidal risk independent of current symptoms of insomnia, nightmares, depression, anxiety, and PTSD (Nadorff et al., 2013b). Lastly, recent evidence suggests that the relation between insomnia symptoms and nightmares may not be mediated by depression for all groups. For example, a recent study by Ribeiro et al. (2012) of young adults in the military found that insomnia symptoms were associated with suicidal ideation after controlling for symptoms of depression, hopelessness, anxiety, PTSD diagnosis, and drug and alcohol abuse. Thus, although some studies have found that the relation between insomnia symptoms and suicidal ideation is mediated by psychopathology, other studies suggest that the presence of insomnia may have both a direct and indirect effect on suicidal ideation.

Research has also found that insomnia symptoms are associated with overt suicidal behavior. Hall et al. (1999) interviewed one hundred patients who made suicide attempts that required medical care in an emergency room, and found that insomnia symptoms were prevalent among suicide attempters. The vast majority of suicide attempters (92%) reported at least one symptom of insomnia, and nearly half (46%) reported difficulty with all three insomnia symptoms: falling asleep, staying asleep, and waking too early. Insomnia symptoms have also been shown to predict death by suicide. Fawcett et al. (1990) conducted a ten year study of 954 patients with major affective disorders to examine the proximal and distal predictors of death by suicide. Global insomnia was one of only five risk factors that were found to be associated with deaths by suicide in the next twelve months (Fawcett et al., 1990). Similarly, in a prospective study of 13,259 participants, individuals who self-reported experiencing insomnia had an increased risk for suicide (Fujino et al., 2005). Lastly, a recent chart review study of U.S. Veterans who died by suicide found that Veterans who reported sleep problems had a shorter time to death by suicide after their last VA appointment after controlling for age, region, and several mental illnesses including substance use disorders, suggesting that the presence of sleep problems may result in an increase in imminent suicide risk (Pigeon et al., 2012).

### 1.2. Nightmares and suicidality

Nightmares are also a risk factor for suicidal behavior. In a study sampling college students, nightmares were shown to be an independent risk factor for suicidal ideation after controlling for symptoms of depression, anxiety, post-traumatic stress disorder, and insomnia (Nadorff et al., 2011). Nightmares have also been found to be associated with suicidal ideation in a sample of adult sleep patients (Krakow et al., 2011). Further, duration of nightmare symptoms was also found to be associated with suicidal risk independent of several symptoms of psychopathology (Nadorff et al., 2013b).

Nightmares, like insomnia, have also been shown to be associated with overt suicidal behavior. Sjöström et al. (2007) studied a sample of individuals who made a medically serious suicide attempt, finding that those who reported having nightmares had higher suicidality scores than individuals who had made a medically serious suicide attempt but did not report nightmares. Further, Sjöström et al. (2009) followed these individuals over two years, finding that, even after controlling for depression, PTSD, and substance abuse, those who reported persistent nightmares were at more than four times greater risk of re-attempting suicide than those who did not report having nightmares. Lastly, nightmares have also been shown to be associated with death by suicide. Tanskanen et al. (2001) conducted a prospective study, finding that individuals who reported experiencing occasional nightmares were at a 57% greater risk to die by suicide, and those who reported experiencing frequent nightmares were at 107%

greater risk of suicide when compared to those who did not report experiencing nightmares. Thus, nightmares have been shown to be a strong predictor of suicidal behavior, and several studies have found this relation to be independent of psychopathology.

### 1.3. The interpersonal–psychological theory of suicide

One of the most prominent theories of suicidal behavior is the interpersonal–psychological theory of suicide (IPTS; Joiner, 2005; Van Orden et al., 2008). The theory postulates that to have the desire to die by suicide, an individual must perceive him or herself as a burden to others and feel a lack of belongingness. According to the theory, when this desire for death is combined with the acquired capability to enact lethal self-harm, a person is at greatest risk of dying by suicide. As such, the three-way interaction of the IPTS constructs is theorized to bestow the greatest risk for suicidal behavior. Several studies have provided empirical support for that interaction in the prediction of suicide risk and suicidal behavior (e.g., Anestis and Joiner, 2011; Joiner et al., 2009). The IPTS has been extensively researched over the last several years, and has a great deal of empirical support (see Van Orden et al., 2010 for a thorough review of the empirical support for the IPTS framework).

### 1.4. Sleep-related difficulties and the IPTS

No research has yet to directly examine a relation between sleep disorders and the IPTS, but some associated studies suggest that the IPTS represent a useful framework for understanding the role of sleep disorders in suicidality. A recent qualitative study examining insomnia sufferers identified three superordinate themes associated with the experience of insomnia, one of which was feeling isolated and like an outsider (Kyle et al., 2010). Thus, it is reasonable to predict that individuals who struggle with sleep problems may also report feeling a lack of belongingness.

In addition, a recent review of the literature on the occupational impact of insomnia symptoms found that insomnia symptoms are reliably associated with being absent from work, having more accidents, being less productive, and having less job satisfaction (Kucharczyk et al., 2012). Although it has yet to be tested, this impairment in one's job functioning may lead an individual to feel like a burden to others.

Lastly, there is reason to believe that those with sleep problems may have higher acquired capability than those without sleep problems. In a recent study on pain sensitivity, Haack et al. (2012) found that individuals who suffered from primary insomnia experienced spontaneous pain more frequently and intensely and reported more subjective pain than individuals without insomnia. Over time, having higher levels of pain may lead to faster habituation to pain, thus increasing the acquired capacity for suicide.

### 1.5. Statement of the problem

Although there is much evidence supporting the idea that sleep problems, such as insomnia symptoms and nightmares, are related to suicidal behaviors, research has yet to directly examine the relation between these variables and the IPTS. This research is important as it will determine whether the IPTS can be used to conceptualize why sleep problems lead to greater suicide risk, and may lead to new treatments to help mitigate these risks. The purpose of the present studies was to address this conceptual and empirical gap by investigating whether insomnia symptoms and nightmares are related to the constructs in the IPTS, as well as whether these constructs mediate the relation between insomnia symptoms, nightmares, and suicide risk and behavior. We hypothesize that both insomnia symptoms and nightmares will

be positively correlated with perceived burdensomeness, thwarted belongingness, and acquired capability. However, despite this association, we predict that insomnia symptoms and nightmares will be associated with suicidal risk and past suicidal behaviors independent of the IPTS constructs. We predict these variables will explain variance above and beyond the IPTS because sleep problems have been shown to be associated with suicide risk and behavior above and beyond constructs related to the IPTS, such as depression and anxiety (Nadorff et al., 2013b; Sjöström et al., 2009). Further, sleep disturbances have been linked to cognitive deficits such as problem solving (Fortier-Brochu et al., 2012), which has been shown to be related to suicide risk (Linda et al., 2012).

## 2. Study 1

### 2.1. Method

#### 2.1.1. Participants

Participants were obtained from a survey of 747 undergraduate students from a large, public university in the Southern United States. The sample was 57% female, with an age range of 18–33 years (Mean age = 18.9 years, SD = 1.4 years). Approximately 74% of participants identified themselves as Caucasian, 21% African American, 2% other, and less than 1% Hispanic, Asian Pacific Islander, and Native American. Participants were recruited using the SONA system, which is an online survey manager, and were given course credit for participating in the study. The study was approved by the institution's IRB and participants read a cover page describing the study prior to participation.

#### 2.1.2. Measures

*The Disturbing Dreams and Nightmare Severity Index (DDNSI; Krakow et al., 2002).* The DDNSI was used as a measure of nightmare frequency and severity. It assesses bad dream and nightmare frequency, severity and intensity. Scores greater than 10 may indicate the presence of a nightmare disorder (Krakow et al., 2002). In the present sample, reliability was adequate ( $\alpha = 0.87$ ).

*The Insomnia Severity Index (ISI; Bastien et al., 2001).* The ISI is a 7-item self-report measure that assesses an individual's insomnia symptoms over the last two weeks. Each item is scored on a 0–4 scale with total scores ranging from 0 to 28. However, due to an administration error, the first three items in the present studies were scored on a 0 to 3 scale (Never to Severe) instead of a 0 to 4 scale (Never to Very Severe), resulting in a total possible score of 25. The ISI has been shown to have adequate test–retest reliability over three months and concurrent validity with sleep diaries and polysomnography (Bastien et al., 2001; Savard et al., 2005). The ISI has also been used to determine the presence or absence of clinically significant insomnia symptoms using a cutoff of 15 (Bernert et al., 2007; Tang et al., 2007). In this sample, reliability was acceptable ( $\alpha = 0.80$ ).

*The acquired capability for suicide scale—Fearlessness about death (ACSS; Bender et al., 2007; Ribeiro et al., In Press).* ACSS is a seven-item Likert-style self-report measure derived from the original 20-item ACSS that examine the degree to which participants have habituated to the fear of one's death. Both the original ACSS and the ACSS-FAD have exhibited strong convergent and discriminate validity and adequate internal consistency (e.g. Witte et al., 2012). In this sample, reliability was acceptable ( $\alpha = 0.78$ ).

*The Interpersonal Needs Questionnaire (INQ; Van Orden et al., 2008).* INQ is a 15-item Likert-type self-report measure that assesses perceived burdensomeness (6 items) and thwarted belongingness (9 items). The original scale was 25-items; however, a recent examination of the psychometric properties of the measure

revealed the 15-item version to be optimal (Van Orden et al., 2012). Van Orden et al. (2008) found a significant interaction, as predicted, between perceived burdensomeness and thwarted belongingness scales in relation to suicidal ideation, with higher scores on both subscales conferring the greatest level of risk. Further, scores on the INQ were not significantly associated with scores on the ACSS, supporting the IPTS distinction between suicidal desire and the capability for suicide. In this sample, both the perceived burdensomeness ( $\alpha = 0.90$ ) and thwarted belongingness ( $\alpha = 0.91$ ) exhibited acceptable reliability.

*The Center of Epidemiological Studies Depression Scale (CES-D; Radloff, 1977).* The CES-D is a 20-item, self-report measure of depressive symptoms that is scored on a four-point scale (0–3) with scores ranging from 0 to 60. It has been demonstrated to be a valid screening measure for detecting depressive symptoms (Weissman et al., 1977). In the overall sample, the mean was 14.75 (SD = 10.31) with acceptable reliability ( $\alpha = .90$ ).

*The Suicidal Behaviors Questionnaire—Revised (SBQ-R; Osman et al., 2001).* The SBQ-R, revised from the Suicidal Behaviors Questionnaire (Linehan, 1981), is a 4-item, likert-style self-report measure designed to assess levels of suicidal risk. The SBQ's inquires about past suicidal thoughts and attempts, past suicidal ideation and threats, and future suicidal behavior. A cutoff score of 7 for the general population or 8 for psychiatric inpatients may be used to determine clinically significant levels of suicide risk (Osman et al., 2001). In the present sample, reliability was acceptable ( $\alpha = 0.81$ ).

*Suicide Attempt History.* Suicide attempt history was assessed with the item "How many times have you attempted suicide?" Due to the low number of suicides, the scale was dichotomized so those reporting no prior suicide attempts received a score of 0 and those reporting one or more attempt were given a score of one. A total of 37 participants (4.95%) reported having a prior suicide attempt and 710 participants reported never attempting suicide.

#### 2.1.3. Procedure

Data were collected online using the SONA online survey system. Participants logged onto the SONA system and selected the study from a list of all of the available studies. Participants were then shown a cover sheet informing them about the project and their rights, and those who consented to participate in the study continued to the survey. At the conclusion of the survey, participants were shown a page with contact information for local mental health services should they desire counseling following the study. Participants were awarded course credit for participating in the study.

#### 2.1.4. Examination of distributions

The study measures were also examined for normality of their distributions. The suicidal behaviors questionnaire deviated from normality (skew = 2.13, kurtosis = 4.47). A log transformation was employed to restore normality. Following the transformation, the skew (1.35) and kurtosis (0.73) were reduced.

#### 2.1.5. Selection of covariates

An ANOVA was utilized to test for effects of sex and ethnic background and regression analyses were utilized for age. Although only ethnic background was significantly associated with our DVs, sex and age were related to other IVs. Thus, all of these variables were controlled in our analyses. All analyses were conducted using SAS (v. 9.3) statistical software.

### 3. Results

To test the first hypothesis, which predicted that sleep difficulties would be associated with all three components of the IPTS, correlation analyses were conducted (see Table 1). As predicted, insomnia symptoms and nightmares were positively correlated with perceived burdensomeness and thwarted belongingness. However, contrary to our prediction, neither nightmares nor insomnia symptoms were associated with acquired capability.

To examine whether insomnia symptoms and nightmares were associated with suicide risk independent of the constructs of the IPTS, we conducted a hierarchical linear regression. In this regression we entered burdensomeness, belongingness, and capability in step 1, the first order interactions of these variables in step 2, the second order interaction of all three variables in step 3, and lastly the sleep variable in step 4. Thus, the regression will examine whether each sleep variable is associated with suicide risk independent of the IPTS constructs and their interactions. This method was chosen in an effort to mirror the interactive nature of the IPTS model and to replicate prior work (e.g., Joiner et al., 2009). We also included an alternative model in which the last step controlled for symptoms of depression, to assess whether psychopathology fully accounted for the relationships between suicide risk and the variables in steps 1 through 4.

After controlling for the IPTS, we found that insomnia symptoms were no longer associated with suicide risk (see Table 2) but nightmares remained significantly associated with suicide risk. After adding depressive symptoms to the model, nightmares

were no longer statistically significant ( $\beta = .07$ ,  $t = 1.93$ ,  $p = .054$ ; see Table 2).

In a similar manner as was done with suicide risk, we examined whether insomnia symptoms and nightmares were associated with past suicide attempts independent of the constructs of the IPTS using logistic regression. Similar to what was found with suicide risk, insomnia symptoms were not associated with past suicide attempts after controlling for the IPTS constructs (see Table 3) but nightmares remained significantly associated with past suicide attempts independent of the IPTS. Further, the relation between nightmares and past suicide attempts remained significant after adding depressive symptoms to the model (see Table 3).

### 4. Study 2

#### 4.1. Method

##### 4.1.1. Participants

Participants were 604 undergraduates (79.5% female) recruited from a mid-sized public university in the southern United States. Ages ranged from 18 to 55 ( $M = 20.72$ ;  $SD = 4.15$ ). 52.0% of the sample identified as White, 42.4% as African American, 2.8% as Other, 1.7% as Hispanic/Latino, and 1.0% as Asian/Pacific Islander. One participant declined to indicate his or her race/ethnicity. The study was approved by the institution's IRB and participants read a cover page describing the study prior to participation.

**Table 1**  
Correlations of study variables in Studies 1 and 2.

Variable	1	2	3	4	5	6	7	Study 1 M	Study 1 SD	Study 2 M	Study 2 SD
1. Insomnia	–	.29**	.37**	.32**	–.13**	.27**	–.12**	7.58	4.56	6.67	5.58
2. Nightmares	.40**	–	.20**	.16**	–.05	.20**	.21**	2.83	4.54	3.13	5.20
3. Burdensomeness	.21**	.23**	–	.68**	–.08*	.58**	.25**	9.65	6.08	10.05	6.27
4. Belongingness	.26**	.23**	.70**	–	–.13**	.52**	.19**	21.96	11.78	21.98	11.22
5. Capability	–.03	–.09*	.01	–.06	–	–.06	.05	15.05	6.17	13.52	5.86
6. Suicide Risk	–	–	–	–	–	–	.41**	4.51	2.59	–	–
7. Suicide Attempts	.17**	.33**	.21**	.18**	–.01	–	–	–	–	–	–

Ns range from 707 to 738 for study 1 and 527–595 for study 2. Study 2 is presented below the diagonal.

\*  $p < .05$ .

\*\*  $p < .01$ .

**Table 2**  
Study 1 Insomnia symptoms, nightmares and the IPTS constructs in relation to suicide risk.

Predictors	Insomnia symptoms				Nightmares			
	R <sup>2</sup>	$\beta$	t	p	R <sup>2</sup>	$\beta$	t	p
Step 1:	.34				.34			
Age		–.03	–0.81	.42		–.03	–0.78	.43
Sex		–.00	–0.01	.99		–.00	–0.04	.97
Ethnic background		.05	1.42	.16		.05	1.44	.15
Burdensomeness		.38	9.08	< .01		.39	9.22	< .01
Belongingness		.26	5.97	< .01		.25	5.83	< .01
Capability		.00	0.12	.91		.01	0.22	0.83
Step 2:	.34				.35			
Burdensomeness × belongingness		–.05	–0.93	.35		–.07	–1.35	.18
Burdensomeness × capability		.07	1.66	.10		.09	2.18	< .05
Belongingness × capability		.00	0.10	.92		.01	0.25	.80
Step 3:	.34				.34			
Burdensomeness × belongingness × capability		–.05	–0.82	.41		–.00	–0.03	.98
Step 4:	.35				.35			
Insomnia symptoms/nightmares		.07	1.95	.051		.09	2.81	< .01
Step 4 Alt:	.36				.36			
Depressive symptoms		.20	4.06	< .01		.18	3.57	< .01
Insomnia symptoms/nightmares		–.01	–0.33	.74		.07	1.93	.054

**Table 3**

Study 1 Insomnia symptoms, nightmares and the IPTS constructs in relation to suicide attempts.

Predictors	Insomnia symptoms					Nightmares				
	$\beta$	Wald's $\chi^2$	OR	95% CI	$p$	$\beta$	Wald's $\chi^2$	OR	95% CI	$p$
Step 1		39.43			< .01		39.33			< .01
Age	-.22	2.19	0.76	0.528–1.093	.13	-.21	2.08	0.77	0.537–1.099	.15
Sex	.15	1.96	1.71	0.806–3.639	.14	.15	1.98	1.72	0.808–3.657	.16
Ethnic background	.08	1.12	1.18	0.870–1.595	.29	.08	1.10	1.18	0.868–1.594	.29
Burdensomeness	.29	8.92	1.09	1.031–1.158	< .01	.29	9.23	1.09	1.032–1.159	< .01
Belongingness	.23	3.08	1.04	0.996–1.079	.08	.23	3.05	1.03	0.996–1.078	.08
Capability	.21	3.49	1.06	0.997–1.134	.06	.19	2.98	1.06	0.992–1.129	.08
Step 2:		46.26					45.22			
Burdensomeness $\times$ belongingness	-.25	4.63	0.996	0.992–1.000	.03	-.23	4.14	0.996	0.992–1.000	.04
Burdensomeness $\times$ capability	.09	0.81	1.01	0.994–1.016	.37	.09	0.89	1.01	0.994–1.016	.35
Belongingness $\times$ capability	.15	1.44	1.004	0.997–1.011	.23	.13	1.06	1.00	0.997–1.010	.30
Step 3:		46.66					45.73			
Burdensomeness $\times$ belongingness $\times$ capability	-.15	1.03	1.00	0.999–1.000	.31	-.15	1.21	1.00	0.999–1.000	.27
Step 4:		47.34					48.76			
Insomnia symptoms/nightmares	.14	1.61	1.06	0.971–1.148	.20	.22	7.23	1.09	1.024–1.160	< .01
Step 4 Alt:		47.55					48.43			
Depressive symptoms	.05	0.10	1.01	0.960–1.058	.74	.07	0.37	1.01	0.971–1.058	.54
Insomnia symptoms/nightmares	.11	0.82	1.05	0.949–1.152	.36	.20	5.80	1.08	1.015–1.153	.02

#### 4.1.2. Measures

The *Disturbing Dreams and Nightmare Severity Index* (DDNSI; Krakow et al., 2002). DDNSI was again used as a measure of nightmare frequency and severity. In this sample, the scale exhibited acceptable reliability ( $\alpha=0.91$ ).

The *Insomnia Severity Index* (ISI; Bastien et al., 2001). ISI was again used as a measure of insomnia severity. In this sample, the scale exhibited acceptable reliability ( $\alpha=0.87$ ).

*Depression Anxiety Stress Scale—21 Item Version* (DASS-21; Lovibond and Lovibond, 1995). The DASS is a 21-item self-report measure that assesses the severity of depressive, anxiety, and stress symptoms over the course of the previous seven days. The current study utilized the Depression subscale (7 items) as a covariate. Chronbach's alpha for this sample was .88.

The *Acquired Capability for Suicide Scale—Fearlessness About Death* (ACSS; Bender et al., 2007; Ribeiro et al., In Press). ACSS was again used as a measure of the acquired capability for suicide. In this sample, the measure exhibited acceptable reliability ( $\alpha=0.75$ ).

The *Interpersonal Needs Questionnaire* (INQ; Van Orden et al., 2008). INQ was again used as a measure of perceived burdensomeness and thwarted belongingness. In this sample, both the perceived burdensomeness ( $\alpha=0.93$ ) and thwarted belongingness subscales exhibited acceptable reliability ( $\alpha=0.91$ ).

*Suicide Attempt History*. Suicidal behavior was assessed through a series of questions developed for this and other related ongoing projects and based largely upon the Lifetime Suicide Attempt Self-Injury Interview (L-SASI; Linehan and Comtois, 1996). Participants were first asked to indicate how many times throughout the course of their life they have intentionally harmed themselves with at least some intent to die. Participants who endorsed at least one prior attempt were then asked follow-up questions regarding characteristics of those behaviors. Two questions were relevant to the current project. Participants were asked during how many of these behaviors they were certain they intended to die and during how many they were unsure if they intended to die. Because the total of attempts with clear intent and ambiguous intent did not consistently yield a sum equal to the initial question, we opted to sum the totals from the two more specific questions to yield a variable representing participants' lifetime number of suicide attempts, defined as intentionally self-inflicted injury with at least some intent to die (clear or ambiguous).

#### 4.1.3. Procedure

This protocol was approved by the relevant Institutional Review Board and all participants provided informed consent prior to viewing any components of the study. The entire protocol was delivered online and participants were granted course credit for their participation.

#### 4.1.4. Examination of distributions

The study measures were examined for normality of their distributions. Lifetime number of suicide attempts exhibited a non-normal distribution (skew=4.93, kurtosis=28.65). A rank transformation using Blom's formula was employed to restore normality. Following the transformation, the skew (2.82) and kurtosis (6.67) were reduced to acceptable levels (Kline, 2005).

#### 4.1.5. Selection of covariates

An ANOVA was utilized to test for effects of sex and race and regression analyses were utilized to examine age and socioeconomic status. Although these covariates were not associated with suicide attempts, they were related to some of the independent variables and thus were included in the model. All analyses were conducted using SPSS (v. 20) statistical software.

## 5. Results

To test the first hypothesis, which predicted that sleep difficulties would be associated with all three components of the IPTS, correlation analyses were conducted (see Table 1). As predicted, and consistent with study 1, insomnia symptoms and nightmares were positively correlated with perceived burdensomeness and thwarted belongingness. Consistent with the first study, insomnia symptoms were not associated with acquired capability. Lastly, contrary to study 1 and our hypothesis, nightmares were significantly *negatively* associated with acquired capability.

To examine whether insomnia symptoms and nightmares are associated with suicide attempts independent of the constructs of the IPTS, we conducted a hierarchical linear regression with the same independent measures as study 1. Burdensomeness, belongingness, and capability in step 1; their first order interactions in step 2; their second order interactions in step 3; and the sleep variable in step 4. As in study 1, we also included an alternative

**Table 4**  
Study 2 Insomnia symptoms, nightmares and the IPTS constructs in relation to suicide attempts.

Predictors	Insomnia symptoms				Nightmares			
	$R^2$	$\beta$	$t$	$p$	$R^2$	$\beta$	$t$	$p$
Step 1:	.04			<.01	.05			<.01
Age		.04	0.82	.42		.03	0.56	.58
Sex		.02	0.35	.73		.02	0.46	.65
Race		-.04	-0.71	.48		-.04	-0.80	.42
SES		-.00	-0.02	.99		-.00	-.09	.93
Burdensomeness		.10	1.50	.14		.09	1.48	.14
Belongingness		.15	2.30	.02		.15	2.42	.02
Capability		.02	0.51	.61		.02	0.44	.66
Step 2:	.04				.06			
Burdensomeness $\times$ belongingness		.10	1.40	.16		.14	1.87	.06
Burdensomeness $\times$ capability		-.14	-2.14	.03		-.09	-1.37	.17
Belongingness $\times$ capability		.06	1.01	.31		.05	.84	.40
Step 3:	.04				.07			
Burdensomeness $\times$ belongingness $\times$ capability		.05	0.58	.56		.14	1.82	.07
Step 4:	.05				.16			
Insomnia symptoms/nightmares		.13	2.69	<.01		.31	7.01	<.01
Step 4 Alt:	.05				.16			
Depressive symptoms		.02	0.32	.75		-.01	-0.20	.84
Insomnia symptoms/nightmares		.12	2.50	.01		.32	6.91	<.01

model in which the last step controlled for symptoms of depression.

After controlling for the IPTS, consistent with our hypothesis but differing from study 1, we found that insomnia symptoms remained significantly associated with suicide attempts, with this relation remaining after controlling for depressive symptoms (see Table 4). Similar to study 1 and consistent with our hypothesis, nightmares remained significantly associated with suicide attempts after controlling for the IPTS constructs even after controlling for depressive symptoms (see Table 4).

## 6. Discussion

The current study provides new evidence on the association among IPTS components, sleep disorder symptoms, and suicide risk and behavior. As hypothesized, and consistent across two different samples of undergraduate students, both perceived burdensomeness and thwarted belongingness were positively correlated with insomnia symptoms and nightmares. Acquired capability, however, was not found to be correlated with insomnia symptoms or nightmares in Study 1, and in Study 2, was found to be negatively associated with nightmares. Nightmares were found to be independently associated with suicide risk and behavior, after controlling for IPTS constructs in both Study 1 and Study 2, as hypothesized. Further, the relation between nightmares and suicide attempts remained after controlling for depressive symptoms. This pattern of results, however, was not as clear with insomnia symptoms. In Study 1, insomnia symptoms did not account for significant variance in suicide risk or behavior above and beyond the effects of the IPTS, whereas insomnia symptoms were found to be independently associated with suicide behavior in Study 2.

There are several potential explanations as to why insomnia symptoms and nightmares were either not associated, or negatively associated, with acquired capability. First, the duration of symptoms experienced may be critical to the development of acquired capability (for a review of opponent-process theory, see Solomon, 1980; Solomon and Corbit, 1974). For example, although individuals with insomnia symptoms may report more spontaneous pain and report greater levels of subjective pain than individuals without insomnia (Haack et al., 2012), habituation to pain, and the perception of being capable of inflicting and

withstanding pain necessary in death by suicide may require a longer duration of symptom severity to increase an individual's acquired capability. Second, with respect to nightmares, the relations with acquired capability may be context dependent. Prior research has indicated that daydreaming about violence and death (Selby et al., 2007) and the re-experiencing symptoms of PTSD (Bryan and Anestis, 2011) are associated with greater levels of acquired capability, indicating that mental rehearsal of pain and/or provocation may have a similar effect as actual exposure to such stimuli. In this sample, however, it might be that the content of the nightmares did not maintain substantial relevance to pain and the fear of death/bodily harm and, as such, they were unrelated to elevations in those variables. Finally, it may also be the case that insomnia symptoms and nightmares may only be associated with the desire for death and therefore not expected to be associated with acquired capability, which would explain the lack of findings in the current study.

In both Study 1 and 2, nightmares were found to be independently associated with suicide risk and behavior. This finding suggests, then, that nightmares may confer additional risk for suicidal behaviors above and beyond risk associated with perceived burdensomeness and thwarted belongingness. Prior research has documented that nightmares are an independent risk factor for suicidal ideation beyond commonly recognized suicide risk factors like depressive symptoms (Nadorff et al., 2011, 2013b). The current study adds additional evidence that nightmares may be a critical and unique risk factor for suicidal behavior. Although the mechanism by which nightmares confer greater risk for suicide is not entirely clear, it appears that nightmares may be an indicator of overarousal which might be a critical factor in the acute suicidal act (Ribeiro et al., 2013).

In contrast to the consistent direct relation nightmares had on suicide risk and behavior, the current study found conflicting evidence as to the role insomnia symptoms play on suicide risk and behavior. Insomnia symptoms did not account for significant unique variance above and beyond the IPTS variables in Study 1, whereas insomnia symptoms were found to independently predict prior suicide attempts in Study 2. Insomnia symptoms may be uniquely predictive of suicidal behavior due to overarousal associated with suicide (Ribeiro et al., 2013). Thus, it might be possible that duration of symptoms (Nadorff et al., 2013b) is again a critical factor in whether or not insomnia is independently associated

with suicide risk, and therefore may be one explanation as to why the association among insomnia symptoms, IPTS constructs, and suicidal risk and behavior was not consistent across samples in the current study.

### 6.1. Limitations

The current studies had several limitations that should be considered when interpreting results. First, both studies consisted of undergraduate samples, the majority of which were comprised of Caucasian individuals ranging from ages 18 to 33 (although over 40% of participants in Study 2 were African American, thereby introducing a level of diversity across the two samples). Second, the cross-sectional design of these studies prohibited conclusions about causality and directionality of the relations examined. Third, the assessment of sleep problems in these studies captured symptoms and not diagnostic classifications. The assessment tools used in this study, however, are well-validated instruments used within the field with established cut-points. Additionally, the use of symptom measurement and not just diagnoses allows for a fuller interpretation of the continuum of sleep difficulties.

### 6.2. Conclusions and future directions

To the best of our knowledge, this is the first known study to directly test the relation between sleep problems, the IPTS constructs, and suicidal risk and behavior. Findings suggest that insomnia symptoms and nightmares are associated with perceptions of burdensomeness and increased feelings of isolation. Furthermore, sleep problems, like nightmares may be predictive of suicidal behavior, above and beyond risk captured within the IPTS constructs.

The current findings add to the empirical evidence in support of the IPTS and further document the increased risk for suicide associated with sleep problems. Insomnia symptoms and nightmares may be partially associated with suicidal ideation due to the role they play in perceptions of burdensomeness and thwarted belongingness. Consequently, interventions aimed at addressing sleep problems may prove especially useful in decreasing suicide risk and therefore should also decrease levels of perceived burdensomeness and thwarted belongingness. For example, research has shown that treating insomnia symptoms with cognitive-behavioral therapy for insomnia can actually reduce suicidal ideation ( $d=0.56$  for high depression group; Manber et al., 2011). Thus, in addition to being a risk factor, insomnia symptoms may also be a point of intervention in order to reduce the IPTS factors associated with the desire for death by suicide.

The current research suggests several areas for future directions. Replication of the current research in other samples would be beneficial. Because risk factors for suicidal behavior differ by age, and because sleep problems present in qualitatively different ways across the life span, investigation as to how sleep problems, the IPTS factors, and suicide risk varies across the lifespan could prove especially promising.

Finally, the mechanisms underlying the risk associated with sleep problems and suicidal behaviors would benefit from additional research. The current study took an important step in understanding these relations by showing that the IPTS and depressive symptoms cannot alone explain the mechanism by which sleep disorders confer suicide risk. The literature would benefit from future research examining whether related disorders, such as cognitive deficits, may explain the association between sleep problems and suicide risk. This research will likely be useful in better understanding how to identify those at risk, improve interventions, and educate prevention efforts.

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### Conflict of interest

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