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Sleep Disturbance Attributed to Worry and Its Association with Insomnia, Fatigue, and Daytime Sleepiness Beyond Trait Worry and Anxiety in College Students

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ABSTRACT – Sleep disturbance attributed to worry (SAW) represents a specific cognitive belief linking worry to sleep problems, potentially distinguishing individuals whose insomnia is maintained by attributional processes rather than general emotional distress. The present study examined whether SAW predicts insomnia severity, daytime fatigue, and daytime sleepiness after accounting for trait worry and anxiety symptoms. A sample of 113 college students completed self-report measures of SAW, trait worry, anxiety, insomnia severity, fatigue, and daytime sleepiness. Regressions found that SAW predicted unique variance in insomnia severity beyond worry and anxiety but did not account for significant variance in fatigue or sleepiness. These findings suggest that worry-based causal attributions are uniquely tied to nocturnal sleep disruption rather than daytime dysfunction. Results support conceptualizing SAW as a metacognitive attribution influencing pre-sleep arousal and highlight the potential clinical value of addressing worry-based sleep beliefs in insomnia interventions.

Keywords:
Sleep disturbance; Insomnia; Worry; Metacognition; Attribution; Fatigue; Daytime sleepiness; Cognitive–emotional processes

Introduction

Sleep disturbance represents one of the most pervasive complaints in college and young adult populations, with prevalence estimates ranging from 30% to 60% depending on criteria

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(Hershner & Chervin, 2014; Lund et al., 2010). Chronic difficulties initiating or maintaining sleep, as well as subjective nonrestorative sleep, can have cascading effects on emotion regulation, cognitive performance, academic achievement, and overall well-being (Pilcher & Walters, 1997; Taylor, Lichstein, & Durrence, 2003). Among psychological contributors, worry and anxiety are consistently identified as central factors in the onset and maintenance of insomnia (Harvey, 2002; Ong et al., 2012).

However, not all individuals who are anxious or worry develop sleep disturbance, and the pathways linking cognitive–emotional traits to insomnia remain incompletely understood. One underexamined aspect involves the beliefs individuals hold about why they cannot sleep, particularly the extent to which they attribute their sleep problems to worry itself. These causal attributions may intensify pre-sleep cognitive arousal and reinforce maladaptive sleep cognitions, creating a self-sustaining loop of worry about sleep, poor sleep, and daytime dysfunction (Harvey, 2005; Morin et al., 1993).

Worry is a central component of generalized anxiety disorder (Borkovec et al., 1983) and has long been associated with sleep disturbance. Worry involves repetitive, uncontrollable thoughts about potential threats or problems and is often accompanied by emotional and physiological arousal that interferes with sleep onset (Watkins, 2008). Empirical studies show that individuals high in trait worry report poorer sleep quality, longer sleep latency, and more frequent nocturnal awakenings (Harvey, 2002; Guastella & Moulds, 2007).

Worry also predicts pre-sleep cognitive arousal: the racing thoughts and mental tension commonly reported by poor sleepers (Nicassio et al., 1985). In controlled studies, experimentally induced worry delayed sleep onset and increased nighttime awakenings (Tang & Harvey, 2004). Longitudinal evidence suggests that elevated trait worry prospectively predicts the emergence or persistence of insomnia symptoms even when baseline anxiety and depression are controlled (Jansson-Fröjmark & Lindblom, 2008).

Anxiety symptoms, assessed broadly, are similarly linked to insomnia. Both state and trait anxiety contribute to hyperarousal and cognitive rumination that can maintain insomnia (Riemann et al., 2010). However, anxiety and worry, while overlapping, account for their own statistical variance (Kelly, 2004, 2008) and differ conceptually: anxiety encompasses a diffuse physiological and affective state, whereas worry is a more specific, verbal–cognitive process (Mathews, 1990). Therefore, a variable like sleep disturbance ascribed to worry (SAW; (Dregan et al., 2013; Kelly, 2002a) may represent a bridge between these two levels—capturing how individuals interpret the role of worry in their sleep problems.

Cognitive models of insomnia (Harvey, 2002; Morin et al., 1993) emphasize that maladaptive beliefs and appraisals sustain sleep disturbance. People with insomnia often hold distorted cognitions such as “I have no control over my sleep,” or “If I don’t sleep well, I’ll be unable to function” (Morin et al., 1993). These beliefs heighten anxiety about sleep, leading to greater pre-sleep arousal and maladaptive coping (e.g., excessive time in bed, clock-watching). Instruments like the Dysfunctional Beliefs and Attitudes About Sleep Scale (DBAS; Morin et al., 1993) quantify such patterns. High DBAS scores predict both insomnia severity and poor treatment response (Espie et al., 2006; Carney et al., 2006).

The SAW construct shares conceptual ground with DBAS but captures a narrower attributional focus; specifically, the belief that worry causes one's sleep disturbance (Kelly, 2002a, 2003), such a belief may reinforce a vicious cycle: worrying about worry itself (i.e., "I'm worrying again, so I won't be able to sleep") can increase metacognitive anxiety and pre-sleep cognitive load, thereby worsening insomnia (Wells & Papageorgiou, 2001). In this way, SAW may represent a metacognitive component of the broader worry–insomnia relationship.

Kelly (2002a) first developed the SAW Scale (SAWs) to examine the perceived connection between worry and poor sleep. In that initial study with college students, SAWs correlated significantly with trait worry and sleep disturbance; higher SAWs scores predicted shorter self-reported sleep duration and poorer sleep quality. Later work (Kelly, 2003) demonstrated that SAWs correlated positively with perceived stress and negative affect and remained moderately stable over time (Kelly & Forbes, 2004). Although correlated with general worry, SAW appears to tap a distinct attributional dimension—how strongly individuals endorse the idea that their sleep loss is due to worry (Kelly, 2003).

Despite its conceptual relevance, research incorporating SAW into multivariate models alongside established worry and anxiety measures has been limited. Most prior studies examined simple correlations, leaving unclear whether SAW adds predictive value beyond broader emotional constructs. Furthermore, few studies have linked SAW to daytime outcomes such as fatigue and sleepiness, which are often, but not always, consequences of poor sleep.

Insomnia, fatigue, and daytime sleepiness, though related, represent distinct phenomena (Buysse et al., 2008). Insomnia captures subjective sleep difficulty and nighttime disturbance (Soldatos et al., 2000). Fatigue, reflects perceived exhaustion and reduced energy (Krupp et al., 1989), whereas daytime sleepiness reflects physiological sleep propensity during waking hours (Johns, 1991). Although insomnia can lead to fatigue and sleepiness, not all individuals with insomnia experience these daytime symptoms.

Clinical studies suggest that fatigue often relates more strongly to mood disturbance and cognitive–emotional variables (e.g., depression, anxiety) than to objective sleep duration (Fava et al., 2008). Sleepiness, conversely, is influenced by circadian rhythms, sleep debt, and sleep quality, and may show weaker links to cognitive variables like worry (Buysse et al., 2008). Thus, cognitive attributions such as SAW might show a specific relationship with insomnia symptoms, rather than with daytime fatigue or sleepiness per se.

Personality factors, particularly neuroticism, play a notable role in both worry and sleep disturbance. Individuals high in neuroticism report greater negative affectivity, heightened stress reactivity, and more frequent sleep complaints (Williams & Moroz, 2009). As such, it is not surprising individuals with higher trait worry score higher on neuroticism (Servaas et al., 2014). Moreover, neuroticism predicts insomnia onset and maintenance longitudinally, even after adjusting for depression and anxiety (Jansson-Fröjmark & Lindblom, 2008; Duggan et al., 2014). Personality also shapes sleep beliefs: those high in neuroticism endorse more dysfunctional sleep cognitions and exhibit greater cognitive pre-sleep arousal (Gray & Watson, 2002; Barclay & Gregory, 2013).

SAW may be conceptually linked to these patterns. Individuals prone to worry and negative affect may be more likely to interpret sleep disturbance through a worry-based lens, strengthening

the association between neuroticism, anxiety, and insomnia (Kelly, 2003). However, SAW's specificity as an attribution may also mean it predicts insomnia above and beyond trait cognitive perturbation and emotionality. Establishing this specificity is essential to understand whether SAW reflects a generalized distress factor or a distinct cognitive process.

Given these gaps in the literature, the present study aims to examine whether sleep disturbance ascribed to worry predicts insomnia severity and daytime dysfunction beyond the effects of trait worry and anxiety symptoms. Using a sample of college students, the current study analyzes three outcome variables: insomnia severity, waking perceptions of fatigue, and daytime sleepiness. Predictor variables include SAW, trait worry, and general anxiety. Age and gender were included as covariates given their previously observed relationships with these variables (e.g., Lund et al., 2010; Taylor et al., 2005; Becker et al., 2018; Guzmán-González, Munguía, & Pérez-García, 2018). The following hypotheses were formed:

1. H1: SAW will account for significant incremental variance in insomnia severity above and beyond worry, anxiety, age, and gender.
2. H2: SAW will not account for significant incremental variance in daytime fatigue (FSS) or sleepiness (ESS) once the same covariates are controlled.

Such a pattern would support the view that attributing sleep problems to worry reflects a cognitive appraisal process closely tied to nocturnal insomnia rather than to general daytime dysfunction. These findings would add to the literature on maladaptive sleep beliefs and clarify the cognitive specificity of worry-related sleep disturbance, suggesting that interventions targeting sleep-related attributions (e.g., cognitive restructuring of metacognitive beliefs about worry) may be useful adjuncts to traditional insomnia treatments.

Method

Participants

Participants included 113 college students (86 women, 27 men) recruited from undergraduate psychology courses at a mid-sized university in the United States. Ages ranged from 18 to 50 years (M = 23.64, SD = 6.99). The race/ethnicity composition was predominantly White/Caucasian (n = 100; 88.5%), with 10 (8.8%) participants identifying as Black/African American, 1 (0.9%) as Native American, 2 (1.8%) as "other." Participants reported an average of 7.02 hours of sleep per night (SD = 1.51).

Measures

Sociodemographics. Participants self-reported age, gender, race/ethnicity, and average number of hours and minutes slept per 24-hour period (Kumar & Vaidya, 1984).

Sleep Disturbance Ascribed to Worry (SAW). The Sleep Disturbance Ascribed to Worry Scale (SAWs; Kelly, 2002a) consists of five items assessing the extent to which individuals attribute their sleep problems to worry (e.g., "How often are you unable to stop worrying at bedtime?"). Items are rated on a 11-point scale (0 = *never* to 10 = *very often*). Higher scores reflect more

worry-based attributions about sleep disturbance. The scale has demonstrated strong internal consistency (*α*'s = .85–.89; Kelly, 2002a, 2002b, 2003), one-month test–retest reliability (*r* = .83; Kelly & Forbes, 2004), and evidence of convergent validity via correlations with trait worry and perceived stress, and discriminant validity relative to general negative affect (Kelly, 2003).

Trait Worry. Trait worry was assessed using the *Penn State Worry Questionnaire* (PSWQ; Meyer et al., 1990), a 16-item measure assessing the general tendency toward excessive, uncontrollable worry. Responses are rated from 1 (*not at all typical of me*) to 5 (*very typical of me*). Higher scores indicate more trait worry. The PSWQ has demonstrated high internal consistency (α ≈ .91) and test–retest reliability (*r* = .92 over 8–10 weeks; Molina & Borkovec, 1994). The instrument has convergent validity with anxiety and intolerance of uncertainty (Brown et al., 1992).

General Anxiety Symptoms. The Beck Anxiety Inventory (BAI; Beck et al., 1988) was used to assess general physiological and affective symptoms of anxiety. The 21 items are rated from 0 (*not at all*) to 3 (*severely*), based on the intensity of symptoms during the past week. Higher scores indicate more anxiety. The BAI demonstrates excellent internal consistency (αs = .90–.94), one-week test–retest reliability (*r* = .75; Beck et al., 1988), and convergent validity with other anxiety measures such as the Hamilton Anxiety Rating Scale (Fydrich et al., 1992).

Insomnia Severity. The Athens Insomnia Scale (AIS; Soldatos et al., 2000) includes eight items assessing sleep induction, awakenings, early morning awakening, total sleep duration, and daytime functioning over the past month. Responses are rated from 0 to 3, where 0 indicates no problem or "normal" and 3 indicates a severe problem. Higher scores indicate more insomnia severity. The AIS has shown strong internal consistency (α = .87), test–retest reliability (*r* = .89; Soldatos et al., 2000), and concurrent validity with polysomnographic and clinical diagnostic criteria for insomnia (Okajima et al., 2013).

Daytime Fatigue. Daytime fatigue was measured using the Fatigue Severity Scale (FSS; Krupp et al., 1989), a nine-item self-report scale evaluating the impact of fatigue on motivation, physical functioning, and daily activities. Responses range from 1 (*strongly disagree*) to 7 (*strongly agree*), with higher scores indicating greater fatigue severity. The FSS has demonstrated excellent internal consistency (α = .88–.91; Valko et al., 2008), good temporal stability over two weeks (*r* = .84), and sensitivity to fatigue-related clinical conditions.

Daytime Sleepiness. Daytime sleepiness was assessed using the Epworth Sleepiness Scale (ESS; Johns, 1991), an eight-item measure assessing the likelihood of dozing in various daytime situations. Responses range from 0 (*would never* doze) to 3 (*high chance of* dozing). Higher scores reflect greater sleep propensity. The ESS has shown strong internal consistency (α ≈ .82; Johns, 1991), two-week test–retest reliability (*r* = .82), and criterion validity with objective measures of sleep propensity such as the Multiple Sleep Latency Test (Johns, 2000).

Procedure

Participants completed all measures as "paper and pencil" questionnaires at the beginning of regular class times. The questionnaire battery took approximately 15 minutes to complete. Responses were anonymized. Participants received a nominal amount of course credit in exchange for participation as identified by separate informed consent forms. The study was

approved by the university's Institutional Review Board and conducted in accordance with the Declaration of Helsinki.

Statistical Analysis

Data were screened for missing responses, normality, and univariate outliers prior to analysis. Missing data (<1%) were handled by substituting the mean response for that item. One participant did not complete several scales. As such their data is missing from some analyses. Preliminary analyses computed descriptive statistics, reliability estimates, and Pearson correlations among study variables.

Three linear regressions were conducted to test the study's hypotheses. Insomnia severity (AIS), daytime fatigue (FSS), and daytime sleepiness (ESS) served as criterion variables for these analyses.

- Step 1 (Covariates): Age, gender (1 = male, 2 = female), and average self-reported sleep hours per night.
- Step 2 (Cognitive-Emotional Predictors): Trait worry (PSWQ) and anxiety symptoms (BAI).
- Step 3 (Incremental Predictor): Sleep Disturbance Ascribed to Worry (SAWs). Incremental validity of SAWs was assessed via the change in explained variance (ΔR^2) from Step 2 to Step 3. Standardized beta weights were inspected to determine unique predictor contributions.

Results

Descriptive statistics and intercorrelations among study variables are presented in Table 1. As shown in the table, SAWs was significantly correlated with trait worry, anxiety, insomnia severity, and fatigue severity. The SAWs was not significantly related to daytime sleepiness. Trait worry and anxiety were significantly related to all variables.

Table 1: Correlations and descriptive statistics

Variable	1	2	3	4	5	*M*	*SD*	*α*
1. SAWs						18.14	11.08	.855
2. PSWQ	.62**					52.27	14.06	.929
3. BAI	.49**	.42**				12.79	11.07	.917
4. AIS	.57**	.37**	.50**			7.75	3.91	.806
5. FSS	.37**	.31**	.51**	.40**		30.54	12.52	.902
6. ESS	.15	.23*	.28**	.22*	.40**	10.34	3.75	.661

Note: $N = 113$. *$p < .05$, **$p < .01$. SAWs = Sleep Disturbance Ascribed to Worry Scale; PSWQ = Penn State Worry Questionnaire; BAI = Beck Anxiety Inventory; AIS = Athens Insomnia Scale; FSS = Fatigue Severity Scale; ESS = Epworth Sleepiness Scale

As shown in Table 2, In Step 1, covariates accounted for a significant 7.3% of the variance in insomnia severity. Step 2, adding trait worry and anxiety, explained an additional, significant 24.1 of the variance. Step 3, adding SAWs, produced a significant incremental increase of 9.9% of variance. In the final model, higher SAWs scores uniquely predicted greater insomnia severity after controlling for worry, anxiety, sleep duration, age, and gender

Table 2: Linear regression models predicting insomnia severity

	Step 1		Step 2		Step 3	
Variable	*β*	*p*	*β*	*p*	*β*	*p*
Age	.18	.056	.10	.215	.04	.608
Gender	.19	.048	.07	.409	.07	.358
Sleep length	-.08	.410	-.14	.093	-.14	.073
PSWQ			.41	<.001	.30	.001
BAI			.19	.042	-.02	.810
SAWs					.43	<.001
	$\Delta R^2 = .073$, $F = 2.84$, $p = .041$		$\Delta R^2 = .241$, $F = 18.58$, $p < .001$		$\Delta R^2 = .099$, $F = 17.89$, $p < .001$	

As presented in Table 3, covariates accounted for nonsignificant 0.6% of variance in fatigue. Worry and anxiety on Step 2 accounted for a significant increase of 23.1% of variance, mostly due to anxiety. On Step 3, the SAWs accounted for an insignificant 0.6% increase in variance, indicating that SAWs did not significantly improve prediction. Anxiety remained the only significant predictor. As shown in Table 4, The model for daytime sleepiness reached significance only at Step 2, largely due to anxiety. The SAWs was not significant.

Table 3: Linear regression models predicting fatigue severity

	Step 1		Step 2		Step 3	
Variable	*β*	*p*	*β*	*p*	*β*	*p*
Age	.19	.051	.11	.192	.09	.268
Gender	.14	.149	.03	.708	.03	.703
Sleep length	.02	.847	-.04	.650	-.04	.652
PSWQ			.11	.242	.06	.588
BAI			.45	<.001	.42	<.001
SAWs					.10	.360
	$\Delta R^2 = .006$, $F = 2.18$, $p = .095$		$\Delta R^2 = .231$, $F = 17.17$, $p < .001$		$\Delta R^2 = .006$, $F = 0.84$, $p = .360$	

Discussion

The present study examined whether SAW predicts insomnia severity, daytime fatigue, and daytime sleepiness beyond trait worry and general anxiety. Consistent with expectations, SAW uniquely predicted insomnia severity after accounting for these covariates but did not predict

fatigue or sleepiness. This pattern supports the idea that worry-based causal attributions are specifically tied to nocturnal cognitive arousal rather than to daytime dysfunction.

Table 4: Linear regression models predicting daytime sleepiness

	Step 1		Step 2		Step 3	
Variable	*β*	*p*	*β*	*p*	*β*	*p*
Age	-.03	.735	-.09	.361	-.08	.422
Gender	.06	.554	-.03	.774	-.03	.773
Sleep length	-.11	.279	-.15	.111	-.15	.112
PSWQ			.18	.090	.21	.091
BAI			.24	.020	.26	.019
SAWs					-.06	.638
	$\Delta R^2 = .014$, $F = 0.51$, $p = .679$		$\Delta R^2 = .111$, $F = 6.71$, $p = .002$		$\Delta R^2 = .002$, $F = 0.22$, $p = .638$	

The finding that SAW uniquely predicted insomnia extends previous findings (Kelly, 2002a, 2003) and supports attributional and metacognitive accounts of sleep disturbance. SAW reflects the degree to which individuals interpret their sleep problems as caused by worry. Such beliefs may heighten pre-sleep cognitive monitoring and amplify the perception of uncontrollability, reinforcing insomnia symptoms. In contrast, trait worry (Meyer et al., 1990) and general anxiety (Beck et al., 1988) describe dispositional or physiological tendencies rather than explanatory cognitions. Thus, individuals with strong worry-based attributions may differ not in how much they worry, but in how they understand their inability to sleep.

These findings align with cognitive and metacognitive models of insomnia (Harvey, 2002; Espie et al., 2006), which emphasize that beliefs about sleep perpetuate hyperarousal. Attributing insomnia to worry may create a recursive loop: individuals monitor for worry, attempt to suppress it, and in doing so heighten arousal and tension. Over time, this pattern can consolidate into a self-reinforcing "worry–insomnia" schema in which cognitive appraisal, rather than physiological arousal alone, maintains wakefulness (Kelly, 2003). SAW captures this attributional layer of vulnerability and thus explains variance in insomnia that overlaps only partially with general worry or anxiety.

Although SAW was related to fatigue and sleepiness at the bivariate level, it did not add unique predictive value once anxiety and sleep duration were controlled. This suggests that attributional beliefs primarily influence nocturnal processes, that is, difficulty falling or staying asleep, rather than daytime manifestations of low energy or drowsiness. Fatigue and sleepiness, while often conflated, represent distinct constructs (Johns, 1991; Shen et al., 2006). Fatigue involves perceived exhaustion and reduced motivation, whereas sleepiness reflects physiological sleep propensity. The present results imply that anxiety, rather than attributional cognition, better accounts for daytime fatigue, while sleepiness remains more closely tied to sleep quantity and circadian rhythm than to cognitive interpretation.

Together, these findings clarify that SAW is a cause-focused cognition rather than a consequence-focused one. Attributional beliefs appear to shape pre-sleep arousal but contribute little to how individuals experience daytime tiredness. This distinction parallels the "attention–

intention–effort" model (Espie et al., 2006), which describes how efforts to control sleep may ironically sustain insomnia. By emphasizing causal beliefs, SAW highlights a metacognitive mechanism that bridges the cognitive (thought-based) and emotional (arousal-based) aspects of insomnia.

From a conceptual standpoint, the results advance understanding of how cognitive attributions interact with personality and emotional traits. Individuals high in neuroticism or trait worry may be predisposed to interpret physiological arousal through a worry-based lens (Gray & Watson, 2002; Servaas et al., 2014), reinforcing the sense that worry itself is the cause of sleep disruption. Yet, the present findings suggest that SAW's predictive role is not reducible to general negative affectivity. This suggests a degree of cognitive specificity that complements broader emotional dispositions. In this sense, SAW may capture the metacognitive appraisal through which trait worry becomes clinically consequential: transforming normal worry into sleep-interfering rumination.

Recent findings (Kelly, 2015) provide further context for this differentiation. Kelly suggests that "normal" worry, which can be functional and problem-solving, contrasts with pathological worry characterized by perceived uncontrollability. SAW may mark the point at which normal worry crosses that threshold; when individuals view worry as an externalized agent disrupting their sleep, thereby reinforcing helplessness and self-perpetuating anxiety about rest. This interpretation resonates with attributional reformulations of learned helplessness (Abramson et al., 1978), where causal beliefs about internal and uncontrollable factors maintain distress.

Clinically, these results suggest that assessing and modifying worry-based attributions could enhance cognitive-behavioral therapy for insomnia (CBT-I). Traditional CBT-I targets dysfunctional beliefs about sleep and maladaptive behaviors (Morin et al., 2006), but does not always isolate why individuals believe they cannot sleep. When clients attribute insomnia to uncontrollable worry, interventions that focus on metacognitive awareness, such as those described by Wells (2005), may help shift their relationship to worry itself. Measuring SAW at intake or throughout treatment could identify clients whose insomnia is sustained by attributional rather than purely physiological or emotional processes. Reductions in SAW scores may signal therapeutic change in cognitive meaning structures rather than simply reduced symptom intensity.

Several limitations to the current study should be noted. First, the correlational design prevents causal inference; it remains unclear whether worry-based attributions cause insomnia or arise as justifications for persistent sleep difficulty. Longitudinal and experimental designs are needed to test whether reducing SAW precedes improvements in sleep. Second, the sample consisted primarily of college students, limiting generalizability to clinical or older populations where sleep–worry dynamics may differ. Third, all measures relied on self-report, raising potential common-method variance. Incorporating objective sleep measures (e.g., actigraphy) or ecological assessments of pre-sleep thought patterns would provide convergent validity. Additionally, other constructs such as intolerance of uncertainty, metacognitive beliefs about thought control, or cognitive control strategies (e.g., Wells & Papageorgiou, 2001) were not measured; integrating these could clarify SAW's position within the broader network of cognitive

vulnerability factors. Finally, the modest internal consistency of the Epworth Sleepiness Scale (α = .66) suggests cautious interpretation of the nonsignificant sleepiness findings.

Despite these limitations, the present results replicate and extend earlier findings (Kelly, 2002a, 2003) with a modern psychometric framework and additional daytime outcomes. The stability of observed relationships — particularly the robust correlation between SAW and insomnia severity — suggests that attributional beliefs about worry play a consistent role across samples. Importantly, this study strengthens the argument that it is not merely the frequency or intensity of worry but the meaning ascribed to it that differentiates who develops chronic insomnia.

In summary, sleep disturbance attributed to worry represents a distinct cognitive attribution uniquely related to insomnia severity. Individuals who believe their sleep problems are caused by worry appear especially prone to pre-sleep cognitive arousal and persistent insomnia. These results clarify that SAW reflects a metacognitive mechanism linking dispositional worry to specific sleep difficulties. Future research should examine whether modifying these attributions mediates treatment gains in CBT-I or metacognitive therapy. Addressing the meaning of worry, not just its presence, may help improve sleep outcomes for individuals whose nights remain unsettled by their own thoughts.

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References

Abramson, L. Y., Seligman, M. E. P., & Teasdale, J. D. (1978). *Learned helplessness in humans: Critique and reformulation*. Journal of Abnormal Psychology, 87(1), 49–74. https://doi.org/10.1037/0021-843X.87.1.49

Barclay, N. L., & Gregory, A. M. (2013). Quantitative genetic research on sleep: A review of normal sleep, sleep disturbances and associated emotional, behavioural, and health-related difficulties. *Sleep Medicine Reviews, 17*(1), 29–40. https://doi.org/10.1016/j.smrv.2012.01.008

Beck, A. T., Epstein, N., Brown, G., & Steer, R. A. (1988). An inventory for measuring clinical anxiety: The Beck Anxiety Inventory. *Journal of Consulting and Clinical Psychology, 56*(6), 893–897. https://doi.org/10.1037//0022-006x.56.6.893

Becker, S. P., Jarrett, M. A., Luebbe, A. M., Garner, A. A., Burns, G. L., & Kofler, M. J. (2018). Sleep in a large, multi-university sample of college students: Sleep problem prevalence, sex differences, and mental health correlates. *Sleep Health, 4*(2), 174–181. https://doi.org/10.1016/j.sleh.2018.01.001

Borkovec, T. D., Robinson, E., Pruzinsky, T., & DePree, J. A. (1983). Preliminary exploration of worry: Some characteristics and processes. *Behaviour Research and Therapy, 21*(1), 9–16. https://doi.org/10.1016/0005-7967(83)90121-3

Brown, T. A., Antony, M. M., & Barlow, D. H. (1992). Psychometric properties of the Penn State Worry Questionnaire in a clinical anxiety disorders sample. *Behaviour Research and Therapy*, 30(1), 33–37. https://doi.org/10.1016/0005-7967(92)90093-V

Buysse, D. J., Reynolds, C. F. III, Monk, T. H., Berman, S. R., & Kupfer, D. J. (2008). Relationships between the Pittsburgh Sleep Quality Index, Epworth Sleepiness Scale, and clinical/polysomnographic measures in a community sample. *Journal of Clinical Sleep Medicine, 4*(6), 563–571. https://doi.org/10.5664/jcsm.27351

Carney, C. E., Edinger, J. D., Meyer, B., Lindman, L., & Istre, T. (2006). Symptom-focused rumination and sleep disturbance. *Behavioral Sleep Medicine*, *4*(4), 228–241. https://doi.org/10.1207/s15402010bsm0404_3

Dregan, A., Lallukka, T. & Armstrong, D. (2013). Potential pathways from biopsychosocial risk factors to sleep loss due to worry: a population-based investigation. *Journal of Public Mental Health, 12*(1), 43–50. https://doi.org/10.1108/17465721311304230

Duggan, K. A., Friedman, H. S., McDevitt, E. A., & Mednick, S. C. (2014). Personality and healthy sleep: the importance of conscientiousness and neuroticism. *PloS one*, *9*(3), e90628. https://doi.org/10.1371/journal.pone.0090628

Espie, C. A., Broomfield, N. M., MacMahon, K. M. A., Macphee, L. M., & Taylor, L. M. (2006). The attention–intention–effort pathway in the development of psychophysiologic insomnia. *Sleep Medicine Reviews, 10*(4), 215–245. https://doi.org/10.1016/j.smrv.2006.03.002

Fava, M., Ball, S., Nelson, J. C., Sparks, J., Konechnik, T., Classi, P., & Dube, S. (2008). Clinical relevance of fatigue as a residual symptom in major depressive disorder. *Depression and Anxiety, 25*(9), 820–827. https://doi.org/10.1002/da.20311

Fydrich, T., Dowdall, D., & Chambless, D. L. (1992). Reliability and validity of the Beck Anxiety Inventory. *Journal of Anxiety Disorders, 6*(1), 55–61. https://doi.org/10.1016/0887-6185(92)90026-4

Gray, E. K., & Watson, D. (2002). General and specific traits of personality and their relation to sleep and academic performance. *Journal of Personality, 70*(2), 177–206. https://doi.org/10.1111/1467-6494.05002

Guastella, A. J., & Moulds, M. L. (2007). The impact of rumination on sleep quality following a stressful life event. *Personality and Individual Differences, 42*(6), 1151–1162. https://doi.org/10.1016/j.paid.2006.04.028

Guzmán-González, M., Munguía, O., & Pérez-García, A. (2018). Worry among Latinx college students: Relations to anxious arousal, social anxiety, general depression, and insomnia. *Behavioral Sleep Medicine, 16*(3), 279–291. https://doi.org/10.1080/15402002.2017.1326918

Harvey, A. G. (2002). A cognitive model of insomnia. *Behaviour Research and Therapy, 40*(8), 869–893. https://doi.org/10.1016/s0005-7967(01)00061-4

Harvey, A. G. (2005). Unwanted intrusive thoughts in insomnia. In D. A. Clark (Ed.), *Intrusive thoughts in clinical disorders* (pp. 86–118). Guilford Press.

Hershner, S. D., & Chervin, R. D. (2014). Causes and consequences of sleepiness among college students. *Nature and Science of Sleep, 6,* 73–84. https://doi.org/10.2147/NSS.S62907

Jansson-Fröjmark, M., & Lindblom, K. (2008). A bidirectional relationship between anxiety and insomnia: A prospective study. *Journal of Psychosomatic Research, 64*(4), 443–449. https://doi.org/10.1016/j.jpsychores.2007.10.016

Johns, M. W. (1991). A new method for measuring daytime sleepiness: The Epworth Sleepiness Scale. *Sleep, 14*(6), 540–545. https://doi.org/10.1093/sleep/14.6.540

Johns, M. W. (2000). Sensitivity and specificity of the multiple sleep latency test (MSLT), the maintenance of wakefulness test, and the Epworth Sleepiness Scale: Failure of the MSLT as a gold standard. *Journal of Sleep Research, 9*(1), 5–11. https://doi.org/10.1046/j.1365-2869.2000.00199.x

Kelly, W. E. (2002a). Worry and sleep length revisited: Worry, sleep length, and sleep disturbance ascribed to worry. *The Journal of Genetic Psychology, 163*(3), 296–304. https://doi.org/10.1080/00221320209598685

Kelly, W. E. (2002b). Correlations of sense of humor and sleep disturbance ascribed to worry. *Psychological Reports, 91*(3 Pt 2), 1202–1204. https://doi.org/10.2466/pr0.2002.91.3f.1202

Kelly, W. E. (2003). Some correlates of sleep disturbance ascribed to worry. *Individual Differences Research, 1*(2), 137–146. https://doi.org/10.65030/idr.01012

Kelly, W. E. (2004). Examining the relationship between worry and trait anxiety. *College Student Journal, 38*(3), 370 –374.

Kelly, W. E. (2008). Anxiety and stress as contributory factors in pathological and nonpathological worry. *Psychology Journal, 5*(3), 147–157.

Kelly, W. E. (2015). The hunt for normal worry: Empirically distinguishing normal and pathological worry. *Individual Differences Research, 13*, Article e13004. https://doi.org/10.65030/idr.13004

Kelly, W. E., & Forbes, L. (2004). Temporal stability of the Sleep Disturbance Ascribed to Worry Scale. *Perceptual and Motor Skills, 99*(2), 628. https://doi.org/10.2466/pms.99.2.628-628

Krupp, L. B., LaRocca, N. G., Muir-Nash, J., & Steinberg, A. D. (1989). The Fatigue Severity Scale: Application to patients with multiple sclerosis and systemic lupus erythematosus. *Archives of Neurology, 46*(10), 1121–1123. https://doi.org/10.1001/archneur.1989.00520460115022

Kumar, A., & Vaidya, A. K. (1984). Anxiety as a personality dimension of short and long sleepers. *Journal of Clinical Psychology, 40*(1), 197–198. https://doi.org/10.1002/1097-4679(198401)40:1<197::AID-JCLP2270400137>3.0.CO;2-O

Lund, H. G., Reider, B. D., Whiting, A. B., & Prichard, J. R. (2010). Sleep patterns and predictors of disturbed sleep in a large population of college students. *Journal of Adolescent Health, 46*(2), 124–132. https://doi.org/10.1016/j.jadohealth.2009.06.016

Mathews, A. (1990). Why worry? The cognitive function of anxiety. *Behaviour Research and Therapy, 28*(6), 455–468. https://doi.org/10.1016/0005-7967(90)90132-3

Meyer, T. J., Miller, M. L., Metzger, R. L., & Borkovec, T. D. (1990). Development and validation of the Penn State Worry Questionnaire. *Behaviour Research and Therapy, 28*(6), 487–495. https://doi.org/10.1016/0005-7967(90)90135-6

Molina, S., & Borkovec, T. D. (1994). *The Penn State Worry Questionnaire: Psychometric properties and associated characteristics*. In G. Davey & F. Tallis (Eds.), *Worrying: Perspectives on theory, assessment and treatment* (pp. 265 –283). Wiley.

Morin, C. M., Bootzin, R. R., Buysse, D. J., Edinger, J. D., Espie, C. A., & Lichstein, K. L. (2006). Psychological and behavioral treatment of insomnia: Update of the recent evidence (1998–2004). *Sleep, 29*(11), 1398–1414. https://doi.org/10.1093/sleep/29.11.1398

Morin, C. M., Stone, J., McDonald, K., & Jones, S. (1993). Dysfunctional beliefs and attitudes about sleep among older adults with and without insomnia complaints. *Psychology and Aging, 8*(3), 463–467. https://doi.org/10.1037//0882-7974.8.3.463

Nicassio, P. M., Mendlowitz, D. R., Fussell, J. J., & Petras, L. (1985). The phenomenology of the pre-sleep state: The development of the Pre-Sleep Arousal Scale. *Behaviour Research and Therapy, 23*(3), 263–271. https://doi.org/10.1016/0005-7967(85)90004-X

Okajima, I., Nakajima, S., Kobayashi, M., & Inoue, Y. (2013). Development and validation of the Japanese version of the Athens Insomnia Scale (AIS-J). *Psychiatry and Clinical Neurosciences*, 67(6), 420–425. https://doi.org/10.1111/pcn.12073

Ong, J. C., Ulmer, C. S., & Manber, R. (2012). Improving sleep with mindfulness and acceptance: A metacognitive model of insomnia. *Behaviour Research and Therapy, 50*(11), 651–660. https://doi.org/10.1016/j.brat.2012.08.001

Pilcher, J. J., & Walters, A. S. (1997). How sleep deprivation affects psychological variables related to college students' cognitive performance. *Journal of American College Health, 46*(3), 121–126. https://doi.org/10.1080/07448489709595597

Riemann, D., Spiegelhalder, K., Feige, B., Voderholzer, U., Berger, M., Perlis, M., & Nissen, C. (2010). The hyperarousal model of insomnia: A review of the concept and its evidence. *Sleep Medicine Reviews, 14*(1), 19–31. https://doi.org/10.1016/j.smrv.2009.04.002

Servaas, M. N., Riese, H., Ormel, J., & Aleman, A. (2014). The neural correlates of worry in association with individual differences in neuroticism. *Human Brain Mapping, 35*(9), 4303–4315. https://doi.org/10.1002/hbm.22476

Shen, J., Barbera, J., & Shapiro, C. M. (2006). Distinguishing sleepiness and fatigue: Focus on definition and measurement. *Sleep Medicine Reviews, 10*(1), 63–76. https://doi.org/10.1016/j.smrv.2005.07.004

Soldatos, C. R., Dikeos, D. G., & Paparrigopoulos, T. J. (2000). Athens Insomnia Scale: Validation of an instrument based on ICD-10 criteria. *Journal of Psychosomatic Research, 48*(6), 555–560. https://doi.org/10.1016/s0022-3999(00)00095-7

Tang, N. K. Y., & Harvey, A. G. (2004). Effects of cognitive arousal and physiological arousal on sleep perception. *Sleep, 27*(1), 69–78. https://doi.org/10.1093/sleep/27.1.69

Taylor, D. J., Lichstein, K. L., & Durrence, H. H. (2003). Insomnia as a health risk factor. *Behavioral Sleep Medicine, 1*(4), 227–247. https://doi.org/10.1207/S15402010BSM0104_5

Taylor, D. J., Lichstein, K. L., Durrence, H. H., Reidel, B. W., & Bush, A. J. (2005). Epidemiology of insomnia, depression, and anxiety. *Sleep, 28*(11), 1457–1464. https://doi.org/10.1093/sleep/28.11.1457

Valko, P. O., Bassetti, C. L., Bloch, K. E., Held, U., & Baumann, C. R. (2008). Validation of the Fatigue Severity Scale in a Swiss cohort. *Sleep*, 31(11), 1601–1607. https://doi.org/10.1093/sleep/31.11.1601

Watkins, E. R. (2008). Constructive and unconstructive repetitive thought. *Psychological Bulletin, 134*(2), 163–206. https://doi.org/10.1037/0033-2909.134.2.163

Wells, A. (2005). *The metacognitive therapy of anxiety and depression*. Guilford Press.

Wells, A., & Papageorgiou, C. (2001). Brief cognitive therapy for social phobia: a case series. *Behaviour Research and Therapy*, *39*(6), 713–720. https://doi.org/10.1016/s0005-7967(00)00036-x

Williams, P. G., & Moroz, T. L. (2009). Personality vulnerability to stress-related sleep disruption: Pathways to adverse mental and physical health outcomes. *Personality and Individual Differences, 46*(5–6), 598–603. https://doi.org/10.1016/j.paid.2008.12.017