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Autonomic Hyperarousal and Chronotype as Psychobiological Correlates of Nightmare-Relevant Dispositions

William E. Kelly [1]

[1] Department of Psychology, University of the Incarnate Word, San Antonio, Texas, United States

Correspondence: William E. Kelly (wkelly@uiwtx.edu)

ABSTRACT – Nightmare vulnerability appears influenced by both dispositional and psychobiological factors, yet these are rarely examined together. This study tested whether autonomic hyperarousal and chronotype contribute to nightmare proneness, concretization, and distressing nightmares beyond neuroticism. Undergraduate participants (N = 110) completed measures of self-reported hyperarousal, chronotype, nightmare proneness, concretization, neuroticism, and nightmare frequency. Hyperarousal correlated with nightmare proneness, concretization, and nightmares, and uniquely predicted nightmare proneness and concretization after accounting for gender and neuroticism. Chronotype showed modest associations but no unique effects. Nightmare proneness was the only independent predictor of nightmares. Findings highlight autonomic hyperarousal as a broad correlate of nightmare-relevant dispositions, whereas chronotype played a weaker role in this sample.

Keywords:
Nightmare Proneness;
Autonomic Hyperarousal;
Chronotype;
Concretization;
Neuroticism;
Nightmares;
Circadian Rhythms

Introduction

Nightmares hypothetically arise through several processes involving affective vulnerability, cognitive–perceptual style, arousal dysregulation, and sleep–wake patterns (Levin & Nielsen, 2007). Disposition–stress models highlight the role of stable personality factors, particularly negative affect, as predispositions that heighten sensitivity to internal threat cues and dysphoric

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mentation during sleep (Gieselmann et al., 2019; Levin & Nielsen, 2007). Additional etiological factors proposed in the literature include childhood trauma (Nielsen, 2019), sensory processing sensitivity (Carr & Nielsen, 2017), "thin" psychological boundaries (Hartmann, 1984), and potentially related constructs such as openness to experience (Schredl & Rauthmann, 2022).

Among these predispositions, nightmare proneness has emerged as a relatively reliable predictor of nightmares. Nightmare proneness reflects a trait-like vulnerability characterized by intrusive mentation, affective lability, heightened threat sensitivity, and difficulties regulating negative cognitions (Kelly, 2018, 2025). Consistent associations between nightmare proneness and nightmares have been reported across multiple studies and samples (Kelly, 2024), suggesting that nightmare proneness represents a broad domain of cognitive–affective vulnerability (Kelly, 2025).

A central mechanism proposed for nightmare proneness is concretization, described as a process through which vague feelings of helplessness, vulnerability, or hyperarousal are transformed into vivid dream imagery via regressive sensory activation (Kelly, 2023a, 2025; Kelly & Yu, 2019; Kohut, 1977; Yu, 2013). Waking examples may include somatic manifestations of stress, such as psychogenic chest pain (Asnes et al., 1981). In dream contexts, concretization may involve literal representations of internal states; for example, Kohut (1977) describes a patient who feels she is "falling apart" and dreams of her body disintegrating. Concretization is hypothesized to be influenced by a concretizing style, defined as a tendency to experience psychological states in sensory or somatic terms (Kelly et al., 2024).

Although nightmare proneness consistently predicts nightmare occurrences, less is known about psychobiological factors that may contribute to nightmare proneness and concretization. Toscano-Hermoso et al. (2020) reported that nightmare proneness correlated with evening chronotype, while Arbinaga et al. (2019) found associations with physical inactivity. These findings imply that nightmare proneness may interact with, or be influenced by, physiological and circadian factors in addition to its emotional–perceptual aspects.

Two psychobiological variables of particular interest in the sleep and affective–arousal literature are autonomic hyperarousal and chronotype. Prior research has linked nightmares to indicators of autonomic nervous system (ANS) dysregulation, including heart-rate reactivity, EEG arousals, electrodermal fluctuations, and respiration dynamics (Mäder et al., 2023; Paul et al., 2019), as well as to self-reported evening chronotype (Nielsen, 2010; Schredl & Göritz, 2020). The current study examines these variables simultaneously in relation to both nightmares, nightmare proneness, and concretization.

Examining autonomic hyperarousal and chronotype simultaneously may extend prior work that has typically evaluated these variables in isolation; hyperarousal studies focusing on autonomic reactivity during sleep and pre-REM periods (Blaskovich et al., 2020; Paul et al., 2019; Simor et al., 2014), and chronotype studies examining circadian preference in relation to sleep disruption and nightmares (Nielsen, 2010; Schredl & Göritz, 2020). Yet both constructs may influence arousal regulation across the sleep–wake cycle. For instance, hyperarousal reflects physiological instability within the autonomic nervous system across sleep and wake (Joiner et al., 1999; Laurent et al., 2004; Mäder et al., 2023), whereas chronotype indexes circadian timing, sleep–wake alignment and associated cortical and physiological arousal patterns (Chauhan et al.,

2023; Roenneberg et al., 2019; Salehinejad et al., 2021). Testing these variables together allows evaluation of whether circadian influences exert effects on nightmare vulnerability independent of autonomic arousal, or whether previously observed chronotype associations are better explained by underlying hyperarousal. This joint examination might clarify potential overlap or incremental psychobiological pathways contributing to nightmares within neurocognitive models emphasizing interacting affective, arousal, and circadian systems (Kelly, 2025; Levin & Nielsen, 2007).

Physiological hyperarousal (PH) reflects involuntary bodily manifestations of ANS activation, including cardiorespiratory arousal, hot flashes, dizziness, and shakiness (Joiner et al., 1999; Laurent et al., 2004). Although PH is intertwined with limbic processes, some aspects may operate independently (Adhikari et al., 2015; Karemaker, 2017). PH also appears to reflect components of somatic anxiety (Szabo & Lovibond, 2017). Hyperarousal may contribute to nightmares through impaired sleep-stage transitions and panic-like sensations during sleep (Simor et al., 2014; Blaskovich et al., 2020).

Chronotype refers to biologically influenced variations in preferred activity times along the morningness–eveningness continuum (Roenneberg et al., 2019). It is shaped hypothetically by brain-based circadian pacemaker functioning (Chauhan et al., 2023), environmental cues such as light exposure, and social demands (Castañeda et al., 2004; Roenneberg et al., 2019). Individuals with evening chronotypes often experience misalignment between biological rhythms and social schedules, leading to mood disruption and reduced sleep continuity (Balter et al., 2024; Mikulska et al., 2021). Beyond mood disruption, eveningness is associated with delayed sleep timing, increased sleep inertia, inconsistent sleep–wake schedules, and greater circadian desynchrony. These processes may heighten vulnerability to sleep disruptions and nightmares by destabilizing REM regulation and increasing nocturnal arousal. Prior studies have shown that circadian misalignment amplifies emotional reactivity and impairs aspects of affect regulation, with eveningness linked to greater mood instability, stress sensitivity, and irregular sleep–wake patterns that undermine effective overnight emotional processing (Balter et al., 2024; Mikulska et al., 2021; Salehinejad et al., 2021). This suggests a plausible mechanistic pathway through which eveningness may increase the likelihood of nightmare experiences (Nielsen, 2010; Salehinejad et al., 2021). Thus, there is a strong theoretical basis for expecting chronotype to predict nightmares, even if empirical findings have been mixed. These disruptions may contribute to nightmare vulnerability (Nielsen, 2010).

Another broad personality variable relevant to nightmares is neuroticism, characterized by heightened negative affectivity and emotional instability. Neuroticism has been repeatedly linked to nightmares (Kelly & Mathe, 2019; Schredl & Göritz, 2021). Further, nightmare proneness is strongly related to neuroticism (Kelly et al., 2025). Including neuroticism in this study allows examination of whether hyperarousal and chronotype contribute uniquely beyond general affective instability.

Based on previous research, several hypotheses were advanced:

1. Higher autonomic hyperarousal would relate to greater nightmare proneness, concretization, and distressing nightmares.

2. Evening chronotype would be associated with higher nightmare proneness and nightmares.
3. Hyperarousal and chronotype would predict nightmare proneness and concretization beyond neuroticism.
4. Nightmare proneness would uniquely predict nightmares after accounting for neuroticism, hyperarousal, chronotype, and concretization.

By testing these psychobiological factors concurrently and situating them alongside personality traits such as neuroticism and concrete cognitive–affective styles, the study examines differentiation of hypothetically proximal, specific vulnerabilities (e.g., nightmare proneness) from broader physiological or circadian contributors. This distinction refines etiological models of nightmare vulnerability and identifies which variables merit priority in future mechanistic and clinical work.

Method

Participants were 110 undergraduate students enrolled in psychology courses at a U.S. university (82.7% women; 16.4% men; 0.9% nonbinary). The mean age was 20.55 years (*SD* = 4.79), ranging from 18 to 47.

Procedure

Institutional Review Board approval was obtained (Protocol No. 22-192). Students were recruited through the department's research pool to participate in a larger study on "Personality and Sleep." After informed consent, participants completed online questionnaires through a secure survey platform and received nominal course credit in exchange for participation. Duplicate participation was screened via embedded checks.

Measures

Nightmare Proneness. Nightmare proneness was assessed using the 14-item Nightmare Proneness Scale (NPS-14), which measures a tendency toward intrusive mentation, affective instability, and threat sensitivity (Kelly, 2018). An example item is, "Many nights I cannot get to sleep because of worry or tension." Items were rated from 1 (*strongly disagree*) to 7 (*strongly agree*), with higher scores indicating greater vulnerability to nightmares. Prior studies support the measure's validity (Kelly & Yu, 2019) and adequate one-week retest reliability (r = .72; Kelly, 2018).

*Chronotype***.** Chronotype was measured using the 8-item Morningness–Eveningness scale of the Chronotype Questionnaire (CrQ; Ogińska, 2011). The scale assesses relative alertness and preferred timing of daily activity. A sample item is, "I feel sluggish in the morning and 'warm up' slowly during the day." Responses were made using the scale's standard 3-point response format (1 = *true*, 3 = *it depends*, 5 = *not true*). Lower total scores indicate morningness, whereas higher scores indicate more eveningness. The CrQ yields a continuous chronotype score rather than

categorical types. Previous research reports evidence of validity and a two-week retest reliability of r = .88 (Ogińska, 2011).

Physiological Hyperarousal. Physiological hyperarousal was assessed using the 6-item Physiological Hyperarousal Scale (PHS; Joiner et al., 1999). The PHS measures the degree to which individuals experience bothersome ANS-related arousal symptoms over the past month. A sample item is, *"Heart pounding or racing."* Items were rated on a 4-point scale from 0 (*not at all*) to 3 (*severely*). Higher scores reflect greater physiological hyperarousal. Previous studies have demonstrated construct validity and internal consistency coefficients ranging from .71 to .80 (Joiner et al., 1999).

Nightmares. Nightmares were assessed with the Nightmare Experience Scale (NExS; Kelly & Mathe, 2019), which measures the frequency of clearly remembered, bothersome nightmares. A sample item is, "I have nightmares several nights a month." Items are rated from 0 (*strongly disagree*) to 4 (*strongly agree*), with higher total scores reflecting more frequent and distressing nightmare experiences. Adequate criterion validity (Cooper & Kelly, 2023) and two-week retest reliability (r = .86; Kelly & Mathe, 2019) have been demonstrated.

Neuroticism. Neuroticism was assessed using the 6-item Neuroticism scale of the NEO-FFI-30 (NEO-30-N; Körner et al., 2008). The scale measures negative affectivity and affective instability. A sample item is, "Sometimes I feel completely worthless." Items are rated from 0 (*strongly disagree*) to 4 (*strongly agree*). Higher scores indicate more neuroticism. Validity evidence and internal consistency estimates ranging from .81 to .90 have been reported (Carr et al., 2022; Körner et al., 2008).

Concretization. Concretization was measured using the 6-item Concretization Scale (Kelly et al., 2024), which assesses the extent to which individuals respond to psychological or emotional states in sensory, somatic, or literalized ways, reflecting a "concretizing" style. A sample item is, "I get openly aggressive when I feel hurt." Items were rated on a 0 (*strongly disagree)* to 4 (*strongly agree*) scale. Higher scores reflect more of a concretizing style. Prior research reports validity support and internal consistency coefficients between .78 and .86 (Kelly et al., 2024).

Statistical Analyses

Analyses were conducted in SPSS 30.0 for Windows. Descriptive statistics and Cronbach's α estimates were computed for all measures. Pearson correlations assessed associations among physiological hyperarousal, chronotype, nightmare proneness, neuroticism, concretization, and nightmares.

Hierarchical regressions were conducted with three dependent variables: nightmare proneness, concretization, and nightmares. Gender (1 = men, 1.5 = nonbinary, 2 = women) and neuroticism were entered at Step 1, followed by hyperarousal and chronotype at Step 2. A final regression examined whether nightmare proneness predicted nightmares beyond all other variables. Significance was evaluated at $p < .05$ (two-tailed).

Results

Preliminary analyses found that women scored significantly higher than men on all variables, *t*s > 2.09, *p*s < .034, except chronotype, $t = 0.47$, $p = .638$. As such, gender was included as a covariate in regressions. Age did not significantly correlate with any study variables, *rs* < .16, *p*s > .103, and was not considered further.

Table 1 presents descriptive statistics and correlations. Nightmare proneness showed strong associations with neuroticism, concretization, and physiological hyperarousal, and a smaller association with evening chronotype. Nightmares significantly correlated with nightmare proneness, hyperarousal, and concretization but not chronotype. Concretization was strongly related to nightmare proneness and physiological hyperarousal and had small associations with nightmares and evening chronotype.

Table 1: Descriptive statistics and correlations between study variables

Variable	1	2	3	4	5	*M*	*SD*	*α*
1. Nightmare Proneness						50.46	18.39	.911
2. Nightmares	.40**					4.90	4.06	.814
3. Physiological Hyperarousal	.60**	.35**				4.86	3.51	.784
4. Chronotype (eveningness)	.29**	.08	.21*			27.78	7.87	.796
5. Concretization	.63**	.30**	.60**	.25**		9.49	5.58	.852
6. Neuroticism	.70**	.24*	.52**	.23*	.60**	17.85	5.99	.858

Note: $N = 110$. *$p < .050$ **$p < .010$

Regression analyses (Table 2) indicated that neuroticism strongly predicted nightmare proneness and concretization at Step 1. Adding hyperarousal and chronotype significantly improved both models. Hyperarousal remained a unique predictor of nightmare proneness and concretization; chronotype did not.

For nightmares, hyperarousal significantly predicted nightmares after controlling for gender and neuroticism (Table 2). However, when nightmare proneness was added, it became the only unique predictor of nightmares (Table 3).

Discussion

The present study examined whether autonomic hyperarousal and chronotype contributed to nightmare proneness, concretization, and distressing nightmares beyond neuroticism. Several hypotheses were supported. Consistent with expectations, autonomic hyperarousal emerged as a predictor across models. Hyperarousal significantly predicted nightmare proneness, concretization, and distressing nightmares in bivariate analyses, and remained a unique predictor of nightmare proneness and concretization after accounting for neuroticism. These findings align with theories proposing that physiological arousal contributes to the activation of dysphoric dream imagery and shapes the sensory–perceptual qualities characteristic of nightmares (Hartmann, 1984; Nielsen & Levin, 2007). Additional study using more sophisticated methodology is warranted to substantiate such speculation.

Table 2: Regression models predicting nightmare proneness, concretization, and nightmares

Nightmare proneness

	Step 1			Step 2		
Variable	*β*	*t*	*p*	*β*	*t*	*p*
Gender	.10	1.37	.175	.08	1.16	.248
Neuroticism	.67	9.24	<.001	.49	6.40	<.001
Physiological Hyperarousal				.31	4.09	<.001
Chronotype (eveningness)				.11	1.68	.097
	$\Delta R^2 = .496$, $F = 52.71$, $p < .001$			$\Delta R^2 = .085$, $F = 10.65$, $p < .001$		

Concretization

	Step 1			Step 2		
Variable	*β*	*t*	*p*	*β*	*t*	*p*
Gender	.08	0.97	.334	.05	0.73	.467
Neuroticism	.58	7.13	<.001	.37	4.35	<.001
Physiological Hyperarousal				.38	4.57	<.001
Chronotype (eveningness)				.08	1.09	.280
	$\Delta R^2 = .368$, $F = 31.10$, $p < .001$			$\Delta R^2 = .115$, $F = 11.73$, $p < .001$		

Nightmares

	Step 1			Step 2		
Variable	*β*	*t*	*p*	*β*	*t*	*p*
Gender	.08	0.85	.396	.07	0.69	.489
Neuroticism	.22	2.19	.031	.07	0.59	.554
Physiological Hyperarousal				.30	2.83	.006
Chronotype (eveningness)				-.01	0.08	.935
	$\Delta R^2 = .065$, $F = 3.71$, $p = .028$			$\Delta R^2 = .066$, $F = 4.02$, $p = .021$		

The results also provide support for the nightmare proneness model. Nightmare proneness was strongly associated with nightmares and uniquely predicted nightmares when all variables were examined simultaneously. This pattern reinforces the position that nightmare proneness reflects a proximal cognitive–affective vulnerability involving intrusive mentation, affective lability, and sensitivity to threat (Kelly, 2018, 2025). Notably, neuroticism, hyperarousal, and concretization did not retain significance once nightmare proneness was included in the full model, suggesting that nightmare proneness represents a more specific dispositional pathway to nightmare experiences than broader negative affectivity or psychobiological activation.

Table 3: Regression using all variables to predict nightmares

	Step 1			Step 2		
Varaible	*β*	*t*	*p*	*β*	*t*	*p*
Gender	.06	0.62	.535	.04	0.39	.701
Neuroticism	.02	0.16	.870	-.13	0.98	.328
Physiological Hyperarousal	.26	2.18	.032	.18	1.48	.143
Chronotype (eveningness)	-.02	0.19	.854	-.05	0.55	.587
Concretization	.12	0.98	.329	.05	0.38	.705
Nightmare Proneness				.36	2.55	.012
	$\Delta R^2 = .139$, $F = 3.37$, $p = .007$			$\Delta R^2 = .051$, $F = 6.48$, $p = .012$		

Although not directly assessed here, imaginative–attentional traits such as absorption and fantasy proneness may also contribute to nightmare vulnerability. These traits have been linked to nightmares (Kelly, 2023b; Levin & Fireman, 2001–2002) and may amplify sensory immersion in dysphoric dream imagery. Such characteristics could interact with hyperarousal and concretization by heightening the vividness or emotional intensity of internally generated content.

Chronotype showed weaker and less consistent effects. Although correlated modestly with nightmare proneness and concretization, chronotype did not significantly predict nightmares after controlling for other variables. This contrasts with prior work linking eveningness to nightmares (Nielsen, 2010) but is consistent with Schredl and Göritz's (2020) interpretation that chronotype indirectly relates to nightmares through neuroticism. One explanation for differences with previous studies which utilized older samples, is that undergraduate students often experience more flexible schedules, potentially attenuating circadian misalignment. Differences in measurement may also play a role, as the present study examined nightmares using the NExS, whereas other studies have used general nightmare frequency indices.

Several limitations of the current study should be considered. The study relied on self-report questionnaires, a predominantly female undergraduate sample, and a cross-sectional design, all of which limit generalizability and do not allow causal inference. Moreover, the sample was small possibly reducing power for detecting small effects with multiple simultaneous predictors. This constraint may be particularly relevant for chronotype, where effects were smaller. Further, retrospective nightmare measures may introduce recall bias, although short-term agreement with prospective diary methods has been demonstrated (Zunker et al., 2015).

Future research should incorporate physiological indicators of arousal, prospective nightmare tracking, and employ larger, more diverse samples. Advanced analytic approaches, such as serial or moderated mediation models, may help clarify pathways linking arousal, circadian rhythm, cognitive–affective vulnerability, and nightmares. However, larger samples would be needed for this (Sim et al., 2022). Integrating neurobiological measures such as resting-state network connectivity associated with arousal and threat sensitivity may also enhance theoretical understanding (Boyd et al., 2018).

In summary, autonomic hyperarousal appears to be a consistent psychobiological correlate of nightmare proneness, concretization, and distressing nightmares, whereas chronotype showed

weaker effects in this sample. Nightmare proneness emerged as the strongest unique predictor of nightmares, supporting its central role in models of nightmare vulnerability.

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