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More Than Attachment: Relationships Between Noctcaelador, Night Sky Attachment, and Night Sky Watching Frequency

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Abstract

Although noctcaelador was originally conceptualized as attachment to the night sky, operationalizations of the construct have included content extending beyond attachment alone. The present study examined relationships among noctcaelador, night sky attachment, and night sky watching frequency in 126 university students. Night sky watching frequency was positively associated with both attachment to the night sky (Spearman's rho = .55, $p < .001$) and composite noctcaelador scores both with (rho = .73, $p < .001$) and without (rho = .72, $p < .001$) the attachment item. A factor analysis including night sky watching frequency and noctcaelador indicators extracted a single factor accounting for 64.7% of the variance, suggesting a night sky personal significance domain broader than attachment. The findings indicate that attachment to the night sky and night sky watching frequency are strongly associated with noctcaelador but may not be entirely synonymous with it. Implications for research on noctcaelador and related constructs are discussed.

Keywords: Noctcaelador; Night sky attachment; Night sky watching; Night sky connectedness; Night sky affinity; Human-night sky relationship

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1. Introduction

Throughout recorded history, humans have watched the night sky for various purposes such as connection with the universe and ancestors, navigation, passing down cultural stories, and measuring time [1,2]. Recent studies suggest that many contemporary individuals watch the night sky, or stargaze, to feel more connected to the universe and nature, spiritual transcendence, and cope with stress [3]. Watching the night sky at least monthly was reported by 57.5–64.2% of national park visitors and university students [4,5], with higher frequencies among amateur and professional astronomers, i.e., 88% [6]. In one sample, night sky watching was ranked third in preferred evening activities following reading and television [7].

While the findings noted above suggest widespread interest and some degree of personal significance for the night sky, relatively little psychological research has examined the topic. Exposure to night sky imagery is associated with improvement in mood, feelings of restoration and "healing", and a deepened

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sense of purpose in life [8-10]. Some studies have indicated there are individual differences in both engagement with and response to the night sky. For instance, openness to experience of the Big Five personality traits was related to experiencing more awe after viewing night sky imagery [11]. A more specific variable that has been studied in relation to the psychology of night sky watching is 'noctcaelador' [12].

Although noctcaelador was originally conceptualized as night sky attachment (a personal bond with the night sky), its name – coined from the Latin nocturnus ("nocturnal"), caelum ("sky"), and adorare ("to adore") – suggests something broader [12]. Further, noctcaelador measurement encompasses composite scores that extend beyond attachment to also include engagement, enjoyment, and personal significance of the night sky [13]. Though implying a broader framework, research has yet to directly examine contributions of night sky attachment to noctcaelador. Indeed, little research was identified at the time of this writing that directly examined night sky attachment outside of noctcaelador. The current research examines noctcaelador and night sky attachment as potentially separate. Such a distinction might be important to understand if the construct extends beyond its original conceptualization [12].

Noctcaelador is suggested to be related to two primary clusters of traits: a rational, inquisitive cognitive style and acknowledgement of nonordinary perceptual experiences and beliefs [14]. One model of noctcaelador views the concept as a personality variable largely based on psychological structure and positive experiences with the night sky [13]. However, recent researchers have proposed an interesting reconceptualization of noctcaelador as a form of nature connectedness, which they term night sky connectedness [15]. Given its large correlation with noctcaelador [15], both variables might be part of a larger night sky affinity domain. Here night sky affinity refers to an individual's psychological attraction, attachment, interest, reactions to, and engagement with the night sky. While noctcaelador is related to nature connectedness and hypothesized personality variables, these relationships are not strong enough to indicate that noctcaelador can be explained by any of them alone [13,15-17].

It is noteworthy that opportunity to watch the night sky is related to, and to some degree conflated with, interest in astronomy [18]. However, astronomy interest is not necessarily the same as noctcaelador, night sky attachment, or night sky watching. Interest in astronomy appears to be statistically separable from both interest in the night sky and noctcaelador [19,20]. Similarly, noctcaelador and night sky watching may be related but separable.

One possible separation concerns opportunity for night sky engagement. For instance, night sky connection is largely unrelated to living in urban vs. rural locations and the presence of light pollution in one's community [15,21], both of which could conceivably lessen frequent night sky watching. While it is possible that the internet and planetariums could provide a night sky proxy in light polluted locales [22], intentionally watching the night sky seems more likely in areas with darker skies [23]. Hence, availability of the night sky may provide a possible separation between night sky affinity, which might not require direct availability of the night sky, and night sky watching frequency. In any case, noctcaelador and/or attachment might increase positive affect and feelings of restoration after exposure to the night sky [24]. Hence night sky watching, noctcaelador, and night sky attachment may share underlying personality, nature-related, and evolutionary mechanisms [11,15,16,25].

Previous studies have reported correlations between night sky affinity and watching ranging between approximately $r = .24$ [15] to $r = .58$ [5]. The former value was converted from an analysis of variance effect size [26] and therefore may not be directly comparable to a correlation coefficient. Differences in sample characteristics and measurement approaches may also have contributed to the variation in findings. For example, response options in [5] were weighted toward higher frequencies of night sky watching, whereas [15] included comparatively few watching frequency categories. Moreover, both studies relied on composite measures of night sky affinity that, as noted above, included content related to, but not necessarily synonymous with, night sky attachment, including awe-related reactions, restorative functions, and even night sky watching itself.

The above review suggests that the magnitude and nature of the relationship between noctcaelador and night sky attachment, and their relations with night sky watching frequency remain open to further examination. As such, the purpose of the current study was to better understand the relationship between noctcaelador and night sky attachment and both their relationships with night sky watching frequency. Better understanding these relationships might provide more understanding of the noctcaelador construct. It might also provide a foundation for future researchers examining night sky affinity and night sky watching variables as well as models examining possible outcomes such as wellbeing. It was expected that noctcaelador and night sky attachment would be related and have a large statistically significant relationship with night sky watching frequency.

2. Method

2.1 Participants and Procedure

Participants included 126 (83 women, 40 men, 3 identified as nonbinary) students enrolled in undergraduate and graduate psychology courses at a university in the United States. The average age of the sample was 20.24 years (SD = 2.73) ranging from 18 to 37. Most participants identified their race/ethnicity as Latinx (n = 93, 73.8%), followed by White/Caucasian (n = 17, 13.5%), Black or African American (n = 7, 5.6%), Asian (n = 4, 3.2%), Native American (n = 1, 0.7%), and "other" (n = 4, 3.2%).

After providing informed consent, volunteer participants completed hardcopy questionnaires in small group settings. No time limits were set, and no exclusion criteria were used. This study was approved by the research ethics board where data collection took place and followed guidelines of the Declaration of Helsinki.

2.2 Measures

2.2.1 Noctcaelador

The 4-item version of the Noctcaelador Inventory (NI-4) [13] was used as an operational measure of noctcaelador, conceptualized here as a broad night sky affinity orientation. Participants respond using a 1 (strongly disagree) to 5 (strongly agree) scale. Higher total scores indicate more noctcaelador. A separate NI-3 was also calculated including the three items that did not note attachment. Evidence for adequate validity and a 1-month retest reliability coefficient of .81 have been reported [13].

2.2.2 Night Sky Attachment

The NI-4 item specifically assessing attachment ("I feel an emotional attachment to the night sky") was used as a more direct indicator of night sky attachment. In the current dataset, this item had a strong correlation with NI-4 total scores, Spearman's rho = .85, $p < .001$. Using the principal axis factor analysis extraction method [27] a single item reliability coefficient of .748 was obtained (using total scores of the NI-3 in the analysis; eigenvalue = 1.50; 74.56% of the variance extracted). These findings were considered to provide some preliminary evidence of convergent validity and reliability.

2.2.3 Night Sky Watching Frequency

Night sky watching frequency was measured using the following item: "About how often do you make it a point to watch the night-sky (assuming the skies are clear)? Following previous research [28], responses included: (0) Never, (1) Less than once a year, (2) 1 time a year, (3) 2-4 times a year, (4) 1 time a month, (5) 2-3 times a month, (6) 1 time a week, (7) Every 2 or 3 nights, (8) Every night. Preliminary psychometric analyses found the item correlated with total NI-4 scores, Spearman's rho = .72, $p < .001$. The single item reliability coefficient using the principal axis factor method [27] was found to be .715 (using NI-4 total scores in the analysis; eigenvalue = 1.43, 71.5% of the variance extracted). These findings were considered to provide preliminary evidence of convergent validity and reliability.

2.4 Statistical Analyses

Analyses used SPSS 30 for Windows (IBM Corp., Armonk, N.Y., USA). Given the ordinal nature of some variables, Spearman's rho was used for correlation coefficients. A principal axis factor analysis was used to examine dimensionality of NI-4 items and night sky watching frequency. Results were determined to be statistically significant if $p < .050$ (two-tailed).

3. Results

The distribution of responses for night sky watching frequency are presented in Table 1. As seen in the table, 11.9% of participants reported never watching the night sky while 3.2% reported watching every night. Collapsing the categories, 35.7% reported watching 2-3 times a year or less while 64.3% reported watching once a month or more, and 34.1% reported night sky watching at least once a week.

Table 1: Night Sky Watching Frequency Responses

Night Sky Watching Frequency	n	%
Never	15	11.9%
Less than once a year	7	5.6%
1 time a year	3	2.3%
2–4 times a year	20	15.9%
1 time a month	19	15.1%
2–3 times a month	19	15.1%
1 time a week	15	11.9%
Every 2 or 3 nights	24	19.0%
Every night	4	3.2%
Total	126	100%

Table 2 presents Spearman rho correlations between variables. As seen in the table, the NI-3 and NI-4 versions were very strongly correlated with each other. The NI-3 and NI-4 were also strongly correlated with the night sky attachment item and the night sky watching frequency item. The night sky attachment item and night sky watching frequency were significantly correlated, albeit not as strongly as the other variables. The correlation coefficients for night sky watching frequency with the NI-3 and night sky attachment were significantly different, $z = 2.43$, $p = .015$.

Table 2: Correlations and Descriptive Statistics for Study Variables

Variable	1	2	3	M	SD	α
1. Watching Frequency				4.24	2.34	--
2. NI-3	.73			10.56	4.82	.856
3. NI-4	.72	.98		8.08	3.69	.887
4. Attachment	.55	.75	.85	2.48	1.39	--

Note: N = 126. All variables significantly correlated at $p < .001$. NI-3 and NI-4 = Noctcaelador Inventory 3 or 4 item version, respectively

The principal axis factor analysis of NI-4 items and night sky watching frequency extracted 1 factor accounting for 64.7% (eigenvalue = 3.24) of the systematic variance in responses. Factor loadings are presented in Table 3. As presented in the table, all items strongly loaded on the latent factor. Though still strong, the lowest loading was for night sky watching frequency.

Table 3: Factor Analysis of Noctcaelador Inventory-4 Items and Night Sky Watching Frequency	
Item	**Factor Loading**
I feel an emotional attachment to the night sky.	.79
I like to go outside and look at the sky at night often.	.81
Having time to look at the night sky is important to me.	.85
I find more pleasure in looking at the night sky than most people.	.81
About how often you make it a point to watch the night-sky?	.76

4. Discussion

The results were consistent with the expectation that both noctcaelador and night sky attachment would be positively associated with night sky watching frequency. Participants who reported more frequent night sky watching generally endorsed stronger attachment to the night sky, and the magnitude of this relationship was large. Even larger was the relationship between night sky watching frequency and noctcaelador, regardless of whether the attachment item was included. These findings are consistent with previous findings of relationships between night sky watching and night sky affinity [5,15]. However, the present study extends prior findings by using a more balanced measure of night sky watching frequency and composite measures of noctcaelador along with a more direct measurement of night sky attachment. Of note, the finding that 64.3% of individuals reported night sky watching at least monthly is similar to findings from different samples up to two decades earlier [4,5].

An important implication of the findings is that night sky watching frequency and night sky attachment should not be treated as interchangeable indicators. Thus, behavioral engagement with the night sky appears to be an important correlate of attachment rather than a proxy for it. Importantly, the findings further suggest that night sky attachment may represent one important component of noctcaelador rather than being entirely synonymous with it and thus likely not broad enough to define the construct. Noctcaelador lost little variance when not including the attachment item and was more strongly related to night sky watching frequency than attachment itself. Further while the factor analysis replicated previous work [13], it also suggests that night sky watching is part of a larger night sky affinity domain but contributed no more to it than other markers.

Overall, the current findings suggest, as alluded to earlier, that noctcaelador, as operationalized by the NI-4, may capture an affinity orientation reflecting the broader psychological significance of the night sky, including emotional attachment, personal importance, pleasure, and engagement [12,13]. Explicating the domain further, night sky watching may be understood as an observable behavioral engagement component, whereas attachment and other noctcaelador markers, reflect a subjective psychological significance of the night sky.

In addition to implications for the noctcaelador concept, the current findings also have implications for research on nature connectedness, restoration, awe, and wellbeing. Previous studies suggest that exposure to the night sky may be associated with positive affect, restoration, personal meaning, and awe [8-11,24]. The present results suggest that night sky watching frequency and noctcaelador are highly related but perhaps somewhat different aspects of these experiences. The findings also underscore previous findings that indicated underlying psychological variables may influence reactions to the night sky [11,24].

Several limitations of the current study should be noted. First, the cross-sectional design prevents conclusions regarding causation. More frequent observation may contribute to attachment, but attachment may also motivate individuals to observe the night sky more often. Second, the sample consisted primarily of young, Latinx university students which may limit generalizability to other populations. Third, attachment was assessed with a single item. Although this item showed a strong association with noctcaelador scores and preliminary evidence of reliability, future studies would

benefit from multi-item measures accounting for more variance that specifically assess attachment to the night sky. This would allow a more nuanced investigation of its role in noctcaelador. Fourth, night sky watching frequency was assessed through self-report and did not account for contextual influences such as dark sky access, safety, light pollution, nature connectedness, or the availability of outdoor space [15,29,30].

In addition to developing multi-item measures of night sky attachment, future research using longitudinal studies could help clarify whether repeated observation fosters noctcaelador over time or whether attachment or noctcaelador primarily motivate observation. Experimental and experience-sampling approaches may also help determine whether the psychological effects of night sky exposure differ as a function of general attachment styles in addition to night sky attachment. More broadly, future work should further examine whether night sky affinity represents a distinct form of nature connectedness, an aesthetic or existential orientation, or part of a broader constellation of traits involving openness, awe-proneness, and personality organization. Finally, future research could investigate how noctcaelador influences relationships between night sky engagement and wellbeing outcomes, and whether observation frequency and personal night sky significance contribute independently to outcomes such as restoration, meaning, environmental concern, and psychological wellbeing.

In sum, the present findings indicate that night sky watching frequency, attachment to the night sky, and noctcaelador are strongly interrelated concepts that may reflect broader psychological significance of the night sky. Noctcaelador was more strongly associated with night sky watching frequency than attachment alone, suggesting that it may reflect personal significance of the night sky beyond night sky attachment and engagement.

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