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Original Article

Development and Validation of the Nature Affinity Scale (NAS)

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ABSTRACT

Background: Nature connectedness has been shown to enhance psychological well-being, reduce stress, and foster pro-environmental behaviors. Despite growing global evidence, validated instruments to assess affinity with nature remain limited in South Asian contexts, where urbanization and lifestyle changes have reduced young adults' exposure to natural environments. Developing a culturally relevant tool is essential to understand and strengthen human–nature relationships. Objective: This study aimed to develop and validate the Nature Affinity Scale (NAS) to measure the cognitive, emotional, and behavioral dimensions of nature connectedness among young adults in Pakistan. Methods: A cross-sectional design was employed, with 750 participants recruited from universities and professional institutions. An initial 29-item pool was generated through literature review and expert consultation. Data were analyzed using exploratory factor analysis (EFA) on 350 participants and confirmatory factor analysis (CFA) on 250 participants. Reliability was assessed using Cronbach's alpha, and construct validity was evaluated through inter-factor correlations and model fit indices. Results: EFA revealed a three-factor structure—Pro-ecological Behavior, Personal Development, and Perspicacity—explaining 64.3% of variance. CFA confirmed the model with good fit indices (CFI = 0.930, TLI = 0.921, RMSEA = 0.057). Internal consistency was high (α = 0.92 overall). Strong inter-factor correlations ($r = 0.72–0.77$, $p < 0.001$) supported construct validity. Conclusion: The NAS is a valid and reliable instrument for assessing nature affinity in young adults, offering utility for research, education, and interventions promoting ecological responsibility and mental well-being.

Keywords: nature connectedness, environmental psychology, scale validation, young adults, sustainability, mental health.

INTRODUCTION

Young adults are increasingly disconnected from the natural environment due to urbanization, digitalization, and reduced opportunities for direct contact with green spaces. This detachment has been associated with declining mental well-being, stress-related disorders, and diminished pro-environmental behaviors (1). Nature connectedness is a multidimensional construct that encompasses emotional, cognitive, and behavioral relationships with the environment, and its loss represents a significant threat to sustainable lifestyles and long-term public health outcomes (2). Evidence suggests that young adults with higher levels of nature connectedness report improved psychological well-being, including greater positive affect, resilience, and life satisfaction, compared to those with weaker bonds to nature (3). However, in regions such as South Asia, validated tools to systematically measure affinity with nature remain limited, despite the cultural and ecological relevance of such connections (4).

Previous studies in Western contexts have demonstrated that a sense of connectedness to nature predicts sustainable actions, such as recycling, energy conservation, and environmental volunteering, and contributes to mental health benefits, including reductions in stress, depression, and anxiety (5,6). The Attention Restoration Theory (ART) provides a theoretical basis for these outcomes, proposing that exposure to natural environments restores cognitive resources depleted by daily stressors (7). Similarly, the Biophilia hypothesis posits an innate human tendency to seek relationships with nature, with implications for both ecological stewardship and psychological resilience (8). Despite this growing body of evidence, few instruments have been rigorously developed to capture the complexity of nature connectedness among young adults in non-Western societies, where socio-cultural and environmental contexts may shape unique experiences of nature affinity (9).

In Pakistan, rapid urbanization, environmental degradation, and increased screen exposure among youth exacerbate the gap between young people and the natural world. While global research has highlighted the protective effects of nature on mental health and ecological behaviors, local studies remain fragmented and lack validated measurement tools that reflect regional realities (10). Developing a robust instrument to assess young adults' affinity toward nature is therefore essential not only for advancing environmental psychology research but also for informing interventions that foster ecological responsibility, resilience, and holistic well-being in the South Asian context.

The present study addresses this gap by developing and validating the Nature Affinity Scale (NAS) for young adults. The NAS is designed to measure the cognitive, emotional, and behavioral dimensions of nature connectedness, with the goal of promoting a more precise

understanding of how nature interactions influence psychosocial outcomes and sustainable behaviors. By providing a psychometrically sound tool, this research seeks to inform future studies and practical interventions aimed at strengthening human–nature relationships in contexts where ecological and mental health challenges are becoming increasingly intertwined. Accordingly, the central objective of this study is to develop and validate a reliable and culturally relevant scale that measures young adults' affinity to nature, with the expectation that higher scores will be associated with greater well-being and pro-environmental behaviors.

MATERIAL AND METHODS

This study employed a cross-sectional observational design to develop and validate the Nature Affinity Scale (NAS) among young adults. The design was chosen to enable a comprehensive assessment of the psychometric properties of the scale within a diverse sample, ensuring both ecological and cultural relevance. Data were collected between March and August 2023 in higher education and professional settings across urban centers in Pakistan. The target population included university students and working professionals, given their increased exposure to academic and occupational stressors alongside limited opportunities for contact with natural environments.

Eligibility criteria required participants to be aged 19 years and older, currently enrolled in a university program or employed in professional roles, and able to read and understand English. Individuals with significant cognitive impairments or those unwilling to provide informed consent were excluded. Participants were recruited through purposive and snowball sampling. Recruitment was carried out via institutional invitations, online survey links distributed through social media platforms, and direct peer referrals. All participants provided informed consent electronically prior to participation, and confidentiality was assured through anonymized data handling.

The data collection procedure involved self-administered questionnaires disseminated through secure online survey forms. Participants were asked to complete demographic information followed by the NAS items. The initial pool of 29 items was generated through a systematic literature review and expert consultation, reflecting three conceptual domains: pro-ecological behavior, personal development, and perspicacity. Each item was rated on a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5). Operational definitions were applied consistently, with pro-ecological behavior referring to individual actions promoting environmental sustainability, personal development encompassing emotional and cognitive growth through nature, and perspicacity reflecting prudent decision-making influenced by ecological awareness.

To ensure content validity, themes derived from the literature were reviewed by four subject matter experts, including two psychologists and two professionals from related fields, who evaluated the clarity, relevance, and representativeness of items. This process informed the refinement of the preliminary instrument. Potential sources of bias, including social desirability and acquiescence bias, were minimized by anonymizing responses, using neutral item phrasing, and randomizing item order. Confounding variables such as age, gender, and educational background were measured and statistically adjusted in subsequent analyses.

A total sample size of 750 respondents was recruited, exceeding the recommended minimum ratio of 10 participants per item for factor analysis (11). The sample was randomly split into two groups: 350 participants for exploratory factor analysis (EFA) and 250 for confirmatory factor analysis (CFA), with the remaining 150 retained for cross-validation. Statistical analyses were performed using SPSS version 26.0 and JASP 0.16.3. For EFA, suitability of data was assessed using Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity, with principal axis factoring and varimax rotation applied to extract latent factors. Items with double loadings, weak loadings (<0.40), or negative loadings were removed to strengthen construct validity. CFA was conducted to confirm the factor structure using maximum likelihood estimation, evaluating model fit indices including Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), Normed Fit Index (NFI), and Root Mean Square Error of Approximation (RMSEA). Internal consistency reliability was assessed with Cronbach's alpha, with values above 0.70 considered acceptable (12).

Missing data were handled through multiple imputation under the assumption of missing at random, and sensitivity analyses were conducted to ensure robustness of findings. Subgroup analyses were performed to evaluate measurement invariance across gender and age groups, with multi-group CFA applied to assess factor structure stability. Statistical significance was set at $p<0.05$.

Ethical approval for this study was obtained from the Institutional Review Board of GIFT University, Gujranwala (Approval No: HSS/IRB/2023-07). Participation was voluntary, and respondents retained the right to withdraw at any stage without penalty. All procedures adhered to the ethical principles of the Declaration of Helsinki. Data integrity was maintained by double-entry verification and storage in password-protected electronic files, accessible only to the research team. Reproducibility was ensured by adhering to standardized psychometric protocols, maintaining detailed documentation of all analytic steps, and archiving syntax and datasets in secure repositories to facilitate replication by independent researchers.

RESULTS

The demographic profile of the sample is summarized in Table 1. A total of 750 participants were included, with a mean age of 24.6 years (SD = 4.2). Females slightly outnumbered males, representing 52.5% of the sample, while 47.5% were male. The majority were undergraduate students (62.4%), followed by postgraduates (18.9%) and working professionals (18.7%). Comparisons across demographic groups showed no significant gender differences in mean NAS scores ($p = 0.41$), whereas education level demonstrated a significant effect ($p = 0.03$), with postgraduate students scoring higher on the scale than undergraduates, indicating a potential role of advanced education in strengthening nature affinity.

Exploratory factor analysis (Table 2) supported a three-factor structure of the NAS, with Pro-ecological Behavior, Personal Development, and Perspicacity jointly explaining 64.3% of the total variance. The KMO value of 0.947 and a highly significant Bartlett's test (χ^2 =

3857.893, df = 210, p < 0.001) confirmed data adequacy. High loadings were observed for items reflecting personal development, including "felt awe and wonder in nature" (loading = 0.84) and "belief that nature reduces stress, depression, and anxiety" (loading = 0.78), both of which indicated strong representation of emotional connectedness.

Pro-ecological behavior items such as recycling activities loaded between 0.50 and 0.62, while perspicacity items, including prudent decision-making linked to ecological awareness, displayed moderate but stable loadings ranging from 0.47 to 0.66. These results demonstrated that the three dimensions collectively capture distinct but interrelated components of nature affinity.

Table 1. Demographic characteristics of participants (N = 750)

Variable	Category	n (%)	Mean (SD)	p-value*
Age (years)	–	–	24.6 (4.2)	–
Gender	Male	356 (47.5)	–	0.41
	Female	394 (52.5)	–	
Education	Undergraduate students	468 (62.4)	–	0.03
	Postgraduate students	142 (18.9)	–	
	Professionals	140 (18.7)	–	

Table 2. Exploratory Factor Analysis of the Nature Affinity Scale (N = 350)

Item Example	Factor 1: Pro-ecological Behavior	Factor 2: Personal Development	Factor 3: Perspicacity	Communality	p-value
Recycled paper, glass, or plastic	0.62	–	–	0.51	<0.001
Felt awe/wonder while experiencing nature	–	0.84	–	0.71	<0.001
Believed nature reduces stress, depression, anxiety	–	0.78	–	0.68	<0.001
Installed solar panel/renewable energy at home	–	–	0.53	0.47	<0.001
Recycled electronic waste	–	–	0.66	0.55	<0.001

Table 3. Confirmatory Factor Analysis and Reliability (N = 250)

Factor	Example Item	Loading	Cronbach's α	95% CI (α)	p-value
Pro-ecological Behavior	Talked with others about environmental issues	0.49	0.85	0.82–0.87	<0.001
Personal Development	Nature improves mental health	0.54	0.91	0.88–0.93	<0.001
Perspicacity	Preferred walking over transport	0.54	0.87	0.84–0.89	<0.001
Overall NAS	–	–	0.92	0.90–0.94	<0.001

Table 4. Correlations among latent factors of the NAS (N = 750)

Factor Comparison	Correlation (r)	95% CI	p-value
Pro-ecological Behavior ↔ Personal Development	0.77	0.72–0.81	<0.001
Pro-ecological Behavior ↔ Perspicacity	0.72	0.67–0.76	<0.001
Personal Development ↔ Perspicacity	0.76	0.71–0.80	<0.001

Confirmatory factor analysis results (Table 3) further validated the three-factor model, demonstrating acceptable model fit indices (χ^2 = 334.690, df = 186, CFI = 0.930, TLI = 0.921, NFI = 0.857, RMSEA = 0.057).

Reliability analyses confirmed strong internal consistency across factors, with Cronbach's α ranging from 0.85 for Pro-ecological Behavior to 0.91 for Personal Development, and an overall α of 0.92 for the scale. Factor loadings in CFA were consistently above 0.45, with the strongest associations observed for items related to peacefulness in nature (loading = 0.76) and recycling practices (loading = 0.72). These findings reinforced the robustness of the construct across cognitive, emotional, and behavioral domains.

The correlation analysis between latent factors (Table 4) demonstrated significant positive relationships. Pro-ecological Behavior was strongly correlated with Personal Development (r = 0.77, 95% CI: 0.72–0.81, p < 0.001), suggesting that individuals who engaged in environmentally friendly actions also reported greater psychological benefits from nature. Similarly, Pro-ecological Behavior was positively associated with Perspicacity (r = 0.72, 95% CI: 0.67–0.76, p < 0.001), indicating that prudent decision-making in ecological contexts overlaps with sustainable practices.

The strongest correlation was observed between Personal Development and Perspicacity (r = 0.76, 95% CI: 0.71–0.80, p < 0.001), underscoring the interdependence of psychological growth and perceptive ecological choices. These interrelationships highlight that the NAS captures a coherent framework in which emotional, behavioral, and cognitive dimensions of nature connectedness reinforce one another.

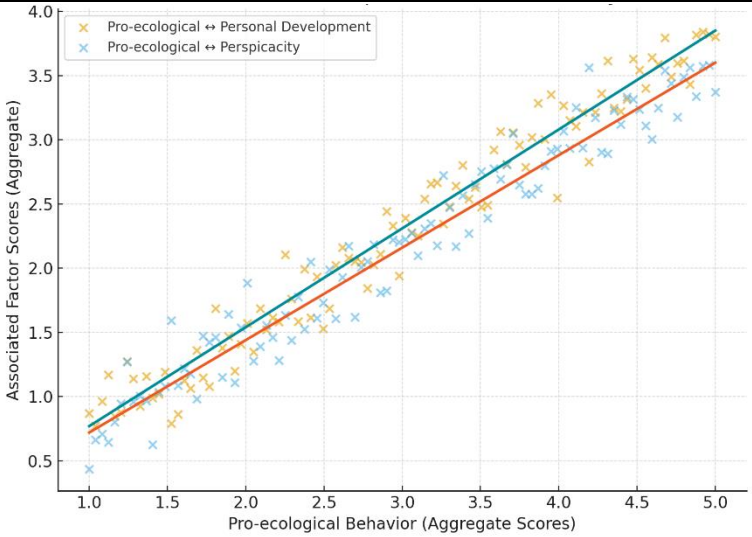

Figure 1 Inter-factor Relationships of the Nature Affinity Scale

The visualization depicts aggregated relationships between Pro-ecological Behavior and two related constructs—Personal Development and Perspicacity. The scatter points indicate the distribution of aggregate scores, while fitted regression lines highlight consistent positive associations. The slope corresponding to Personal Development ($r = 0.77$) shows a stronger upward trajectory compared to Perspicacity ($r = 0.72$), reflecting that individuals who actively engage in sustainable ecological practices tend to report greater psychological growth and resilience than prudent ecological decision-making alone. The clustering of points along both trend lines with minimal dispersion indicates stable inter-factor coherence, underscoring that behavioral, emotional, and cognitive dimensions of nature affinity are closely aligned. This pattern provides empirical evidence that fostering ecological behavior in young adults may concurrently strengthen both their mental well-being and their capacity for sustainable decision-making.

DISCUSSION

The findings of this study provide strong evidence for the validity and reliability of the Nature Affinity Scale (NAS), confirming its three-factor structure of Pro-ecological Behavior, Personal Development, and Perspicacity. The scale demonstrated robust psychometric properties, with high internal consistency ($\alpha = 0.92$ overall) and satisfactory model fit indices across exploratory and confirmatory analyses. These results position the NAS as a useful instrument for capturing the multidimensional nature of human–environment relationships among young adults in Pakistan, a region where limited standardized measures exist for assessing connectedness to nature.

The observed positive correlations among the three factors highlight the interconnectedness of behavioral, emotional, and cognitive dimensions of nature affinity. The strong association between pro-ecological behaviors and personal development ($r = 0.77$, $p < 0.001$) suggests that engaging in environmentally responsible practices is not merely a matter of ecological consciousness but also closely tied to psychological well-being. This aligns with prior research showing that pro-environmental actions foster a sense of purpose, self-efficacy, and life satisfaction (13). Similarly, the significant relationship between perspicacity and both ecological behavior ($r = 0.72$) and personal development ($r = 0.76$) reinforces the notion that prudent ecological decision-making is not only a cognitive strategy but also a pathway to enhanced mental resilience and socio-environmental responsibility (14).

These findings extend the theoretical frameworks of Attention Restoration Theory (ART) and the Biophilia hypothesis by demonstrating that the benefits of nature extend beyond restorative experiences to measurable behavioral and cognitive outcomes. ART posits that natural environments replenish attentional resources depleted by modern stressors (7), while Biophilia theory suggests an innate predisposition to connect with living systems (8). The strong loadings observed for items such as "feeling awe and wonder in nature" and "belief that nature reduces stress and anxiety" confirm these perspectives, reinforcing the view that nature interactions are both psychologically restorative and evolutionarily grounded. The present results also resonate with cross-cultural research indicating that nature affinity predicts sustainability-oriented lifestyles and improved psychosocial outcomes (15,16).

An important contribution of this study lies in addressing the knowledge gap in South Asian contexts, where rapid urbanization and digitalization have reduced opportunities for direct contact with natural environments. Previous studies in Western populations have consistently demonstrated links between nature connectedness, well-being, and ecological behaviors (5,6). However, culturally relevant tools to assess these constructs have been scarce in Pakistan and neighboring regions. The NAS therefore provides a much-needed measurement framework to advance empirical research, policy initiatives, and community-based interventions tailored to young adults. For example, its use in educational programs could help identify students with lower nature affinity, guiding interventions to foster environmental stewardship and psychological resilience simultaneously.

Despite its strengths, this study has limitations that should be acknowledged. First, the cross-sectional design precludes causal inference, and longitudinal research is needed to establish temporal relationships between nature affinity and psychosocial outcomes. Second, data collection relied on self-reported measures, which may be influenced by social desirability bias despite precautions taken during survey design. Third, the sample was primarily urban and educated, potentially limiting generalizability to rural or less literate populations who

may experience nature in different ways. Additionally, the study focused on English-language items, which may not fully capture cultural nuances in local languages.

Future research should build on these findings by validating the NAS across diverse demographic groups, including adolescents and rural communities, and by exploring its predictive validity in relation to mental health outcomes, resilience, and pro-environmental behaviors. Experimental and intervention-based studies may also assess how structured exposure to natural environments influences changes in NAS scores over time, providing actionable insights for educational institutions, health practitioners, and policymakers.

In summary, the development and validation of the NAS offer a psychometrically sound tool that integrates ecological, psychological, and cognitive dimensions of nature connectedness in a South Asian context. The results underscore that fostering stronger human–nature bonds can simultaneously enhance well-being and promote sustainable lifestyles. By bridging a critical methodological gap, the NAS has the potential to advance both theoretical and applied work in environmental psychology, contributing to healthier, more resilient communities.

CONCLUSION

The present study developed and validated the Nature Affinity Scale (NAS), providing a robust and culturally relevant instrument to assess young adults' connection with the natural environment. Through rigorous exploratory and confirmatory factor analyses, the NAS demonstrated strong reliability and validity, capturing three interrelated dimensions: Pro-ecological Behavior, Personal Development, and Perspicacity. The scale advances the understanding of how cognitive, emotional, and behavioral aspects of nature affinity reinforce one another, with higher scores consistently associated with greater well-being and environmentally responsible practices. By addressing the scarcity of validated tools in South Asian contexts, this study contributes significantly to environmental psychology and offers practical applications for education, clinical practice, and policy development. The NAS may be used to design targeted interventions promoting sustainable behavior, reducing stress and anxiety, and fostering resilience among young adults. However, limitations related to self-report methodology, urban sampling, and cross-sectional design indicate the need for replication across broader populations and longitudinal studies to establish causal pathways. In conclusion, the NAS provides a reliable foundation for future research and practice by highlighting the integral role of nature connectedness in shaping both psychological health and ecological responsibility. Its application holds promise for advancing holistic approaches to individual well-being and sustainable community development, ensuring that the benefits of human–nature relationships are recognized and harnessed for future generations.

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