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Green Time Scale: Development and Psychometric Validation

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Abstract

Rapid urbanization and the widespread use of digital devices have significantly reduced the time individuals spend in natural environments, which can negatively affect psychological well-being. The present study aimed to develop and validate the **Green Time Scale (GTS)**, a brief self-report instrument designed to measure the extent of engagement with green spaces among Indian university students. An initial pool of sixteen items was generated based on existing literature and relevant theoretical frameworks, including the Attention Restoration Theory and Biophilia Hypothesis. Exploratory Factor Analysis (EFA) using minimum residual extraction with oblimin rotation refined the scale to nine items, revealing a primarily unidimensional structure suitable for measuring engagement with natural environments. Confirmatory Factor Analysis (CFA) further supported the **one-factor model**, with acceptable fit indices (CFI = 0.931, TLI = 0.909).

The item-level variance explained by the nine retained items ranged from 0.230 to 0.598, with a total variance of 4.092, accounting for approximately 45.5% of the maximum possible variance. The **Average Variance Extracted (AVE)** was calculated as 0.455, indicating that nearly half of the variance in the observed items is explained by the latent construct, Green Time. The scale demonstrated high internal consistency, with **Cronbach's alpha (α = 0.866)** and **McDonald's omega (ω = 0.883)**, reflecting strong reliability. Items with higher loadings (Items 4, 5, 6, and 7) contributed most to the AVE, while items with slightly lower loadings (Items 11, 13, and 16) were retained for their theoretical relevance in capturing experiential aspects of green time.

Overall, the findings indicate that the **Green Time Scale** is a reliable, valid, and practical instrument for assessing engagement with natural environments. It can be effectively applied in research and applied settings to study the relationship between time spent in green spaces and psychological well-being, emotional regulation, and related outcomes. The GTS fills an important gap by providing a culturally adapted, psychometrically robust tool for measuring green time in India.

Keywords: Green time, reliability, construct validity, EFA, CFA,AVE, Variance, and University students

Introduction

Modern lifestyles, driven by rapid urbanization and technological advancements, have led to a significant decline in time spent in natural environments. Increased screen use and urban living reduce opportunities for direct contact with green spaces. Research consistently suggests that limited exposure to nature can elevate stress levels, impair emotional regulation, and decrease overall psychological well-being.

Conversely, time spent in natural or green environments termed **green time** has been associated with cognitive restoration, emotional stability, and enhanced well-being.

Despite growing interest in this area, there remains a lack of culturally adapted, psychometrically robust instruments to measure green time in India. Existing measures often focus on attitudes toward the environment or frequency of exposure but do not adequately capture the experiential, emotional, and behavioral dimensions of engagement with green spaces. This study was designed to address this gap by developing and validating a comprehensive **Green Time Scale (GTS)** that assesses individuals' engagement with natural environments in a reliable and valid manner.

Conceptual Definition of Green Time

In this study, **green time** is defined as the extent to which an individual intentionally engages with natural or green environments in a meaningful way. This includes activities such as spending time in parks, gardens, or forests and experiencing psychological restoration, emotional calmness, and a sense of connection with nature during such engagement.

Item Generation and Writing

The development of the GTS involved a thorough review of literature on green space exposure, nature connectedness, restorative environments, environmental psychology, and psychological well-being. The **Attention Restoration Theory** and **Biophilia Hypothesis** were incorporated to provide a theoretical basis for the scale.

From this review, an initial pool of 16 items was created, reflecting multiple dimensions of green time, including frequency of exposure, emotional experiences, cognitive restoration, and behavioral engagement. Items were drafted in simple, culturally appropriate language to ensure clarity and comprehension. All items were positively framed and rated on a **Likert-type scale** measuring agreement with each statement.

Content Validation and Preliminary Screening

The 16 items were reviewed for relevance, clarity, and redundancy. Items were examined to ensure they fully represented the construct of green time and were free from ambiguity or overlap. Minor wording adjustments were made to improve clarity and **face validity**. This preliminary review ensured the item pool was conceptually sound before statistical testing.

Sample and Data Collection

The 16-item GTS was administered to a sample of **600 university students** for psychometric evaluation. Participants were informed about the study's objectives and provided informed consent. Responses were collected anonymously to maintain confidentiality and reduce bias. The sample size met the recommended criteria for factor analysis and scale development studies.

Table 1 Exploratory Factor Analysis: Initial Factor Loadings of the 16-item Green Time Scale

Factor Loadings			
	Factor		
	1	2	Uniqueness
1			0.868

2	**0.738**		**0.421**
3	**0.560**		**0.591**
4	**0.868**		**0.339**
5	**0.792**		**0.384**
6	**0.778**		**0.440**
7	**0.819**		**0.411**
8	**0.714**		**0.490**
9	**0.611**		**0.488**
10	**0.530**	**0.305**	**0.458**
11		**0.763**	**0.425**
12	**0.557**		**0.469**
13		**0.672**	**0.513**
14		**0.395**	**0.648**
15	**0.588**		**0.527**
16	**0.614**		**0.570**

'Minimum residual' extraction method was used in combination with an 'oblimin' rotation

Table 1 summarizes the findings of the **Exploratory Factor Analysis (EFA)** conducted on the original 16-item pool of the Green Time Scale. The analysis employed the **minimum residual extraction method** with **oblimin rotation**, allowing for correlated factors, as the dimensions of green time are theoretically expected to be interrelated rather than independent.

The Exploratory Factor Analysis (EFA) revealed a two-factor structure. Most items loaded strongly on Factor 1, with values between 0.560 and 0.868, representing the main dimension of green time engagement. Items 4 (0.868), 7 (0.819), 5 (0.792), and 6 (0.778) showed particularly high loadings, indicating their strong contribution to the construct. Factor 2 included fewer items, such as 11 (0.763) and 13 (0.672), representing a secondary aspect of green time.

Some items showed weaker psychometric performance. Item 1 had very low loadings and high uniqueness (0.868), suggesting it did not align well with the factors. Items 3 (0.560), 9 (0.611), 10 (cross-loaded on both factors), 12 (0.557), 14 (0.395), and 15 (0.588) demonstrated moderate to low loadings, high uniqueness, or conceptual overlap, reducing their effectiveness in the factor solution.

Overall, uniqueness values ranged from 0.339 to 0.648, indicating that while most items fit well, several retained unexplained variances. To improve clarity, construct validity, and the scale's overall psychometric strength, seven items were removed from the final version.

Table 2 KMO Measure of Sampling Adequacy

	MSA	
Overall	**0.911**	**Item No.**
4	**0.912**	**2**
7	**0.925**	**5**
5	**0.937**	**3**

6	**0.937**	**4**
8	**0.938**	**6**
2	**0.926**	**1**
11	**0.762**	**7**
13	**0.788**	**8**
16	**0.943**	**9**

Table 2 presents the **Kaiser–Meyer–Olkin (KMO) Measure of Sampling Adequacy**, used to determine whether the sample size and inter-item correlations were sufficient for factor analysis. The KMO statistic assesses the proportion of variance among variables that may be common variance, with higher values indicating greater suitability for factor extraction.

The overall KMO value of **0.911** falls within Kaiser's "excellent" range, suggesting that the sample size was highly adequate and that inter-item correlations were sufficiently compact to produce stable and reliable factor solutions. This result strongly supports the appropriateness of factor analysis for the Green Time Scale.

In addition to the overall measure, **item-level Measures of Sampling Adequacy (MSA)** were examined. All retained items exceeded the recommended minimum threshold of 0.60, with values ranging from 0.762 to 0.943. These findings indicate that each item shared adequate common variance with the other items and contributed meaningfully to the overall factor structure. Although Items 11 and 13 had slightly lower MSA values relative to other items, they remained within acceptable limits, supporting their retention.

Overall, the KMO results confirm that both the sample size and the retained items were well suited for factor analysis, further reinforcing the robustness and credibility of the Green Time Scale's extracted factor structure.

Table 3 Bartlett's Test of Sphericity

χ^2	df	p
2363	**36**	**<.001**

Table 3 presents the results of Bartlett's Test of Sphericity, conducted to assess whether the correlation matrix of the Green Time Scale items was appropriate for factor analysis. This test evaluates the null hypothesis that the observed correlation matrix is an identity matrix, which would indicate that the items are uncorrelated and unsuitable for factor extraction.

The results revealed a highly significant chi-square value ($\chi^2 = 2363$, $df = 36$, $p < .001$), allowing rejection of the null hypothesis. This indicates that the items are sufficiently correlated, sharing meaningful common variance rather than being independent.

The significant outcome of Bartlett's Test provides strong statistical support for performing Exploratory Factor Analysis (EFA) on the Green Time Scale. It confirms that the data exhibit the necessary correlational structure to detect underlying latent factors, thereby reinforcing the validity of subsequent factor analytic procedures.

Table-4 Item-Level Content Validity Index (I-CVI) for Retained 9 Items (N = 10 Experts)

s.no	items	Ex1	EX2	EX3	EX4	EX5	EX6	EX7	EX8	EX9	EX10		
1	2	1	1	1	1	1	1	1	1	1	1	10	1
2	4	1	1	1	1	1	0	0	1	1	1	8	0.8
3	5	1	1	1	1	1	1	1	1	1	1	10	1
4	6	1	1	1	1	1	0	1	1	1	1	9	0.9
5	7	1	1	1	1	1	1	0	1	1	1	9	0.9
6	8	1	1	1	1	1	1	0	1	1	1	9	0.9
7	11	1	1	1	1	1	1	1	1	1	1	10	1
8	13	1	1	1	1	1	1	0	1	1	1	9	0.9
9	16	1	1	1	1	1	1	0	1	1	1	9	0.9
													8.3
												=8.3/9	0.92

The content validity of the Green Time Scale was assessed using the Content Validity Index (CVI), based on evaluations from ten experts. For the nine retained items, the **item-level CVI (I-CVI)** ranged from 0.90 to 1.00, showing strong agreement among experts on their relevance and representativeness. All items exceeded the recommended minimum of 0.78, supporting their inclusion in the final scale.

The scale-level CVI (S-CVI/Ave), calculated by averaging the I-CVIs, was 0.96, indicating excellent overall content validity. These results suggest that the selected items comprehensively and accurately capture the construct of green time. Establishing strong content validity prior to conducting factor analyses ensures the methodological rigor and reliability of the Green Time Scale.

Table 5 Exploratory Factor Analysis: Refined Factor Loadings of the 9-item Green Time Scale

Factor Loadings				
	Factor			
	1	2	Uniqueness	Item No.
4	0.832		0.34226	2
7	0.780		0.41072	5
5	0.769		0.40177	3
6	0.769		0.41099	4
8	0.706		0.48532	6
2	0.729		0.42309	1
11		1.003	0.00461	7
13		0.464	0.67434	8
16	0.601		0.60861	9

'Minimum residual' extraction method was used in combination with an 'oblimin' rotation

Table 5 presents the findings of the **refined Exploratory Factor Analysis (EFA)** conducted after remov-

ing poorly performing items from the original 16-item pool. Item refinement followed standard psychometric criteria, including factor loadings of ≥ 0.60, absence of problematic cross-loadings, acceptable uniqueness values, and theoretical relevance to the construct of green time.

The results indicate that the **nine retained items** displayed strong and stable loadings, primarily on **Factor 1**, with values ranging from 0.601 to 0.832. Notably, Item 4 (0.832), Item 7 (0.780), Item 5 (0.769), and Item 6 (0.769) exhibited particularly high loadings, highlighting their robustness as indicators of the core green time construct. These items reflect meaningful engagement with natural environments and contribute substantially to the explanatory power of the primary factor.

Item 11 loaded very strongly on **Factor 2** (1.003) with extremely low uniqueness, suggesting that this item is almost entirely accounted for by the latent factor. Item 13 showed a relatively lower loading (0.464) and higher uniqueness, yet it was retained due to its theoretical importance in capturing an experiential aspect of green time that complements the primary dimension. Item 16 also demonstrated an acceptable loading (0.601), indicating a meaningful contribution to the construct

Table 6 Confirmatory Factor Analysis: Standardized Factor Loadings for the 9-item Green Time Scale

Factor Loadings						
Factor	**Indicator**	**Estimate**	**SE**	**Z**	**p**	**Item No.**
Factor 1	**16**	**0.620**	**0.0378**	**16.41**	**<.001**	**9**
	13	**0.516**	**0.0539**	**9.57**	**<.001**	**8**
	11	**0.480**	**0.0524**	**9.15**	**<.001**	**7**
	8	**0.671**	**0.0346**	**19.40**	**<.001**	**6**
	2	**0.728**	**0.0351**	**20.77**	**<.001**	**1**
	6	**0.727**	**0.0339**	**21.42**	**<.001**	**4**
	5	**0.738**	**0.0339**	**21.75**	**<.001**	**3**
	7	**0.773**	**0.0361**	**21.40**	**<.001**	**5**
	4	**0.749**	**0.0327**	**22.95**	**<.001**	**2**

Table 6 shows the results of the Confirmatory Factor Analysis (CFA) conducted to confirm the factor structure obtained from the refined Exploratory Factor Analysis (EFA). While EFA suggested two factors, theoretically, green time represents a single construct. Therefore, a one-factor model was tested, following the recommendation of Hair et al. (2010) to prioritize theoretical justification when choosing the final factor structure.

Standardized factor loadings ranged from 0.480 to 0.773, indicating moderate to strong associations between the items and the latent factor. All loadings were significant at $p < .001$, and Z-values ranged from 9.15 to 22.95, confirming the stability and robustness of the item–factor relationships. Items 7 (0.773), 4 (0.749), and 5 (0.738) showed the highest loadings, highlighting their importance in representing engagement with green environments. Items 11 and 13, although lower, were retained due to their theoretical relevance in capturing experiential aspects of green time.

Overall, the CFA supports the convergent validity of the Green Time Scale, demonstrating that the nine items consistently measure a single underlying construct of green time engagement.

Table-7 Item-Level Variance

Item	Standardized Loading	Variance Explained (Loading²)	Item No.
4	0.749	0.561	2
5	0.738	0.544	3
6	0.727	0.529	4
7	0.773	0.598	5
8	0.671	0.450	6
2	0.728	0.530	1
11	0.480	0.230	7
13	0.516	0.266	8
16	0.620	0.384	9
Total	-----	4.092	

The variance for the nine retained items of the Green Time Scale was calculated by squaring the standardized CFA loadings to see how much each item contributes to the overall construct. Variance per item ranged from 0.230 (Item 11) to 0.598 (Item 7), showing that all items play a meaningful role in measuring Green Time. Items 4–7 had the highest contribution, while Items 11, 13, and 16 were retained for their theoretical importance. The total variance explained by the nine items was 4.092, about 45.5% of the maximum possible variance, supporting the scale's construct validity. Along with CFA results and reliability measures, these findings confirm that the scale reliably reflects a single underlying factor."

Table-8 Average Variance Extracted (AVE)

Item	Standardized Loading	Loading² (Variance Explained)	Item No.
4	0.749	0.561	2
5	0.738	0.544	3
6	0.727	0.529	4
7	0.773	0.598	5
8	0.671	0.450	6
2	0.728	0.530	1
11	0.480	0.230	7
13	0.516	0.266	8
16	0.620	0.384	9
Sum	–	4.092	
AVE	–	0.455	

Calculation:

$$\textbf{AVE} = \frac{\sum(\text{standardized loading}^2)}{\text{number of items}} = \frac{4.092}{9} \approx 0.455$$

The Average Variance Extracted (AVE) for the Green Time Scale was 0.455, meaning that around 45.5% of the variance in the items is explained by the latent factor, Green Time. While AVE values above 0.50 are ideal, values near 0.45 are acceptable for newly developed scales, especially when reliability is strong (Cronbach's α = 0.866, McDonald's ω = 0.883). This shows that the items collectively represent the construct well. Items with higher loadings, such as 4, 5, 6, and 7, contributed more to the AVE, while items with lower loadings (11, 13, 16) were kept for their theoretical importance in capturing different experiences of green time.

Table 9 Test for Exact Fit

χ^2		df	p
190		27	<.001

Table 9 presents the results of the **test for exact model fit**, which examines whether the proposed measurement model perfectly reproduces the observed covariance matrix. The **chi-square statistic** tests the null hypothesis that there is no discrepancy between the observed data and the model-implied covariance matrix.

In the present study, the chi-square value was $\chi^2 = 190$ with 27 degrees of freedom, and the result was statistically significant ($p < .001$). it is widely recognized in structural equation modeling that the chi-square statistic is highly sensitive to sample size. Even models with good fit often yield significant chi-square values when sample sizes are moderate to large.

Thus, the significant chi-square in this study does not necessarily indicate poor model fit. Instead, it underscores the importance of considering additional **goodness-of-fit indices**, which provide a more practical and nuanced assessment of model adequacy. Accordingly, alternative indices such as **CFI, TLI, and RMSEA** were evaluated to determine the overall fit of the Green Time Scale measurement model.

Table 10 Fit Measures

			RMSEA 90% CI	
CFI	TLI	RMSEA	Lower	Upper
0.931	0.909	0.100	0.0871	0.114

Table 10 presents the overall **goodness-of-fit indices** used to assess the adequacy of the one-factor measurement model of the Green Time Scale. Multiple indices were examined to provide a comprehensive evaluation of both absolute and incremental model fit, as relying on a single index may yield an incomplete assessment.

The **Comparative Fit Index (CFI)** was 0.931, exceeding the recommended threshold of 0.90, indicating a good fit between the proposed model and the observed data. Similarly, the **Tucker–Lewis Index (TLI)** was 0.909, also surpassing the acceptable cutoff, further supporting the adequacy of the model. These incremental fit indices suggest that the one-factor model explains the observed data substantially better than a null model.

The **Root Mean Square Error of Approximation (RMSEA)** value for the model was 0.100, slightly above the usual cutoff of 0.08. However, RMSEA can be higher in models with few items or low degrees of freedom. Considering that CFI = 0.931 and TLI = 0.909 show good fit, the model is acceptable. RMSEA values near 0.10 are reasonable in small, theoretically justified models (Browne & Cudeck, 1993; Kline, 2016).

Taken together, the fit indices indicate that the proposed **one-factor model demonstrates acceptable to good overall fit**, supporting the **factorial validity** of the nine-item Green Time Scale.

Table 11 Scale Reliability Statistics

Cronbach's α	McDonald's ω	Composite Reliability (CR)
0.866	**0.883**	**0.880**

Reliability of the Green Time Scale

The Green Time Scale (GTS) showed strong reliability, indicating that its items consistently measure the intended construct. The overall internal consistency was high, with Cronbach's alpha (α) = 0.866 and McDonald's omega (ω) = 0.883. Additionally, the Composite Reliability (CR) was calculated as 0.884, further confirming that the items collectively provide a stable and dependable measurement. These values demonstrate that the scale items are well correlated and capture the underlying construct reliably. The slightly higher omega and CR values also support the reliability of the scale, even considering minor multidimensional characteristics. Overall, these results suggest that the GTS is a trustworthy and robust tool for assessing engagement with green and natural environments.

Table-12 Norms

Category	Raw Score Range (X)	Z-Score Range (Z)
Low Green Time	**≤ 10**	**≤ -1**
Average	**11 – 23**	**-1 to +1**
High Green Time	**≥ 24**	**≥ +1**

"Based on the Green Time Scale data, the mean score of the sample was 17.19 with a standard deviation of 6.30. Norms were established using Z-scores, where scores one standard deviation below the mean or lower ($X \leq 10$, $Z \leq -1$) are classified as **Low Green Time**, indicating limited engagement with natural environments. Scores within one standard deviation of the mean ($X = 11–23$, $-1 < Z < +1$) are classified as **Average**, representing typical engagement. Scores one standard deviation above the mean or higher ($X \geq 24$, $Z \geq +1$) are classified as **High Green Time**, reflecting strong engagement with green spaces. These normative categories allow for the meaningful interpretation of individual scores relative to the sample."

Validated Green Time Scale

The **final GTS** consists of **9 items** designed to measure individuals' engagement with green and natural environments. Respondents rate each statement on a Likert-type scale, indicating the extent to which it applies to them. Higher scores reflect greater engagement with green time activities.

Scoring

All 9 items are positively worded and rated on a **5-point Likert scale** ranging from 1 (Less than 30 minutes), 2 (30 Minutes -1hours), 3(1-2 hours), 4 (2-4 hours), to 5 (More than 4 hours). No reverse scoring is required. Item scores are summed to generate a **total score ranging from 9 to 45**, with higher scores indicating more frequent and meaningful interaction with natural environments. The total score may be used as a continuous variable for statistical analysis or categorized into levels based on sample-specific criteria.

Discussion

The present study successfully developed and validated a concise, psychometrically sound **Green Time Scale**. The systematic process of item generation, refinement, and validation ensured that the final scale captures the essential aspects of green time while maintaining strong reliability and validity. These findings are consistent with existing literature emphasizing the psychological benefits of engagement with natural environments.

Reducing the scale from 16 to 9 items improved its **parsimony** without compromising conceptual coverage. The final scale provides a practical and reliable tool for researchers, and educators to assess the role of green time in **psychological well-being, emotional regulation, and related outcomes**.

Conclusion

In conclusion, the Green Time Scale exhibits **strong psychometric properties**, including high internal consistency, a clear factor structure, and acceptable model fit. The scale offers a reliable and valid measure of green time engagement and can be effectively applied in research and practice. Future studies may investigate its applicability across diverse populations and examine its **predictive validity** with respect to mental health and well-being outcomes.

Reference

1. Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen & J. S. Long (Eds.), Testing structural equation models (pp. 136–162). Sage.
2. Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). Multivariate Data Analysis (7th ed.). Pearson.
3. Kaplan, R., & Kaplan, S. (1989). The experience of nature: A psychological perspective. Cambridge University Press.
4. Kline, R. B. (2016). Principles and practice of structural equation modeling (4th ed.). Guilford Press.
5. Kuo, F. E., & Taylor, A. F. (2004). A potential natural treatment for attention-deficit/hyperactivity disorder: Evidence from a national study. American Journal of Public Health, 94(9), 1580–1586. https://doi.org/10.2105/AJPH.94.9.1580
6. Li, D., Sullivan, W. C., & Chang, C. Y. (2020). Nature exposure and mental health: The role of green space in stress reduction. Frontiers in Psychology, 11, 580. https://doi.org/10.3389/fpsyg.2020.00580
7. Ulrich, R. S. (1983). Aesthetic and affective response to natural environment. In I. Altman & J. F. Wohlwill (Eds.), Behavior and the natural environment (pp. 85–125). Springer.
8. World Health Organization. (2016). Urban green spaces and health: A review of evidence. WHO Regional Office for Europe.

SCALE ITEMS

S.NO	ITEMS	Less than 30 minutes	30 mintues-1 hours	1-2 hours	2-4 hours	More than 4 hours
1	How much time do you spend practicing yoga or meditation in green or natural areas?					
2	How much time do you spend walking in green spaces during the morning?					
3	How much time do you spend walking in green spaces during the evening?					
4	How much time do you spend cycling in green or natural areas on a working day?					
5	How much time do you spend cycling in green or natural areas on holidays or weekends?					
6	How much time do you spend swimming in outdoor natural environments?					
7	How much time do you spend participating in gardening or other greenery-related activities?					
8	During a typical week, how many total hours do you spend visiting local green spaces?					
9	What is the longest continuous time you usually spend in a green or natural environment?					