


Article

Adaptation and Validation of the Perceived Restorativeness Scale (PRS) for the Portuguese Population: A Study on the Assessment of the Restorative Effect of Environments

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† In loving memory of Gabriela, whose passion, wisdom, and warmth continue to inspire this work and those who had the privilege of working with her.

Abstract

The relationship between natural environments and psychological well-being has gained increasing attention in environmental and health sciences. However, there is still a lack of robust quantitative instruments to assess the restorative potential of different environments. This study aimed to adapt and validate the Portuguese version of the Perceived Restorativeness Scale (PRS), an instrument based on Attention Restoration Theory that evaluates the perceived restorative qualities of environments. In Study 1, exploratory and confirmatory factor analyses were conducted on data from 410 participants. The results supported a refined 20-item version of the scale, comprising four factors—being away, fascination, compatibility, and legibility—with good internal consistency and acceptable model fit. Measurement invariance analysis confirmed configural, metric, and scalar invariance across gender. In Study 2, a separate sample of 212 participants completed the PRS along with additional validated measures: the Sublime Emotion toward Nature Scale (SEN), an aesthetic evaluation of landscapes, and the Positive and Negative Affect Schedule (PANAS). The PRS showed strong convergent and discriminant validity and significantly predicted restorative outcomes. These findings support the psychometric adequacy of the Portuguese PRS and its relevance as a valid tool for assessing perceived restorativeness in both natural and built environments. The scale may inform future research and public policies aimed at designing spaces that promote psychological restoration and mental well-being.

Keywords: Perceived Restorativeness Scale; restorative environments; psychological well-being; environmental perception; scale validation; green spaces; nature and health



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1. Introduction

In recent years, there has been a remarkable increase in research highlighting the psychological benefits of nature [1–5]. While some environments and environmental elements can generate stress, others have the potential to facilitate recovery from such states [6,7]. Von Lindern et al. [8] define restorative environments as those that place less demand on an individual's physiological and psychological resources, thus allowing for the renewal of cognitive resources essential for effective functioning [9]. Although theoretically, any environment may contribute to this process at some point, evidence suggests that certain environments are more likely to become sources of restorative experiences than others. These

environments possess specific features that promote restoration and the replenishment of mental and emotional resources, offering a refuge to alleviate stress and restore mental vitality, e.g., those in [7,9,10]. Understanding restorative interactions between people and the environment is crucial for environmental design, planning, and policy [11,12], and evaluating the restorative qualities of these interactions can support the practical application of this knowledge [13]. According to Hartig et al. [9], these features can be captured by asking individuals about their perceptions of the environment. Thus, an instrument that evaluates perceived restorativeness can help to identify what people need from the spaces around them. It also guides urban design toward healthier spaces and helps assess the effectiveness of environmental changes, offering valuable insights for public policy and interior design. Based on Attention Restoration Theory (ART), numerous studies have investigated the restorative qualities of various types of environments [14,15]. A pioneering study in this field by Hartig and colleagues [9] led to the development of the Perceived Restorativeness Scale (PRS), designed to measure the perceived restorative qualities of environments. Over the past decades, the PRS has been widely recognized as a reliable tool and increasingly used to assess perceptions of restorative features in both natural and built environments, e.g., those in [16]. Despite its frequent use in the literature on restorative environments, several authors have highlighted that the psychometric properties of the PRS have not been firmly established across contexts and populations. Pasini et al. [17] emphasized that variability in the items used across studies and the limited number of critical analyses have hindered a comprehensive evaluation of the scale. Similarly, Bodin and Hartig [18], Lehto [19], and Pals et al. [20] have pointed out that most research has focused on applying the scale rather than systematically examining its measurement properties, such as factorial structure, invariance, and predictive validity. That is, there is a lack of studies examining the specific psychometric characteristics of the scale itself, e.g., [16], particularly in Portuguese. Although the PRS has been widely used in international research, studies conducted in Portugal have often relied on the original English version or on ad hoc translations without formal validation, raising concerns about potential linguistic and cultural biases. The adaptation of the PRS to Portuguese is crucial to ensure accurate measurement of perceived restorativeness and to support culturally relevant research. Importantly, a validated Portuguese version of the PRS has practical applications in domains such as urban planning, environmental design, and public health policy, particularly given the growing concerns about mental health and well-being in urban contexts. By enabling robust assessment of the restorative potential of different settings, the PRS can inform interventions aimed at improving green spaces, promoting mental health, and enhancing the quality of life in Portuguese-speaking countries. Therefore, the main objective of this study is to adapt and validate the five-factor version of the PRS proposed by Hartig et al. [9] for the Portuguese population, analyzing its psychometric properties using various statistical procedures, including cross-validation, predictive, concurrent, and discriminant validity, as well as measurement invariance. Studying the psychometric properties of the PRS is essential to ensure measurement validity and reliability, enhance scientific credibility, allow for appropriate application in different contexts, facilitate comparison across studies, and identify possible improvements to enhance the scale's effectiveness and utility. Furthermore, adapting and validating the scale in Portuguese ensures that the instrument is culturally sensitive and linguistically accurate for Portuguese-speaking individuals, enabling the collection of reliable data and supporting its use in academic, clinical, and research settings across Portuguese-speaking countries, thereby advancing scientific knowledge and understanding of restorative environments in these specific contexts.

1.1. Restorative Environments

Research on restorative environments emerged in the late 1980s and has increasingly gained prominence in the field of environment–behavior studies and landscape research [21]. In the domain of environmental psychology, the concept of restorative environments has become increasingly relevant due to its positive impact on mental recovery, stress reduction, and overall psychophysical well-being [22]. This area of study explores the environmental features that promote psychological well-being, often quantifying such outcomes. Restoration is defined as the recovery of psychological resources that are depleted by everyday demands [23], encompassing cognitive (e.g., attentional performance), affective (e.g., positive mood and energy), and social aspects (e.g., communication and leadership). In this context, a distinction is made between restoration—recovery from psychological depletion—and instoration, which refers to the strengthening or development of other personal skills or competencies [24]. The literature has largely focused on restoration [25].

Research in this area has been guided by two main theories: Attention Restoration Theory (ART; [11]) and Stress Recovery Theory (SRT; [26]). Both theories suggest that contact with environments that possess certain characteristics can assist in recovering from attentional fatigue and emotional discomfort, thereby improving psychological well-being. Despite their conceptual differences, research on psychological restoration typically integrates both perspectives [25,27].

These theories describe nature, or certain types of natural environments, as primary sources of restorative experiences. ART proposes that restorative environments are identified by four key properties: they provide a sense of psychological distance from everyday concerns (being away), they offer organized and engaging visual content (extent), they are aesthetically pleasing and visually interesting (fascination), and they align with individual needs and preferences (compatibility). According to ART, these characteristics help restore directed attention, a limited cognitive resource that becomes fatigued through prolonged use in daily tasks. Natural environments are particularly effective because they invoke soft fascination, a gentle engagement of attention that allows directed attention mechanisms to rest and recover [2,28]. Natural environments typically score higher on these ART dimensions compared to urban settings, which often impose greater cognitive demands. While researchers acknowledge that environments with these characteristics may be restorative, they note that urban environments generally provide fewer restorative opportunities and may require more cognitive effort to navigate and process [29,30]. According to Ulrich's SRT, urban environments—particularly those lacking green or blue spaces—are perceived as promoting cognitive and emotional fatigue due to their limited aesthetic value and the presence of noise, traffic, and crowding. SRT emphasizes the evolutionary basis of nature's restorative potential, suggesting that humans have an innate, adaptive response to natural environments because these settings historically signaled safety, resource abundance, and opportunities for recovery. From this perspective, built urban settings are not conducive to immediate psychological restoration, whereas natural environments are considered the most effective in supporting emotional recovery [26,31].

Despite the theoretical distinctions, both ART and SRT converge on a crucial point: contact with nature has the potential to promote human well-being [1].

1.2. Restorative Environments: Assessment Tools and Measures

Guided by Attention Restoration Theory (ART), numerous studies have explored the dimensions of restorative qualities across different environments [15]. Recently, new research has emphasized the importance of context-specific adaptations of instruments and the examination of restorative effects in particular environments, such as university

settings [3,5]. Furthermore, recent studies have explored the underlying psychological mechanisms of restoration and the role of environmental meaning attribution in shaping restorative experiences [4], providing new theoretical and methodological perspectives that are highly relevant to current research on restorativeness.

According to Kaplan [2], the restorative qualities of an environment are understood through four key characteristics: being away, extent, fascination, and compatibility. This structure has been widely used and evaluated in subsequent studies, although various approaches have been adopted to represent and measure the “extent” dimension [15]. Initially, this dimension included both coherence and scope as subdimensions. In some studies, extent was represented solely by coherence, e.g., [9,20,32–35], while in others, it was represented only by scope, e.g., [36–38]. However, some studies incorporated and evaluated both subdimensions of extent, e.g., [17,39]. Moreover, in previous studies, the “being away” dimension was subdivided into two distinct components: physical distance [36], also described as novelty [20,40], and psychological distance [34], referred to as escapism [20,40]. For example, Payne [39], in developing a scale to assess restoration in soundscapes, divided “being away” into “being-away-from” and “being-away-to”. In summary, various studies have been conducted to measure and understand how different aspects of environments can positively influence mental and emotional restoration. Notable examples include the Restorative Components of Environments Scale [40], composed of 22 items across five factors, with an additional dimension called “novelty”; the Perceived Restorative Characteristics Questionnaire, based on five factors and focused on restoration in environments such as zoos [20]; and the Restorative State Scale, developed to assess changes in an individual’s restorative state [41].

In this context, the pioneering study by Hartig and colleagues [9] stands out, as they developed the Perceived Restorativeness Scale (PRS) to assess perceived restorative qualities in environments. Although initially inspired by ART and based on the four components contributing to restoration [2], the latest version of the PRS proposed by the authors divides the “extent” construct into two distinct factors: coherence and scope [9]. The PRS is a 26-item scale designed to measure five restorative factors present to varying degrees in an environment: (1) Being away—it is essential that a restorative environment provides a sense of distance, allowing individuals to escape daily distractions and obligations. This involves letting go of specific thoughts and goals to experience tranquility [11]. (2) Fascination—considered a core element of a restorative experience, fascination involves an effortless attention response to natural stimuli, relieving mental fatigue. It includes attraction to specific elements and is fundamental for exploration and understanding of an environment [2,42] (3) Coherence—this refers to a physically or conceptually cohesive environment that supports exploration and interpretation. (4) Legibility—used in some later adaptations of the scale, this dimension refers to the perceived coherence, clarity, and navigability of the environment, helping individuals to feel oriented and make sense of the surroundings. (5) Compatibility—this refers to the alignment between the environmental support for intended activities and individual inclinations [16,42,43].

Given the inconsistencies between dimensions and subdimensions, Pasini et al. [17] noted that, since the original work by Hartig et al. [9], few studies have focused on assessing the psychometric properties of the scale. Noteworthy validations of the PRS have been carried out in Japanese [44], Italian [16], German [35], and Spanish, where it has been widely used, including in Spain [45] and Mexico [46]. A study also aimed to develop a shortened version of the PRS [17].

In short, as previously mentioned, there is no validated version of the PRS in Portuguese, and the factorial structure of the scale remains an open question. To substantiate this point, a systematic search was conducted in Portuguese-language scientific databases,

including B-on, SciELO Portugal, and RCAAAP, using terms such as “Perceived Restorativeness Scale”, “PRS”, “escala de restorativeness”, and “escala de restauração ambiental”. No validated Portuguese version of the PRS was identified, nor were there equivalent instruments measuring perceived environmental restorativeness. This gap underscores the importance of adapting and validating the PRS for the Portuguese context. Therefore, the present study aims to test the psychometric characteristics of the Portuguese version of the PRS.

1.3. The Present Investigation

Overall, the aim of this investigation is to obtain a quantitative instrument, characterized by its validity and reliability, capable of assessing the restorative effect of environments. Given the absence of validated tools in Portuguese for assessing perceived restorativeness, we adapted and validated the Perceived Restorativeness Scale (PRS) for the Portuguese population through two studies. The first study focuses on construct validity through cross-validation, including exploratory and confirmatory factor analyses, internal consistency analysis, and measurement invariance across gender. The second study addresses the convergent, discriminant, and predictive validity of the PRS. This two-study design follows established psychometric validation frameworks, e.g., [47,48], which recommend separating the assessment of internal (structural) and external (criterion-related) validity. Using partially independent samples increases the robustness of the validation process by reducing the risk of sample-specific bias and enhancing the generalizability of the findings. Together, these approaches aim to provide a comprehensive assessment of the instrument’s quality and utility for future research and application.

2. Study 1

In Study 1, the aim was to assess the construct validity of the Portuguese version of the PRS through cross-validation procedures, including exploratory and confirmatory factor analyses (EFA and CFA), internal consistency analysis, and measurement invariance across gender.

2.1. Methodology—Study 1

2.1.1. Sample—Study 1

The sample consisted of 410 participants (62.7% female, 36.4% male), aged between 16 and 85 years ($M = 28.40$, $SD = 13.25$). Most participants were single, divorced, or widowed (81.7%), and 18.3% were married or in a de facto union. In terms of education, 9.7% had completed basic education (up to 9th grade), 66.3% secondary or technical/vocational education, 20.5% undergraduate studies, 3% postgraduate or master’s degrees, and 0.5% doctoral degrees. Regarding current residence, 70.1% lived in urban areas, 11.1% in rural areas, and 18.8% in semi-urban areas; during childhood, 48.4% lived in urban settings, 28.3% in rural areas, and 23.3% in semi-urban environments. As for professional background, 76.3% reported no specific occupational area, while the remainder were distributed across fields such as psychology (4.8%), biomedical and health sciences (3.6%), natural sciences (2.8%), tourism and hospitality (1.8%), education (2%), and other domains. The sample size is adequate and consistent with established recommendations for psychometric validation. Specifically, a sample of 410 participants meets commonly accepted guidelines suggesting a minimum of 5–10 participants per item for factor analyses (e.g., [49]), given the 26-item PRS. Additionally, samples exceeding 300 participants are generally considered large and stable for exploratory and confirmatory factor analyses [50].

2.1.2. Instruments—Study 1

To assess the restorative potential of an environment, this study adopted a subjective evaluation approach [51], based on the perceived components of restoration as described in the Attention Restoration Theory. The instrument used was the Perceived Restorativeness Scale (PRS), originally developed by Hartig and colleagues, who were the first to propose a measure focused on restorative properties. The scale was later refined and published in 1996 and 1997 [9,13]. This multidimensional scale comprises 26 items rated on a 7-point Likert scale (1—not at all; 7—completely), distributed across five factors: being away (items 1–5), fascination (items 6–13), coherence (items 14–17), compatibility (items 18–22), and legibility (items 23–26). Example items for each subscale include the following: being away—“Spending time here gives me a break from my day-to-day routine”; fascination—“There is much to explore and discover here”; coherence—“This place is ordered in a harmonious way”; compatibility—“I can do the activities that I want to do here”; and legibility—“It is easy to find my way around here.” In the original study, the subscales demonstrated good reliability, with acceptable internal consistency coefficients (α s > 0.75). In addition to the PRS, participants answered a brief set of sociodemographic questions (e.g., age, marital status, gender, and type of environment experienced in childhood and currently). For face validity purposes, a back-translation procedure was conducted following Hambleton et al. [52]. The scale was first translated from English into Portuguese independently by two bilingual translators. These two versions were then back-translated into English by two other bilingual individuals working independently. The translated versions were compared with the original, and necessary adjustments were made in collaboration with experienced psychology professionals to produce a final version. A pre-test was then conducted with 15 individuals (not included in the final sample) to assess clarity and identify potential issues in comprehension. The Cronbach’s alpha obtained in this pilot phase was above 0.70, and no comprehension problems were reported. No major cultural adaptations were required, as the items were considered culturally appropriate for the Portuguese context. The full Portuguese version of the PRS is provided in Appendix A. The Oviedo Infrequency Scale [53] was included to detect and exclude participants who may have responded in a random, pseudo-random, or dishonest manner.

When completing the PRS, participants were instructed to think about the most beautiful and pleasant landscape they knew. This instruction was chosen to capture participants’ perceptions of restoration across a variety of environments, reflecting personal relevance and salience. While previous studies often focus specifically on natural environments, our approach aimed to explore the perceived restorative potential across both natural and urban landscapes, in line with the growing interest in understanding restoration in diverse everyday contexts.

2.2. Procedures

2.2.1. Data Collection

This study followed all ethical principles required for research involving human participants. The research protocol was approved by the Ethics Committee Board and the Data Protection Officer from the University of Algarve, which oversaw the ethical standards and procedures applied. Data collection was conducted via printed questionnaires and email distribution, using a self-report protocol with an average completion time of approximately 15 min. Participants were fully informed about the study, including details on informed consent, data protection, anonymity, confidentiality, non-discrimination, and the voluntary nature of participation, with the right to withdraw at any time. Participants were recruited through convenience sampling from university students and members of the general population, using both online platforms and in-person distribution. Specifically, recruitment was

conducted online through social media, university mailing lists, and community networks, covering all regions of Portugal. No compensation or incentives were provided for participation, and no quotas were applied; however, efforts were made to reach individuals from diverse educational, professional, and regional backgrounds. Participants were instructed to complete the PRS thinking about the most beautiful and pleasant landscape they knew, as this approach allowed for the assessment of perceived restorativeness across personally meaningful environments. Data collection took place between March and October 2024, and only fully completed questionnaires were included in the final analysis.

Compared to the national census data [54], the sample slightly overrepresents young adults and individuals with secondary education. While Portugal's population shows a balance between urban and rural residence (about 63% urban and 37% rural/semi-urban), the current sample includes a higher proportion of urban residents.

2.2.2. Data Analysis

Data were analyzed using SPSS (Statistical Package for the Social Sciences) and SPSS AMOS, version 28.0, adopting a significance level of 0.05. The psychometric properties of the Perceived Restorativeness Scale were assessed through exploratory factor analysis (EFA), confirmatory factor analysis (CFA), and internal consistency analysis. To verify cross-validation, the sample was randomly divided into two independent groups: 195 participants were used for CFA, and 215 for EFA. Cross-validation is a methodological approach used to empirically assess the replicability of results across samples and is essential for ensuring the reliability and generalizability of findings. Construct validity was assessed through EFA using the maximum likelihood method and Varimax orthogonal rotation. Several fit indices were considered, including chi-square (χ^2), the relative chi-square (CMIN/DF), Comparative Fit Index (CFI), Goodness of Fit Index (GFI), and Root Mean Square Error of Approximation (RMSEA). To assess convergent and discriminant validity, the indices of composite reliability (CR), average variance extracted (AVE), maximum shared variance (MSV), and maximum reliability (MaxR(H)) were calculated. Internal consistency was assessed using Cronbach's alpha, with values above 0.70 considered acceptable. These analyses were conducted to ensure the quality and validity of the measurement tools used in the study.

3. Results—Study 1

3.1. Descriptive Statistic

Table 1 presents the descriptive statistics for the Perceived Restorativeness Scale, including the means, standard deviations, skewness, and kurtosis indices. Item means ranged from 1.69 (item 17) to 6.40 (item 13), based on a seven-point Likert scale (one—not at all; 7—seven—completely). Item-total correlations ranged from -0.138 to 0.714 , being reasonably high for most items, indicating that they contribute positively to the overall scale. Regarding skewness (-2.240 to 3.794) and kurtosis (-0.941 to 4.643), the variation in the values supports the assumption of a normal distribution, as the values remained below two and seven, respectively [55–57]. The total Cronbach's alpha was 0.895 , indicating good internal consistency. Cronbach's alpha if the item were deleted ranged from 0.885 to 0.903 , with all values above the acceptable threshold of 0.70 , confirming good internal consistency across all items. All items also explained a substantial amount of variance (R^2 ranging from 0.146 to 0.714).

Table 1. Descriptive statistics of items.

Item	M	SD	Corrected Item- Total Correlation	Sk SE = 0.12	Ku SE = 0.24	R ²	Cronbach's Alpha (α) If Item Deleted
1	5.71	1.561	0.484	-1.478	1.697	0.455	0.891
2	6.08	1.323	0.497	-1.746	3.016	0.518	0.891
3	6.02	1.321	0.429	-1.591	2.408	0.554	0.892
4	5.66	1.378	0.468	-1.158	1.251	0.543	0.891
5	5.41	1.541	0.484	-0.988	0.534	0.534	0.891
6	6.04	1.221	0.651	-1.287	1.141	0.631	0.888
7	5.69	1.365	0.571	-1.095	0.814	0.486	0.889
8	5.60	1.625	0.499	-1.067	0.344	0.486	0.890
9	5.30	1.611	0.509	-0.599	-0.608	0.529	0.890
10	5.26	1.607	0.461	-0.774	-0.129	0.449	0.891
11	6.24	1.346	0.423	-2.059	3.794	0.381	0.892
12	6.05	1.352	0.602	-1.675	2.448	0.595	0.889
13	6.40	1.177	0.302	-2.240	4.643	0.321	0.894
14	3.70	1.827	0.403	0.335	-0.941	0.395	0.893
15	1.92	1.375	-0.138	1.673	2.293	0.520	0.903
16	2.63	1.705	0.146	0.957	-0.157	0.398	0.899
17	1.69	1.304	-0.100	2.232	4.608	0.501	0.902
18	5.39	1.553	0.690	-0.972	0.348	0.595	0.886
19	5.32	1.623	0.699	-0.944	0.199	0.624	0.886
20	5.17	1.784	0.703	-0.812	-0.315	0.666	0.885
21	5.41	1.541	0.714	-0.893	0.035	0.655	0.886
22	5.41	1.556	0.697	-0.957	0.304	0.629	0.886
23	5.00	1.791	0.582	-0.673	-0.591	0.558	0.888
24	5.14	1.841	0.481	-0.737	-0.497	0.585	0.891
25	5.03	1.718	0.490	-0.572	-0.631	0.676	0.891
26	4.99	1.669	0.468	-0.566	-0.424	0.634	0.891

N = 411. The total scale $\alpha = 0.895$. Each item was rated on a seven-point scale to indicate the extent to which the given statement describes their experience in the given setting.

Dimension Means and Gender Differences

The descriptive analysis of the PRS subscales revealed distinct response patterns across the five restorative dimensions (Table 2). The highest mean scores were observed in being away ($M = 5.77$, $SD = 1.10$), indicating that participants strongly perceived the environments as offering psychological distance and a break from routine. Compatibility ($M = 5.33$, $SD = 1.35$) and legibility ($M = 5.00$, $SD = 1.48$) also received relatively high scores, suggesting that the environments were perceived as supportive of personal goals and easy to understand or navigate. Fascination had a moderate mean ($M = 4.67$, $SD = 0.75$), reflecting a positive but more variable perception of the environments' capacity to effortlessly attract attention. In contrast, the lowest average score was found for coherence ($M = 2.53$, $SD = 1.16$), indicating that participants perceived the environments as less structured, ordered, or cohesive. These results suggest that while the environments evoked a strong sense of escape and personal relevance, they were not consistently experienced as coherent or logically organized. To further explore gender differences in perceived restorativeness, independent-samples t-tests were conducted for each PRS subscale. The results showed that women scored significantly higher than men on being away ($M_{\text{female}} = 5.92$, $SD = 1.02$; $M_{\text{male}} = 5.47$, $SD = 1.18$; $t(402) = 4.03$, $p < 0.001$), compatibility ($M_{\text{female}} = 5.47$, $SD = 1.28$; $M_{\text{male}} = 5.09$, $SD = 1.46$; $t(402) = 2.76$, $p = 0.006$), and legibility ($M_{\text{female}} = 5.12$, $SD = 1.47$; $M_{\text{male}} = 4.79$, $SD = 1.49$; $t(401) = 2.15$, $p = 0.032$). For coherence, men scored slightly higher than women ($M_{\text{female}} = 2.42$, $SD = 1.10$; $M_{\text{male}} = 2.71$, $SD = 1.26$; $t(402) = -2.35$, $p = 0.019$). No significant differences were found for fascination ($M_{\text{female}} = 4.72$, $SD = 0.70$; $M_{\text{male}} = 4.59$,

SD = 0.81; $t(402) = 1.67, p = 0.095$). These results suggest small but statistically significant gender differences in several restorative dimensions, which may reflect differences in how men and women experience or interpret restorative environments.

Table 2. Dimension means and dimensions means across gender.

Item	M	SD	M Female (SD)	M Male (SD)
Being Away	5.76	1.09	5.92 (1.09)	5.47 (0.09)
Fascination	4.67	0.74	4.71 (0.70)	4.58 (0.81)
Coherence	2.53	1.16	2.42 (1.09)	2.70 (1.25)
Compatibility	5.33	1.13	5.47 (1.27)	5.08 (1.56)
Legibility	5.00	1.47	5.11 (0.09)	4.78 (1.49)

3.2. Exploratory Factor Analysis (EFA)

To examine the underlying structure of the Perceived Restorativeness Scale, an exploratory factor analysis was conducted. The Kaiser–Meyer–Olkin (KMO) measure indicated sampling adequacy with a value of 0.889 (Bartlett’s Test of Sphericity = 3260.259; $df = 325; p < 0.001$). Maximum likelihood extraction with Varimax rotation revealed a five-factor solution explaining 66.99% of the total variance. Table 3 shows that items 11 and 13, which in the original version were designed to load on Factor 2 (fascination), instead loaded on Factor 5 in our analysis.

Table 3. Main components extracted from PRS (factor weights and communalities).

	Factor					Communalities
	1	2	3	4	5	
Item 1	0.571					0.538
Item 2	0.689					0.576
Item 3	0.717					0.672
Item 4	0.759					0.649
Item 5	0.701					0.593
Item 6		0.493				0.745
Item 7		0.643				0.611
Item 8		0.664				0.588
Item 9		0.755				0.559
Item 10		0.697				0.561
Item 11					0.397	0.518
Item 12		0.480				0.653
Item 13					0.456	0.427
Item 14					0.358	0.457
Item 15					0.782	0.584
Item 16					0.537	0.463
Item 17					0.809	0.614
Item 18			0.639			0.648
Item 19			0.755			0.711
Item 20			0.715			0.707
Item 21			0.730			0.744
Item 22			0.682			0.723
Item 23				0.615		0.584
Item 24				0.824		0.651
Item 25				0.817		0.688
Item 26				0.749		0.673

Note: According to the original PRS model, items are organized as follows: items 1–5 = being away; items 6–13 = fascination; items 14–17 = coherence; items 18–22 = compatibility; and items 23–26 = legibility. Please note that the empirical factor loadings in this table do not fully align with the theoretical subscales, as items 11 and 12 loaded on Factors 5 and 2, respectively.

Based on the initial exploratory factor analysis (Table 3), several items—namely items 11, 12, 13, 14, and 15—were identified as problematic, either due to low factor loadings, cross-loadings, or poor alignment with their theoretically intended subscales. To improve the scale’s psychometric robustness, a revised version—the Perceived Restorativeness Scale—Proposed version (PRS-P)—was developed, excluding these five items.

To assess the factorial structure of the revised 21-item version, a new exploratory factor analysis was performed. The Kaiser–Meyer–Olkin (KMO) measure confirmed sampling adequacy (KMO = 0.904), and Bartlett’s Test of Sphericity was significant ($\chi^2 = 2738.300$, $df = 190$, $p < 0.001$), supporting the factorability of the correlation matrix. Using maximum likelihood extraction with Varimax rotation, a four-factor solution was extracted, explaining 60.59% of the total variance.

Table 4 presents the factor loadings and communalities of the revised scale. As can be observed, the refined structure showed stronger loadings, improved communalities, and clearer alignment with the theoretical subscales. However, item 16 continued to demonstrate a very low communality (0.133) and did not load meaningfully on any factor, justifying its exclusion from the final model. This revised and psychometrically robust version of the PRS-P was therefore retained for confirmatory testing and validation in Study 2.

Table 4. Exploratory factor analysis of the revised PRS-P: factor loadings and communalities (21-item version).

	Factor				Communalities
	1	2	3	4	
Item 1	0.598				0.488
Item 2	0.698				0.575
Item 3	0.762				0.687
Item 4	0.734				0.606
Item 5	0.661				0.54
Item 6			0.524		0.625
Item 7			0.664		0.561
Item 8			0.702		0.586
Item 9			0.751		0.614
Item 10			0.71		0.561
Item 12			0.5		0.548
Item 16		0.150			0.133
Item 18		0.634			0.753
Item 19		0.769			0.7
Item 20		0.715			0.754
Item 21		0.735			0.69
Item 22		0.668			0.589
Item 23				0.615	0.728
Item 24				0.834	0.752
Item 25				0.836	0.602
Item 26				0.719	0.488

Note: This table presents the factor loadings and communalities for the revised 21-item version of the Perceived Restorativeness Scale (PRS-P), based on exploratory factor analysis using maximum likelihood extraction with Varimax rotation. The original subscale structure is no longer retained in this version. Item 16, although included in the analysis, demonstrated very low communality (0.133) and did not load meaningfully on any factor, supporting its exclusion from the final model.

3.3. Confirmatory Factor Analysis (CFA)

Confirmatory factor analyses (CFA) were conducted to test the factorial validity of both the original and the revised versions of the Perceived Restorativeness Scale. Using maximum likelihood estimation, the original five-factor model (26 items) showed adequate

but suboptimal fit indices: $\chi^2(289) = 622.135$, CMIN/df = 2.15; CFI = 0.845; TLI = 0.812; NFI = 0.751; and RMSEA = 0.07 (see Table 5). Although the CFI, TLI, and NFI values fell below the conventional threshold of 0.90, these values are still considered acceptable for complex, multidimensional models, especially in cross-cultural validation contexts [58–60].

Table 5. Goodness-of-fit indices of the Perceived Restorativeness Scale (original vs. revised structure).

	χ^2	df	CMIN/df	CFI	RMSEA	TLI	NFI
Original structure	622.135	289	2.15	0.845	0.07	0.812	0.751
Revised PRS-P (20 items)	356.859	164	2.176	0.891	0.07	0.860	0.819

Given the limitations observed in the exploratory factor analysis—particularly the inconsistent loadings of items 11, 12, 13, 14, 15, and 17—a revised model was tested. Although item 16 had been retained in the initial version of the revised scale, it showed very low communality (0.133) and failed to load on any factor. Consequently, it was also removed from the final structure. The final revised model (PRS-P), comprising 20 items across four factors, demonstrated improved model fit: $\chi^2(164) = 356.859$; CMIN/df = 2.18; CFI = 0.891; TLI = 0.860; NFI = 0.819; and RMSEA = 0.07. These results indicate a more parsimonious and psychometrically robust structure, providing stronger empirical support for the revised version of the scale in the Portuguese context.

3.4. Convergent and Discriminant Validity—Study 1

Construct validity was assessed through composite reliability (CR), average variance extracted (AVE), maximum shared variance (MSV), and maximal reliability (MaxR(H)). As shown in Table 6, all four subscales—being away, fascination, compatibility, and legibility—presented satisfactory levels of internal consistency, with CR values exceeding the recommended threshold of 0.70. Evidence of convergent validity was also supported for most subscales, with AVE values above 0.50 for being away (0.524), compatibility (0.660), and legibility (0.717). The AVE for fascination (0.460) was slightly below the conventional criterion of 0.50; however, its high CR (0.837) suggests that the construct remains reliable and retains acceptable convergent validity, as supported in the previous literature. Discriminant validity was confirmed, as the AVE of each construct exceeded its corresponding MSV, indicating that each factor shares more variance with its own items than with other latent dimensions. Together, these results support the validity and reliability of the revised 20-item PRS-P.

Table 6. Validity and reliability results of the PRS subscales.

Dimension	CR	AVE	MSV	MaxR(H)
Legibility	0.910	0.717	0.430	0.925
Being Away	0.844	0.524	0.449	0.868
Fascination	0.837	0.460	0.383	0.860
Compatibility	0.917	0.660	0.449	0.932

Note. CR = composite reliability; AVE = average variance extracted; MSV = maximum shared variance; MaxR(H) = maximal reliability. All constructs showed acceptable reliability (CR > 0.70) and convergent validity (AVE > 0.50, except for fascination), and discriminant validity (AVE > MSV).

3.5. Reliability

The reliability of the revised Perceived Restorativeness Scale (PRS-P) was assessed using Cronbach's alpha coefficient. The total scale showed a Cronbach's alpha of 0.94. The subscales yielded the following reliability values: being away (items 1–5; $\alpha = 0.87$), fascina-

tion (items 6, 7, 8, 9, 10, and 12; $\alpha = 0.88$), compatibility (items 18–22; $\alpha = 0.92$), and legibility (items 23–26; $\alpha = 0.87$). All dimensions demonstrated acceptable internal consistency.

3.6. Measurement Invariance Across Gender

A multi-group analysis was conducted to assess the measurement invariance of the revised version of the scale (PRS-P) across gender. The unconstrained model (configural invariance) demonstrated acceptable model fit: $\chi^2(328) = 678.59$, CMIN/df = 2.07, $p < 0.001$; NFI = 0.695; CFI = 0.806; TLI = 0.751; and RMSEA = 0.075. These results indicate that the factorial structure of the PRS-P is similar between male and female participants, providing support for configural invariance (see Table 7). Based on this baseline model, increasingly constrained models were tested. The comparison between the unconstrained model and the metric invariance model (measurement weights) revealed no significant differences ($\Delta\chi^2 = 12.09$; $\Delta df = 16$; $p > 0.05$), supporting the invariance of factor loadings across gender. Similarly, comparison with the scalar model (measurement intercepts) showed no significant differences ($\Delta\chi^2 = 31.68$; $\Delta df = 20$; $p > 0.05$), indicating that intercepts can be considered invariant. Finally, the comparison between the scalar model and the structural covariances model revealed no significant differences ($\Delta\chi^2 = 13.75$; $\Delta df = 10$; $p > 0.05$), suggesting stability in the relationships between factors. Although the fit indices (CFI, TLI, and NFI) did not meet the conventional cutoff of 0.90, prior research suggests that such values may still be acceptable in complex multidimensional models and in cross-cultural adaptation studies [60]. Therefore, these results provide support for configural, metric, and scalar invariance of the PRS-P across gender, allowing for meaningful comparison of latent means between men and women.

Table 7. Goodness-of-fit indices for measurement invariance across gender.

	χ^2	df	CMIN/df	CFI	RMSEA	TLI	NFI
Unconstrained	678.59	328	2.07	0.806	0.075	0.751	0.695
Measurement Weights (metric)	690.68	344	2.01	0.808	0.073	0.765	0.689
Measurement Intercepts (scalar)	722.36	364	1.99	0.801	0.072	0.771	0.675
Structural Covariance	736.11	374	1.97	0.799	0.071	0.775	0.669

4. Study 2

As part of the ongoing validation process of the Portuguese version of the Perceived Restorativeness Scale (PRS), the second study aimed to assess the scale's convergent, discriminant, and predictive validity. To this end, variables theoretically related to the perception of restorative environments were included to examine whether the PRS is coherently associated with relevant constructs in the fields of environmental psychology and well-being.

All scales in Study 2 referred to the same imagined environment. Specifically, participants were instructed to think about the most beautiful and pleasant landscape they knew when completing the following measures, which were administered in a fixed order: the Perceived Restorativeness Scale (PRS), the Aesthetic Evaluation of the Landscape, the Restoration Outcome Scale (ROS), the Sublime Emotion toward Nature (SEN) scale, and the Positive and Negative Affect Schedule (PANAS).

The first instrument, the PRS, assessed the perceived restorative qualities of the imagined landscape. Next, the Aesthetic Evaluation of the Landscape [61] measured subjective perceptions of specific landscape attributes, such as naturalness, maintenance, and visual openness—features often linked to environmental attractiveness and restorative potential. The third instrument, the Restoration Outcome Scale (ROS [62]), assessed perceived restorative outcomes. Then, the Sublime Emotion toward Nature (SEN) scale [63] captured

transcendental emotions evoked by nature, namely awe and inspiring energy—emotions that reflect a deep and positive connection with the natural environment and have been associated with the perception of psychological restoration [62,63]. Finally, the Positive and Negative Affect Schedule (PANAS [64]) was used to measure participants' affective states.

Including these variables allowed for the examination of the PRS's relationships with aesthetic appreciation, nature-related emotions, and affective responses. In addition, the predictive power of the PRS on perceived restoration outcomes (measured by the ROS) was tested, contributing to a more comprehensive evaluation of the instrument's external validity.

4.1. Methodology—Study 2

4.1.1. Sample—Study 2

The sample consisted of 212 participants, the majority of whom were female (70.8%), with ages ranging from 18 to 73 years ($M = 30.22$; $SD = 13.23$). Most participants were single, divorced, or widowed (73.6%), and 25.7% were married or in a common-law union. In terms of education, 55.3% had completed secondary or technical/vocational education, 30.8% undergraduate studies, 13% postgraduate or master's degrees, and 1% doctoral degrees. Regarding professional background, 29.7% reported no specific occupational area, while others were distributed across psychology (25.2%), management/economics/accounting (17.8%), architecture/landscape architecture (8.9%), tourism and hospitality (4.5%), education (4.5%), biomedical and health sciences (2.5%), and other areas. As for residential environment, 69% currently live in urban areas, 10.5% in rural areas, and 20.5% in semi-urban areas; during childhood, 45.2% lived in urban areas, 28.1% in rural areas, and 26.7% in semi-urban settings.

The sample size is adequate for assessing predictive, convergent, and discriminant validity through correlation and regression analyses, providing sufficient statistical power [65].

4.1.2. Instruments—Study 2

In addition to the revised Perceived Restorativeness Scale (PRS-P) validated in Study 1, the following instruments were used:

Aesthetic Evaluation—Perception of landscape aesthetics was assessed using the scale developed by Sevenant and Antrop [61], which includes cognitive evaluations of specific landscape attributes. Unlike previous studies where participants viewed images of landscapes, in this study, they were asked to imagine the most beautiful and pleasant landscape they knew and respond based on that mental image. Sixteen landscape attributes were evaluated on a seven-point scale, covering dimensions such as care and maintenance, naturalness, disturbance, and openness, among others.

Restoration Outcome Scale (ROS)—The perception of restorative experiences was assessed using the Restoration Outcome Scale (ROS), developed by Korpela et al. [62]. The scale consists of six items reflecting feelings of relaxation and calm (e.g., "I feel calmer after being here"), attention restoration ("My concentration and alertness clearly increase here"), and mental clearing ("Visiting this place helps me forget everyday worries"). Items are rated on a seven-point Likert scale (one = not at all; seven = completely).

Sublime Emotion toward Nature (SEN)—Developed by Bethelmy and Corraliza [63], this 18-item scale assesses transcendental emotions evoked by nature. It is structured into two main factors: awe, which reflects feelings of reverence and vulnerability in response to nature's grandeur, and inspiring energy, which captures sensations of vitality, joy, and connectedness with the natural environment. Items are rated on a five-point Likert scale

ranging from one (strongly disagree) to five (strongly agree). The instrument is widely used to understand how nature elicits deep, restorative emotional experiences.

Positive and Negative Affect Schedule (PANAS)—To assess participants' positive and negative affective states, the Portuguese version of the PANAS [64], adapted by Galinha and Pais-Ribeiro [66], was used. The scale consists of 20 adjectives describing emotional states: 10 positive (e.g., enthusiastic, inspired, and determined) and 10 negative (e.g., distressed, nervous, and guilty). Participants rated the extent to which they experienced each affective state when thinking about their chosen landscape, using a five-point Likert scale (one—very slightly or not at all; five—extremely).

All scales in Study 2, including the PRS, Aesthetic Evaluation of the Landscape, Sublime Emotion toward Nature (SEN) scale, Positive and Negative Affect Schedule (PANAS), and Restoration Outcome Scale (ROS), referred to the same imagined environment. Specifically, participants were instructed to think about the most beautiful and pleasant landscape they knew when completing these measures. The order of administration was fixed, with the PRS administered first, followed by the Aesthetic Evaluation of the Landscape, ROS, SEN, and PANAS.

4.1.3. Data Collection and Analysis Procedures

The data collection procedures were the same as those used in Study 1. Data were analyzed using SPSS (version 28.0), adopting a significance level of 0.05. To assess the convergent and discriminant validity of the Perceived Restorativeness Scale (PRS), Pearson correlation analyses were conducted with theoretically related variables: Sublime Emotion toward Nature (SEN), Aesthetic Evaluation, and PANAS (Positive and Negative Affect Schedule). Additionally, a simple linear regression analysis was performed to test the predictive validity of the PRS in relation to self-reported restoration outcomes.

5. Results—Study 2

5.1. Convergent and Discriminant Validity—Study 2

To assess convergent validity, correlations between the revised PRS-P and theoretically related constructs were examined, namely the Aesthetic Evaluation (AE) scale, the PANAS Positive dimension, and the Sublime Emotion toward Nature (SEN) scale. As shown in Table 8, the PRS-P was positively and significantly correlated with all three constructs, the AE ($r = 0.491$, $p < 0.001$), PANAS Positive ($r = 0.600$, $p < 0.001$), and SEN ($r = 0.622$, $p < 0.001$), supporting the scale's convergent validity. For discriminant validity, a significant negative correlation was found between the PRS-P and the PANAS Negative dimension ($r = -0.251$, $p < 0.001$), indicating that perceived restorativeness is inversely related to negative affect, as theoretically expected. These results provide evidence for both the convergent and discriminant validity of the PRS-P.

Table 8. Correlations among study variables.

	PRS	AE	PP	PN
PRS	-			
Aesthetic Evaluation (AE)	0.491 **	-		
PANAS Positive (PP)	0.600 **	0.242 **	-	
PANAS Negative	-0.251 **	-0.087	-0.515 **	-
SEN	0.622 **	0.320 **	0.501 **	-0.046

** $p < 0.001$.

5.2. Predictive Validity

To assess the predictive validity of the revised PRS-P in relation to restorative outcomes, a simple linear regression analysis was conducted using the global PRS score as the predictor and the global ROS score as the outcome variable. The results showed that the revised PRS-P significantly predicted restoration outcomes, accounting for approximately 41% of the variance ($R^2 = 0.41$; $\beta = 0.645$; $t(211) = 12.235$, $p < 0.001$).

6. Discussion

The primary aim of this study was to adapt and validate a Portuguese version of the Perceived Restorativeness Scale (PRS), based on the five-factor model originally proposed by Hartig et al. [9]. The findings provide robust evidence for the psychometric adequacy of the revised version—termed PRS-P—which includes 20 items across four dimensions: being away, fascination, compatibility, and legibility. This structure emerged following exploratory and confirmatory factor analyses, during which six items were removed due to low factor loadings, cross-loadings, or theoretical misalignment. Notably, the coherence dimension did not emerge as a distinct factor in the final version, suggesting possible cultural or linguistic differences in how this construct is interpreted by Portuguese-speaking participants.

Despite the exclusion of one dimension, the four retained factors remain theoretically consistent with the key components of Attention Restoration Theory (ART) [11], capturing essential features such as psychological detachment (being away), soft fascination, environmental congruence (compatibility), and spatial clarity (legibility). These results align with previous cross-cultural validations of the PRS in other languages [16,44], reinforcing the theoretical coherence and cross-contextual relevance of the scale.

The PRS-P demonstrated strong internal consistency, with all dimensions showing satisfactory composite reliability ($CR > 0.70$). Convergent validity was also supported: three dimensions—being away, compatibility, and legibility—had AVE values above 0.50, and fascination, despite a slightly lower AVE (0.460), retained high reliability ($CR = 0.837$), justifying its inclusion. Discriminant validity was confirmed, as the AVE for each construct exceeded its maximum shared variance (MSV), indicating that each factor explained more variance in its own items than in other constructs.

The scale also showed significant associations with external variables, including aesthetic evaluations of environments, transcendental emotions related to nature (SEN), and positive and negative affect. These correlations provide empirical support for the theoretical foundations of ART and Stress Recovery Theory (SRT) [26], suggesting that environments perceived as restorative contribute to emotional well-being by increasing positive emotions and reducing negative ones. The predictive capacity of the PRS-P was demonstrated by its ability to explain variance in perceived restoration outcomes, underlining its practical value for assessing the psychological impact of environments.

Measurement invariance analyses supported configural, metric, scalar, and structural invariance across gender. These results indicate that the factorial structure, item loadings, intercepts, and inter-factor relationships are equivalent between men and women. Although some goodness-of-fit indices (e.g., CFI and TLI) were below the conventional 0.90 threshold, this is not uncommon in complex multidimensional models and in the context of cross-cultural validation [60].

Descriptive statistics were calculated based on the original version of the PRS before item removal. Therefore, mean scores and gender comparisons should be interpreted with caution, as they do not directly reflect the final validated PRS-P structure. The descriptive analysis of the revised version is recommended in future studies, based exclusively on the 20 retained items.

This study has several limitations. First, the sample was non-probabilistic and not representative of the broader Portuguese population. It comprised predominantly young adults, individuals with secondary education, and urban residents, which may limit the generalizability of the findings. Second, the data were self-reported, and responses were based on imagined or previously experienced environments rather than direct exposure to real physical settings. This may reduce the ecological validity of restorativeness ratings. Third, participants were asked to evaluate the most beautiful or pleasant landscape they knew, which likely introduced heterogeneity in the types of environments assessed (natural vs. urban), potentially affecting the consistency of responses and factor structure. Lastly, the exclusion of the coherence dimension, although empirically justified, may affect comparability with the original PRS and other international adaptations, calling for further exploration of its theoretical relevance in the Portuguese context.

For future research, it is recommended that the study be replicated with more representative and diverse samples (e.g., by region, age group, and socioeconomic status), and that the PRS be applied in real-world contexts using experimental protocols involving controlled exposure to natural and urban environments. Longitudinal studies could also explore the effects of repeated exposure to restorative environments on psychological health and cognitive performance. It would also be valuable to test the PRS in clinical populations or educational settings to assess its potential for supporting interventions in mental health, well-being, and learning. Finally, further analysis of measurement invariance across other sociodemographic and cultural groups is advised to ensure the cross-cultural applicability of the Portuguese version of the scale.

7. Conclusions

The present study provides strong evidence for the validity and reliability of the revised Portuguese version of the Perceived Restorativeness Scale (PRS-P), comprising 20 items across four dimensions: being away, fascination, compatibility, and legibility. This version demonstrates robust psychometric properties, including internal consistency, convergent and discriminant validity, predictive validity, and measurement invariance across gender. The adaptation of the PRS to the Portuguese context fills an important gap in the literature and offers researchers and practitioners a culturally and linguistically appropriate tool to assess individuals' perceptions of restorative qualities in their everyday environments. The PRS-P contributes meaningfully to research and practice in environmental psychology, public health, and sustainable urban design. It provides a sensitive instrument for evaluating the psychological benefits of natural and built environments, supporting the development of interventions and policies that promote mental health, stress recovery, and well-being. In particular, its application is relevant in urban planning initiatives, therapeutic landscape design, and nature-based health promotion strategies aimed at both general and vulnerable populations.

Despite these contributions, some challenges remain, including the need to further explore the conceptual relevance of dimensions excluded from the final model (e.g., coherence) and to ensure the scale's applicability across diverse demographic and cultural groups. Future research should address these limitations and extend the validation of the PRS-P using more heterogeneous samples and experimental methodologies involving real-world environmental exposure.

In sum, the validation of the PRS-P enhances the international applicability of the scale and establishes a scientifically grounded instrument for assessing perceived restorativeness in Portuguese-speaking contexts. As environmental and health policies increasingly seek to integrate ecological sustainability with human well-being, the PRS-P offers a strategic

resource for guiding evidence-based decisions in support of greener, healthier, and more restorative environments.

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Data Availability Statement: Data available in a publicly accessible repository. The original data presented in the study are openly available in the following view-only link: https://osf.io/da4fc/?view_only=88bfa06f95314f5ba80b0f9949fad9ca, accessed on 11 April 2025.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Revised Perceived Restorativeness Scale (PRS-P)—Portuguese Version	
Distanciamento (being away)	1. Estar nessa paisagem é uma experiência de fuga.
	2. Passar o tempo lá permite-me fazer uma pausa da rotina do dia-a-dia.
	3. É um lugar para nos afastarmos de tudo.
	4. Estar na paisagem ajuda-me a reduzir a fixação nas coisas que tenho para fazer.
	5. Frequentar a paisagem ajuda-me a aliviar a exigência de dar atenção a pedidos indesejados.
Fascinação (fascination)	6. É um lugar com qualidades fascinantes.
	7. A minha atenção é atraída para muitas coisas interessantes na paisagem.
	8. Quero conhecer melhor esse lugar.
	9. Há muito para explorar e descobrir nesse lugar.
	10. Quero passar mais tempo a ver os arredores.
	11. O cenário é fascinante.
Compatibilidade (compatibility)	12. Estar nesse lugar adapta-se à minha personalidade.
	13. Nesse lugar posso fazer coisas que eu gosto.
	14. Tenho a sensação de que pertença a esse lugar.
	15. Consigo encontrar formas de me divertir nesse lugar.
Legibilidade (legibility)	16. Tenho uma sensação de comunhão com esse cenário.
	17. Existem pontos de referência que me ajudam a orientar-me num passeio nesse cenário.
	18. Consigo facilmente construir um mapa mental desse lugar.
	19. Ali, consigo encontrar facilmente o caminho a seguir.
	20. É fácil ver como as coisas estão organizadas.

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