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**Further Development of a
Measure of Perceived
Environmental Restorativeness**

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Further development of a measure of perceived environmental restorativeness

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ABSTRACT

Restorative environments help people to renew psychological resources needed for effective functioning. The design and management of restorative environments can be aided with an instrument for measuring qualities of restorative person-environment transactions. This paper reports a study carried out to further develop such a measure, the Perceived Restorativeness Scale (PRS). Initial PRS development studies raised questions about item characteristics and a potentially related lack of correspondence between PRS indicators and the constructs set out in attention restoration theory, the theoretical basis for the PRS. The study takes up scale development and validity issues raised in the previous studies by including new items, revising previously used items, and applying confirmatory factor analysis to test different models relating PRS indicators to theoretical constructs. Data used in the primary analyses were evaluations from 313 university undergraduates of a non-spectacular freshwater marsh, an environment about which people could be expected to have widely diverging views with respect to restorative qualities. The results point to the suitability of a 4-factor model that is consistent with attention restoration theory.

Restorative environments enable the renewal of cognitive resources needed for effective functioning. Conceivably, any environment can aid this process for someone at sometime, though a moment's reflection tells us that some environments are much more likely than others to be sources of restorative experiences. Indeed, some environments are stereotyped through reference to their high restorative potential. For some, the stereotypical restorative environment is the home, the place one retreats to at the end of a long work day. For others, it is a campsite beside a lake in the mountains, a place where one is far away from the traffic, noise, and crowds of the city. Yet such places are not universally regarded as places for restoration. For some, the residence is just another workplace or the setting for tense interpersonal relations, and the lakeside campsite is associated with coldness, biting insects, bad food, and poor sleep. Even for those who regularly seek them out for restoration, the restorativeness of such places may well diminish over periods of time spent in them; after two weeks in the mountains, the city may regain some appeal. So it is: The restorative potential seen in a place varies from one person to another, and over time for any one person.

No one environment, then, is restorative for all people at all times. In fact, no one environment *can* be restorative for any one person all of the time. Restoration is a process tied to some preceding deficit or deficits, to some antecedent condition from which one

recovers. As such, it is a process that can eventually be completed; the relevant psychological resources can eventually be renewed, something like equilibrium can be regained. When that has happened, the person-environment transaction by definition can no longer serve restoration. An on-going experience in the given environment may still be psychologically beneficial, but the benefits are other than restorative. Or the on-going experience there may lead to the depletion of psychological resources.

Rather than focusing on any one environment, theories concerned with restorative environments emphasize certain characteristics or qualities of the transactions between a person and the environment (Kaplan & Kaplan, 1989; Ulrich, Simons, Losito, Fiorito, Miles, & Zelson, 1991). These qualities are to be found to some greater or lesser extent in all person-environment transactions, restorative and otherwise. There are reasons to expect that these restorative qualities will be more characteristic of experiences in some environments than of experiences in others, reasons which conform to some extent with stereotypic notions regarding the overall restorative quality of those places. Most notably, evolutionary assumptions common to two well-known restorative environments theories (e.g., Kaplan & Kaplan, 1989; Ulrich *et al.*, 1991) provide a basis for the hypothesis that natural environments will, *in general*, be disproportionately restorative in comparison to built environments. Still, theories about restorative environments do not make absolute statements regarding the restorativeness of any one environment or type of environment over time.

Understandings of restorative person-environment transactions can be useful in environmental design, planning, and policy (Kaplan & Kaplan, 1989; Kaplan, 1983; Ulrich, 1992), and measurement of restorative qualities of person-environment transactions can help in applying such understandings (Hartig, Korpela, Evans, & Gärling, 1996). These qualities are accessible by asking people about their perceptions of environments. In addition to supplementing other forms of input that might be sought from potential or current users in creating, modifying, or caring for a given environment, a valid measurement instrument can also be used to test hypotheses based on underlying theory. This can involve examining the relations between restorative qualities and the restorative effects actually engendered in the experience of given environments. This in turn can involve testing the role of perceived restorativeness in mediating between different physical environments and the restoration outcomes realized in them.

The present study is part of an on-going effort to develop a valid measure of the restorative potential in given environments. The measure is based on attention restoration theory, an approach to understanding restorative environments that has been advanced primarily by Stephen and Rachel Kaplan (Kaplan & Kaplan, 1989; Kaplan, 1983, 1995; Kaplan & Talbot, 1983).¹ Attention restoration theory sets out theoretical constructs that are useful for characterizing a broad range of possible person-environment transactions that may proceed over extended periods of time. The theory builds on assumptions about the evolution of human cognitive capabilities in natural environments and the significance of the resultant constraints in those capabilities for functioning in contemporary environments. It starts from James' (1892) distinction between two forms of attention, which the Kaplans refer to as

directed attention and fascination. Most significant in this distinction is the assumption that, whereas directed attention requires effort, fascination is effortless. Functioning in contemporary environments typically makes demands on the capacity to inhibit distractions, a capacity that is basic to directed attention. Prolonged use of directed attention in functioning diminishes this capacity, and the ability to further direct attention consequently weakens. The resultant directed attention fatigue may become manifest not only in performance decrements such as decreased helping behavior and increments in accidents, but also in negative emotions, irritability and decreased sensitivity to interpersonal cues. Restoration of the directed attention capability requires entering a situation in which functioning does not involve demands on directed attention but can instead rely on fascination.

Yet fascination is only one of four interrelated characteristics of restorative experiences. A necessary first condition for restoration involves getting distance from further demands on directed attention and the ordinarily present or routine aspects of one's life. Three ways in which a sense of *being away* can come about include escaping from unwanted distractions in the surroundings, distancing oneself from one's usual work and reminders of it, and suspending the pursuit of particular purposes (Kaplan & Kaplan, 1989). To the extent that all three of these occur in a situation, restoration is enabled. This formulation recognizes that people can want to be away from demands and routines ranging from minor annoyances to matters of substantial personal significance. It also recognizes that geographical distancing is less critical than psychological distancing, and that the two are not perfectly correlated.

Being away implies movement to some other situation. That situation is less likely to be restorative if it lacks certain qualities. One of these, *extent*, is treated by the Kaplans (1989) as a function of connectedness and scope. Connectedness refers to the relatedness of the immediately perceived environmental elements or features, both to one another and, as a whole, to some larger organizational structure, such as a mental representation of the area.² Scope refers to the scale of the domain in which the perceptual and organizational activity takes place. It can encompass the immediate surroundings and areas that are out of sight but imagined. Conceptual domains such as intellectual problems and imaginary worlds can also be described in terms of their scope. Extent thus relies on the structuring of perceptual and conceptual elements and the scale of the frame of reference to which the organized elements might in turn be related. As the relevant frame of reference may exist in a conceptual or imaginary domain, extent can be experienced through intellectual activities, and not only in physical environments.

If one is away from everyday routines and demands on directed attention, fascination can more readily come into function. *Fascination*, or effortless attention, can go toward particular contents and events and can also be engaged in processes of exploring and making sense of an environment, processes that are essential to building a sense of extent. However, the relationship between fascination and restoration has some nuances. People can be fascinated by events that may have negative implications for their mental and emotional states, such as violence. Also, fascination can sometimes preclude a focus on that which the particular situation demands one attend to. The term "soft fascination" has been used to represent an

experience of moderate fascination with aesthetically pleasing stimuli (Kaplan & Kaplan, 1989). Thus, fascination may have pleasantness and intensity dimensions as well as a functionality dimension. Although soft fascination is assumed to be most conducive to restoration, restoration may be advanced by more intense fascinations, particularly those that fit in or contribute to a sense of extent.

A fourth construct in attention restoration theory is *compatibility*. The term refers to the match between the person's goals and inclinations, environmental demands, and the information available in the environment for the support of intended and required activities (Kaplan, 1983). This formulation holds that a person's activity in an environment is a function of personal intentions as well as environmental dictates. The potential for engaging in an activity is seen as a function of the information available to support that activity. When the supporting patterns of information are interesting and contribute to a sense of extent, compatibility will be high. In short, compatibility exists in situations in which what the person wants to do matches with what the environment demands and supports.

Attention restoration theory offers a set of constructs that can help us understand the restorative experiences of purposive individuals. These constructs have been in the focus of efforts to develop a measure of restorative qualities perceived in environments, the Perceived Restorativeness scale. The validity of the Perceived Restorativeness scale (PRS) has been assessed in a series of four previous studies (Hartig, Korpela *et al.*, 1996). Those studies gave preliminary indications of adequate reliability and validity for the PRS, but raised new questions or left key questions unanswered. The primary question concerns the factor structure of the instrument. In those studies, the same four sites were evaluated by American, Swedish, and Finnish students. The sites were located at different positions on two theoretically meaningful dimensions (natural-built; outdoor-indoor), and various means were used to present the sites to subjects (on-site, video, photographic slides). Analyses of evaluations were then completed for each of the sites in each study. Looking across sites and studies, the pattern of results showed generally adequate to strong internal consistencies for four subscales composed of items intended to represent the theoretical constructs in the attention restoration framework. However, instead of a steady correspondence between *a priori* subscales and empirical factors, factor analyses showed the intended being away, fascination, and compatibility items aligning in various combinations with three of the empirical factors, which tended to have moderate to strong correlations. In contrast, the remaining empirical factor consistently was defined by the items intended to represent the extent construct. Following up on these results, the evaluations were subjected to an additional analysis in which two rather than four factors were specified for extraction prior to oblique rotation. Looking across sites and studies, the intended being away, fascination, and compatibility items were consistently aligned with one empirical factor and the intended extent items with the other. These two factors tended to be weakly correlated (see also Korpela & Hartig, 1996). In short, then, the results raised the question of whether evaluations obtained with that version of the PRS are best represented in terms of (a) two orthogonal factors (2-factor model), with evaluations of being away, fascination, and compatibility loading on a General Restorativeness factor; (b) a second-order factor model with loading of

first-order being away, fascination, and compatibility factors on a second-order general factor (second-order factor model); or (c) four factors (4-factor model), which would be largely consistent with attention restoration theory but for the obliqueness of some factors.

An operational explanation for the obliqueness in the four-factor solution referred to the use of words that would have confounded preference with the different restorative factors or that simultaneously tapped into the whole set of restorative factors (S. Kaplan, personal communication, October 30, 1995). For example, the word "good" in one of the intended being away items - "Spending time here gives me a good break from my day-to-day routine" - may have forced subjects to also make evaluations of the potential for fascination, extent, and/or compatibility. Another explanation of this type was offered for the consistency with which the intended extent items had defined a separate factor, whether in the 4- or 2-factor solution. The relative independence of this factor, it was suggested, owed to the negative wording of all four of those items (T. Herzog, personal communication, October 12, 1995; S. Kaplan, personal communication, October 30, 1995). Since the content of those items was most in keeping with a hypothesized coherence aspect of extent (and the subscale accordingly referred to as the Coherence subscale), there was in any case inadequate sampling of items from the domain of the extent construct.

Although the factor analytic results prompted the detection of problems with the PRS, other results from the four studies were more encouraging with respect to reliability and validity. Composite scores based on the 2-factor solution consistently correlated in predicted ways with subscale scores from another environmental evaluation measure and an emotional state measure. Also, the environments that had been evaluated could be reliably differentiated on the basis of the composite scores, and in ways that had been predicted on theoretical grounds. That the pattern of between-site differences in Coherence ratings was not the same as that obtained with the General Restorativeness scores, but differed in reasonable and interpretable ways, suggested that the distinctiveness of the Coherence factor in the factor analytic results did not owe only to the negative wording of its constituent items.

Results obtained by Korpela and Hartig (1996) gave another view on the psychometric properties of the preliminary PRS. In this study subjects evaluated favorite and unpleasant places of their own designation, and also the central square of the town in which they lived. These subjects were the same as those in the fourth study reported by Hartig, Korpela *et al.* (1996), and they evaluated the central square and the favorite and unpleasant places before evaluating the four sites of interest in the studies reported by Hartig, Korpela *et al.* (1996). The central square and the favorite and unpleasant places were evaluated on the basis of memory or imagination; thus, with the exception of the central square, the sites were the same across subjects only in terms of their presumed personal significance. Multivariate analyses paralleled those of the validation studies. Internal consistency among items in the *a priori* being away, fascination, coherence, and compatibility subscales was again generally adequate to strong. In contrast to the factor analytic results of Hartig, Korpela *et al.* (1996), a more consistent 4-factor solution was obtained in which there was closer correspondence between theoretical and empirical factors. Given this, and in light of the exploratory character of the

study, further analyses were based on composite scores for the four *a priori* subscales. These analyses, like those of Hartig, Korpela *et al.* (1996), spoke to the sensitivity of the PRS to meaningful differences between environments, and indicated criterion validity with respect to the self-reported emotional states that subjects associated with the given environments.

In sum, previous studies have given some indication of reliability and validity for the PRS, but have raised questions about its factor structure and have prompted critical comments on the construction of some items. In an effort to further develop the PRS, the present study takes up these issues in several ways.³ First, some items were revised. Second, negatively worded items were included for constructs other than coherence. Third, in an attempt to better represent the extent construct, items were included to represent *legibility*. A construct often used in related environmental evaluation research, legibility refers to the possibilities one sees in an environment for staying oriented and making sense of the surroundings as one proceeds further (S. Kaplan & R. Kaplan, 1982; Kaplan & Kaplan, 1989). It was a point of discussion whether legibility plays a larger role in extent than it does in compatibility (T. Herzog, personal communication, October 12, 1995; S. Kaplan, personal communication, October 30, 1995). Finally, confirmatory factor analyses enabled an empirical comparison of the three candidate models: 2-factor, 4-factor, and second-order.

METHOD

Subjects. The total sample consisted of 488 students, mostly either social ecology or biology majors, recruited from one lower-division and two upper-division courses at the University of California at Irvine. The mean age of participants (44.4% male) was 21.4 years (range: 17-50). For reasons to be explained below, the analyses of primary interest are based on a subsample ($n = 313$).

Study site. In contrast to the previous PRS development studies, each of which involved evaluation of several sites expected to differ in perceived restorative potential, the present study involved evaluation of only one site. The San Joaquin Marsh Reserve is a 202 acre remnant of the freshwater marsh system that once covered much of what is now Orange County, California. It is bounded on three sides by freeways, surface streets, and other development, and on the fourth by a flood control dike which contains a stream that runs through agricultural and residential areas before emptying into a coastal estuary. Because seasonal flooding of this stream no longer passes through the marsh, vegetation that formerly had been flushed out on a regular basis has been allowed to collect, and areas that had been open water are now filled with cattails and reeds. The marsh is also bisected by a berm on top of which a major traffic artery is situated.

Given its particular characteristics, it was expected that this site would elicit evaluations in the middle of the range of restorative potential. The density and uniformity of the vegetation, the extent to which the vegetation limits views, the extent to which commercial buildings are present in and enclose the longer views that are available, and the audibility of automobile traffic and overflights into a nearby airport were all reasons to expect that the marsh would

receive middle-range evaluations. Such evaluations would be relatively low for natural environments to which the subjects would ordinarily have had access, which include some exceptional beach and mountain areas. These characteristics of the marsh also gave reason to expect considerable variability in evaluations.

Measures. The Perceived Restorativeness Scale (PRS) described by Hartig, Korpela *et al.* (1996) consisted of 16 items designed to tap the factors being away, fascination, coherence, and compatibility. In the present study, those 16 items, some slightly revised, were joined with 15 new items designed for the scale development purposes described earlier; that is, new items were added so that some of the theoretical constructs might be better represented, and some of those items were worded negatively. Those items ultimately retained for the present version of the PRS are given in the Appendix. Responses were made using a 7-point scale to indicate the extent to which the given statement described their experience in the given setting (0 = Not at all; 6 = Completely).

Procedure. All participants filled out a questionnaire containing the PRS and other items during a single class period, either on location in the marsh or in a lecture hall. For those students who completed the questionnaire in the lecture hall, evaluation of the marsh with the PRS was aided by projecting a color slide of the marsh onto a large screen.⁴ The questionnaire required about 35 minutes to complete.

RESULTS

The PRS measures used in the present study were derived with a series of exploratory principal factor analyses (PFA). The first included only the 16 items (some slightly revised) from that version of the PRS used in the previous studies. As in the previous studies, the extraction of four factors was specified and communality estimates were derived iteratively, using the highest correlation of each variable with any other variable as a starting value. However, in contrast to the oblimin rotation used in the previous studies, the final solution was varimax rotated to maximize the operational distinctiveness of the concepts; the possible obliqueness of the theoretical constructs was a question for the confirmatory factor analyses. The loadings and item communalities are given in Table 1; the numbering of the items corresponds to that given in the Appendix. The pattern of factor loadings from this analysis shows close correspondence between *a priori* subscale membership of the items and their loadings on the four empirical factors. Consistent with the results of Hartig, Korpela *et al.* (1996), the intended being away, fascination, and compatibility items had cross loadings which pointed to the empirical relatedness of the factors defined by those items. The solution accounted for 57.6% of the variance in evaluations.

The next step in the derivation of PRS measures involved a series of three PFA. These were meant to strengthen existing subscales through the addition of new items. All three analyses were carried out as the analysis above with respect to the extraction of factors, derivation of communality estimates, and rotation of the final solution. The first analysis included the 16 initial PRS items plus the 15 new items. It marked two of the new items for exclusion from

A priori Subscale	Item #	Factor				h ²
		I	II	III	IV	
Being Away	1	.29	.29	.12	.68	.64
	2	.43	.29	.15	.56	.61
Fascination	6	.68	.19	.11	.30	.61
	7	.77	.20	-.03	.04	.64
	8	.72	.38	-.06	.11	.68
	9	.60	.21	.14	.30	.51
	10	.63	.32	.04	.23	.56
Coherence	14	-.03	.02	.50	.05	.25
	15	.02	.09	.57	-.10	.35
	16	.00	-.04	.75	.10	.58
	17	.15	-.01	.67	.19	.51
Compatibility	18	.52	.59	.03	.23	.67
	19	.57	.55	-.08	.18	.66
	20	.36	.77	.04	.14	.75
	21	.55	.47	.08	.26	.60
	22	.37	.61	.09	.29	.60

Table 1. Factor loadings and item communalities for the 16 original Perceived Restorativeness Scale (PRS) items.

Note: The item numbers correspond to those given in the Appendix. An item's highest loading is given in bold faced type.

further analysis; both had loadings of less than .30 in the unrotated matrix. The second analysis excluded those items and marked three more new items for elimination due to mismatch between theoretical intent and empirical result. The third analysis then included the 26 remaining items; the four factor solution accounted for 52.6% of the variability in evaluations. The loadings and item communalities are given in Table 2; the numbering of the items corresponds to that given in the Appendix. Note that the results show the intended legibility items aligning with Compatibility rather than with Coherence. Thus, rather than combining them with the Coherence items to represent extent, those items were joined with the Compatibility items for this study. Similarly, three of the intended compatibility items had their strongest loadings on the Fascination factor. Because those items more frequently

A priori Subscale	Item #	Factor				h ²
		I	II	III	IV	
Being Away	1	.29	.74	.07	.11	.66
	2	.44	.65	.13	.13	.65
	3	.22	.71	.14	.12	.59
	4	.34	.52	.36	.09	.53
	5	.33	.60	.32	.10	.59
Fascination	6	.69	.30	.15	.09	.61
	7	.67	.17	.27	-.07	.55
	8	.67	.23	.36	-.12	.65
	9	.66	.26	.14	.14	.55
	10	.63	.29	.26	-.01	.55
	11	.50	.29	.15	.38	.51
	12	.67	.34	.15	.14	.61
	13	.46	.13	.06	.35	.36
Coherence	14	-.03	.05	.01	.47	.23
	15	-.03	-.05	.20	.57	.36
	16	.01	.08	-.02	.74	.56
	17	.21	.14	-.05	.66	.50
Compatibility	18	.51	.44	.44	-.02	.64
	19	.54	.38	.42	-.14	.62
	20	.36	.41	.55	-.03	.60
	21	.54	.41	.43	.04	.64
	22	.37	.45	.52	.08	.62
	23	.25	.23	.43	-.10	.31
	24	.28	.22	.56	.09	.45
	25	.01	.01	.64	.07	.41
	26	.23	.06	.52	.14	.35

Table 2. Factor loadings and item communalities for the Perceived Restorativeness Scale (PRS).

Note: The item numbers correspond to those in the Appendix. An item's highest loading is in bold faced type. Items 23-26 were to represent legibility, and are aligned here as an aspect of Compatibility.

loaded on a Compatibility factor in previous studies, and in the present study had substantial secondary loadings on the Compatibility factor, they also were used to represent Compatibility.

Two composite scores apiece were calculated for the Being Away (BA), Fascination (FA), Coherence (CO), and Compatibility (CM) subscales, for use in the confirmatory factor analyses to follow.⁵ Each composite score was the average of two or more of the items from the given subscale. The division in terms of the number of items contributing to each composite score was as even as possible.⁶ For some subjects the composite score could not be calculated because of a missing value for one or more of the constituent items; for these cases, the mean based on the remaining subjects' scores was imputed. The number of such cases never exceeded 1.2% of the sample.

The next step in analysis involved a hierarchical set of three confirmatory factor analyses (CFA) of the data from the revised scale. These directly tested the fit of the data to the different models suggested by theory and the results of Hartig, Korpela *et al.* (1996). The models were as follows: (1) a 2-factor model in which being away, fascination, and compatibility indicators load on one factor and coherence indicators on the second; (2) a second-order factor model in which the relatedness of Being Away, Fascination, and Compatibility factors is driven by a second-order factor; and (3) a 4-factor model which consists of separate but oblique Being Away, Fascination, Coherence, and Compatibility factors.

The data used in the CFA were from a subset ($n = 313$) of the initial sample. The particular reduction in the number of cases was made to bring the set of CFA into agreement with the structural equation modeling to be done as part of the larger study (see Note 3); poor estimates of a key variable, General Ecological Behavior (GEB), were obtained for some subjects, so the structural equation modelling was carried out only with those subjects for whom an adequate estimate was obtained (for further details, see Kaiser & Wilson, 1997). It is not certain whether the factors that might have affected the reliability of the GEB measure (e.g., hasty responding, homogeneity of the sample) also would have affected evaluations provided with the PRS items; use of the subsample is assumed by us to be a conservative approach to analysis.⁷ The covariance matrix used in the confirmatory factor analyses is given in Table 3, along with descriptive statistics for the various composite scores.

The CFA testing the 2-factor model (Model 1) produced the following fit statistics: $\chi^2 = 258.97$, $df = 19$, $p = .0001$, non-normed fit index (NNFI) = 0.77, root mean square error of approximation (RMSEA) = 0.20. The CFA testing the second-order model (Model 2) produced the following fit statistics: $\chi^2 = 40.38$, $df = 17$, $p = .001$, NNFI = 0.98, RMSEA = 0.07. The CFA testing the 4-factor model (Model 3) produced the following fit statistics: $\chi^2 = 21.20$, $df = 14$, $p = .097$, NNFI = 0.99, RMSEA = 0.04. Model 2 provides a better fit to the data than Model 1 ($\Delta df = 2$, $\Delta \chi^2 = 218.59$, $p < .001$), but Model 3 provides a better fit than Model 2 ($\Delta df = 3$, $\Delta \chi^2 = 19.18$, $p < .001$). Model 3 is also more satisfying from a theoretical perspective. The reliability parameters and correlations between the factors for this model are

given in Figure 1. It appears that although a model with four separate factors is more in keeping with the data than the 2-factor or second-order models, the Being Away, Fascination, and Compatibility factors are nonetheless highly correlated.⁸

Scale	n	M	SD	Covariance Matrix								
				BA1	BA2	FA1	FA2	CO1	CO2	CM1	CM2	
BA1	313	3.93	1.30	1.69								
BA2	313	3.89	1.30	1.34	1.70							
FA1	313	4.48	1.08	0.92	0.85	1.17						
FA2	313	4.66	0.97	0.70	0.64	0.82	0.93					
CO1	313	3.99	1.28	0.33	0.29	0.24	0.16	1.64				
CO2	313	3.88	1.39	0.26	0.22	0.19	0.15	1.03	1.94			
CM1	313	3.69	1.12	0.94	0.91	0.85	0.67	0.05	0.00	1.26		
CM2	313	3.77	1.01	0.76	0.72	0.69	0.61	0.07	0.12	0.93	1.03	

Table 3. Descriptive statistics for the Perceived Restorativeness Scale (PRS) variables and the covariance matrix used as input for the confirmatory factor analyses.

Notes: BA - Being Away; FA - Fascination; CO - Coherence; CM - Compatibility. Means for the PRS indicators fall on a 0-6 scale, with larger values indicating a stronger presence of the given restorative quality.

Figure 1. The 4-factor model of perceived restorativeness.

DISCUSSION

Studies reported by Hartig, Korpela *et al.* (1996) gave some indications of reliability and validity for an initial version of the Perceived Restorativeness scale (PRS), but raised interrelated questions about its underlying factor structure, the construction of some items, and the adequacy with which the given items represented their target theoretical constructs. Such questions need to be resolved in order to maximize the value of the PRS as a tool for the development as well as application of restorative environments theory.

To help address these questions, evaluations of a freshwater marsh were obtained from university students using a revised version of the PRS. The current version of the PRS included previously used items that had been revised to eliminate problematic word choices and some additional items for better representation of target constructs. Also, confirmatory factor analyses were used to assess the suitability of different models relating the measured

variables to the target constructs specified in attention restoration theory. These analyses indicated that a 4-factor model consistent with attention restoration theory fit the data obtained with the revised PRS better than the 2-factor model and 2-factor higher-order model that emerged as alternatives from the analyses reported by Hartig, Korpela *et al.* (1996).

Exploratory factor analyses used to establish indicators for use in the confirmatory factor analyses shed some light on two additional issues. The first concerns both the representation of the extent construct and the consistency with which the items used to represent extent had defined a separate factor in the analyses of Hartig, Korpela *et al.* (1996). The extent items used in those studies were in fact more accurately considered as representative only of the coherence aspect of extent. Moreover, they represented coherence in negative terms. That they were the only negatively worded items in the earlier version of the PRS suggested an operational explanation for the consistency with which those items defined a separate factor, no matter whether the extraction of two or four factors had been specified. Those studies had also provided evidence that the operational explanation was not sufficient, but inclusion of negatively worded items for other constructs was viewed as a step that could be taken to ameliorate lingering doubts. The use of negatively worded items to represent Fascination in the present version of the PRS offers additional evidence that the operational explanation is insufficient. Specifically, as shown in Table 2, Items 11 and 13 have loadings greater than .35 on the Coherence factor, the only non-Coherence items with loadings of that magnitude. Yet their highest loadings still are with the Fascination factor. This suggests that negative wording alone cannot explain the distinctiveness of the Coherence factor as seen in this and the previous studies.

The second issue also starts from concern for the representation of extent. In the effort to more adequately sample items from the domain of the extent construct, and so to represent more than its hypothesized coherence/connectedness aspect, items were included to represent legibility, a concept drawn from Kaplan and Kaplan's (1982) theoretical framework for the prediction of environmental preferences. Since it had been a matter of discussion as to whether legibility plays a larger role in extent than it does in compatibility (T. Herzog, personal communication, October 12, 1995; S. Kaplan, personal communication, October 30, 1995), it was of interest whether these items would align with the proposed coherence items or with the proposed compatibility items. In the present study they aligned with a Compatibility factor. This is hardly conclusive evidence that legibility is more an aspect of compatibility than extent, given lingering uncertainties about the adequacy of the PRS measures for those constructs. Still, it serves as a reminder of the fact that each of the factors in attention restoration theory is described with respect to more than one key aspect (e.g., content and process fascination; connectedness and scope), and a measure that is theoretically satisfying and complete should represent these various aspects. A related question is how the various preference predictors might map onto the restorative factors and contribute to such representation. In any case, researchers planning to use the present version of the PRS should not combine the present legibility items with the present compatibility (or coherence) items unless such a combination is indicated by the results of appropriate factor analyses.

As with the previous PRS development studies, the present study is limited by narrow sampling of subjects and environments. Only one environment was evaluated, and by a rather small and homogenous sample. Future research with the PRS could benefit from the inclusion of larger numbers of environments and subjects, not to mention the use of non-student subject samples. The present study simply constitutes another step toward the goal of a valid measure with both theoretical and practical utility.

NOTES

1. Roger Ulrich (1983; Ulrich *et al.*, 1991) provides another view on restorative environments that places more emphasis on emotional and psychophysiological aspects of restoration. For discussions of the similarities and differences between the attention restoration approach and the psychophysiological stress reduction approach, see Hartig, Mang, and Evans (1991; Hartig & Evans, 1993; Hartig, Bök, Garvill, Olsson, & Gärling, 1996).
2. Connectedness is analogous to coherence as referred to in previous theorizing in this line. The treatment of extent in the Kaplans' (1989) articulation of attention restoration theory is an expansion on Kaplan and Talbot's (1983, pp. 189-190) treatment of pattern, distance, and higher-level levels of coherence as influences on the scope of potentially restorative environments.
3. The present study was part of a larger study concerned with relations between environmental attitudes, ecological behavior, and perceptions of environmental restorativeness within the context of university-level environmental education. This report only concerns the PRS development issues referred to above, and to the extent possible excludes details that do not bear on those issues.
4. The fact that only one group of students completed their forms in the classroom should not be an issue, since they had visited the study site and had most likely driven through portions of the site at some time in travelling to and from the campus. Furthermore, Hartig, Korpela *et al.* (1996) found that mean PRS evaluations of other environments did not significantly differ when made on-site or with the aid of slide or video simulations.
5. Composite scores based on all of the items for a given PRS subscale are strongly correlated with their respective factor scores. For the whole sample, minus cases with a missing value on any item in the factor analysis ($n = 458$), the correlations are as follows: BA, $r = .91$; FA, $r = .92$; CH, $r = .94$; CM, $r = .82$.
6. With the exception of the Coherence subscale, different combinations of items in a composite score for a given subscale did not substantially change the results. The variations due to different partitions of the Coherence items suggest that those items may in fact align in two factors. This is a possible subject for further research. In the present study, the partition used was that which yielded the highest average reliability for the two composite scores.

7. Composite scores based on all items for a given PRS subscale are strongly correlated with their respective factor scores in the subsample with reliable GEB estimates, minus cases with a missing value on any item in the factor analysis ($n = 292$): BA, $r = .98$; FA, $r = .99$; CH, $r = .93$; CM, $r = .92$.

8. A test of this model based on the full sample ($n = 488$) also yields an acceptable fit to the data ($\chi^2 = 25.50$, $df = 14$, $p = .03$, NNFI = 0.99, RMSEA = 0.04). Note that the χ^2 statistic is affected by sample size, which is in this analysis increased by 175 participants over that involved in the analysis reported in the main body of the results. This increase can be held partly responsible for the decrease in model fit as represented by the χ^2 statistic. Note also that the NNFI is independent of sample size and does not change in this analysis. This suggests that the model still fits well. Thus, the model fit for the whole sample concurs with the findings from the subset of 313.

AUTHOR NOTES

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REFERENCES

- Hartig, T., Böök, A., Garvill, J., Olsson, T. & Gärling, T. (1996). Environmental influences on psychological restoration. *Scandinavian Journal of Psychology*, *37*, 378-393.
- Hartig, T., & Evans, G.W. (1993). Psychological foundations of nature experience. In T. Gärling & R.G. Golledge (Eds.), *Behavior and environment: Psychological and geographical approaches*. Amsterdam: North-Holland, pp. 427-457.
- Hartig, T., Korpela, K.M., Evans, G.W., & Gärling, T. (1996). *Validation of a measure of perceived environmental restorativeness* (Göteborg Psychological Reports, 26:7). Göteborg, Sweden: Department of Psychology, Göteborg University.
- Hartig, T., Mang, M., & Evans, G.W. (1991). Restorative effects of natural environment experiences. *Environment & Behavior*, *23*, 3-26.
- James, W. (1892). *Psychology: The briefer course*. New York: Holt.
- Kaiser, F.G., & Wilson, M. (1997). *Assessing people's ecological behavior: A cross-cultural measure*. Manuscript under review.
- Kaplan, R., & Kaplan, S. (1989). *The experience of nature: A psychological perspective*. Cambridge: Cambridge University Press.
- Kaplan, S. (1983). A model of person-environment compatibility. *Environment & Behavior*, *15*, 311-332.
- Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology*, *15*, 169-182.
- Kaplan, S., & Kaplan, R. (1982). *Cognition and environment: Functioning in an uncertain world*. New York: Praeger.
- Kaplan, S., & Talbot, J.F. (1983). Psychological benefits of a wilderness experience. In I. Altman & J.F. Wohlwill (Eds.), *Behavior and the natural environment* (pp. 163-203). New York: Plenum Press.
- Korpela, K., & Hartig, T. (1996). Restorative qualities of favorite places. *Journal of Environmental Psychology*, *16*, 221-233.
- 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). New York: Plenum Press.
- Ulrich, R.S. (1992). Effects of interior design on wellness: Theory and recent scientific research. *Journal of Health Care Interior Design*, *3*, 97-109.
- Ulrich, R.S., Simons, R.F., Losito, B.D., Fiorito, E., Miles, M.A., & Zelson, M. (1991). Stress recovery during exposure to natural and urban environments. *Journal of Environmental Psychology*, *11*, 201-230.

APPENDIX

The results are based on a version of the Perceived Restorativeness Scale (PRS) comprised of the 26 items below. Participants made their responses using a 7-point scale to indicate the extent to which the given statement described their experience in the given setting (0 = Not at all; 6 = Completely).

The items are grouped by subscale membership (Being Away, Fascination, Coherence, and Compatibility, respectively):

1. Being here is an escape experience. *
2. Spending time here gives me a break from my day-to-day routine. †
3. It is a place to get away from it all.
4. Being here helps me to relax my focus on getting things done.
5. Coming here helps me to get relief from unwanted demands on my attention.

6. This place has fascinating qualities. *
7. My attention is drawn to many interesting things. *
8. I want to get to know this place better. †
9. There is much to explore and discover here. *
10. I want to spend more time looking at the surroundings. †
11. This place is boring. (-)
12. The setting is fascinating.
13. There is nothing worth looking at here. (-)

14. There is too much going on. (-) *
15. It is a confusing place. (-) *
16. There is a great deal of distraction. (-) *
17. It is chaotic here. (-) *

18. Being here suits my personality. *
19. I can do things I like here. *
20. I have a sense that I belong here. *
21. I can find ways to enjoy myself here. †
22. I have a sense of oneness with this setting. *
23. There are landmarks to help me get around. ‡
24. I could easily form a mental map of this place. ‡
25. It is easy to find my way around here. ‡
26. It is easy to see how things are organized. ‡

Notes: (-) an item for which the value must be reversed in coding; (*) the item is from the earlier PRS and is in its original form; (†) the item is from the earlier PRS but is in a revised form; (‡) the item was designed to represent legibility.

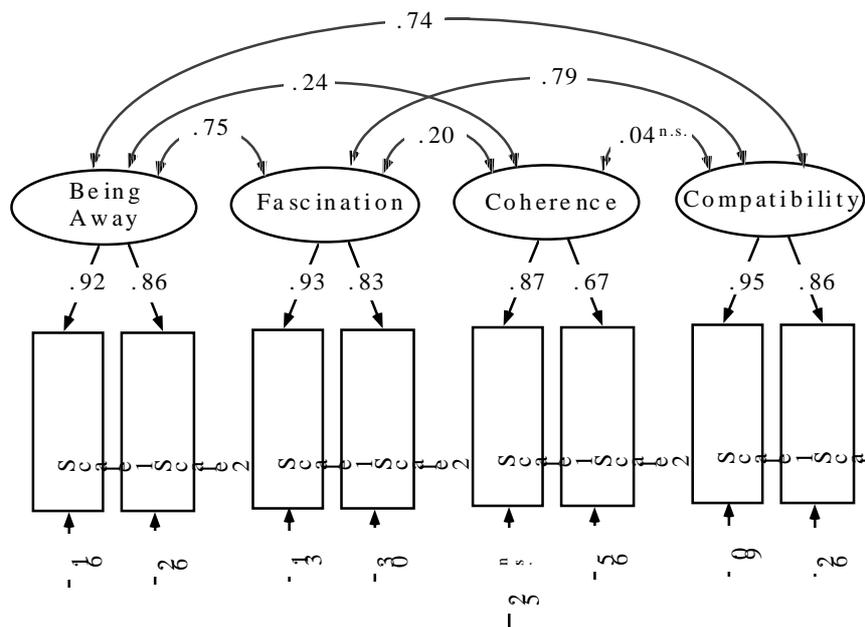


Figure 1. 4-factor model of perceived restorativeness.