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# A Measure of Restorative Quality in Environments

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**Restorative environments help renew psychological resources depleted in environments that do not fully support intended functions. The design of restorative environments can be aided and underlying theory elaborated with a means for measuring psychological factors thought to work in restorative experiences. This paper reports on four studies carried out to develop such a measure, the Perceived Restorativeness Scale (PRS). Each study employed several strategies for assessing reliability and validity. Factor analysis was used to examine the stability of the measure's factor structure across different sites and studies. To assess criterion, convergent, and discriminant validities, measures of emotional states and other environmental qualities were also completed for each site. The sites selected for evaluation differed on theoretically relevant dimensions (natural-urban; outdoor-indoor), enabling checks on the PRS's sensitivity to meaningful differences among environments. The results were consistent across the studies, which also involved different subject populations (American, Swedish, Finnish) and presentation modes (on-site, video, photographic slides). Although the factor analytic results introduce some interpretive qualifications, substantial validity coefficients and sensitivity to meaningful differences between sites speak to the utility of the measure.**

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## INTRODUCTION

Environments often are not fully supportive of individuals' activities, and those individuals may therefore need opportunities to restore psychological resources that have been lost due to the lack of compatibility (S. Kaplan, 1983). In identifying factors that work to help a person replenish resources or otherwise recover from excessive demands, research on restorative environments also points to factors that make for more supportive environments.

Development and utilization of restorative environments theory could be quickened with a measurement tool that accurately represents core constructs. A valid measure of environmental restorativeness could help efforts to link theoretical factors to specified outcomes of experiences in different settings. It could also be used to assess the restorative potential of existing and proposed settings, and so to inform various kinds of design efforts. For example, it might aid in the development of restorative settings in urban public spaces by enabling designers to examine the restorative quality ratings that potential users have given to proposed alternative configurations of natural and architectural elements. In this it could supplement other forms of input that might be sought from potential users of the space (cf. Kaplan, 1978).

The potential utility of such a measure was first discussed in a report of a field experiment that compared restoration under natural, urban, and passive relaxation conditions (Hartig, Mang, and Evans, 1991). At the end of the procedure subjects used a prototype scale to evaluate their experience in terms of factors specified in an early statement of attention restoration theory (Kaplan and Talbot, 1983). The results indicated that scores from the scale differentiated in the expected manner between the environments under study. Restorativeness scores were also reliably correlated with self-reported emotions and proofreading performance.

This paper describes four studies conducted to further develop the measure of environmental restorativeness used initially by Hartig *et al.* (1991). We begin by overviewing attention restoration theory and the measure's target constructs. We then outline strategies used in the studies to help establish a sound Perceived Restorativeness Scale (PRS).

## Attention Restoration Theory

One approach to understanding restorative environments has been advanced by Stephen and Rachel Kaplan and associates (Kaplan and Kaplan, 1989; S. Kaplan, 1983; Kaplan and Talbot, 1983).[1] Their attention restoration theory builds on assumptions about the evolution of human cognitive capabilities in natural environments. It also builds on a distinction between directed attention and fascination (after James, 1892). The Kaplans assert that in contrast to directed attention, fascination is effortless and without capacity limitations. They also observe that functioning in contemporary environments typically makes demands on our capacity for directing attention, and that over time the ability to direct attention may weaken. Directed attention fatigue may be reflected in negative emotions, irritability, decreased sensitivity to interpersonal cues, decreased helping behaviour, performance decrements on tasks requiring directed attention, and in accidents. Restoration of the directed attention capability requires entering a situation in which functioning does not involve demands on directed attention but can instead permit fascination to come into play. Natural environments in particular are thought to afford such opportunities. However, fascination is only one of four factors thought to work in a restorative experience, whether in a natural environment or some other kind of environment. The four factors are discussed below.

### *Being away*

A necessary condition for restoration involves getting distance from some ordinarily present or routine aspects of one's life. The Kaplans (1989) describe three ways to bring about a sense of being away. One is to escape from unwanted distractions in the surroundings. Another is to distance oneself from one's usual work and reminders of it. The third is to suspend the pursuit of particular purposes. Restoration is enabled to the extent that all three are found in a situation. This formulation recognises that people can want distance from demands ranging from annoying trifles to matters of great personal significance. It also recognises that the distance sought need not be geographical, but can be purely psychological or some mix of the two.

Relations between being away and potential psychological outcomes are suggested by research on outdoor recreation motives. Numerous studies of recreation motivations show a desire to escape conditions such as noise and stimulation overload coinciding with expectations of stress reduction (Driver and Knopf, 1976; Driver, Nash, and Haas,

1987; Knopf, 1983, 1987; Schreyer, 1986). However, treatments of the escape motive have been primarily concerned with physical movement to outdoor recreation settings, and so have not dealt with some of the psychological issues represented by the being away construct. Also, some research indicates that geographical distancing is not a sufficient condition for restoration (e.g., Hartig *et al.*, 1991), though a moment's reflection would as well tell us that where one is away to and what one can do while there are clearly important.

### *Extent*

Being away implies movement to some other situation, and that situation is less likely to support restoration if it lacks certain qualities. The Kaplans (1989) propose extent as one of these. It is viewed as a function of connectedness and scope. Connectedness refers to the relatedness of immediately perceived elements or features of the environment, to one another and, as a coherent whole, to some larger organisational structure, such as a mental representation of the area. Scope refers to the scale of the domain in which the perceptual and organisational activity is situated. The domain can encompass the immediate surroundings and areas that are out of sight but imagined. Conceptual domains (e.g., intellectual problems, 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 organised elements might in turn be related. In that the relevant frame of reference may exist in a wholly conceptual or imaginary domain, extent can be experienced through immersion in intellectual activities as well as in physical environments.

Empirical evidence of the role of extent in restoration is more suggestive than direct, but comes from more than one source. The coherence construct used in the Kaplans' environmental evaluation research refers to the ease with which one can organise and structure a scene (Kaplan and Kaplan, 1982, p. 82), and as such it constitutes a preliminary level of connectedness.[2] Coherence has been found to reliably predict environmental preference (Herzog, 1985, 1989; Kaplan and Kaplan, 1989; cf. Küller, 1972; Ulrich, 1977; Wohlwill, 1976), which may in turn be indicative of restorative potential. Yet the environmental evaluation findings are based on ratings of photographic simulations of environments, and speak mainly to the importance of the connectedness of the immediately perceived elements in the visual array. However, other evidence bears on connectedness of a higher order, and so also on scope. Cognitive mapping research considers people's ability to make sense of the world beyond their immediate surround. Mental representations of environments are outcomes of on-going elaborative efforts to achieve an adequate basis for movement through those environments (e.g., Evans, 1980; Gärling and Evans, 1991; Gärling and Golledge, 1989). Furthermore, cognitive maps are not limited to geographical representations, but can also be vehicles for social meanings (e.g., Milgram and Jodelet, 1976; Stokols and Shumaker, 1981). The elaboration of mental representations, a common and manifold activity, presumably is often experienced as rewarding, and sometimes in ways that promote restoration. Conversely, conditions that do not facilitate map building may make demands on directed attention, and so may engender directed attention fatigue.

### *Fascination*

If one is away from everyday routines and demands on directed attention, it is more likely that an effortless attention can help in the development of a sense of extent.

Fascination can go toward particular contents and events and can also be caught up in the processes of making sense and exploration that contribute to the sense of extent. The relationship between fascination and restoration is, however, not straightforward. People can be fascinated by events that may negatively affect their mental and emotional states, such as violence. Also, fascination can be so strong as to preclude a focus on that which is required by the demands of the situation. The Kaplans (1989) introduced the term "soft fascination" to represent an experience of moderate fascination with aesthetically pleasing stimuli. In this formulation fascination has pleasantness and intensity dimensions in addition to a functionality dimension (cf. Herzog, Black, Fountaine, and Knotts, 1997). Although soft fascination is thought to be most conducive to restoration, more intense fascinations may also contribute to restoration, particularly if they fit in or contribute to the sort of perceptual/cognitive framework needed for a sense of extent.

Models of attention typically are not concerned with fascination (cf. Wickens, 1984). Some aspects of fascination, such as reflexiveness, effortlessness, and involuntariness, are seen in work on the orienting reflex (Rohrbaugh, 1984) and automatic processes (Kahneman and Triesman, 1984; Schneider, Dumais, and Shiffrin, 1984). Although applied research on directed attention and vigilance is concerned with preventing overload, little work has been done to document the role of fascination in speeding recovery of a depleted directed attention capacity. The operative assumption appears to be that capacity is recovered during rest (Cohen, 1978). The value of fascination in recovery of capacity is suggested by self-reported satisfactions gained from gardening (R. Kaplan, 1973, 1983) and studies that have employed behavioural measures of attention to document recovery of directed attention capacity following depletion (Cimprich, 1993; Hartig *et al.*, 1991).

### *Compatibility*

Compatibility refers to the match between the person's goals and inclinations, the demands made on the person by environmental conditions, and the patterns of information available in the environment for support of purposive and required activities (S. Kaplan, 1983). This formulation holds that a person's activity in an environment is a function of environmental dictates and personal intentions. It also views the potential for engaging in an activity as a function of the information available in the environment to support that activity. Compatibility can be found in situations in which what one wants to do matches what the environment demands and supports. It is high when the supporting patterns of information are interesting and contribute to a sense of extent. A high level of compatibility is thought to permit reflection, which can contribute to particularly profound and lasting outcomes.

That compatibility figures in restoration is suggested by other analyses of the match between environmental demands, chosen activities, and environmental supports for those activities. Compatibility is an extension of person-environment congruence and fit concepts that are common to the environment-behaviour literature. These particular notions of congruence and fit come from systems models of environmental stress, which view stress as the result of a mismatch between needs or goals and the environmental supports for meeting those needs or goals (Evans and Cohen, 1987; Stokols, 1979; see also Caplan and Van Harrison, 1993). Analogs of compatibility also appear in work dealing with forms of positive experience; Czikszentmihalyi's (1975) "flow" and Quarrick's (1989) "absorption" share features of high compatibility experiences. Both Czikszentmihalyi and Quarrick refer to the importance of

situational supports for intrinsically interesting activities in which one becomes immersed or loses a sense of self.

In sum, attention restoration theory offers a set of constructs useful for understanding various restoration outcomes realised by purposive individuals acting in full-scale environments. This set of constructs was of primary interest in the present effort to develop a measure of restorative quality in environments.

### *Validation Strategies*

In developing the Perceived Restorativeness Scale (PRS) the goal was a valid, reliable measurement tool that could (a) represent the constructs being away, fascination, extent, and compatibility, and; (b) distinguish between environments differing in restorative potential. Four methodological strategies were used toward this end in the present studies. First, calculations of the internal consistency of specified sets of items were used to establish a priori subscales, and then factor analyses were used to examine the correspondence between the a priori subscales and the empirical factors obtained.

Second, convergent, discriminant, and criterion validities were assessed using data obtained with another environmental evaluation scale (Studies 1 and 2 only) and a measure of emotional states. PRS scores were examined with regard to correlations and non-correlations with scores from factors measured by the other scales, some of which were similar to factors in attention restoration theory, some of which were different, and some of which represented restoration outcomes that should be predictable by PRS scores.

Third, each subject evaluated several places so that the sensitivity of the PRS could be assessed. As the places selected for evaluation were chosen because they differed in theoretically relevant ways (e.g., in the presence of natural elements), it was furthermore possible to see if PRS scores could reflect theoretically meaningful differences among environments.

Fourth, to see whether the PRS could enable evaluations that would be consistent in terms of both underlying factor structure and the relative magnitude of scores, core aspects of the procedure were replicated with different presentation modes and with subjects from different populations (see Craik and Feimer, 1987). The studies reported here all required that university student subjects complete paper-and-pencil versions of the scale in evaluating a set of four sites. In Study 1, American subjects gave on-site evaluations of either four or eight sites. American subjects in Study 2 were randomly assigned to a field condition or a video simulation condition, and evaluated four of the environments from Study 1. In Study 3, Swedish subjects evaluated the four environments used in both Studies 1 and 2 on the basis of photographic slide simulations. Study 4 replicated Study 3, but with Finnish subjects.[3]

## STUDY 1

### *Method*

#### *Research design and subjects*

Eight sites were selected according to a two (natural vs. built) by two (outdoor vs. indoor) by two (high vs. low restorativeness) scheme. Reference to natural-built and indoor-outdoor characterisations reflects two theory-based expectations: (1) Given

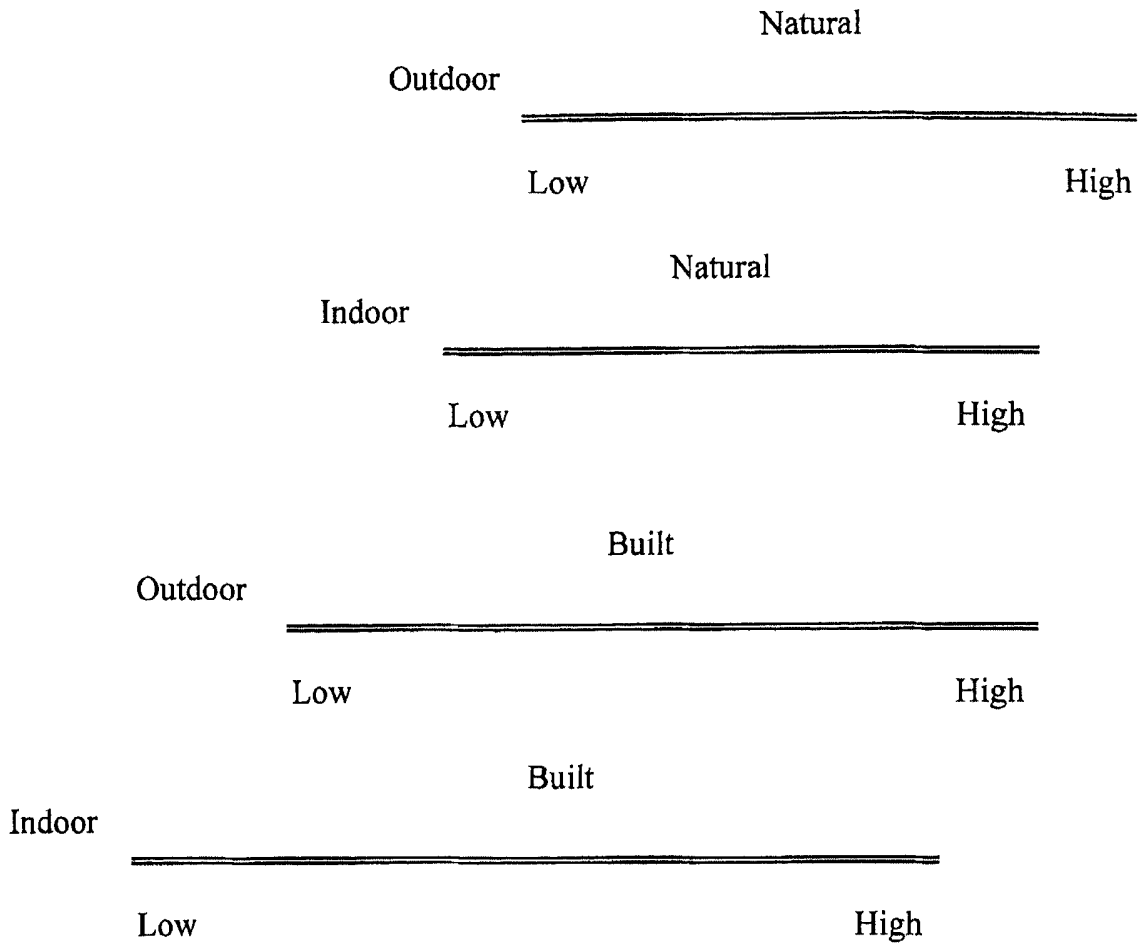


*Fig. 1.* Hypothesised ranges of restorative potential for different types of physical environments.

human evolution in natural environments, and the adaptedness of human psychological processes to conditions in natural environments, non-threatening natural environments will *in general* be experienced as more restorative than non-threatening built environments; (2) Because restorativeness lies in qualities of person-environment transactions that are more likely to be limited in relevant ways in indoor environments (e.g., view is restricted), outdoor environments will *in general* be experienced as more restorative than indoor environments. To emphasise the general character of these statements, a continuum or range of restorative potential was hypothesised to exist in each of the four broad environment types (natural/outdoor; natural/indoor; built/outdoor; built/indoor) included in the study design (see Figure 1). Sites were then chosen so that high and low restorative potentials might be represented for each of those continua.

The eight sites were assumed to be familiar to subjects ($n$ = 115; 58 female), all being on or adjacent to the campus of the University of California at Irvine, where the subjects were undergraduate students. Descriptions of the sites are given in Table 1.

With the given research design, pairs of sites could be formed for which there was little basis for predicting relative restorativeness, given possible countervailing influences among the research design variables (e.g., N/I/H vs. B/O/H). Predictions

Table 1. *Descriptions of the study sites.*

| Site # and Label | Description |
|---|---|
| 1 Natural/outdoor/high restorativeness (N/O/H) | A rock garden in the centre of a large park; exotic plants, shady alcoves, and views out to large trees and buildings. |
| 2 Natural/outdoor/low restorativeness (N/O/L) | A large lawn adjacent to a major street, with a concrete pedestrian bridge, large buildings, and some trees nearby. |
| 3 Built/outdoor/high restorativeness (B/O/H) | An outdoor shopping mall with diverse shops, alcoves, potted plants, a fountain, and some architectural variety. |
| 4 Built/outdoor/low restorativeness (B/O/L) | A loading dock area facing onto a parking lot, with featureless walls around, garbage cans nearby, and views out to street trees. |
| 5 Natural/indoor/high restorativeness (N/I/H) | A study room with soft chairs, many plants, and views out onto trees and landscaping. |
| 6 Natural/indoor/low restorativeness (N/I/L) | A much larger study room with hard, fixed seating, large planters, and large windows facing onto adjacent trees. |
| 7 Built/indoor/high restorativeness (B/I/H) | A video and billiards game room with background music and much social activity. |
| 8 Built/indoor/low restorativeness (B/I/L) | The bottom floor of a large concrete parking structure. |

were only made about the relative restorativeness of the natural vs. built and outdoor vs. indoor characterisations, the high vs. low restorativeness distinction within each of the four broad environment types, and the relative restorativeness of four specific sites: the rock garden (N/O/H), the outdoor mall (B/O/H), the formal study room with plants and views onto trees (N/I/L), and the parking garage (B/I/L). These four sites will be referred to as the primary sites.

### *Measures*

The present version of the Perceived Restorativeness Scale (PRS) consists of 16 items (see Table 2). Respondents indicate on a 7-point scale (0 = Not at all, 6 = Completely) the extent to which the given statement fits their experience of the given environment. Note that the statements do not refer to indoor vs. outdoor or natural vs. built aspects of environments.

Another environmental measure was administered to help assess convergent and discriminant validities. Küller's (1972, 1979) semantic scale (KSS) consists of 36 individual words. Subjects use a 7-point scale to indicate how well the given word (e.g., large, lavish, open) describes some currently occupied environment (1 = Slightly, 7 = Very). The KSS measures the following eight factors: Pleasantness; Complexity (i.e., variation, intensity, contrast, and abundance); Unity (i.e., the fit of the different parts of the environment into a coherent whole); Enclosedness (i.e., a sense of spatial enclosure); Potency (i.e., power latent in the environment, and its characterisation in terms of masculine and feminine gender stereotypes); Social Status (i.e., evaluation in socio-economic terms); Affection (i.e., the seeming familiarity of the environment, whether gained through personal experience or through cultural or biological background); and Originality (i.e., what is unusual and surprising in the environment).

Finally, a measure of emotional states was used to gauge criterion validity. The Zuckerman Inventory of Personal Reactions (ZIPERS; Zuckerman, 1977) consists of 12 items that measure Positive Affect (i.e., positive emotions), Sadness, Attentiveness, Fear Arousal, and Anger/Aggression. Subjects indicate the extent to which they are

Table 2. *The Perceived Restorativeness Scale (PRS) items used in the present studies, grouped according to their intended subscale designation.*

| |
|---|
| *Being Away* |
| It is an escape experience. |
| Spending time here gives me a good break from my day-to-day routine. |
| *Fascination* |
| The setting has fascinating qualities. |
| My attention is drawn to many interesting things. |
| I would like to get to know this place better. |
| I want to explore the area. (In Study 2 this item was replaced by the item below.) |
| There is much to explore and discover here. |
| I would like to spend more time looking at the surroundings. |
| *Coherence (Extent)* |
| There is too much going on. |
| It is a confusing place. |
| There is a great deal of distraction. |
| It is chaotic here. |
| *Compatibility* |
| I can do things I like here. |
| I have a sense that I belong here. |
| I have a sense of oneness with this setting. |
| Being here suits my personality. |
| I could find ways to enjoy myself in a place like this. |

experiencing the given reactions and feelings at that moment using 5-point scales (1 = Not at all, 5 = Very much).

### Procedure

All subjects visited at least those four environments for which there were specific predictions of relative restorativeness (i.e., the primary sites; Sites 1, 3, 6, 8). Some subjects ($n$ = 39) visited all eight sites. No more or less than four sites were visited in a given day. Subjects went in small groups ($n$ = 1–7) through a series of four sites, escorted by a researcher. Groups were led so that the time and route taken between the sites would be fairly uniform across subjects. On arrival at a site subjects were asked to take a few minutes to look around. Researchers avoided directing subjects' attention, leaving them to use the time to explore the site as they so chose. While subjects walked around, the researcher went to a centrally located position to which subjects could return. When they returned to this position they were handed clipboards with the forms arranged in the following order: ZIPERS (with instructions to relate how the given environment made them feel), PRS, and KSS. When all subjects had completed their evaluations the group moved on to the next site. On average, about 14 minutes were required to evaluate each site. Data collection took place during periods when pedestrian flow on the campus was at its lowest, i.e., Friday afternoons and weekend days.

## Results and Discussion

The evaluations for each site were analysed separately. In initial analyses of inter-item correlations within subscales composed of items intended for each of the theoretical constructs, the results indicated that the subscales in general had adequate to high internal consistency (Cronbach $\alpha$s > .75), an indication of reliability (see Note 3).

Table 3. *From the 4- and 2-factor solutions for the outdoor shopping mall (B/O/H) ratings, the communalities for the Perceived Restorativeness Scale (PRS) items, the factor structure matrices, and the correlations among factors.*

| PRS Items Arranged by A Priori Subscale | | 4-factor Solution | | | | | 2-factor Solution | | |
|---|---|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | $h^2$ | I | II | $h^2$ |
| Being Away | 1 | **.70** | −.12 | .48 | .35 | .63 | **.63** | −.17 | .41 |
| | 2 | **.79** | −.13 | .73 | .24 | .74 | **.82** | −.18 | .68 |
| Fascination | 3 | **.67** | .06 | .56 | −.25 | .53 | **.68** | .12 | .50 |
| | 4 | **.62** | .07 | .62 | −.27 | .53 | **.68** | .12 | .50 |
| | 5 | **.85** | −.15 | .71 | −.05 | .77 | **.86** | −.10 | .73 |
| | 6 | **.85** | .07 | .60 | −.15 | .75 | **.80** | .12 | .68 |
| | 7 | **.91** | .00 | .61 | −.08 | .83 | **.83** | .05 | .70 |
| Coherence | 8 | −.02 | .33 | −.08 | **−.41** | .21 | −.05 | **.40** | .16 |
| | 9 | −13. | **.62** | −.31 | −.39 | .47 | −23. | **.68** | .49 |
| | 10 | .15 | **.67** | .10 | −.41 | .52 | .14 | **.67** | .50 |
| | 11 | −.08 | **.77** | −.17 | −.17 | .62 | −.13 | **.64** | .41 |
| Compatibility | 12 | .57 | −.24 | **.75** | .05 | .59 | **.71** | −.26 | .54 |
| | 13 | .62 | −.21 | **.80** | .14 | .67 | **.76** | −.26 | .61 |
| | 14 | .66 | −.35 | **.67** | .17 | .60 | **.72** | −.36 | .61 |
| | 15 | .60 | −.20 | **.86** | .13 | .75 | **.77** | −.26 | .62 |
| | 16 | .58 | .03 | **.84** | −.14 | .75 | **.74** | .00 | .56 |
| | | I | II | III | | | I | | |
| Factor Correlations | II | −.03 | | | | | −.10 | | |
| | III | .69 | −.17 | | | | | | |
| | IV | −.01 | −.38 | .02 | | | | | |

Note: An item's highest correlation is given in bold-faced type.

However, the best available extent subscale in some sites showed insufficient reliability, and the content of its items seemed to be most representative – in negative terms – of coherence as described in the Kaplans' (e.g., 1989) environmental evaluation and restorative environments theorising (see Note 2). The subscale will consequently be referred to as the a priori coherence subscale.

When evaluations of each of the four primary sites were then factor analysed to see what underlying dimensions helped simplify interpretation of variability within the item set, the initial results tempted interpretation in terms of fascination, coherence, and compatibility factors; the intended being away items lined up variously with a priori fascination or compatibility items. Yet there were indications that a 2-factor solution would be more consistent across sites. Consequently, another round of analyses was completed in which extraction of two factors was specified. In each analysis the factor-item correlations clearly related the dominant factor to the 12 a priori being away, fascination, and compatibility items. The a priori coherence items, on the other hand, defined the second factor. The 2- and 4-factor obliquely rotated solutions for the outdoor shopping mall (B/O/H) evaluations are given in Table 3 for illustration.

The factor analyses involved small samples of individuals, environments, and items (especially for being away), so the results cannot be taken as an indication that a simplified theoretical model is necessary. However, the results rendered problematic

Table 4. *Correlations between Perceived Restorativeness Scale (PRS) subscales and Küller Semantic Scale (KSS) subscales, calculated for each site.*

| | | KSS Subscales | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Site | PRS Subscale | CO | UN | EN | OR | PL | AF | PO | SS |
| N/O/H | General | .00 | **.49** | **−.31** | **.62** | **.77** | **.23** | .02 | .20 |
| | Coherence | **−.33** | .09 | **−.25** | −.04 | **.25** | −.03 | −.16 | −.02 |
| N/O/L | General | .02 | **.54** | .02 | **.51** | **.56** | .30 | .10 | .05 |
| | Coherence | −.23 | .06 | .04 | −.28 | −.01 | .05 | −.16 | .06 |
| B/O/H | General | **.27** | **.23** | **−.38** | **.79** | **.79** | .15 | −.06 | **.24** |
| | Coherence | **−.31** | .12 | **−.25** | .06 | **.26** | .12 | .05 | −.11 |
| B/O/L | General | .37 | .07 | .07 | **.47** | **.65** | −.12 | .24 | .28 |
| | Coherence | −.26 | .07 | −.14 | −.25 | −.05 | .12 | −.34 | −.12 |
| N/I/H | General | .23 | .34 | **−.42** | **.74** | **.82** | .13 | −.08 | **.50** |
| | Coherence | −.08 | .07 | −.08 | −.02 | .15 | −.32 | .00 | .07 |
| N/I/L | General | **.22** | **.35** | **−.38** | **.73** | **.78** | −.01 | −.16 | **.41** |
| | Coherence | **−.22** | .18 | −.12 | −.09 | **.29** | −.03 | .01 | .10 |
| B/I/H | General | .06 | .18 | −.13 | **.54** | **.70** | .24 | .08 | .13 |
| | Coherence | −.33 | .31 | −.30 | .08 | **.69** | −.06 | −.13 | −.08 |
| B/I/L | General | .08 | .12 | **−.26** | **.54** | **.62** | .06 | −.01 | .20 |
| | Coherence | **−.43** | −.05 | −.16 | −.09 | **.37** | .10 | **−.39** | −.05 |

Note: For primary sites (N/O/H, B/O/H, N/I/L, B/I/L), the correlations are based on *ns* ranging from 109–115. For the remaining sites the *ns* range from 34–39. CO = Complexity; UN = Unity; EN = Enclosedness; OR = Originality; PL = Pleasantness; AF = Affection; PO = Potency; SS = Social Status. Bold-faced values – $p < .01$; underlined, bold-faced values – $p < .001$.

the use in the remaining analyses of scores for each of the a priori subscales, in that scores for the being away, fascination, and compatibility subscales would share too much variance. Consequently, the remaining analyses were carried out with the scores from those subscales combined into one subscale, referred to as the General subscale (for General Restorativeness). The coherence items were joined in a second composite score after reversal of the item codes so that greater coherence would be represented by larger values rather than smaller values.

These scores were then used in further validity assessments. Correlations between the PRS and Küller semantic scale (KSS) subscale scores provide some support for the construct validity of the PRS, with correlations between constructs thought to be related and discrimination between dissimilar constructs largely as expected (see Table 4). For example, in the data from all four primary sites, positive correlations were found as expected between General subscale scores and KSS Originality, while Coherence scores were negatively correlated with Complexity. Counter to expectations, however, a reliable positive correlation between Coherence and Unity was not found for any of the sites. No predictions were made about relations between PRS subscale scores and the KSS Affection, Potency, and Social Status subscales, and, appropriately, few significant correlations were in fact found.

It was furthermore expected that PRS subscale scores would correlate positively with ZIPERS Positive Affect and Attentiveness, and negatively with Sadness, Fear Arousal, and Anger/Aggression. Here, too, some supportive results were obtained (see Table 5). For example, General scores had moderate positive correlations with

Table 5. *Correlations between Perceived Restorativeness Scale (PRS) subscales and Zuckerman Inventory of Personal Reactions (ZIPERS) subscales, calculated for each site.*

| Site | PRS Subscale | ZIPERS Subscale | | | | |
|---|---|---|---|---|---|---|
| | | PA | S | A | A/A | F/A |
| N/O/H | General | **.49** | .01 | .13 | −.13 | .18 |
| | Coherence | **.23** | −.10 | .12 | **−.23** | −.19 |
| N/O/L | General | .33 | −.10 | .12 | −.12 | **.39** |
| | Coherence | .24 | .05 | .00 | **−.40** | −.16 |
| B/O/H | General | **.63** | **−.29** | .16 | **−.42** | .12 |
| | Coherence | .08 | −.16 | **.24** | −.07 | **−.26** |
| B/O/L | General | .22 | −.16 | .07 | −.18 | .10 |
| | Coherence | .11 | −.20 | .17 | −.26 | −.04 |
| N/I/H | General | **.67** | **−.41** | −.21 | **−.42** | −.06 |
| | Coherence | −.14 | .04 | .08 | −.17 | −.31 |
| N/I/L | General | **.49** | **−.37** | **.23** | **−.52** | −.01 |
| | Coherence | .02 | −.15 | .06 | **−.33** | **−.42** |
| B/I/H | General | **.44** | −.35 | .08 | −.23 | .13 |
| | Coherence | .19 | −.10 | .29 | **−.47** | −.20 |
| B/I/L | General | **.37** | −.03 | **.31** | −.14 | .03 |
| | Coherence | .11 | −.14 | .15 | **−.40** | **−.42** |

Note: For primary sites (N/O/H, B/O/H, N/I/L, B/I/L) the correlations are based on *n*s ranging from 110–115. For the remaining sites the *n*s range from 34–39. Bold-faced values – $p < .01$; underlined, bold-faced values – $p < .001$.

Positive Affect in most sites, and Coherence scores were negatively correlated with Anger/Aggression in 5 of 8 sites.

Finally, three sets of analyses were carried out to assess the sensitivity of the PRS to differences between sites. The first set of analyses tested the hypotheses about relative restorativeness in terms of the natural-built and outdoor-indoor characterisations. These analyses were based on the data from subjects who had evaluated all eight sites. Comparing the average General and Coherence scores of the four natural sites with the scores for the four built sites, the statistical tests indicated that the General and Coherence scores were on average larger in the natural environments. The General and Coherence scores were also on average larger for the outdoor than for the indoor environments (see Table 6).

Also using the data from subjects who had evaluated all eight sites, the next set of analyses checked the sensitivity of the PRS to the relative restorativeness (high vs. low) of the two sites in each of the four broad environment-types described in the study design (N/O, B/O, N/I, B/I). In each case the high vs. low judged restorativeness distinction was accurately represented in General subscale scores. When Coherence scores were tested, the sites in the N/O and N/I cells were not found to reliably differ, but differences between the B/O and the B/I sites did register. These differences suggest that the relation between coherence and restoration is other than simply linear positive; in each case the site judged to have higher restorative potential in terms of General scores had lower Coherence scores (indicating more distraction, confusion, and so forth). In light of the characteristics of the built environments being compared (outdoor mall vs. loading dock, game room vs. parking garage), the finding gives more rather than less support for the sensitivity of the PRS; the disassociation of General

Table 6. *Perceived Restorativeness Scale (PRS) subscale descriptive statistics for the eight sites, calculated for each of the subsamples used in analyses of differences in site evaluations.*

| PRS Subscale, Subsample # | | Site | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | N/O/H | N/O/L | B/O/H | B/O/L | N/I/H | N/I/L | B/I/H | B/I/L |
| General – 1 | M | 5.31 | 4.68 | 4.75 | 1.73 | 3.51 | 2.77 | 4.71 | 1.88 |
| | SD | 1.06 | 1.00 | 1.06 | 0.99 | 1.39 | 1.17 | 1.11 | 1.07 |
| | *n* | 39 | 34 | 37 | 38 | 39 | 38 | 38 | 39 |
| General – 2 | M | 5.09 | | 4.27 | | | 2.53 | | 1.64 |
| | SD | 1.09 | | 1.25 | | | 1.08 | | 0.81 |
| | *n* | 74 | | 74 | | | 73 | | 73 |
| Coherence – 1 | M | 6.19 | 5.91 | 4.73 | 5.41 | 6.37 | 6.31 | 3.65 | 4.32 |
| | SD | 0.67 | 0.79 | 1.02 | 1.35 | 0.70 | 0.65 | 1.40 | 1.53 |
| | *n* | 39 | 36 | 38 | 38 | 39 | 39 | 39 | 39 |
| Coherence – 2 | M | 6.12 | | 4.79 | | | 6.29 | | 4.53 |
| | SD | 0.75 | | 1.23 | | | 0.83 | | 1.58 |
| | *n* | 76 | | 76 | | | 75 | | 73 |

Note: Values for the means and standard deviations fall on a scale from one to seven, where lower values indicate, for example, lower fascination, compatibility, or coherence.

and Coherence scores makes sense. With respect to the lack of differences between the N/O and the N/I sites in Coherence evaluations, one can reasonably argue that the findings owe to generally high coherence in the natural environments sampled.

The third set of comparisons among the sites involved only the evaluations of the four primary sites (Sites 1, 3, 6, and 8), and used the data from that subsample of subjects who had evaluated only the primary sites. One pair of statistical tests indicated that the General and Coherence scores for the rock garden (N/O/H) were reliably higher than those for the outdoor shopping mall (B/O/H). The next pair of tests showed that the outdoor mall was higher on the General subscale but lower on Coherence than the study room (N/I/L), a result that also raises questions about the form of the relationship between coherence and the other theoretical factors. The third pair of tests confirmed that the N/I/L site had higher General and Coherence scores than the parking garage (B/I/L). One can infer from these comparisons that the natural sites received higher average General and Coherence scores from subjects in this subsample than did the built sites.

Additional analyses assessed the differences between pairs of sites for which no hypothesis of relative restorativeness had been forwarded. These post hoc tests showed that the PRS was in most cases sensitive to a difference between sites. Where no difference was detected (e.g., General scores for the N/O/L and B/O/H sites), the outcome speaks to either scale insensitivity or similar levels of the quality or qualities in question. Given the latter, and following up on implications of previous comparisons, two broad points can be made. First, although natural environments might have greater restorative potential than built environments *in general*, some built environments will have similar or greater restorativeness than some natural environments. (A similar statement can be made about indoor and outdoor environments.) Second, a difference between sites in terms of their General scores need not be paralleled by a similar difference in their Coherence scores.

## STUDY 2

A second study was carried out to see whether evaluations obtained in naturalistic settings would differ from those given for video simulations of the same sites. Research on environmental preferences has found high correlations between evaluations obtained on-site and with one or another form of simulation (see e.g., Craik and Feimer, 1987). Since preference may reflect restorativeness, it is of interest whether evaluations of restorativeness obtained with simulations are similar to those obtained on-site. As with simulation methods in preference research, using simulations to elicit restorativeness evaluations could eliminate the need to transport people to sites and so increase the number of sites that could be evaluated.

### *Method*

#### *Subjects and research design*

Groups of undergraduate students at the University of California at Irvine (69.5 per cent female) were randomly assigned to naturalistic ($n$ = 43) or simulated ($n$ = 52) study settings. The four primary sites from the first study were used again. These were the sites for which specific restorativeness ranking predictions had been made. Each subject evaluated all four sites, either starting in Site 1 and finishing in Site 8 or vice versa.

#### *Simulations*

Each video simulation led the viewer on a slow walk through the given site. Images were captured from eye level with slight side to side panning. The walk lasted about five minutes. It was followed by continuous slow panning in 360° from a central location for about 12 minutes; this provided a referent for subjects while they completed their forms. The four videos were then arranged on individual tapes in one of the two orderings of sites described above. Sound was not retained due to poor quality recordings. The videos were shown with large-screen televisions (~4' diagonal).

#### *Procedure*

The different field and video conditions were run simultaneously. In the field conditions small groups of subjects ($n$ = 4–10) were led through the sites by individual researchers. On arrival at a site, the subjects filled out the ZIPERS (with instructions to relate how the given environment made them feel), PRS, and then KSS. When all subjects had completed their evaluations the group moved on to the next site. On average, it took the on-site subjects about 12 minutes to complete their evaluations. Data collection took place during periods of low pedestrian flow on campus.

In the simulation conditions small groups of subjects ($n$ = 4–9) were taken to one or another large room in which the large screen televisions had been set up for projection of the simulations. Once the "tour" of a given site had ended, subjects completed their evaluations in the order ZIPERS, PRS, and KSS. They were instructed to imagine themselves in the given environment as they completed the forms, which took about 14 minutes on average. They were given a 5-minute break between evaluations.

### *Results and Discussion*

The results of this study conform with those of Study 1. Initial multivariate analyses were again repeated with the PRS evaluations of each of the sites. The a priori subscales showed generally sufficient internal consistency for all but the extent/coherence subscale, yet the factor analyses again recommended the use of General and

Table 7. *Perceived Restorativeness Scale (PRS) subscale descriptive statistics for the four sites, according to experimental condition.*

| PRS Subscale, Experimental Condition | | Site | | | |
|---|---|---|---|---|---|
| | | N/O/H | B/O/H | N/I/L | B/I/L |
| General | M | 5.20 | 4.53 | 2.74 | 1.61 |
| On-site | SD | 1.06 | 1.10 | 1.10 | 1.04 |
| | *n* | 41 | 42 | 43 | 42 |
| General | M | 5.13 | 4.48 | 2.53 | 1.79 |
| Video | SD | 1.09 | 1.13 | 1.12 | 0.98 |
| | *n* | 50 | 47 | 51 | 52 |
| Coherence | M | 5.70 | 4.75 | 6.43 | 5.14 |
| On-site | SD | 1.11 | 0.90 | 0.64 | 1.34 |
| | *n* | 41 | 41 | 43 | 40 |
| Coherence | M | 5.95 | 4.79 | 6.13 | 5.72 |
| Video | SD | 1.02 | 1.16 | 0.95 | 1.29 |
| | *n* | 52 | 50 | 52 | 52 |

Note: Values for the means and standard deviations fall on a scale from one to seven, where lower values indicate, for example, lower fascination, compatibility, or coherence.

Coherence scores for subsequent analyses. Correlations between the PRS and KSS subscales again showed considerable agreement between similar constructs and discrimination between dissimilar constructs, and the reliable correlations between the PRS and ZIPERS subscales were also again in keeping with expectations. As in Study 1, statistical tests confirmed that the General and Coherence scores for the rock garden (N/O/H) were reliably higher than those for the outdoor mall (B/O/H); that the outdoor mall was higher on the General subscale but lower on the Coherence subscale than the formal study room with plants (N/I/L); and that the N/I/L site had higher General and Coherence subscale scores than the parking garage (B/I/L).

Of particular interest in this study was whether evaluations differed according to whether they were obtained on-site or with video simulations. The statistical tests indicated that the evaluations of the various sites obtained with the use of simulations were not significantly different from those obtained on-site. This was true for both the General and Coherence subscale scores (see Table 7).

## STUDY THREE

Speaking of the generalisability of environmental assessments, Craik and Feimer (1987) identify as a desirable measurement property the relative independence of assessments from variables such as the character of the specific observers, the way in which places are presented to observers, and the specific time at which the ratings are recorded (p. 898). In the present study, residents of Umeå, Sweden evaluated the four environments used in both Studies 1 and 2, but on the basis of brief photographic slide simulations. The degree of subjects' familiarity with the sites was uniformly low in this study, rather than uniformly high as in the previous studies. Furthermore, it was possible for a seasonal offset to work in the evaluations, in that the simulations showed summer conditions in the sites but the evaluations were obtained during winter months. Of interest was whether the pattern of results obtained (though not necessarily

the magnitude of the scores) would be consistent with that seen in Studies 1 and 2, despite the changes in subject characteristics and the circumstances of the evaluation task.

## Method

### Subjects and research design

Undergraduate students from Umeå University (37 female, 38 male) evaluated five sites. The first was the central square of Umeå, a setting chosen because of its familiarity for the subjects. The four remaining settings were those from Studies 1 and 2 (N/O/H, B/O/H, N/I/L, B/I/L); these were presented in random orders.

### Simulations

Except for the central square, each setting was represented with eight colour slides. The slides for the outdoor sites and the study room were obtained in early afternoon hours in clear weather. The parking garage slides were taken in early morning hours in order to avoid traffic in the garage. All slides gave eye-level views of the settings. For all sites, the selection of slides gave views around an arc from a central area. The breadth of the arc varied across sites, depending upon the presence of walls and other view-obstructing features. It was intended that the arrangement of the slides give an overall impression of the place without depicting movement to a degree that would leave subjects disoriented.

The eight slides were shown at a rate of one every 15 seconds. Thus, the duration of each simulation (about two minutes) was much briefer than that of the video simulations or the visits on-site. With projection from behind the subjects, the image on the screen was roughly 3 × 4 feet in area.

### Procedure

Small groups of subjects ($n$ = 1–10) were instructed to evaluate each of the four study sites on the basis of the brief photographic simulation. Each subject was given a packet which included an instruction sheet and five sets of the scales, with the Zuckerman Inventory of Personal Reactions (ZIPERS) stapled in front of the PRS. The Küller semantic scale was not used in this study. All materials were translated into Swedish. The instructions directed subjects to imagine themselves in the given setting when completing their evaluations, and the instructions of the ZIPERS were modified to obtain subjects' views on how they would feel if they were in the setting. Following general instructions, subjects were asked to complete the evaluation of Umeå's central square. In this they were to draw on their memory of the place. Evaluation of this site was intended to acquaint subjects with the questionnaires. When all subjects were finished, they were shown slides of the first site in the given randomly determined sequence. After the slides had been shown, subjects were directed to fill out the questionnaires while bearing in mind the place they had just seen. This process was repeated without pause until they had evaluated all four simulated sites.

## Results and Discussion

The results of this study are largely consistent with those obtained in Studies 1 and 2. Initial multivariate analyses were repeated with the PRS evaluations of each of the sites. The a priori subscales, including extent/coherence, almost without exception had sufficient internal consistency, but the factor analyses again recommended reliance on

a 2-factor solution for calculation of scores for use in further analyses. PRS General and Coherence scores were again often correlated with ZIPERS subscales scores in keeping with expectations. As in Studies 1 and 2, statistical tests confirmed that the General and Coherence scores for the rock garden (N/O/H) were reliably higher than those for the outdoor mall (B/O/H); that the outdoor mall was higher on the General subscale but lower on the Coherence subscale than the formal study room with plants (N/I/L); and that the N/I/L site had higher General and Coherence scores than the parking garage (B/I/L).

In sum, the pattern of results obtained in the present study fits with that of the previous studies, despite differences in the nationality of subjects, their degree of familiarity with the sites, the presentation mode, and the time of year relative to the season depicted in the simulation.

## STUDY FOUR

The last in this series of studies replicates Study 3 in most respects, including the time of year in which evaluations were obtained. The primary difference for present purposes is that it was carried out in Tampere, Finland. It affords another opportunity to see whether evaluations of the study sites would be consistent with those seen in the earlier studies, despite differences in subject characteristics and the circumstances of the evaluation task.

### *Method*

#### *Subjects and research design*

Undergraduate students from the University of Tampere (49 female, 29 male) evaluated seven settings. The first was Tampere's central square, a setting chosen because of its presumed familiarity. The next two settings were a favourite and an unpleasant place of the individual subject's choosing. Half of the subjects evaluated the favourite place first, the other half vice versa. Results of the evaluations of the first three settings are presented by Korpela and Hartig (1996) and will not be discussed here. The remaining sites were those used in Studies 1, 2 and 3. The order of presentation was varied randomly.

#### *Simulations*

The four settings for which simulations were required were represented with duplicates of the colour slides used in Study 3. As in Study 3, the slides were shown at a rate of one every 15 seconds. Projection was from behind the subjects, and the image on the screen was approximately 3 × 4 feet in area.

#### *Procedure*

The procedure was essentially the same as in Study 3, but for use of Finnish translations of the ZIPPERS and PRS and the evaluation of a favourite and an unpleasant place on the basis of memory just prior to evaluation of the four study sites.

### *Results and Discussion*

The results of this study agree with those from Studies 1, 2, and 3. A priori subscales again had generally sufficient internal consistency, and the factor analyses again recommended the use of General and Coherence scores in subsequent analyses.

General and Coherence scores again often correlated reliably with scores for the various ZIPERS subscales in keeping with expectations. As in Studies 1–3, statistical tests confirmed that the General and Coherence scores for the rock garden (N/O/H) were reliably higher than those for the outdoor mall (B/O/H); that the outdoor mall had higher General scores but lower Coherence scores than the formal study room with plants (N/I/L); and that the N/I/L site had higher General and Coherence subscale scores than the parking garage (B/I/L).

In sum, as with Study 3, the pattern of results found in Study 4 fits well with that seen in Studies 1 and 2, despite differences in the nationality of subjects, their degree of familiarity with the sites, the presentation mode, and the time of year relative to the season depicted in the simulation.

## GENERAL DISCUSSION

The four studies presented here provide evidence that the present version of the PRS is a useful measure of restorative quality in environments. However, the results also indicate some qualifications that must be kept in mind when interpreting data obtained with it. The most significant qualification concerns the factorial validity of the PRS, particularly with regard to the a priori being away, fascination, and compatibility subscales. Internal consistencies were generally sufficient for those three a priori subscales across the sites in all four studies. Yet factor analyses which specified a 4-factor solution did not uncover a structure that was stable across sites, with three factors consistently defined in terms of the a priori being away, fascination, and compatibility items. Instead, the results suggest a 2-factor solution in which those items all loaded on one factor and Coherence items on the other. These results raise questions as to the appropriateness of separate subscales based on the a priori being away, fascination, and compatibility item assignments. Unless otherwise indicated by factor analysis of the given data (cf. Korpela and Hartig, 1996), studies using the present version of the PRS can parsimoniously combine the a priori being away, fascination, and compatibility items into a General Restorativeness subscale.

This is not to say that the being away, fascination, and compatibility constructs should be viewed as necessarily related in theory. The constructs are conceived of as independent rather than dependent (S. Kaplan, personal communication, October 30, 1995), even though they are described as mutually reinforcing within restorative (vs. non-restorative) experiences. As the sets of factor analyses involved limited samples of individuals, items, and environments, they do not provide sufficient indication that a simplified theoretical model is needed. Also, problems with the items themselves may account for their orientation to correlate with one large empirical factor (e.g., use of the word "good" in the one a priori being away item may invoke an estimate of compatibility as well, and thus draw possible compatibility and being away factors together). The conservative approach is to proceed with the assumption that the theoretical factors are independent until further research shows how that assumption might be modified. Together with larger samples of people and environments, further research can use revised and new items and more rigorous confirmatory factor analytic methods to enhance our understanding of the factorial properties of the PRS and of the underlying theory.

Qualifications also apply with respect to the extent construct. First, the domain of possible extent items was not adequately represented in the present PRS. The a priori extent items that were retained were assumed to be most representative – in negative

terms – of coherence, an analog of connectedness (see Kaplan and Talbot, 1983). Second, questions can be raised regarding the adequacy of measurement of even this coherence aspect of extent. In contrast to the other a priori subscales, the coherence subscale was more often characterised by low internal consistency. However, the grouping of the coherence items in the factor analyses remained relatively stable across the sites and studies, including instances in which the internal consistency of the a priori subscale was sufficient. One explanation for this stability refers to the fact that the coherence items were the only negatively worded items. However, the pattern of remaining results, especially those bearing on the sensitivity to differences among sites, suggests that the standing of coherence items in the factor analytic results cannot be explained simply through reference to a methodological artifact. In any case, further research with the PRS should use additional, positively worded items to represent more than just the coherence aspect of extent.

Qualifications duly noted, it should be remembered that other evidence bears on the utility of the PRS as a measure of restorative quality in environments. In each study the patterns of convergent, discriminant, and criterion validity coefficients were largely as expected. There was in the first two studies general conformance with expectations of convergence, discrimination, and no association between scores for the KSS subscales and PRS subscale scores. The correlations with ZIPERS subscale scores were in all four studies similarly consistent with expectations and suggest adequate criterion validity for the PRS with respect to self-reports of emotional states, particularly positive emotions and anger/aggression.

Also with respect to validity and reliability, the PRS proved to be sensitive to theoretically meaningful differences between sites. In all four studies, General subscale scores differentiated in the expected fashion between sites selected on the basis of their location on natural-built and outdoor-indoor continua. That Coherence subscale scores were differentially sensitive to the site characteristics and did not simply move in tandem with General subscale scores in evaluations of all sites speaks further to the construct validity of the Coherence subscale. It counters the methodological argument for the consistency with which the a priori coherence items defined a distinct factor in the 2-factor solution. If it were simply a matter of the negative wording of items and the subscale had no conceptual content, then one might expect the Coherence ratings to fall in a pattern of differences like that seen in the General scores.

The reader is cautioned against over-interpreting the results of the experimental comparison in Study 2. That the evaluations obtained on-site did not differ significantly from those obtained using simulations does not necessarily mean that a period spent viewing a simulation will in fact be as restorative as a similar period in the actual environment. Because the extent to which people can enter into and interact with a setting is typically limited with a simulation (virtual reality technology providing an exception), its restorativeness may be muted. On the other hand, simulations may not include the less pleasant qualities found in some naturalistic settings, and so may be more pleasing than the actual environments, at least for that period during which a simulation holds the person's attention. The present results only speak to the suitability of simulations as a means for eliciting evaluations of restorativeness. They do not speak to the adequacy of simulations as means to restoration.

In closing, a valid, reliable measure of perceived restorative quality in environments provides a way to examine the interplay of theoretical factors and the links those factors may have with specified outcomes of experiences in given settings. Such a

measure also has practical value; it can be used to assess the restorative potential of existing and proposed settings, and so to inform various kinds of design efforts. The present version of the PRS is a needed attempt at such a measure, one which the present studies suggest can serve the purposes just mentioned. Further revisions should strengthen these capabilities.

## NOTES

1. For another view on restorative environments, see Ulrich (1983; Ulrich, Simons, Losito, Fiorito, Miles, and Zelson, 1991). For discussions of the similarities and differences between the approach described here and that of Ulrich and associates, see Hartig, Mang, and Evans (1991; Hartig and Evans, 1993; Hartig, Böök, Garvill, Olsson, and Gärling, 1996).
2. Indeed, the treatment of extent in the Kaplans' (1989) articulation of ART 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. Of these, pattern coherence is closest to the coherence construct used in the environmental evaluation research.
3. Some further details on the validation strategies are provided by Hartig, Korpela, Evans, and Gärling (1996), together with additional methodological details and comprehensive reporting and discussion of the statistical results from the four studies.

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