Journal of Environmental Psychology (2001) **21,** 31–44
0272-4944/01/010031 + 13 $35.00/0

doi:10.1006/jevp.2000.0179, available online at http://www.idealibrary.com on IDEAL®

Journal of ENVIRONMENTAL PSYCHOLOGY

RATING SCALE MEASURES OF RESTORATIVE COMPONENTS OF ENVIRONMENTS

KARIN LAUMANN[1], TOMMY GÄRLING[2] AND KJELL MORTEN STORMARK[3]

[1]*Research Centre for Health Promotion, University of Bergen, Norway,*
[2]*Department of Psychology, Göteborg University, Sweden,*
[3]*Regional Competence Centre for Child and Adolescent Psychiatry, University of Bergen, Norway*

Abstract

Two studies were conducted with the aim of developing a set of rating scale measures of restorative components of environments. In Study 1, 238 Norwegian undergraduates acting as subjects imagined themselves to be either in a nature environment or a city environment which they rated on unipolar scales intended to describe how they experienced the environments. In Study 2 another sample of 157 subjects recruited from the same population of Norwegian undergraduates viewed videos of a forest, park, sea area, city, and a snowy mountain, imagining themselves to be in these environments while performing ratings on the same scales. In both studies factor analyses yielded results in agreement with a theory proposed by Kaplan and Kaplan (1989). However, the being away factor posited by the theory was split into two factors, one with high loadings on rating scales tapping being physically away, the other with high loadings on rating scales tapping being psychologically away. The remaining three factors were defined by rating scales tapping extent, fascination, and compatibility, respectively. Composite measures of the factors had acceptable reliability. Furthermore, as predicted, environments with nature elements generally scored higher than city environments on all measures. Compatibility and fascination predicted preference ratings of the environments, whereas escape and compatibility predicted selfratings of relaxation.

Introduction

Viewing natural scenes contributes to reducing stress, promotes more positive moods and feelings, and may facilitate recovery from illness (Moore, 1981; Ulrich, 1981, 1984; Verderber, 1986; Parsons, 1991; Ulrich *et al.*, 1991; Cimprich, 1992, 1993; McAndrew, 1993). A theory attempting to explain these effects was proposed by Kaplan and Kaplan (1989). According to this theory, four components of environments account for their restorativeness: being away, extent, fascination, and compatibility. These components refer to properties of environments which trigger mental processes or states that contribute to restorative experiences.

The purpose of the present research was to develop rating scale measures of the four components postulated by Kaplan and Kaplan (1989). To develop such measures has at least two important motivations. First, by empirically showing that the hypothesized restorative components are separate constructs, an evaluation of Kaplan and Kaplan's (1989) theory is achieved. Second, it is necessary to be able to measure the restorative components to find out how they are related to different outcome measures. There is hardly any other way of doing this than requesting human observers to report how they experience different environments in these respects (Craik & Feimer, 1987).

The first component that Kaplan and Kaplan (1989) describe as being necessary in a restorative environment is being away. For an environment to be restorative, one must feel a sense of 'being away' due to a change of scenery as well as an escape from some aspects of life that are ordinarily present, such as distractions, obligations, and pursuits of purposes and thoughts.

The second component is extent. Here the two properties connectedness and scope are important. Scope refers to the environment that is extended in time and space, so that it is perceived to be possible to enter and spend time in it (Kaplan *et al.*, 1983).

The environment must also be sufficiently connected to constitute a larger whole.

The third component, fascination, is essential for restoration according to Kaplan and Kaplan (1989) because the theory distinguishes between involuntary and directed (or voluntary) attention. Involuntary attention does not demand mental effort and is attracted by stimuli having a 'directly fascinating quality'. Directed attention, on the other hand, demands mental effort that can be depleted. Nature is assumed to attract involuntary attention due to its fascinating qualities, while directed attention recovers. Fascination is important for the restorative experience precisely because it provides this opportunity for recovering from depleted directed attention capacity (Kaplan & Kaplan, 1989).

The fourth component is compatibility, which refers to a fit between the environment, the individual's inclination, and the actions required by the environment (Kaplan, 1983). Compatibility is, for instance, fostered if there is a fit between the individual's purposes for action and the demands imposed by the environment (Kaplan & Kaplan, 1989).

Hartig *et al.* (1996, 1997) have developed a perceived environmental restorativeness scale (PRS) with the aim of measuring the restorative components of environments derived from Kaplan and Kaplan's (1989) theory. In a series of studies Hartig *et al.* attempted to validate the factor structure of the scale employing U.S., Finnish, and Swedish student samples and different environments and presentation media. The results did not consistently confirm the four-factor structure. In general only two factors emerged. A peculiarity was that only negatively worded descriptions loaded on one of the factors which was labeled coherence. Rating scales aimed at measuring the other components all loaded on the second factor.

The objective of the present research is to develop another set of rating scale measures of the four components of restorative environments, being away, extent, fascination, and compatibility. In doing this, an attempt is made to remedy some of the noted shortcomings of the PRS.

An important property of measures of restorative components of environments is that they can discriminate between different environments. Hartig *et al.* (1996, 1997) showed that the PRS discriminated between environments that were selected to be more or less restorative. According to Kaplan and Kaplan (1989), nature is especially rich in restorative potential. Therefore, one should expect differences in the restorative components between nature and city environments. In Study 1 subjects were requested to rate from memory city and natural environments with the aim of showing that these environments differ in restorativeness. In Study 2 another sample of subjects rated videos of different natural and city environments.

Mystery (the promise of new information), which is assumed to be a subcomponent of fascination, has in several studies been found to predict preferences for environments (Herzog, 1989; Kaplan & Kaplan, 1989). Coherence, which is a subcomponent of extent, has similarly been shown to do this (Wohlwill, 1976; Ulrich, 1977; Herzog, 1985, 1989; Kaplan & Kaplan, 1989). In addition, Kaplan and Kaplan (1989) conclude that: 'a preferred environment is more likely to be a restorative environment' (p. 189). Thus, it may be expected that the measures of the restorative components would predict preferences for the environments. This was investigated in both Studies 1 and 2 by including measures of preference for the environments.

Study 1

In Study 1 selection was made of descriptors to be included in the rating scale measures of the restorative components being away, extent, fascination, and compatibility. Factor and reliability analyses were performed with the aim of constructing the four measures. In order to test whether the measures can distinguish between more and less restorative environments, ratings were made of a natural and a city environment which subjects recalled from memory. Furthermore, analyses were performed to investigate whether environmental preference correlates with the ratings of the restorative components.

Method

Measures. In constructing the rating measures, descriptive phrases were selected on the basis of Kaplan and Kaplan's (1989) description of the four restorative components; being away, extent, fascination, and compatibility. A set of unipolar rating scales was in this way compiled and pretested in two samples. On the basis of the pilot results, descriptors were removed if they failed to show high correlations with other descriptors intended to tap the same component or if their inclusion reduced Cronbach's alpha. This resulted in 38 unipolar rating scales being retained.

In order to check on the English translation of the adjectives, they were first translated from Norwegian into English by one individual, then

translated back by another individual. A high similarity between the English and Norwegian translations were found and small differences were easily resolved.

A questionnaire administered to subjects consisted of one module with the descriptors presented on single pages for the two places. A seven-step rating scale was used for each adjective with the steps verbally and numerically defined as not at all (0), very little (1), rather little (2), neither little nor much (3), rather much (4), very much (5), and completely (6).

Background questions were asked in another module of the questionnaire following the pages with the rating scales. These questions included age and sex. Another set of questions asked whether subjects had visited the environments identified in the instructions for the rating scales. Finally, a measure of nature vs city preferences was included. On a seven-point rating scale subjects indicated how much they in general liked to be in nature, and on another identical rating scale how much they liked to be in a city environment.

Subjects and procedure. Subjects consisted of 321 Norwegian university students enrolled in different undergraduate courses. They filled out the questionnaire after a lecture. The questionnaire included two pages of rating scales, one for the nature environment (a familiar high mountain area) and another one for the city environment (downtown of Oslo, the capital of Norway). The instructions requested subjects to imagine that they were present in the setting identified by its name at the moment they filled out the questionnaire. In the mountain area there was snow at this time and in the city it was early spring. In each case the subjects were asked to check each rating scale so that the number corresponded to the degree it described how they experienced the environment.

If a subject indicated that he or she had never been to any of the environments, his or her questionnaire was excluded from the data analysis. Incompletely answered questionnaires were also discarded. Data were therefore analysed for 238 subjects; 93 men and 145 women. Their mean age was 22·9 years.

Results and discussion

After a preliminary principal axis analysis (PA) of the ratings of the nature environment which extracted four factors, another 16 rating scales were excluded. The reasons were that their inclusion led to a reduction of Cronbach's alpha, that they had loadings of less than 0·35 on all factors, or that they had loadings higher than 0·35 on more than one factor. The remaining 22 rating scales included seven with the highest loading on being away, four with the highest loading on extent, six with the highest loading on fascination, and five with the highest loading on compatibility. The descriptions are presented in Table 1.

An additional principal components analyses (PCA) was run to determine the number of factors (Stevens, 1996). According to the eigenvalue criterion larger than 1·0, five factors were extracted in the analysis on the ratings of the nature environment. These factors explained 65·9 per cent of the variance (factor 1, 30·5%; factor 2, 14·1%; factor 3, 8·9%; factor 4, 7·0%; and factor 5, 5·4%). In the parallel PCA on the ratings of the city environment, five factors were also extracted with an eigenvalue of larger than 1·0. They explained 67·2 per cent of the variance (factor 1, 28·3%; factor 2, 16·9%; factor 3, 8·6%; factor 4, 7·8%; and factor 5, 5·6%).

An iterated principal axis (PA) factor analysis with orthotran/varimax rotation (Hoffman, 1978; Gorsuch, 1983) of five factors was performed to investigate the factor structure. An oblique rotation was chosen because the factors may not be uncorrelated if they all relate to restoration. As Table 1 shows, the factor solution for the nature setting yielded a factor structure closely similar to the hypothesis based on Kaplan and Kaplan's (1989) theory. However, the being away factor posited by the theory was split in to two factors labeled being away 1 (or novelty) and being away 2 (or escape). Rating scales with the highest loadings on the novelty factor include physically being away in a novel setting and doing something unusual. Adjective scales with the highest loadings on the escape factor included the psychological feeling of being away from work routine and demands, expectations, and obligations. Kaplan and Kaplan (1989) used the concept escape to denote psychologically being away. It may also be seen, in Table 2, that as expected the factors were correlated. The correlations between fascination and extent and fascination and compatibility were moderate. The correlation between extent and compatibility was low. Escape was moderately correlated with all other factors. Novelty had a low correlation with escape, extent, and fascination, and a low negative correlation with compatibility.

A parallel PA factor analysis on the ratings of the city environment yielded a closely similar factor structure (see Table 1), except for some rating scales (nos 18 & 21) defining compatibility which also

TABLE 1

Orthotran/varimax rotated loadings from factor analysis of the ratings of nature and city environment (Study 1)

	Nature						City					
	Factor					Communalities	Factor					Communalities
	1	2	3	4	5		1	2	3	4	5	
1. I am in a different setting than usual	**0·71**	0·01	0·03	−0·02	−0·04	0·66	**0·69**	0·03	0·04	−0·05	0·08	0·62
2. I do something different than I usually do	**0·71**	0·04	−0·03	0·03	0·08	0·65	**0·58**	0·08	−0.03	0·09	−0·04	0·54
3. I am in a different environment than usual	**0·75**	−0·05	0·03	0·00	−0·07	0·72	**0·69**	0·01	0·00	−0·00	−0·03	0·66
4. When I am here I feel free from work and routine	0·24	**0·39**	−0·03	0·13	0·08	0·49	0·10	**0·59**	−0·08	0·14	0·04	0·59
5. When I am here I feel free from other peoples' demand and expectations	−0·09	**0·57**	0·12	0·00	0·04	0·54	0·01	**0·75**	0·09	−0·07	0·01	0·72
6. When I am here I do not need to think of my responsibility	−0·04	**0·62**	0·00	−0·03	0·02	0·55	0·00	**0·67**	0·03	−0·05	0·03	0·55
7. I am away from my obligations	0·00	**0·83**	0·01	−0·02	−0·04	0·92	0·00	**0·77**	−0·01	−0·00	−0·02	0·74
8. The elements here go together	0·11	−0·04	**0·44**	−0·07	−0·01	0·29	−0·03	0·04	**0·67**	0·03	−0·07	0·58
9. The surroundings are coherent	−0·05	0·10	**0·57**	0·02	0·01	0·55	−0·08	0·15	**0·66**	−0·05	−0·06	0·57
10. All the elements constitute a larger whole	−0·10	0·01	**0·62**	0·09	−0·01	0·63	0·08	−0·14	**0·57**	0·09	0·03	0·49
11. The existing elements belong here	0·08	0·08	**0·35**	0·17	0·05	0·44	0·11	−0·04	**0·52**	0·00	0·17	0·49
12. There is plenty to discover here	0·03	0·03	−0·03	**0·54**	−0·09	0·43	0·14	0·05	−0·04	**0·51**	0·07	0·49
13. There are many things here that I find beautiful	0·22	−0·03	0·04	**0·37**	0·20	0·49	−0·10	0·08	0·14	**0·43**	0·07	0·49
14. There is plenty that I want to linger on here	0·00	−0·01	0·08	**0·50**	0·05	0·54	−0·06	0·13	0·12	**0·57**	−0·08	0·60
15. This setting has many things that I wonder about	−0·07	−0·05	0·13	**0·44**	−0·07	0·37	0·08	−0·19	−0·01	**0·60**	−0·21	0·42
16. There are many objects here that attract my attention	0·01	0·02	−0·03	**0·61**	−0·02	0·59	0·12	−0·08	0·01	**0·58**	0·05	0·57
17. I am absorbed in these surroundings	−0·01	0·04	0·05	**0·53**	0·07	0·61	−0·08	0·03	0·12	**0·54**	−0·05	0·51
18. The environment gives me the opportunity to do activities that I like	0·03	0·07	−0·12	0·16	**0·59**	0·68	−0·05	0·13	−0·15	**0·39**	**0·33**	0·59
19. I can handle the kinds of problems that arise here	−0·01	−0·05	0·11	−0·21	**0·64**	0·48	−0·06	0·08	0·13	−0·06	**0·46**	0·44
20. I rapidly adapt to this setting	−0·02	−0·00	−0·09	0·20	**0·49**	0·52	−0·14	0·03	0·06	0·14	**0·48**	0·66
21. There is an accordance between what I like to do and these surroundings	−0·11	0·14	−0·07	0·23	**0·47**	0·67	−0·14	0·12	−0·06	**0·35**	**0·35**	0·65
22. I am capable of meeting the challenge of this setting	0·05	−0·03	0·12	−0·09	**0·69**	0·64	0·15	−0·19	0·04	−0·12	**0·72**	0·74

*Factor loadings over 0·30 or highest loadings on the factor are shown in bold

TABLE 2
Inter-correlations between rotated factors obtained from ratings of nature and city environments (Study 1)

	Nature				City			
	Novelty	Escape	Extent	Fascination	Novelty	Escape	Extent	Fascination
Escape	0·33***				0·39***			
Extent	0·22***	0·37***			0·01	0·18**		
Fascination	0·13*	0·34***	0·51***		0·04	0·23***	0·41***	
Compatibility	−0·15*	0·30***	0·19**	0·47***	−0·29***	0·01	0·42***	0·52***

*$p<0·05$, **$p<0·01$,*** $p<0·001$.

TABLE 3
Means and standard deviation for the restorative index scale obtained from the ratings of nature and city environments (Study 1). The t *statistics from paired sample tests*

	Nature		City		
Index	*M*	S.D.	*M*	S.D.	*t*
Novelty (items 1, 2, 3)	4·56	1·14	3·21	1·31	11·97***
Escape (items 4, 5, 6, 7)	4·03	1·00	2·70	1·07	15·14***
Extent (items 8, 9, 10 11)	4·01	0·89	2·93	1·02	13·61***
Fascination (items 12, 13, 14, 15, 16, 17)	3·91	0·82	3·31	0·92	8·11***
Compatibility (items 18, 19, 20, 21, 22)	3·78	0·99	3·56	0·97	2·29*

*$p<0·05$, **$p<0·01$,***$p<0·001$.

TABLE 4
Multiple linear regression of preference for nature and city environment on the restorative indexes (Study 1) r *denotes zero order correlations,* β *standardized regression coefficients, and* t *corresponding test statistics*

	Nature			City		
	r	β	*t*	*r*	β	*t*
Novelty	−0·06	−0·07	−1·32	−0·23***	−0·12	−2·13*
Escape	0·29***	0·08	1·23	0·04	0·01	0·19
Extent	0·27***	−0·02	−0·23	0·25***	−0·04	−0·65
Fascination	0·51***	0·30	4·54***	0·43***	0·09	1·53
Compatibility	0·58***	0·41	6·56***	0·67***	0·61	9·43***
	$R^2=0·41$			$R^2=0·47$		
	F (5,230) = 32·47***			F (5,230) = 40·45***		

*$p<0·05$, **$p<0·01$,***$p<0·001$.

loaded on fascination. Fascination and extent, fascination and compatibility, and extent and compatibility were moderately correlated. Novelty and escape also had a moderate correlation. Novelty had a low negative correlation with compatibility.

A canonical correlation analysis was run to assess the similarity between the factor matrices for the nature and city environments (Gorsuch, 1983). A canonical correlation of 0·99, chi-square ($p<0·001$), indicated a close similarity of the factor structures. Thus, the results do not refute the hypothesis that the same restorative components describe both natural and city environments.

The following indexes were formed to measure each factor: novelty rating scales 1–3, escape 4–7, extent 8–11, fascination 12–17 and compatibility 18–22. Cronbach's alpha computed for these indexes varied between 0·76 and 0·86. Mean scores are given in Table 3. Paired-sample *t*-tests showed that at $p<0·05$ the mean scores on all five indexes were reliably higher for the nature setting than for the city setting. Therefore, it is indicated that the measure may satisfactorily differentiate between more restorative (nature) and less restorative (city) environments.

The results of sets of multiple linear regression analyses shown in Table 4 indicate that the indexes of novelty, escape, extent, fascination, and compatibility reliably predicted preferences for both the nature and city environments. Compatibility had the highest significant beta weights in both environments; 0·41 and 0·61, respectively. For the nature environment, the beta weight for fascination was also significant.

Study 2

The aim of Study 2 was to further test the ability of the rating scale measures to differentiate between environments varying in restorativeness. A larger number of city and nature environments were therefore selected.

Photos have often been used as stimuli in studies of environmental preferences. Zube *et al.* (1975) found a high correlation between judgements based on photos and on-site judgements. Vining and Orlando (1989) compared photos to videos of a residential area, finding considerable agreement between the two representational media. Other studies have concluded that adding sound and motion influence preferences and ratings of scenic beauty by increasing realism (Anderson *et al.* 1983; Hetherington *et al.* 1983; Brown & Daniel, 1991). In Study 2 videos with sound tracks were recorded of the different environments and presented to the subjects.

Study 1 showed that the summed ratings of the restorative components predicted preference. It also supported the hypothesis that fascination and compatibility were the most important predictors. It may, however, be noted that a distinction between preference and relaxation is important in explanations of restorative or stress-reducing effects of nature. For instance, in Ulrich's (1993) evolutionary theory it is claimed that physiological stress reduction and positive emotions (considered to be equivalent to relaxation) are the most important stress-reducing components of nature environments. Also Kaplan and Kaplan's (1989) component 'being away' may be related to relaxation, referring as it does to escaping from everyday stress and strain. Russell and his colleagues (Russell *et al.*, 1981; Russell & Snowgrass, 1987) showed that relaxation, tranquillity, and other similar affective descriptors represent a distinct cluster relatively independent of an excitement cluster (e.g. exciting, arousing, exhilarating). The relaxation cluster was positively related to a pleasantness cluster (e.g. pleasant, pleasing, nice) which presumably is close to preference.

A second aim of Study 2 was to explore whether there is a difference between environmental preference and relaxation so that the former is related to the restorative components of fascination and compatibility whereas the latter is related to being away. If so, this would add to the discriminative validity of the rating scale measures of the restorative components.

Method

Stimulus material. The stimulus material consisted of five videos taken of walks through different environments (forest, park, sea area, a city and a snowy mountain). The videos were recorded with a Thomson digital video camera. They were taken on a sunny day and included sounds from the settings recorded with a Sony stereo microphone connected to the camera. Each video was edited so that it consisted of a sequence of 12 pictures each lasting for 15 s. Some of these are shown in Figure 1 in black and white.

The forest video was taken along a road in a forest. Several small forest lakes and creeks could be seen in the pictures. The sounds emanated from birds, insects, creaks, and rustle of the leaves within the trees.

The park video was taken in Tøyen Park, Oslo. It is a botanical park with various plant species from different parts of the world and large lawns. There was also an artificial creek present. At the edge of the park, the surrounding city environment was visible in some pictures. The sounds were predominantly traffic sounds and people talking in the park. There were also sounds of birds and water from the creek.

The video from the sea area was taken on an island (Herdla). In this video one could see the coastline and the sea. In some pictures, a grassy field close to the water was noticeable, and in one picture some cows were grazing. A few birds could be seen. The sounds came from the waves, birds (mostly seagull and crows), insects, and some boats passing by.

The city video was taken in downtown Oslo. The video commenced in a major pedestrian street, then passed by the bus and train stations, and finally ended in a busy rush-hour street. The sounds consisted of people talking, performing street musicians, cars and construction machines.

The mountain video was taken on Mount Finse in the middle of March when the mountain was covered with snow and ice. Even though sound recordings were made, the setting is so quiet that no audible sounds were present.

Questionnaire. The questionnaire included questions about sex and age and the rating scales used to measure the restorative components in Study 1. It also included a preference question: 'How much would you like to be in this environment?' and a question to measure relaxation: 'How relaxed would you feel in this environment?' Responses to these questions were obtained on a five-point rating scale

FIGURE 1. Pictures from the five videos in Study 2: forest, park, sea area, city, and mountain.

with verbally and numerically defined steps ranging from very little (1) to very much (5).

Subjects and procedure. Another 177 university students were recruited as subjects. After a lecture they were shown the five videos on a large screen in the order forest, park, sea area, city, and mountain. Each time subjects checked the rating scales and answered the preference and relaxation questions. The demographic questions were answered before the presentation of the videos. The written instructions to the subjects were: 'Imagine that you are in the environment shown in the video. Check the rating scales so that your response describe your experience of the environment.' Twenty subjects were excluded from the data analysis due to incomplete answers to the questionnaire, thus leaving 157 subjects. They consisted of 52 men and 105 women with a mean age of 21·0 years.

Results and discussion

Separate PCAs were conducted for each environment. In each case the eigenvalue criterion indicated that five factors should be extracted. The five factors explained between 69·6 per cent (city) and 78·9 per cent (mountain) of the variance (factor 1 between 31·7% and 43·7%, factor 2 between 12·3% and 13·2%, factor 3 between 8·5% and 10·7%, factor 4 between 6·9% and 8·3%, and factor 5 between 5·5% and 6·1%). Table 5 displays the factor structure obtained from iterated PA factor analyses with orthotran/varimax rotation of five factors. As can be seen, the factor loadings for all environments are very similar to those obtained in Study 1. The being away factor was again split in two factors, novelty and escape. The other factors were extent, fascination and compatibility. The pattern of factor inter-correlations was also similar (Table 6): escape, extent, fascination, and compatibility correlated moderately. Novelty showed negative or weak positive correlations with the other factors.

Canonical correlation analyses were used to assess the similarity between the factor matrices for the different environments. All the canonical correlations between the factor matrices for the different places were 0·98 or 0·99 ($p<0{\cdot}001$). Thus, the observation is confirmed that the factor structures for the different environments are very similar. Cronbach's alphas were satisfactorily high, varying between 0·82 and 0·94. A single exception was that for compatibility in the park for which Cronbach's alpha was only 0·68. Indexes were constructed for each factor and environment by calculating means of the ratings on the rating scales with high loadings. The index means for each environment are shown in Table 7. One-way repeated-measures analyses of variance (ANOVAs) showed that each factor differentiated reliably between the environments [$F(4, 624) = 100{\cdot}18$, $p<0{\cdot}001$, for novelty; $F(4, 624) = 234{\cdot}94$, $p<0{\cdot}001$, for escape; $F(4,624) = 189{\cdot}28$, $p<0{\cdot}001$, for extent; [$F(4, 624) = 82{\cdot}25$, $p<0{\cdot}001$, for fascination; and $F(4, 624) = 119{\cdot}01$, $p<0{\cdot}001$, for compatibility]. Paired sample *t*-tests showed that the forest and sea area were rated reliably higher than the city on all restorative indexes. In the case of the mountain the same pattern was found except for compatibility where there were no significant differences. Comparisons of the ratings of the park and city yielded a different pattern. The park was rated reliably higher on novelty and escape, while the city was rated reliably higher than the park on extent, fascination, and compatibility.

Since the ratings of preference and relaxation correlated rather strongly, from 0·48 (city) to 0·78 (sea area), hierarchical multiple linear regression analyses were performed on the preference ratings entering the ratings of relaxation in a first step, or vice versa, then entering the indexes in the next step. As Table 8 shows, the restorativeness indexes reliably predicted preference for all the environments. The change in R^2 after relaxation had been entered ranged from 0·05 (sea area) to 0·38 (city). The beta weights corresponding to compatibility were significant for all environments, ranging from 0·17 to 0·54. Fascination also had significant beta weights for the forest, park, and city. A few other beta weights also reached significance but not consistently across the environments.

The change in R^2 from the regressions on the relaxation ratings were generally lower, although reaching significance for all environments (Table 9). The lowest value was 0·03 (sea area), the highest value 0·19 (park). All beta weights for escape were significant, ranging from 0·16 (sea area) to 0·29 (park and city). Compatibility had significant beta weights for the forest (0·19) and the park (0·21). No other indexes yielded beta weights which were significant across all environments. In summary, compatibility appears to predict both the preference ratings and the relaxation ratings. There was also a difference in that preference was related to fascination and relaxation to escape.

General discussion

The main finding of this research is that the factor analyses of the adjective scales yielded a five-factor structure consistent with Kaplan and Kaplan's (1989) theory. The five factors were novelty, escape, extent, fascination, and compatibility. Thus, the restorative components of an environment must be measured with a set of scales tapping different dimensions. In fact, the results fulfilled Carmines and Zeller's (1979) criteria for a multidimensional measure: (1) the first unrotated factor only accounted for a modest amount of variance among the items; (2) a gradual decrease of the explanatory power of the subsequent factors was observed; (3) only a minority of the rating scales had considerably higher loading on the first factor; and (4) the factors beyond the strongest factor were meaningful. Furthermore, the rating scale measures (indexes) had high reliability, especially when considering that each index is based on relatively few rating scales.

TABLE 5

Orthotran/varimax rotated loadings from factor analyses of the ratings of forest, park, sea area, city and mountain environments (Study 2)

	Forest						Park						Sea area						City						Mountain					
	Factor					Communalities	Factor					Communalities	Factor					Communalities	Factor					Communalities	Factor					Communalities
Index	1	2	3	4	5		1	2	3	4	5		1	2	3	4	5		1	2	3	4	5		1	2	3	4	5	
1	**0·73**	0·04	−0·03	−0·06	0·06	*0·70*	**0·85**	−0·02	0·02	−0·04	0·04	*0·78*	**0·81**	−0·01	−0·01	−0·03	0·01	*0·74*	**0·78**	0·00	0·02	0·05	0·06	*0·72*	**0·80**	−0·05	−0·02	0·06	0·05	*0·87*
2	**0·68**	0·10	0·01	0·09	−0·04	*0·58*	**0·59**	0·22	0·03	−0·02	−0·12	*0·47*	**0·75**	0·06	0·03	−0·01	−0·01	*0·64*	**0·62**	0·01	−0·02	0·03	−0·04	*0·52*	**0·74**	0·06	−0·01	−0·03	0·09	*0·61*
3	**0·80**	−0·09	0·04	0·01	0·08	*0·83*	**0·87**	−0·01	−0·05	0·07	0·01	*0·82*	**0·88**	0·01	−0·06	0·05	−0.02	*0·88*	**0·74**	−0·03	0·02	−0·04	−0·04	*0·78*	**0·80**	−0·02	0·01	0·03	−0·01	*0·82*
4	0·12	**0·44**	0·07	0·13	0·08	*0·59*	0·16	**0·55**	0·03	0·07	0·13	*0·62*	0·07	**0·54**	−0·06	0·16	0·15	*0·69*	−0·03	**0·71**	0·03	0·08	−0·00	*0·71*	−0·01	**0·55**	0·10	0·04	0·00	*0·74*
5	−0·02	**0·51**	0·03	−0·04	0·05	*0·48*	0·04	**0·71**	0·07	−0·07	0·06	*0·79*	0·03	**0·69**	0·12	−0·02	0·01	*0·82*	−0·08	**0·72**	0·05	0·03	0·09	*0·70*	−0·06	**0·62**	−0·01	0·07	−0·09	*0·69*
6	0·00	**0·63**	−0·05	−0·09	−0·02	*0·52*	0·00	**0·68**	0·03	−0·04	−0·06	*0·64*	0·06	**0·73**	0·01	0·00	0·02	*0·82*	0·10	**0·68**	0·04	−0·02	0·01	*0·59*	0·05	**0·62**	0·01	−0·03	0·03	*0·70*
7	0·02	**0·71**	0·00	−0·06	−0·08	*0·72*	0·06	**0·75**	−0·02	0·04	0·00	*0·86*	−0·01	**0·75**	0·07	−0·06	0·03	*0·89*	0·03	**0·82**	−0·06	0·02	−0·02	*0·82*	0·04	**0·75**	−0·03	−0·11	0·04	*0·89*
8	−0·03	−0·11	**0·79**	−0·06	−0·05	*0·68*	0·09	0·00	**0·67**	0·05	0·01	*0·68*	−0·12	0·03	**0·52**	−0·05	0·07	*0·49*	−0·09	0·03	**0·75**	−0·04	−0·02	*0·71*	0·05	−0·04	**0·67**	−0·09	0·07	*0·65*
9	0·02	0·01	**0·72**	−0·04	−0·02	*0·64*	−0·03	0·03	**0·66**	0·00	−0·02	*0·67*	−0·06	0·09	**0·62**	−0·03	0·01	*0·69*	0·04	0·15	**0·66**	−0·08	0·00	*0·56*	−0·03	−0·01	**0·69**	0·04	−0·05	*0·81*
10	0·01	0·15	**0·51**	0·01	0·00	*0·49*	−0·11	0·02	**0·62**	−0·02	−0·05	*0·57*	−0·01	0·14	**0·51**	0·12	−0·06	*0·64*	−0·05	0·01	**0·74**	0·00	0·00	*0·68*	−0·04	0·05	**0·54**	0·03	−0·01	*0·58*
11	0·00	−0·02	**0·61**	0·00	0·02	*0·48*	0·06	−0·02	**0·69**	0·01	0·02	*0·70*	0·12	−0·09	**0·65**	0·08	0·00	*0·67*	0·12	−0·15	**0·66**	0·23	−0·01	*0·56*	−0·01	−0·03	**0·76**	−0·04	−0·05	*0·81*
12	−0·07	−0·14	0·00	**0·37**	0·20	*0·52*	0·09	−0·04	0·09	**0·51**	−0·05	*0·42*	0·06	−0·16	0·08	**0·44**	0·18	*0·44*	0·02	0·01	−0·02	**0·57**	0·09	*0·49*	0·05	−0·14	0·06	**0·53**	0·13	*0·69*
13	0·03	0·18	0·10	**0·42**	−0·08	*0·61*	0·15	−0·03	−0·06	**0·62**	0·06	*0·52*	−0·10	0·16	−0·06	**0·61**	−0·04	*0·71*	−0·04	0·19	−0·07	**0·42**	0·06	*0·38*	0·03	0·09	0·08	**0·46**	−0·02	*0·59*
14	0·06	0·13	−0·00	**0·43**	0·01	*0·56*	0·01	0·02	−0·09	**0·68**	−0·02	*0·63*	−0·09	0·19	−0·13	**0·63**	0·01	*0·76*	−0·06	0·14	0·00	**0·61**	−0·08	*0·58*	0·00	0·04	−0·07	**0·66**	−0·02	*0·84*
15	0·01	−0·16	−0·07	**0·61**	−0·13	*0·48*	−0·08	−0·09	0·09	**0·56**	−0·17	*0·48*	0·05	0·00	0·10	**0·47**	−0·04	*0·42*	0·09	−0·11	−0·02	**0·64**	−0·05	*0·44*	−0·04	−0·06	−0·04	**0·66**	−0·13	*0·64*
16	0·00	−0·03	−0·02	**0·56**	−0·02	*0·63*	−0·08	−0·04	0·00	**0·63**	0·05	*0·63*	0·09	−0·16	0·09	**0·62**	0·06	*0·64*	0·22	−0·13	0·09	**0·66**	0·08	*0·54*	0·04	0·00	−0·01	**0·51**	0·15	*0·77*
17	−0·01	0·09	0·01	**0·51**	0·00	*0·75*	−0·08	0·10	0·11	**0·51**	−0·13	*0·57*	−0·17	0·29	0·03	**0·47**	−0·11	*0·65*	−0·04	−0·06	0·09	**0·58**	−0·01	*0·48*	−0·05	0·15	0·05	**0·46**	0·02	*0·75*
18	−0·05	0·05	0·01	0·13	**0·40**	*0·59*	−0·14	0·15	−0·07	**0·32**	**0·32**	*0·51*	0·04	−0·03	−0·01	0·15	**0·59**	*0·65*	−0·20	0·14	−0·00	**0·55**	−0·06	*0·61*	−0·02	−0·01	0·02	0·01	**0·57**	*0·74*
19	0·09	0·01	−0·06	−0·18	**0·66**	*0·55*	0·07	−0·02	−0·04	−0·14	**0·44**	*0·20*	0·01	0·03	−0·01	−0·08	**0·59**	*0·49*	−0·05	0·06	0·01	−0·01	**0·75**	*0·82*	−0·06	−0·05	−0·05	0·00	**0·54**	*0·59*
20	−0·15	0·19	0·09	0·03	**0·27**	*0·51*	−0·24	0·03	0·08	0·00	**0·49**	*0·46*	−0·22	0·12	0·14	0·15	**0·21**	*0·47*	−0·26	0·00	0·14	0·23	**0·30**	*0·57*	−0·03	0·04	0·04	0·01	**0·53**	*0·74*
21	−0·19	0·07	0·03	0·07	**0·39**	*0·65*	−0·15	0·09	0·06	**0·37**	**0·31**	*0·64*	−0·07	0·11	0·01	0·18	**0·44**	*0·63*	−0·27	0·18	0·07	**0·46**	−0·05	*0·62*	−0·07	0·09	0·03	0·06	**0·48**	*0·81*
22	0·05	−0·09	−0·02	0·02	**0·59**	*0·59*	−0·03	0·04	−0·02	0·09	**0·37**	*0·23*	−0·06	−0·01	0·03	−0·05	**0·62**	*0·59*	−0·02	0·03	−0·01	0·04	**0·69**	*0·69*	0·08	−0·03	−0·01	−0·08	**0·66**	*0·71*

*Factor loadings over 0·30 or highest loadings on the factor are shown in bold

TABLE 6
Intercorrelations between rotated factors obtained from the ratings of forest, park, sea area, city and mountain (Study 2)

	Novelty	Escape	Extent	Fascination
Forest				
Escape	−0·29***			
Extent	−0·11	0·45***		
Fascination	−0·33***	0·61***	0·43***	
Compatibility	−0·50***	0·41***	0·25**	0·62***
Park				
Escape	−0·03			
Extent	−0·16*	0·46***		
Fascination	−0·19*	0·47***	0·48***	
Compatibility	−0·21**	0·32***	0·23**	0·32***
City				
Escape	0·01			
Extent	−0·25**	0·27***		
Fascination	−0·34***	0·34***	0·24**	
Compatibility	−0·39***	0·21**	0·28***	0·36***
Sea area				
Escape	−0·06			
Extent	−0·13+	0·45***		
Fascination	−0·19*	0·43***	0·54***	
Compatibility	−0·31***	0·46***	0·38***	0·46***
Mountain				
Escape	−0·15+			
Extent	−0·13+	0·56***		
Fascination	−0·25**	0·56***	0·55***	
Compatibility	−0·44***	0·54***	0·41***	0·64***

+$p<0·10$, *$p<0·05$, **$p<0·01$, ***$p<0·001$.

The observed factor structure was invariant across different nature and city environments and two presentation modes (imagining being in a place, viewing videos of environments). In particular the former is important, since a primary purpose with developing the rating scale measures is to use them in research attempting to disentangle environmental effects on various stress-related outcomes. Therefore, it is also reassuring that the indexes differentiated between the different environments.

There were a few notable differences in factor loadings in Study 2 between the natural and city environments; that is, two rating scales which for all other places uniquely loaded on the compatibility factor loaded on the fascination factor for the city and the park. This raises the question deserving more attention in future research of whether fascination differs in natural and city environments. The deviating rating scales tap activities which are possible to do in the place. Fascination in a city environment may be more related to activities than to the environment *per se*.

Kaplan and Kaplan's (1989) theory posits four restorative components, whereas the present findings add a fifth component since the being away rating scales loaded on two separate factors, novelty and escape. Novelty is measured by rating scales tapping physically being in another setting or doing new things. In contrast, escape is measured by rating scales tapping the psychological feeling of being away from an everyday context.

Escape, extent, fascination, and compatibility were found to be moderately positively correlated. Novelty was not correlated or slightly negatively correlated with the other factors. If it is assumed that restorative components should be correlated, this suggests that novelty is not a restorative component at all. In fact, its content seems to have little relation to the other restorative components.

In Study 1 preferences for nature and city environments were predicted from the indexes of the different restorative components, in particular compatibility and fascination. This result was replicated in Study 2 which also showed that ratings of relaxation were predicted from escape and compatibility. The results were thus consistent with Kaplan and Kaplan's (1989) theory, which implies that fascination and compatibility would predict preference, while being away would predict relaxation. A theoretical implication appears to be that restoration–

TABLE 7

Means and standard deviations for the restorative index scales obtained from the ratings of forest, park, sea area, mountain and city. Results of t*-test for the differences in mean between the nature environments and city (Study 2)*

	Forest			Park			Sea area			Mountain			City	
Index	*M*	S.D.	*T*	*M*	S.D.	*t*	*M*	S.D.	*t*	*M*	S.D.	*t*	*M*	S.D.
Novelty (items 1, 2, 3)	3·59	1·13	11·77***	3·38	0·96	12·85***	3·14	1·24	7·96***	4·24	1·11	16·97***	1·95	1·7
Escape (items 4, 5, 6, 7)	4·42	0·98	21·58***	2·89	0·91	12·66***	4·34	1·03	19·94***	4·29	1·12	18·46***	1·75	0·99
Extent (items 8, 9, 10 11)	4·69	0·89	11·54***	2·96	1·16	−4·18***	4·94	0·76	14·59***	5·10	0·84	15·81***	3·37	1·12
Fascination (items 12, 13, 14, 15, 16, 17)	4·16	0·92	8·28***	2·85	0·85	−3·51***	4·27	0·86	10·52***	3·79	1·11	4·96***	3·17	0·97
Compatibility (items 18, 19, 20, 21, 22)	3·94	0·92	3·59***	3·29	0·75	−2·86**	4·22	0·81	7·30***	3·43	1·28	−0·64	3·51	0·95

*$p<0·05$, **$p<0·01$, ***$p<0·001$.

TABLE 8

Prediction of preference from restorative index scales for forest, park, city, sea area and mountain (Study 2)

	Forest			Park			Sea area			City			Mountain		
Step 1	r^2 = 0·46			r^2 = 0·36			r^2 = 0·61			r^2 = 0.22			r^2 =0·57		
Relaxation	F (1/155) = 131·29***			F (1/155) = 85·79***			F (1/155) = 239·95***			F (1/155) = 45·58***			F (1/155) = 201·70		
Step 2	r^2 = 0·67			r^2 = 0·49			r^2 = 0·66			r^2 = 0·59			r^2 = 0·76		
Restorative	F (6/150) = 50·28***			F (6/150) = 23·85***			F (6/150) = 47·82***			F (6/150) = 38·01***			F (6/150) = 79·33***		
Indexes	Δr^2 = 0·21 F (5/150) = 18·91***			Δr^2 = 0·13 F (5/150) = 7·73***			Δr^2 = 0·05 F (5/150) = 4·29***			Δr^2 = 0·38 F (5/150) = 28·43***			Δr^2 = 0·19 F (5/150) = 24·40***		
	r	*β*	*t*	*r*	*β*	*t*	*r*	*β*	*t*	*r*	*β*	*t*	*r*	*β*	*t*
Relaxation	0·68***	0·30	4·58***	0·59***	0·49	6·4***	0·78***	0·63	10·41***	0·48***	0·09	1·36	0.75***	0·30	4·69***
Novelty	−0·37***	−0·002	−0·05	−0·19**	−0·11	−1·7+	−0·22**	−0·01	−0·09	−0·35***	−0·03	−0·47	−0·42***	−0·11	−2·51*
Escape	0·39***	−0·01	−0·18	0·29***	−0·15	−2·01*	0·50***	0·03	0·47	0·37***	0·05	0·75	0·54***	0·05	0·93
Extent	0·11	−0·10	−1·96+	0·38***	0·06	0·97	0·38***	−0·02	−0·27	0·33***	0·04	0·78	0·39***	0·02	0·42
Fascination	0·58***	0·19	2·99**	0·46***	0·23	3·28***	0·48***	0·07	1·08	0·65***	0·29	4·40***	0·58***	−0·002	−0·04
Compatibility	0·76***	0·49	6·99***	0·51***	0·17	2·14*	0·58***	0·21	3·20**	0·73***	0·45	5·45***	0·83***	0·54	8·67***

+$p<0·10$, *$p<0·05$, **$p<0·01$, ***$p<0·001$.

TABLE 9

Prediction of relaxation from restorative index scales for forest, park, city, sea area and mountain (Study 2)

	Forest			Park			Sea area			City			Mountain		
Step 1	r^2 = 0·46			r^2 = 0·36			r^2 = 0·61			r^2 = 0·23			r^2 = 0·57		
Preference	F (1/155) = 131·29***			F (1/155) = 85·79***			F (1/155) = 239·95***			F (1/155) = 45·58***			F (1/155) = 201·70***		
Step 2	r^2 = 0·55			r^2 = 0·54			r^2 = 0·64			r^2 = 0·36			r^2 = 0·67		
Restorative	F (6/150) = 30·25***			F (6/150) = 29·75***			F (6/150) = 43·67***			F (6/150) = 13·79***			F (6/150) = 49·82***		
Indexes	Δr^2 = 0·09			Δr^2 = 0·19			Δr^2 = 0·03			Δr^2 = 0·13			Δr^2 = 0·10		
	F (5/150) = 5·89***			F (5/150) = 12·29***			F (5/150) = 2·34*			F (5/150) = 5·97***			F (5/150) = 9·01***		
	r	β	t	r	β	t	r	β	t	r	β	t	r	β	t
Preference	0·68***	0·41	4·58***	0·59***	0·44	6·44***	0·78***	0·67	10·41***	0·48***	0·14	1·36	0·75***	0·42	4·69***
Novelty	−0·39***	−0·13	−2·06*	0·04	0·16	2·66**	−0·21**	−0·05	−0·94	−0·23**	−0·06	−0·76	−0·26***	0·03	0·49
Escape	0·48***	0·23	3·49***	0·53***	0·29	4·24***	0·52***	0·16	2·46*	0·45***	0·29	3·87***	0·64***	0·26	4·14***
Extent	0·17*	−0·01	−0·001	0·42***	0·12	1·85+	0·39***	0·03	0·42	0·27***	0·04	0·52	0·46***	0·07	1·17
Fascination	0·48***	−0·02	−0·23	0·34***	−0·10	−1·51	0·46***	0·04	0·54	0·42***	0·08	0·92	0·59***	0·10	1·56
Compatibility	0·64***	0·19	2·02*	0·49***	0·21	2·89**	0·51***	−0·01	−0·17	0·50***	0·19	1·71+	0·69***	0·14	1·53

+$p<0·10$, *$p<0·05$, ** $p<0·01$, ***$p<0·001$.

outcome variables should be split into at least two. Relaxation is one factor, and another one is a more cognitive restoration, as described by Kaplan and Kaplan's (1989) theory when referring to the effects of involuntary attention, which is assumed to be highly correlated with preference (Kaplan and Kaplan, 1989).

Taken together, the present studies indicate that the developed rating scales provide meaningful and reliable measures of the restorative components of nature and city environments posited by the theory of Kaplan and Kaplan (1989). Being away (escape), extent, fascination, and compatibility are experienced by naïve observers as separate constructs. They furthermore use these constructs to distinguish between environments which vary in the degree of natural elements. The constructs are also important for their preferences for these environments as well as to the degree they experience them as relaxing.

Acknowledgements

This research was financially supported by a grant from the Norwegian Research Council (grant no 110795/730) to the first author. The authors thank Terry Hartig and Rachel and Stephen Kaplan for valuable comments on earlier versions of the manuscript, Øyvind Martinssen for statistical advice, and Leif Edvard Aarø for statistical advice and comments on the manuscript.

Notes

Reprint requests and correspondence should be addressed to: Karin Laumann, Research Centre for Health Promotion, Christiesgt 13, N-5015 Bergen, Norway. Tel.: +4755588988; Fax: +4755589887; E-mail: Karin.Laumann@psych.uib.no

References

Anderson, L. M., Mulligan, B. E., Goodman, L. S. & Regen, H. Z. (1983). Effects of sounds on preferences for outdoor settings. *Environment and Behavior*, **15,** 539–566.

Brown, T. C. & Daniel, T. C. (1991). Landscape aesthetics of riparian environments: relationship of flow quantity to scenic quality along a wild and scenic river. *Water Resources Research*, **27,** 1787–1795.

Carmines, E. G. & Zeller, R. A. (1981). *Reliability and Validity Assessment.* Beverly Hills, CA: Sage.

Cimprich, B. (1992). Attentional fatigue following breast cancer surgery. *Research in Nursing and Health*, **15,** 199–207.

Cimprich, B. (1993). Developments of an intervention to restore attention in cancer patients. *Cancer Nursing*, **16,** 83–92.

Craik, K. H. & Feimer, N. (1987). Environmental assessment. In D. Stokols & I. Altman, (Eds), *Handbook of Environmental Psychology*, Vol. 2. New York: Wiley, pp. 891–918.

Gorsuch, R. L. (1983). *Factor Analysis*, 2nd edition. Hillsdale, NJ: Erlbaum.

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: Gothenburg, Göteborg University.

Hartig, T., Korpela, K., Evans, G. W. & Gärling, T. (1997). A measure of perceived environmental restorativeness. *Scandinavian Housing and Planning Research*, **14,** 175–194.

Herzog, T. R. (1985). A cognitive analysis of preference for waterscapes. *Journal of Environmental Psychology*, **5,** 225–241.

Herzog, T. R. (1989). A cognitive analysis of preference for urban-nature. *Journal of Environmental Psychology*, **9,** 27–43.

Hetherington, J., Daniel, T. C. & Brown, T. C. (1993). Is motion more important than it sounds? The medium of presentation in environment perception research. *Journal of Environmental Psychology*, **13,** 283–291.

Hoffman, R. J. (1978). Complexity and simplicity as objective indices descriptive of factor solutions. *Multivariate Behavioral Research*, **13,** 247–250.

Kaplan, S. (1983). A model of person–environment compatibility. *Environment and Behavior*, **15,** 311–332.

Kaplan, S. & Kaplan, R. (1989). *The Experience of Nature: A Psychological Perspective.* New York: Cambridge University Press.

Kaplan, S., Bardwell, L. V. & Slakter, D. B. (1993). The museum as a restorative environment. *Environment and Behavior*, **25,** 725–742.

McAndrew, F. T. (1993). *Environmental Psychology.* Pacific Grove, CA: Brooks/Cole.

Moore, E. O. (1981). A prison environment's effect on health care service demands. *Journal of Environmental Systems*, **11,** 17–34.

Parsons, R. (1991). The potential influences of environmental perception on human health. *Journal of Environmental Psychology*, **11,** 1–23.

Russell, J. A. & Snowgrass, J. (1987). Emotion and the environment. In D. Stokols & I. Altman, (Eds), *Handbook of Environmental Psychology,* Vol. 1. New York: John Wiley, pp. 245–280.

Russell, J. A., Ward, L. M. & Pratt, G. (1981). Affective quality attributed to environments: a factor analytic study. *Environment and Behavior*, **13,** 259–288.

Stevens, J. (1996) *Applied Multivariate Statistics for the Social Sciences.* Mathwah, NJ: Erlbaum.

Ulrich, R. S. (1977). Visual landscape preference: a model and application. *Man–Environment Systems*, **7,** 279–293.

Ulrich, R. S. (1981). Natural versus urban scenes: some psychophysiological effects. *Environment and Behavior*, **13,** 523–556.

Ulrich, R. S. (1993). Biophilia, biophobia and natural landscapes. In S. R. Kellert & E. O. Wilson, (Eds), *The Biophilia Hypothesis*. Washington, DC: Island Press, pp. 73–137.

Ulrich, R. S. (1984). View through a window may influence recovery from surgery. *Science*, **244,** 420–421.

Ulrich, R. S., Dimberg, U. & Driver, B. L. (1991). Psychophysiological indicators of leisure benefits. In B. L. Driver, P. J. Brown & G. L. Peterson, (Eds), *Benefits of Leisure*. State College, PA: Ventura.

Verderber, S. (1986). Dimensions of persons–window transactions in the hospital environment. *Environment and Behavior*, **18,** 450–466.

Vining, J. & Orlando, B. (1989). The video advantage: a comparison of two environmental representational techniques. *Journal of Environmental Management*, **29,** 275–283.

Wohlwill , J. F. (1976). Environmental aesthetics: the environment as a source of affect. In I. Altman & J. F. Wohlwill, (Eds), *Human Behavior and the Environment* Vol. 1. New York: Plenum, pp. 37–86.

Zube, E. H., Pitt, D. G. & Anderson, T. W. (1975). Perception and prediction of scenic resource values of the Northeast. In E. Zube, R. Brush & J. Fabos, (Eds), *Landscape Assessment: Values, Perceptions and Resources*. Stroudsburg PA: Dowden, Hutchinson & Ross, pp. 151 –167.