Biodiversity, Perceived Restorativeness, and Benefits of Nature: A Study on the Psychological Processes and Outcomes of On-Site

Sigrun Kabisch · Anna Kunath
Petra Schweizer-Ries · Annett Steinführer (Eds.)

Vulnerability, Risks, and Complexity

Impacts of Global Change on Human Habitats

Advances in People-Environment Studies
Volume 3

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Vulnerability, Risks, and Complexity
Impacts of Global Change on Human Habitats

Dedication

On April 21, 2011, Gabriel Moser, the great *spiritus rector* of people-environment studies, died. Having a background in environmental psychology, he was always open-minded to the contributions of other disciplines as well as interdisciplinary and transdisciplinary approaches. During his time as President of IAPS (2004–2008) he founded the series ***Advances in People-Environment Studies*** together with David Uzzell. We dedicate this 3rd volume of the series to him.

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David Uzzell; PhD, FBPsS, FRSA, Prof., Surrey, UK, Past-President of the International Association for People-Environment Studies (IAPS).
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HOGREFE

Library of Congress Cataloging information for the print version of this book is available via the Library of Congress Marc Database

Cataloging data available from Library and Archives Canada

http://www.hogrefe.com

PUBLISHING OFFICES
USA: Hogrefe Publishing, 875 Massachusetts Avenue, 7th Floor, Cambridge, MA 02139
Phone (866) 823-4726, Fax (617) 354-6875;
E-mail customerservice@hogrefe-publishing.com
EUROPE: Hogrefe Publishing, Merkelstr. 3, 37085 Göttingen, Germany
Phone +49 551 99950-0, Fax +49 551 99950-111,
E-mail publishing@hogrefe.com

SALES & DISTRIBUTION
USA: Hogrefe Publishing, Customer Services Department,
30 Amberwood Parkway, Ashland, OH 44805
Phone (800) 228-3749, Fax (419) 281-6883,
E-mail customerservice@hogrefe.com
UK: Hogrefe Publishing c/o Marston Book Services Ltd, PO Box 269,
Abingdon, OX14 4YN, UK
Phone +44 1235 465577, Fax +44 1235 465556,
E-mail direct.orders@marston.co.uk
EUROPE: Hogrefe Publishing, Merkelstr. 3, 37085 Göttingen, Germany
Phone +49 551 99950-0, Fax +49 551 99950-111,
E-mail publishing@hogrefe.com

Format: PDF

ISBN 978-1-61676-435-7

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Biodiversity, Perceived Restorativeness, and Benefits of Nature

A Study on the Psychological Processes and Outcomes of On-Site Experiences in Urban and Peri-Urban Green Areas in Italy

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Abstract

Research on restorative environments has frequently showed a more positive impact of natural vs. built environments on human well being. However, the restorative potential of different typologies of nature has been less investigated. A still open issue is the role of biodiversity in the restoration process. This study compared five typologies of urban green spaces possessing increasing levels of biodiversity: An urban plaza with green elements, an urban park, a pinewood, a botanical garden, and a peri-urban natural area. One hundred and twenty-five residents of Padua, Italy, filled in a questionnaire that measured length and frequency of visits to the green spaces, activities performed there, perceived restorativeness, and affective qualities of the place, self-reported benefits of the visit. Results showed a positive relation between biodiversity in the settings, perceived restorative properties, and self-reported benefits. Perceived restorativeness and

From S. Kabisch, A. Kunath, P. Schweizer-Ries, A. Steinführer: *Vulnerability, Risks, and Complexity: Impacts of Global Change on Human Habitats* (ISBN 9781616764357) © 2012 Hogrefe Publishing.

affective qualities also mediate the relation between exposure to nature and self-reported benefits. Theoretical and practical implications are discussed.

Key words: affective qualities, biodiversity, place-experience, psychological benefits, restorative environments

Introduction

Restorative environments are settings capable of promoting, and not merely allowing, the recovery of psychological well-being, defined through stress reduction, increase in positive emotions, and renewal of cognitive resources (Hartig, 2004). The literature on restorative environments has assumed an evolutionary perspective as a theoretical framework (the *Biophilia* Hypothesis, Wilson, 1984), postulating that human beings, who have evolved in natural environments, have developed an innate tendency to positively respond to nature as a consequence of an adaptation process. This positive response also includes psychological restoration, conceived by Ulrich (1983) and Kaplan and Kaplan (1989) in terms of stress reduction (*Stress Reduction Theory* – SRT) and recovery of directed attention (*Attention Restoration Theory* – ART), respectively. Several studies have provided empirical evidence supporting both SRT (e.g., Hartig, Mang, & Evans, 1991; Ulrich et al., 1991) and ART (e.g., Berto, 2005; Staats, Kievet, & Hartig, 2003). Kaplan (1995) has also suggested an integrative framework in this respect, explaining how stress and directed attention may be related. Recent studies have provided empirical support for this relationship. Laumann, Gärling, and Stormark (2003) showed that mentally fatigued people perform better in a cognitively demanding task after viewing a natural vs. urban video. In a field study, Hartig, Evans, Jamner, Davis, and Gärling (2003) found better physiological, emotional and cognitive outcomes for people taking a walk in a natural area than in an urban environment. The study suggests that physiological and attention restoration can complement each other, even if it is difficult to establish which process mediates the other.

Empirical research on restorative environments has consistently shown the benefits of human-nature transactions in several domains. The role of wilderness in promoting psychological well-being has been explored for some time (e.g., Kaplan & Talbot, 1983): People in wild environments can distance themselves from everyday life, reflect on their goals from a different perspective, experience relaxation and peace. With reference to everyday environments, Ulrich (1984) showed that a view onto a natural vs. built scene through a window in a hospital promotes a better and faster recovery in surgery patients. Similar findings were found also in residential settings, university dormitories (Tennessen & Cimprich, 1995) and workplaces (Heerwagen & Orians, 1986). In urban settings, where

distressing places and situations are widespread, the beneficial effects of green areas have also been identified: Nature emerged as a resource for the promotion of physical activity and psychological well-being (Ulrich & Addoms, 1981), and positive social interaction (e.g., Sullivan, Kuo, & DePooter, 2004).

Measuring the Restorative Potential of Environments

ART identifies four environmental properties promoting restoration: *Being away* implies a change of scenery and/or experience compared to daily routines; *fascination* refers to the capability of aesthetically pleasant environments to catch a person's attention without mental effort; *extent* refers to the properties of connectedness and scope in environments, because all elements are coherently related to one another, and promise to engage the mind beyond what is being immediately perceived; *compatibility* has to do with the level of perceived congruence between the characteristics of the environment and people's needs and inclinations. To measure these properties, Hartig, Korpela, Evans, and Gärling (1997) developed the Perceived Restorativeness Scale (PRS), which consists of 26 items measuring the four restorative properties proposed by ART. Through the use of this and other similar tools, and concurrent measures of physiological and cognitive restoration, the empirical literature has consistently revealed more positive responses to natural vs. built settings (Berto, 2005; Hartig et al., 2003; Laumann et al., 2003; Purcell, Peron, & Berto, 2001; Staats et al., 2003; van den Berg, Koole, & van der Wulp, 2003). More recently, Scopelliti & Giuliani (2004) emphasised that many studies on restorative environments conceived people-environment transactions leading to restoration in terms of visual perception of the environment – often analysed through a photo or video presentation – whereas the role of overall experience in the environment (e.g., the multi-sensorial character of perception itself, individual feelings, activities performed, etc.) was less considered. Scott and Canter (1997) have shown empirically that people conceptualise the environment differently, depending on whether the focus is on the visual perception or on the experience in the place. It is questionable whether mere visual perception can adequately represent the complexity of the process leading to restoration in a real environment. In this respect, Staats and Hartig (2004) analysed the role of social interaction in restorative experience, and found that – when perceived safety is controlled for – the presence of other people may diminish the benefits of natural environments. Scopelliti and Giuliani (2005) considered both the activity performed and social interaction as potential moderators of positive outcomes for the elderly. They found an effect of social interaction on the restorative potential of natural environments, which was perceived to be higher when people were alone. The authors suggest that social interaction in natural environments may represent a source of distraction from the relationship with the environment, which is restorative in itself. Thus, it is clear that the role of variables moderating restorative nature experience needs further investigation.

Open Issues in Research on Restorative Environments

In the study of restorative environments, nature has often been considered as an undifferentiated typology and contrasted to built environments. Little attention has been paid to the analysis of the restorative potential of *different* kinds of natural environments. Fuller, Irvine, Devine-Wright, Warren, and Gaston (2007) found that biodiversity can increase the psychological benefits associated with experiencing green areas. This preliminary result is still compatible with an evolutionary perspective, because biodiversity plays a fundamental role in life support and for an ecosystem's continuity (e.g., Wilson, 1999). It is then possible to hypothesise that human beings developed positive responses to this specific feature of natural settings in the course of evolution. Therefore, it seems to be interesting to better understand if – and how – there can be a relationship between biodiversity and psychological restoration.

A further issue is to understand how various experiences in restorative environments, in terms of length and frequency of exposure to nature, and activities performed there, can affect restoration.

Because the literature on restorative environments has mainly considered restoration as an outcome (or effect) promoted by people-environment transactions, it is important to gain more insight into the role of psychological processes, such as perceptions of and affect toward the environment, which might, in turn, lead to psychological benefits.

A better understanding of the environmental properties and psychological mechanisms promoting restoration can also support more sustainable and health-oriented planning and management of everyday environments.

The Study

This study aimed at analysing the relationships between ecological-structural and psychological variables, namely biodiversity and restoration, in urban and peri-urban green areas, and at examining the role of some experience variables (length and frequency of visits, activities performed) in promoting restoration. A further aim was to better understand what psychological mechanisms – if any – intervene in the process linking exposure to nature to restoration. The study was conducted in the city and the peri-urban area of Padua, Italy. Five settings with a different level of biodiversity were identified as a context for the study. A photo of each of these five settings is shown in Figure 1.

Aims and Hypotheses

Three main aims and related hypotheses were identified for this study.

The first aim was to analyse the relationships between the level of biodiversity and the restorative potential of environments. It was hypothesised that:

H1: The level of biodiversity positively affects the perception of restorative properties and perceived benefits.

The second aim was to analyse the effect of experience variables, referring to both activities performed and exposure to the environment (length and frequency of visits), on the restorative potential of environments. On the basis of studies on social interaction in restorative environments, it was hypothesised that:

H2: Environmentally-oriented vs. socially-oriented activities in restorative environments increase the perception of restorative properties and perceived benefits.

In accordance with the literature on wilderness, which stresses the evolution through time of people-environment transactions and benefits, it was hypothesised that:

H3: The length and the frequency of visits in restorative environments positively affect the level of perceived benefits.

The third aim was to understand the role of psychological variables (perceived restorativeness and affective quality of the environment) in the restoration process. The mediation of these variables in the relationship between exposure to nature (length and frequency of visits) and perceived well-being was tested (Baron & Kenny, 1986; Evans & Lepore, 1997).

Methods

Selection of Environments

Five environmental typologies in the urban and peri-urban area of Padua, with different levels of biodiversity, were identified according to forestry science parameters. The environments were: The mixed built-natural square *Prato della Valle*, the urban park *Parco Iris*, the pinewood, the botanical garden, and the peri-urban green area *Colli Euganei*. The level of biodiversity ranged from a minimum at *Prato della Valle* up to a maximum at *Colli Euganei*.

Participants, Procedure, and Measures

An opportunistic sample of 124 respondents (62 females; mean age 37.2 y; SD = 15.1) was contacted at the sites. Participants were almost equally distributed across the five settings (n = 23, 26, 26, 24, 25 for square, urban park, pinewood, botanical garden and peri-urban area, respectively). Subjects were invited to take part in the study and asked to fill in a paper-and-pencil questionnaire, referring to their experience in the environment. The questionnaire was arranged as follows:

Section 1: open-ended, multiple-choice, and Likert-type scale questions on exposure to the environment (length and frequency of visits, crowding), main activity performed

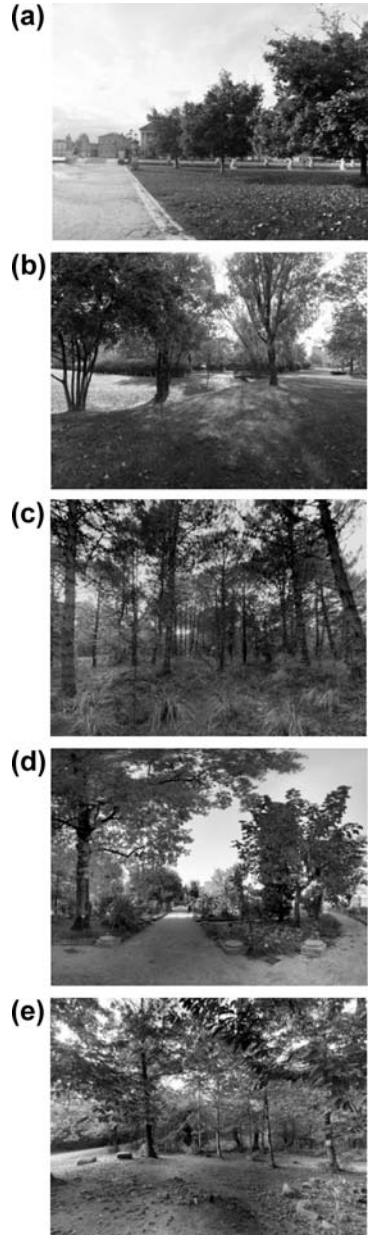

Figure 1. Pictures representing the five sites: (a) urban square; (b) urban park; (c) pinewood; (d) botanical garden; (e) peri-urban green area. (Photographs: the authors)

(socialising, walking, contemplation, or physical activity), and socio-demographic data. These measures were adapted from a previous study (Lafortezza, Carrus, Sanesi, & Davies, 2009).

Section 2: Italian version of the PRS (Pasini, Berto, Scopelliti, & Carrus, 2009), measuring the restorative properties of the environments on a 5-step Likert scale (0–4). Examples of items are: "*Spending time here gives me a break from my day-to-day routine*" (being-away); "*It is chaotic here*" (extent); "*This place is fascinating*" (fascination); "*I can do things I like here*" (compatibility).

Section 3: a measure of the affective quality of environments, based on the Russell and Pratt (1980) model, in which the bipolar adjectives unpleasant-pleasant, distressing-relaxing, sleepy-arousing, gloomy-exciting, were used (higher scores correspond to the presence of positive qualities). These measures were taken from the Italian version of the affective qualities scale (Perugini, Bonnes, Aiello, & Ercolani, 2002).

Section 4: a measure of psychological and physical benefits experienced in the environment on a 5-step Likert scale (0–4). The items used were "*How much do you feel psychologically better than usual?*" and "*How much do you feel physically better than usual?*" The items were adapted from Lafortezza et al. (2009).

Results

Effects of Biodiversity Levels on the Restorative Potential of the Settings

The level of biodiversity, ranging across the five environmental typologies considered, was used as an independent factor and each of the four restorative components were considered separately as dependent variables. The potential effect of the perceived level of crowding in the settings was controlled for as covariate, and for this reason we chose an ANCOVA model to test the hypotheses; a significant effect of the covariate was detected ($F_{(4,\ 119)} = 26.54$, $p < .001$). Coherently with hypothesis 1, results showed a significant effect of the level of biodiversity on each component: *Being away* ($F_{(4,\ 118)} = 12.25$, $p < .001$, $\eta^2 = .29$), *extent* ($F_{(4,\ 118)} = 12.97$, $p < .001$, $\eta^2 = .31$), *fascination* ($F_{(4,\ 118)} = 22.04$, $p < .001$, $\eta^2 = .43$), *compatibility* ($F_{(4,\ 118)} = 24.80$, $p < .001$, $\eta^2 = .46$) as well as on an average aggregate *restorativeness* score ($F_{(4,\ 118)} = 25.55$, $p < .001$, $\eta^2 = .46$). A significant effect of the level of biodiversity was also detected for psychological ($F_{(4,\ 118)} = 10.36$, $p < .001$, $\eta^2 = .26$) and physical ($F_{(4,\ 118)} = 9.51$, $p < .001$, $\eta^2 = .24$) benefits reported by the respondents. Figure 2 shows a general trend in which the mean scores of the dependent variables increase as settings shift from a lower level to a higher level of biodiversity. In the histograms, significant differences between the settings are indicated by colours for each of the dependent variables, at the level of $p < .05$. In the case of *being away*, the mixed colour for *Parco Iris* indicates a non-significant difference with both the urban square *Prato della Valle*, on the one hand, and the pinewood and the botanical garden, on the other hand.

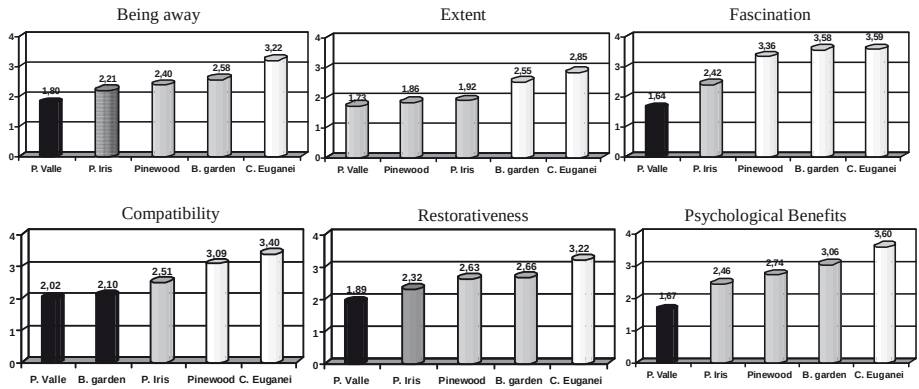

Figure 2. Mean scores of restorative properties and psychological benefits across the five environments.

Effects of Experience Variables on the Restorative Potential of the Environment: Activity, Length, and Frequency of Visits

To assess the effects of the various activities carried out during the experience upon the perceived restorative potential and self reported benefits, we distinguished between four groups of respondents, according to the main activity they reported while in the setting. These activities were socialising with other people ($N = 16$), walking ($N = 43$), contemplating the place ($N = 39$), and physical exercise ($N = 26$), and they can be considered as indicators of increasing levels of personal involvement with the setting.

Coherently with hypothesis 2, results showed a significant effect of the main activity on three of the restorative components: *Being away* ($F_{(3,\ 120)} = 7.45$, $p < .001$, $\eta^2 = .16$), *fascination* ($F_{(3,\ 120)} = 9.33$, $p < .001$, $\eta^2 = .19$) and *compatibility* ($F_{(3,\ 120)} = 6.42$, $p < .001$, $\eta^2 = .14$). No significant effect of the main activity emerged on *extent* ($F_{(3,\ 120)} = 3.83$, *ns*). A significant effect of the main activity also emerged on the aggregate score of *restorativeness* ($F_{(3,\ 120)} = 10.43$, $p < .001$, $\eta^2 = .21$) and on the psychological ($F_{(3,\ 120)} = 7.59$, $p < .001$, $\eta^2 = .16$) and physical ($F_{(3,\ 120)} = 18.17$, $p < .001$, $\eta^2 = .31$) benefits reported by the respondents.

Figure 3 shows a general trend in which the mean scores of the dependent variables increase when respondents shifted from an activity that implied a lower level of involvement with the setting (such as socialising) towards activities implying a higher level of involvement (such as walking, contemplating the place, and performing physical exercise). Again, the colours in the histograms indicate significant differences between the activities for each of the dependent variables, at the level of $p < .05$.

A hierarchical multiple regression analysis was also performed to assess the role of length and frequency of visits to the environment upon the self-reported benefits. In a first block, experience variables related to exposure to the environment (length and frequency

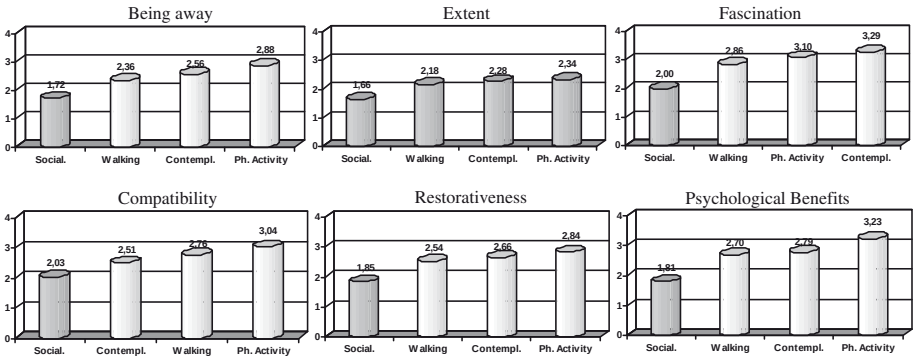

Figure 3. Mean scores of restorative properties and psychological benefits for different activities in the environment.

of visits to the setting) were inserted as predictors. In a second block, the psychological variables referring to the perceived properties of the environment were added to the model (perceived restorativeness and affective qualities of the place), using an aggregate score of self-reported psychological and physical benefits as the criterion. Prior to the final test, bivariate correlations among predictors were calculated, to check for possible multicollinearity. This eventuality was ruled out, since the maximum correlation value was $r = .53$ (between the affective qualities *pleasant* and *relaxing*).

In line with hypothesis 3, as shown in Table 1, the predictors at step 1 accounted for a significant proportion of variance in the criterion ($R^2 = .113$, $F_{(2,\ 121)} = 7.68$, $p < .01$). Both length and frequency of visits emerged as significant positive predictors of self-reported benefits: ($\beta = .228$ and .241, respectively; $p < .01$). The addition of predictors at step 2 significantly increased the proportion of explained variance ($R^2 = .513$, $F_{(5,\ 118)} = 24.85$, $p < .001$). After controlling for the variables in block 2, length and frequency of visits were no longer significant, while perceived *restorativeness* ($\beta = .410$, $p < .001$) and the affective qualities *arousing* ($\beta = .215$, $p < .01$) and *relaxing* ($\beta = .158$, $p < .05$) positively predicted self-reported benefits.

These results suggest a mediating role of the perceived characteristics of the environment, namely perceived restorativeness and affective qualities, upon the relationship between exposure to the environment, expressed in terms of length and frequency of visits, and the positive outcomes reported by the participants. The results of mediation analyses are reported in the next paragraph.

Mediation Effects of Perceived Environmental Characteristics on the Relationship Between Exposure to Nature and Self-Reported Benefits

To test the mediation model, multiple regression and Sobel test were performed. Figure 4 shows how the relationship between length of the visit in the natural setting and

Table 1. Hierarchical multiple regression analysis: predictors of perceived benefits

		β	t	p
Model 1: Exposure to the environment variables				
Length of visit		.228	2.666	.009
Frequency of visits		.241	2.816	.006
Model 2: Psychological variables				
Length of visit		.105	1.570	.119
Frequency of visits		.122	1.853	.066
Restorativeness		.420	4.891	.000
Affective quality: Arousing		.215	2.788	.006
Affective quality: Relaxing		.158	1.981	.049
Model fit	R	R^2	F	p
Model 1	.336	.113	7.68	.001
Model 2	.716	.513	24.85	.000

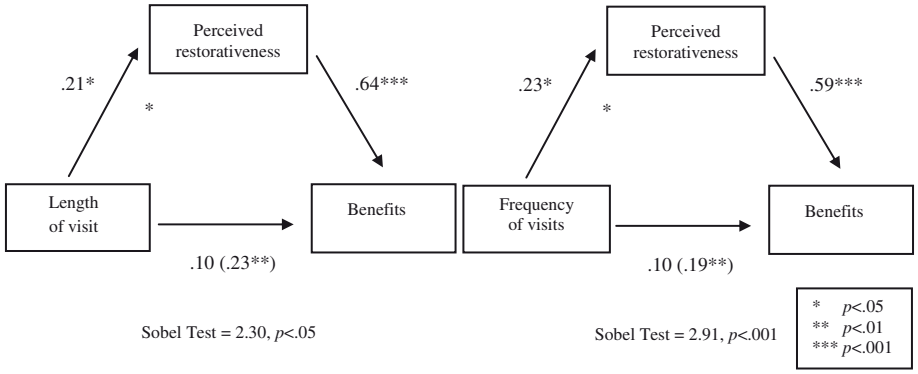

Figure 4. Mediation analysis: the role of perceived restorativeness.

self-reported benefits was fully mediated by perceived restorativeness (Sobel test: 2.30, $p < .05$): The relationship ($\beta = .23$, $p < .01$) between length of visit and self-reported benefits was no longer significant when controlling for perceived restorativeness. This, in turn, positively predicted self-reported benefits ($\beta = .64$, $p < .001$). Similarly, the relationship between frequency of visits to the natural setting and self-reported benefits was fully mediated by perceived restorativeness (Sobel test: 2.91, $p < .001$), with a significant predictor-criterion relationship ($\beta = .19$, $p < .01$) dropping down to non-significance after

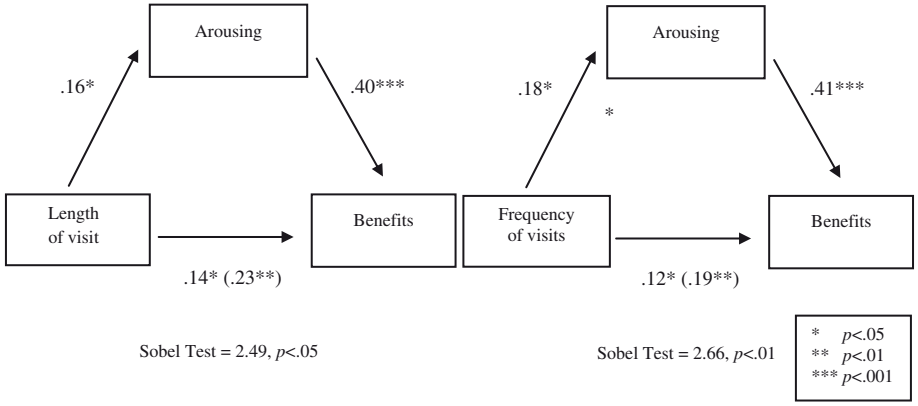

Figure 5. Mediation analysis: the role of the affective quality arousing.

controlling for the effect of the mediator, which, in turn, significantly predicted the criterion ($\beta = .59$, $p < .001$). In other words, spending more time in contact with nature leads individuals to better acknowledge its restorative properties, and this, in turn, leads them to perceive more beneficial outcomes.

A further set of regressions was performed to test for the mediating role of affective qualities of the place on the relationship between exposure to nature and self-reported benefits. Figure 5 shows how the relationship between length of the visit in the natural setting and self-reported benefits is partially mediated by the *arousing* affective quality of the environment (Sobel test: 2.49, $p < .05$): The significant relationship ($\beta = .23$, $p < .01$) between length of visit and self-reported benefits decreased to $\beta = .14$, $p < .05$ after controlling for the *arousing* quality, and this, in turn, positively predicted self-reported benefits ($\beta = .40$, $p < .001$). Likewise, the relationship between frequency of visits to the natural setting and self-reported benefits is partially mediated by the *arousing* affective quality of the environment (Sobel test: 2.66, $p < .01$), with a substantial decrease in the predictor-criterion association after controlling for the effect of the mediator (from $\beta = .19$, $p < .01$ to $\beta = .12$, $p < .05$), which in turn significantly predicts the criterion ($\beta = .41$, $p < .001$). Again, these results suggest that spending more time in contact with nature causes individuals to perceive it as more beneficial, and this can partly be attributed to an increased perception of the presence of arousing elements in the environment.

The same test, performed for the *relaxing* affective quality, did not show a mediation pattern, because the predictor-mediator link was not significant for either the length or the frequency of visits. Therefore, only a direct effect of the *relaxing* quality of the environment on experienced benefits – as it emerged from the multiple regression analysis – was found.

Discussion

This study addressed some undeveloped issues in the literature on restorative environments. Previous research often considered the broad natural vs. built environments distinction, demonstrating the higher restorativeness of the former over the latter (Berto, 2005; Hartig et al., 1991, 2003; Laumann et al., 2003; Tennessen & Cimprich, 1995; Ulrich et al., 1991). In the present study, we analysed the role of the level of biodiversity, which differentially characterises various typologies of urban nature, and the moderating effect of place-experience variables (activities performed and exposure to the environment) in the perception of the restorative properties of the environment and associated benefits.

Our comparisons showed an increase in the restorative properties and benefits experienced by respondents as a function of the level of biodiversity: From setting with the lowest biodiversity (*Prato della Valle*) to those with the highest (*Colli Euganei*), with the middle-level settings (*Parco Iris*, the pinewood, the botanical garden) in between. This general trend is in line with our hypothesis and previous findings (Fuller et al., 2007), suggesting a relationship between ecological-structural properties of environments and psychological processes.

At a general level, the amount of contact with nature was found to affect its positive outcomes: Respondents who spent a longer time and repeatedly visited natural settings reported more benefits. These results indicate that an evolution of the experience over time occurs, yielding deeper restoration and thus confirming previous findings (Kaplan & Talbot, 1983).

In line with previous research showing more restorative outcomes for people in solitude (Scopelliti & Giuliani, 2005; Staats & Hartig, 2004), we also found a moderating effect of the activities performed in the environment on the perception of the restorative properties and experienced benefits: People involved in environmentally-oriented activities showed a more positive experience than people involved in socialising activities.

In terms of the psychological processes promoting restoration, our analyses showed that the relationship between exposure to the natural environment, expressed in terms of length and frequency of visits, and experienced benefits is mediated by the perception of the restorative properties and the arousing affective quality of the environment. In other words, the more, longer and deeper the transactions with the environment are, the more people are able to perceive its positive qualities, and these perceptions, in turn, promote positive outcomes. A different pattern emerged for the affective quality *relaxing*, which is not linked to the amount of exposure and might thus represent an immediately perceivable feature of restorative settings.

Conclusions

The study has demonstrated the role of biodiversity in promoting benefits for people spending time in urban natural environments. This suggests that the richness of

biodiversity in these environments should be preserved, not only for the sake of nature itself, but also for the positive outcomes for residents. This finding can thus encourage decision makers to develop more sustainable policies in urban settings, and it also addresses the paradox that characterises current urban development. On the one hand, as van den Berg et al. (2007) suggest, the compact city provides ecological advantages in terms of carbon emissions, and therefore urban sprawl might be seen as a negative phenomenon that needs to be buffered. At the same time, the global phenomenon of urbanisation and increasing building density in cities often reduces urban residential quality and negatively affects people's well-being. Therefore, urban planning strategies that promote the presence of larger natural spaces rich in biodiversity could contribute to improving residents' health status.

Our findings also support the hypothesis that various experiences in urban natural environments may promote benefits to different extents. These results might be helpful for a healthier management of urban and peri-urban natural settings: The arrangement and layout should provide a positive involvement through differentiation of areas, accessibility and variety of activities. This would invite people to spend more time in the environment and would offer them opportunities for a more intensive interaction with nature.

Our study also has some shortcomings: The reliability of the results from this relatively small sample should be confirmed in future research with larger samples, and also in different geographical areas and with different populations. For example, epidemiological studies have suggested the plausibility of a link between green space availability and well-being at a population level (e.g., Mitchell & Popham, 2008). Future studies should address this question more directly, for instance, through longitudinal field studies. These might make it possible to test the impact of changes in exposure to biodiversity-rich green spaces, for example, as a consequence of residential mobility or urban development plans.

Despite these shortcomings, the present findings provide the basis for new theoretical insights and also offer practical suggestions for more sustainable management and use of urban natural environments.

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