Nearby nature and wellness
Evidence from scientific studies

Prepared by William C. Sullivan
Department of Landscape Architecture
University of Illinois at Urbana-Champaign
http://willsull.net
April 2013

To what extent does regular contact with nature promote wellness? Scientists from a host of disciplines have been exploring this question for three decades. The findings span a considerable range: from the restoration of mental fatigue, to reduced crime, to increased opportunities for creative play among children.

You may find the material below useful in working with local governments and policy-makers. As public servants who have sworn an oath to promote the health and well-being of their constituents, policy makers will certainly be interested to know that nearby nature has significant and consistent impacts on public health and wellness.

I’ve pulled the titles and abstracts (some of the abstracts have been modified) for a range of studies into six categories here: 1) Nature and restoration from mental fatigue; 2) Nature & children; 3) Stress reduction; 4) Community, safety, & crime; 5) Nature and mood; and 6) Nature and physical health.

Nature, Restoration, & Mental Fatigue

Restorative activities of community-dwelling elders
Jansen DA, von Sadovszky V
Western Journal of Nursing Research
26 (4): 381-399 JUN 2004

This study was conducted to identify the restorative activities of community-dwelling elders. Exposure to restorative activities, such as observing nature, is associated with improved concentration, more effective cognitive functioning, and feelings of greater mental energy, peacefulness, and refreshment. Little literature exists regarding the types and benefits of restorative activities engaged in by elders, a group in need of means to promote optimal daily functioning. A qualitative descriptive design was used. Thirty (28 women, 2 men) community-dwelling elders (ages 65 to 92 years) were interviewed using open-ended questions to ascertain their perceptions of restorative activities. A content analysis of themes produced 12 categories of restorative activities: creative outlets, altruism, nature, social connections, cognitive challenges, physical activity, reading, family connections, spirituality and reflection, cultural activities, travel, and other activities. Additional studies with larger, culturally diverse samples and more, men are warranted before implementing restorative interventions with elders in the hopes of promoting optimal functioning and well-being.

Choosing restorative environments across the lifespan: A matter of place experience
Scopelliti M, Giuliani MV
Journal of Environmental Psychology
24 (4): 423-437 DEC 2004

Previous research on restorativeness has emphasized mainly the potential of natural environments. In our hypothesis, built environments are also likely to be recognized as restorative places. In this study, focusing on restorative experiences more than on environments alone, attention is drawn on the relative importance of the four restorative components proposed by "attention restoration theory" - being-away, extent, fascination, compatibility-in leisure experiences of people at different stages of the lifespan, and on the characterization of these experiences in terms of relaxation and excitement. We also take account of the time available for restoration and the context in which the need for restoration may emerge, according to three models of the relationships between work and leisure: spillover, compensation and segmentation. Results show that natural and built environments can have different restorative potentials in relation to the stage of the lifespan and to the time available for restoration; moreover, in people’s perception, the four restorative components differ from each other in their relative importance. The social and affective dimensions came out as important features of restorative experiences. Finally, relaxation and excitement in leisure patterns were shown to be differentially...
related to work characteristics. Briefly, restorativeness emerged as the result of a global "place experience".

**Exposure to restorative environments helps restore attentional capacity**

Berto R.
*Journal of Environmental Psychology*
25 (3): 249-259 Sep 2005

Three experiments were designed to test the hypothesis that exposure to restorative environments facilitates recovery from mental fatigue. To this end, participants were first mentally fatigued by performing a sustained attention test, then they viewed photographs of restorative environments, non-restorative environments or geometrical patterns; and finally they performed the sustained attention test again. Only participants exposed to the restorative environments improved their performance on the final attention test, and this improvement occurred whether they viewed the scenes in the standardized time condition or in the self-paced time condition. Results are in agreement with Kaplan’s (1995) Attention Restoration Theory, and support the idea that restorative environments help maintain and restore the capacity to direct attention.

**Effect of urban vegetation on psychological restorativeness**

Hernandez B, Hidalgo MC
*Psychological Reports*
96 (3): 1025-1028 Part 2, Jun 2005

This study analyzes the contribution that natural elements in the city make to restorativeness, that is, the potential of certain environments to help recover the capacity to focus attention, reduce mental fatigue, and reduce stress. We presented photographs of 12 urban scenes (streets, industrial areas, and buildings) with and without vegetation to 214 university students, divided into 12 groups. Individuals then completed the *Perceived Restorativeness Scale*. Results support the hypothesis that urban environments with natural elements yield higher restorativeness than urban environments that lack green spaces.

**Assessing the restorative components of environments**

Herzog TR, Maguire CP, Nebel MB
*Journal of Environmental Psychology*
23 (2): 159-170 Jun 2003

We used a direct rating approach based on definitions of each construct to measure the four components of a restorative environment proposed by attention restoration theory (ART): being away, extent, fascination, and compatibility. We used the same approach to measure two criterion variables, perceived restorative potential (PRP) of a setting and preference for the setting, as well as four additional predictor variables (openness, visual access, movement ease, and setting care). Each participant rated 70 settings, 35 each from urban and natural environments, for only one of the variables. Mean ratings were higher for the natural than the urban settings for both criterion variables and all four restorative components, with differences significant in all cases except for fascination. Correlations across settings generally followed the predictions of ART, but collinearity appeared among several sets of variables, most notably being away and setting category, PRP and preference, and extent and fascination. Despite these problems, regression analysis showed that being away and compatibility predicted PRP and that the pattern of prediction for PRP and preference was somewhat different.

**The nature of the view from home: Psychological benefits**

Kaplan R
*Environment and Behavior*

Depending on what is in the view, looking out the window may provide numerous opportunities for restoration. Unlike other restorative opportunities, however, window viewing is more frequent and for brief moments at a time. The setting is also experienced from afar rather than while being in it. A study conducted at six low-rise apartment communities, using a survey with both verbal and visual material, provides considerable support for the premise that having natural elements or settings in the view from the window contributes substantially to residents’ satisfaction with their neighborhood and with diverse aspects of their sense of well-being. Views of built elements, by contrast, affected satisfaction but not wellbeing. Views of the sky and weather did not have a substantial effect on either outcome. The potential of nature content in the view from home to contribute so significantly to satisfaction and wellbeing suggests clear action mandates.

**An environmental intervention to restore attention in women with newly diagnosed breast cancer**

Cimprich B, Ronis DL
*Cancer Nursing*

Earlier research indicated that attentional fatigue with reduced capacity to direct attention in women treated for breast cancer may be ameliorated by a theoretically based intervention involving regular exposure to the natural environment. This study tested the efficacy of a natural environment intervention aimed at restoring attention in 157 women with newly diagnosed breast cancer. Capacity to direct attention was assessed with a brief battery of objective measures at two time points: approximately 17 days before surgery (time 1) and 19 days after surgery (time 2). A randomly assigned intervention protocol was initiated after the first assessment.
and before any treatment. The intervention comprised a home-based program involving 120 minutes of exposure to the natural environment per week. The intervention group (n = 83) showed greater recovery of capacity to direct attention from the pretreatment (time 1) to the pre-adjuvant therapy period (time 2), as compared with the nonintervention group (n = 74). A significant effect of the natural environment intervention was observed even after control was used for the effects of age, education, and attention scores at time 1, other health problems, symptom distress, and extent of surgery. The findings suggest therapeutic benefits for capacity to direct attention from early intervention aimed at restoring attention in women with newly diagnosed breast cancer.

Coping with poverty: Impacts of environment and attention in the inner city
Kuo FE
Environment and Behavior
33 (1): 5-34 Jan 2001

Considerable evidence suggests that exposure to "green" environments can enhance human effectiveness and make life's demands seem manageable. Does this phenomenon extend to poor inner cities, where green space is minimal and life's demands may be overwhelming? In 145 urban public housing residents randomly assigned to buildings with and without nearby nature, attentional functioning and effectiveness in managing major life issues were compared. Residents living in buildings without nearby trees and grass reported more procrastination in facing their major issues and assessed their issues as more severe, less soluble, and more long-standing than did their counterparts living in greener surroundings. Mediation tests and extensive tests for possible confounds supported the attention restoration hypothesis that green space enhances residents' effectiveness by reducing mental fatigue. These findings suggest that urban public housing environments could be configured to enhance residents' psychological resources for coping with poverty.

Views To Nature: Effects On Attention
Tennesen CM, Cimprich B
Journal of Environmental Psychology

This study is based on a theoretical view that suggests that under increased demands for attention, individuals' capacity to direct attention may become fatigued. Once fatigued, attentional restoration must occur in order to return to an effectively functioning state. An attention-restoring experience can be as simple as looking at nature. The purpose of this study was to explore whether university dormitory residents with more natural views from their windows would score better than those with less natural views on tests of directed attention. Views from dormitory windows of 72 undergraduate students were categorized into four groups ranging from all natural to all built. The capacity to direct attention was measured using a battery of objective and subjective measures. Natural views were associated with better performance on attentional measures, providing support for the proposed theoretical view.

Aggression and violence in the inner city: Effects of environment via mental fatigue
Kuo FE, Sullivan WC
Environment and Behavior
33 (4): 543-571 Jul 2001

S. Kaplan suggested that one outcome of mental fatigue may be an increased propensity for outbursts of anger and even violence. If so, contact with nature, which appears to mitigate mental fatigue, may reduce aggression and violence. This study investigated that possibility in a setting and population with relatively high rates of aggression: inner-city urban public housing residents. Levels of aggression were compared for 145 urban public housing residents randomly assigned to buildings with varying levels of nearby nature (trees and grass). Attentional functioning was assessed as an index of mental fatigue. Residents living in relatively barren buildings reported more aggression and violence than did their counterparts in greener buildings. Moreover, levels of mental fatigue were higher in barren buildings and aggression accompanied mental fatigue. Tests for the proposed mechanism and for alternative mechanisms indicated that the relationship between nearby nature and aggression was fully mediated through attentional functioning.

Environmental preference and restoration: (How) are they related?
Vn den Berg AE, Koole SL, Vn der Wulp NY
Journal of Environmental Psychology
23 (2): 135-146 Jun 2003

Does the widely documented tendency to prefer natural over built environments owe to the perception of greater restorative potential in natural environments? In the present experimental study we tested the mediating role of restoration in environmental preferences. Participants viewed a frightening movie, and then were shown a video of either a natural or a built environment. We used two examples of each type of environment. Participants' mood ratings were assessed before and after they viewed the frightening movie, and again after viewing the environmental video. Participants also rated the beauty of the environment shown (to indicate preference) and performed a test of concentration after viewing the environmental video. The results indicate that participants perceived the natural environments as more beautiful than the built environments. In addition, viewing natural environments elicited greater improvement in mood and marginally better concentration than viewing built environments. Mediation analyses revealed that affective restoration accounted for a substantial proportion of the preference for the
natural over the built environments. Together, these results help substantiate the adaptive function of people’s environmental preferences.

Assessing the restorative components of environments
Herzog TR, Maguire CP, Nebel MB
Journal of Environmental Psychology
23 (2): 159-170 Jun 2003

We used a direct rating approach based on definitions of each construct to measure the four components of a restorative environment proposed by attention restoration theory (ART): being away, extent, fascination, and compatibility. We used the same approach to measure two criterion variables, perceived restorative potential (PRP) of a setting and preference for the setting, as well as four additional predictor variables (openness, visual access, movement ease, and setting care). Each participant rated 70 settings, 35 each from urban and natural environments, for only one of the variables. Mean ratings were higher for the natural than the urban settings for both criterion variables and all four restorative components, with differences significant in all cases except for fascination. Correlations across settings generally followed the predictions of ART, but collinearity appeared among several sets of variables, most notably being away and setting category, PRP and preference, and extent and fascination. Despite these problems, regression analysis showed that being away and compatibility predicted PRP and that the pattern of prediction for PRP and preference was somewhat different.

Where to recover from attentional fatigue: An expectancy-value analysis of environmental preference
Staats H, Kieviet A, Hartig T
Journal of Environmental Psychology
23 (2): 147-157 Jun 2003

Preferences for natural and urban environments can be framed in terms of (1) beliefs about the likelihood of psychological restoration during a walk in each type of environment and (2) the evaluation of restoration given differing restoration needs. We conducted an experiment to test hypotheses about restoration as a basis for environmental preferences. Imaging ourselves as attentionally fatigued or fully refreshed, participants (N = 101) evaluated recovery, reflection, and social stimulation outcomes. Next, they viewed slides simulating a walk through a forest or an urban center, then rated the likelihood of recovery, reflection, and social stimulation outcomes following such a walk. This procedure was repeated with the second environment. Preference for the forest over the city was twice as strong given attentional fatigue. The greater likelihood of restoration in the natural environment in conjunction with more positive evaluation of recovery when fatigued appears to explain this pattern. The results have implications for environmental preference conceptualizations and our understanding of the relationship between preference and restoration.

Psychophysiological responses and restorative values of natural environments in Taiwan
Chun-Yen Chang, William E. Hammitt, Ping-Kun Chen, Lisa Machnik, Wei-Chia Su
Landscape and Urban Planning
85: 79-84 2008

This study examined the psychological and physiological responses of subjects while viewing nature scenes. According to the Attention Restoration Theory, there are four components of restorative environments: Being Away, Extent or Coherence, Fascination, and Compatibility. The present study used 4 images as a hypothetical representation of each of those four components. 110 participants viewed total 12 images while their physiological responses were measured by electromyography (EMG), electroencephalography (EEG), and blood volume pulse (BVP) measurements and psychological responses were measured by using the perceived restorativeness scale. The results show there is high degree of congruency between the psychological measures and the physiological measures. There is evidence from this study that viewing virtue nature scenes has positive impact on the restoration of human well-being.

Selective attention and heart rate responses to natural and urban environments.
Journal of Environmental Psychology
23, 125-34 July 2003

In the present study, 28 female undergraduate students (age range 18-24) finished a proofreading task to generate mental load and then completed Posner’s attention-orienting task. After that, subjects viewed a video of either an urban or natural environment and then subjects completed Posner’s attention-orienting task for a second time. To exam the level of autonomic arousal, cardiac inter-beat interval (IBI) was measure continuously during the whole process.

Subjects who viewed the urban video had significantly short IBI (higher HR) measured as the difference from baseline than subjects who viewed the nature video. The nature group also had significant longer IBI during the video as compare to the baseline phase, F (1, 26) = 5.62, p< 0.05, while those viewed the urban video didn’t have significant change as compare to their baseline level, F (1, 26) = 0.16, p> 0.05.

These results indicate that the nature video had a relaxing effect on autonomic functions. This finding supports Ulrich’s theory (1993) that autonomic arousal reduction and subsequent effect of stress reduction are considered as main restorative effects of nature.
A comparison of the restorative effect of a natural environment with that of a simulated natural environment.
Anette Kjellgren, Hanne Buhrkall
Journal of Environmental Psychology. 30: 464-472 2010

In the present study, each of all 18 subjects attended two experiments within a natural environment in a woody park and a simulated natural environment in a laboratory room. Data about subjects’ stress level, physiological situation, depression level, and emotional state were collected several times during the experiments.

All 18 subjects were asked to finish Stress—Visual Analogue Scale (S-VAS) three times to evaluate their changes of stress level. A repeated-measure ANOVA and subsequent pairwise comparisons (Bonferroni correction) were performed. The result indicated that subjects’ stress levels were significantly and equally reduced after they were exposed to either the natural environment or the simulated natural environment (p<0.003).

The result of analysis on the pulse and the systolic and diastolic blood pressure indicated these three physiological measures were significantly lower after exposure to the natural environment and the simulated natural environment.

All 18 subjects answered the open-ended questions about their experience of exposure to two environments. The qualitative analysis indicated that subjects had a merely positive descriptions on their experience of the natural environment, as a contrast, subjects had partly positive, but mainly negative descriptions on their experience of the simulated natural environment. These results indicated that the natural environment caused a higher degree of ASC (Altered states of consciousness) and increased energy.

Reducing sedentary behavior: The relationship between park area and the physical activity of youth
Epstein LH, Raja S, Gold SS, Paluch RA, Pak Y, Roemmich JN
Psychological Science 17 (8): 654-659 Aug 2006

This study examined the extent to which characteristics of neighborhood environments are related to the substitution of physical activity for sedentary behavior among youth. Fifty-eight 8- to 15-year-old youth participated in a within-subjects crossover design with three phases: baseline, increased sedentary behavior, and decreased sedentary behavior. The relations between changes in physical activity and design, diversity, and density attributes of the neighborhood environment were determined using random coefficient models. Compared with girls, boys showed greater increases in physical activity when sedentary behaviors were reduced and greater decreases in physical activity when sedentary behaviors were increased. Greater access to parks was associated with greater physical activity when sedentary behaviors were reduced.

Go outside and play! Contributions of an urban environment to the developing and well-being of children
Jutras S
Canadian Psychology 44 (3): 257-266 Aug 2003

The virtues of children playing outside have been widely promoted. Nevertheless, the poor quality of the urban environment is partly behind the reason why children remain indoors more than in former times. This article brings together knowledge from environmental, community, developmental and health psychology for two purposes: The first is to examine the influence of the urban environment on children’s wellness and on how children benefit from their environment to play and develop. The second objective presents recommendations regarding intervention, research and social policy for psychologists to follow favoring children’s development within the urban environment.

We focus on two urban environments: Spaces adjoining their residence provide children with stimulation, op-
opportunities to run around, play and explore the physical and social world, develop personal identity, self-esteem and enhance their ability to deal with stress. However, children have less and less access to these spaces in the city, primarily because of parents' fears of traffic, deviance, criminality as well as the deterioration of the physical environment. The second urban environment we focus on are playgrounds, which can also serve children's physical, cognitive and social developmental needs. However, playgrounds may not live up to the expectations of children and pose their own problems of safety due to poor design or maintenance of equipment, as well as issues of social deviance such as bullying or criminality.

The impact of three environmental characteristics were studied. The contact of children with natural elements (vegetation, water, earth, small animals) furthers their comprehension of nature and their creativity, and promotes their interaction with the world. Moreover, natural elements exert positive physiological effects countering stress. Unfortunately, today's city-dwellers benefit little from these advantages because their daily contacts with nature are restricted.

Physical, cognitive and psychological limitations make children vulnerable to traffic accidents, especially in poor neighbourhoods where traffic is fast and intense, and playgrounds are rare or non-existent. As more often the victim of accidents, children are restricted in their freedom of movement, exploration, and participation in social or cultural activities. Many Canadian children live in hostile neighbourhoods, surrounded by criminality or dilapidation. Many adults fear for themselves in their neighbourhoods and restrict their children's play outside.

The article continues with the presentation of an action plan. There are a number of ways to increase place attachment and sense of belonging within the neighbourhood so that children can play safely. It is also important to respect the existing safety guidelines for playgrounds. Suggestions for intervening to reduce hostility within the neighbourhood are presented, particularly those that increase social capital.

In order to develop an understanding of the impact of the physical environment on children, this paper suggests some avenues for evaluative, fundamental, applied or action research. Some political aspects are discussed, with emphasis on the rights of children, in accordance with the National Children's Agenda and the conclusions of the United Nations Convention on the Rights of the Child.

In conclusion, the contribution of psychologists interested in children's wellness is solicited in order to promote a suitable environment where children can play at ease, move around the city safely, with more autonomy, and take advantage of public areas where they will develop their social skills.

**Nearby nature - A buffer of life stress among rural children**

Wells NM, Evans GW
*Environment and Behavior* 35 (3): 311-330 May 2003

Identifying mechanisms that buffer children from life's stress and adversity is an important empirical and practical concern. This study focuses on nature as a buffer of life stress among rural children. To examine whether vegetation near the residential environment might buffer or moderate the impact of stressful life events on children's psychological well-being, data were collected from 337 rural children in Grades 3 through 5 (mean age = 9.2 years). Dependent variables include a standard parent-reported measure of children's psychological distress and children's own ratings of global self-worth. In a rural setting, levels of nearby nature moderate the impact of stressful life events on the psychological well-being of children. Specifically, the impact of life stress was lower among children with high levels of nearby nature than among those with little nearby nature. Implications of these finding are discussed with respect to our understanding of resilience and protective mechanisms.

**Growing up in the inner city - Green spaces as places to grow**

Taylor AF, Wiley A, Kuo FE, Sullivan WC

Children growing up in the inner city are at risk for a range of negative developmental outcomes. Do barren, inner-city neighborhood spaces compromise the everyday activities and experiences necessary for healthy development? Sixty-four urban public housing outdoor spaces (27 low vegetation, 37 high vegetation) were observed on four separate occasions. Overall, inner-city children's everyday activities and access to adults appeared remarkably healthy; of the 262 children observed, most (73%) were involved in some type of play, and most groups of children (87%) were supervised to some degree. In relatively barren spaces, however, the picture was considerably less optimistic: Levels of play and access to adults were approximately half as much as those found in spaces with more trees and grass, and the incidence of creative play was significantly lower in barren spaces than in relatively green spaces.

**Views of nature and self-discipline: Evidence from inner city children**

Taylor AF, Kuo FE, Sullivan WC

Children growing up in the inner city are at risk of academic underachievement, juvenile delinquency, teenage pregnancy, and other important negative outcomes. Avoiding these outcomes requires self-discipline. Self-
Coping with ADD - The surprising connection to green play settings

Taylor AF, Kuo FE, Sullivan WC
Environment and Behavior
33 (1): 54-77 Jan 2001

Attention Restoration Theory suggests that contact with nature supports attentional functioning, and a number of studies have found contact with everyday nature to be related to attention in adults. Is contact with everyday nature also related to the attentional functioning of children? This question was addressed through a study focusing on children with Attention Deficit Disorder (ADD). This study examined the relationship between children’s nature exposure through leisure activities and their attentional functioning using both within- and between-subjects comparisons. Parents were surveyed regarding their child’s attentional functioning after activities in several settings. Results indicate that children function better than usual after activities in green settings and that the “greener” a child’s play area, the less severe his or her attention deficit symptoms. Thus, contact with nature may support attentional functioning in a population of children who desperately need attentional support.

Evaluating a children’s hospital garden environment: Utilization and consumer satisfaction

Whitehouse S, Varni JW, Seid M, Cooper-Marcus C, Ensberg MJ, Jacobs JR, Mehlenbeck RS
Journal of Environmental Psychology
21 (3): 301-314 Sep 2001

The Leichtag Family Healing Garden at Children’s Hospital and Health Center, San Diego was planned and built as a healing environment space for patients, families, and staff. A Post-Occupancy Evaluation (POE) was conducted to determine whether the garden was meeting the goals of reducing stress, restoring hope and energy, and increasing consumer satisfaction. Results from behavioral observations, surveys, and interviews indicated a number of benefits of the garden. The garden was perceived as a place of restoration and healing, and use was accompanied by increased consumer satisfaction. However, the garden was not utilized as often or as effectively as intended. Children, parents and many staff members recommended changes for the garden, such as the inclusion of more trees and greenery, and more interactive ‘things for kids to do. In addition, the majority of family members surveyed throughout the hospital did not know about the garden. Based on the findings, recommendations for changes were developed. To promote better use of the garden, these research findings can be used to guide the future planning, design, building, and subsequent evaluation of garden environments in children hospitals and pediatric settings.

The natural environment as a playground for children - Landscape description and analyses of a natural landscape

Ingunn Fjørtoft, Jepstein Sageie
Landscape and Urban Planning
48(1/2):83-97 Jan 2000

The present study examined the relationship between landscape structure and topography of a natural environment, a small scale forest, and affordness of it as a playscape for children. The landscape metrics of vegetation and two topography attributes, roughness and slope, have been measured and analysis in the GIS. Play activities of 46 children in the age group of 5-7 years for 2 h every day when they attended kindergarten have been observed and reported by kindergarten teachers. By employing spatial overlay analysis and correlation plots, the spatial relationship between landscape characteristics and children’s play activities were visualized. The results indicate several important issues: First, trees contribute a lot to multiple activities such as climbing trees, symbolic play and construction play. Second, the shrubs also had influence on all the play activities except for climbing trees. Third, Slope and roughness had relation with specific activities. Challenging activities such as climbing rocks and sliding took place in the area with a mean slope of 22.5° (S.D.=7.8, ranged from 15° - 30°). Places with high roughness (mean=−0.8, S.D.=4.8) accommodated climbing activities but disfavoured sliding. Collectively, this study indicated there are specific relations between landscape characteristics and playing activities of children, which shed light for future policy and planning of outdoor play spaces for children.
Nature and Recovery from Stress

Human response to window views and indoor plants in the workplace
Chang CY, Chen PK
Hortscience
40 (5): 1354-1359 Aug 2005

We examined the effects of window views and indoor plants on human psycho-physiological responses in workplace environments. The effects were recorded by measuring participant's electromyography (EMG), electroencephalography (EEG), blood volume pulse (BVP), and state-anxiety. Photo Impact was used to simulate the environment in an office, where six conditions were examined: 1) window with a view of a city, 2) window with a view of a city and indoor plants, 3) window with a view of nature, 4) window with a view of nature and indoor plants, 5) office without a window view, and 6) office without a window view and indoor plants. Participants were less anxious when watching a view of nature and/or when indoor plants were present. When neither the window view nor the indoor plants were shown, participants suffered the highest degree of tension and anxiety.

Residence in the social ecology of stress and restoration
Hartig T, Johansson G, Kylin C
Journal of Social Issues
59 (3): 611-636 2003

We relate residence to health within a social ecological model of stress and restoration. As an isolated setting and in relation to other everyday settings, we discuss the residence in terms of demands, coping resources and responses, and opportunities for restoration. Our model indicates how processes operating above the household level can affect health by modifying the quantity, quality, and distribution of demands, resources, and restoration opportunities within and across the settings of everyday life, including the residence. We illustrate some of these social ecological dynamics with the case of home-based telework. Concluding, we discuss the utility of the model for environmental interventions intended to alleviate health-threatening chronic stress.

Selective attention and heart rate responses to natural and urban environments
Laumann K, Garling T, Stormark KM
Journal of Environmental Psychology
23 (2): 125-134 Jun 2003

We tested the hypothesis that exposure to nature stimuli restores depleted voluntary attention capacity and affects selective attention. Before viewing a video of either a natural or an urban environment, 28 subjects first completed a proofreading task to induce mental load and then performed Posner's attention-orienting task. After viewing the video they performed the attention-orienting task a second time. Cardiac inter-beat interval (IBI) was measured continuously to index autonomic arousal. Before the video both groups reacted faster to validly versus invalidly cued targets in the attention-orienting task. After the video, the urban group was still faster on validly versus invalidly cued trials, but in the nature group this difference disappeared. During the video the nature group had a longer mean IBI (lower heart rate) measured as the difference from baseline than the urban group. The results suggest that reduced autonomic arousal during the video engendered less spatially selective attention in the nature group compared to the urban group.

The view from the road: Implications for stress recovery and immunization
Parsons R, Tassinary LG, Ulrich RS, Hebl MR, Grossman-Alexander M
Journal of Environmental Psychology
18 (2): 113-140 Jun 1998

A considerable body of folklore and scientific research alludes to the efficacy of the vernacular environment to influence both aesthetic experience and general well-being. To examine explicitly whether stress recovery and/or immunization varies as a function of the roadside environment, 160 college-age participants, both male and female, viewed one of four different video-taped simulated drives through outdoor environments immediately following and preceding mildly stressful events. Overall, it was anticipated that participants who viewed artifact-dominated drives, relative to participants who viewed nature-dominated drives, would show greater autonomic activity indicative of stress (e.g. elevated blood pressure and electrodermal activity), as well as show altered somatic activity indicative of greater negative affect (e.g. elevated electromyographic (EMG) activity over the brow region and decreased activity over the cheek region). In addition, it was expected that participants who viewed nature-dominated drives would experience quicker recovery from stress and greater immunization to subsequent stress than participants who viewed artifact-dominated drives. The overall pattern of results is consistent with both hypotheses and the findings are interpreted to support postulating a sympathetic-specific mechanism that underlies the effect of nature on stress recovery and immunization.
Green space as a buffer between stressful life events and health
Agnes E. van den Berg, Jolanda Maas, Robert A. Verhij, Peter P Groe
Social Science & Medicine
70: 1203-1210 2010
This study aims to investigate whether the exposure to green space can mitigate negative impacts of stressful life events on human health. The health data and data on stressful life events were obtained within the framework of the second Dutch National Survey of General Practice (DNSGP-2) in 2000-2002. A random sample of 12699 participants completed a health interview survey (response rate 64.5%).

Community, Safety, & Crime

The human dimensions of urban greenways: planning for recreation and related experiences
Gobster PH, Westphal LM
Landscape and Urban Planning
68 (2-3): 147-165 MAY 30 2004
In this paper, we summarize findings from a series of interrelated studies that examine an urban greenway, the 150 mile Chicago River corridor in Chicago, USA, from multiple perspectives, stakeholder viewpoints, and methodological techniques. Six interdependent "human dimensions" of greenways are identified in the studies: cleanliness, naturalness, aesthetics, safety, access, and appropriateness of development. Together, these dimensions form a core set of concerns relating to how people perceive and use the greenway for recreation and related experiences. While these dimensions show good consistency across our studies and are supported by the literature in the field, the quantitative and qualitative methods used also uncovered a rich variation in how the dimensions are construed by different stakeholder groups and along different reaches of the corridor. Using local demonstration projects from along the corridor, we illustrate how principles inherent in each dimension can be applied to improve the success of greenways through design, management, or programming. We conclude by discussing the applicability of these dimensions and methods of study to understand other urban and non-urban greenways, and suggest how the findings from such studies can be used to inform greenways planning, policy, and management.

Preferences for and attitudes towards street flowers and trees in Sapporo, Japan
Todorova A, Asakawa S, Aikoh T
Landscape and Urban Planning
69 (4): 403-416 OCT 30 2004
The benefits of street vegetation, in particular the importance of trees, for urban dwellers have been given wide attention. There is, however, a lack of research on flowers as an element of street vegetation. This paper explores preferences for various street-planting models, particularly those with different compositions of flowers, with or without trees. Eighty-one residents of Sapporo evaluated 59 photomontage simulations and answered a questionnaire concerning their attitudes to street flowers. Results revealed trees to be the factor with the greatest influence on preference. Among possible elements for the space beneath trees from a choice including soil, grass, hedge and flowers, flowers were the most favoured. In particular, low and ordered compositions of brightly coloured flowers were the most preferred. Tall flowers were not found to be either attractive or appropriate for streetscapes in this case study. A factor analysis of the variables related to attitudes towards street flowers revealed the following five factors: "psychological benefits and aesthetic value", "natural-environmental", "practical concerns", "effort to maintain" and "non-aesthetic". The highest rated items were all related to the aesthetic and psychological benefits of street flowers. Flowers were the most preferred element beneath street trees and were seen as not only contributing to the aesthetic quality of a street but also having a positive influence on psychological well-being.
Resident perceptions and expectations of rooftop gardens in Singapore

Yuen B, Hien WN
Landscape and Urban Planning
73 (4): 263-276 DEC 15 2005

Using data from the high-rise, high-density city of Singapore, this paper examines residents’ perceptions and expectations of rooftop gardens in Singapore. In particular, it discusses: To what extent is the roof gardens being used? Why do local residents visit roof gardens? What benefits do local residents perceive? The discussion has implications for the potential of rooftop greening, a new but increasingly common addition of open space in today’s growing urban areas. With the continuing trend towards urbanization and taller buildings, rooftop spaces stand to offer residents doorstep green oases in the skyline of high-rise buildings.

The political ecology of uneven urban green space: The impact of political economy on race and ethnicity in producing environmental inequality in Milwaukee

Heynen N, Perkins HA, Roy P
Urban Affairs Review
42 (1): 3-25 SEP 2006

This article investigates the role of urban political economy, private-public property relations, and race and ethnicity in the social production of Milwaukee’s urban forest. By integrating urban-forest canopy-cover data from aerial photography, United States Census data, and qualitative data collected through in-depth interviews, this analysis suggests that there is an inequitable distribution of urban canopy cover within Milwaukee. Since urban trees positively affect quality of life, the spatially inequitable distribution of urban trees in relation to race and ethnicity is yet another instance of urban environmental inequality that deserves greater consideration in light of contemporary and dynamic property relations within capitalist societies.

The restorative effects of roadside vegetation: Implications for automobile driver anger and frustration

Cackowski JM, Nasar JL
Environment and Behavior
35 (6): 736-751 Nov 2003

Anger and frustration may contribute to unsafe driving and may trigger instances of aggressive driving or road rage. Research shows that stress, fatigue from the exercise of directed attention, or a combination of these factors, can exacerbate anger and frustration. It also suggests that exposure to vegetation can facilitate recovery from stress and fatigue. Can highway vegetation mitigate automobile driver anger and frustration? We assigned 106 participants at random to view one of three video-tapes of highway drives, which varied in the amount of vegetation versus man-made material. The experiment obtained Spielberger State-Trait Anger Expression Inventory (STAXI) measures of anger before and after video exposure and obtained a measure of frustration tolerance after the video. No significant effect on anger emerged, but the results for frustration tolerance showed higher frustration tolerance (respondents spent more time on unsolvable anagrams) after exposure to videotapes with more vegetation. Parkway design and roadside vegetation appear to have restorative effects in reducing frustration.

Where does community grow? The social context created by nature in urban public housing

Coley RL, Kuo FE, Sullivan WC
Environment and Behavior

This study examines how the availability of nature influences the use of outdoor public spaces in two Chicago public housing developments. Ninety-six observations were collected of the presence and location of trees and the presence and location of youth and adults in semiprivate spaces at one high-rise and one low-rise public housing development. Results consistently indicated that natural landscaping encourages greater use of outdoor areas by residents. Spaces with trees attracted larger groups of people, as well as more mixed groups of youth and adults, than did spaces devoid of nature. In addition, more dense groupings of trees and trees that are located close to public housing buildings attracted larger groups of people. These findings suggest that natural elements such as trees promote increased opportunities for social interactions, monitoring of outdoor areas, and supervision of children in impoverished urban neighborhoods.

Fertile ground for community: Inner-city neighborhood common spaces

Kuo FE, Sullivan WC, Coley RL, Brunson L
American Journal of Community Psychology
26 (6): 823-851 Dec 1998

Research suggests that the formation of neighborhood social ties (NSTs) may substantially depend on the informal social contact which occurs in neighborhood common spaces, and that in inner-city neighborhoods where common spaces are often barren no-man’s lands, the presence of trees and grass supports common space use and informal social contact among neighbors. We found that for 145 urban public housing residents randomly assigned to 28 architecturally identical buildings, levels of vegetation in common spaces predict both use of common spaces and NSTs; further use of common spaces mediated the relationship between vegetation and NSTs. In addition, vegetation and NSTs were significantly related to residents’ senses of safety and adjustment. These findings suggest that the use and characteristics of common spaces may play a vital role in the natural growth of community, and that im-
proving common spaces may be an especially productive focus for community organizing efforts in inner-city neighborhoods.

Green common spaces and the social integration of inner-city older adults
Kweon BS, Sullivan WC, Wiley AR
*Environment and Behavior*
30 (6): 832-858 Nov 1998

For older adults, social integration and the strength of social ties are profoundly important predictors of well-being and longevity. Can the physical environment be designed to promote older adults' social integration with their neighbors? We examined this possibility by testing the relationships between varying amount of exposure to green outdoor common spaces and the strength of ties among neighbors. Results of interviews with 91 older adults (between the ages of 64 and 91 years) from one inner-city neighborhood show that the use of green outdoor common spaces predicted both the strength of neighborhood social ties and sense of community. Although the strength of these relationships were modest, the findings suggest that the characteristics of outdoor common spaces can play a role in the formation and maintenance of social ties among older adult residents of inner-city neighborhoods. The results have implications for designers, managers, and residents of housing developments.

Transforming inner-city landscapes: Trees, sense of safety, and preference
Kuo FE, Bacaicoa M, Sullivan WC
*Environment and Behavior*

How would inner-city residents respond to the incorporation of trees and grass in their neighborhoods? Law enforcement officials have argued that, in these settings, trees and other forms of vegetation increase fear. Tree density, tree placement, and levels of grass maintenance were manipulated in photo simulations of neighborhood outdoor space. One hundred residents of Chicago’s Robert Taylor Homes living adjacent to the space rated the images with respect to preference and sense of safety. Although tree placement (subspaces created by trees, formality of arrangement) had little effect on sense of safety and no effect on preference, both tree density and grass maintenance had strong effects on preference and sense of safety (eta(2)s from .49 to .89). Surprisingly, tree density and grass maintenance increased both preference and sense of safety. Results suggest that, contrary to some views, trees and grass maintenance can increase sense of safety in inner-city neighborhoods.

Preference and perceived danger in field/forest settings
Herzog TR, Kutzli GE
*Environment and Behavior*
34 (6): 819-835 Nov 2002

The authors investigated preference, perceived danger, and fear for a sample of 70 field/forest settings. Predictor variables included perception-based variables (visual access, penetration, movement ease), information-based variables (mystery, concealment, refuge), and variables thought to intervene between concealment and danger (entrapment, rearview concern). All variables were rated by independent groups. Danger and fear were strongly positively correlated for these settings, but preference and danger had a more modest negative correlation. Factor analysis of the strongly intercorrelated predictor variables yielded two factors, interpreted as Visibility and Locomotor Access. Both factors were positive predictors of preference and negative predictors of danger. Further analyses suggested feelings of entrapment could mediate the positive relation between concealment and danger and that after controlling for other indicators of visibility, mystery has a positive relation to preference. In general, the role of visual and locomotor access in accounting for preference or danger reactions is highlighted by these findings.

Woodland spaces and edges: their impact on perception of safety and preference
Jorgensen A, Hitchmough J, Calvert T
*Landscape and Urban Planning*
60 (3): 135-150 Aug 15 2002

The interaction between spatial arrangement and vegetation structure was systematically examined in the context of an urban park in an impoverished area of Sheffield, UK. Local residents rated digitally manipulated photographs depicting different spatial arrangements of mature trees and edge treatments for safety and preference. Spatial arrangement was the most important factor in determining sense of safety but not preference. Perception of edge treatment varied significantly according to variation in spatial arrangement in ratings for both safety and preference. The results of this study suggest that more naturalistic vegetation can be introduced into parks and green spaces without necessarily making the parks appear unsafe.

Environment and crime in the inner city: Does vegetation reduce crime?
Kuo FE, Sullivan WC
*Environment and Behavior*
33 (3): 343-367 May 2001

Although vegetation has been positively linked to fear of crime and crime in a number of settings, recent findings in urban residential areas have hinted at a possible
negative relationship: Residents living in “greener” surroundings report lower levels of fear, fewer incivilities, and less aggressive and violent behavior. Ibis study used police crime reports to examine the relationship between vegetation and crime in an inner-city neighborhood. Crime rates for 98 apartment buildings with varying levels of nearby vegetation were compared. Results indicate that although residents were randomly assigned to different levels of nearby vegetation, the greener a building’s surroundings were, the fewer crimes reported. Furthermore, this pattern held for both property crimes and violent crimes. The relationship of vegetation to crime held after the number of apartments per building, building height, vacancy rate, and number of occupied units per building were accounted for.

**Variations in perceptions of danger, fear and preference in a simulated natural environment**

Matthew Andrews, Birgitta Gatersleben  
*Journal of Environmental Psychology*, 30(4):473-481 April 2010

Based on the theory of prospect-refuge theory, this study designed three simulated environmental conditions with various levels of prospect-refuge by using a series of photographs of a natural park. 269 Participants were randomly assigned to exposure to one of three conditions and their overall and specific types of danger, fear, and preference. The study showed several effects of prospect-refuge: The high prospect-low refuge (higher visibility, fewer hiding places and more accessibility) condition was perceived as a significantly less dangerous, less fearful setting, more preferred for walking than both the medium and low prospect-high refuge environment. Levels of prospect-refuge also had a impact on the perceived likelihood of encountering a physical danger or becoming lost, however, there is no significant difference of the perceived social danger between conditions.

**The anatomy of the safe and social suburb: An exploratory study of the built environment, social capital and residents’ perceptions of safety.**


This study examined the relationship between physical characteristics of three types of suburb street networks and residents’ social capital, perceived of safety, and participation of activities. 335 residents of three suburbs in metropolitan Perth, WA, participated a phone survey and the study measured their social capital and feelings of personal safety. After controlling for demographic characters, the study found that the built environment had a significant effect on social capital and feeling of safety. Among characteristics of built environment, the number and perceived adequacy of destin- nation were two had significant relation with social capital and sense of safety. Upkeep level of suburb neighborhood also was found to have positive relation with social capital and sense of safety.

---

**Nature and Mood**

**Effects of an indoor plant on creative task performance and mood**

Shibata S, Suzuki N  

This study investigated the effect of an indoor plant on task performance and on mood. Three room arrangements were used as independent variables: a room with (1) a plant, or (2) a magazine rack with magazines placed in front of the participants, or (3) a room with neither of these objects. Undergraduate students (M= 35, F= 55) performed a task of associating up to 30 words with each of 20 specified words in a room with one of the three room arrangements. Task performance scores showed that female participants performed better in view of the plant in comparison to the magazine rack (p < 0.05). Moreover, mood was better with the plant or the magazine rack in the room compared to the no object condition (p < 0.05). However, the difference in task performance was highly influenced by the evaluation about the plant or the magazine rack. We suggest that compatibility between task demand and the environment is an important factor in facilitating task performances.

**To nature or not to nature: Associations between environmental preferences, mood states and demographic factors**

Regan CL, Horn SA  
*Journal of Environmental Psychology* 25 (1): 57-66 Mar 2005

Thematic analysis of free-response questionnaires explored the role of mood states and demographic factors in moderating preferences for natural environments, in children and adults. Individual differences influenced overall preferences (nature or not nature) but had few significant effects on between-mood comparisons. Current theories on the restorative properties of natural environments suggest that (i) the stressed mood state would be associated most strongly with a preference for nature and (ii) that demographic factors would not strongly influence preference for nature in the stressed mood state. Results lend only partial support to these views. When the sample was divided into sub-categories by age, gender, rural/urban home environment, proportion of nature around home environment, nature hobbies and nature holidays, the mood state relaxed produced a greater percentage of nature prefer-
ence responses than stressed. Stressed was, however, ranked first or second for preference for green nature in 10 of the 13 sub-groups. The implications of the findings are discussed in the light of restorative theories.

**Change in mood as a function of environmental design: Arousal and pleasure on a simulated forest hike**

Staats H, Gatersleben B, Hartig T
*Journal of Environmental Psychology*
17 (4): 283-300 Dec 1997

Withdrawal of land from agricultural production is creating possibilities for reforestation in several areas of Europe. Reforestation can serve recreational as well as ecological goals. The present study considers the effects of two ecologically significant forest design characteristics, accessibility and vegetation density, on mood, an outcome relevant to recreational planning. It simultaneously addresses the more general question of how changes in mood correspond to movement through an environment. The two forest design variables were manipulated both between and within subjects in a two (high accessibility vs interrupted accessibility) by two (dense vs half-open vegetation) design by four (consecutive forest sections) design. The experimental manipulations combined sets of sequential photographic slides with verbal descriptions regarding aspects of accessibility (i.e. presence vs absence of a path, passability, possibilities for orientation). Subjects (n=98) were randomly sampled residents of Leiden, recruited by telephone and screened for prior hiking experience. All provided seven affective appraisals for two preliminary recreational area sections and then the four experimental forest sections. The affective appraisals could be interpreted in terms of arousal and pleasure dimensions of mood. Arousal and pleasure scores were both affected by the accessibility manipulations in keeping with expectations while the manipulations of vegetation density were somewhat less influential.

**Nature-Based Recreation, Mood Change, And Stress Restoration**

Hull RB, Michael SE
*Leisure Sciences*
17 (1): 1-14 Jan-Mar 1995

People recreating outdoors (at an urban park) and people recreating indoors (in their homes) assessed their moods at the start, middle, and end of their brief (less than 2-hr) leisure experiences. Moods changed slightly but significantly, and some of these changes were consistent with predictions that leisure reduces stress. Contrary to expectations, recreating near nature produced no more restoration than did recreating indoors, away from nature.

**Negative mood and adult place preference**

Korpela KM

**Environment and Behavior**
35 (3): 331-346 May 2003

The association between negative mood and place preferences was studied in an adult sample. The respondents described their experiences of favorite and unpleasant places and their mood in a questionnaire mailed to the residents of three housing areas in the metropolitan area. In comparison with low negative mood scorers, high negative mood scorers were significantly more often alone in their favorite places or only with passers-by. Adults with high negative mood were also more likely to choose natural favorite places than other places. No association between the level of negative mood and type of unpleasant place or reasons for disliking that place was found. Speculatively, people with high levels of negative emotion in comparison with other people may not recognize any different negative environmental features but are more tuned for recognizing the physical environment as an opportunity to improve mood through occasional retreat to favorite settings.

**Small-Scale Urban Nature Parks: Why Should We Care?**

Joshua W. R. Baur; Joanne F. Tynon
*Leisure Sciences*
32(2): 195-200 2010

This study pointed out the importance of small-scale urban nature parks which has been ignored by most of scholars in the field of recreation research. The authors suggested that, firstly, small-scale natural parks located in highly urbanized areas offer convenient and attractive opportunities for residents to gain benefits on their physical and mental well-being. Secondly, those parks can promote social capital and social networks which may lead to a better situation of overall community well-being; Thirdly, there are some specific groups of urban residents who may gain remarkable benefits from easy access to local urban parks, such as low socioeconomic residents. The rational of why many urban residents choose rather local urban parks than remote wilderness settings have been illustrated in the article.

**Can Nature Make Us More Caring? Effects of Immersion in Nature on Intrinsic Aspirations and Generosity**

Netta Weinstein, Andrew K. Przybylski, Richard M. Ryan
*Personality and Social Psychology Bulletin*
35 (10): 1315-1329 August 2009

To examine the effects of nature on valuing intrinsic and extrinsic aspiration, four studies have been conducted. In study 1, participants’ self-report value of intrinsic and extrinsic aspiration were collected before and after they viewed images of nature or cityscapes. Immersion and positive affect have also been assessed. Study 2 has a similar procedure as that of study 1 be-
sides participants also completed the Connectedness to Nature Scale (CNS) and Autonomy subscale of Basic Psychological Needs scales following the intervention. Study 3 shared a similar procedure with study 1 and 2 but participants in this study need completed the decision task as the final step. In study 4, participants completed an online questionnaire the night before coming to the lab. Then they were randomly assigned to nature condition with presence of plants and non-nature condition with absence of plants. After completed a number of filler surveys and assessment of positive affect upon entering the lab, they were asked to take a 5-min’s relaxation period. After which, they completed evaluation of intrinsic and extrinsic aspirations, immersion, nature connectedness, and personal autonomy. The results of all four studies showed that participants in nature condition valued intrinsic aspirations more and extrinsic aspirations less than they had before their exposure to nature images or plants in lab after controlling for biased responding and positive affect. On the other hand, participants in non-nature condition valued extrinsic aspirations more and intrinsic aspirations less. Higher immersion in nature indicated higher nature relatedness and autonomy but higher immersion in non-nature predicted lower nature relatedness and autonomy. Generally, the results suggested contact with nature has positive effect on promoting intrinsic aspirations, enhancing sense of autonomy, nature relatedness, and generosity.

Vitalizing effects of being outdoors and in nature

Richard M. Ryan, Netta Weinstein, Jessey Bernstein, Kirk Warren Brown, Louis Mistretta, Marylène Gagne

Journal of Environmental Psychology

30 (2): 159-168. 2010

By employing multiple methods including survey, experiment, and diary, the authors conducted five studies to examine the vitalizing effects of being outdoors and contact with nature in actual and imagined context. In study 1, vignette measures were used to evaluate the influence of being outdoor on participants perceived vitality. The results showed people reported higher levels of vitality when outside comparing to baseline vitality. Three contextual variables including setting, social, and activity had main impacts on situational vitality. In study 2, participants were randomly either to an indoor or outdoor condition to examine the vitalizing effect of actually being outdoor environment versus being indoor environment. Participants completed assessment of Subjective Vitality before and after 15 min-walking in a building or a outdoor footpath within a natural outdoor setting. The results showed walking in nature had a statistically significant (p< .01) effect on promoting vitality whereas perceived change of vitality had a negative trend (p> .25) for the indoor-group of participants. In study 3, participants were randomly assigned to view a set of images of natural outdoor setting or those of constructed or built environments. The result showed nature images promoted Subjective Vitality (p< .05) but artificial images decreased Subjective Vitality (p < .05). In study 4 and 5, the authors used a diary method to examine the effect of outdoor activities and presence of nature while they were in outdoor environment. Day-end results indicated that participants who spent at least 20 min outdoors had gained a higher subjective vitality. Moreover, the presence of nature had an independent effect on energize participants. Collectively, these five studies indicate that being outdoors and contact with nature have positive effect on subjective vitality.

Nature, Biophilia, & Health

Dementia wander garden aids post cerebrovascular stroke restorative therapy: A case study

Detweiler MB, Warf C

Alternative Therapies in Health and Medicine

11 (4): 54-58 Jul-Aug 2005

An increasing amount of literature suggests the positive effects of nature in healthcare. The extended life expectancy in the US and the consequent need for long-term care indicates a future need for restorative therapy innovations to reduce the expense associated with long-term care. Moving carefully selected stroke patients’ sessions to the peaceful setting of a dementia wander garden, with its designed paths and natural stimuli, may be beneficial. Natural settings have been shown to improve attention and reduce stress-both important therapy objectives in many post-stroke rehabilitation programs. In this case study, using the dementia wander garden for restorative therapy of a non-dementia patient was a novel idea for the restorative therapy group, which does not have a horticultural therapy program. The dementia wander garden stage of the post-stroke rehabilitation helped the patient through a period of treatment resistance. The garden provided both an introduction to the patient’s goal of outdoor rehabilitation and a less threatening environment than the long-term care facility hallways. In part because the patient was less self-conscious about manifesting his post-stroke neurological deficits, falling, and being viewed as handicapped when in the dementia wander garden setting, he was able to resume his treatment plan and finish his restorative therapy. In many physical and mental rehabilitation plans, finding a treatment modality that will motivate an individual to participate is a principal goal. Use of a dementia wander garden may help some patients achieve this goal in post-stroke restorative therapy.

The mental and physical health outcomes of green exercise

Pretty J, Peacock J, Sellens M, Griffin M

International Journal of Environmental Health Research

15 (5): 319-337 OCT 2005

Both physical activity and exposure to nature are known separately to have positive effects on physical and mental health. We have investigated whether there
is a synergistic benefit in adopting physical activities whilst being directly exposed to nature (‘green exercise’). Five groups of 20 subjects were exposed to a sequence of 30 scenes projected on a wall whilst exercising on a treadmill. Four categories of scenes were tested: rural pleasant, rural unpleasant, urban pleasant and urban unpleasant. The control was running without exposure to images. Blood pressure and two psychological measures (self-esteem and mood) were measured before and after the intervention. There was a clear effect of both exercise and different scenes on blood pressure, self-esteem and mood. Exercise alone significantly reduced blood pressure, increased self-esteem, and had a positive significant effect on 4 of 6 mood measures. Both rural and urban pleasant scenes produced a significantly greater positive effect on self-esteem than the exercise-only control. This shows the synergistic effect of green exercise in both rural and urban environments. By contrast, both rural and urban unpleasant scenes reduced the positive effects of exercise on self-esteem. The rural unpleasant scenes had the most dramatic effect, depressing the beneficial effects of exercise on three different measures of mood. It appears that threats to the countryside depicted in rural unpleasant scenes have a greater negative effect on mood than already urban unpleasant scenes. We conclude that green exercise has important public and environmental health consequences.

Healthy nature healthy people: ‘contact with nature’ as an upstream health promotion intervention for populations

Maller C, Townsend M, Pryor A, Brown P, St Leger L
Health Promotion International
21 (1): 45-54 Mar 2006

Whilst urban-dwelling individuals who seek out parks and gardens appear to intuitively understand the personal health and well-being benefits arising from ‘contact with nature’, public health strategies are yet to maximize the untapped resource nature provides, including the benefits of nature contact as an upstream health promotion intervention for populations. This paper presents a summary of empirical, theoretical and anecdotal evidence drawn from a literature review of the human health benefits of contact with nature. Initial findings indicate that nature plays a vital role in human health and well-being, and that parks and nature reserves play a significant role by providing access to nature for individuals. Implications suggest contact with nature may provide an effective population-wide strategy in prevention of mental ill health, with potential application for sub-populations, communities and individuals at higher risk of ill health. Recommendations include further investigation of ‘contact with nature’ in population health, and examination of the benefits of nature-based interventions. To maximize use of ‘contact with nature’ in the health promotion of populations, collaborative strategies between researchers and primary health, social services, urban planning and environmental management sectors are required. This approach offers not only an augmentation of existing health promotion and prevention activities, but provides the basis for a socio-ecological approach to public health that incorporates environmental sustainability.

Green space, urbanity, and health: how strong is the relation?

Maas J, Verheij RA, Groenewegen PP, de Vries S, Spreeuwenberg P
Journal of Epidemiology and Community Health
60 (7): 587-592 Jul 2006

Study objectives: To investigate the strength of the relation between the amount of green space in people’s living environment and their perceived general health. This relation is analysed for different age and socioeconomic groups. Furthermore, it is analysed separately for urban and more rural areas, because the strength of the relation was expected to vary with urbanity.

Design: The study includes 250 782 people registered with 104 general practices who filled in a self administered form on sociodemographic background and perceived general health. The percentage of green space (urban green space, agricultural space, natural green space) within a one kilometre and three kilometre radius around the postal code coordinates was calculated for each household.

Methods: Multilevel logistic regression analyses were performed at three levels - that is, individual level, family level, and practice level - controlled for sociodemographic characteristics.

Main results: The percentage of green space inside a one kilometre and a three kilometre radius had a significant relation to perceived general health. The overall relation was generally present at all degrees of urbanity. The relation was somewhat stronger for lower socioeconomic groups. Elderly, youth, and secondary educated people in large cities seem to benefit more from presence of green areas in their living environment than other groups in large cities.

Conclusions: This research shows that the percentage of green space in people’s living environment has a positive association with the perceived general health of residents. Green space seems to be more than just a luxury and consequently the development of green space should be allocated a more central position in spatial planning policy.

Vitamin G: effects of green space on health, well-being, and social safety

Groenewegen PP, den Berg AE, de Vries S, Verheij RA
BMC Public Health
6: Art. No. 149 Jun 7 2006

Background: Looking out on and being in the green elements of the landscape around us seem to affect
health, well-being and feelings of social safety. This article discusses the design of a research program on the effects of green space in the living environment on health, well-being and social safety.

Methods/design: The program consists of three projects at three different scales: at a macro scale using data on the Netherlands as a whole, at an intermediate scale looking into the specific effect of green space in the urban environment, and at micro scale investigating the effects of allotment gardens. The projects are observational studies, combining existing data on land use and health interview survey data, and collecting new data through questionnaires and interviews. Multilevel analysis and GIS techniques will be used to analyze the data.

Discussion: Previous (experimental) research in environmental psychology has shown that a natural environment has a positive effect on well-being through restoration of stress and attentional fatigue. Descriptive epidemiological research has shown a positive relationship between the amount of green space in the living environment and physical and mental health and longevity.

The program has three aims. First, to document the relationship between the amount and type of green space in people’s living environment and their health, well-being, and feelings of safety. Second, to investigate the mechanisms behind this relationship. Mechanisms relate to exposure (leading to stress reduction and attention restoration), healthy behavior and social integration, and selection. Third, to translate the results into policy on the crossroads of spatial planning, public health, and safety. Strong points of our program are: we study several interrelated dependent variables, in different ordinary settings (as opposed to experimental or extreme settings), focusing on different target groups, using appropriate multilevel methods.

Increasing walking - How important is distance to, attractiveness, and size of public open space?
American Journal of Preventive Medicine
28 (2): 169-176 Suppl. 2, Feb 2005

Background: NATell-designed public open space (POS) that encourages physical activity is a community asset that could potentially contribute to the health of local residents.

Methods: In 1995-1996, two studies were conducted: an environmental audit of POS over 2 acres (n =516) within a 408-km² area of metropolitan Perth, Western Australia; and personal interviews with 1803 adults (aged 18 to 59 years) (52.9% response rate). The association between access to POS and physical activity was examined using three accessibility models that progressively adjusted for distance to POS, and its attractiveness and size. In 2002, an observational study examined the influence of attractiveness on the use of POS by observing users of three pairs of high- and low-quality (based on attractiveness) POS matched for size and location.

Results: Overall, 28.8% of respondents reported using POS for physical activity. The likelihood of using POS increased with increasing levels of access, but the effect was greater in the model that adjusted for distance, attractiveness, and size. After adjustment, those with very good access to large, attractive POS were 50% more likely to achieve high levels of walking (odds ratio, 1.50; 95% confidence level, 1.06-2.13). The observational study showed that after matching POS for size and location, 70% of POS users observed visited attractive POS.

Conclusions: Access to attractive, large POS is associated with higher levels of walking. To increase walking, thoughtful design (and redesign) of POS is required that creates large, attractive POS with facilities that encourage active use by multiple users (e.g., walkers, sports participants, picnickers).

Can the physical environment determine physical activity levels.?
Ewing R
Exercise and Sport Sciences Reviews
33 (2): 69-75 Apr 2005

Does your place of residence affect your level of physical activity and ultimately your weight and health? There is relatively strong evidence of association between compact development patterns and use of active travel modes such as walking and transit. There is weaker evidence of linkage between compact development, overall physical activity, and downstream weight and health effects.

The significance of parks to physical activity and public health - A conceptual model
Bedimo-Rung AL, Mowen AJ, Cohen DA
American Journal of Preventive Medicine
28 (2): 159-168 Suppl. 2, Feb 2005

Park-based physical activity is a promising means to satisfy current physical activity requirements. However, there is little research concerning what park environmental and policy characteristics might enhance physical activity levels. This study proposes a conceptual model to guide thinking and suggest hypotheses. This framework describes the relationships between park benefits, park use, and physical activity, and the antecedents/correlates of park use. In this classification scheme, the discussion focuses on park environmental characteristics that could be related to physical activity, including park features, condition, access, aesthetics, safety, and policies. Data for these categories should be collected within specific geographic areas in or around the park, including activity areas, supporting areas, the
overall park, and the surrounding neighborhood. Future research should focus on how to operationalize specific measures and methodologies for collecting data, as well as measuring associations between individual physical activity levels and specific park characteristics. Collaboration among many disciplines is needed.

Post-occupancy evaluation of healing gardens in a pediatric cancer center
Sherman SA, Varni JW, Ulrich RS, Malcarne VL
Landscape and Urban Planning

This study evaluates three healing gardens surrounding a pediatric cancer center. All gardens contained seating, flowers and plants, but varied in size, features, and in user groups’ access to them. A post-occupancy evaluation (POE) yielded a dataset of 1400 garden-users for whom demographic information, activities, and length-of-stay were recorded. Results indicate differential usage patterns across gardens, user category (patient, visitor, or staff), and age (adults and children). The largest garden with most direct patient access was the most used. Staff mostly used the gardens to walk-through or to sit and eat, rarely interacting with features intended for active engagement. Despite patient and child-friendly designs, the overwhelming majority of visitors were adults who mostly engaged in sedentary activities. Children who did use the gardens interacted with garden features significantly more than adults. Although patient rooms are situated at ground-level around the gardens to promote window views of the gardens, the findings suggest an inverse relationship between patient window use and the number of people in the gardens. Finally, preliminary data suggest that emotional distress and pain are lower for all groups when in the gardens than when inside the hospital. Provisional design implications of these findings are discussed.

Topophilia and the quality of life
Ogunseitan OA
Environmental Health Perspectives
113 (2): 143-148 Feb 2005

With this research I tested the hypothesis that individual preferences for specific ecosystem components and restorative environments are significantly associated with quality of life (QOL). A total of 379 human subjects responded to a structured 18-item questionnaire on topophilia and to the 26-item World Health Organization’s Quality of Life (WHOQOL-Bref) instrument. Confirmatory factor analyses revealed four domains of topophilia (ecodiversity, synesthetic tendency, cognitive challenge, and familiarity) and four domains of QOL (physical, psychological, social, and environmental). Synesthetic tendency was the strongest domain of topophilia, whereas the psychological aspect of QOL was the strongest. Structural equation modeling was used to explore the adequacy of a theoretical model linking topophilia and QOL. The model fit the data extremely well: chi(2) = 5.02, p = 0.414; correlation = 0.12 (p = 0.047). All four domains of topophilia were significantly correlated with the level of restoration experienced by respondents at their current domicile for cognitive challenge: r = 0.19; p < 0.01; familiarity: r = 0.12; p < 0.05; synesthetic tendency: r = 0.18; p < 0.01; ecdodiversity (the highest value): r = 0.28; p < 0.01.

Beyond toxicity - Human health and the natural environment
Frumkin H
American Journal Of Preventive Medicine
20 (3): 234-240 Apr 2001

Research and teaching in environmental health have centered on the hazardous effects of various environmental exposures, such as toxic chemicals, radiation, and biological and physical agents. However, some kinds of environmental exposures may have positive health effects. According to E.O. Wilson’s “biophilia” hypothesis, humans are innately attracted to other living organisms. Later authors have expanded this concept to suggest that humans have an innate bond with nature more generally. This implies that certain kinds of contact with the natural world may benefit health. Evidence supporting this hypothesis is presented from four aspects of the natural world: animals, plants, landscapes, and wilderness. Finally, the implications of this hypothesis for a broader agenda for environmental health, encompassing not only toxic outcomes but also salutary ones, are discussed. This agenda implies research on a range of potentially healthful environmental exposures, collaboration among professionals in a range of disciplines from public health to landscape architecture to city planning; and interventions based on research outcomes.

The relationship of urban design to human health and condition
Jackson LE
Landscape and Urban Planning
64 (4): 191-200 Aug 15 2003

The population of the United States of America is currently experiencing increased illness from dispersed and synergistic causes. Many of the acute insults of the past have receded due to centralized health care and regulatory action. However, chronic ailments including
asthma and allergies, animal-transmitted diseases, obesity, diabetes, heart disease, and depression are on the rise. These diverse illnesses join with forest fragmentation, stream degradation, wetlands destruction, and the concomitant loss of native species to suggest detrimental contributions from the built environment.

This paper surveys the state of the science on the impacts of urban design on human health and well-being. Drawing primarily on recent peer-reviewed literature in a broad array of health, planning, and environmental fields, it outlines the influence of design at three spatial scales on aspects of physical and mental health, and social and cultural vibrancy. Selected ecological effects are also discussed to illustrate shared associations with urbanization. While causal chains are generally complex and not always completely understood, sufficient evidence exists to reveal urban design as a powerful tool for improving human condition.

Solutions are discussed at the personal and professional level, emphasizing cross-disciplinary collaboration in urban planning and design, and the participation of residents in shaping their living environment. At the parcel scale, greenery and access to it visually and physically are the principal keys to health. These elements must be incorporated into relatively high-density neighborhood designs that include public buildings, open space, mixed land use, and pedestrian walkways to increase physical exercise and enhance civic life. Finally, neighborhoods must be embedded in existing urban infrastructure to provide larger cultural and business opportunities and reduce reliance on the automobile. Further research is recommended to strengthen the associations between design and health. Increased communication on this subject is also necessary between design and health practitioners and their clients and colleagues.

**Greening healthcare: Practicing as if the natural environment really mattered**


The natural world’s role in human well-being is an essential, yet often forgotten, aspect of healthcare. Of particular importance are the benefits one can derive through interaction with natural environments. While health is an obvious goal of allopathic medicine, many healthcare settings are neither nurturing nor healing. Reincorporating the natural world into the design of settings in which medicine is practiced is one way to complement conventional healing modalities and move healthcare toward teeing more green.” This article discusses the breadth of existing knowledge available on the positive aspects of interaction with nature and provides a comprehensive theoretical perspective for future research.

**Natural environments — healthy environments? An exploratory analysis of the relationship between greenspace and health**


Are people living in greener areas healthier than people living in less green areas? This hypothesis was empirically tested by combining Dutch data on the self-reported health of over 10,000 people with land-use data on the amount of greenspace in their living environment. In the multilevel analysis we controlled for socioeconomic and demographic characteristics, as well as urbanity. Living in a green environment was positively related to all three available health indicators, even stronger than urbanity at the municipal level. Analyses on subgroups showed that the relationship between greenspace and one of the health indicators was somewhat stronger for housewives and the elderly, two groups that are assumed to be more dependent on, and therefore exposed to, the local environment. Furthermore, for all three health indicators the relationship with greenspace was somewhat stronger for lower educated people. Implications for policymaking and spatial planning are discussed briefly.

**Physical environmental stimuli that turn healthcare facilities into healing environments through psychologically mediated effects: systematic review**


This paper reports a systematic review to determine the effects of physical environmental stimuli in healthcare settings on the health and well-being of patients.

Background. The concept of healing environments suggests that the physical environment of the healthcare setting can encourage the healing process and patients’ feelings of well-being. Understanding the effects of physical environmental stimuli will allow us to design healthcare environments that generate these potential health benefits.

Method. A search was conducted using the MedLine, PsychInfo, Embase, CINAHL, Iconda, ScienceDirect, Compendex and the ISI Citation Indexes databases. Studies were included if they concerned interventions involving health effects of environmental stimuli in healthcare settings on patients, and were based on controlled clinical trials published in peer-reviewed journals. Both clinical and psychological outcome measures were included. The search was completed in 2005.

Findings. Of the over 500 potentially relevant studies identified, only 30 met all criteria and were included in this review. Predominantly positive effects were found.
for sunlight, windows, odour and seating arrangements. Inconsistent effects were found for sound, nature, spatial layout, television and multiple stimuli interventions. In general, both the size and direction of effects seem highly dependent on characteristics of patient populations and healthcare settings.

Conclusions. Studies that manipulate several environmental stimuli simultaneously clearly support the general notion that the physical healthcare environment affects the well-being of patients. However, when scrutinizing the effects of specific environmental stimuli, conclusive evidence is still very limited and difficult to generalize. The field thus appears to be in urgent need of well-conducted, controlled clinical trials. At present, and on the basis of the available research, it would be premature to formulate evidence-based guidelines for designing healthcare environments.

Land use planning and health and well-being
Hugh Barton
Land Use Policy
265: S115-123 2009

In this paper, the author discussed the relations between the planning of settlements and health. From the analysis of the history of modern planning, the author pointed out that contemporary urban planning has mostly lost the vision of creating humane living conditions for citizens as modern planner had in 19th century cities. Based on the settlement health map, the author discussed a series of topics to illustrate how the land use influence human health from a variety of ways: lifestyles choices in relation to physical activities, active travel, and diet, mental well-being and community; the local economy and income, health inequalities and strategic land use transport planning, pollution and urban form, and impacts on global ecology.

In addition, the author pointed out that cardio-vascular disease and chronic depression are associated with particular social and environmental conditions. Disenfranchises households are more vulnerable to many health problems because social inequality often caused health inequalities. Unfortunately, the connection between health and land use planning has in practice been ignored until recently. He also pointed the planning of “green infrastructure” in urban area is vital to create healthy human settlements.

The author pointed out the importance to create a coherent, shared philosophy to address the complexity of the relationship between land use and health. The action can be put on agenda since significant progress has been achieved in the related research areas. In the future, however, shift of political priorities is crucial to make inaction effective. At the end of this paper, the author pointed out a few promising research areas: integrated settlement theory, normative planning strategies, health well-being and spatial planning, population, social mix and health inequalities, lifestyle, and community networks, mental well-being.

Rural and urban park visits and park-based physical activity
Kendal A. Shores, Stephanie T. West
Preventive Medicine
50(1): S13-S17 2010

To investigate how people use rural and urban park, this study used System for Observing Play and Recreation in Communities (SOPARPC) at four rural and four urban parks. There were more than 6500 park visits recorded over 28 summer hours. Trained observers observed each park for four hours on each of seven days of the week. Observers recorded visitors’ gender, age, target area, the park site, primary activity, and physical activity intensity besides number of presence of visitors. The results showed there were similarity and difference between use of urban and rural park. In terms of similarity, trail-based park was the most popular type of park both in all urban parks (62.5% of all presence) and rural area (66.2% of all presence). Moreover, there was no linear association was found between participation level and size of the park or the number of amenities in the parks in this study. In terms of difference, rural parks were mainly used at Friday and weekend whereas urban parks visits distributed more evenly during seven days of a week. Only 2.7% of visitors used the rural park in morning whereas 29.4% of visitors used the urban park in morning. 53.5% of visitors’ presence in urban parks was that of children whereas adult was the major users of the urban park (42.3%). Compare to urban parks, users in rural parks had a trend of having more sedentary activities (urban: 22.7%, rural: 50.5%) and less vigorous activities (urban: 72.2%, rural: 42.8%). As an conclusion, although similarities were found between usage of rural and urban parks, differences between them were significant and need researchers pay more attention to the physical activity studies in the rural areas.

Psychological benefits of exercise paired with virtual reality: Outdoor Exercise energizes whereas indoor virtual exercise relaxes
Thomas G. Plante, Cara Cage, Sara Clements, and Allison Stover

In the present study, 112 undergraduate students (47 males and 65 females) were randomly assigned to one of three 20-min experimental conditions. The first condition was to take a brisk outdoor walk in a campus; the second condition was to walk on a treadmill integrated with watching the virtual reality video presentation of the same campus walk in a laboratory room; the third condition was to watch the virtual reality video without any exercise in a laboratory room. The baseline and post-experiment data were collected to evaluate subjects’ enjoyment, social desirability, energy, tension, calmness, and tiredness under each of three conditions.

The results show greater perceived energy for participants who had the walking outside than those who
viewed the virtual reality walk without actual physical exercise. This difference was more significant for female than males participants. Participants walking in the laboratory with the virtual natural scenes were more relaxed and had least level of perceived tension. There was no significant difference between the group of walking outside and the group of viewing virtual nature without having physical exercise in terms of tension and calmness.

The desirability of views of city skylines after dark
Jack L. Nasar, Kathryn Terzano
Journal of Environmental Psychology
30 (2010) 215-225

To examine people’s perception and preference of natural scenes, skylines after dark, and skylines during the day, this study used digital color photographs and conducted three studies. 59 participants involved in study 1 and they rated their subjective pleasantness of each scene. The result showed that participants had similar rating to Night Skylines and Natural Scenes, which is higher than the Day Skylines. In Study 2, 56 other participants choose from each of seven sets of each kind of scene the one they would like most to make it into a framed picture for their home or office and they also reported the reason. Most of participants prefer Night Skyline, followed by Natural Scenes and then Day Skylines. The attractive was the most frequently reason for preference, and people also stated exciting was the reason why they picked Night Skyline. In addition, Relaxing and Peaceful was the main reason why people chose Natural scenes. In study 3, 22 participants finish the survey including rating of 21 stimuli, which had been used in study 1 and 2, on nine 7-point bi-polar scales: smoothness of transitions, curvilinearity, regularity of surface texture/lines, smoothness of surface texture, complexity, Naturalness, order or coherence, openness, and upkeep. Natural scenes were rated by 23 participants as more natural, orderly, open, and curvilinear, less complex and as having smoother transitions than either Day or Night Skylines. There was few difference between two kinds of skylines but small and medium effects in complexity and in order.