

RESEARCH ON THE BENEFICIAL ASPECTS OF THE EXPERIENCE OF NATURE IN CITIES

A LITERATURE REVIEW

TKF FOUNDATION

OPEN SPACES SACRED PLACES
NATIONAL AWARDS INITIATIVE

PREPARED BY:
KATHLEEN WOLF, PH.D.
KATRINA FLORA
ELIZABETH HOUSLEY

FEBRUARY 27, 2012

1. RESEARCH & THE OPEN SPACES SACRED PLACES NATIONAL AWARD INITIATIVE

The TKF Foundation is launching the Open Spaces Sacred Places (OSSP) National Awards Initiative in early 2012. The award program will fund the design and creation of significant new OSSPs, to include high quality research, then outreach communications about the beneficial impacts on users of a specific type of urban nature setting.

Grants will be awarded from a funding pool totaling \$5 million. Funding will be provided to cross-disciplinary teams that conceptualize, plan, design, and implement a physical space, conduct associated research study(s), and disseminate findings. Twelve planning grants were awarded in 2011 to initiate the first phase of the national award program. The RFP for full awards outlines specific information about the grants program, funding levels, and the application process.

2. RESEARCH PURPOSE & EXPECTATIONS

For the past 16 years the TKF Foundation has funded the creation of more than 130 Open Spaces Sacred Places. Observations of users of these previously built OSSP sites suggest that time spent in sacred places in nature can be transformational, providing remarkable experiences of renewal and restoration. A bench and journal are installed at every OSSP site. Thousands of people have described in journal entries how OSSP spaces have made a positive, sometimes powerful, difference in their lives.

One major purpose of the OSSP Initiative is to incorporate place-based research in order to

explore and verify the experiences and impacts of OSSPs on individuals and their lives. Nearly 40 years of research in the social sciences and public health indicates how important it is for people to have access to experiences of nearby nature in cities.

Recent books and web resources provide helpful summaries:

- *The Nature Principle* by Richard Louv
- *Healing Spaces: The Science of Place and Well-Being* by Esther Sternberg
- Green Cities/Good Health at the University of Washington:
www.greenhealth.washington.edu
- Landscape and Human Health Laboratory at the University of Illinois at Urbana-Champaign:
<http://lhhl.illinois.edu/>

Yet the merits of nature encounters are often overlooked in urban planning and community design. New studies and research will express the full value of OSSPs, providing compelling evidence and science-based recommendations for policy and decision-makers who influence urban places.

The overarching goal for the research activity within the OSSP Awards is to engage a community of scientists to generate more complete knowledge about the benefits and impacts that result from user experiences of nature-based sacred spaces in cities. It is expected that the proposed science will be rigorously designed and implemented, leading to peer-reviewed publication. While investigators may focus on a single project site it is expected that the sum of studies across the initiative will serve as an insightful, conceptually

based body of knowledge that will serve to focus attention and effort on the creation of OSSPs in many cities.

3. POTENTIAL RESEARCH THEMES

The TKF Foundation anticipates that project teams that are supported by the OSSP Initiative Awards will build on current knowledge to help create new insights and theories regarding the importance of green space in urban lives. Studies will be place-based, with research questions and methods to be developed by scientists in coordination with other members of their cross-disciplinary site design and construction teams.

Research questions and methodological approaches should be informed by prior research findings in the social science and public health disciplines, and should seek new advances in concepts or theory of human health, personal or community resilience, and well-being.

The TKF Foundation provides some resources to aid in developing research questions and approaches. At the outset of the grant program a select group of Firesouls and TKF staff were interviewed to assess their interpretations of the value and meaning of existing sacred spaces, as reported in *User Experiences of Open Spaces Sacred Places: Insights from Firesouls Focus Groups*.

This report speaks more directly to the expected research approach for the National Awards projects. It lists (later in the report) a collection of social and health sciences references and relevant journal publications.

The TKF Foundation is highly interested in research proposals that acknowledge the rich foundation of research questions and methods as described in the published articles, then seek to further expand the knowledge base with innovative, transformative science.

The articles in the collection generally align with the following themes (Figure 1):

- **OSSP Experience:** articulate and measure a user's significant or meaningful experience(s) while directly in an OSSP,
- **Individual Consequence:** explore the extended consequences concerning the mental and/or physical state of the user after a site visit or in between site visits,
- **Life Context:** consider how a person or group functions across different contexts, such as home, school, or work, based on OSSP experience(s), and
- **Economic Value:** assess the economic implications of any of the prior themes.

Proposed research may address any combination of these themes (or other innovative concepts) but should be framed in a way that would be of interest to urban policy or decision-makers.

4. LITERATURE REVIEW

The table that follows is a collection of articles that should provide ideas for research concepts, methods, and results reporting in peer-reviewed journals. The collection is certainly not exhaustive but does provide examples of the diversity of theory, conceptual foundations, and methodology that has been applied to

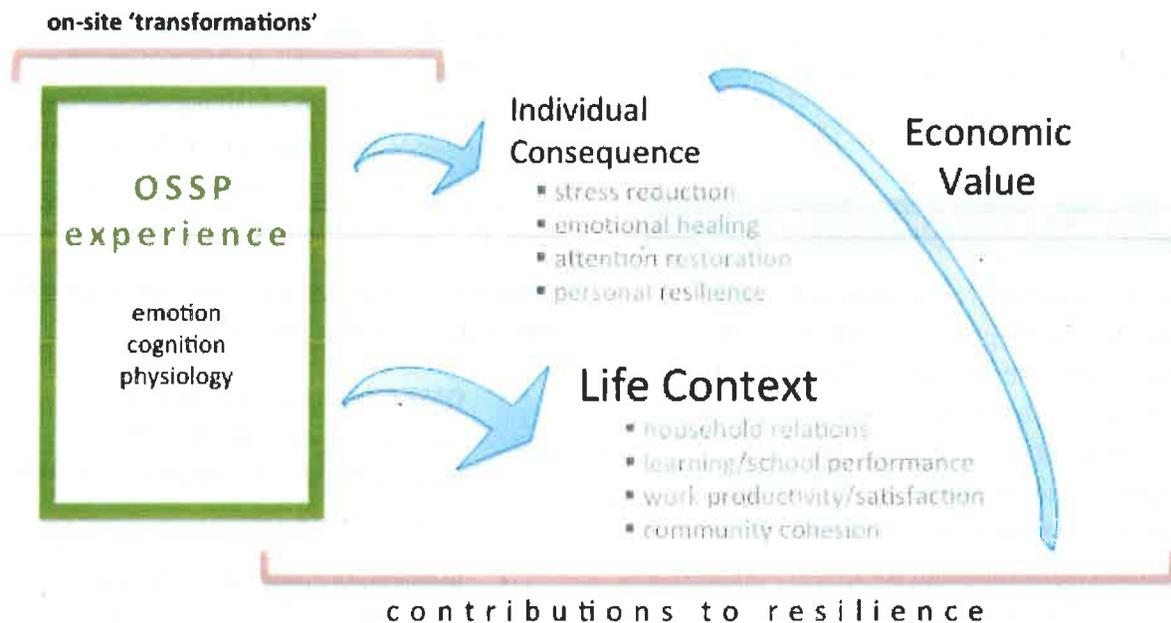


Figure 1: research opportunities by theme

investigations of human response to urban nature. The articles may not depict conditions or populations that exactly resemble OSSP sites and users. Nonetheless, the science reports exhibit a diverse array of cognitive, emotive, and physiological responses that may be similar to outcomes experienced by OSSP users.

A recurring message within the collected literature, sometimes explicitly stated and sometimes not, is the concept of resilience. From a psychological perspective, resilience is a person's (or a community's) ability to withstand or recover quickly from challenges or difficult conditions. OSSP teams should consider the concept of resilience in their research planning and implementation.

The article collection can serve as a resource for OSSP teams as they prepare integrated design and research proposals. The sample articles are

sorted by themes, explained in more detail in the next subsections. Following these four introductions is the table of articles, and the report ends with a complete listing of article abstracts.

OSSP EXPERIENCE

The foundation or basis of research will be user experiences of OSSPs that have been designed to meet specific needs or situations. Each OSSP contains a bench and journal. Across thousands of journal entries are reports of transformational experiences while in OSSPs. Past research indicates that experiences of nearby nature in cities can prompt fairly rapid responses, sometimes noted by a person but often below consciousness. An initial level or theme of research would be to investigate the direct effects of real time experiences of OSSPs.

INDIVIDUAL CONSEQUENCE

Immediate response to a nature site may have lingering effects after a person leaves, or may carry over between site visits. There can be secondary effects or responses of individuals or groups, and may include physical, emotional, and mental well-being of the user due to their site-based experience.

These studies report the durable changes or impacts on a person or small social groups due to nature-based experiences or visits. Some of the reported effects pertain to a general sense of mental or emotional health. Others address how nature experiences may serve as therapy for various diagnosed conditions.

LIFE CONTEXT

Residual effects of nature experience may have more extensive secondary influences in a

person's life. Urban lifestyles are complex, and people are called on to function in a variety of contexts. These studies propose research questions to include lasting impacts in the workplace, home, school, and community.

ECONOMIC VALUE

There has been little effort to translate the known benefits of the human experience of nature to economic terms. Many studies have assessed the role of landscape or the presence of trees, and improved property values (known as hedonic valuation). A few have explored reduced health care costs that are a consequence of more active lifestyles and increased physical activity. Expanded valuation approaches could better demonstrate the economic implications of providing adequate green spaces for people in urban settings.

5. TABLE OF SELECTED ARTICLES ABOUT NATURE RESPONSE

**OSSP EXPERIENCE
INDIVIDUAL CONSEQUENCE**

Research Construct or Question	Measure for Outcome	Finding or Results¹	Citation
1. Can auditory stimulation facilitate physiological stress recovery?	skin conductance level (sympathetic activation) and heart rate variability (parasympathetic activation)	There was no heart rate effect, and skin conductance recovery was faster with natural sounds.	Alvarsson, J.J., S. Wiens, and M.E. Nilsson. 2010. Stress Recovery During Exposure to Nature Sound and Environmental Noise. <i>International Journal of Environmental Research and Public Health</i> 7, 3: 1036-046.
2. Can nature experiences improve cognitive functioning (per attention restoration theory or ART)?	Positive and Negative Affect Schedule, backwards digit-span task and the Attention Network Task	Cognitive functioning performance improved when participants walked in nature.	Berman, M.G., J. Jonides, and S. Kaplan. 2008. The Cognitive Benefits of Interacting with Nature. <i>Psychological Science</i> 19, 12: 1207-1212.
3. Can horticulture therapy (HT) aid those with dementia?	observation using behavior and affect codes at timed intervals, comparing HT and traditional activities.	H.T. participants were more actively engaged, showed less non-engagement behavior and more positive affect in HT.	Gigliotti, C.M., and S.E. Jarrott. 2005. Effects of Horticulture Therapy on Engagement and Affect. <i>Canadian Journal on Aging</i> 24, 4: 367-377.
4. What effect does horticulture therapy have on depression severity, considering attentional capacity?	Beck Depression Inventory, Attentional Function Index, Brooding Scale, and Being Away and Fascination subscales from the Perceived Restorativeness Scale	Being away and fascination appear to work as active components in a therapeutic horticulture intervention for clinical depression.	Gonzalez, M.T., T. Hartig, et al. 2010. Therapeutic Horticulture in Clinical Depression: A Prospective Study of Active Components. <i>Journal of Advanced Nursing</i> 66, 9: 2002-2013.
5. Why might natural environments better serve physiological, emotional, and attentional restoration than urban surroundings?	Measures for blood pressure, Zuckerman's Inventory of Personal Reactions (ZIPERS), Overall Happiness Scale (OHS), Necker Cube Pattern Control task (NCPCT), Search and Memory Test	Participants had decrease in BP, higher levels of happiness and positive affect, lower levels of anger and faster attention in natural environments as compared to urban.	Hartig, T., G.W. Evans, L.D. Jammer, D.S. Davis, and T. Gärling. 2003. Tracking Restoration in Natural and Urban Field Settings. <i>Journal of Environmental Psychology</i> 23: 109-123.

¹ All reported results are statistically significant at p<0.05

Research Construct or Question	Measure for Outcome	Finding or Results ¹	Citation
6. What are restorative effects of relaxation in a natural environment vs. an indoor, natural simulation?	Hospital Anxiety Depression Scale, Stress-VAS scale, Syllogism tests, emotional state test, stress and energy scale, APZ-questionnaire, measures for altered states of consciousness, physiological measures	Both environments facilitated stress reduction, with the natural environment also increasing energy and altered states of consciousness, and possibly promoting restoration.	Kjellgren, A., and H. Buhrkall. 2010. A Comparison of the Restorative Effect of a Natural Environment with a Simulated Natural Environment. <i>Journal of Environmental Psychology</i> 30, 4: 464-472.
7. What effect does a day trip to a forest park have on the human immune system?	Profile of Mood States; blood samples: white blood cells counts, NK activity, proportion of NK and T cells, and perforin; cortisol and adrenaline concentration in urine	The day trip to the forest park increased the NK activity, number of NK cells, and levels of intracellular anti-cancer proteins, and effects lasted for at least 7 days post trip.	Li, Q., M. Kobayashi, et al. 2010. A Day Trip to a Forest Park Increases Human Natural Killer Activity and the Expression of Anti-Cancer Proteins in Male Subjects. <i>Journal of Biological Regulators and Homeostatic Agents</i> 24, 2: 157-166.
8. Can garden walking serve as a treatment for depression and sadness?	Geriatric Depression Scale, walking guide and reflective journal, interview process using hermeneutic phenomenology	Garden walking and reflective journaling decreased depression scores in older adults, with four themes reported.	McCaffrey, R., C. Hanson, and W. McCaffrey. 2010. Garden Walking for Depression: A Research Report. <i>Holistic Nursing Practice</i> 24, 5: 252-259.
9. How does the design of exterior space affect dementia patients?	comparison of incident reports for extended time in facilities with variable exterior environments, PAMIE test	The use of exterior environments (gardens) reduced incidents of aggressive behavior and improved risk management.	Mooney, P., and P.L. Nicell. 1992. The Importance of Exterior Environment for Alzheimer Residents: Effective Care and Risk Management. <i>Healthcare Management Forum</i> 5, 2: 23-29.
10. What are the emotional and stress response effects of shinrin-yoku (forest activity)?	Multiple Mood Scale-Short Form, State-Trait Anxiety Inventory A-State Scale	Forest environments are advantageous with respect to acute emotions, especially among those experiencing chronic stress.	Morita, E., S. Fukuda, et al. 2007. Psychological Effects of Forest Environments on Healthy Adults: Shinrin-Yoku (Forest-Air Bathing, Walking) As a Possible Method of Stress Reduction. <i>Public Health</i> 121, 1: 54-63.

Research Construct or Question	Measure for Outcome	Finding or Results¹	Citation
11. What are the specific components of small urban parks that support restoration?	assigned values for physical components of parks, psychological variables (being away, fascination, etc.), preference ratings	The variables most predictive of restoration were: % of ground surface covered by grass, the amount of trees and bushes visible from the given point of view, and apparent park size.	Nordh, H., T. Hartig, et al. 2009. Components of Small Urban Parks That Predict the Possibility for Restoration. <i>Urban Forestry & Urban Greening</i> 8, 4: 225-235.
12. What is the relationship between stress, park-based leisure, and psycho-physiological health among older adults?	questionnaire: park use (frequency, activity, companionship, and perceived benefits), personal health of those over 50, five-day diary study, physiological health (blood pressure, BMI, etc.)	Significant interactive effects between stress and: length of park stay, physiological health indicator, BMI. Also direct relationships between length of stay and blood pressure.	Orsega-Smith, E., A.J. Mowen, L.L. Payne, and G. Godbey. 2004. The Interaction of Stress and Park Use on Psycho-Physiological Health in Older Adults. <i>Journal of Leisure Research</i> 36, 2: 232-257.
13. Does time in a garden increase ability to focus and/or reduce stress for elderly persons?	concentration tests (the Necker Cube pattern Control test, Digit Span Forward, Digit Span Backward and Symbol Digit Modalities Test), blood pressure and heart rate	Powers of concentration increased for very elderly after a visit to a garden outside the geriatric home, compared to resting indoors in a favorite room.	Ottosson, J., and P. Grahn. 2005. A Comparison of Leisure Time Spent in a Garden with Leisure Time Spent Indoors: On Measures of Restoration in Residents in Geriatric Care. <i>Landscape Research</i> 30, 1: 23-55.
14. What are the physiological stress effects of shinrin-yoku (forest walking and breathing)?	measures of salivary cortisol, blood pressure, pulse rate, and heart rate variability	Forest environments experiences. Lower concentrations of cortisol, pulse rate, and blood pressure; changes in nerve activity	Park, B.J., Y. Tsunetsugu, et al. 2010. The Physiological Effects of Shinrin-Yoku (Taking in the Forest Atmosphere or Forest Bathing): Evidence From Field Experiments in 24 Forests Across Japan. <i>Environmental Health and Preventive Medicine</i> 15, 1: 18-26.
15. What are the use patterns and benefits of various users of pediatric cancer center healing gardens?	observation of garden use and window usage, scales measuring anxiety, sadness, anger, worry, fatigue, and pain	Staff, visitors, and patients differed in interaction behavior, with emotional distress and pain lower for all when in the garden	Sherman, S.A., J.W. Varni, et al. 2005. Post-Occupancy Evaluation of Healing Gardens in a Pediatric Cancer Center. <i>Landscape and Urban Planning</i> 73, 2-3: 167-183.

Research Construct or Question	Measure for Outcome	Finding or Results¹	Citation
16. Does exposure to a natural outdoor setting increase concentration levels for children with ADHD?	concentration test using Digit Span Backwards	Children with ADHD concentrated better after the walk in a park than after a downtown walk or neighborhood walk.	Taylor, A.F., and F.E. Kuo. 2009. Children with Attention Deficits Concentrate Better After Walk in the Park. <i>Journal of Attention Disorders</i> 12, 5: 402-409.
17. Does exposure to natural environments effect physiological stress recovery?	introduced stressor, self-ratings of affective states, physiological measures: heart period, muscle tension, skin conductance and systolic blood pressure	Stress recovery was faster and more complete when subjects were exposed to natural rather than urban environments.	Ulrich, R.S., R.F. Simons, et al. 1991. Stress Recovery During Exposure to Natural and Urban Environments. <i>Journal of Environmental Psychology</i> 11, 3: 201-230.
18. How are environmental preference and restoration related?	introduced stressor, POMS subscales, overall happiness/stress measures, d2 Mental Concentration Test	Natural environments elicited greater improvement in mood and marginally better concentration. Restoration was related to nature preference.	Van den Berg, A.E., S.L. Koole, and N.Y. van der Wulp. 2003. Environmental Preference and Restoration:(How) Are They Related? <i>Journal of Environmental Psychology</i> 23, 2: 135-146.
19. How might we design communities that balance settlement density with satisfactory access to nature experience?	Literature review of relations between stress, restoration needs, and environmental preferences	Advocates for the use of reviewed findings to influence spatial planning and urban design	Van den Berg, A.E., T. Hartig, and H. Staats. 2007. Preference for Nature in Urbanized Societies: Stress, Restoration, and the Pursuit of Sustainability. <i>Journal of Social Issues</i> 631: 79-96.
20. What is the causal impact of common domestic gardening activities on recovery from stress?	Stroop task, salivary cortisol levels, and the Positive and Negative Affect Schedule	Gardening led to a stronger decrease in cortisol levels compared to reading. Positive mood was fully restored after gardening, but deteriorated during reading.	Van den Berg, A.E. and M.H.G. Custers. 2011. Gardening Promotes Neuroendocrine and Affective Restoration from Stress. <i>Journal of Health Psychology</i> 16: 3-11.
21. What are the effects of horticultural therapy on patients participating in a cardiac rehabilitation program?	Profile of Mood States inventory, HR obtained through pulse oximetry	Horticultural therapy group showed reduced POMS total mood disturbance scores and reduced heart rates.	Wichrowski, M., J. Whiteson, et al. 2005. Effects of Horticultural Therapy on Mood and Heart Rate in Patients Participating in An Inpatient Cardiopulmonary Rehabilitation Program. <i>Journal of Cardiopulmonary Rehabilitation</i> 25, 5: 270-274.

Research Construct or Question	Measure for Outcome	Finding or Results ¹	Citation
22. What is the best regime or dose(s) of green exercise required to improve mental health?	Rosenberg Self-Esteem Scale, Profile of Mood States (POMS)	Green exercise improved mood and self-esteem, and additional variables provided even greater increase in mental health	Barton, J., and J. Pretty. 2010. What Is the Best Dose of Nature and Green Exercise for Improving Mental Health? A Multi-Study Analysis. <i>Environmental Science & Technology</i> 44, 10: 3947-3955.

LIFE CONTEXT

Research Construct or Question	Measure for Outcome	Finding or Results ²	Citation
23. Can regular nature experiences reduce attentional fatigue in women treated for breast cancer?	experimental treatments of routine nature exposure, tested cognitive function tests	Regular exposure to nature reduced fatigue. Nature intervention before the start of treatment prevented attentional fatigue.	Cimprich, B., and D.L. Ronis. 2003. An Environmental Intervention to Restore Attention in Women with Newly Diagnosed Breast Cancer. <i>Cancer Nursing</i> 26, 4: 284.
24. What role does nature availability at one's workstation play in employee well being?	survey for self reported ailments and job satisfaction	Windows with nature views associated with reduced absenteeism, increased job satisfaction, less task frustration.	Kaplan, R. 1993. The Role of Nature in the Context of the Workplace. <i>Landscape and Urban Planning</i> 26, 1-4: 193-201.
25. Do regular visits to a local favorite place affect feelings of restoration and self-reported physical symptoms?	Restoration Outcome Scale, Daily Hassles and Uplifts Scale, journal entries	Subjects visiting favorite places achieved a higher total daily level of restorative experiences, but no difference in physical symptoms.	Korpela, K.M., and M.P. Ylén. 2009. Effectiveness of Favorite-Place Prescriptions: A Field Experiment. <i>American Journal of Preventive Medicine</i> 36, 5: 435-438.
26. What is the role of use of favorite, natural settings in regulating negative feelings and stress?	16-page questionnaire, residential area experiences, issues of environmental health	Respondents with health complaints more likely to select natural favorite places, and greater emotional benefits from their visits to favorite places.	Korpela, K.M., and M. Ylén. 2007. Perceived Health Is Associated with Visiting Natural Favourite Places in the Vicinity. <i>Health & Place</i> 13, 1: 138-151.
27. Do vegetated neighborhood common spaces give rise to stronger neighborhood social ties?	measures of "greenness" of building's common space, resident use of common space, neighborhood social ties (NSTs), sense of safety	Levels of vegetation in predict use levels of common spaces and NSTs, also related to residents' sense of safety and adjustment	Kuo, F.E., W.C. Sullivan, et al. 1998. Fertile Ground for Community: Inner-City Neighborhood Common Spaces. <i>American Journal of Community Psychology</i> 26, 6: 823-851.

² All reported results are statistically significant at $p < 0.05$

Research Construct or Question	Measure for Outcome	Finding or Results²	Citation
28. Can outdoor residential environments affect residents' ability to cope with life adversity?	nature measures adjacent to urban public housing, attentional functioning, life issues management	Residents without nearby nature were less able to address major issues; assessed issues as more severe, less soluble, and more long-standing.	Kuo, F.E. 2001. Coping with Poverty: Impacts of Environment and Attention in the Inner City. <i>Environment and Behavior</i> 33, 1: 5-34.
29. Does aggression increase with mental fatigue? Do natural settings assist in mental fatigue recovery?	interviews in Chicago public housing, compared reported aggression levels high vs. low amounts of nearby vegetation.	General aggression was greater for people without vegetation. No correlation for more violent aggression or aggression towards children.	Kuo, F.E., and W.C. Sullivan. 2001. Aggression and Violence in the Inner City: Effects of Environment Via Mental Fatigue. <i>Environment and Behavior</i> 33, 4: 543-571.
30. Can nature experience treatments supplement traditional approaches to managing ADHD?	children engaged in green activity, parents reported effects of different activities and settings on ADHD	Green out-door activities and settings reduced ADHD symptoms.	Kuo, F.E., and A.F. Taylor. 2004. A Potential Natural Treatment for Attention-Deficit/ Hyperactivity Disorder. <i>American Journal of Public Health</i> 94, 9: 1580.
31. Can outdoor spaces have an effect on older adults' social integration with their neighbors?	extent of nature in nearby outdoor common spaces, interviews of public housing residents: social integration, sense of local community, physical health, fear of crime	The use of green outdoor common spaces predicted both the strength of neighborhood social ties and sense of community.	Kweon, B.S., W.C. Sullivan, and R. Angel. 1998. Green Common Spaces and the Social Integration of Inner-City Older Adults. <i>Environment and Behavior</i> 30, 6: 832-858.
32. How does nearby nature affect student academic achievement?	nature levels, potential student access to nature, academic records and behavior	Positive between nature exposure, standardized test scores, graduation rates, %s of students planning to attend college, fewer occurrences of criminal behavior.	Matsuoka, R.H. 2010. Student Performance and High School Landscapes: Examining the Links. <i>Landscape and Urban Planning</i> 97, 4: 273-282.

Research Construct or Question	Measure for Outcome	Finding or Results ²	Citation
33. How does level of personal crisis influence nature experience, and vice versa?	demographic questionnaire, SCI-93 Protocol (crisis measures), RAS Protocol (recreational activities), Fatigue Protocol	Experiencing nature has a more powerful influence on the rehabilitation of people greatly affected by a crisis. Having many prior nature experiences reduces crisis affects.	Ottosson, J., and P. Grahn. 2008. The Role of Natural Settings in Crisis Rehabilitation: How Does the Level of Crisis Influence the Response to Experiences of Nature with Regard to Measures of Rehabilitation? <i>Landscape Research</i> 33, 1: 51.
34. Do urban parks facilitate social cohesion? Does social interaction and place attachment contribute?	immigrant populations, survey, observations, interviews	Urban parks are more inclusive green spaces than non-urban green areas and can promote social cohesion.	Peters, K., B. Elands, and A. Buijs. 2010. Social Interactions in Urban Parks: Stimulating Social Cohesion? <i>Urban Forestry & Urban Greening</i> 9, 2: 93-100.
35. Do inner city children having 'greener' views from home display more self-discipline?	children in public housing units; varied outdoor vegetation; interviews; measures of concentration, gratification, impulse inhibition	Girls with more near-home nature had higher levels of self-discipline. Boys did not show a difference.	Taylor, A.F., F.E. Kuo, and W.C. Sullivan. 2002. Views of Nature and Self-Discipline: Evidence From Inner City Children. <i>Journal of Environmental Psychology</i> 22, 1-2: 49-63.
36. Does easy access from home to a natural environment affect a child's cognitive functioning skills?	pre/post test for cognitive function, parent survey of situation reactions, Attention Deficit evaluation scale	Natural elements near the home environment have a positive effect on children's cognitive functioning.	Wells, N.M. 2000. At Home with Nature: Effects of "Greenness" on Children's Cognitive Functioning. <i>Environment and Behavior</i> 32, 6: 775-795.

ECONOMIC VALUE

Research Construct or Question	Measure for Outcome	Finding or Results ³	Citation
37. How do city park systems economically benefit cities?	case study analysis, values attributes (property value, tourism, direct use, health, community cohesion, clean water, and clean air)	Scientific valuation approaches for city park systems are rudimentary. More method development is needed.	Harnik, P., and B. Welle. 2009. <i>Measuring the Economic Value of a City Park System</i> . Washington, D.C.: The Trust for Public Land, 19 pp.
38. How can community gardening foster well-being and resilience on multiple levels: individual, social group and natural environment?	literature review of studies showing relationship between contact with plants and individual benefits (e.g. cognitive), social group benefits (e.g. crime reduction), and economic benefits	Community gardening potential method to enhance well-being and further the resilience capacity of individuals and communities.	Okvat, H.A., and A.J. Zautra. 2011. Community Gardening: A Parsimonious Path to Individual, Community, and Environmental Resilience. <i>American Journal of Community Psychology</i> 47, 3/4: 374-387.
39. What are the benefits and economic values that accrue to users and nearby residents of open space and other outdoor amenities?	literature review of direct economic effects, property value impacts, hedonic pricing	Parks, recreation areas, and compact developments produce positive economic outcomes for developers, homeowners, and local governments.	Shoup, L., and R. Ewing. 2010. <i>The Economic Benefits of Open Space, Recreation Facilities and Walkable Community Design</i> . Robert Wood Johnson Foundation - Active Living Research, 28 pp.

³ All reported results are statistically significant at $p < 0.05$

6. ABSTRACTS

This section contains the published abstracts for each of the articles presented in the preceding table, listed in alphabetical order by first author.

Alvarsson, J.J., S. Wiens, and M.E. Nilsson. 2010. Stress Recovery During Exposure to Nature Sound and Environmental Noise. *International Journal of Environmental Research and Public Health* 7, 3: 1036-1046.

Research suggests that visual impressions of natural compared with urban environments facilitate recovery after psychological stress. To test whether auditory stimulation has similar effects, 40 subjects were exposed to sounds from nature or noisy environments after a stressful mental arithmetic task. Skin conductance level (SCL) was used to index sympathetic activation, and high frequency heart rate variability (HF HRV) was used to index parasympathetic activation. Although HF HRV showed no effects, SCL recovery tended to be faster during natural sound than noisy environments. These results suggest that nature sounds facilitate recovery from sympathetic activation after a psychological stressor.

Barton, J., and J. Pretty. 2010. What Is the Best Dose of Nature and Green Exercise for Improving Mental Health? A Multi-Study Analysis. *Environmental Science & Technology* 44, 10: 3947-3955.

Green exercise is activity in the presence of nature. Evidence shows it leads to positive short and long-term health outcomes. This multi-study analysis assessed the best regime of dose(s) of acute exposure to green exercise required to improve self-esteem and mood (indicators of mental health). The research used meta-analysis methodology to analyze 10 UK studies involving 1252 participants. Outcomes were identified through a priori subgroup analyses, and dose-responses were assessed for exercise intensity and exposure duration. Other subgroup analyses included gender, age group, starting health status, and type of habitat. The overall effect size for improved self-esteem was $d = 0.46$ (CI 0.34-0.59, $p < 0.00001$) and for mood $d = 0.54$ (CI 0.38-0.69, $p < 0.00001$). Dose responses for both intensity and duration showed large benefits from short engagements in green exercise, and then diminishing but still positive returns. Every green environment improved both self-esteem and mood; the presence of water generated greater effects. Both men and women had similar improvements in self-esteem after green exercise, though men showed a difference for mood. Age groups: for self-esteem, the greatest change was in the youngest, with diminishing effects with age; for mood, the least change was in the young and old. The mentally ill had one of the greatest self-esteem improvements. This study confirms that the environment provides an important health service.

Berman, M.G., J. Jonides, and S. Kaplan. 2008. The Cognitive Benefits of Interacting with Nature. *Psychological Science* 19, 12: 1207-1212.

We compare the restorative effects on cognitive functioning of interactions with natural versus urban environments. Attention restoration theory (ART) provides an analysis of the kinds of environments that lead to improvements in directed-attention abilities. Nature, which is filled with intriguing stimuli, modestly grabs attention in a bottom-up fashion, allowing top-down directed-attention abilities a chance to replenish. Unlike natural environments, urban environments are filled with stimulation that captures attention dramatically and additionally requires directed attention (e.g., to avoid being hit by a car), making them less restorative. We present two experiments that

show that walking in nature or viewing pictures of nature can improve directed-attention abilities as measured with a backwards digit-span task and the Attention Network Task, thus validating attention restoration theory.

Cimprich, B., and D.L. Ronis. 2003. An Environmental Intervention to Restore Attention in Women with Newly Diagnosed Breast Cancer. *Cancer Nursing* 26, 4: 284.

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 preadjuvant 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, 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.

Gigliotti, C.M., and S.E. Jarrott. 2005. Effects of Horticulture Therapy on Engagement and Affect. *Canadian Journal on Aging* 24, 4: 367-377.

Implementing generationally appropriate activities for persons with dementia is a challenging task. Horticulture therapy (HT) addresses this challenge through the use of plants to facilitate holistic outcomes. Utilizing the model of environmental press, the current study sought to analyze adult day service (ADS) participants' responses to HT as compared to traditional activities. HT activities were conducted once a week for a half an hour at four different ADS programs over the course of 9 weeks. Observational data were collected during HT and traditional ADS activities using a modified dementia care mapping (DCM) technique. Observers coded predominant behavioural and affectual responses for each participant. HT activities facilitated higher levels of productive engagement and positive affect and lower levels of non-engagement than did traditional ADS activities. Therefore, HT offers dementia-care staff a viable activity alternative that is well received by clients and inclusive of all interested persons, despite cognitive limitations.

Gonzalez, M.T., T. Hartig, G.G. Patil, E.W. Martinsen, and M. Kirkevold. 2010. Therapeutic Horticulture in Clinical Depression: A Prospective Study of Active Components. *Journal of Advanced Nursing* 66, 9: 2002-2013.

Aim. This paper is a report of a study conducted to assess change in depression severity, perceived attentional capacity and rumination (brooding) in individuals with clinical depression during a therapeutic horticulture program and to investigate if the changes were mediated by experiences of being away and fascination.

Background. Individuals with clinical depression suffer from distortion of attention and rumination. Interventions can help to disrupt maladaptive rumination and promote restoration of depleted attentional capacity.

Method. A single-group study was conducted with a convenience sample of 28 people with clinical depression in 2009. Data were collected before, twice during, and immediately after a 12-week therapeutic horticulture program, and at 3-month follow-up. Assessment instruments were the Beck Depression Inventory, Attentional Function Index, Brooding Scale, and Being Away and Fascination subscales from the Perceived Restorativeness Scale.

Findings. Mean Beck Depression Inventory scores declined by 4.5 points during the intervention ($F = 5.49, P = 0.002$). The decline was clinically relevant for 50% of participants. Attentional Function Index scores increased ($F = 4.14, P = 0.009$), while Brooding scores decreased ($F = 4.51, P = 0.015$). The changes in Beck Depression Inventory and Attentional Function Index scores were mediated by increases in Being Away and Fascination, and decline in Beck Depression Inventory scores was also mediated by decline in Brooding. Participants maintained their improvements in Beck Depression Inventory scores at 3-month follow-up.

Conclusion. Being away and fascination appear to work as active components in a therapeutic horticulture intervention for clinical depression.

Harnik, P., and B. Welle. 2009. *Measuring the Economic Value of a City Park System*. Washington D.C.: The Trust for Public Land, 19 pp.

In 2003, The Trust for Public Land's Center for City Park Excellence gathered two dozen park experts and economists in Philadelphia for a colloquium to analyze how park systems economically benefit cities. Based on this conversation and subsequent consultation with other leading economists and academics, the center identified seven attributes of city park systems that provide economic value and are measurable—property value, tourism, direct use, health, community cohesion, clean water, and clean air. This report describes the value factors and the rationale for calculations, then describes five test cases of valuation—the cities of Washington, D.C., San Diego, Boston, Sacramento, and Philadelphia.

Hartig, T., G.W. Evans, L. D. Jammer, D.S. Davis, and T. Gärling. 2003. *Tracking Restoration in Natural and Urban Field Settings*. *Journal of Environmental Psychology* 23: 109-123.

We compared psychophysiological stress recovery and directed attention restoration in natural and urban field settings using repeated measures of ambulatory blood pressure, emotion, and attention collected from 112 randomly assigned young adults. To vary restoration needs, we had half of the subjects begin the environmental treatment directly after driving to the field site. The other half completed attentionally demanding tasks just before the treatment. After the drive or the tasks, sitting in a room with tree views promoted more rapid decline in diastolic blood pressure than sitting in a viewless room. Subsequently walking in a nature reserve initially fostered blood pressure change that indicated greater stress reduction than afforded by walking in the urban surroundings. Performance on an attentional test improved slightly from the pretest to the midpoint of the walk in the nature reserve, while it declined in the urban setting. This opened a performance gap that persisted after the walk. Positive affect increased and anger decreased in the nature reserve by the end of the walk; the opposite pattern emerged in the urban environment. The task manipulation affected emotional self-reports. We discuss implications of the results for theories about restorative environments and environmental health promotion measures.

Kaplan, R. 1993. The Role of Nature in the Context of the Workplace. *Landscape and Urban Planning* 26, 1-4: 193-201.

The well-being of the workforce is clearly a matter of concern to the employer. Such concern translates to considerable costs in the form of fringe benefit packages, health promotion programs, ergonomics, and other ways to reduce absence and enhance health and satisfaction. Despite such efforts, however, one way to address well-being that entails relatively low costs has been largely ignored in the work context. Proximity and availability of the natural environment can foster many desired outcomes, even if the employee does not spend a great amount of time in the natural setting. A theoretical framework is presented that helps explain why even the view from the window can have a positive impact with respect to well-being. Results from two studies offer some substantiation. Further research on the role of nature in the workplace is essential; however, decisions to provide health promoting programs and to enhance fringe benefit packages have not been offered as a direct consequence of empirical verification. While providing windows at work may not be a simple matter, other ways to increase contact with vegetation may provide a low-cost, high-gain approach to employee well-being and effectiveness.

Kjellgren, A., and H. Buhrkall. 2010. A Comparison of the Restorative Effect of a Natural Environment with a Simulated Natural Environment. *Journal of Environmental Psychology* 30, 4: 464-472.

This study aimed to compare the restorative effects of 30 min relaxation in a natural environment with an indoor simulation of the same natural environment. A repeated-measure design was carried out and 18 participants suffering from stress and/or burnout syndrome were counterbalanced into the two conditions. Both physiological measures and psychological instruments were applied. Further, qualitative descriptions of experiences were obtained. A phenomenological analysis of the qualitative data resulted in six categories for the natural environment: Intensified sensory perception; A feeling of harmony and union with nature; Well-being and quality of life; Renewed energy and awakening; "Here-and-now" thinking; and A sense of tranquility, while for the simulated natural environment, there were five categories: Restlessness and anxiety; Lack of concentration; A sense of being cut off from nature's sensory input; A longing to be in 'real' nature; and Positive emotions. The natural environment yielded a significantly higher rating of degree of altered states of consciousness (ASC) and energy than the simulated natural environment. The results suggest that both environments facilitated stress reduction, with the natural environment additionally bringing increased energy and ASC, thus possibly enhancing and promoting restoration.

Korpela, K.M., and M.P. Ylén. 2009. Effectiveness of Favorite-Place Prescriptions: A Field Experiment. *American Journal of Preventive Medicine* 36, 5: 435-438.

Background: Previous studies suggest that favorite places provide stress-alleviating experiences and serve emotion regulation. This study used a prospective, experimental design to investigate the hypothesis that a group of adults instructed to regularly visit their local favorite places will experience greater daily restoration and fewer self-reported physical symptoms than a group instructed to avoid all favorite-place visits.

Methods: Members of the favorite-place group were asked to visit their local favorite places at least once per day on 5 weekdays. They visited five times, on average, and also reported all other place visits in a structured place diary. Members of the not-visiting group visited their favorite place 0-1 times and daily reported all place visits outside the home. The control group, which was given instructions that did not mention favorite places, reported all place visits outside the home. Restorative experiences (assessed on the Restoration Outcome Scale and including

attentiveness, relaxation, clearing one's mind, subjective vitality, and self-confidence) and self-reported physical symptoms (headache, backache, muscle tension and pain) were measured with structured health diaries using Likert scales. Data were collected in 2006 and analyzed in 2007 and 2008.

Results: Every day the group visiting favorite places experienced significantly stronger restorative experiences than the not-visiting and control groups. The groups did not differ in the amount of self-rated physical symptoms reported at the end of each day. In all groups such symptoms decreased toward the end of the week.

Conclusions: Favorite-place prescriptions and visits affect subjective well-being. Health counseling and research on coping strategies should not ignore the use of sociophysical environments for self- and emotion-regulation.

Korpela, K.M., and M. Ylén. 2007. Perceived Health Is Associated with Visiting Natural Favourite Places in the Vicinity. *Health & Place* 13, 1: 138-151.

Visiting favourite natural settings may serve as a resource for regulating negative feelings and coping with perceived stress. The authors investigated the association between perceived health, the selection and experiential qualities of favourite places in four residential areas; 211 respondents (average age 40 years) responded to the questionnaire. Respondents with a certain amount of health complaints, such as headaches, chest or stomach pains, and faintness or dizziness, were more likely to select natural favourite places than those with few complaints. Respondents with health complaints benefited more in emotional terms from their visits to the favourite place although they did not visit their places more frequently than others. The change toward positive feelings was associated in particular with natural favourite places and relaxing in them. The results give impetus to research on the self-regulation of mood and neighbourhood context in health.

Kuo, F.E. 2001. Coping with Poverty: Impacts of Environment and Attention in the Inner City. *Environment and Behavior* 33, 1: 5-34.

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.

Kuo, F.E., and A.F. Taylor. 2004. A Potential Natural Treatment for Attention-Deficit/Hyperactivity Disorder: Evidence From a National Study. *American Journal of Public Health* 94, 9: 1580.

Objectives. We examined the impact of relatively "green" or natural settings on attention-deficit/hyperactivity disorder (ADHD) symptoms across diverse sub-populations of children.

Methods. Parents nationwide rated the aftereffects of 49 common after-school and weekend activities on children's symptoms. Aftereffects were compared for activities conducted in green outdoor settings versus those conducted in both built outdoor and indoor settings.

Results. In this national, nonprobability sample, green outdoor activities reduced symptoms significantly more than did activities conducted in other settings, even when activities were matched across settings. Findings were consistent across age, gender, and income groups; community types; geographic regions; and diagnoses.

Conclusions. Green outdoor settings appear to reduce ADHD symptoms in children across a wide range of individual, residential, and case characteristics.

Kuo, F.E., and W.C. Sullivan. 2001. Aggression and Violence in the Inner City: Effects of Environment Via Mental Fatigue. *Environment and Behavior* 33, 4: 543-571.

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.

Kuo, F.E., W.C. Sullivan, R.L. Coley, and L. Brunson. 1998. Fertile Ground for Community: Inner-City Neighborhood Common Spaces. *American Journal of Community Psychology* 26, 6: 823-851.

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 18 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 improving common spaces may be an especially productive focus for community organizing efforts in inner-city neighborhoods.

Kweon, B.S., W.C. Sullivan, and R. Angel. 1998. Green Common Spaces and the Social Integration of Inner-City Older Adults. *Environment and Behavior* 30, 6: 832-858.

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.

Li, Q., M. Kobayashi, H. Inagaki, Y. Hirata, Y.J. Li, K. Hirata, T. Shimizu, H. Suzuki, M. Katsumata, Y. Wakayama, T. Kawada, T. Ohira, N. Matsui, and T. Kagawa. 2010. A Day Trip to a Forest Park Increases Human Natural Killer Activity and the Expression of Anti-Cancer Proteins in Male Subjects. *Journal of Biological Regulators and Homeostatic Agents* 24, 2: 157-166.

We previously reported that 2-night/3-day trips to forest parks enhanced human NK activity, the number of NK cells, and intracellular anti-cancer proteins in lymphocytes, and that this increased NK activity lasted for more than 7 days after the trip in both male and female subjects. In the present study, we investigated the effect of a day trip to a forest park on human NK activity in male subjects. Twelve healthy male subjects, aged 35-53 years, were selected after giving informed consent. The subjects experienced a day trip to a forest park in the suburbs of Tokyo. They walked for two hours in the morning and afternoon, respectively, in the forest park on Sunday. Blood and urine were sampled in the morning of the following day and 7 days after the trip, and the NK activity, numbers of NK and T cells, and granulysin, perforin, and granzyme A/B-expressing lymphocytes, the concentration of cortisol in blood samples, and the concentration of adrenaline in urine were measured. Similar measurements were made before the trip on a weekend day as the control. Phytoncide concentrations in the forest were measured. The day trip to the forest park significantly increased NK activity and the numbers of CD16(+) and CD56(+) NK cells, perforin, granulysin, and granzyme A/B-expressing NK cells and significantly decreased CD4(+) T cells, the concentrations of cortisol in the blood and adrenaline in urine. The increased NK activity lasted for 7 days after the trip. Phytoncides, such as isoprene, alpha-pinene, and beta-pinene, were detected in the forest air. These findings indicate that the day trip to the forest park also increased the NK activity, number of NK cells, and levels of intracellular anti-cancer proteins, and that this effect lasted for at least 7 days after the trip. Phytoncides released from trees and decreased stress hormone levels may partially contribute to the increased NK activity.

Matsuoka, R.H. 2010. Student Performance and High School Landscapes: Examining the Links. *Landscape and Urban Planning* 97, 4: 273-282.

High school students today are experiencing unprecedented levels of school-related stress. At the same time, a growing body of research has linked views of nature with restoration from mental fatigue and stress reduction. How important are such views for students while they are at school? This study investigated 101 public high schools in southeastern Michigan to examine the role played by the availability of nearby nature in student academic achievement and behavior. The analyses revealed consistent and systematically positive relationships between nature exposure and student performance. Specifically, views with greater quantities of trees and shrubs from cafeteria as well as classroom windows are positively associated with standardized test scores, graduation rates, percentages of students planning to attend a four-year college, and fewer occurrences of criminal behavior. In addition, large expanses of landscape lacking natural features are negatively related to these same test scores and college plans. These featureless landscapes included large areas of campus lawns, athletic fields, and parking lots. All analyses accounted for student socio-economic status and racial/ethnic makeup, building age, and size of school enrollment.

McCaffrey, R., C. Hanson, and W. McCaffrey. 2010. Garden Walking for Depression: A Research Report. *Holistic Nursing Practice* 24, 5: 252-259.

This study was designed to determine the effect of garden walking and reflective journaling on adults who are 65 years old and older with depression. The Geriatric Depression Scale measured depression. Four themes emerged from the interview data collected from each participant.

Mooney, P., and P.L. Nicell. 1992. The Importance of Exterior Environment for Alzheimer Residents: Effective Care and Risk Management. *Healthcare Management Forum* 5, 2: 23-29.

Evidence shows that environments especially designed for cognitively impaired seniors can maintain or increase their level of functioning. Little emphasis has so far been placed on the prosthetic role that may be played by exterior environments. This study attempted to determine the value that specially designed exterior spaces may have in reducing undesired behaviours, thereby minimizing risks to the patients and potential liability to the institution. The researchers evaluated whether (a) poor environments increase residents' frustrations and can precipitate catastrophic behaviour and (b) freedom of movement and opportunities to avoid crowding, noise and excess stimulation minimize the frequency of aggressive behaviour. Findings were that the use of exterior environments reduced incidents of aggressive behaviour, and contributed significantly to a risk management program.

Morita, E., S. Fukuda, J. Nagano, N. Hamajima, H. Yamamoto, Y. Iwai, T. Nakashima, H. Ohira, and T. Shirakawa. 2007. Psychological Effects of Forest Environments on Healthy Adults: Shinrin-Yoku (Forest-Air Bathing, Walking) As a Possible Method of Stress Reduction. *Public Health* 121, 1: 54-63.

Objectives: Shinrin-yoku (walking and/or staying in forests in order to promote health) is a major form of relaxation in Japan; however, its effects have yet to be completely clarified. The aims of this study were: (1) to evaluate the psychological effects of shinrin-yoku in a large number of participants; and (2) to identify the factors related to these effects.

Methods: 498 healthy volunteers took part in the study. Surveys were conducted twice in a forest on the same day (forest day) and twice on a control day. Outcome measures were evaluated using the Multiple Mood Scale-Short Form (hostility, depression, boredom, friendliness, wellbeing and liveliness) and the State-Trait Anxiety Inventory A-State Scale. Statistical analyses were conducted using analysis of variance and multiple regression analyses.

Results: Hostility ($P < 0.001$) and depression ($P < 0.001$) scores decreased significantly, and liveliness ($P < 0.001$) scores increased significantly on the forest day compared with the control day. The main effect of environment was also observed with all outcomes except for hostility, and the forest environment was advantageous. Stress levels were shown to be related to the magnitude of the shinrin-yoku effect; the higher the stress level, the greater the effect.

Nordh, H., T. Hartig, C.M. Hagerhall, and G. Fry. 2009. Components of Small Urban Parks That Predict the Possibility for Restoration. *Urban Forestry & Urban Greening* 8, 4: 225-235.

In densifying cities, small green spaces such as pocket parks are likely to become more important as settings for restoration. Well-designed small parks may serve restoration well, but earlier research on restorative environments does not provide detailed information about the specific components of the physical environment that support restoration. In this study we assessed the extent to which hardscape, grass, lower ground vegetation, flowering plants, bushes, trees, water, and size predicted

the judged possibility for restoration in small urban green spaces. We took individual parks as the units of analysis. The parks were sampled from Scandinavian cities, and each park was represented by a single photo. Each photo was quantified in terms of the different objective park components and also rated on psychological variables related to restoration. The ratings on the psychological variables being away, fascination, likelihood of restoration, and preference were provided by groups of people familiar with such parks. The variables most predictive of the likelihood of restoration were the percentage of ground surface covered by grass, the amount of trees and bushes visible from the given viewing point, and apparent park size. Formal mediation analyses indicated distinctive patterns of full and partial mediation of the relations between environmental components and restoration likelihood by being away and fascination. Our results provide guidance for the design of small yet restorative urban parks.

Okvat, H.A., and A.J. Zautra. 2011. Community Gardening: A Parsimonious Path to Individual, Community, and Environmental Resilience. *American Journal of Community Psychology* 47, 3/4: 374-387.

The goal of this paper is to introduce community gardening as a promising method of furthering well-being and resilience on multiple levels: individual, social group, and natural environment. We examine empirical evidence for the benefits of gardening, and we advocate the development and testing of social ecological models of community resilience through examination of the impact of community gardens, especially in urban areas. The definition of community is extended beyond human social ties to include connections with other species and the earth itself, what Berry has called an Earth community. We discuss the potential contribution of an extensive network of community gardens to easing the global climate change crisis and address the role of community psychologists in community gardening research and policy-oriented action.

Orsega-Smith, E., A.J. Mowen, L.L. Payne, and G. Godbey. 2004. The Interaction of Stress and Park Use on Psycho-Physiological Health in Older Adults. *Journal of Leisure Research* 36, 2: 232-257.

Stress can have a negative influence on psychological and physical health, particularly among older adults. However, park-based leisure experiences, can have a positive influence upon mood states, stress, and health of this population. This study examined the relationship between stress, park-based leisure, and physiological health among older adults (ages 50-86). There were significant interactive effects between: 1) stress and length of park stay and, 2) stress and desired health benefits in their relationship to the physiological health indicator, body mass index (BMI). There were also direct relationships between park companionship and perceived physical health and between length of park stay and lower systolic blood pressures. This study offers early evidence that park-based leisure experiences correspond with physiological health indicators among older adults. Implications for future health-based leisure research and policy are discussed.

Ottosson, J., and P. Grahn. 2005. A Comparison of Leisure Time Spent in a Garden with Leisure Time Spent Indoors: On Measures of Restoration in Residents in Geriatric Care. *Landscape Research* 30, 1: 23-55.

During the past 20 years, findings have indicated that nature plays an active role in helping people recover from stress and fatigue. Two of the most cited theories in this field are Rachel and Stephen Kaplan's theory of recovery from Directed Attention Fatigue in nature and Roger Ulrich's theory of aesthetic and affective responses to natural environments and stress recovery. One aim of the present study is to test whether being outdoors in a green recreational environment causes people

to be more focused, compared to being in a room indoors (in line with hypotheses suggested by the Kaplans). Another aim is to test whether people experience stress reduction, i.e. as evidenced by changes in blood pressure and heart rate, if they are placed in an environment with many green elements (in line with hypotheses suggested by Ulrich). The overall study design is that of an intervention study. Fifteen elderly persons living at a home for very elderly people participated. Their powers of concentration, blood pressure and heart rate were measured before and after an hour of rest in a garden or in an indoor setting. Seven elderly people were randomly chosen to have their first series of tests in a garden, while eight elderly people had their first series of tests indoors. The results indicate that powers of concentration increase for very elderly people after a visit to a garden outside the geriatric home in which they live, compared to that after resting indoors in their favourite room. The results did not show any effects on blood pressure or heart rate. It is suggested that having a one-hour rest outdoors in a garden setting plays a role in elderly people's powers of concentration, and could thereby affect their performance of activities of daily living. One important factor in this study was that both the outdoor environment and the indoor environment at the home were highly valued by participants.

Ottosson, J., and P. Grahn. 2008. The Role of Natural Settings in Crisis Rehabilitation: How Does the Level of Crisis Influence the Response to Experiences of Nature with Regard to Measures of Rehabilitation? *Landscape Research* 33, 1: 51.

We compare people greatly affected by a crisis with those less affected to explore how level of crisis influences their response to experiencing nature. A questionnaire comprising a validated protocol to evaluate frequency of stress conditions, the level of crisis retention, reorientation and rehabilitation potential was answered by 547 individuals. The questionnaire also comprises items on everyday activities. Our findings may be interpreted as follows: experiencing nature has a more powerful influence on the rehabilitation potential of people greatly affected by a crisis; taking a walk also has an influence, although not of equal importance; the social factor has more influence on the rehabilitation potential of people affected by a crisis to a low/moderate degree. Individuals who have many experiences of nature are less affected by their crisis than are those who have few such experiences. We suggest that the rehabilitative effect of nature is tied to its function as an enriched environment. During stays in natural settings, an interaction takes place between sensory stimulation, emotions and logical thought—an interaction that leads to a new orientation and new ways of seeing one's self and one's resources. This seems to largely be a question of how we human beings take in and process information.

Park, B.J., Y. Tsunetsugu, T. Kasetani, T. Kagawa, and Y. Miyazaki. 2010. The Physiological Effects of Shinrin-Yoku (Taking in the Forest Atmosphere or Forest Bathing): Evidence From Field Experiments in 24 Forests Across Japan. *Environmental Health and Preventive Medicine* 15, 1: 18-26.

This paper reviews previous research on the physiological effects of Shinrin-yoku (taking in the forest atmosphere or forest bathing), and presents new results from field experiments conducted in 24 forests across Japan. The term Shinrin-yoku was coined by the Japanese Ministry of Agriculture, Forestry, and Fisheries in 1982, and can be defined as making contact with and taking in the atmosphere of the forest. In order to clarify the physiological effects of Shinrin-yoku, we conducted field experiments in 24 forests across Japan. In each experiment, 12 subjects (280 total; ages 21.7 +/- 1.5 year) walked in and viewed a forest or city area. On the first day, six subjects were sent to a forest area, and the others to a city area. On the second day, each group was sent to the other area as a cross-check. Salivary cortisol, blood pressure, pulse rate, and heart rate variability were used as

indices. These indices were measured in the morning at the accommodation facility before breakfast and also both before and after the walking (for 16 +/- 5 min) and viewing (for 14 +/- 2 min). The R-R interval was also measured during the walking and viewing periods. The results show that forest environments promote lower concentrations of cortisol, lower pulse rate, lower blood pressure, greater parasympathetic nerve activity, and lower sympathetic nerve activity than do city environments. These results will contribute to the development of a research field dedicated to forest medicine, which may be used as a strategy for preventive medicine.

Peters, K., B. Elands, and A. Buijs. 2010. Social Interactions in Urban Parks: Stimulating Social Cohesion? *Urban Forestry & Urban Greening* 9, 2: 93-100.

People from all ethnic backgrounds spend some of their leisure time in green areas. This study found that urban parks are more inclusive green places than non-urban green areas, and that urban parks can promote social cohesion. The objective of the research was to establish the extent to which urban parks facilitate social cohesion and how social interaction and place attachment can contribute to such cohesion. Quantitative research (a survey) and qualitative research (observations and interviews) carried out in five urban parks in the Netherlands revealed that there are many similarities in the ways that ethnic groups use urban parks and in the meanings of such parks to these groups. Urban parks are sites where different ethnic groups mingle and where informal and cursory interactions can stimulate social cohesion. Furthermore, being involved and concerned with parks can facilitate attachment to these places. Urban parks can provide a vital locality where everyday experiences are shared and negotiated with a variety of people. The design of a park, its location and people's image of the park in combination with the cultural characteristics of various ethnic groups inform the opportunities for intercultural interactions.

Sherman, S.A., J.W. Varni, R.S. Ulrich, and V.L. Malcarne. 2005. Post-Occupancy Evaluation of Healing Gardens in a Pediatric Cancer Center. *Landscape and Urban Planning* 73, 2-3: 167-183.

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 1,400 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.

Shoup, L., and R. Ewing. 2010. *The Economic Benefits of Open Space, Recreation Facilities and Walkable Community Design*. Robert Wood Johnson Foundation - Active Living Research, 28 pp.

Overweight and obesity rates have risen dramatically in the United States since the 1970s, and, during a similar time period, physical activity rates have declined in both children and adults. Being

physically active is more than a personal decision; community design and the availability of open spaces and recreation areas strongly influence how active people are. Walkable neighborhoods, parks and open spaces also are believed to generate economic benefits to local governments, home owners and businesses through higher property values and correspondingly higher tax assessments. The economic benefits of open, walkable spaces can play an important role in policy-makers' decisions about zoning, restrictions on land-uses, government purchase of lands for parks and similar initiatives. This research synthesis reviews the sizable body of peer-reviewed and independent reports on the economic value of outdoor recreation facilities, open spaces and walkable community design. It focuses on economic benefits that accrue to nearby homeowners and to other users of open space.

Sullivan, W.C., F.E. Kuo, and S. DePooter. 2004. The Fruit of Urban Nature: Vital Neighborhood Spaces. *Environment and Behavior* 36, 5: 678-700.

What makes a neighborhood space vital? This article explores the possibility that the presence of trees and grass may be one of the key components of vital neighborhood spaces. We report on 758 observations of individuals in 59 outdoor common spaces in a residential development. Twenty-seven of the neighborhood common spaces were relatively green, whereas 32 were relatively barren. Results indicate that the presence of trees and grass is related to the use of outdoor spaces, the amount of social activity that takes place within them, and the proportion of social to nonsocial activities they support. The findings improve and broaden our understanding of the physical characteristics that influence social contact among neighbors and provide evidence that nature plays an important role in creating vital neighborhood spaces.

Taylor, A.F., and F.E. Kuo. 2009. Children with Attention Deficits Concentrate Better After Walk in the Park. *Journal of Attention Disorders* 12, 5: 402-409.

Objective: In the general population, attention is reliably enhanced after exposure to certain physical environments, particularly natural environments. This study examined the impacts of environments on attention in children with ADHD.

Method: In this within subjects design, each participant experienced each of three treatments (environments) in single blind controlled trials. Seventeen children 7 to 12 years old professionally diagnosed with ADHD experienced each of three environments—a city park and two other well-kept urban settings—via individually guided 20-minute walks. Environments were experienced 1 week apart, with randomized assignment to treatment order. After each walk, concentration was measured using Digit Span Backwards.

Results: Children with ADHD concentrated better after the walk in the park than after the downtown walk ($p = .0229$) or the neighborhood walk ($p = .0072$). Effect sizes were substantial (Cohen's $d = .52$ and $.77$, respectively) and comparable to those reported for recent formulations of methylphenidate.

Conclusion: Twenty minutes in a park setting was sufficient to elevate attention performance relative to the same amount of time in other settings. These findings indicate that environments can enhance attention not only in the general population but also in ADHD populations. "Doses of nature" might serve as a safe, inexpensive, widely accessible new tool in the tool kit for managing ADHD symptoms.

Taylor, A.F., F.E. Kuo, and W.C. Sullivan. 2002. Views of Nature and Self-Discipline: Evidence From Inner City Children. *Journal of Environmental Psychology* 22, 1-2: 49-63.

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-discipline, in turn, may draw on directed attention, a limited resource that can be renewed through contact with nature. This study examined the relationship between near-home nature and three forms of self-discipline in 169 inner city girls and boys randomly assigned to 12 architecturally identical high-rise buildings with varying levels of nearby nature. Parent ratings of the naturalness of the view from home were used to predict children's performance on tests of concentration, impulse inhibition, and delay of gratification. Regressions indicated that, on average, the more natural a girl's view from home, the better her performance at each of these forms of self-discipline. For girls, view accounted for 20% of the variance in scores on the combined self-discipline index. For boys, who typically spend less time playing in and around their homes, view from home showed no relationship to performance on any measure. These findings suggest that, for girls, green space immediately outside the home can help them lead more effective, self-disciplined lives. For boys, perhaps more distant green spaces are equally important.

Ulrich, R.S., R.F. Simons, B.D. Losito, E. Fiorito, M.A. Miles, and M. Zelson. 1991. Stress Recovery During Exposure to Natural and Urban Environments. *Journal of Environmental Psychology* 11, 3: 201-230.

Different conceptual perspectives converge to predict that if individuals are stressed, an encounter with most unthreatening natural environments will have a stress reducing or restorative influence, whereas many urban environments will hamper recuperation. Hypotheses regarding emotional, attentional and physiological aspects of stress reducing influences of nature are derived from a psycho-evolutionary theory. To investigate these hypotheses, 120 subjects first viewed a stressful movie, and then were exposed to color/sound videotapes of one of six different natural and urban settings. Data concerning stress recovery during the environmental presentations were obtained from self-ratings of affective states and a battery of physiological measures: heart period, muscle tension, skin conductance and pulse transit time, a non-invasive measure that correlates with systolic blood pressure. Findings from the physiological and verbal measures converged to indicate that recovery was faster and more complete when subjects were exposed to natural rather than urban environments. The pattern of physiological findings raised the possibility that responses to nature had a salient parasympathetic nervous system component; however, there was no evidence of pronounced parasympathetic involvement in responses to the urban settings. There were directional differences in cardiac responses to the natural vs urban settings, suggesting that attention/intake was higher during the natural exposures. However, both the stressor film and the nature settings elicited high levels of involuntary or automatic attention, which contradicts the notion that restorative influences of nature stem from involuntary attention or fascination. Findings were consistent with the predictions of the psycho-evolutionary theory that restorative influences of nature involve a shift towards a more positively-toned emotional state, positive changes in physiological activity levels, and that these changes are accompanied by sustained attention/intake. Content differences in terms of natural vs human-made properties appeared decisive in accounting for the differences in recuperation and perceptual intake.

Van den Berg, A.E., S.L. Koole, and N.Y. van der Wulp. 2003. Environmental Preference and Restoration:(How) Are They Related? *Journal of Environmental Psychology* 23, 2: 135-146.

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.

Van den Berg, A.E., T. Hartig, and H. Staats. 2007. Preference for Nature in Urbanized Societies: Stress, Restoration, and the Pursuit of Sustainability. *Journal of Social Issues* 631: 79-96.

Urbanicity presents a challenge for the pursuit of sustainability. High settlement density may offer some environmental, economic, and social advantages, but it can impose psychological demands that people find excessive. These demands of urban life have stimulated a desire for contact with nature through suburban residence, leading to planning and transportation practices that have profound implications for the pursuit of sustainability. Some might dismiss people's desire for contact with nature as the result of an anti-urban bias in conjunction with a romantic view of nature. However, research in environmental psychology suggests that people's desire for contact with nature serves an important adaptive function, namely, psychological restoration. Based on this insight, we offer a perspective on an underlying practical challenge: designing communities that balance settlement density with satisfactory access to nature experience. We discuss research on four issues: how people tend to believe that nature is restorative; how restoration needs and beliefs shape environmental preferences; how well people actually achieve restoration in urban and natural environments; and how contact with nature can promote health. In closing, we consider urban nature as a design option that promotes urban sustainability.

Van den Berg, A.E. and M.H.G. Custers. 2011. Gardening Promotes Neuroendocrine and Affective Restoration from Stress. *Journal of Health Psychology* 16: 3-11.

Stress-relieving effects of gardening were hypothesized and tested in a field experiment. Thirty allotment gardeners performed a stressful Stroop task and were then randomly assigned to 30 minutes of outdoor gardening or indoor reading on their own allotment plot. Salivary cortisol levels and self-reported mood were repeatedly measured. Gardening and reading each led to decreases in cortisol during the recovery period, but decreases were significantly stronger in the gardening group. Positive mood was fully restored after gardening, but further deteriorated during reading. These findings provide the first experimental evidence that gardening can promote relief from acute stress.

Wells, N.M. 2000. At Home with Nature: Effects of "Greenness" on Children's Cognitive Functioning. *Environment and Behavior* 32, 6: 775-795.

The nearby natural environment plays a far more significant role in the well-being of children residing in poor urban environments than has previously been recognized. Using a premove/postmove longitudinal design, this research rules out the effects of various extraneous variables that have plagued previous studies and explores the linkage between the naturalness or restorativeness of the home environment and the cognitive functioning of low-income urban children. Both before and after relocation, objective measures of naturalness are employed along with a standardized instrument measuring the children's cognitive functioning. Results indicate that children whose homes improved the most in terms of greenness following relocation also tended to have the highest levels of cognitive functioning following the move. The implications with respect to policy and design are also discussed.

Wichrowski, M., J. Whiteson, F. Haas, A. Mola, and M.J. Rey. 2005. Effects of Horticultural Therapy on Mood and Heart Rate in Patients Participating in An Inpatient Cardiopulmonary Rehabilitation Program. *Journal of Cardiopulmonary Rehabilitation* 25, 5: 270-274.

PURPOSE: To assess the effects of horticultural therapy (HT) on mood state and heart rate (HR) in patients participating in an inpatient cardiac rehabilitation program.

METHODS: Cardiac rehabilitation inpatients (n = 107) participated in the study. The HT group consisted of 59 subjects (34 males, 25 females). The control group, which participated in patient education classes (PECs), consisted of 48 subjects (31 males, 17 females). Both HT sessions and PEC are components of the inpatient rehabilitation program. Each group was evaluated before and after a class in their respective modality. Evaluation consisted of the completion of a Profile of Mood States (POMS) inventory, and an HR obtained by pulse oximetry.

RESULTS: Changes in the POMS total mood disturbance (TMD) score and HR between preintervention and postintervention were compared between groups. There was no preintervention difference in either TMD score (16 ± 3.6 and 19.0 ± 3.2 , PEC and HT, respectively) or HR (73.5 ± 2.5 and 79 ± 1.8 , PEC and HT, respectively). Immediately following the intervention, the HT TMD was significantly reduced (post-TMD = 1.6 ± 3.2 , $P < .001$), while PEC TMD was not significantly changed (TMD = 17.0 ± 28.5). After intervention, HR fell in HT by 4 ± 9.6 bpm ($P < .001$) but was unchanged in PEC.

CONCLUSION: These findings indicate that HT improves mood state, suggesting that it may be a useful tool in reducing stress. Therefore, to the extent that stress contributes to coronary heart disease, these findings support the role of HT as an effective component of cardiac rehabilitation.

