



Executive Summary

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Parks and Other Green Environments: Essential Components of a Healthy Human Habitat

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**National Recreation
and Park Association**

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Parks and Other Green Environments: Essential Components of a Healthy Human Habitat

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Executive Summary

Nature advocates and nature lovers have long claimed that parks and other green environments play an important—even crucial—role in human health. In their time, leaders such as Thoreau, Muir, and Olmsted asserted that “contact with nature” was important to psychological, physical, and spiritual health. Through the decades, parks advocates, landscape architects, and popular writers have trumpeted the healing powers of nature.

Until recently, however, these claims had not undergone rigorous scientific assessment. Are these intuitions correct? Or like so many other widely held beliefs, were they doomed to evaporate as soon as they were subjected to the harsh light of scientific scrutiny?

In the past couple decades and especially the last few years, scientists all over the world have been turning their attention to this question in diverse ways. Researchers have studied the effects of nature in many different populations, and have examined many forms of nature: Chicago public housing residents living in high-rises with a tree or two and some grass outside their apartment buildings; college students exposed to slide shows of natural scenes while sitting in a classroom; children with attention deficit disorder playing in a wide range of settings; senior citizens in Tokyo with varying degrees of access to green walkable streets; and middle-class volunteers spending their Saturdays restoring prairie ecosystems, just to name a few. The scope and variety of health outcomes and health-related outcomes have been similarly impressive.

As important as, or more important than, the diversity of this research is the rigor with which the work has been conducted. In any field with enthusiasts, you will find a plethora of well-meaning but flimsy studies purporting to “prove” the benefits of [X]. The literature on the benefits of “contact with nature” is no exception. For every rigorous study on the benefits of parks, nature-based kindergartens, horticultural therapy, and so on, there has been a cornucopia of weak findings accompanied by extravagant claims.

But in the last decade or so, rigorous work on this question has become more of a rule than an exception. No longer are studies relying solely on what research participants *report* (read: believe) to be the benefits of nature. Increasingly, benefits have been measured objectively: police crime reports; blood pressure; performance on standardized neurocognitive tests; physiological measures of immune system functioning.

Rather than relying on small, self-selected samples of nature lovers such as park-goers, scientists are increasingly relying on study populations that have no particular relationship to nature—for example, children receiving care from a clinic network targeting low-income populations, or all UK residents younger than retirement age listed in national mortality records for years 2001-2005.

And scientists are routinely taking into account income and other differences in their studies. The question is no longer, *do people living in greener neighborhoods have better health outcomes?*

(They do.) Rather, the question has become, *do people living in greener neighborhoods have better health outcomes when we take income and other advantages associated with greener neighborhoods into account*?

The answer is yes. Yes, the benefits of nature that have been intuited and written about through the ages have withstood rigorous scientific scrutiny. Yes, we still find these benefits when we measure them objectively; yes, we still find these benefits when non-nature lovers are included in our studies; and yes, we still find these benefits even when income and other factors that could explain a nature-health link are taken into account. In the face of the tremendously diverse and rigorous tests to which the nature-human health hypothesis has been subjected, the strength, consistency, and convergence of the findings are remarkable.

This monograph presents an overview of what scientists have discovered about the relationship between nature and human health, focusing on the most compelling findings. It focuses on three classic indicators of health drawn from animal research. Studies of laboratory and zoo animals, as well as animals in the wild living in degraded and fragmented habitat tells us that organisms living in unfit habitats undergo social, psychological, and physical breakdown. The scientific study of what Richard Louv has coined “nature deficit disorder” in people mirrors the animal research on unfit habitats. When we compare people with more versus less ready access to parks and other green environments, we find that they exhibit differences in well-being and functioning in each of the three trademark domains: social, psychological, and physical health.

Just as rats and other laboratory animals housed in unfit environments undergo systematic breakdowns in healthy, positive patterns of social functioning, so too do people. In greener settings—rooms, buildings, neighborhoods, and larger areas with more vegetation, we find that people are more generous and more desirous of connections with others; we find stronger neighborhood social ties and greater sense of community, more mutual trust and willingness to help others; and we find evidence of healthier social functioning in neighborhood common spaces—more (positive) social interaction in those spaces, greater shared use of spaces by adults and children. In less green environments, we find higher rates of aggression, violence, violent crime, and property crime— even after controlling for income and other differences. We also find more evidence of loneliness and more individuals reporting inadequate social support.

Access to nature, whether it is in the form of bona fide natural areas or in bits or views of nature, impacts psychological, as well as social functioning. Greater access to green views and green environments yields better cognitive functioning; more proactive, more effective patterns of life functioning; more self-discipline and more impulse control; greater mental health overall; and greater resilience in response to stressful life events. Less access to nature is linked to exacerbated attention deficit/hyperactivity disorder symptoms, more sadness and higher rates of clinical depression. People with less access to nature are more prone to stress and anxiety, as reflected not only individuals’ self-report but also measures of pulse rate, blood pressure, and stress-related patterns of nervous system and endocrine system anxiety, as well as physician-diagnosed anxiety disorders.

The impacts of parks and green environments on human health extend beyond social and psychological health outcomes to include physical health outcomes. Greener environments enhance recovery from surgery, enable and support higher levels of physical activity, improve immune system functioning, help diabetics achieve healthier blood glucose levels, and improve functional health status and independent living skills among older adults. By contrast, environments with less green are associated with greater rates of childhood obesity; higher rates of 15 out of 24 categories of physician-diagnosed diseases, including cardiovascular diseases; and higher rates of mortality in younger and older adults. Most important, all of these studies take into account the role that income might play in an apparent link between access to nature and physical health outcomes. While it is true that richer people tend to have both greater access to nature and better physical health outcomes, the comparisons here show that people *of the same socio-economic status* who have greater access to nature have better physical health outcomes.

Rarely do the scientific findings on any question align so clearly. While for scientists the search for greater understanding of how and why and when contact with nature impacts health continues, for society as a whole the findings are clear. Parks and other green environments are an essential component of a healthy human habitat. While street trees, parks, and public green spaces are often regarded as mere amenities—ways to beautify our communities and make life a little more pleasant, the science tells us that they play a central role in human health and healthy human functioning. Much like eating greens provides essential nutrients, so does seeing and being around green. To promote a healthier, kinder, smarter, more effective, more resilient, more vital populace, communities should be designed to provide every individual with regular, diverse sources of “Vitamin G.”

Chapter 1

Introduction

Homo Sapiens at the Crossroads

We humans are at a pivotal moment in our history as a species. *Homo sapiens*, a primate that evolved on the savannahs of Africa, has officially become a predominately urban species, with more than 50% of us worldwide living in towns and cities. What kind of world are we creating for ourselves (and other species)? What kind of world *should* we create for ourselves?



Source: <http://blog.nature.org/2010/01/the-great-urbanization/>

According to the United Nations' Population Division, the moment in which *Homo sapiens* officially became an urban species occurred sometime in 2008¹. By 2030, roughly 70% of humanity will live in urban areas, and if present trends continue, those areas will be less and less green—with fewer street trees, fewer gardens and parks, fewer green elements, and fewer green views. In the last couple decades, we as a species have moved from living, working, and playing in predominately natural landscapes to living, working, and playing in predominately human-made settings, surrounded by human-made objects, human technologies, human-made climate, and human-made forms of stimulation and entertainment.

What are the implications of this change in habitat for our species? On the one hand, a hallmark of *Homo sapiens* is our adaptability to different environments and conditions—humans are found in nearly

¹ United Nations Population Fund. (2007). State of World Population 2007: Unleashing the Potential of Urban Growth. New York, NY.

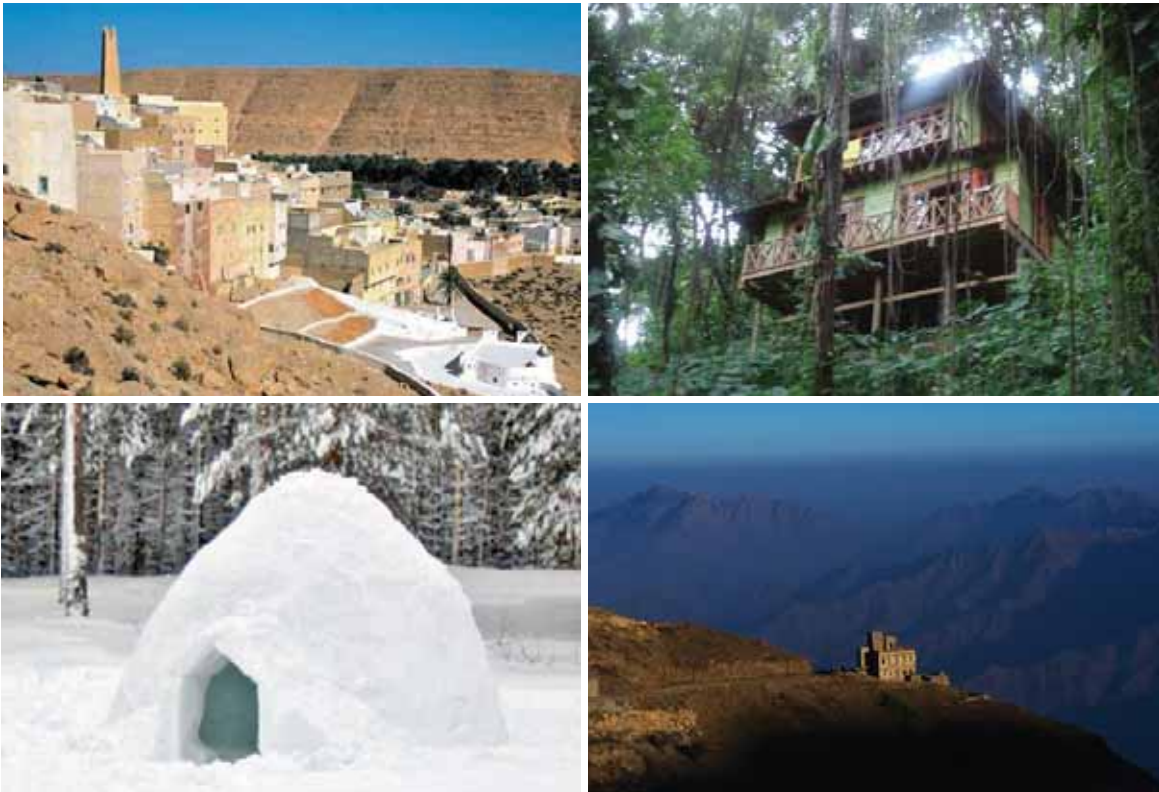
40%:4%

The percentage of children ranking “watching TV or playing computer games” as most important to them, as compared to the percentage ranking “saving the environment” as most important to them. From a survey of more than ten thousand 5- to 18-year-olds in ten countries worldwide.

every corner of the planet, from tropical jungle to arid drylands, from valleys to mountain tops, from coastal lands to interiors, from the frozen north to the Sahara. And we’ve proven clever at turning otherwise inhospitable places into comfortable places through the miracles of irrigation, heating, cooling, and the long-distance transport of goods. It might appear that, for we humans, “all the world is our oyster”.

“First we shape our dwellings; thereafter, they shape us.”

– Churchill, 1943.



Images of human dwellings in diverse environments. NOTE: Larger images are available at the links provided.²

² Rainforest (tropical jungle) dwelling from: <http://media-cdn.tripadvisor.com/media/photo-s/01/2d/37/b8/a-kanopi-treehouse.jpg>
 Arctic dwelling: <http://www.east-haven.k12.ct.us/eha/grade4/nativeampeaslee/inuites/shelter.htm>
 Mountain top: http://www.flickr.com/photos/phil_marion/2556978831/
 Valley dwelling: <http://unesdoc.unesco.org/images/0014/001453/145300e.pdf>
 View of Dwellings in the M'Zab Valley, Algeria, 2002 © Olivier Brestin

On the other hand, humans evolved in the natural world, surrounded by natural elements, organisms, and processes. For 99.95% of the last two million years, our species has been on an extended camping trip, living in the wild and making our way by hunting and gathering; only in the last 10,000 years did we move into our first villages and develop agriculture. In what ways did this evolutionary history shape us to be tuned to nature, in ways we might only dimly recognize? In creating a human-made world increasingly cut off from nature, is it possible that we routinely overlook some key requirements for a healthy human habitat?

The patterns of diet observed in developed nations suggest that we don't always know, or choose, what's best for us. Given ready access to a wide variety of foods, the diet that humans gravitate toward is deadly suboptimal, and even actively unhealthy. As the principal caretakers of our bodies, we choose to eat more fat, sugar, and salt than our bodies can handle, and less fiber, less citrus, and fewer leafy greens than our bodies need. There is nothing to guarantee that human habitat choices are optimal, either.

Just how suboptimal is the affluent diet?

The diet we gravitate toward when we have a lot of choice is suboptimal—but just how suboptimal is it? Thirteen members of the Tarahumara Indian tribe, a Mexican people with a very low incidence of risk factors for coronary heart disease, were given a diet typical of affluent societies for five weeks. The affluent diet, with generous quantities of cheese, butter, lard, egg yolks, white flour, soft drinks, table sugar and jelly, stood in striking contrast with the Tarahumaras' traditional diet of corn tortillas and pinole (a corn-based drink). After just five weeks, the affluent diet had produced an average increase of 39 percent in "bad cholesterol" (low-density lipoprotein), and participants had gained substantial weight—7% of their prior body weight, or 8 pounds on average. "I think the study shows how universal the effect of that [affluent] diet is," says Martha McMurry, R.D., one of the authors. "Human beings in general cannot adjust to this diet without developing long-term health problems."³

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What Scientists Have Found: "Vitamin G" and the Healthy Human Habitat

Ironically, just at the moment in our evolutionary history when we have turned decisively toward an urban existence with less and less contact with nature, scientists studying the impacts of the physical environment on people have discovered the importance of our connection to the natural world. In the last two decades, research on the impacts of green environments on human social, psychological, and physical health has burgeoned, and the evidence for the link between nature and human health has become so convincing that researchers have taken to using the phrase "Vitamin G" to capture nature's role as a necessary ingredient in a healthy life⁴ (Maas, 2008). Much as nutrition scientists have discovered that fruits and vegetables play a crucial role in a healthy human diet, environmental scientists have discovered that trees, parks, and natural elements play an essential role in a healthy human habitat.

This monograph provides a sampling of some of the most surprising, interesting, and compelling evidence on "nature deficit disorder". Because such a tremendous collection of relevant studies has now accumulated, an all-inclusive description of each piece of evidence is neither feasible nor desirable. This review provides merely a sampling from the buffet, concentrating on two aims: quality and variety of evidence. Wherever possible, the focus here has been on studies employing objective measures rather than self-report measures; experimental designs or large-scale studies with statistical controls versus small, correlational studies; and studies where contact with nature is the focus of study, as opposed to studies where nature is part of some larger topic, such as nature programs, or differences between rural and urban

³ McMurry, MP, Cerqueira, MT; Connor, SL; & Conner, WE. (1991). Changes in lipid and lipoprotein levels and body weight in Tarahumara Indians after consumption of an affluent diet. *New England Journal of Medicine*, 325(24):1740-2.

⁴ Maas, J. (2008). *Vitamin G: Green environments- healthy environments*. Utrecht: Nivel

areas. All studies described here have been drawn from published scientific journal articles and have thus withstood rigorous scientific review.

Of the many dozens of rigorously conducted, interesting, high quality studies that have been conducted, the collection here is designed to show the tremendous variety of ways in which scientists have gone about answering this question. This sampling is chosen to highlight the diversity of ways in which lack of contact with nature leads to social, psychological, and physical dysfunction, and the diversity of ways in which regular contact with the natural world helps humans thrive, enables us to be robust and resilient in the face of challenges and perturbations, and promotes optimal functioning. Many excellent studies—and a handful of brilliant ones—have been omitted in favor of showing the diversity of populations, measures of health, and nature comparisons employed in the larger body of work.

Why the emphasis on variety, as well as quality? Not only does presenting a variety of studies potentially make for more interesting reading, but the diversity of the evidence base itself adds scientific rigor. Every measure, every research method, every study has its limitations. True experiments give us confidence in the cause-and-effect relationship in what we're studying—they tell us, yes, A really does cause B. But true experiments are extremely expensive to conduct, and therefore can be conducted on a relatively small number of people. By contrast, large-scale correlational studies give us some confidence that their findings are true of more than just some small subset of people and circumstances, but generally give us less confidence in a cause-and-effect relationship between nature on the one hand, and health on the other. When evidence from a broad range of investigators, measures, research methods, populations, and circumstances all points to the same conclusion, the convergence of evidence gives us confidence that the findings transcend the flaws of any single study or method.

Chapter 2

Social Functioning and Breakdown

Laboratory and zoo animals housed in unfit habitats show disruptions in social behavior and functioning. As biologists have long observed, keeping animals in unfit physical environments can play havoc with their patterns of interaction, transforming them from smooth and largely positive to markedly antisocial and aggressive.



Source: http://farm1.static.flickr.com/103/287075034_fc100836f4.jpg

As early as 1965, Leyhausen described the effects of unnatural crowding on cats that formerly got along companionably: "...the community turns into a spiteful mob. They all seldom relax, they never look at ease, and there is a continuous hissing, growling, and even fighting. Play stops altogether..."⁵ Calhoun documented even more extreme forms of social dysfunction among rats, including cannibalism and atypical and nonfunctional nest construction, with infant mortality rising to 96%.⁶ Thus in nonhuman animals, unfit habitats lead to markedly less positive, less healthy patterns of interaction among individuals and even between parent and offspring.

To what extent are these patterns of social dysfunction true of people housed in settings with a deficit of natural elements and views? While the effects are not nearly as severe as Leyhausen and Calhoun documented for laboratory animals, they are similar in kind: antisocial behavior increases, and prosocial behavior decreases.

In one of the poorest neighborhoods in America—Chicago's Robert Taylor Homes—scientists examined levels of aggression and violence among residents of the high-rise apartment buildings. They found that residents of apartment buildings facing views of only concrete and asphalt reported systematically higher levels of aggression and violence than did their counterparts living in identical buildings with views of trees

⁵ Leyhausen, P. (1965). Maternal Behavior in Mammals. *Zeitschrift Fur Versuchstierkunde*, 7 (1-3), 96

⁶ Calhoun, J.B. (1963). Population Density and Social Pathology. *Scientific American*, 32 (February): 139-148.

and grass.⁷ Asked about different forms of aggression they had engaged in during conflicts with their partner, residents in barren buildings reported more psychological aggression, more mild violence, and more severe violence, as well as more aggression overall than did residents of greener buildings. Asked about aggression in conflicts with their children, residents of barren buildings also reported using a greater range of psychologically aggressive behaviors, but showed no differences in other forms of aggression.



More and less green apartment buildings at Robert Taylor Homes

Photo credit: William Sullivan

The differences in aggression were found even though residents are assigned to apartments purely on the basis of whose name is at the top of the years long waiting list when an apartment becomes available. Further, residents in barren buildings showed no preexisting differences from their neighbors in greener buildings. They were similar in age, education, employment, income, size of household, marital status, number of children, years in apartment, years in public housing, health ratings, health symptoms, alcohol use, prescription drug use, and other drug use. What distinguished them was simply that they had been unlucky enough to be assigned to buildings with relatively barren surroundings.

Might the differences in reported aggression and violence in barren buildings simply reflect a grimmer outlook—and memories—on the part of their residents, as opposed to actual differences in aggressive incidents? A follow-up study in another of America's poorest neighborhoods, Ida B. Wells low-rise apartment development, suggests the aggression residents are reporting is real.⁸ In this study, scientists pored over two years' worth of police crime reports from more than 98 apartment buildings, and found systematically more violent crimes in the buildings with the least vegetation. The effects of nature deprivation on aggression reported by residents of barren high-rise buildings are mirrored by police reports of assault, batteries, robberies, and homicides in barren low-rise apartment buildings.

⁷ Kuo, F.E., & Sullivan, W.C. (2001). Aggression and Violence in the Inner City: Effects of Environment via Mental Fatigue. *Environment & Behavior*, Special Issue, 33(4), 543-571.

⁸ Kuo, F.E., & Sullivan, W.C. (2001). Environment and crime in the inner city: Does vegetation reduce crime? *Environment & Behavior*, 33(3), 343-367.



Relatively barren and relatively green courtyards at Ida B. Wells

Photo credit William Sullivan

Interestingly, police crime reports for property crimes at Ida B. Wells show a similar pattern to those for violent crimes. Thefts, vehicle thefts, burglary, and arson are higher for buildings barren of tree and grass cover. Combining violent and property crimes, we see that levels of nearby vegetation accounted for a substantial percentage of the total number of crimes reported per building. Compared to buildings with low levels of vegetation, those with medium levels had 42% fewer total crimes, 40% fewer property crimes, and 44% fewer violent crimes. The contrast between low and high levels of vegetation was even more striking. Buildings with high levels of vegetation had 52% fewer total crimes, 48% fewer property crimes, and 56% fewer violent crimes than buildings with low levels of vegetation.

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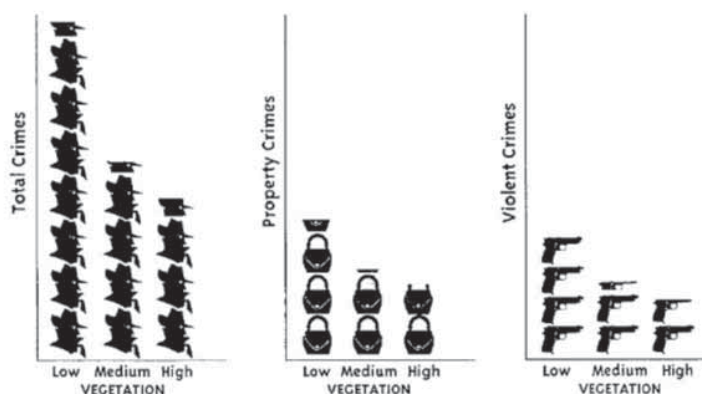


Figure 1: Mean number of crimes reported per building with different amounts of vegetation (each icon is one reported crime)

A former mayor speaks on the relationship between parks and other public spaces and crime:

How have public spaces helped change Bogotá?

For one thing, we've seen a reduction in crime. And people have a different attitude toward their city. In the worst recession we've ever had, people were asked to pay a 10 percent voluntary tax to support various city services, including parks. More than 40,000 people did so, which I think speaks to the greater sense of community people feel.⁹

⁹ From his interview with Susan Ives in *Land & People*, Fall 2002. The Politics of Happiness: A conversation with Enrique Peñalosa. http://www.tpl.org/tier3_cd.cfm?content_item_id=10710&folder_id=2225

Patterns of aggression and crime at Ida B. Wells and Robert Taylor Homes tell us that greener environments reduce aggressive behavior. When we examine the flip side of aggression and crime to look at positive social behavior—acts of neighboring, caring, and friendliness, we find that vegetation is associated with better social behavior across the board. More green translates to less aggression, less transgression, more socializing, and more acts of caring.

At Ida B. Wells, the low-rise neighborhood, many apartment buildings are arranged around common courtyards; some of these courtyards have ample tree cover while others have minimal or no tree or grass cover.¹⁰ Scientists examined patterns of social functioning around these different courtyards and found striking differences. Whereas common spaces without trees or grass tended to be more or less abandoned, outdoor common spaces with trees received considerable use—and the more trees in a courtyard, the more people were observed using it simultaneously. These findings suggested that trees might contribute to a number of positive outcomes—crime deterrence through the presence of “eyes on the street,” supervision of children’s outdoor play, and opportunities for neighbors to meet and form social ties.



Relatively barren and relatively green courtyards at Ida B. Wells (aerial photo)

Photo credit William C. Sullivan

Further work at Robert Taylor Homes confirmed that the presence of trees and grass in common spaces encourages their use, and that the more a courtyard is used, the stronger the neighborhood social ties among residents sharing that space. Individuals living adjacent to relatively green common spaces knew more of their neighbors, reported their neighbors were more concerned with helping and supporting one another, had a stronger feeling of belonging, and had more social activities and more visitors.¹¹

¹⁰ Kuo, F.E., Sullivan, W.C., Coley, R.L., & Brunson, L. (1998). Fertile ground for community: Inner-city neighborhood common spaces. *American Journal of Community Psychology*, 26(6), 823-851

¹¹ Kuo, F.E., Sullivan, W.C., Coley, R.L., & Brunson, L. (1998). Fertile ground for community: Inner-city neighborhood common spaces. *American Journal of Community Psychology*, 26(6), 823-851

Social Ties as the First Line of Defense for Social Services

While neighborhood social ties are welcome and appreciated in all populations, they may serve an especially critical function in low-income communities, particularly among female heads of household. In poverty, an important survival strategy is to share resources through family and friendship networks (Belle, 1982)¹². Because poor families tend to be limited in mobility and have limited access to more distant family and friends, they may have few options other than nearby neighbors for resource-sharing (Riger and Lavrakas, 1981)¹³. In low-income inner-city communities, neighborhood social ties may provide an informal safety net that serves as the first line of defense before individuals turn to social services.

The green effect on people's prosocial behavior is visible not only at a relatively small scale—when we compare different buildings in the same neighborhood—but also at a larger scale, when we compare neighborhoods with one another. Scientists examined 65 census tracts in Los Angeles (a census tract contains around 4,000 people), and discovered that people living in census tracts with parks report higher levels of mutual trust and willingness to help one another than their counterparts living in census tracts without parks. This relationship holds true even when researchers take into account other differences between census tracts that could affect levels of trust and aid in a community, such as overall levels of poverty, the number of liquor outlets, and the number of elementary schools. The researchers also took into account differences in the survey respondents such as age, education, income, sex, marital status, employment, and ethnicity from one census tract to another.

Urban Parks as Green Walls or Green Magnets? Interracial Relations in Neighborhood Boundary Parks

Adapted excerpts from an article by Paul H. Gobster.

In large metropolitan areas, it is not uncommon for parks to be located between racially different neighborhoods—for example, you might find a park sandwiched by a Polish neighborhood on one side and an Hispanic neighborhood on the other. What is the role of these “boundary parks” in interracial relations?¹⁴

In a 1995 paper, William D. Solecki and Joan M. Welch discuss how boundary parks can become “green walls,” buffering people from different groups from coming into contact or interacting with each other.¹⁵

Using Chicago's successful Warren Park as a case study, U.S. Forest Service scientist Paul Gobster provides a different perspective, suggesting that parks need not always act as green walls, but can instead act as “green magnets.” He suggests some specific ways the design and management of boundary parks can turn them into “active agents in improving interracial

relations.” Here are a few of Gobster's ideas for making boundary parks green magnets:

- Locate high-use facilities such as play lots, trails, and field houses along the perimeter of the park where they are visible and easily accessible, rather than in the center, “out of sight and out of mind;”
- Provide a full range of facilities and a full range of programs that draw diverse audiences throughout the year;
- Provide good physical management of the site and good supervision of its users.

Running through these suggestions is a simple common thread: by creating venues that attract diverse residents into comfortable, safe, and positive shared activities, parks can play a crucial role in bringing different groups of people together.

¹² Belle, D.E. (1982). The impact of poverty on social networks and supports. *Marriage and Family Review*, 5(4), 89-103.

¹³ Riger, S., & Lavrakas, P.J. (1981). Community ties: Patterns of attachment and social interaction in urban neighborhoods. *American Journal of Community Psychology*, 9, 55-66.

¹⁴ Gobster, P.H. (1998). Urban parks as green walls or green magnets? Interracial relations in neighborhood boundary parks. *Landscape and Urban Planning*, 41: 43-55

¹⁵ Solecki, W.D., and Welch, J.M. (1995). Urban Parks- Green Spaces or Green Walls. *Landscape and Urban Planning*, 32(2), 93-106

The green effect on social functioning and health extends far beyond urban, low-income, minority populations in Chicago and Los Angeles. A Dutch study of more than 10,000 households in the Netherlands used aerial photographs of the percentage of vegetation within 1 km and 3 km of each household's address and used it to predict residents' social integration and sense of being connected with others.¹⁶ The less green a person's living environment is the more likely that person is to report feeling lonely and report not having adequate social support. The study included households from a wide range of living conditions, from rural to heavily urban, and took respondents' income and other characteristics into account.



Source: http://www.homexchangevacation.com/photos/9017_1_32f8ca819b4cc6773704f2a4c05bad64.jpg



Source: http://images.travelpod.com/users/green/netherlands.1125390540.canal_boat_trip_008.jpg

A recent study has replicated these findings in the micro-environment, at the scale of rooms, as well as buildings and neighborhoods. Scientists at the University of Rochester conducted a series of painstakingly rigorous, carefully controlled studies in which they randomly assigned college students and graduate students to view either slides of nature scenes or cityscapes.¹⁷

¹⁶ Maas, J., van Dillen, S.M.E., Verheij, R.A., & Groenewegen (2009). Social contacts as a possible mechanism behind the relation between green space and health. **Health and Place**, 15(2): 586-595.

¹⁷ Weinstein, N., Przybylski, A.K., & Ryan, R.M. (2009). Can Nature Make Us More Caring? Effects of Immersion in Nature on Intrinsic Aspirations and Generosity. **Personality and Social Psychology Bulletin**, 35(10): 1315-1329



University students watched slideshows of either nature scenes or cityscapes before scientists measured the students' caring for others.

Images taken from Weinstein et al (2009).

After the slide show, students who reported feeling immersed in the places shown also showed changes in their “social aspirations.” After immersion in nature scenes, students resonated more with altruistic, other-focused aspirations such as having deep, enduring relationships and working toward the betterment of society. Moreover, given five dollars and asked to decide how to distribute it, students were more generous and less likely to keep the amount for themselves after immersion in nature. By contrast, students immersed in cityscapes reported increased self-focused aspirations such as being financially successful and being admired. The pattern of increased generosity after nature immersion held when the nature and cityscape slide shows were replaced with the presence and absence of live plants in an office-like setting. Students immersed in the setting with living plants were more generous; students immersed in the setting without plants were less generous.

Greener rooms, greener buildings, and greener neighborhoods produce healthier social behavior and less social dysfunction. If contact with nature can help people be their kinder, gentler selves, perhaps greening cities could help rid urban societies of some of their most striking social ills—violence, aggression, and social disintegration.

Chapter 3

Psychological Functioning and Breakdown

Parks and vegetation enhance psychological health. It's no surprise to many that a quiet walk in a park, a few minutes of gardening, or gazing out onto a green window view can bring a sense of well-being and a restful calm. But the familiar impacts of green spaces on our moods go far beyond merely small, momentary changes in our emotional states: being in and around green space has measurable effects on our physiology, functioning, and mental health status.

Psychological benefits of gardens, as reported by hospital patients and their visitors	
How do you feel after spending time in the garden?	
• More relaxed, calmer	79%
• Refreshed, stronger	25%
• Able to think/cope	22%
• Feel better, more positive	19%
• Religious or spiritual connection	6%
• No change of mood	5%
What is it about the garden that helps you feel better?	
• Trees, plants, nature	59%
• Smells, sounds, fresh air	58%
• Place to be alone or with friend	50%
• Views, sub-areas, textures	26%
• Practical features, benches, etc.	17%
• Don't know	8%

Responses from 143 garden users at four San Francisco Bay Area hospitals

From Cooper, Marcus, C. and M. Barnes. (1995). *Gardens in Health Care Facilities: Uses, Therapeutic Benefits, and Design Considerations*. Martinez, CA: The Center of Health Design.

Alleviating Stress and Anxiety

In the study of how green environments affect us, much scientific attention has gone toward the impacts of green environments on stress and anxiety. Dozens upon dozens of studies have been conducted on this topic, and while not every measure of stress or anxiety shows a nature effect in every study, the overall pattern of findings is crystal clear. Although green environments don't always reduce stress, they certainly can, and generally do.

In Japan, *shinrin-yoku*—taking in the forest atmosphere, or “forest bathing”—is believed to have health benefits, and scientists there have been testing this idea. A series of field experiments involving 280 male college students and 24 forests across Japan has yielded an astonishing collection of findings.¹⁸ In each study, six participants walked in and viewed a forest on one day and a city on another; another six participants experienced the city first, and then the forest. Each participant was subjected to a panel of stress

¹⁸ Park, B.J., Yuko Tsunetsugu, Tamami Kasetani, Takahide Kagawa, and Yoshifumi 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.

measures in the morning before breakfast, just before their environmental exposure, and just after. The results show that a 15 minute session of walking in a forest environment reduces stress more than the same experience in a city environment, as measured by a wide range of indicators: lower concentrations of cortisol, lower pulse rate, lower blood pressure, greater parasympathetic nerve activity, and lower sympathetic nerve activity. These findings indicate that both components of the human endocrine stress system are reliably affected by a 15-minute exposure to a forest environment. Both the sympathetic adrenal medullary axis, which helps the body prepare to deal with a stressor, and the hypothalamic-pituitary-adrenal axis, which shows aftereffects of stress—show positive effects of a small dose of nature.



Forest viewing and walking

The effect of green environments on stress and anxiety is by no means limited to momentary exposures, forest environments, or male college students. Scientists examined the prevalence of physician-diagnosed anxiety disorders in more than 345,000 residents of the Netherlands—male, female, and of all ages—and found substantially lower rates of anxiety disorders among those living in relatively green areas than among those living in less green areas, where “green” was measured in terms of parks, agricultural lands, and other forms of green open space.¹⁹ In residential areas with 10% green space, the annual prevalence rate was 26 out of 1,000; in residential areas with 90% green space, the annual prevalence was 18 per 1,000. The association between green space and psychological health was strongest for the groups most likely to spend a lot of time near home—children, individuals with low levels of education and income, and individuals between the ages of 45 and 65. It’s important to note that the link between green environments and anxiety was not found in the densest, most urban areas. This may be because the nature measured in the study did not include the smaller bits of green—gardens, street trees—that may be the most important sources of nature in highly dense urban settings.²⁰

Why does it matter how stressed and anxious individuals feel? Anxiety is not merely uncomfortable, but has ramifications for health and functioning. Two interesting studies illustrate the importance of green environments’ effect on stress and anxiety. The first examines the relationship between green workplaces and work-related stress. In a study comparing job satisfaction and job stress in 931 office workers with and without window views of trees in Seoul, those employees who had views of trees from their workplace reported significantly less job stress and significantly more job satisfaction, regardless of their age, gender, or—most importantly— job category.²¹ Reducing job stress and increasing job satisfaction is, in turn, likely to have a number of important payoffs for employers, including increased productivity, reduced absenteeism, and reduced employee turnover.

¹⁹ Maas, J, Verheij, RA, Vries, S, Spreeuwenberg, P, Schellevis, FG, & Groenewegen, PP. (2009). Morbidity is related to a green living environment. *J Epidemiol Community Health*, 0, 1-7.

²⁰ Ulrich RS, Simons RF, Losito BD, Fiorito E, Miles MA, & Zelson M. (1991). Stress recovery during exposure to natural and urban environments. *J. Environ. Psychol* 11(31):201-230.

²¹ Shin WS. (2007). The influence of forest view through a window on job satisfaction and job stress. *Scand J Forest Res* 22(3):248-53.

A second study, conducted in rural upstate New York, shows some of the benefits of green environments' stress-relieving properties for children.²² Researchers examined the impacts of green environments on rural children's resilience in the face of stressful life events. The greenness of 337 third to fifth graders' residential environments was assessed with questions about the view from their living room, the ground surface just outside their home (e.g., grass or concrete), and the presence of indoor plants inside the home. Children living in relatively green environments were found to be more resilient. Stressful life events such as family strife, divorce, and being picked on in school generally yield greater psychological distress and lower ratings of global self-worth in children, but this relationship is dampened in greener households. It may be that daily exposure to a green environment can act much like shock absorbers that cushion the impact of bumps in the road, helping children achieve and maintain a sense of calm and well-being despite challenges and losses in their lives.

Easing Depression

Spending time in green environments can relieve not only anxiety and stress, but also sadness and depression. In the Dutch study on anxiety, above, the annual prevalence of physician-classified depression in areas containing 10 percent green space was 32 per 1,000; in areas containing 90 percent, it was 24 per 1,000. Along the same lines, a longitudinal study of more than 6,900 adults examined the impacts of volunteering on mental health over a 20-year period²³, and found that people who volunteered for environmental organizations in midlife in 1974 reported lower levels of depression in 1994. Environmental volunteers are half as likely as non-volunteers to show depressive symptoms 20 years later, whereas other forms of volunteering lower one's risk (for depression) by roughly 10 percent. The study accounted for income and other factors.

In Their Own Words: Older Adults Describe Their Experience of a Garden Walk Program

- I like being in the garden before anyone else is there.
- I liked the peace and serenity of the garden.
- Every time I came to the garden I saw something different. Each day the garden had different surprises for me. When the weather was cloudy the garden looked entirely different than when it was sunny.
- When I want to be peaceful in my heart now, I just stop and think of the garden.
- I had good days and bad days before the garden, but now I really look forward to my own time and interaction with the garden. I actually think I have become addicted to coming here and spending time reflecting about my life.
- I learned a lot about myself in the garden. The walk gave me time to think about my life (the good and the bad) and to come to terms with who I am and how I lived my life. I had not done this before and am so grateful to have had this opportunity.
- I think everyone should have the wonderful experience of walking in this peaceful garden. I loved the sound of the bamboo—one day when it was a little windy, the bamboo was swishing and cracking and I stood there for over an hour.

Statements from participants in a six-week garden walk program at Morikami Park in Boca Raton, Florida, in which older adults took walks at their own pace twice a week in a Japanese garden, stopping as needed for rest and reflection.

McCaffrey, R. and Lynn, C.E. (2007). The effect of healing gardens and art therapy on older adults with mild to moderate depression. *Holist Nurs Pract* 21(2):79-84.

²² Wells, N.M. & Evans, G. (2003). Nearby nature: A buffer of life stress among rural children. *Environment & Behavior*, 35(3), 311-330.

²³ Pillemer, K, Fuller-Rowell, TE, Reid, MC, & Wells, NM. (2010). Environmental volunteering and health outcomes over a 20-year period. *The Gerontologist*, 1-9

Promoting Optimal Functioning

Thus far, all the psychological effects of green environments presented here have pertained to emotion: anxiety, depression, and other stress-related emotions as well as the physiological sequelae of such emotions. Another large and well-documented category of green effects has to do with cognition: concentration, being able to think well enough to deal with major challenges in one's life, and attention deficit/hyperactivity disorder (AD/HD).

One example of a study on green environments and concentration comes from an assisted living community in Lund, Sweden.²⁴ Fifteen elderly residents of the community (average age, 84; highest age, 97) were asked to spend an hour resting in a green outdoor setting on one occasion, and an hour resting indoors in their favorite room on another. Seven residents had their garden session first; eight had their indoors session first. All underwent tests of concentration before and after their sessions. Results indicate that powers of concentration increase for the elderly after an hour in a green setting outside their geriatric home, whereas an hour in their favorite room had no effect.



Photo taken in the grounds surrounding the buildings at the Martenslund old people's home

Cognitive Abilities Play a Key Role In Older Adults' Capacity for Independent Living

Cognitive declines lead to increased difficulty with what gerontologists call "instrumental activities of daily living,"²⁵ and older adults who receive cognitive training show significantly less subsequent decline in everyday functioning.²⁶ Thus regular time in green environments has the potential to extend older adults' independence. As the old and very old constitute an increasingly large proportion of the population, finding ways of promoting optimal functioning among seniors has tremendous ramifications for seniors themselves, their families, and society.

²⁴ Ottosson, J., & Grahn, P.A. (2005). 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, 23-55.

²⁵ Stuck AE, Walther JM, Nikolaus T, Bula CJ, Hohmann C, Beck JC. Risk factors for functional status decline in community-living elderly people: a systematic literature review. *Soc Sci Med*. 1999; 48:445-469.

²⁶ SL Willis, SL Tennstedt, M Marsiske, K Ball, J Elias, KM Koepke, JN Morris, GW Rebok, FW Unverzagt, AM Stoddard & E Wright. 2006. Long-term Effects of Cognitive Training on Everyday Functional Outcomes in Older Adults. *JAMA* 296(23):2805-2814.

Another study examining the links between green environments, cognitive functioning, and life functioning comes from Robert Taylor Homes in inner-city Chicago (the site of the aggression and violence findings described in Chapter 2).²⁷ In Chicago public housing, residents are randomly assigned to identical apartment buildings. Some of these buildings are surrounded entirely by asphalt and concrete; others have the occasional tree or a bit of grass. Residents' performance on tests of concentration and their self-reported effectiveness in managing the most important challenges in their life were compared across more green and less green apartment buildings.



A “green” view at Robert Taylor Homes—note the contrast between this “green” environment and the one in the Martenslund geriatric home—green environments range from lush to fairly minimal.

Residents living in buildings without nearby trees and grass reported more procrastination in facing their major challenges and assessed their challenges as more severe, less soluble, and more long-standing than did their counterparts living in greener surroundings. Residents of the greener and less green apartment buildings did not differ in personal characteristics, household characteristics, well-being, substance abuse, social ties, or attitudes toward nature. Statistical tests showed that the enhanced effectiveness of residents in greener buildings at managing life problems could be traced to their enhanced ability to concentrate.

The Lund and inner-city Chicago findings, taken together, indicate that the psychological benefits of green environments can be found for both lush green settings such as those at the retirement home, and the minimally green settings found in urban public housing and for both younger and older adults. Another study from the same Chicago public housing development extends these findings to children, and to a different aspect of optimal functioning: self-discipline. Three aspects of self-discipline were tested: the

Why Self-Discipline Matters—Especially For Poor, Inner City Youth

Self-discipline is an important personal characteristic, perhaps nowhere more so than in poor, dangerous inner-city neighborhoods. The greater a young person's capacity to resist distraction, the better they perform in school²⁸; the more a young person is able to control their impulses, the less likely they are to fall prey to the temptations of drug use or unprotected sex²⁹; and the more a young person is able to delay gratification, the more able they are to make the short-term sacrifices that are so important in achieving later success³⁰.

²⁷ Kuo, F.E. (2001). Coping with Poverty: Impacts of environment and attention in the inner city. *Environment & Behavior*, 33(1), 5-34

²⁸ Mantzicopoulos, P.Y. (1995). A comparison of boys and girls with attention problems: Kindergarten through second grade. *American Journal of Orthopsychiatry*, 64(4), 522-533

²⁹ Donoghue, M.J. and Ree, R.H. (2000). Homoplasy and developmental constraint: A model and an example from plants. *American Zoologist*, 40(5), 759-769

³⁰ Shoda, Y., Mischel, W., Peake, P. K. (1990). Predicting adolescent cognitive and self-regulatory competencies from preschool delay of gratification: Identifying diagnostic conditions. *Developmental Psychology*, 26(6), 978-986.

ability to resist distractions, the ability to inhibit impulses, and the ability to delay gratification. On each of these measures, girls who lived in greener apartments scored higher than their counterparts. Boys, however, showed no differences, perhaps because boys spend less time in and around the home.

Reducing Attention Deficit Symptoms

A number of studies has examined whether green environments enhance attention in children with attention deficits. In one, 7- to 11-year old children diagnosed with attention deficit/hyperactivity disorder (ADHD) took individual, guided 20-minute walks in each of three quiet, safe Midwestern settings—a neighborhood, a downtown area, and an urban park. After each walk, the children went indoors and were given tests of concentration by a researcher who did not know which walk they had just been on. Children's concentration performance was better after the walk in the park than after the walks in the other two settings, regardless of the order in which the walks were taken. The difference in performance after the park walk was surprisingly large – as large as, or larger than, the peak performance boosts shown for two widely prescribed ADHD medications- Metadate CD and Concerta- on a similar task.

Another study in this line of investigation tells us that the green effect for children with ADHD is not limited to exposure gained through walks, or to Midwestern park settings, or to 7- to 11-year-olds. More than 450 parents nationwide were presented with a list of common after-school and weekend activities and asked to rate the aftereffects of those activities—as conducted in different social and physical settings—on their child's ADHD symptoms. Parents consistently rated activities conducted in relatively green settings as having helpful effects on symptoms. Moreover, parents rated activities in green settings as more helpful than activities conducted indoors or in outdoor settings without vegetation. The green advantage was found across the board: in boys and in girls; in children from 5- to 18-years old; in children living in different sized communities, from rural to inner-city; and in all different parts of the country.

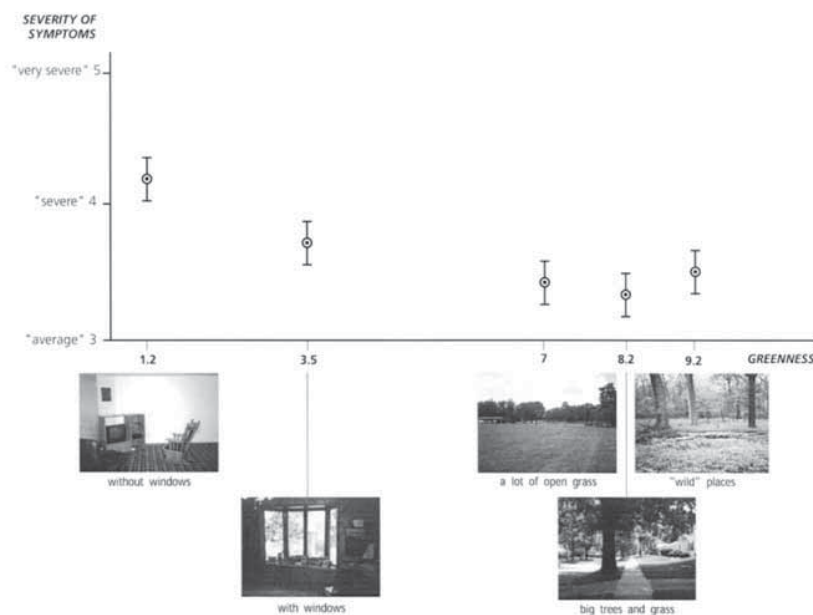


Figure 2: Mean Severity of Attention Deficit Symptoms for Five Play Settings

The greener a child's play environment, the less severe their attention deficit symptoms are in general. From Faber, Taylor, Kuo, & Sullivan (1998). *Coping with ADD. Environment & Behavior*.

AD/HD: A Problem Worth Solving

The Mayo Clinic assesses the prevalence of AD/HD at over 7% of school-aged children, or roughly 1 in 13 children.³¹ Current treatments—drugs and behavioral therapy—offer only limited relief, and the drugs sometimes have side effects, including sleep disturbances, lack of appetite, flattened affect, and slowed growth.

The financial ramifications of AD/HD are considerable. Total excess cost of AD/HD in the US in 2000 was \$31.6 billion. Of this total, \$1.6 billion was for the treatment of patients, \$12.1 billion was for all other health care costs of persons with AD/HD, \$14.2 billion was for all other health care costs of family members with AD/HD, and \$3.7 billion was for the work loss cost of adults with AD/HD and adult family members of persons with AD/HD.³²

Promoting Overall Mental Health

Given the impacts of green space on stress, anxiety disorders, depression, cognitive and life functioning, and attention deficit disorders, it is perhaps not entirely surprising to find that green space improves mental health overall. Researchers in Australia surveyed Adelaide residents about their neighborhood and their mental health.³³ More than 1,800 people responded. Even after adjusting for income and other differences, survey respondents who reported living in highly green neighborhoods were 1.6 times more likely to have better mental health than respondents who reported the lowest level of neighborhood greenness.

The Hidden Common Thread: The Role of Green Experiences in Resilience

One common theme that runs through the scientific work on the psychological benefits of green environments, sometimes explicitly, and sometimes not- is the concept of resilience. Resilience is the capacity of a substance or object to recoil or spring back into shape after bending, stretching, or being compressed. In a psychological context, resilience is a person's ability to withstand or recover quickly from difficult conditions. Resilience is common to all or nearly all of the psychological effects of green environments on people reviewed here.

Green environments help people withstand and recover from threat and potential loss—which we experience on a physiological and emotional level as stress and anxiety. Green environments help people withstand and recover from actual loss—which we experience on an emotional level as depression. And green environments help people withstand and recover from the aftermath of dealing with challenging situations—which we experience as cognitive or psychological fatigue. In all these cases, green environments help us maintain and regain well-being and vitality in the face of difficulty.

By contrast, environments lacking green do not seem to aid in recovery. Measure after measure of perturbation—whether they be a racing heart; raised blood pressure; elevated cortisol levels; or feelings of distress, anxiety, anger, sadness, or fatigue—are slow to recover to baseline levels after we have been challenged in urban environments. Some environments—noisy, chaotic, illegible, or dangerous even add to our perturbation.

To the extent that life offers an abundance of losses, stressors, demands, and other perturbations, and to the extent that the urban environment itself so often adds to these difficulties, the power of green environments to help us recover becomes all the more necessary. The view of trees from a window, a walk in the park, a few moments quietly contemplating a garden at the end of the long day—all of those aid in our continued function, with the power to calm, soothe, and revitalize. The importance of green environments is all the keener for more vulnerable individuals—the young, the very old, the poor, and the infirm.

³¹ Barbaresi WJ, Katusic SK, Colligan RC, Weaver AL, Pankratz VS, Mrazek DA, & Jacobsen SJ. (2004). How common is attention-deficit/hyperactivity disorder? Towards resolution of the controversy: results from a population-based study. *Acta Paediatr Suppl* 93(445):55-9.

³² Swensen, A.R., Birnbaum, H.G., Sechik, K., Marynchenko, M., Greenberg, P., & Claxton, A. (2003). ADHD: Increased costs for patients and their families. *Journal of the American Academy of Child and Adolescent Psychiatry*, 42(12), 1415-1423

³³ T Sugiyama, E Leslie, B Giles-Corti, N Owen. Associations of neighbourhood greenness with physical and mental health: do walking, social coherence and local social interaction explain the relationships? *J Epidemiol Community Health* 62(5) 2008.

Chapter 4

Physical Functioning and Breakdown

Naturalists, landscape architects, philosophers, and urban planners have long claimed the physical health benefits of spending time in the natural world, but science has been slow to document the link between nature and physical health—and slow to even ask the question.

The first compelling scientific evidence of a link between green space and physical health came in 1984 from a suburban hospital in Pennsylvania.³⁴ In that hospital, surgical patients recovering from gall bladder operations were assigned to a number of rooms, depending on the timing of their surgery and which of the rooms happened to be available. Of those rooms, two were identical save for the view: one looked out on a natural scene—trees and some grass; the other faced a brick wall. A comparison of the records for 23 pairs of patients carefully matched in personal characteristics, characteristics of the surgery, and prognosis showed that recovery was reliably faster for the patient assigned to the room with the natural view. Patients with a green view relied on lower strength pain medications overall, received fewer negative comments in nurses’ notes, had slightly lower scores for minor postsurgical complications, and went home sooner after their operations. This study revolutionized hospital design—not only has access to nature become part of the evaluation criteria in the accreditation of hospitals, but hospitals now vie in marketing themselves as providing the most extensive and innovative spaces for healing.

Table 1: Comparison of Analgesic Doses per Patient for Wall-View and Tree-View Groups

Number of Doses						
Analgesic Strength	Days 0-1		Days 2-5		Days 6-7	
	Wall Group	Tree Group	Wall Group	Tree Group	Wall Group	Tree Group
Strong	2.56	2.40	2.48	0.96	0.22	0.17
Moderate	4.00	5.00	3.65	1.74	0.35	0.17
Weak	0.23	0.30	2.57	5.39	0.96	1.09

Can money grow on trees? More money per person is spent on health care in the United States than in any other nation in the world, and a greater percentage of total income is spent on health care in the U.S. than in any other United Nations member state except for East Timor.³⁵ These findings suggest that relatively simple changes in window placement and landscaping outside the hospital can yield reliably shorter recovery times, fewer demands on medical staff, and lower medication costs—it is perhaps not surprising that the hospital industry has recognized the financial ramifications.

³⁴ Ulrich, R.S. (1984). View through a window may influence recovery from surgery. *Science*, 224, 42-421.
³⁵ WHO (May 2009). “World Health Statistics 2009”. World Health Organization. Retrieved 2009-08-02.

Curiously, despite its provocative findings and subsequent impact on the multibillion-dollar hospital industry, this 1984 study was not followed by a spate of new studies on the connections between access to nature and health. The subsequent 15 years saw a continued dearth of research on this topic. It was almost as if the scientific community viewed the nature-health link with such skepticism that it largely refused to even conduct studies in this area. Recently however, the field has more than made up for its initial slowness in addressing the question of nature and health. In the past decade or so, dozens of extremely rigorous, often staggeringly large-scale studies have been published. Any one of these studies might be characterized as a landmark study; together, their cumulative impact is profound. Almost overnight, the idea that nature might have something to do with physical health has evolved from an interesting conjecture to a convincingly documented reality. The studies reviewed here represent only a small sampling of the burgeoning research in this area, but should give a taste of the diversity of investigators and methods of investigation, the rigor with which questions have been attacked, and the convergence of findings.

A few studies suffice to show us that the physical health benefits of parks and vegetation begin in childhood and extend across the lifespan. At one end, scientists in Indiana were curious as to whether the “greenness” of a neighborhood might be tied to rates of childhood obesity.³⁶ To find out, they used satellite photo-based measurements of neighborhood greenness to predict weight and weight gains in more than 3,800 children living in and around the Indianapolis area. A network of primary care clinics provided records of body mass index (BMI) measurements for girls and boys aged 3- to 16-years old taken two years apart; the home addresses for these children were then used to calculate the amount of tree and grass cover within a kilometer of their residence. Through statistical procedures, children were carefully equated on factors likely to impact their weight—age, sex, neighborhood income, neighborhood density, family insurance status (as a proxy for family income), and so forth. On average, children living in greener neighborhoods weighed less than their same-age, same-sex counterparts living in less green neighborhoods. Furthermore, children in greener neighborhoods were less likely to show weight gains over the two-year period than their same-age, same-sex peers, living in less green neighborhoods.

Independent Living Skills: A Lynchpin In Older Adults' Quality of Life

Independent living skills enable older adults to continue living in their own home, independently. With the loss of these skills, older adults become dependent on others. Not only do many older adults resent and fear having to rely on others after a life of taking care of themselves and others, but the financial ramifications of maintaining versus losing independent living skills are dire. “Nursing home care is expensive and many Americans are financially unprepared for this type of care. The estimated average annual cost of nursing home care is between \$67,000 and \$100,000 (MetLife Market Survey, 2006). When savings run out, those who must have nursing home care must enroll in Medicaid, which can bankrupt individuals and might eventually bankrupt the health care system.”³⁷

At the other end of the lifespan—and across the globe—Japanese scientists were interested in environmental factors predicting longevity in the very old in Tokyo, a densely populated, intensely developed megacity. In 1992, this scientific team surveyed over 3,000 elderly Tokyo residents about their residential environments; five years later, they returned to discover who was still alive and who had died.³⁸ One cluster of environmental factors consistently predicted survival, even after taking into account individuals' age, sex, marital status, socioeconomic status, and health status in 1992: the presence of walkable green streets and spaces near an individuals residence. Men and women aged 89, 84, 79, and 74 years old in 1992 were more likely to be alive five years later if they had ready access to green, walkable places and

³⁶ Bell, J.F., Wilson, J.S., & Liu, G.C. (2008). *Am J Prev Med* 2008;35(6):547–553.

³⁷ Evans, Nancy. (2008). *Older Adults and Their Care*. http://www.nursingceu.com/courses/251/index_nceu.html

³⁸ Takano, T., Nakamura, K., & Watanabe, M. (2002). Urban residential environments and senior citizens' longevity in megacity areas: the importance of walkable green spaces. *J Epidemiol Community Health*, 56:913-918.

paths. Further, those that had had easy access to green space and expressed an interest in staying in the community also reported better functional status (e.g., not needing help to get out of bed) and independent living skills at the time of the follow-up. Thus parks and vegetation enhance health in the very young, and stave off debilitation and death in the very old.

Childhood Obesity: A National Epidemic

In the last three decades, childhood obesity has skyrocketed: obesity has doubled among 2-5 year olds and 12-19 year olds, and tripled among children 6-11 years old.³⁹ By 2003-2004, fully one third of children were overweight, and 17% were clinically obese.⁴⁰

A 2009 study in the journal *Health Affairs* concluded that the costs of hospitalizations related to childhood obesity rose from \$125.9 million in 2001 to \$237.6 million in 2005. America spends as much as \$147 billion annually on the direct and indirect costs of obesity. In the year of the most recent CDC study, 2006, that made up 9.1 percent of medical spending.⁴¹ According to one estimate, children treated for obesity incur roughly three times more health care costs than the average insured child.

Tragically, children diagnosed with obesity are far more likely to be diagnosed with mental health disorders or bone and joint disorders than non-obese children, and are two to three times more likely to be hospitalized.⁴²

Campaign to get kids outside spreads to federal government, nationwide coalition

By Emily Thiersch

In 2010, the concern over childhood obesity and nature deprivation in children has reached the U.S. federal government and a broad spectrum of organizations. In June 2010, Michelle Obama launched the “Let’s Move Outside” campaign to combat child obesity and promote family health. The campaign, coordinated by the U.S. Departments of the Interior (DOI) and Agriculture (USDA), provides resources that help families locate parks, waterways, and trails—in their communities and across the country—and plan play activities.

Alongside the “Let’s Move Outside” initiative, a coalition of businesses and non-profits—including REI, YMCA, the Natural Wildlife Foundation (NWF), and others—announced a new strategic partnership. OAK, the Outdoors Alliance for Kids, is encouraging a robust government initiative to get kids outdoors, empowering young leaders by providing them with experience participating in the conservation movement, and promoting events that help connect families with the outdoors.

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To what extent do health benefits apply to the many years spanning childhood and old age? In the United Kingdom, a recent study probed the relationship between green space and mortality in the population of England in all persons of less than retirement age.⁴³ The study examined the spatial distribution of 366,348 deaths in a total study population of more than 40 million people. Using a generalized land use database from 2001, researchers calculated the percentage of green space in each of 32,482 Lower Super Output Areas (LSOAs)—LSOAs are analogous to census areas, but smaller, containing roughly 1,500 people on average. The scientists then traced every death registered and matched to an LSOA in England

³⁹ Koplan JP, Liverman KT, Kraak VI, eds. Preventing childhood obesity: health in the balance. Washington DC: The National Academies Press, 2005.

⁴⁰ Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the U.S., 1999–2004. *JAMA* 2006; 295:1549–55.

⁴¹ <http://www.cnn.com/2010/HEALTH/02/09/fact.check.obesity/index.html>

⁴² http://www.medstat.com/pdfs/childhood_obesity.pdf

⁴³ Mitchell, R. & Popham, F. (2008). Effect of exposure to natural environment on health inequalities: An observational population study. *Lancet* 372: 1655–60

between 2001 and 2005, along with the cause of death. Greener LSOAs show lower rates of mortality overall (deaths from any cause), and lower rates of mortality due to circulatory disease in particular. Further, differences in mortality rates due to income deprivation are substantially reduced in greener areas: in the least green areas, the poorest die at roughly twice the rate of the richest; in the greenest areas, the poorest die at 1.43 times the rate of the richest. In other words, ready access to parks, open spaces, and other agricultural land reduces mortality across the lifespan—not just in the elderly—and accounts for fully half of poverty-related mortality.

A study conducted in the Netherlands helps detail the breadth and scope of health effects of contact with nature. Does nature enhance health across the board? Or does it increase the prevalence of some diseases only—and perhaps decrease the prevalence of others? Scientists in the Netherlands examined electronic medical records for more than 345,000 people and tallied the prevalence of 24 disease categories derived from the International Classification of Primary Care. These categories cover the full range of the most prevalent diseases founded in general practice, and include cardiovascular diseases, musculoskeletal diseases, respiratory diseases, neurological diseases, and digestive diseases, among others (the findings for anxiety disorders and depression were described in Chapter 2).⁴⁴

For each patient, the researchers calculated the percentage of green space within one kilometer and three kilometers of their residence address and used these measures of residential greenness to predict physician-diagnosed disease categories. It is important to note that these measures of greenness did not take into account smaller “bits” of nature, such as gardens or tree lined city streets; thus the kinds of vegetation likely to be most important in highly urban settings were not included. The scientists did take demographic characteristics and socioeconomic factors into account, and they restricted their study to patients who had lived at their current address for at least a year. Out of the 24 disease clusters examined, 15 were significantly less frequent in greener environments, and none were more frequent. In sum, a whole host of different diseases is less prevalent in green environments, and this relationship is not due to income or social status differences in the people who live in greener and less green environments.

The relationship was stronger for children and individuals with lower socioeconomic status, perhaps because individuals in these groups are likely to be less mobile and spend a greater proportion of their time within one kilometer of their home. Perhaps not surprisingly given the kinds of vegetation measured, the nature-health relationship was strongest in slightly urban areas and not apparent in very strongly urban areas.

⁴⁴ Maas, J., Verheij, R.A., Vries, S., Spreeuwenberg, P., Schellevis, F.G., Groenewegen, P.P. (2009). Morbidity is related to a green living environment. *J Epidemiol Community Health*, 0, 1-7.

**Prevalence Rates per 1,000 In Living Environments with 10% and 90%
Green Space for Different Disease Clusters**

Cluster Prevalence per 1,000	10% green space	90% green space
Cardiovascular		
High blood pressure	23.8	22.4
Cardiac disease	4.7	4.0
Coronary heart disease	1.9	1.5
Stroke, brain hemorrhage	0.92	0.76
Musculoskeletal		
Neck and back complaints	125	106
Severe back complaints	99.2	65.8
Severe neck, shoulder complaints	75.6	63.3
Severe elbow, wrist and hand complaints	23.0	19.3
Osteoarthritis	21.8	21.3
Arthritis	6.7	6.2
Mental		
Depression	32	24
Anxiety disorder	26	18
Respiratory		
Upper respiratory tract infection	84	68
Bronchiolitis/pneumonia	16.0	14.7
Asthma, COPD	26	20
Neurological		
Migraine/severe headache	40	34
Vertigo	8.3	6.6
Digestive		
Severe intestinal complaints	14.9	12.3
Infectious disease of the intestinal canal	6.5	5.1
Miscellaneous		
MUPS	237	197
Chronic eczema	5.5	4.9
Acute urinary tract infection	23.2	19.4
Diabetes Mellitus	10	8
Cancer	4.9	4.4

This table is based on results from multilevel logistic regression analysis controlling for demographic and socioeconomic characteristics and urbanistically that were centered around the average.

COPD, chronic obstructive pulmonary disease. MUPS: medically unexplained physical symptoms.



How does living in a place like this, with green views and places all around, affect human health?

How Does Nature Promote Human Health? Some Clues

What accounts for the link between nature and physical health? Why does access to nature improve health in some respects and not others? One answer that has been advanced by many researchers is that people with ready access to green outdoor places are more likely to engage in physical activity. We might expect that people with pleasant, green, walkable neighborhoods are more likely to take walks in their neighborhoods, or that people with nearby parks are more likely to use those parks for recreation. As regular exercise is one of the strongest factors in the health of older adults⁴⁵, this makes sense.

But exercise is not the only answer. One particularly striking example of the health benefits of contact with nature beyond mere exercise comes from Japan, where scientists examined the impacts of “forest bathing”—the taking in of forest atmosphere through a walk in a forested setting—on blood glucose levels in non-insulin-dependent diabetic patients.⁴⁶ Eighty-seven patients took a total of 237 forest walks at a relaxed pace, walking for either 3 or 6 kilometers, and had their blood glucose levels measured before and after each walk. The shorter walk consisted of about 5,000 steps and took about 30 minutes; the longer walk was twice as long. Blood glucose levels dropped roughly 40% after both the shorter and longer walks—38.9% after the shorter walk, and 40% after the longer walk.

The following table pulls together findings from studies and shows the drop in blood glucose in diabetic and non-diabetic individuals after various kinds of exercise. A few striking comparisons emerge. First, blood glucose drops precipitously in diabetics but only a relatively small amount in non-diabetic individuals—in other words, forest walks reduce blood glucose only where it should. Second, the drop associated with half an hour of walking in a forested environment for diabetics is much larger than the drop after half an hour of other forms of exercise. For diabetics, the decreases in blood glucose that follow walking in a forested environment cannot simply be due to the exercise in and of itself. Finally, the contrast between

⁴⁵ Williamson, J. & Pahor, M. (2010). Evidence regarding the benefits of physical exercise. *Arch Intern Med*, 170(2): 194-201. See also, Qi Sun; Mary K. Townsend; Olivia I. Okereke; Oscar H. Franco; Frank B. Hu; Francine Grodstein. Physical Activity at Midlife in Relation to Successful Survival in Women at Age 70 Years or Older. *Arch Intern Med*, 2010; 170 (2): 194-201.

⁴⁶ Ohtsuka Y, Yabunaka N, & Takayama S. (1998). Shinrin-yoku (forest-air bathing and walking) effectively decreases blood glucose levels in diabetic patients. *International Journal of Biometeorology* 41, 3: 125-127.

the drop in blood glucose after forest bathing and the drop after three hours of cycling suggest that walking in a forested environment is much more powerful and efficient than other forms of exercise, yielding substantially greater benefits in half an hour than even three hours of cycling.

Decreases In Blood Glucose in Response to Different Forms of Exercise in Diabetic and Normal Populations.

Decrease	Form of Exercise	Population	Source
74	30 min. walking in forest	diabetics	Ohtsuka
7	30 min. walking in forest	normals	Ohtsuka
13	30 min. cycling	diabetics	Schneider et al ⁴⁷
16.5	40 min. cycling	diabetics	Paternostro-Bayles et al ⁴⁸
40	3 hours cycling	diabetics	Koivisto et al ⁴⁹
24.5	half mile walking	diabetics	Klachko et al ⁵⁰

All decreases in blood glucose are reported in mg – 100 ml⁻¹

Table compiled from information in Ohtsuka et al, 1998.

Clearly, the benefits of forest walks in diabetic populations cannot be achieved simply by walking. Similarly, it is difficult to explain the many studies in which people who are seated or lying down show physiological and psychological changes in response to photographs, slide shows, or window views of nature in terms of exercise. While green environments do seem to encourage physical activity, and physical activity clearly contributes to health, the health benefits of green environments are clearly not traceable solely to their impacts on physical activity.

One of the most exciting lines of investigation into nature and health provides a clue to another possible mechanism underlying the nature-health connection. Not only may natural settings enable and encourage regular physical activity, but exposure to nature seems to directly stimulate immune functioning. The immune system is responsible for the body's response to attack; it is composed of an army of different cells whose job is to seek out and neutralize various threats. Natural killer cells are our bodies' defense against tumors and viral infections—they seek out and destroy tumors, and similarly attack viral infections. The more natural killer cells and the more active they are, the better they function. T cells and B cells are some of our bodies' other important defenders—they identify and attack a variety of invaders, including specific pathogens, bacteria, and viruses. Higher T and B cell counts reflect better immune system functioning.

Japanese scientists took individuals on 3-day, 2-night trips to forested or urban areas, and took six different measures of immune system functioning and stress before, during, and after the trips.⁵¹ Each of the measures of immune system functioning were significantly higher on forest bathing days than on the normal working day, whereas the measure of stress was significantly lower on forest bathing days than on the normal working day. Forest bathing increased the number of a variety of different T and B cells in

⁴⁷ Schneider SH, Khachadurian AK, Amorosa LF, Gravras H, Fineberg SE, Ruderman NB (1987) Abnormal glucoregulation during exercise in type II (non-insulin-dependent) diabetes. *Metabolism* 36:1161–1166.

⁴⁸ Paternostro-Bayles M, Wing RR, Robertson RJ (1989) Effect of life-style activity of varying duration on glycemic control in type II diabetic women. *Diabetes Care* 12:34–37.

⁴⁹ Koivisto VA, DeFronzo RA (1984) Exercise in the treatment of type II diabetes. *Acta Endocrinol [Suppl]* 206:107–111.

⁵⁰ Klachko DM, Lie TH, Cunningham EJ, Chase GR, Burns TW (1972) Blood glucose levels during walking in normal and diabetic subjects. *Diabetes* 21:89–100.

⁵¹ Li, Q. 2010. Effect of forest bathing trips on human immune functioning. *Environ Health Prev Med.* 2010 Jan; 15(1):9-17.

the blood, the number of natural killer cells, and natural killer activity. The increases in natural killer activity lasted for more than 30 days after the trip, suggesting that a forest bathing trip once a month would enable individuals to maintain a higher on-going level of natural killer activity. By contrast, a visit to popular areas of a city as a tourist did not increase any of the measures of immune functioning. What accounts for the different effects of forested and urban environments on human immune functioning? A partial answer lies in another study by some of the same investigators.

Trees give off a variety of phytoncides (volatile wood essential oils) and fragrances, which are breathed in during forest bathing. While the atmospheric concentrations of phytoncides in forests are most likely too low and too variable to mostly explain the immune system boosts found from forest bathing, the recently established antimicrobial and natural killer activity-enhancing properties of these oils must play a part.⁵²

The potential mechanisms by which green environments support physical health are many. Green outdoor environments might promote health by way of encouraging and enabling physical activity: walking and biking along tree-lined streets, gardening, ecological restoration volunteering, hunting, hiking, kayaking, or participating in sports and outdoor games in parks and recreation areas. Green views and environments might also promote health by enhancing immune function, by reducing the debilitating effects of stress on cardiovascular health, by preventing the accidents caused by mental fatigue, by preventing the harm caused by aggression and violence, and by improving air quality.

It is likely that different health outcomes can be traced back to different combinations of these mechanisms. As of yet, we know little about which of the many possible mechanisms are real, which health outcomes they promote, or what their relative contributions are. What we do know is that, regardless of the particular pathways by which they do so, green environments contribute materially to physical health—to the individual's subjective experience of health, to reduced risk for a wide variety of physician-diagnosed morbidities, to improved immune functioning and reduced health symptoms, and to longevity itself.

⁵² Li, Q., Nakatai, A., Matsushina, H., Miyazaki, Y., Krensky, AM, Kawada, T., & Morimoto, K. (2006). Phytoncides (wood essential oils) Induce Human Natural Killer Cell Activity. *Immunopharmacology and Immunotoxicology*: 28(2), 319-333.

Chapter 5

Emergent Themes and Implications for Creating a Healthy Human Habitat

A number of larger themes emerge from the scientific literature on green environments and human health. First and most obviously, parks and other green environments are essential components of a healthy human habitat. They contribute in myriad ways to social functioning, psychological functioning and health, and physical health. To be sure, people can clearly *survive* without regular contact with nature or elements of nature: in the study of older adults in intensely urbanized Tokyo, not everyone who lacked access to green, walkable paths and places died; in fact, most of them were still alive on the five-year follow-up. At the same time, it is clear that humans need a connection to nature to thrive, and that they are worse off when they lack regular contact with nature.

The notion of Vitamin G captures this well. The human body needs a variety of vitamins and nutrients. In general, the body does not immediately collapse when there is a dietary deficiency; however, for fully healthy functioning, these nutrients must be taken in. Just so with green environments.

A second emergent theme in this review is that green environments must be experienced to yield health benefits. While Manhattanites take real comfort, satisfaction, and pride in knowing that Central Park is there, study after study demonstrates that the presence of green *in the places we spend time* has systematic impacts on our health and functioning.

This is particularly striking in smaller-scale studies that compare outcomes for residents of the same neighborhood. Two single mothers may live within shouting distance of each other in identical buildings in Chicago public housing, but it is the mom in the greener building that performs better on tests of concentration and reports meeting her life challenges more proactively. The fact that both mothers live within a mile of spectacular green areas on Lake Michigan is not enough to overcome the benefits of having a view of trees and grass from home.

Thus while urban planners and landscape architects have long recognized the importance of providing access to resources, the findings here go beyond theoretical access to actual access. This is, what matters most is not whether one *could* get to a green environment regularly but rather whether one *does* get to a green environment regularly. Similarly, it turns out that placing plants at the back of a classroom does not have the hoped-for effects on students' concentration: but the fact that the students *could* be looking at those plants during the school day does not overcome the fact that the students' desks are facing the opposite direction.⁵³ Green environments must be experienced in order to yield health benefits—they might not be noticed, or consciously registered as “green,” but they must be part of the actual array of stimuli meeting the senses.

⁵³ Han, KT. (2009). Influence of limited visible leafy indoor plants on the psychology, behavior, and health of students at a junior high school in Taiwan. *Environment and Behavior*, 41(5), 658-692.



A quiet dose of green.

A third theme is that extended, concentrated, or immersive exposures may be particularly helpful. A two-night, three-day stay in a forested area was sufficient to enhance immune functioning for an entire month. Similarly, the dramatic impacts of a view of trees on patients recovering from gall bladder surgery were likely made possible by their relative restriction of movement—the view may not have been terribly green, but they received a sustained dose of it over the course of multiple days. By the same token, in the few studies where different levels of greenness are distinguished beyond merely present/absent or low/high and other aspects of the environment are the same, the greener the environment, the greater or more reliable the benefits.^{54 55 56} And in the studies in which research participants watched urban and nature slide shows and were then asked about their aspirations, the impacts of the slide show on participants' altruistic aspirations were substantially greater if they reported feeling immersed in the experience. A dose of green is good, and a bigger dose may generally be better.

A final theme that emerges from this review is that while extended, concentrated, or immersive exposures may have the most powerful effects, Vitamin G can be effective in many forms and doses. What constitutes a “relatively green” setting in an inner city is likely to differ substantially from what a rural parent considers “relatively green,” and yet in the nationwide study of ADHD, activities conducted in “relatively green” settings were helpful to children's ADHD symptoms across the board. Further, green doses were efficacious for a whole variety of activities, ranging from “nature activities” such as hiking, fishing, and climbing trees, to non-nature activities such as reading in a shady backyard or playing basketball in a neighborhood park.⁵⁷

Surprisingly, what constitutes a green environment seems to be quite broad in some ways. That is, while it turns out that placing plants where people don't see them has little effect, a view of green and even a distant view of green can be quite effective. Thus an interior space, like a room in a hospital, can be a green environment. It is the experience of nature that seems to matter. Along these same lines, it turns out that videos, slide shows, photos, and depictions of nature are often helpful, although less reliably so than *in situ* experiences of nature. Thus while the health benefits of greener environments may be greater for more immersive, sustained, or “concentrated” forms of nature, it is important to note that some dose of nature is also generally better than none.

⁵⁴ Kuo, F.E., Sullivan, W.C., Coley, R.L., & Brunson, L. (1998). Fertile Ground for community: Inner-city neighborhood common spaces. *American Journal of Community Psychology*, 26(6), 823-851

⁵⁵ Tennessen, C.M., & Cimprich, B. (1995). Views to Nature: Effects on Attention. *Journal of Environmental Psychology*, 15, 77-85

⁵⁶ Barton, J., Pretty, J. (2010). What is the best dose of nature and green exercise for improving mental health? A multi-study analysis. *Environment Sciences and Technology*, 44(10), 3947-3955. It is important to note that Pretty et al 2010 actually report the greatest effects for short (5 minute) exposures—however, the long exposure and short exposure environments in their analysis are different; thus it is not clear whether the strong effects observed for their 5 minute exposures are due to the duration of the exposure or to the power of the particular environment involved.

⁵⁷ Kuo, F.E., & Faber-Taylor, A. (2004). A potential natural treatment for attention-deficit/hyperactivity disorder: evidence from a national study. *American Journal of Public Health*, 94(9), 1580-1586

Implications for Creating Healthier Human Habitats

As we rush pell-mell into an intensely urbanized existence, the scientific findings on the impacts of green environments on human health have a number of implications. In particular, if we take the four themes that emerge from this review seriously, they can be seen to have direct implications for how we might shape cities, metropolitan areas, smaller communities, and outlying areas to maximize human health. Parks and other green environments are essential components of a healthy human habitat; green environments must be part of the actual stimulus array meeting on the senses to be effective; extended, concentrated, or immersive exposures may be particularly helpful; and “Vitamin G” can be effective in many forms and doses. To increase human intake of Vitamin G, then, we should:

1. Provide as much nature, in as many forms, as possible
2. Bring nature to people



Nature in the city.

3. Bring people to nature

The following lists detail a variety of concrete ways in which we might maximize Vitamin G intake. As with all recommendations generated from a single perspective, it should be viewed more as a series of hypotheses than as a set of prescriptions. With that said, *all other things being equal* (which they seldom are), to maximize human health benefits, we should consider shaping our world as follows.

All Other Things Are Not Always Equal: A Cautionary Note

The complex relationship between parks and crime in New York reminds us of the importance of greening environments in a thoughtful way. It is not enough to simply provide parks, or make places greener. Green environments can, and should be, designed to yield maximum benefits. A poorly designed green environment may yield little in the way of health benefits, or even detract from health.

While the Ida B. Wells study reveals substantially lower crime rates for apartment buildings with more tree and grass cover, and while findings from more recent studies in Tallahassee and Portland seem to be echoing this pattern, it is important to note that not all “high green” areas are “low crime.” A program to track crime in New York City’s 20 largest parks found that crime varied widely from park to park. In the 18 months studied, while half of the parks had five or fewer crimes and two of the parks had not a single reported crime, one park reported 99 crimes in the same period.

Well-maintained, well-used parks where visibility is good tend to be low in crime; neglected, abandoned parks with substantial understory and poor visibility may aid and conceal crime. In high-crime neighborhoods, it may be especially important for parks to be easily surveyed by passersby.⁵⁸

⁵⁸ <http://www.ny4p.org/pdfs/TrackingCrimefinal.pdf>

Parks and Crime: A Success Story

The Bryant Park Corporation is known nationally as one of the innovators in park management. Since 1985 the corporation has operated the park, and today it receives no public money, relying only on revenues from events and concessions to run the park. Bryant Park has regularly been the highest scoring site on New Yorkers for Parks' Annual Report Card on Parks, an award-winning independent survey of the maintenance conditions of more than 100 neighborhood parks.

Bryant Park has not always been a model urban park, however. In the 1970s and 80s, the park had an extremely high crime rate and was overrun with drug dealers. Following a redesign of the space and the dedicated attention of the Bryant Park Corporation, the park today is extremely safe.⁵⁹

1. *Provide as much nature, in as many forms, as possible.*

- A diverse palette of green places has at least two advantages. It can help reach individuals with different aesthetic preferences, and it may encourage any given individual to experience nature in more ways, more frequently.
- Create systems and hierarchies of green outdoor places with a few major green nodes (e.g., Central Park), many smaller green areas (ranging from smaller city parks to neighborhood parks to soccer fields), and myriad microexperiences of green (from green views, to window boxes, to green interiors).
- Design green outdoor places to add to the diversity of ways people can experience nature.
- Create systems and hierarchies of green transportation corridors, from green highways to tree-lined streets, green alleys, walking paths, and streams.



Source: <http://blog.nature.org/2010/02/the-great-urbanization-and-what-it-means-for-nature-part-3/>

2. *Bring nature to people.*

- The principle here is simply to find the places where people are and green them.
- Green places used by large numbers of people—airports, shopping malls, campuses, plazas.
- Green paths used by large numbers of people. Green major transportation corridors.

⁵⁹ *ibid*

New York “Forest Kindergarten” Gets Kids Outside, Regardless of Weather

By Emily Thiersch

Adapted from the November 29, 2009, New York Times article, “For Forest Kindergarteners, Class Is Back to Nature, Rain or Shine,” by Liz Leyden.

While their young counterparts across the country experience the outdoors for a brief interlude during the school day—perhaps merely chasing butterflies across a concrete schoolyard—kindergarteners at the Waldorf School of Saratoga Springs, New York, never go a day without intense, immersive contact with nature: wet, spiny, prickly, uncompromised nature. Regardless of the weather, children spend three hours every morning outdoors. They learn not to insulate themselves from inclement weather by hibernating inside, but to brave the elements, and they are tougher for it. When it rains, kids find and haul long branches to use for protective tepees and plant garlic bulbs in the soft, wet mud.

Waldorf teacher Sigrid D’Aleo said she had seen children at their best when outdoors. “Their large motor skills developed, they worked out their social issues in a better way, they had more imaginative play,” D’Aleo said. “Children’s senses are so overtaxed in these modern times, so here, it is very healthy for them.”

Richard Louv, author of *Last Child in the Woods*, agrees. “[Being outside] helps us use all our senses at the same time,” he said. “It seems to be the optimum state of learning, when everything is coming at us in lots of different ways.”

The Saratoga Springs kindergarten, one of just a few “forest kindergartens” in the country, opened in September 2009. It occupies a 325-acre tract, called the Hemlock Trail, of a state park. The 23 students, ages 3 ½–6, spend the first half of the day outside, then meet for formal lessons in a farmhouse on the property or the main school building nearby. While such outdoor kindergartens are rare here, they are common in some European countries and are becoming more popular at a time when children are increasingly deprived of contact with the natural world.

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- In order to integrate natural elements into routine, daily activities, green the places where individuals spend a lot of time, or spend time regularly—schools, homes, workplaces, daycare centers, hospitals, and long-term care facilities.
- Make views from frequent vantage points green (e.g., views from offices, homes, and classrooms).
- Make daily commutes green. Better yet, maximize health benefits by making daily commutes active and green—provide green biking paths, and pay special attention to greening sidewalks to common destinations. Give people more reason to use green paths by designing them with more destinations and easier access.
- Bring green to daily settings where it is lacking—inner-city neighborhoods, schoolyards.
- To bring nature to the heart of the city where land is at a premium, take advantage of lost and wasted urban lands. Such projects can not only support human health but also contribute to environmental health and revitalize communities and local economies.
- Select sites for parks and recreation facilities so as to (a) increase access to nature and (b) increase the variety of forms of nature and activities in nature each individual has access to. Identify neighborhoods with a green deficit, and work with residents to find ways of providing more green.
- Wherever possible, alter the design, operation, and maintenance of highly used places and spaces to encourage locals to assume as much of their stewardship as possible. Involve users in selecting, designing, installing, maintaining, and changing the natural elements in the spaces they inhabit as much as possible. By working with soil, planting and tending gardens, people can nurture themselves and their communities while nurturing the environment.

- Along these lines, make housing developments greener. Create “child- and nature-friendly communities”—subdivisions where children (and younger and older adults) have ready, safe access to green places and wild places; where local natural features have been preserved; where rules and regulations give children the freedom to climb trees, pick berries, play in the mud, and look for frogs in the creek.

In an article in *Landscape* magazine, landscape critic J.B. Jackson envisions the well-designed city as one where:

“...we everywhere feel at home; it reminds us, everywhere and at all times, that we are in an environment no less natural, no less stimulating than the environment of the country dweller. Its trees and parks and lawns are more than agents of health: they tell us of the passage of seasons, and its open places tell us the time of day... If it cannot provide us with the sounds of the remoter landscape, it at least provides us with areas where the sounds of human voices and footsteps are not drowned out by mechanical noises; it provides us with quiet. It cannot imitate all of nature, but it gives us archways and pools of daylight, and flights of steps and views; the splash of water in fountains, echoes and music; the breath of damp cool air, the harmony of colors and the unpolluted sun; indeed it gives us so much that our excursions into the countryside cease to be headlong flights from a sterile environment and become a conscious searching for the missing ingredients: solitude in the presence of other forms of life, space, and mystery.”

Landscape Planning and Stress

Grahn & Stigsdotter

“The results (of this study) suggest that the more often a person visits urban open green spaces, the less often he or she will report stress-related illnesses. The same pattern is shown when time spent per week in urban open green spaces is measured. The distance to public urban open green spaces seems to be of decisive importance, as is access to a garden, in the form of a private garden or a green yard immediately adjacent to, for instance, an apartment building. *People do not usually compensate for lack of green environments in their own residential area with more visits to public parks or urban forests.* (emphasis added) According to our results, laying out more green areas close to apartment houses, and making these areas more accessible, could make for more restorative environments. Outdoor areas that provide environments free from demands and stress, and that are available as part of everyday life, could have significant positive effects on the health of town-dwellers in Sweden. This may also apply to other Western societies.”⁶⁰

3. Bring people to nature

The principle here is to find green places, protect them, and devise ways to encourage people to spend significant, frequent amounts of time in them. Land use planning has a tendency to regard open, undeveloped land as merely a (relatively) inexpensive blank slate on which to put things. By contrast, the scientific findings on green environments and health suggest that these parcels and pockets of nature play a key role in a healthy human habitat – they should be actively and vigorously protected, and then managed to maximize their human health benefits, as well as their benefits to the environment and other species.

⁶⁰ Grahn, P., & Stigsdotter, U.A. (2003). Landscape planning and stress. *Urban Forestry and Urban Greening*, 2(1), 1-18

Tips For Administering a Public Garden “Walking for Well-Being” Program for Older Adults

From the Morikami Museum

http://www.morikami.org/clientuploads/pdf/Manual_Stroll_for_Well_Being.pdf

In any program of garden walks, participants must be informed of the distances they may find themselves walking in order to allow them to determine whether or not they have the physical stamina for such activity. Walking in the garden is not by any means intended to be a strenuous exercise. During the study at The Morikami, individual participants sometimes felt as though they could not walk the entire 7/8 of a mile around the garden. Participants in the subsequent program are cautioned to go only as far as they feel comfortable, rest on a bench, and then turn back, as time spent in the garden can be adequate without walking the entire length of the pathway. At The Morikami, several water stations are present throughout to provide drinking water, and benches and rocks are available for sitting and resting. Park employees routinely monitor the walkways in golf carts to assist anyone who cannot complete the walk. Measures must be in place to assure the participant's comfort at all times and to provide for emergencies.

- Enable public access to wilder, remote places. Provide hiking paths through restricted nature preserves, space for (limited) parking, maps, and other orientation materials. In order to protect the special nature of these places, it may be critical not only to enable access, but to manage it—at the same time, a strict “no trespassing” approach to potential visitors constitutes a major missed opportunity.
- Provide transportation and low- or no-fee days for low-income and other underserved communities. Target populations who underuse parks and bring large, cohesive groups out at a time—e.g., members of a neighborhood, or a bowling league, or a community center. Establish regular “no fee” days a few times a year, to improve access.
- Provide more facilities in urban and community parks to accommodate a diversity of uses—walking paths, expensive and inexpensive water features, picnic tables, chess tables, internet access, concessions...
- Design, operate, and maintain green outdoor spaces that facilitate both non-green focused activities (e.g., reading in a hammock, sharing a meal outdoors) and green activities (e.g., gardening, nature walks).
- In designing green landscapes for health, emphasize characteristics that engage individuals for more than a glance—incorporate dynamic elements such as the movement of leaves and patterns of sunlight on water, and provide opportunities for locomotion through the landscape. Create environments that unfold as the individual experiences them.
- Provide programming that gets people into nature. Non-nature based programs conducted in green environments are helpful—the health benefits of being in nature don't absolutely require actual hands' on involvement. But nature-based programs have the added benefits of giving people a more concentrated dose and teaching them new ways of connecting with nature so they can “self-medicate” in the future.
- Enable and support special events programming that brings people out who might never otherwise visit.
- Make spending time in, and moving through, parks and other green outdoor places safe, pleasant, and rewarding.
- Let the general public know of the health benefits of contact with nature
- Involve locals in installing, maintaining, and improving parks and recreation areas. While citizen stewardship will require a whole set of skills, procedures, and know-how than traditional management, citizen stewardship also has the potential to build people's familiarity, use of, and attachment to the land, as well as their sense of community.

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Parks and Other Green Environments: Essential Components of a Healthy Human Habitat

BIOGRAPHICAL PROFILE

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Frances E. (Ming) Kuo is a nationally and internationally recognized scientist examining the impacts of urban landscapes on human health. Her research focuses on how the presence of trees, grass, and other natural elements within the settings of daily life supports healthy human functioning in both individuals and communities. Starting in 1993, she led a series of studies on the impacts of green residential spaces on human functioning in inner city Chicago, for which she and her collaborators received the Environmental Design Research Association's Achievement Award. Subsequently, she and her former student Dr. Andrea Faber Taylor began examining the impacts of green spaces on Attention Deficit/Hyperactivity Disorder (AD/HD); that line of investigation has yielded both rigorously controlled evidence of a cause-and-effect relationship between physical environments and AD/HD symptoms, as well as a large, national study documenting the generalizability of this relationship. Currently, in addition to her AD/HD work, Dr. Kuo is investigating positive impacts of schoolyard environments on students' academic achievement (as measured by standardized test scores), as well as how residential environments can support active living among older adults. Dr. Kuo's work has convincingly linked healthy urban ecosystems to stronger, safer neighborhoods, lower crime, reduced AD/HD symptoms, reduced aggression, and an array of mental health indicators.

Dr. Kuo is regularly asked to keynote at national and international venues. Her work is of interest to a wide range of audiences: the 22-nation European COST (Co-operation of Scientific and Technical Research) on Health and the Natural Environment, the North American Association of Environmental Educators, the International Horticultural Congress, the International Society for Urban Health, the Environmental Design Research Association, the American Association for the Advancement of Science, and an international meeting on Environmental Psychology in Zurich.

Dr. Kuo's work is having impacts on environmental policy nationally and internationally. Within the U.S., Dr. Kuo's work was instrumental in a \$10 million tree planting in Chicago—the largest in the City's history—and in transforming

the face of public housing in Chicago. She has given invited testimony to the U.S. Secretary of Agriculture's National Urban & Community Forestry Advisory Council on multiple occasions, and her work was used to successfully argue for an urban forestry resolution at the U.S. Conference of Mayors. The United States Centers for Disease Control and Prevention (CDC), the United States Department of Agriculture, and the National Institutes of Health have consulted with her in developing research agenda. Recently, Dr. Kuo assisted in the development of Sustainable Sites guidelines, a LEED-style credit system for sustainable landscapes that is receiving national and international attention. She is currently assisting in developing sustainable landscaping guidelines for the U.S. federal government, and her work has been used by agencies and organizations in Wales, Canada, the Netherlands, and the Caribbean to argue for the preservation and expansion of urban greenspace.

The media has taken great interest in the relationship between urban green space and human health. Dr. Kuo's work has been featured on CNN's *Headline News*, NPR's *All Things Considered*, *The Today Show*, *Good morning America*, and a PBS documentary *The Forests Where We Live*. Newspaper coverage includes articles in the *New York Times*, *Washington Post*, *Dallas Morning News*, *Philadelphia Inquirer*, *Seattle Times*, *Chicago Tribune*, *Wall Street Journal*, and *New Jersey Sentinel*, as well as articles in Canada, UK, Germany, Poland, and Chile. The Salt Lake City Olympic Committee highlighted her work as a part of its "Healthy Environments, Healthy People" theme for the 2001 Games.

Dr. Kuo is a faculty member at the University of Illinois at Urbana-Champaign, where she directs the multidisciplinary Landscape and Human Health Laboratory. She holds appointments in both the Department of Natural Resources and Environmental Sciences and in the Department of Psychology. Her background is in cognitive psychology and environmental psychology, with degrees from the University of California, Berkeley (M.A.) and the University of Michigan (Ph.D.).



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