Nature Therapy: Part One: Evidence for the Healing Power of Contact with Nature

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ABSTRACT

Human enjoyment of natural environmental settings is common to all cultures. It is a complex, evolutionary, psychophysiological response with notable potential to positively impact both physical and mental health of individuals and populations. Four decades of research have produced a large body of empirical and experimental studies demonstrating the benefits of contact with Nature. A sufficient evidence base now allows for meaningful systematic reviews and meta-analyses to begin to guide health recommendations. This is the first of three articles to review the state of the science on the potential health benefits of contact with Nature, covering Visual Nature, Forest Therapy, Gardening, Residential Greenspace, and Blue Space.

Keywords: Nature Therapy; Biophilia; Green Space; Blue Space; Forest Therapy

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INTRODUCTION

For countless generations, humans have utilized therapeutic properties of the natural world. Aside from herbal and nutritional remedies provided by the abundant landscape, there is potentially healing power in having physical contact with the environment itself. Every person has experienced the relaxing calm of walking next to a gentle forest stream or felt the invigoration of a glorious sunrise. Research efforts within the last few decades have attempted to empirically measure the benefits of these ancient natural experiences, and demonstrate their value as potential healthcare interventions. The results of these studies on the effects of Nature on human health have been astounding and extensive. In every area of investigation so far, from physical biomarkers to mental health metrics, from community birth outcomes to population mortality rates, the evidence shows that exposure to certain natural environments, elements, and features can be extremely beneficial to human health and well-being.

After nearly 40 years of research, there is now enough accumulated evidence to allow for large-scale systematic reviews and meta-analyses. This article is the first in a three-part series to review the research on the emerging field of Nature Therapy.* Part One describes the background and origins of the research as well as some of its applications. Part Two will detail the multiple health conditions that evidence shows may benefit from Nature Therapy. Part Three will delineate proposed mechanisms of action and potential future applications.

*Note: No standardized terminology currently exists to describe the field and concepts discussed here. Commonly used terms include Nature Therapy, Ecotherapy, Forest Therapy, Wilderness Therapy, Horticulture Therapy, Contact with Nature, Nature-Based Therapeutics, and Ecological Medicine. Each of these terms has a specific meaning, but in many cases their meanings overlap. For consistency, the term Nature Therapy will be used throughout this article series.

BIOPHILIA AND HUMAN HISTORY

Biophilia is a hypothesis put forward by renowned biologist E.O. Wilson that states humans have an innate desire to connect with nature and other living beings. The relationship of the human species with the natural world is as ancient as humans themselves. Our history as a species is inseparable from the plants, animals, and landscapes that surround us. Throughout the millennia, our ancestors were constantly connected to and immersed in the living world around them, perhaps with little sense of separation from it. Life proceeded within the same general range of environmental parameters for hundreds of thousands, if not millions, of years. Any significant changes that occurred to the landscape or climate happened very slowly, or for major events like volcanos or earthquakes, very rarely. The majority of time was spent in relative homeostatic harmony with the surrounding world compared with the rapidly oscillating environmental changes and various sensory stimuli of the modern era.

The continual immersion of our ancestors within natural landscapes for countless generations strongly influenced the evolution of our species. Every aspect of development was adapted to coincide with the surroundings. Via the process of natural selection, our ancestors experienced constant selection pressures over successive generations, gradually influencing every aspect of their anatomy and physiology. Continual exposure to natural environmental stimuli became the background context to which homeostatic regulation of core functions such as sympathetic nervous system Fight, Flight or Freeze (FFF) and parasympathetic Rest and Digest (R&D) activity of the autonomic nervous system (ANS) were predicated. Long-term health and survival became dependent on proper ANS balance, with parasympathetic R&D function required for chronic health maintenance.

In the absence of any acute stimuli to activate the sympathetic FFF response, a longer amount of time in parasympathetic R&D would confer better maintenance function and a greater survival

advantage. Over hundreds of thousands of years, the ANS adapted to exist in parasympathetic R&D in the presence of natural environmental stimuli, providing optimal function to neuroendocrine, immunological, and cardiovascular responses. In contrast, sympathetic FFF activation from stimuli such as the motion of a potential predator, or natural disruptions like a forest fire, were disruptions that required temporary attention, but the ability to exist in and quickly return to baseline provided optimal functioning and the best chance for survival.

This set of adaptations was acquired over millions of years and is still with us today. Our entire beings are the result of previous generations' constant exposure to these natural settings. We feel relaxed going for a walk on the beach or tending our garden at the end of a long day, and we feel restored throughout our bodies and minds as a result, because of the evolutionarily adapted parasympathetic R&D activation that occurs upon exposure to those naturally occurring environmental baseline stimuli. We feel this affinity for the natural world because it has been hardwired into us.

This biophilic response has been studied and detected in every culture around the world.[1] It is the reason that empirical studies of the healing power of Nature show ubiquitous benefit in such a wide range of areas. Regardless of their mode of application, the mechanisms by which Nature impacts health are responsible not only for the *preventive* function of health maintenance, as discussed above, but also for the *restorative* capacity of nature to promote healing, which will be discussed in Part Three.

Defining what constitutes contact with Nature in the modern era can be challenging. Spending 4 days on a wilderness camping trip is a very different experience than taking a walk in a local park or tending a backyard garden. This entire area of research, therefore, should not be seen as a single type of intervention but may instead be more appropriately considered as an entire field of research exploration, similar to the topics of nutrition or energy medicine. The variety of ways to connect to Nature suggest that clustering studies based on the type of exposure may be the most useful way to analyze health impacts and benefits.

RESEARCH MODELS FOR NATURE THERAPY

VISUAL NATURE

The first scientific investigations into the health benefits of contact with Nature followed a traditional laboratory-based controlled model of exposure. The pioneers in this type of research used the controlled environment of laboratory settings to eliminate complex and potentially confounding variables such as temperature, humidity, or ambient noise that complicate real-world field studies. In these studies, participants were exposed to different environments, for example natural versus built settings, and then assessed for a variety of outcomes. In the initiating study of this area of research, hospital post-operative recovery rooms with natural vs. built views (i.e., views of the adjacent nature park vs. brick wall of another hospital wing) were shown to substantially influence recovery time (7.96 days vs. 8.70 days, P=0.025), pain level (as measured by analgesic dosing frequency), and patients' subjective affect (as described by nursing notes of patients' negative mood, 1.13/patient vs. 3.96/patient, P<0.001).[2] This groundbreaking approach allowed other researchers to realize that what was formerly an implicit assumption that natural scenes are relaxing could instead be explicitly measured for its health-promoting and restorative potential.

Since that first study in 1984, many other research designs have been utilized to empirically measure the benefits of exposure to nature. Other "view through a window" studies have been conducted, assessing mental functioning and focused attention.[3] As research in this field has progressed, methods of experimental comparison have included photo, video, and virtual reality representations of natural and built settings.[4–8] Regardless of the format, the results of these studies were instrumental in establishing a correlation between contact with Nature and positive, healing experiences, which could be measured and potentially used in clinically meaningful ways. The application of these findings can be seen in many different settings, such as workplaces, prisons, and hospital intensive care units (ICUs),[9] and will be explored more in Part Two. In addition, the evidence these studies provided has allowed for theorizing about mechanisms of action

(to be discussed in a separate article), as well as the development of other research models.

FOREST BATHING

One of the most well-known examples of Nature Therapy is the Japanese practice of *shinrin-yoku* or Forest Bathing. Cultures around the world have long recognized the restorative biophilic effect of a walk in the forest, but *shinrin-yoku* is something else entirely. The process involves a full mind–body immersion in the forest environment. Participants of *shinrin-yoku* are encouraged to slow down and appreciate every aspect of their woodland surroundings using each of the five senses. This gives Forest Bathing a meditative-like quality akin to a walking mindfulness meditation. It can be done alone or in groups to share the experience.

Since the first research published in the late-2000s,[10,11] there have been multiple studies demonstrating the physical and mental health benefits of *shinrin-yoku*. These studies typically have participants experience immersion in forested environments for anywhere from 20 min to 3 days, while collecting pre- and post-exposure data on various health markers. Often these studies involve a cross-over design with additional exposure to a more developed or urban setting serving as a control or comparison.

In the almost 15 years of research on *shinrin-yoku*, many areas of health benefit have been explored. Recent meta-analyses in 2019 and 2017 have demonstrated the restorative effect on forest vs. urban settings in cross-over exposure trials measuring salivary cortisol (mean difference in pre-post measurements [MD]=−0.05 µg/dl, 95% confidence interval [CI]: 0.06 to −0.04; $P<0.01$; $I^2=88\%$), systolic blood pressure (MD −3.15 mmHg, 95% CI: −4.12 to −2.18, $P<0.001$, $I^2=1\%$), diastolic blood pressure (MD −1.75 mmHg, 95% CI: −2.38 to −1.13, $P<0.001$, $I^2=24\%$) and heart rate (MD −3.84 bpm, 95% CI: −5.27 to −2.40, $P<0.001$, $I^2=39\%$).[12,13]

A 2019 systematic review of 28 studies, including 12 high-quality randomized controlled trials (RCTs), found significant empirical benefit of forest versus urban exposure in a wide variety of metrics, including cardiovascular and hemodynamic function; neuroendocrine function; metabolic function; immune and inflammatory responses; antioxidant levels; and electrical physiological function.[14] This same review found positive benefits of Forest Bathing on participant emotional state, internalized attitudes, psychophysiological recovery, and adaptive behaviors. A 2017 review of 64 studies found similar results for the restorative mental and physical benefits of *shinrin-yoku*,[15] the specifics of which will be discussed in Part Two of this series. As a method of experiencing Nature Therapy, Forest Bathing has a significant track-record of benefit.

GARDENING

Gardening is another way that people easily have contact with the natural world. Tending the earth to grow food, medicines, and flowers is one of the oldest human behaviors. It is cited as the foundational act that transitioned our species from nomadic hunter−gatherer tribes into settled civilizations. Most ancient civilizations have records of or myths about gardening and agriculture in their own ancient pasts, often in connection with health and healing. As a specific healing modality, gardening has been recommended at least since the mid-19th century. Dr. Benjamin Rush, who is known as the Father of American Psychiatry, recommended it for his patients.[16] Today the fields of Therapeutic Horticulture (TH) and Horticultural Therapy (HT) are well recognized for their beneficial effects.

A 2017 meta-analysis of 22 studies, including 76 controlled comparisons, demonstrated statistically significant health effects of gardening on many different biopsychosocial outcome metrics.[17] The aggregate medium effect size (Hedge's $d=0.42$, 95% CI: 0.36–0.48) of all indicators in this analysis, including subgroups of health variables such as BMI, heart rate, and salivary cortisol ($d=0.31$, 95% CI: 0.21–0.40), as well as well-being variables including depression, anxiety, quality of life, sense of community and life satisfaction ($d=0.47$, 95% CI: 0.39–0.54) indicates that spending time in a garden is a reliable, valid, and consistently beneficial application of Nature Therapy.

RESIDENTIAL GREENSPACE

Not everyone has the ability or desire to spend time in a forest or garden. Issues of availability, mobility, proximity, interest, and safety can limit

a person's ability to access the benefits of a direct nature experience. Studies show, however, that even passive types of Nature Therapy have a positive health impact. One of the most widely studied phenomena is the impact of residential greenspace or the amount of vegetation such as trees, parks, and lawns that surround a person's home.

Rather than assessing the effect of acute active exposures to natural settings on health measures, researchers used a geographic information systems (GIS) approach to measure the impact of chronic passive exposure. This approach relies on GIS mapping software and public land-use datasets to associate vegetation within a given radius (e.g., 500 meters) of study participants' residential addresses with specific health outcomes. Because most people spend significant portions of their lives in and around their homes, the restorative effect of contact with nature in that environment accumulates in ways that are detectable.

By using very large datasets that allow even more highly powered statistics, the GIS method takes an epidemiological approach to assessing the impact of residential greenspace at a population level. Some of these studies include hundreds of thousands, or even millions, of people. One of the first studies of this kind, published in *The Lancet* in 2008, used the UK National Health Service (NHS) dataset of 41 million people to demonstrate that residential proximity to increasing amounts of greenspace was greatly beneficial. Mortality rates for people living in the areas of lowest quantity of greenspace compared with those living in the highest greenspace areas were twice as high for both cardiovascular-related (incidence rate ratio [IRR]=2.19, 95% CI: 2.04–2.34, $P<0.0212$) and all-cause mortality (IRR=1.93, 95% CI: 1.86–2.01, $P<0.0001$).[18]

This groundbreaking study helped establish the basis for a methodology that has been used frequently in subsequent studies. A 2019 systematic review of nine longitudinal studies,[19] assessing a total of 8.3 million people from seven countries, showed a 4% decreased risk of all-cause mortality for every 10% incremental increase in vegetation density (hazard ratio [HR]=0.96, 95% CI: 0.94–0.97, I^2 95%, $P<0.0001$) using the normalized differentiation vegetation index (NDVI) scale, a commonly used infrared satellite-based system for quantifying land-use type.[20] A 2016 systematic review of 12 studies, assessing over 115 million people from five countries, found similar effects of high versus low residential greenspace on cardiovascular (risk ratio [RR]=0.96, 95% CI: 0.94–0.97, P-het=0.26) and all-cause mortality (RR=0.92, 95% CI: 0.87–0.97, P-het<0.001) risks.[21] Many other health outcomes, from rates of chronic physical disease to serious mental illness, have been similarly assessed, and will be addressed in Part Two of this article series.

As with all population-based studies, statistical controls were used for potentially confounding factors. Probably the most important potential confounder is socioeconomic status (SES), such as household income or education level, which reflects known influencers of health status. SES is also highly correlated with the quantity and quality of residential greenspace density.[22] In other words, more affluent people tend to live in areas with greater access to greenspace than those less well off. By controlling for these SES factors, researchers are able to more accurately assess the specific impact of natural surroundings on health measures. The better quality studies take other potential confounders, such as smoking status, neighborhood crime rates, and air pollution levels into account as well.

Although most of these studies are observational and therefore cannot provide causative links, large-scale, large-powered epidemiological studies provide substantial supportive evidence of the health-promoting benefits of contact with nature and green spaces.

BLUE SPACE

A large tradition exists for the use of water in a healing context, from ancient myths to modern spas and hot springs. Traditional seaside sanatoria were used for centuries as places of recuperation from conditions such as consumption (tuberculosis) and melancholia (depression). A 2017 systematic review of 35 studies found a slight positive association between exposure to blue spaces and benefits to mental health, including measures of subjective well-being.[23] Other potential benefits of exposure to blue spaces pertaining to cardiovascular health, general health, likelihood of physical activity, and reduced rates of obesity showed some positive but

less consistent findings. Research into the effects of exposure to blue space is not as developed as its greenspace counterpart, and so definitive statements about its therapeutic potential are not currently possible.

CONCLUSION

Nature is a broad concept. It encompasses everything outside of the human-made environment. Humans have connected with nature since before recorded history, possibly with little sense of separation from it. Nature is the context within which we and all living things evolved. Spending time in these settings, whether forest, garden, beach, or neighborhood parks, provides us with an opportunity to experience the therapeutic benefits of coming home.

Part Two of this series will focus on the array of health conditions that research indicates may benefit from Nature Therapy. Part Three will explore proposed mechanisms of action for these health benefits, and discuss ways in which Nature Therapy has been applied and can be applied on behalf of individual, public, and planetary health.

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