



Incorporating nature into workspaces is increasingly popular, whether it be through plants in the office, natural views, or locating close to parks and greenspace. But what can workplaces really expect in terms of benefits from increasing access to nature for their employees? What kinds of nature matter? What studies can be applied to the workplace? Here at IWBI and Nature Sacred we break down the latest evidence, its implications for the workplace, and emerging trends.

### The theories behind the benefits of nature for human health and well-being

The most common and well – tested theories on why nature benefits human health come from two key theories that argue that nature, due to its ability to engage our attention in a 'soft fascination,' helps to restore our ability to concentrate, <sup>1,2</sup> recover faster from stress, <sup>3</sup> reduce burnout, <sup>4</sup> and improve our mood. <sup>4</sup> These studies have been tested for over thirty years from everything from wilderness excursions <sup>5,6</sup> to urban parks <sup>7</sup> to lab studies of nature videos. <sup>8,9</sup> More recently, some research has further explored outcomes on the role that nature plays in increased socialization, cohesion, physical activity, <sup>10</sup> and health, <sup>11</sup> mostly done in urban parks.

## What does the research say about nature and key workplace outcomes?

The following key outcomes are the most relevant to workplaces on the benefits of nature:



Research has shown that contact with nature can improve task performance, usually through increased attention and focus. This is often evaluated with cognitive tests that measure productivity through proxy measures, such as the speed of completion for tasks, <sup>12</sup> classic cognitive load tests (often working memory), error rate, <sup>13</sup> short-term memory, <sup>14-17</sup> and higher order mental functions – argued by some to be supported by directed attention that can suppress distractions and increase the load on working memory. <sup>18</sup>

These tests are useful for understanding how quickly employees can complete challenging tasks and their ability to concentrate, and as they are often lab - tested, researchers can point to nature, versus other factors, that is influencing the task performance outcome. However, as they are often done with virtual nature (such as pictures or videos), some have argued that the experience of real-world nature can be more complex. Furthermore, the typical tasks expected of many white - collar employees, particularly at an advanced level, are often much more complex than those measured by the tasks commonly used in these studies. However, some studies done on real - world access to nature such as views or physical access to green roofs from the workplace, or walks in a park, have found similar results, such as improved attention 19 or

focus <sup>20,21</sup> respectively. In addition, other researched benefits of nature, such as attention restoration, creativity, socialization, and stress reduction (see below) indicate that when combined with other types of measurement these productivity tests can provide a useful indicator of workplace benefits. Lastly, studies that have shown reduced cognition from high levels of CO2 <sup>22</sup> and bio – effluents <sup>23</sup> point to the potential for plants, with their known ability to clean the air, <sup>24</sup> to also positively impact cognition in buildings.

#### KEY MEASURED OUTCOMES FOR TASK PERFORMANCE

- Short term memory has been found to improve after watching videos of nature, <sup>15</sup> being exposed to biophilia in the workplace, <sup>14</sup> and walks in urban greenspace. <sup>16</sup>
- Improved concentration has been found after viewing both real nature, such as green roofs <sup>19,25</sup> and window views, <sup>26</sup> and virtual nature, including nature images <sup>27</sup> and videos, <sup>28</sup> and taking nature walks <sup>29</sup> to name a few.
- Improved task performance has been found after viewing plants, <sup>13</sup> after a nature retreat, <sup>6</sup> and in buildings, with 72% of employees indicating that they felt more alert and productive in a building with numerous biophilic elements and gardens. <sup>30</sup>



Research has shown that contact with nature can reduce stress and improve mood, often through the restorative qualities of nature. There is some indication that the visual and symbolic qualities of nature, for example viewing 'naturalized' green roofs, 19 or taking work breaks in hospital gardens 4 allows people to take short 'mental breaks' by letting their mind wander, and it is this 'soft fascination' quality of nature that researchers posit explains the mental restoration benefits. 2,31 Mental restoration is often evaluated both through psychological measures such as psychological tests or questions that evaluate mental health, such as levels of stress, 16,32,33 depression, 34 anxiety, 16 or mood, 35,36 as well as physiological tests that evaluate the body's response to stress, such as high blood pressure, 15,34 cortisol levels (used to measure stress), 37,38 and heart rate. 39,40 These tests have been done in laboratory work, 8 meta - analyses of multiple studies, 41 and population - level studies, 42,43 which when combined with both physiological and psychological tests speak to a strong link between contact with nature and improved health.

Most of these studies have been done on large – scale nature such as parks or population studies, but lab or in – situ studies with very small doses of nature have recreated their results with as little as five minutes of exposure. 14,44,45 Thus while few of these studies have been done on office workers to date, there are some indications that the benefits of nature around stress and burnout reduction, 4,41 improvement of mood, 46 restoration 47 and overall subjective well-being 45 can also benefit office

workers. For example, poor mental health has been linked to absenteeism, a higher number of sick days, and increased mortality. <sup>48-50</sup> Stress in particular has been linked to burnout, which was recently recognized as a health condition by the World Health Organization. <sup>51</sup> Mood has been linked to engagement, <sup>52,53</sup> which may be as good an indicator of performance and attrition as traditional measures of productivity. <sup>54</sup> Lastly, the general benefit of restoration – whether of attention, mood, or recovery from stress – point to overlapping benefits for the workplace.

#### KEY MEASURED OUTCOMES FOR STRESS REDUCTION, MOOD, AND RESTORATION

- Research has found that access to both outdoor greenspace, 32,39 such as forests, 55, urban parks, 56 and tree cover, 57 and indoor nature, 41 including plants 58 and nature imagery, 58,59 can lead to stress reduction.
- The effects of nature on mental fatigue and restoration is well-documented in the literature with a 2015 systematic review finding 41 studies on nature's attention restoration potential. <sup>18</sup> This topic has been studied across various types of nature including landscape art, window views, plants, and outdoor nature <sup>47,60,61</sup> with higher plant biodiversity often being associated with greater restoration. <sup>6</sup>.
- Studies have shown that exposure to nature can lead to improved mood <sup>7,63-65</sup> with physical nature often providing the greatest benefit to mood, <sup>63</sup> including the potential to moderate or reduce noise annoyance, a key issue in urban areas. <sup>7</sup>



A less - known benefit of contact with nature for the workplace is increased socialization. Most research on social benefits has looked at community - scale greenspace, such as parks, 66 vacant lots, 67 and gardens, 68 showing that spending time in nature or viewing nature has been linked to increased social interaction, 69 decreases in feelings of loneliness and increases in social cohesion, 66 and increases in residential or place attachment, pride, and perceived quality of life. 60,68 Most of these are measured through psychological metrics such as the social cohesion and trust scale, 66 surveys that ask about the use of common spaces and attachment, 60,70,71 observation of the use of common spaces, 72 or semi structured focus groups 69 and interviews. 68 Researchers attribute these outcomes partly to the qualities of nature itself - it makes parks and urban areas more inviting for people to spend time in, 73 and much research has been done on exactly which qualities of nature - such as trees, meadows, and flowers – people find most attractive. 74-76 Increased physical activity, again most often researched by park visits, is another potential benefit. 77-80

While few studies have looked at the impact of nature in the workplace on socialization, there are key benefits that translate to the workplace. Loneliness has been linked to poorer health outcomes and reduced life expectancy, 81-83 while increased physical

activity has been linked to reduced levels of depression 84-86 and improved cognitive function, including memory, 87,88 in addition to other health benefits. 89,90 Furthermore, there is some indication that socialization, here in the form of face-to-face interactions, is a key component of increased workplace performance, trust in coworkers, and decreased isolation. 91 This makes nature in the workplace particularly relevant to debates around enticing workers back to the office post – COVID for collaborative work. Thus while nature and socialization has not generally been tested in the workplace, research does point to the potential for natural views and plants in the workplace to benefit social interaction in the workplace.

#### KEY MEASURED OUTCOMES FOR SOCIALIZATION:

- Nature, in particular neighborhood greenspace and urban nature, has been found to increase community social cohesion. 34,66,92
- Research has indicated that neighborhood common spaces, 72 green roofs 69 and urban parks 93 increase social interaction.
- Community greenspace, including neighborhood gardens and revitalized vacant lots, have been found to increase neighborhood pride 68 and place attachment. 67



Creativity may be one of the least - studied components of the benefits of nature, but those studies that do exist have found that time spent in nature (most commonly studied),94 viewing nature, 95 or around indoor plants 35,96 have been linked to creative performance, 97 problem-solving 6,95 or the creative process. 98 Many of these studies have been done on creative professionals 98 or students, 6,35,97,99,100 but a few have been done on office workers. 96 Measurements include drawing tasks, 99 questionnaires, 99,100 creativity problem - solving tasks, <sup>6</sup> qualitative interviews, <sup>98</sup> assessments, <sup>97</sup> and alternative uses tasks. 97 While the exact mechanism is unclear, researchers have posited that time in nature can re-charge directed attention, which is a key component of the preparation and incubation phase of the creative process, 98 that spaciousness and unpredictability are predictors of creative performance, 97 and that plant foliage may facilitate creative work. 35,96

#### KEY MEASURED OUTCOMES FOR CREATIVITY:

- Nature imagery 99 and connectedness 98 has been shown to improve creative thinking
- Those more connected to nature were found to prefer innovative thinking styles. 100
- After a 4 day nature retreat, students improved by 50% on a creative problem solving task. 6



# Nature in the workplace and sustainability

There are additional potential benefits of incorporating nature into the workplace that may align with other goals of an organization. For example, many projects that pursue healthy building certification also pursue green building certification, or at the very least also have Sustainable Development Goals (SDG) or report on Environmental, Social, and Governance (ESG) metrics. While research on occupant satisfaction in green versus conventional buildings is currently mixed, <sup>101</sup> there is some indication that the benefits to occupants from sustainable buildings may be psychological-and in particular increase pride in the workplace, <sup>102</sup> which has been linked to increased engagement. <sup>103</sup>

Furthermore, as shown by some successful city – level initiatives, incorporating nature into buildings can be an effective symbolic gesture of a larger environmental and social commitment that can help publicize less – visible green initiatives. 104
Lastly, while the aesthetics of some urban greening projects that also have ecological goals (such as habitat or stormwater management) can be perceived as 'messy' and 'unkempt,' research has also shown that these more visually interesting projects that prioritize biodiversity and habitat increase fascination and thus attention restoration and concentration. 19,105,106

## Moving forward: What does this mean for your workplace?

While many organizations have heard about the potential benefits of providing access to nature for their occupants, there are still many real and perceived barriers to doing so. Some of these include not really believing that benefits from nature are 'real' or as real as say, indoor air quality. However, the combination of both subjective (such as surveys) and objective (such as heart rate, cortisol levels, and blood pressure) measures over the last thirty years provide solid evidence that access to nature does have measurable positive outcomes for mental and physical health as well as improved performance. Future research includes targeting exactly which types of nature, and how much, will lead to which outcomes, the pathways through which this occurs, 107,108 as well as cultural and sociodemographic variations. 109

From a workplace perspective, projects do not need to wait for this research to develop to realize the benefits of providing more access to nature for their occupants. While in general more nature is better to give that sense of 'restoration', the symbolic aspect of nature means that even small interventions can provide measurable benefits. These benefits include views of nature (parks or green roofs), plants in the workplace (including a green wall), and even locating close to urban pocket parks. Nature interventions are particularly effective when combined with a full sensory experience, such as the sound of water, plants with scent or herbs, and

lots of visual interest that can help encourage 'fascination', 'being away', 'extent', and 'compatibility'. 2 While more elaborate plant interventions do require maintenance, the benefits far outweigh other costly amenities such as elaborate lobbies and may align with other sustainability goals (such as a green roof). Fear that plants will attract bugs or aggravate allergies can be a minor barrier, but examples from around the world indicate that these are not insurmountable. Adding nature to buildings is in fact on-trend with the movement to 're-wild' our cities110 and make workplaces and buildings less sterile and 'dead zones.' This is particularly important given the rising demand for access to nature in cities and buildings during the current hybrid work model. 111,112 Lastly, while real plants are best, more and more research is showing that even natural materials and design interventions that mimic nature (often called biophilia) - such as shiny surfaces for water, the use of wood, and carpets and fabrics that mimic nature, can provide calming effects when real plants are not possible. 113,114 As with any specialized intervention, it is always a good idea to hire someone who is experienced with plants and can provide effective solutions that are climate and design appropriate for your space. Lastly, designing access to nature interventions can simultaneously address multiple objectives, even in "small nature" settings in and near workplaces. For example, projects can balance ecological and environmental benefits as well as individual and collective health and wellbeing

outcomes. These could include accessible green roofs that provide opportunities for respite for workers as well as habitat for migratory birds and insects, or at - grade rain gardens that also provide stormwater management. As these small - scaled nature projects often align with city - level urban greening policies - level benefits, they may be eligible for developer benefits or incentives. Cutting edge best practices for landscape design for these kinds of nature interventions include creating green spaces that incorporate such elements as a portal, path, destination and surround to provide concrete guidance for designing spaces that encourage wellbeing. 115 For examples of real - world nature solutions in the workplace see this hospital garden at Legacy Emanuel Medical Center in Portland, Oregon, that is integrated into the institution's human resources program; or this green roof, which incorporates a contemplative space adjacent to its rooftop labyrinth at the American <u>Psychological Association in Washington D.C.</u>



### References

- Kaplan R, Kaplan S. Preference, restoration, and meaningful action in the context of nearby nature. Urban place: Reconnecting with the natural world. 2005:271-298.
- Kaplan S. The restorative benefits of nature: Toward an integrative framework. Journal of Environmental Psychology. 1995;15(3):169-182.
- Ulrich RS. Biophilia, Biophobia, and Natural Landscapes. In: Kellert SR, Wilson EO, eds. The Biophilia Hypothesis.
   Washington D.C.: Island Press; 1993:73–137.
- 4. Cordoza M, Ulrich RS, Manulik BJ, et al. Impact of Nurses Taking Daily Work Breaks in a Hospital Garden on Burnout. American Journal of Critical Care. 2018;27(6):508-512.
- Kaplan R. Wilderness perception and psychological benefits:
   An analysis of a continuing program. Leisure Sciences.
   1984;6(3):271-290.
- Atchley RA, Strayer DL, Atchley P. Creativity in the Wild: Improving Creative Reasoning through Immersion in Natural Settings. PLOS ONE. 2012;7(12):e51474.
- Li D, Deal B, Zhou X, Slavenas M, Sullivan WC. Moving beyond the neighborhood: Daily exposure to nature and adolescents' mood. Landscape and Urban Planning. 2018;173:33-43.
- Van den Berg AE, Jorgensen A, Wilson ER. Evaluating restoration in urban green spaces: Does setting type make a difference? Landscape and Urban Planning. 2014;127:173-181.
- Snell TL, McLean LA, McAsey F, Zhang M, Maggs D. Nature Streaming: Contrasting the Effectiveness of Perceived Live and Recorded Videos of Nature for Restoration. Environment and Behavior. 2018.
- Markevych I, Schoierer J, Hartig T, et al. Exploring pathways linking greenspace to health: Theoretical and methodological guidance. Environmental Research. 2017;158:301–317.
- White MP, Alcock I, Grellier J, et al. Spending at least 120 minutes a week in nature is associated with good health and wellbeing. Scientific Reports. 2019;9(1):7730.

- 12. Stenfors CUD, Van Hedger SC, Schertz KE, et al. Positive Effects of Nature on Cognitive Performance Across Multiple Experiments: Test Order but Not Affect Modulates the Cognitive Effects. Frontiers in Psychology. 2019;10.
- Adamson K, Thatcher A. Do Indoor Plants Improve Performance Outcomes?: Using the Attention Restoration Theory. 2019; Cham.
- Yin J, Zhu S, MacNaughton P, Allen JG, Spengler JD.
   Physiological and cognitive performance of exposure to biophilic indoor environment. Building and Environment. 2018:132:255-262.
- 15. Pilotti M, Klein E, Golem D, Piepenbrink E, Kaplan K. Is Viewing a Nature Video After Work Restorative? Effects on Blood Pressure, Task Performance, and Long-Term Memory. Environment and Behavior. 2015;47(9):947-969.
- Bratman GN, Daily GC, Levy BJ, Gross JJ. The benefits of nature experience: Improved affect and cognition.
   Landscape and Urban Planning. 2015;138:41–50.
- Schertz KE, Berman MG. Understanding Nature and Its Cognitive Benefits. Current Directions in Psychological Science. 2019;28(5):496-502.
- 18. Ohly H, White MP, Wheeler BW, et al. Attention Restoration Theory: A systematic review of the attention restoration potential of exposure to natural environments. Journal of Toxicology and Environmental Health, Part B. 2016;19(7):305-343.
- Loder A. 'There's a meadow outside my workplace'. A
  phenomenological exploration of aesthetics and green roofs
  in Chicago and Toronto. Landscape and Urban Planning.
  2014;126:94-106.
- Jiang B, Schmillen R, Sullivan WC. How to Waste a Break:
   Using Portable Electronic Devices Substantially Counteracts

   Attention Enhancement Effects of Green Spaces. Environment and Behavior. 2018.

- Kasap EZ, Agzitemiz F, Unal G. Cognitive, Mental and Social Benefits of Interacting with Nature: A systematic review.
   Journal of Happiness and Health. 2021;1(1):16-27.
- 22. Allen JG, MacNaughton P, Satish U, Santanam S, Vallarino J, Spengler JD. Associations of Cognitive Function Scores with Carbon Dioxide, Ventilation, and Volatile Organic Compound Exposures in Office Workers: A Controlled Exposure Study of Green and Conventional Office Environments. Environmental Health Perspectives. 2016;124(6):805-812.
- 23. Zhang X, Wargocki P, Lian Z, Thyregod C. Effects of exposure to carbon dioxide and bioeffluents on perceived air quality, self-assessed acute health symptoms, and cognitive performance. Indoor Air. 2017;27(1):47-64.
- Kobayashi KD, Kaufman AJ, Griffis J, McConnell J. Using houseplants to clean indoor air. University of Hawaii;2007.
- Lee KE, Williams KJH, Sargent LD, Williams NSG, Johnson KA. 40-second green roof views sustain attention: The role of micro-breaks in attention restoration. Journal of Environmental Psychology. 2015;42:182-189.
- Tennessen CM, Cimprich B. Views to nature: Effects on attention. Journal of Environmental Psychology. 1995;15(1):77-85.
- Gamble KR, Howard JH, Jr., Howard DV. Not just scenery: viewing nature pictures improves executive attention in older adults. Exp Aging Res. 2014;40(5):513-530.
- Snell TL, McLean LA, McAsey F, Zhang M, Maggs D. Nature Streaming: Contrasting the Effectiveness of Perceived Live and Recorded Videos of Nature for Restoration. Environment and Behavior.0(0):0013916518787318.
- Berman MG, Jonides J, Kaplan S. The Cognitive Benefits of Interacting with Nature. Psychological Science. 2008;19(12):1207-1212.
- Lerner A, Stopka M. The Financial Benefits of Biophilic Design in the Workplace: A Review and Summary of Current Research. Chicago: Mist Environment; 2016.
- Kaplan S. Meditation, Restoration, and the Management of Mental Fatigue. Environment and Behavior. 2001;33(4):480-506.
- Hazer M, Formica MK, Dieterlen S, Morley CP. The relation ship between self-reported exposure to greenspace and human stress in Baltimore, MD. Landscape and Urban Planning. 2018;169:47-56.

- 33. Meredith GR, Rakow DA, Eldermire ERB, Madsen CG, Shelley SP, Sachs NA. Minimum Time Dose in Nature to Positively Impact the Mental Health of College-Aged Students, and How to Measure It: A Scoping Review. Frontiers in Psychology. 2020;10.
- Shanahan DF, Bush R, Gaston KJ, et al. Health Benefits from Nature Experiences Depend on Dose. Scientific Reports. 2016;6:28551.
- Shibata S, Suzuki N. Effects of the Foilage Plant on Task Performance and Mood. Journal of Environmental Psychology. 2002;22(3):265-272.
- Tyrväinen L, Ojala A, Korpela K, Lanki T, Tsunetsugu Y,
  Kagawa T. The influence of urban green environments on
  stress relief measures: A field experiment. Journal of
  Environmental Psychology. 2014;38:1-9.
- Ward Thompson C, Roe J, Aspinall P, Mitchell R, Clow A,
   Miller D. More green space is linked to less stress in
   deprived communities: Evidence from salivary cortisol
   patterns. Landscape and Urban Planning. 2012;105(3):221-229.
- Hunter MR, Gillespie BW, Chen SY-P. Urban Nature
   Experiences Reduce Stress in the Context of Daily Life Based on Salivary Biomarkers. Frontiers in Psychology. 2019;10.
- Twohig-Bennett C, Jones A. The health benefits of the great outdoors: A systematic review and meta-analysis of greenspace exposure and health outcomes. Environmental Research. 2018;166:628-637.
- Lanki T, Siponen T, Ojala A, et al. Acute effects of visits to urban green environments on cardiovascular physiology in women: A field experiment. Environmental Research. 2017;159:176-185.
- 41. Bjornstad S, Patil GG, Raanaas RK. Nature contact and organizational support during office working hours: Benefits relating to stress reduction, subjective health complaints, and sick leave. Work (Reading, Mass). 2015;53(1):9-20.
- 42. Korpela K, Borodulin K, Neuvonen M, Paronen O, Tyrväinen L. Analyzing the mediators between nature-based outdoor recreation and emotional well-being. Journal of Environmental Psychology. 2014;37:1-7.
- 43. Ward Thompson C, Aspinall P, Roe J, Robertson L, Miller D. Mitigating Stress and Supporting Health in Deprived Urban Communities: The Importance of Green Space and the Social Environment. International Journal of Environmental Research and Public Health. 2016;13(4):440.

- 44. Van den Berg MMHE, Maas J, Muller R, et al. Autonomic Nervous System Responses to Viewing Green and Built Settings: Differentiating Between Sympathetic and Parasympathetic Activity. International Journal of Environmental Research and Public Health. 2015;12(12):15860-15874.
- 45. Hu C, Zhu K, Huang K, et al. Using natural intervention to promote subjective well-being of essential workers during public-health crises: A Study during COVID-19 pandemic. Journal of Environmental Psychology. 2022;79:101745.
- 46. Larsen L, Adams J, Deal B, Kweon B-S, Tyler E. Plants in the workplace: The effects of plant density on productivity, attitudes, and perceptions. Environment and Behavior. 1998;30(3):261-281.
- Nejati A, Rodiek S, Shepley M. Using visual simulation to evaluate restorative qualities of access to nature in hospital staff break areas. Landscape and Urban Planning. 2016;148:132–138.
- 48. Stewart WF, Ricci JA, Chee E, Hahn SR, Morganstein D. Cost of Lost Productive Work Time Among US Workers With Depression. JAMA. 2003;289(23):3135-3144.
- 49. OECD. Sick on the Job? 2012.
- 50. Walker ER, McGee RE, Druss BG. Mortality in mental disorders and global disease burden implications: a systematic review and meta-analysis. JAMA Psychiatry. 2015;72(4):334-341.
- 51. World Health Organization. Burn-out an "occupational phenomenon": International Classification of Diseases.
  World Health Organization. Mental Health Web site.
  https://www.who.int/mental\_health/evidence/burn-out/en/.
  Published 2019. Accessed 6/18, 2019.
- Ilies R, Scott BA, Judge TA. The Interactive Effects of Personal Traits and Experienced States on Intraindividual Patterns of Citizenship Behavior. Academy of Management Journal. 2006;49(3):561-575.
- 53. Albrecht SL, Su MJ. Job resources and employee engagement in a Chinese context: the mediating role of job meaningfulness, felt obligation and positive mood. International Journal of Business and Emerging Markets. 2012;4(4):277-292.
- Corporate Leadership Council. Driving performance and retention through employee engagement. 2004.
- 55. Antonelli M, Barbieri G, Donelli D. Effects of forest bathing (shinrin-yoku) on levels of cortisol as a stress biomarker. a systematic review and meta-analysis. International Journal of Biometeorology. 2019.

- 56. Wang X, Rodiek S, Wu C, Chen Y, Li Y. Stress recovery and restorative effects of viewing different urban park scenes in Shanghai, China. Urban Forestry & Urban Greening. 2016;15:112-122.
- Jiang B, Li D, Larsen L, Sullivan WC. A Dose-Response Curve
   Describing the Relationship Between Urban Tree Cover Density
   and Self-Reported Stress Recovery. Environment and Behavior.
   2016;48(4):607-629.
- 58. Beukeboom CJ, Langeveld D, Tanja-Dijkstra K. Stress -Reducing Effects of Real and Artificial Nature in a Hospital Waiting Room. The Journal of Alternative and Complementary Medicine. 2012;18(4):329-333.
- 59. Sjolander A, Jakobsson Ung E, Theorell T, Nilsson A, Ung KA. Hospital Design with Nature Films Reduces Stress-Related Variables in Patients Undergoing Colonoscopy. Herd. 2019:1937586719837754.
- 60. Arnberger A, Eder R. The influence of green space on community attachment of urban and suburban residents.

  Urban Forestry & Urban Greening. 2012;11(1):41-49.
- 61. Grassini S, Revonsuo A, Castellotti S, Petrizzo I, Benedetti V, Koivisto M. Processing of natural scenery is associated with lower attentional and cognitive load compared with urban ones. Journal of Environmental Psychology. 2019;62:1-11.
- 62. Schebella MF, Weber D, Schultz L, Weinstein P. The
  Wellbeing Benefits Associated with Perceived and Measured
  Biodiversity in Australian Urban Green Spaces. Sustainability.
  2019;11(3):802.
- 63. Brooks AM, Ottley KM, Arbuthnott KD, Sevigny P. Naturerelated mood effects: Season and type of nature contact. Journal of Environmental Psychology. 2017;54:91-102.
- 64. Neill C, Gerard J, Arbuthnott KD. Nature contact and mood benefits: contact duration and mood type. The Journal of Positive Psychology. 2018:1–12.
- 65. Li HN, Chau CK, Tse MS, Tang SK. On the study of the effects of sea views, greenery views and personal characteristics on noise annoyance perception at homes. The Journal of the Acoustical Society of America. 2012;131(3):2131-2140.
- 66. Van den Berg MM, van Poppel M, van Kamp I, et al. Do Physical Activity, Social Cohesion, and Loneliness Mediate the Association Between Time Spent Visiting Green Space and Mental Health? Environment and Behavior. 2019;51(2):144-166.
- 67. Stewart WP, Gobster PH, Rigolon A, Strauser J, Williams DA, van Riper CJ. Resident-led beautification of vacant lots that connects place to community. Landscape and Urban Planning. 2019;185:200-209.

- 68. Petrovic N, Simpson T, Orlove B, Dowd-Uribe B. Environmental and social dimensions of community gardens in East Harlem.

  Landscape and Urban Planning. 2019;183:36-49.
- 69. Wilkinson S, Orr F. The Impact Of Horticulture Therapy On Mental Health Care Consumers On A Retrofitted Roof. Annual Pacific Rim Real Estate Society Conference; January 18th, 2017; Sydney.
- Kemperman A, Timmermans H. Green spaces in the direct living environment and social contacts of the aging population. Landscape and Urban Planning. 2014;129:44-54.
- Dadvand P, Hariri S, Abbasi B, et al. Use of green spaces, self-satisfaction and social contacts in adolescents: A population-based CASPIAN-V study. Environ Res. 2019;168:171-177.
- Sullivan WC, Kuo FE, Depooter SF. The Fruit of Urban Nature: Vital Neighborhood Spaces. Environment and Behavior. 2004;36(5):678-700.
- 73. Kweon B-S, Sullivan WC, Wiley AR. Green Common Spaces and the Social Integration of Inner-City Older Adults. Environment and Behavior. 1998;30(6):832-858.
- 74. Southon GE, Jorgensen A, Dunnett N, Hoyle H, Evans KL. Biodiverse perennial meadows have aesthetic value and increase residents' perceptions of site quality in urban green-space. Landscape and Urban Planning. 2017;158:105-118.
- 75. Coley RL, Sullivan WC, Kuo FE. Where Does Community Grow? :The Social Context Created by Nature in Urban Public Housing. Environment and Behavior. 1997;29(4):468-494.
- 76. Wang R, Zhao J, Meitner MJ, Hu Y, Xu X. Characteristics of urban green spaces in relation to aesthetic preference and stress recovery. Urban Forestry & Urban Greening. 2019;41:6–13.
- Sallis JF, Cerin E, Conway TL, et al. Physical activity in relation to urban environments in 14 cities worldwide: a cross-sectional study. The Lancet. 2016;387(10034):2207-2217.
- Villeneuve PJ, Jerrett M, Su JG, Weichenthal S, Sandler DP.
   Association of residential greenness with obesity and physical activity in a US cohort of women. Environmental Research. 2018;160:372–384.
- Kaczynski AT, Henderson KA. Environmental Correlates of Physical Activity: A Review of Evidence about Parks and Recreation. Leisure Sciences. 2007;29(4):315-354.
- 80. Schipperijn J, Cerin E, Adams MA, et al. Access to parks and physical activity: An eight country comparison. Urban Forestry & Urban Greening. 2017;27:253-263.

- Jessen MAB, Pallesen AVJ, Kriegbaum M, Kristiansen M. The
  association between loneliness and health a survey-based
  study among middle-aged and older adults in Denmark. Aging
  & Mental Health. 2018;22(10):1338-1343.
- 82. Smith KJ, Victor C. Typologies of loneliness, living alone and social isolation, and their associations with physical and mental health. Ageing and Society. 2019;39(8):1709-1730.
- 83. Holt-Lunstad J, Smith TB, Baker M, Harris T, Stephenson D. Loneliness and Social Isolation as Risk Factors for Mortality: A Meta-Analytic Review. Perspectives on Psychological Science. 2015;10(2):227-237.
- 84. Rebar AL, Stanton R, Geard D, Short C, Duncan MJ, Vandelanotte C. A meta-meta-analysis of the effect of physical activity on depression and anxiety in non-clinical adult populations. Health Psychol Rev. 2015;9(3):366-378.
- 85. Felipe B. Schuch, Ph.D. " Davy Vancampfort, Ph.D. " Joseph Firth, Ph.D. " et al. Physical Activity and Incident Depression: A Meta-Analysis of Prospective Cohort Studies. American Journal of Psychiatry. 2018;175 (7):631-648.
- 86. Bennie JA, Teychenne MJ, De Cocker K, Biddle SJH.
  Associations between aerobic and muscle-strengthening exercise with depressive symptom severity among 17,839 U.S.
  adults. Preventive Medicine. 2019;121:121-127.
- 87. Loprinzi PD, Frith E. Association Between Perceived Physical Activity and Cognitive Function in Older Adults. Psychol Rep. 2019;122(1):108-116.
- 88. Loprinzi PD, Frith E, Edwards MK, Sng E, Ashpole N. The
  Effects of Exercise on Memory Function Among Young to
  Middle-Aged Adults: Systematic Review and Recommendations
  for Future Research. American Journal of Health Promotion.
  2018;32(3):691-704.
- 89. Fuzeki E, Engeroff T, Banzer W. Health Benefits of Light-Intensity Physical Activity: A Systematic Review of Accelerometer Data of the National Health and Nutrition Examination Survey (NHANES). Sports Med. 2017;47(9):1769-1793.
- Cheng W, Zhang Z, Cheng W, Yang C, Diao L, Liu W.
   Associations of leisure-time physical activity with cardiovascular mortality: A systematic review and meta-analysis of 44 prospective cohort studies. Eur J Prev Cardiol.
   2018;25(17):1864-1872.
- 91. Waber B, Magnolfi J, Lindsay G. Workspaces That Move People. Harvard Business Review. October, 2014.

- 92. Jennings V, Bamkole O. The Relationship between Social Cohesion and Urban Green Space: An Avenue for Health Promotion. International Journal of Environmental Research and Public Health. 2019;16(3):452.
- 93. Campbell LK, Svendsen ES, Sonti NF, Johnson ML. A social assessment of urban parkland: Analyzing park use and meaning to inform management and resilience planning. Environmental Science & Policy. 2016;62:34-44.
- 94. Ratcliffe E, Gatersleben B, Sowden PT, Korpela KM.
  Understanding the Perceived Benefits of Nature for
  Creativity. The Journal of Creative Behavior. 2021;n/a(n/a).
- 95. Rich DL. Effects of Exposure to Nature and Plants on Cognition and Mood: A Cognitive Psychology Perspective, Cornell University; 2007.
- Bringslimark T, Hartig T, Patil GG. Psychological Benefits of Indoor Plants in Workplaces: Putting Experimental Results into Context. 2007;42(3):581.
- Studente S, Seppala N, Sadowska N. Facilitating creative thinking in the classroom: Investigating the effects of plants and the colour green on visual and verbal creativity. Thinking Skills and Creativity. 2016;19:1-8.
- Plambech T, Konijnendijk van den Bosch CC. The impact of nature on creativity – A study among Danish creative professionals. Urban Forestry & Urban Greening. 2015;14(2):255-263.
- Van Rompay TJL, Jol T. Wild and free: Unpredictability and spaciousness as predictors of creative performance. Journal of Environmental Psychology. 2016;48:140-148.
- 100. Leong LYC, Fischer R, McClure J. Are nature lovers more innovative? The relationship between connectedness with nature and cognitive styles. Journal of Environmental Psychology. 2014;40:57-63.
- 101. Altomonte S, Schiavon S. Occupant satisfaction in LEED and non-LEED certified buildings. Building and Environment. 2013;68:66-76.
- 102. Kato H, Too L, Rask A. Occupier perceptions of green workplace environment: the Australian experience. Journal of Corporate Real Estate. 2009;11(3):183-195.
- 103. Jostle. Bridging the Engagement Gap: How leaders can get the levels of engagement they strive for. In: Jostle Corporation: https://intranet.jostle.me/bridging-the-engagement-gap.

- 104. Loder A. Greening the City: Exploring Health, Well-being, Green Roofs, and the Perception of Nature in the Workplace. Toronto: Geography and the Centre for Environment, University of Toronto; 2011.
- 105. Joanne C, Chia-Ching W, Chun-Yen C. Landscape Ecology. 2022.
- 106. Carrus G, Scopelliti M, Lafortezza R, et al. Go greener, feel better? The positive effects of biodiversity on the well-being of individuals visiting urban and peri-urban green areas. Landscape and Urban Planning. 2015;134(0):221-228.
- 107. Frumkin H, Bratman GN, Breslow SJ, et al. Nature Contact and Human Health: A Research Agenda. Environmental health perspectives. 2017;125(7):075001-075001.
- 108. Shanahan DF, Fuller RA, Bush R, Lin BB, Gaston KJ. The Health Benefits of Urban Nature: How Much Do We Need? BioScience. 2015;65(5):476-485.
- 109. Dean JH, Shanahan DF, Bush R, et al. Is Nature Relatedness Associated with Better Mental and Physical Health? International Journal of Environmental Research and Public Health. 2018;15(7):1371.
- 100. Malloy C. Cities' Answer to Sprawl? Go Wild. Bloomberg CityLab. CityLab Web site. https://www.bloomberg.com/news/features/2021-10-22/urban-rewilding-aids-biodiversity-climate-resilience. Published 2021. Accessed Nov 4, 2021.
- III. McKeough T. Today's Must-Have Amenity? A little green space. New York Times. https://www.nytimes.com/2021/10/15/realestate/outdoor-space-nyc-apartments.html. Published 2021. Accessed Dec 4, 2021.
- 112. Lenaerts A, Heyman S, De Decker A, et al. Vitamin Nature: How Coronavirus Disease 2019 Has Highlighted Factors Contributing to the Frequency of Nature Visits in Flanders, Belgium. Frontiers in Public Health. 2021;9.
- 113. Andreucci MB, Loder A, McGee B, Brajković J, Brown M. Exploring Regenerative Co-benefits of Biophilic Design for People and the Environment. In: Catalano C, Andreucci MB, Guarino R, Bretzel F, Leone M, Pasta S, eds. Urban Services to Ecosystems: Green Infrastructure Benefits from the Landscape to the Urban Scale. Cham: Springer International Publishing; 2021:391–412.
- 114. Richardson M, Butler CW. Nature connectedness and biophilic design. Building Research & Information. 2022;50(1-2):36-42.
- 115. Srinivasan N, Sachs N. The Power of Sacred Places, 25 years of Science and Evidence-based Design of Healing Green Spaces: A Landscape Architect's Guide. (2021) https://naturesacred.org/new-report-the-power-of-sacred-places/