# Green-Booting the Office

Designing a healthier office for employees in Toronto

by

Tania Melissa Tullio

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# Abstract

This study explored the current-state urban office environment in the Greater Toronto Area, examining whether a deficit of nature influences the stress employees experience at work. Mixed research methods were used to conduct the study, including a literature review, expert interviews, surveying methods, and in-context interviews with people working in Toronto offices. The study demonstrates that people who live in cities have a strained relationship with nature; that the stress experienced from city life and office environments is made worse by this disconnection from nature; and that if offices were designed differently—to better integrate nature into our daily lives—people would likely feel mentally and physically healthier. The findings potentially have implications for three levels of stakeholders—employers, designers, and policymakers. Recommendations include tactics to better integrate nature in everyday activities in city environments to mitigate the impact of nature deficit.

# Acknowledgements

There are several people who played a critical role in my success of this research study.

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Thanks, as well, to Cathy Clarke, for sharing her Research Methods paper on a similar topic. It was timely, as I had been developing my interview guide and was about to kick off interviews when Cathy reached out, and some of the considerations that her team included in their paper were highly relevant to my own interviews.

Finally, thanks to my manager, Patrick Dunn, for giving me the time and space to work on this project when I needed it.

# Table of Contents

# List of Tables

# List of Figures

# 0.0 Introduction

This Major Research Paper is an exploration of the current state urban office environment in the Greater Toronto Area. It attempts to make a connection between our disconnection from nature and the stress we experience, specifically in office environments. I seek to add to existing research in the related field of biophilia by taking a human-centered approach, focusing on the emotional and physical impact that urban offices have on workers. My study made use of mixed research methods, including a literature review, expert interviews, quantitative surveying methods, and in-context semi-structured interviews with people working in Toronto offices.

## 0.1 Overview of the Problem Space

According to a time activity survey (Matz et al, 2014), adult Canadians spend about 5.4% of our time outdoors. We spend more time in our cars (about 6%) and in our workplaces (about 8%) than we do in nature.



The Workplace is a source of stress for

# 6 in 10

Canadian workers

*Figure 1 Workplace as source of stress*

Disproportionately, Canadians report that the workplace is a source of stress (Crompton, 2011). An unhealthy amount of stress leads to poor mental health: CAMH estimates that each week, 500,000 workers are unable to work due to mental illness, which costs the economy billions of dollars per year (Mental Illness and Addictions: Facts and Statistics, n.d.). A recent study by Sanofi (2016), a company that conducts a healthcare survey each year with major health insurers, found that 59% of workers have some chronic health condition, and of those respondents, 19% of reported having some chronic mental health condition, like anxiety or depression.

**What's making us sick?** Among the contributing factors, people who live in cities are experiencing *nature deficit* (noted in Briggs, 2016)—an increased detachment from natural spaces. There is ample evidence that people who live in cities with access to green spaces—for example, parks, wooded areas, or gardens—have improved mental, physical, and psychological outcomes (Stigsdotter et al., 2010; White, 2013).

## 0.2 What this Study Demonstrates

This Major Research Paper will demonstrate that people who live in cities have a strained relationship with nature; that the stress we experience from city life and working in office environments is made worse by this disconnection from nature; and that if our offices were designed differently—to better integrate nature into our daily lives—we would likely feel mentally and physically healthier.

**1**  Our relationship to nature is strained.

**2**  Stress at work is increased by our nature deficit.

**3**  A green-booted office would benefit employees
(& provide a competitive advantage to employers).

*Figure 2 Key findings from study*

This paper is broken down into six sections, as well as several appendices:

- In **Section 1**, I provide an executive summary of the key findings and implications from my research.

- In **Section 2**, I explore and build the case for *biophilia*, a theory proposed by Edward Wilson in his 1984 book of the same name that talks about our innate, human attraction to natural processes, living things, and nature. I summarize several academic, industry, and policy sources that provide evidence to support the theory, and introduce the emergent field and contemporary practices of *biophilic design*.

- In **Section 3**, I provide an overview of my research approach. I outline gaps I uncovered in my literature review, and the major lines of enquiry and hypotheses for my research study to build on the research. I acknowledge the limitations of my research—namely, that a larger sample would provide deeper insights into this problem space (my survey had 52 respondents, and I interviewed 9 people working in offices in the GTA).

- In **Section 4**, I illustrate the key insights and findings that emerged from my primary research, and synthesize this with the supporting evidence from my literature review. I show how my primary research validated the initial hypotheses, and begin to uncover some of the underlying causes of our disconnection from nature, which are further elaborated in Section 5.

- In **Section 5**, I provide recommendations to three levels of stakeholders, as well as a proposed approach for each to consider in mitigating the impact of nature deficit in urban office environments and cities. I illustrate the interconnectedness among all stakeholders, and the potential impact that an integrated biophilic design approach could have for each.

- Finally, in **Section 6**, I outline several areas of exploration for future research studies for the biophilic design of urban offices and cities in the future.

# 1.0 Executive Summary

## 1.1 Our Workplaces are Making us Sick

Canadians spend about 9% of our time in indoor work or office settings (Matz et al, 2014), yet a disproportionate number of us—six in 10 Canadian workers—report that our workplace is a source of stress (Crompton, 2011). An unhealthy amount of stress leads to poor mental health: CAMH estimates that each week, 500,000 workers are unable to work due to mental illness, which costs the economy billions of dollars per year (Mental Illness and Addictions: Facts and Statistics, n.d.).



The Workplace is a source of stress for

## 6 in 10

Canadian workers

*Figure 3 Workplace as a source of stress*

What's making us sick? Among the contributing factors, people who live in cities are experiencing *nature deficit* (Briggs, 2016)—an increased detachment from natural spaces; indeed, city-dwelling Canadians spend only about 6% of their time outdoors (Matz et al, 2014). There is ample evidence that people who live in cities with access to green spaces—for example, parks, wooded areas, or gardens—have improved mental, physical, and psychological outcomes (Stigsdotter et al., 2010; White, 2013).

## 1.2 Premise and Main Findings

This research paper argues that part of the reason that urban office workers are experiencing stress is because of a basic inaccessibility of their offices to natural spaces within walking distance in which people can more effectively "reset" from mental strain (Barton, 2008; Gillis & Gatersleben, 2015). I posit that having more access to natural outdoor or indoor spaces would mitigate the mental health

**1** Our relationship to nature is strained.

**2** Stress at work is increased by our nature deficit.

**3** A green-booted office would benefit employees
(& provide a competitive advantage to employers).

*Figure 4 Key findings from study*

impacts caused by stress and nature deficit. Furthermore, people who do have access to natural spaces and spend time in them would likely feel healthier and happier than people who do not.

My research uncovered that, indeed, the people I interviewed who work in Toronto offices are largely disconnected from nature; work-related stress is exacerbated by this nature deficit; and that providing more access to nature would be beneficial to their wellbeing.

## 1.3 Background Research and Research Questions

### 1.3.1 Biophilia: Origins and Evidence Base

The theory of biophilia was popularized by Edward O. Wilson in his book, *Biophilia*, in 1984, in which the author makes the argument that human beings are innately drawn to natural processes, living things, and nature, more broadly. In that same year a widely cited study was conducted by Roger S. Ulrich, a behavioural scientist and proponent of evidence-based design. Ulrich demonstrated that surgical patients being treated with the same conditions who had a view to natural environments had fewer complications and shorter stays after their surgeries, giving credence to the biophilia theory (Ulrich, 1984; Browning, Ryan, & Clancy, 2014).

Ulrich's research was also one of the first to specifically link the built environment to the health of people who spend time in those spaces (A conversation with Roger Ulrich, 2010). As a result, practitioners across several design disciplines, including interior designers, architects, and

environmental designers, have more recently begun to consider how biophilic design can be applied in other contexts—namely, office buildings. Terrapin Bright Green, a design consultancy founded by environmental strategists and green architects, published its 14 Patterns of Biophilic Design in 2014 (Browning, Ryan, & Clancy). These attempts to create frameworks and guidelines for biophilic design are directly linked to the evidence-based design philosophy that Ulrich kicked off decades earlier.

Several interjurisdictional academic papers (Stigsdotter et al., 2010; White, Alcock, Wheeler & Depledge, 2013; Gray & Birrell, 2014; Gillis & Gatersleben 2015; An, Colarelli, O'Brien & Boyajian, 2016) and government policy reports (Leech, Nelson, Burnett, Aaron & Raizenne, 2002; Bergeron, 2009; Matz et al., 2014; Zupancic, Kingsley, Jason & Macfarlane, 2015) find that access to natural spaces, and biophilic design elements, are correlated with a variety of positive health outcomes, including mental, physical, and psychological wellbeing; furthermore, exposure to natural spaces—as little as 20 minutes—provides a mechanism by which we can effectively recover from mental strain (Attention Restoration Theory, in Gillis & Gatersleben, 2015, and San Martin-Feeney, 2010).

### 1.3.2 Research Questions

While there are ample examples of empirical evidence that biophilic design approaches can help create better, healthier spaces for indoor office workers, what's missing from the research is the human factor: how do people working in urban offices experience their work environments on an emotional level? What, if any, is their connection to nature or natural spaces? How might including natural elements into the design of their offices change their work experiences? On the other hand, are people who work in spaces without access to nature affected negatively? If so, in what ways, and to what degree?

In addition, a lack of primary research from Canadian communities means that design strategies for our indoor spaces in the Greater Toronto Area (GTA) lack context: how might having four seasons (and long, cold winters) influence the ways we access outdoor, natural spaces?

## 1.4 Research Methods

This study sought to add to existing research in the biophilic design field by focusing on the workplace experiences of urban office workers in Toronto. My study made use of mixed research methods, including a literature review, expert interviews, quantitative surveying methods, and in-context semi-structured interviews with people working in Toronto offices.

**Literature review:** My research scan included academic papers and contemporary literature on a number of related topics, including biophilic design and biophilic design patterns; nature deficit; employee wellness and wellbeing; and the built environment and its impact on health. This scan revealed a gap in Canadian-based studies, as well as a deficit in in-context primary research, which helped shape my research approach.

**Expert interviews**: I spoke to experts from Steelcase, Gensler, and Stantec, three global design firms who apply leading-edge research into the office and building designs that they provide to clients. From those interviews, I was able to gain insight into some of the best practices in biophilic design for urban office settings.

**Surveying:** I conducted a 34-question survey, used both as a data collection tool, and to identify and recruit participants for interviews. I promoted the survey through personal and professional networks, via social media (Twitter, LinkedIn). Fifty-two people responded to my survey, and 17 expressed interest in participating in future stages of my research.
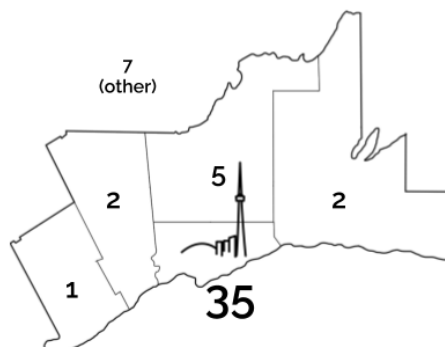


*Figure 5. Survey respondent data.*

**In-context interviews**: I conducted nine interviews with people who worked in large public sector organizations, startups, and small private enterprises in the GTA. Four participants were male, and five were female; five between the ages of 18-34, and four between the ages of 35-50. Interviews took place on-site at the person's place of work, and took up to 1.5 hours (one hour for the interview, and up to 30

minutes to tour the site in order to take photos of the spaces that interviewees have access to in their regular work day). From these interviews, I gained deep insights to the current state of the urban office experience in Toronto, and uncovered several connections that support the biophilia theory, as well as the best practices and literature on biophilic design.

### 1.4.1 Limitations

While the data collected from survey respondents proved valuable in my analysis, the number of respondents was ultimately too small to draw any statistically significant conclusions.

For the in-context interviews, I was acquainted with 8 of the 9 participants who agreed to a one-on-one interview with me, either from previous work experiences or through my personal networks. There may have been some self-selection as a result, in terms of who I was able to recruit for the interviews: these nine participants were likely more inclined to speak to me because they share a high degree of interest in the subject matter, and because they are personal acquaintances.

I would have benefitted from having a larger number of participants to diversify the types of people I spoke to. However, using this research method helped me to effectively uncover rich, contextualized data from the interviews, from which I was able to extract several valuable findings in combination with the evidence I uncovered from literature review.

## 1.5 Findings

### 1.5.1 Our Relationship to Nature is Strained

All the people I interviewed noted that while they were drawn to natural spaces, for the most part, they do not spend time in natural spaces while at work. Participants are more likely to make use of natural spaces on their time off, while at home.

It appears that this disconnection from nature is reinforced by an inaccessibility to nature. The importance of spending time in nature is perceived as a separate activity from work; it is not integrated as a daily experience.

Spending time in nature is perceived as separate from work.

*Figure 6 Key finding: spending time in nature is perceived as separate from work*

This is unfortunate, since it has been shown that spending time in natural spaces provides people with a way to recover mentally from stressful situations (Gillis & Gatersleben, 2015; San Martin-Feeney, 2010). Because people are not accessing natural spaces from their workplaces, they do not have daily opportunities to benefit from the healing, "resetting" effects that natural spaces provide, which is especially harmful since work is a source of stress for 6 in 10 Canadians, as noted previously (Crompton, 2011).

### 1.5.2 Proximity and Access Matter

All the participants I spoke to worked in roles that afforded them a lot of flexibility in terms of break-taking: they all said that their breaks were not documented or tracked, and they could use their own discretion throughout the day when they needed time away from a work task. As noted in the previous finding, they do not use this break-time to seek out natural spaces, generally, even though most of them (5 of 8) had said in the survey during phase 1 that they have "walking distance" access to natural spaces from work.

> When people are reminded of nature with on-site biophilic elements, they seek out these spaces during breaks.

*Figure 7 Key finding: when people are reminded of nature with on-site biophilic elements, they seek out these spaces during breaks*

Ultimately, upon visiting their workplaces, I discovered that only one has reasonable access to natural spaces around their workplace; furthermore, the two participants who had on-site natural elements—waterfall elements, lots of living plants in common areas, and a courtyard full of trees and plants—said they spent a lot of time in those spaces during their breaks.

Two factors contribute to whether employees use the natural spaces available to them:

**Proximity**, or being a reasonable distance from their workplace (on-site, integrated features appear to be used frequently by interviewees), and

**Programming**, employer-supported messaging to reinforce the use of natural spaces.

**Inaccessibility of nature**

**Disconnection from nature**

**Not spending time in nature**

A reinforcing systemic loop. An inaccessibility to nature leads to a feeling of disconnection from nature; being disconnected from nature leads us to spend less time in nature, reinforcing our disconnection from nature.
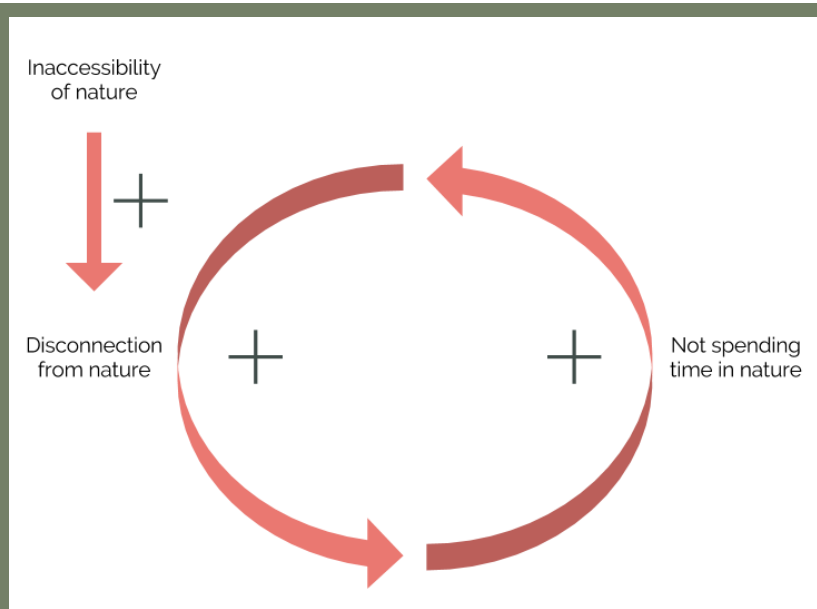
*Figure 8. Reinforcing loop: Disconnection from nature.*

When people are reminded of nature visually, through on-site biophilic elements, and when this is reinforced by employer-driven communications, they are more likely to seek out these spaces when taking breaks from work.

### 1.5.3 Work-Related Stress is Exacerbated by Lack of Access to Nature

| Employees need natural sunlight (4 of 9 are in offices without access to natural light) | Employees feel disconnected from colleagues | Participants feel somewhat trapped in their offices |
|---|---|---|

"I can't go outside to [a park]. I need to have… maybe it's light."

"I think [the office is] very isolating. It siloes people, and this office, it's an older office, so it has that effect."

"We have our boardrooms, called 'the cave,' we hate being in there."

*Figure 9. Work-related stress from nature deficit.*

For the most part, the workplaces that I visited are not designed to support wellbeing, and very likely contribute to work-related stress expressed by participants. Specifically, the spaces lack two key elements that leading experts and certification programs note are necessary for employee wellbeing: natural light, and spaces that provide the opportunity for social connections with other people (see WELL Building Standard certification; WorkWell℠ methodology by Gensler, in Siller, 2017; Steelcase's six dimensions of wellbeing, in *Wellbeing*, 2014; and Terrapin Bright Green LLC, noting the *natural and diffuse light pattern* on p. 34).

> "When I go outside, even for a little bit, it's almost like my brain is taking a breath, and I can kind of process what I'm feeling. And then… I relax."

*Figure 10 Quote: "When I go outside, even for a little bit, it's almost like my brain is taking a breath, and I can kind of process what I'm feeling. And then… I relax."*

Most (6 of 9) of my interview participants expressed a desire for more open and collaborative work spaces, and all of them said that access to natural light during the work day is a basic need that for many is not being met (4 of 9 did not have direct access to sunlight from their workspace, where they spend an average of six hours a day).

### 1.5.4 Nature Matters to People

Despite the disconnection from nature people experience from the workplace, nature nonetheless plays a significant role in people's lives, in two critical ways related to health and wellbeing:

**Nature helps people "reset":** Participants noted that when they spend time in nature, it is as if they are "emptying out" the stress and toils of the day; it quite literally restores people to a better state of mind.

**Nature connects people to something more profound than themselves:** Nature is solitary for some, and for others, recognizing nature in their lives provides a spiritual, even religious, experience. Almost all participants described their sense of wonder, awe, and majesty when they have immersive experiences in nature.

> " [in nature] it feels like your capacity has grown to fill that space… all that stuff that was just cluttering up has moved out "

*Figure 11 Quote: "[in nature] it feels like your capacity has grown to fill that space… all that stuff that was just cluttering up has moved out."*

In her 2010 Master of Science thesis, San Martin-Feeney found that urban dwellers experience mental restoration in parks, and these spaces allow people to connect to nature, and to self-reflect, while in those spaces (p. 61-64). This directly supports Wilson's biophilia hypothesis: people seem to be naturally drawn to green spaces, and the reason they seek them out is to self-reflect, "reset," calm their minds, and feel a sense of solitude.

### 1.5.5 The Green-Booted Office

While it may not ever be possible to replicate the deeper feelings that people experience when immersed in larger natural spaces, workplaces that include natural features would be beneficial to employees, and may even provide a competitive advantage for employers interested in creating not just healthy, but aesthetically pleasing spaces that are attractive to employees today:

> " Somebody put a lot of thought into this… it shows an intent that's positive and generous, he [the employer] doesn't have to do any of that stuff. "

*Figure 12 Quote: "Somebody put a lot of thought into this… it shows an intent that's positive and generous, he [the employer] doesn't have to do any of that stuff."*

**Workplaces and culture are connected**: An investment in biophilic design elements would not be taken for granted by employees; many are aware that spaces set expectations for certain behaviours, and an employer who takes extra steps to support employee wellbeing would stand out.

**People think of nature as "real"**: Overwhelmingly, participants believe if natural elements are to be incorporated in indoor spaces, they should be organic, even living. The sentiment that participants expressed has robust secondary research to validate it. One of the biophilic patterns noted in Terrapin Bright Green (2014) that has the strongest evidence base is a *nature in the space* pattern, the first one highlighted in the paper: *visual connection to nature*. Having a view to nature is beneficial to human health, which one of the earliest papers by Roger Ulrich demonstrated in 1984. Since Ulrich's findings, the visual connection to nature biophilic pattern has been connected to all three categories of health benefits noted in Terrapin Bright Green's literature scan: stress reduction, cognitive performance, and emotion, mood, and preference (p. 12).

## 1.6 Implications

The findings in my paper have implications for several stakeholders, including employers and wellness program administrators, urban planners, building designers and architects, and policymakers in Canadian cities.

### 1.6.1 Employers and Employees

The opportunity from an employer's point of view is to establish an integrated wellness approach that includes not just a benefits package for staff, but programming that supports overall employee wellness. Employers may want to consider where investing in biophilic design elements, especially access to *nature in the space* features, may fit in relation to their broader health and wellness programming for staff, since it has been shown that these elements contribute to mental restoration. Integration of these biophilic patterns would need to be considered carefully to maximize their use, and a broader employee wellness strategy should be in place to reinforce behaviours through sustained communication efforts.

### 1.6.2 Design Consultants and Architects

One barrier that workplace consultants and designers have today is demonstrating the return on investment in incorporating biophilic elements. The field is still quite emergent, and as such, organizations like Steelcase and Gensler invest a lot of time and money to conduct in-house research,

such as employee engagement and wellness surveys from clients to build the evidence base for their design proposals.

Still, as more companies recognize the impact on employee productivity from incorporating biophilic design elements (Clancy, 2014), designers should consider staying ahead of the curve by applying for certifications like the WELL Building Standard AP courses, and Fitwel designations.

### 1.6.3 Urban Planners and Policymakers

A major challenge in a city like Toronto is our notable lack of green spaces in which to immerse ourselves. To get to natural spaces, most people working in offices would need to go out of their way to access them. A more systemic opportunity lies with our city officials and policymakers.

Investments in parks and recreational areas have been shown to generate sustained revenue through job creation, tourism, and economic activity (e.g., Ontario's Greenbelt (Spence, 2012) and Toronto's waterfront (Economic Growth, Waterfront Toronto, n.d.). More importantly, building and protecting more green spaces is crucial in conserving natural ecosystems and biodiversity, and in responding to climate change (David Suzuki Foundation, 2012, p. 17).

The next step from a policy lens is to consider the idea of designing biophilic *cities* (Beatley & Newman, 2013) that are resilient, sustainable, and support better health outcomes for citizens: "there is much value in fact in getting people out of buildings and to thinking more holistically about the natural qualities and conditions of the larger urban environments in which these buildings sit." Beatley and Newman cite several examples of cities that have incorporated biophilic design into city planning, including things like restoring tree canopies to moderate air pollutants (New York); restoring wetlands to mitigate the impact of hurricanes and floods (New Orleans); and converting rooftops to green roofs to conserve energy and reduce urban temperatures (Toronto).

### 1.6.4 Recommendations

Using my findings about proximity and programming as a framework, the following two opportunities and recommendations to stakeholders emerged from my research:

| | Employers | Designers | Policymakers |
|---|---|---|---|
| **Opportunity #1: Nature at Work** | Invest in nature-in-the-space elements, especially in high-traffic areas of the office<br><br>Lease / buy space with on-site features / nearness to natural spaces<br><br>Design spaces to maximize sunlight flowing through the space | Create evidence-based frameworks and share research broadly to demonstrate ROI of biophilic elements<br><br>Consider user personas in designing spaces for multiple needs / work styles | Raise money through policy frameworks (e.g., development charges) specifically to build parks / green spaces<br><br>Create incentive programs for buildings to go beyond building code standards and design biophilic buildings (e.g., LEED, WELL) |
| **Opportunity #2: Enhanced Wellness Programming** | Include language in health and wellness strategies to encourage use of green spaces<br><br>Integrate outings to natural spaces / nearby parks in daily activities like "walking meetings"<br><br>Create special interest projects for staff to *green-boot* the space, growing indoor plants<br><br>Allocate space (e.g., a meeting room) for meditative / restorative purposes (like a quiet room) | Train and certify consultants in latest programs (WELL, Fitwel)<br><br>Create thought leadership pieces and publish them broadly among designers and stakeholders<br><br>Include wellness strategies as part of the consultant work (not for an extra change) | Build nature into Canada's physical activity guidelines and socialize this in schools / public institutions<br><br>Ensure school curriculum includes learning about the importance of nature |

*Table 1 Summary: recommendations to stakeholders*

## 1.7 Future Research and Conclusions

This study was exploratory in nature, and therefore left me with more questions than answers. My recommended next steps to build on this research would be the following:

- Conducting periodic quantitative surveys to emulate the study conducted in the UK (White et al, 2013), measuring people's wellbeing and access to green spaces. I would add questions that are framed around our diverse seasons, which would fill a gap in the literature and existing evidence.

- Conducting workplace experiments, testing different biophilic elements and whether they have an impact on employee engagement, wellness, and satisfaction at work.

- Conducting more primary research on employee experiences similar to this study. A significant gap in Canadian papers are deeper, ethnographic insights that would reveal more specific opportunities in this space.

Some research questions I am left with are the following:

- Desirability questions:
  - How might we enhance people's awareness about the restorative aspects of being in natural spaces?
  - What might motivate people to seek out natural spaces more frequently?
  - What needs would people with different work styles and experiences have?
- Viability questions:
  - What's the optimal "ROI" on workplaces that include biophilic design elements? Which elements have the most impact on wellbeing, and in what situations?
  - How might the human and social impact of biophilic designed spaces be measured in a meaningful way to build a business case for it among employers, building designers, or policymakers?
- Feasibility:
  - How much better might people feel if there were more access to nature during work days?
  - How much nature do employees in urban offices need on a daily basis to have a marked impact on their wellbeing?
  - How might spaces be optimally designed for various firms and workplace cultures (e.g., a law firm versus a government agency versus a technology startup)?

I can reasonably interpret my findings to conclude that people are naturally drawn to green spaces and seek them out instinctively; feel good when they are immersed in them; and would value more access to these spaces within an urban context. Moreover, my revised hypothesis would be that if more employers invested in indoor spaces with biophilic elements, especially *nature in the space*, it would likely provide them with a competitive advantage in terms of attracting talent: people feel deep connections to nature, and if natural elements were more mindfully integrated within physical workplaces, I am confident people would benefit from their use.

The following impacts could result in the long term if a more integrated biophilic design practice were used across all stakeholders:
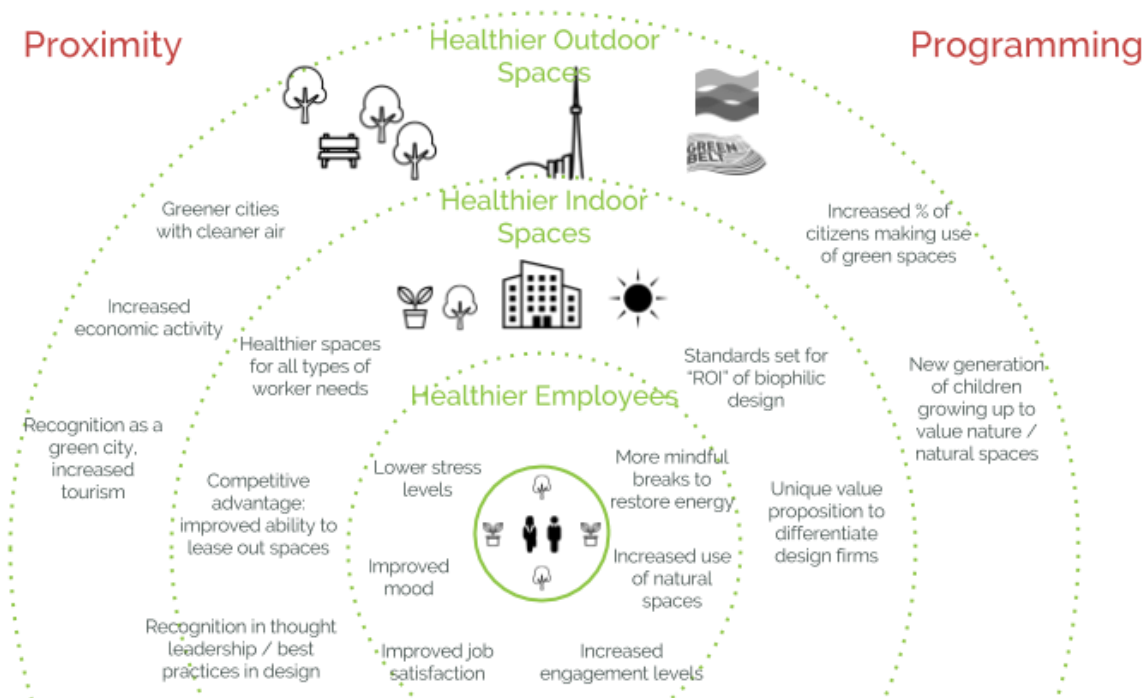


*Figure 13 Map of potential impact on stakeholders*

All stakeholders would be wise to consider integrating biophilic design in their practice, as it becomes increasingly clear from the research the positive impact it has on the wellbeing of people working and living in cities.

# 2.0 Overview of the Problem Space

## 2.1 Canadians Spend 90% of their Time Indoors

A national time-activity survey found that city-dwelling Canadians spend only about 6% of their time outdoors (Leech, Nelson, Burnett, Aaron, & Raizenne, 2002). Seventy percent of young people in Canada aged 13-20 spend an hour or less outside per day, according to the 2012 Youth Survey on Nature and the Outdoors (David Suzuki Foundation). Employees working in office environments are similarly disconnected from public green spaces, especially in urban centres like the City of Toronto: Toronto ranks 23rd out of 35 global cities in terms of the percentage of public green spaces it provides its citizens (World Cities Culture Forum, n.d.).

The problem we are experiencing in cultures like ours is a so-called *nature deficit*—a phrase coined by Richard Louv in his 2005 book, *Last Child in the Woods* (noted in Briggs, 2016). Nature deficit entails an increasing alienation from natural environments, and it is taking a toll on our overall wellbeing: a Danish study by Stigsdotter et al. (2010) shows that study participants "living more than 1 km away from a green space have 1.42 higher odds of experiencing stress than do respondents living less than 300m from a green space." In the UK, Dr. Mathew White's 2013 paper showed evidence that "on average, individuals have both lower mental distress and higher wellbeing when living in urban areas with more green space" (White, Alcock, Wheeler, & Depledge, 2013). This finding was drawn from the data of 10,000 individuals over the course of 18 years of surveying using data from the UK's General Health Questionnaire.

Given that 60% of the world's population will live in cities by 2030 (United Nations Sustainable Development Action Plan, 2015)—and considering that, in 2011, 86% of Ontario's population was already living in urban centers (Population, urban and rural, by province and territory (Ontario), n.d.)—the way we design our urban spaces is increasingly becoming important for citizen health. More research into this problem space would be relevant to urban planners, building designers and architects, employers and wellness program administrators, and policymakers in Canadian cities.

## 2.2 Our Offices are Making us Sick

Despite the fact that we spend less than 9% of our time in indoor work or office settings (Matz et al, 2014), a disproportionate number—six in 10 Canadian workers—report that their workplace is a source of stress (Crompton, S., 2011).



The Workplace is a source of stress for

# 6 in 10

Canadian workers

*Figure 14 Workplace as a source of stress*

There is a compelling business incentive for companies to turn their attention to new ways to improve their employees' wellbeing: the Centre for Mental Health in the UK estimates that employees who work in a state of poor mental health—a state called presenteeism, when people choose to go to work while ill—costs the UK economy £15 billion per year (Centre for Mental Health – Managing Preenteism, 2011), "almost twice the cost of absence" (cited in *Wellbeing*, 2014). In Canada, CAMH estimates that each week, 500,000 workers are unable to work due to mental illness (Mental Illness and Addictions: Facts and Statistics, n.d.).

The findings in this study provide a deeper dive on the urban office today: the workplace experience, how the office environment might affect employees' sense of wellbeing, and whether elements connecting employees to nature might improve employees' sense of wellbeing.

## 2.3 Biophilic Design is Part of the Solution

### 2.3.1 Theoretical Origins of Biophilia

Much of the background research I conducted when exploring this problem was about biophilic design. The theory of biophilia was popularized by Edward O. Wilson in his book, *Biophilia*, in 1984, in which the author makes the argument that human beings are innately drawn to natural processes, living things, and nature, more broadly. Biophilic design is an emerging design practice that examines how we might design spaces that incorporate patterns found in nature. I was interested in exploring whether biophilic design patterns could be applied in offices to potentially help mitigate the impacts of our increasing disconnection from nature.

In the same year Wilson's *Biophilia* was published, a widely cited study was conducted by Roger S. Ulrich, a behavioural scientist and proponent of evidence-based design. Ulrich demonstrated that surgical patients being treated with the same conditions who had a view to natural environments had fewer complications and shorter stays after their surgeries (Ulrich, 1984; Browning, Ryan, & Clancy, 2014), giving credence to Wilson's theory. His paper, and ongoing research showing the effect of nature on people's sense of wellbeing, have had a significant impact on the design of patient rooms and hospitals (Yamaguchi, 2015; Franklin, 2012). As one physician noted in a 2012 Scientific American article, "In 1984 we all took it for granted that hospitals were noisy, smelly, disorienting mazes" (Franklin).

Ulrich's research was one of the first to specifically link the built environment to the health of people who spend time in those spaces (A conversation with Roger Ulrich, 2010). As a result, practitioners across several design disciplines, including interior designers, architects, and environmental designers, have more recently begun to consider how biophilic design can be applied in other contexts—namely, office buildings. Kellert, Heerwagen, and Mador began to codify the emergent biophilic design field in 2008 with their book, *Biophilic Design: The Theory, Science and Practice of Bringing Buildings to Life*. In 2014, Terrapin Bright Green, a design consultancy founded by environmental strategists and green architects, published its 14 Patterns of Biophilic Design (Browning, Ryan, & Clancy) for design researchers and practitioners alike to introduce biophilic elements into the architectural design of spaces. These attempts to create frameworks and guidelines for biophilic design are directly linked to the evidence-based design philosophy that Ulrich kicked off decades earlier.

### 2.3.2. Academic Research

There is mounting evidence from peer reviewed publications in several jurisdictions that biophilic design supports wellbeing, including research from the UK, Australia, and Denmark. My academic research scan began with two studies which explored how access and availability of green spaces may impact people over time. Stigsdotter et al. (2010) demonstrate that people living more than 1 km from green spaces are 1.42 times more likely to report experiencing stress than those who live within 300 m. Furthermore, their study finds that people who generally report low stress levels are more likely to visit green spaces. This corroborates evidence from my own primary research.

White et al.'s analysis builds on the research done in Denmark, and includes a rigorous analysis of government collected survey data from 10,000 participants over the course of 18 years. Their report examines whether participants' self-reported "life satisfaction" scores change if they move from areas

with more or less available green space (the UK keeps data on geographic areas and the density of green spaces, like parks and gardens, accessible to people living in those areas). It is true, according to their synthesis, that people who live in areas with lots of green spaces are happier overall than those who do not. Similarly, a few of my interviewees who had recently moved to offices with less access to parks expressed that they missed having access to those spaces.

In two other papers from Australia and the UK, researchers examined to what extent incorporating biophilic design in the built environment makes a difference in psychological health. Gray and Birrell (2014) discuss the outcomes of the first part of a longitudinal study in Australia that looks at the effect of a temporary construction work site designed with biophilic elements on its occupants. The study measured four specific biophilic elements: open space; natural lighting and ventilation; nature in the space (i.e., indoor plants); and collaborative work spaces. A synthesis of qualitative data (interviews and surveying methods) concludes that employees perceive that the biophilic elements help reduce their stress levels; they feel more connected to the work; and there is an overall improvement in morale. In contrast, some participants in my study noted their sense of isolation because their workplaces were not designed with the elements analysed in Gray and Birrell's study.

Gillis and Gatersleben's research (2015) synthesizes the evidence currently available in the environmental psychology field to evaluate the biophilic design patterns currently being applied by design consultancies today (these patterns will be discussed in more detail later in my paper). Gillis and Gatersleben compare their analysis of the biophilic design patterns against two theories that have emerged in environmental psychology: Attention Restoration Theory and Stress Recovery Theory. These two theories posit that the design of certain environments can help people recover mentally from stressful situations. Gillis and Gatersleben conclude that the most evidence (and most of the research done to date) validates that the first biophilic design category, "direct experience of nature," does have an impact on stress recovery, and that all elements across all categories have some evidence to support their role in stress recovery. However, the researchers note that a one-size-fits-all approach should not be applied for every situation, and the way the patterns are executed should depend on context and people's specific experiences and needs. Later on in my paper, I will describe some best practices in this regard.

More recently, a study from An, Colarelli, O'Brien, and Boyajian (2016) builds additional evidence for the *nature in the space* patterns noted earlier. Their research studies the use of natural elements and

sunlight on employee wellbeing, analyzing data from 444 employees across the United States and India. Their literature review covers many of the topics mentioned in this paper, and their hypotheses are similar: that "exposure to natural elements in the workplace will be positively related to employees' mental health (lower depressed mood and anxiety) and work attitudes (higher job satisfaction and organizational commitment)." The researchers run an experiment to test participants' exposure to biophilic elements, which included direct (i.e., organic plants), indirect (i.e., a window view to nature, and direct or indirect exposure to natural light), and representational (i.e., screensavers and photographs of nature) elements. They studied the impact of these elements on participants' mental health and job satisfaction. They conclude that sunlight has a greater impact on the outcomes than natural elements, but exposure to natural elements in general were associated with less depressed moods. Their study uniquely found a connection between depressed mood and job satisfaction, implying that biophilic elements that influence mood, especially direct exposure to sunlight, could have a tangible impact on employees' work experience overall.

It is worth noting here that academic research examining biophilic design in a Canadian context is quite limited. However, my secondary research did show that academic interest in this field is growing in Canada. When I first started my research, a former OCAD University Master of Design graduate, Cathy Clarke, reached out to me and shared a paper from her Research Methods course entitled *Nature in the Workplace: Research Exploration* (Clarke, Greenwood, O'Neil, & Russek, 2014). Her research team began with a very similar premise as mine: *Given there is a nature deficit and that people spend the majority of their lives at work, how might we incorporate nature into workplace design?* Clarke and her research team conducted expert interviews with four people working in the areas of workplace wellness, workplace design, and nature. One of their respondents, Greg Ward, Manager of Compensation and Benefits for Microsoft Canada, foresaw that "nature in workplace design and wellness programs could be the next leading edge innovation for wellness if a strong enough argument could be made for the return on investment." Incidentally, I found similar opinions from my conversations with consultants from two global design consultancies, Gensler and Steelcase, which are noted in section 1.4 (Expert Advice).

While I was unable to find peer reviewed research into this space from Canadian authors, I did uncover two graduate-level research papers on biophilic design from Canadian institutions: Marion Lanktree's 2010 Master of Design thesis, *Investigating Interactive Biophilic Design in Interior Environments* (from Carleton University) and Daniella San Martin-Feeney's 2010 Master of Science thesis, *Green Space, Blue*

*Space and Mental Health in an Urban Setting: A phenomenological Study* (from the University of Alberta).

Lanktree's study tests whether simulated biophilic design elements, built with interactive digital technologies, would be favoured by research participants over those without biophilic elements. Much of Lanktree's literature review overlaps with my own, and additionally includes research from interaction design fields to inform the experiment she conducted. She built six interactive exhibits for a local museum (three biophilic, and three non-biophilic), making observations of 120 first-time visitors who interacted with the exhibits (measuring how much time they spent at each exhibit, and how they were reacting). She followed up the observations with semi-structured interviews to gain deeper insights about participants' experiences. Interestingly, she found that overall, people spent more time interacting with the non-biophilic exhibits; however, all of the people interviewed (30 interviewees) said they would prefer that the biophilic installations would be integrated in more permanent, everyday interior designs. She concludes that people perceive digital technologies as a contemporary medium, and whether biophilic or not in nature, would be seen as innovative when used in interior spaces. This has implications for how biophilic design is executed in an indoor setting, and corresponds to a key finding from my primary research: people expect natural elements in design to be derived from organic elements—that is, from non-simulated sources. I will expand on this finding in section 4.0 of this paper.

Like Gillis and Gatersleben, San Martin-Feeney (2010) is interested in the role of biophilic design in the built environment in supporting psychological recovery from stress, drawing from the previously mentioned Attention Restoration Theory. Her paper includes a thorough literature review of quantitative studies examining the role that the proximity of green spaces has in research participants' overall sense of health, with findings similar to White et al, and other papers I previously mentioned. She noted a gap in the research, "a lack of qualitative studies examining the experience of mental restoration itself taken from the perspective of individuals undergoing this experience." Her research aimed to understand the experiences of 15 participants living in an urban context who said they gain a sense of mental restoration from spending time in parks. Her argument is that by understanding the subjective meaning that people attach to the phenomena of mental restoration as a result of spending time in parks, researchers can determine how elements in the built environment contribute to this phenomenon, which can be applied in park design in the future. San Martin-Feeney's paper finds that there are four ways that urban dwellers experience mental restoration in parks: connections to nature, connections to community, connections to self, and the park environment itself (p. 56). Some of her

insights are very similar to those that I uncovered; people seem to be naturally drawn to green spaces, and the reason they seek them out is to self-reflect, "reset," calm their minds, and feel a sense of solitude (p. 61-64).

My scan of academic research into the topic of biophilic design and its role in the wellbeing of people working in urban environments provided the evidence base I needed to determine the focus of my research question, and the type of research I wanted to pursue for this project. It became clear to me that in-context, qualitative evidence originating from Canada is missing from the literature and would be a valuable addition to the existing evidence.

### 2.3.3. Policy Reports

At the policy level, studies that explore more specifically how the built environment impacts health outcomes are more prevalent. A report produced by Kim Bergeron for the Association of Public Health Epidemiologists in Ontario looked at the built environment and its impact on chronic health conditions. Her study is a literature review of several other studies that looks at chronic risk factors like physical activity, healthy weights, tobacco use, alcohol consumption, and exposure to ultraviolet radiation. She correlates these factors with study participants' built environments. The report concluded that while there is evidence to suggest a link between the built environment, physical activity, obesity, and chronic diseases, there is a need for more interdisciplinary and primary research. In particular, the report emphasizes a need for primary research in a Canadian context; Bergeron notes that most of the literature does not take into account the potential impact that our diverse seasons may have on the way we access outdoor spaces (e.g., in cold weather conditions).

In Toronto, the city recently produced a series of reports to provide an evidence-based perspective on healthy city design. One report looks specifically at the role of green spaces on the physical and mental wellbeing of citizens (Zupancic, Kingsley, Jason & Macfarlane, 2015). It summarizes a literature review of 106 studies, finding that green spaces have a statistically significant impact on several health outcomes, including mental health, physical activity, wellbeing, physical health, social connectivity, cardiovascular disease, mortality, weight status, and birth outcomes (p. 8-9). It also cites four papers that explored the impact of green space on mental health, including White et al (noted earlier). Overwhelmingly, the literature review concludes that green spaces have a demonstrated positive impact on citizens' physical and mental health.

Both of the aforementioned reports almost exclusively cite research done in other jurisdictions, and both conclude that more research that originates in Canadian communities is needed to provide a local context. However, the overall conclusions are compelling, and make a case for increased access to green spaces for people living in cities, which supports my initial hypotheses. In the Toronto Public Health report, it is notable that proximity (distance) to green spaces, and the density of green spaces, emerge as important factors in how people perceive their wellbeing (p. 18-21). This finding emerged in my primary research as well, which will be elaborated later on in this paper (4.0 Findings and Insights).

### 2.3.4. Certifications

With more and more evidence that human-made spaces play a role in wellbeing, two new certification programs have been developed to create standards and best practices for healthier built environments, both from an environmental lens (i.e., carbon footprint, building efficiency), and from a human lens (i.e., the health of people dwelling in indoor spaces).

The **WELL Building Standard** was developed by the International WELL Building Institute. It is a rigorous program that focuses on the health and wellbeing of people who dwell within buildings. The standard was developed over six years through a peer-reviewed process, validated by health and medical practitioners. Buildings with WELL certification are tested against seven elements, each with dozens of subcategories that are evaluated:

- **Air**, which includes an evaluation of things like humidity control, cleaning protocol, smoking bans, and ventilation effectiveness;
- **Water**, which includes water quality, quality testing, and drinking water promotion;
- **Nourishment**, which includes access to fruits and vegetables, mindful eating spaces, and the food environment;
- **Light**, which includes daylight modeling, "right to light," and circadian emulation;
- **Fitness**, which includes physical activity spaces, active transportation support, and active furnishings;
- **Comfort**, which includes accessible design, sound reducing surfaces, and impact reducing surfaces; and
- **Mind**, which includes biophilia (qualitative and quantitative), building health policy, and healthy sleep policy.

The program offers an accreditation exam for design practitioners.

**Fitwel** is a standard developed by various U.S. government departments and experts to provide a more accessible certification program for existing buildings. The Fitwel system includes the following evidence-based Health Impact Categories:

- Impacts community health;
- Instills feelings of wellbeing;
- Increases physical activity;
- Reduces morbidity and absenteeism;
- Provides healthy food options;
- Supports social equity for vulnerable populations; and
- Promotes occupant safety.

Establishments that are interested in an assessment by Fitwel would register online, submit a benchmark project on their business, upload a completed scorecard for review, and achieve a star-rating for the project. Fitwel also offers individuals a course to become ambassadors of the program, and people can also join a network of champions online.

I suspect that with biophilic design emerging as a practice in the built environment design space, it is possible that these certification programs, and others related to it—like the Leadership in Energy and Environmental Design, or LEED standard for buildings—may consider incorporating some of the following biophilic design patterns in the near future.

### 2.3.5 Emerging Design Practice: Biophilic Design Patterns

The 14 patterns of biophilic design proposed by Browning, Ryan, and Clancy (2014) brings together evidence from various interdisciplinary fields, including architectural history and health sciences. They are synthesized from a review of 500 research papers, including some previously mentioned in this paper (Ulrich, 1984; Kellert, Heerwagen, and Mador, 2008; etc.). The purpose of the Browning, Ryan, and Clancy paper is to provide a framework for students or practitioners whose work includes designing products or experiences for the built environment, as few resources are available in terms of practical applications of biophilic design.

The 14 patterns fall into three categories:

## 1: Nature in the Space

This is the physical presence of real, organic elements, like plants and water, as well as sounds and fragrances found in nature.

*Green wall at Guilford, by waferboard ([Flickr](Flickr))*


*Figure 15 Image of a green wall*


*Figure 16 Image of a spiral staircase*

## 2: Nature Analogues

This category refers to non-organic materials that mimic the patterns found in nature, such as fractal patterns (Taylor, 2017).

This spiral overpass mimics the golden ratio, a geometric pattern found in nature. Image retrieved from [Pixabay](Pixabay).

## 3: Nature of the Space

This group of patterns is more abstract, referring to more intrinsic, evolutionary needs of our species. For example, spaces that include long vantage points are naturally attractive to us because they allow us to assess and situate ourselves in a space (prospect); partially obscured views that reveal themselves through movement tap into our curiosity.

As you enter the Steelcase showroom, an angular tunnel provides an incomplete view to the distant skyscrapers from the 24th floor to evoke a sense of mystery.
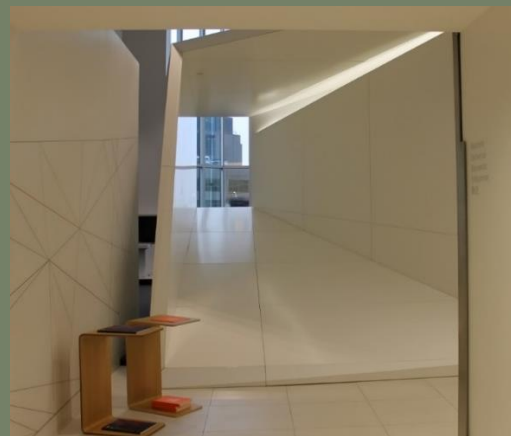

*Figure 17 Image of Steelcase's entryway*

*Table 2 Three categories of biophilic patterns: Nature in the space; nature analogues; nature of the space*

As noted previously, Gillis and Gatersleben (2015) provide a detailed review of the evidence available to support the three biophilic design categories. The table below is a summary of academic research that supports each of the 14 biophilic design patterns. The authors of the Terrapin Bright Green paper use asterisks (*) to rate the quality and quantity of evidence available for each design pattern, on a scale of 1 to 3. This table has been simplified and replicated from the Terrapin Bright Green paper (p. 12):

**Category 1: Nature in the Space**

| Design Pattern | Description | Quality / Quantity of Evidence |
|---|---|---|
| 1. Visual connection with nature | A view to elements of nature, living systems and natural processes. | *** |
| 2. Non-visual connection with nature | Auditory, haptic, olfactory, or gustatory stimuli that engender a deliberate and positive reference to nature, living systems or natural processes. | ** |
| 3. Non-rhythmic sensory stimuli | Stochastic and ephemeral connections with nature that may be analyzed statistically but may not be predicted precisely. | ** |
| 4. Thermal and airflow variability | Subtle changes in air temperature, relative humidity, airflow across the skin, and surface temperatures that mimic natural environments. | ** |
| 5. Presence of water | A condition that enhances the experience of a place through seeing, hearing or touching water. | ** |
| 6. Dynamic and diffuse light | Leverages varying intensities of light and shadow that change over time to create conditions that occur in nature. | ** |
| 7. Connection with natural systems | Awareness of natural processes, especially seasonal and temporal changes characteristic of a healthy ecosystem. | |

*Table 3 Category 1: Nature in the Space*

**Category 2: Nature Analogues**

| Design Pattern | Description | Quality / Quantity of Evidence |
|---|---|---|
| 1. Biomorphic forms and patterns | Symbolic references to contoured, patterned, textured or numerical arrangements that persist in nature. | * |
| 2. Material connection with nature | Materials and elements from nature that, through minimal processing, reflect the local ecology or geology and create a distinct sense of place. | |
| 3. Complexity and order | Rich sensory information that adheres to a spatial hierarchy similar to those encountered in nature. | ** |

*Table 4 Category 2: Nature Analogues*

**Category 3: Nature of the Space**

| Design Pattern | Description | Quality / Quantity of Evidence |
|---|---|---|
| 1. Prospect | An unimpeded view over a distance, for surveillance and planning. | *** |
| 2. Refuge | A place for withdrawal from environmental conditions or the main flow of activity, in which the individual is protected from behind and overhead. | *** |
| 3. Mystery | The promise of more information, achieved through partially obscured views or other sensory devices that entice the individual to travel deeper into the environment. | ** |
| 4. Risk/Peril | An identifiable threat coupled with a reliable safeguard. | * |

*Table 5 Category 3: Nature of the Space*

While my research did not specifically set out to validate each of the specific biophilic design patterns, the Findings and Insights section of this paper will provide some initial discussions on where my research supports the existing evidence base.

## 2.4 Expert Advice: A Holistic Approach is Needed

While my study found that employees' interactions with natural spaces and indoor elements could play a restorative role in an office context, several other factors come into play in terms of employees' overall sense of wellbeing at work. The configuration of the office has an impact on the employee experience, as well as the technologies and functional spaces available to people: open versus closed

layouts; access to collaborative and private spaces as needed; places nearby where employees can walk away from stressful situations and clear their heads.

Other factors are less physical, and more cultural: is the work meaningful? Does it provide adequate mental stimulation based on an employee's expertise and personal interests? Are there policies in place to support wellness, such as breaks, paid vacations, and health benefits?

In conversations with experts from two global firms—Steelcase, an office furniture manufacturer and workplace consultancy, and Gensler, an architecture, design, planning, and consulting firm—it became clear to me that designing a healthier office requires a holistic approach.

The approach that Steelcase uses for office design includes six key dimensions (in *Wellbeing*, 2014, p. 21):

1. **Optimism**, which fosters creativity and innovation;
2. **Mindfulness**, which supports engagement;
3. **Authenticity**, which allows employees to feel comfortable being themselves;
4. **Belonging**, which fosters connections with others in the workplace;
5. **Meaning**, which supports a sense purpose and connection to the work; and
6. **Vitality**, which offers employees spaces and tools that encourage movement.

Fostering a connection to nature is specifically mentioned in the sixth dimension, *vitality*: the design considerations for this dimension include bringing nature in, "with daylight, views, ventilation, patios," and supporting active lifestyles, "with centrally located stairways, outdoor walking paths, and bicycle racks."

Aside from improving employees' view to and connection to natural elements, in the same *Wellbeing* issue, Steelcase highlights its approach to an interconnected workplace: a blend of shared versus owned spaces, and individual versus collaborative spaces (p.20):
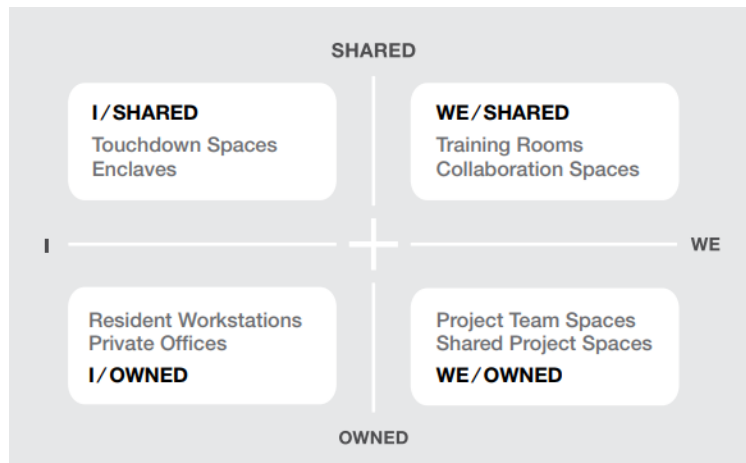
*Figure 18 Screenshot taken from the Wellbeing issue, p. 20, published in 360° Magazine by Steelcase*

Clearly, many of the biophilic design patterns are making their way into the approach that Steelcase uses when designing spaces for its clients. The description of the "vitality" element mirrors many *nature in the space* and *nature of the* space patterns, including *visual connection with nature*, *thermal and airflow variability*, and *prospect*; the "I" spaces and "enclaves" relate to *refuge* elements (Terrapin Bright Green LLC, 2014, p. 9-10).

Gensler recently launched its WorkWell[sm] methodology (Siller, D., 2017), which reinforces the need for a holistic approach to wellness: it highlights eight dimensions of employee wellbeing, based on insights gleaned from interviews with clients and their employees, as well as data from their 2016 U.S. Workplace Survey. Gensler argues that wellbeing is "a business strategy aimed



*Figure 19 Image retrieved from the GenslerOnWork website*

at increasing employee productivity, enhancing engagement, and improving overall health and happiness in the workplace," which leads to better bottom-line outcomes for businesses.

It is notable that the eight dimensions of wellbeing includes one element specifically centered around nature: "Views to nature heal, soothe, restore and energize while reducing stress and preparing us for new tasks." This sounds like it was directly informed by the mounting literature previously mentioned that demonstrates the restorative impact that views to nature have on people who are physically or psychologically stressed (Gillis & Gatersleben, 2015; Ulrich, 1984; San Martin-Feeney, 2010).

Gensler's approach to biophilic design provides a best practice example in this emerging practice, taking the imperative to design healthier (and greener) buildings, offices, and spaces for employees one step further: they recently won the Living Building Challenge Petal Certification for their design of the Etsy headquarters in New York (Gensler-Designed Etsy HQ Achieves Living Building Challenge Certification, 2017). This certification sets rigorous standards for sustainability, not just in terms of designing healthier environments for building dwellers, but creating sustainable buildings and spaces that create net-positive impacts on the environment (Living Building Basics, n.d.).

# 3.0 Research Methods

## 3.1 Major Research Questions

It became clear to me from my secondary research scan and expert interviews that as more people move into cities to live and work, it will become critical that our indoor spaces be designed to better support our health.

What was missing in my secondary research was the human factor: how do people working in urban offices experience their work environments on an emotional level? What, if any, is their connection to nature or natural spaces? How might including natural elements into the design of their offices change their work experiences?

Since work, in particular, seems to disproportionately affect our health negatively, and access to natural elements seem to have a positive effect on health, it follows that our work environments would better serve employees if they included natural elements.

On the other hand, are people who work in spaces without access to nature affected negatively? If so, in what ways, and to what degree?

### 3.1.1 Lines of Inquiry

This study set out to build on the existing research mentioned in Section 2. My intention was to understand better the human factors that play a role in overall wellbeing for employees who work in urban office settings, and probe into the extent which urban office employees experience a deficit from nature in their day-to-day lives.

My key lines of inquiry were as follows:

1. Relationship to Nature
   - How do people working in urban offices relate to nature and natural spaces? What definition do people use to describe "natural spaces"?
   - To what extent might people be experiencing a deficit of nature from their work environments?
2. Stress and The Office
   - What are some ways that people who work in offices experience stress?
   - What are some causes of stress? What are the ways in which they mitigate stress?
   - To what extent might their urban office environment affect their stress levels?
3. The Green-Booted Office
   - What are some ways that urban office workers would suggest improving their office experience?
   - To what extent do they think that using biophilic design patterns, or increasing their access to natural spaces, might improve their sense of wellbeing while at work?

### 3.1.2 Hypotheses

I started the project with the following hypotheses, which were each validated, as my findings demonstrate:

1. Offices in the GTA do not have adequate access to nature for their employees.
2. People who don't have access to natural spaces near their workplaces experience more stress while at work.
3. People who spend time in nature would self-report as healthier, mentally and/or physically.
4. Introducing biophilic elements in the workplace would be desirable.

## 3.2 Methodological Approach

My study made use of mixed research methods:

- A thorough literature review of both academic papers and contemporary literature on a number of related topics, including:
    - Biophilic design and biophilic design patterns;
    - Nature deficit;
    - Employee wellness and wellbeing; and
    - The built environment and its impact on health.
- Expert interviews with leading firms in urban office design;
- Quantitative surveying methods, used both as a data collection tool, and to identify and recruit participants for interviews; and
- Applied ethnography, which involved in-context interviews with recruits who worked in the GTA, at their place of employment.

Each of these methods is described below, as well as some of the notable outputs collected from these methods.

## 3.3 Literature Review

I started my research with a keyword search that uncovered works in published, peer reviewed journals, such as the *International Journal of Architectural Research*; *Buildings*; *International Journal of Environmental Research and Public Health*; and even the *Scandinavian Journal of Public Health*, among several others. I simultaneously conducted a scan of news stories and web articles on the research topics, which led me to sources like the Terrapin Bright Green website, and the Greenbiz website, which features stories that often link to academic studies on biophilic design outcomes.

Many of the sources that I uncovered in my literature review are cited throughout this paper, and a detailed summary is available in section 2.3.

## 3.4 Surveying



**52 Respondents**

*Twice as many female respondents*

*Most live in the City of Toronto*

7 (other)

5

2

2

1

35

*Most are content with their jobs*

5    42    5

*Most consider themselves healthy*

42    10
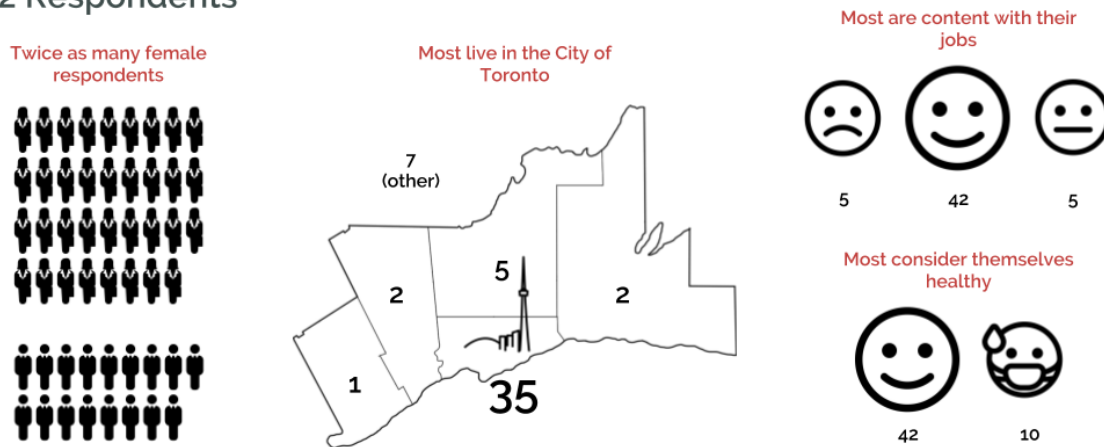
*Figure 20 Survey respondent data*

The first phase of my primary research was a three-part, 34-question survey that used mostly closed-ended questions to capture quantitative data from respondents about their personal profile (demographics, including age, gender, and location); workplace features (including questions about their use of any workplace benefits, and their access to and use of any natural spaces or biophilic elements); and personal health information (including whether they consider themselves to be in good or poor health, and whether they live with any invisible or visible disabilities). A list of the survey questions is available in the appendix of this paper.

I promoted the survey through my personal social media accounts (Twitter and LinkedIn), as well as through direct emails to personal contacts of mine. While I did not ask people to share my study, a few people forwarded my email or retweeted the Tweets related to the survey, which helped reach broader audiences. A total of 52 participants responded to the survey.

The survey was also used to recruit participants for the second phase of my research. I collected email addresses from participants who indicated that they were interested in participating in the second phase of my study, and reached out to them directly to invite them for a one-on-one interview.

### 3.4.1 Survey Design Considerations

My survey design was inspired by the research conducted in the UK by White et al. (2013). I decided to follow a similar approach when composing the survey questions to build on existing findings around participants' proximity to green spaces, since the research from the UK showed that people who moved to areas that had greater access to green spaces had improved health outcomes. In my survey, I asked two questions related to people's access ("within walking distance") to biophilic elements, or natural spaces, at their place of work. They were given a list to choose from that included parks; wooded areas; conservation areas with walking trails; outdoor gardens; indoor gardens or greenhouses; lakes, ponds, or rivers; green wall (a wall covered by living plants); fountains or other water features; outdoor green spaces that include gardens, trees, and other natural landscaping (e.g., ponds, tree-covered courtyards); and/or indoor gardens, solariums, or greenhouses.

Respondents were then asked how frequently they spend time in these kinds of spaces (if available to them) at work versus outside of work, and then asked how much time, on average, they typically spend in these kinds of spaces at work versus outside of work. I defined an adequate amount of frequency to be at least "a few times a month," and an adequate amount of time as "up to 30 minutes." I decided to analyse this section of the data in this way to be consistent with findings by various researchers, as cited by Browning, Ryan, and Clancy (2014), since there is empirical evidence showing that as little as 20 minutes of immersion in nature leads to health benefits.

## 3.5 Applied ethnography



*Figure 21 Interview respondent data*

The second phase of my research included one-on-one, semi-structured interviews with people who worked in large public sector organizations, startups, and small private enterprises. Four participants were male, and five were female; five between the ages of 18-34, and four between the ages of 35-50. Interviews took place on-site at the person's place of work, and took up to 1.5 hours (one hour for the interview, and up to 30 minutes to tour the site in order to take photos of the spaces that interviewees have access to in their regular work day).

Of the 52 survey respondents from Phase 1 of the study, 17 expressed interest in the second phase of the research. I sent a first round of invitations to only 13 of the number that expressed interest. I only received seven acceptances, and ended up extending an invitation to two others on the list of interested participants (one accepted), and recruited one other participant through word of mouth. Ultimately, I conducted nine interviews between August 15 and September 15, 2017.

Overall, I was satisfied with the mix of participants I was able to recruit:

- I was aiming to include a mix of male and female participants, and at least one quarter of participants who identified as living with a disability (in this case, more than half of respondents live with an invisible disability).

- I was also aiming to find a mix of participants who worked in spaces with and without biophilic elements or natural spaces (five of the nine indicated they do not have access to these spaces).

I spent about an hour with each of the nine interview participants, in a three-part interview exploring the following lines of inquiry:

1. Relationship to Nature
    - How do people working in urban offices relate to nature and natural spaces? What definition do people use to describe "natural spaces"?
    - To what extent might people be experiencing a deficit of nature from their work environments?
2. Stress and The Office
    - What are some ways that people who work in offices experience stress?
    - What are some causes of stress? What are the ways in which they mitigate stress?
    - To what extent might their urban office environment affect their stress levels?
3. The Green-Booted Office
    - What are some ways that urban office workers would suggest improving their office experience?
    - To what extent do they think that using biophilic design patterns, or increasing their access to natural spaces, might improve their sense of wellbeing while at work?

From these lines of inquiry, I attempted to build a narrative that would move the interview from broad topics, to more narrowly defined approaches to biophilic design that I wanted to test with participants. The questions began with an exploration of participants' personal connection to natural spaces: the emotions they equate with spending time in nature; the definitions they attach to what "natural" or "natural spaces" means to them; and their attitudes and motivations for spending time in nature, if they do so at all. The storytelling would continue, moving into questions about participants' current relationship to (and possible detachment from) nature, and whether this plays a role in their stress levels in the context of where they are currently employed. This second set of questions were also meant to uncover any workarounds that people use to mitigate stress, and whether nature plays a role in any of these tactics. Finally, the last set of questions probed the more specific elements of biophilic design that might appeal to them to help address a possible nature deficit, if this is something they experience on a daily basis.

To aid with the third set of questions, I showed participants two sets of photos. The first set of photos was an example of an office designed mainly using *nature analogues* and *nature of the space* patterns (Browning, Ryan, and Clancy, 2014): these are features that represent or mimic certain experiences in nature, but do not include living, natural elements, like living plants. I showed them photos of the Steelcase showroom as an example.
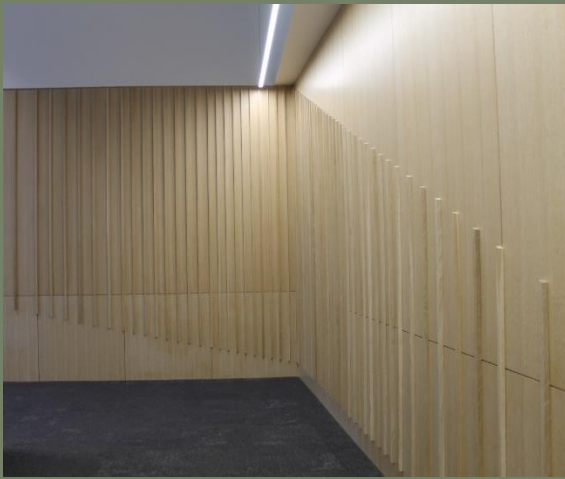


*Figure 22 Steelcase entryway: natural wood paneling*

*The Steelcase entrance hallway features wood-paneled walls, with an interesting texture (a nature analogue) that gives the impression of natural movement.*



*Figure 23 Steelcase workspace: open floor plan*

*The Steelcase showroom features an open, end-to-end view of the entire space, with extremely high ceilings (which correspond to prospect patterns).*

The second set of photos was an example of an office designed largely with *nature in the space* patterns (Browning, Ryan, and Clancy, 2014): these offices feature a visual connection to real natural spaces (like windows that have a view to trees or other natural spaces), real plants inside the office, and/or sounds of nature (like the presence or sound of water flowing). I used photos of Google's Tel Aviv office to illustrate these features.



*Figure 24 Google office featuring living plants*

*One room in the Google office features a living ceiling and wall with green plants and flowers. (Inside the New Google Tel Aviv Office, 2013).*

I used the two sets of photos to create a contrast between the two approaches to biophilic design to provide more direct input into how my research participants define "natural spaces." I wanted to test whether the *nature in the space* (trees, living plants) or *nature of the space* (prospect, refuge, mystery) elements could potentially be more restorative to people working in offices without access to parks or other natural spaces. My hunch was that people would be more drawn to the former than the latter, which turned out to be true.

## 3.6 Expert Interviews

Prior to recruiting participants for the one-on-one interviews, I spoke to three people working in major design consultancies (Steelcase, Gensler, and Stantec. The purpose of the interviews was to gain a better understanding about the field and contemporary design methods used by firms that provide consulting services to employers in the urban office environment. All three experts were familiar with Browning, Ryan, & Clancy's (2014) 14 biophilic design patterns. One had obtained her Accredited Professional certification in the International WELL Building Institute standard, and is a Fitwel Ambassador.

The line of questions I asked experts was different than the ones I used during the employee interviews. I reframed the expert questions to understand better what role design firms play in designing healthy

workplaces for employees, and what tensions might exist in delivering on the promise of biophilic design:

1. Talk about your work
   - What kind of clients come to you? What are some of the things they ask for?
   - What role do you think a company like yours has in designing healthy spaces?
   - What role do you think a company like yours has in designing green spaces?
2. Talk about biophilic and holistic office design
   - How much of the work your firm does is inspired by nature?
   - How do you think your work contributes to employee experiences?
     - Based on your expertise, how important do you think it is it to create healthy spaces for employees?
   - Describe some of the projects you've worked on. What would you say is the "healthiest" space your company has designed?
     - Tell me about the kind of research that goes into a project like that.
     - Tell me about the skills and knowledge that people who work on your designs should have. Why?
3. Talk about evidence-based design
   - Do you test whether your designs make an impact on the people who live in them?
     - What are some ways that you might validate the design on paper with how it operates in real life?

From interviews with experts at leading-edge global design firms, I was able to gain insight into some of the best practices in biophilic design for urban office settings, which helped inform my concluding recommendations.

## 3.7 Limitations

### 3.7.1 Surveying

While the data collected from survey respondents proved valuable in my analysis, the number of respondents was ultimately too small to draw any statistically significant conclusions. However, many interesting data points are uncovered in the next section of this report, which can be used to inform future research.

Because I primarily promoted the survey through my own personal networks, and people passed along my survey through their networks, it is possible that participants worked in similar fields and had similar employer experiences. This could have skewed the types of respondents who filled out the survey (for example, 71% of the survey respondents had some form of employer-paid health insurance coverage, whereas the national average is about 66% (CLHIA, 2016)).

In addition:

- Twice as many females (35) responded to the survey as male (17) participants.
- The survey used only closed-ended questions. Including some open-ended responses may have been insightful and would have supplemented the deeper research I was able to achieve in the one-on-one interviews, especially given the low number of overall respondents.

The survey did serve its purpose: I was able to recruit an adequate amount of participants to the second phase of the study.

### 3.7.2 Applied Ethnography

I was acquainted with 8 of the 9 participants who agreed to a one-on-one interview with me, either from previous work experiences or through my personal networks. Because I was personally acquainted with almost all of the participants, a benefit to this was that it was easy to establish a level of comfort with them when it came time to discuss topics about their personal health and how they manage stress, which helped me probe deeper into their attitudes and motivations in terms of how and when they access natural spaces, and how they feel within these spaces (which, when initially exploring the topic, seemed to them like a difficult question to answer).

However, there may have been some self-selection as a result, in terms of who I was able to recruit for the interviews: these nine participants were likely more inclined to speak to me because they share a high degree of interest in the subject matter, and because they are personal acquaintances.

I would have benefitted from having a larger number of participants to diversify the types of people I spoke to (I was aiming for at least 10, and ideally, 12); however, using this research method helped me to effectively uncover rich, contextualized data from the interviews, from which I was able to extract several valuable findings.

# 4.0 Findings

## 4.1 Our Relationship to Nature is Strained

The survey I conducted in the first phase of my research asked people several questions to determine what sort of natural spaces are available to them within walking distance, and how often they spend time in those spaces, both at work and at home. Most people, regardless of whether they have access, say they do not typically use the green spaces available to them when they are at work:



*Figure 25 Survey respondents: access and use of nature*

Interestingly, almost all of people who reported "fair" or "poor" mental or overall health also reported that they did not spend time in natural spaces at work (8 of 13 respondents in the survey). This is consistent with Stigsdotter et al. (2010), whose study demonstrated that people who generally report low stress levels are more likely to visit green spaces, implying that if my survey respondents had more direct, daily access to natural spaces, especially during the work day, they would benefit from such features.

| Relationship to Nature: Attitudes and Motivations | Total |
|---|---|
| Actively seeks nature outdoors | 9 |
| Experiences nature deficit at work | 5 |
| Disconnecting, being alone/solitary | 5 |
| Spiritual connection (religious or otherwise - sense of wonder/awe) | 4 |
| Nature is healing; helps me "reset" | 4 |
| Nature is *natural*, wild, little intervention from humans | 4 |
| Nature is relaxing | 3 |
| Feels largely disconnected from nature at the moment due to busyness | 3 |
| My research has triggered them to think about nature or their space more | 3 |
| Nature is open space, less density (i.e., people) | 2 |
| Nature is public, should be shared / enjoyed by all | 1 |

*Table 6 Codified responses: Relationship to Nature*

This finding—that people do not generally access natural spaces while at work—was consistent in my phase 2 interviews as well. All the people I interviewed noted that while they were drawn to natural spaces, for the most part, they do not spend time in natural spaces while at work.

# Spending time in nature is perceived as separate from work.

*Figure 26 Key finding: Spending time in nature is perceived as separate from work.*

Participants are more likely to make use of natural spaces on their time off, while at home:

(Participant 6) I live in midtown, so I have a bunch of parks around me that are just walking distance away, [a nearby cemetery] is one of my favourite places. I just take the [trail] and that's enough for me most weekends, I'll just do that, that makes my weekend, that's all I do sometimes

(Participant 18) I like going hiking. Walking along the Humber river, Don river, the trails... Lakeshore as well. I tried some different things when I had a low mood, and I found rhythmic exercises helped for me. Something with rhythm helps relax the mind, so you don't focus on the negative things you've been thinking about.

Gillis and Gatersleben's synthesis (2015) demonstrates that biophilic design, in particular *nature in the space* (design that makes use of living, organic elements), can help people recover mentally from stressful situations. Because people are not accessing natural spaces from their workplaces, they do not have daily opportunities to benefit from the healing, "resetting" effects that natural spaces provide, which is especially harmful since, as noted in my opening paragraphs, work is a source of stress for Canadians.

Three participants expressed that being busy gets in the way of them spending as much time in natural spaces as they might like; as a result, they noted that they feel quite disconnected from nature much of the time. One participant reflected on a trip she had planned specifically to reconnect with nature (plans which were ultimately deferred to a future date):

> (Participant 53) A one-night camping trip with portaging and canoeing. The specific reason for going was because I don't recall the last time I've seen a star. I don't remember what they look like. Which is kind of sad. It was for that reason that I thought, OK, I'll be in a forest, near water, under a night's sky. But with all the work that's been piling up… it's just not possible.

From the interviews, it seemed that spending time in nature is perceived as separate from work. This is especially true when people are busy and work needs to get done; people do not prioritize time for nature when at their workplaces. However, it also seems that this strained relationship to nature is reinforced because nature is not easily accessible to people, as the next section will highlight.

## 4.2 Proximity and Programming Matter

| Stress and the Office: Office Culture (Current) | Total |
|---|---|
| Unstructured time / breaks / lots of flexibility | 9 |
| Generally works independently/solitary work | 9 |
| Autonomy | 9 |
| Workplace culture/environment has a notable influence on wellbeing | 7 |
| Spends most time in front of a computer | 7 |
| Lacks socialization / collaboration spaces | 5 |
| No access to natural light | 4 |
| Telework is an option | 4 |
| Doesn't generally take breaks | 3 |
| Likes challenges (mental stimulation, problem solving) | 3 |
| Creative work is desired | 3 |
| Standing desk is available | 2 |

*Table 7 Codified responses: Describing the current office environment/culture*

All the participants I spoke to worked in roles that afforded them a lot of flexibility in terms of break-taking: they all said that their breaks were not documented or tracked, and they could use their own discretion throughout the day when they needed time away from a work task. In addition, everyone said that most of their work was done independently of others. While four of the participants would occasionally be involved in collaborative work (or, being in supervisory or leadership roles, would require them to lead team meetings), most of their day would be spent on their own deliverables.

Given this autonomy, I probed, asking them what they do on their breaks. I wanted to uncover whether they would seek out the natural spaces available to them while at work, as they had indicated in the phase 1 survey responses.

Although 5 of the 8 participants who responded to my phase 1 survey said they had "walking distance" access to natural spaces from the work site, I found out during my visit of their workplaces that only one could realistically walk to these spaces if they took a break from work.

## When people are reminded of nature with on-site biophilic elements, they seek out these spaces during breaks.

*Figure 27 Key finding: When people are reminded of nature with on-site biophilic elements, they seek out these spaces during breaks.*

In contrast, two participants did have nicely designed interior spaces on site, with waterfall elements, lots of living plants in common areas, and even a courtyard; both said they made use of these spaces frequently while on short breaks. This latter point indicates that proximity and access matter: if natural spaces are made available on site, people will be drawn to them and use them. One participant who had a building with a variety of interior biophilic elements talked about a park near his workplace for which he feels a strong connection. As a probing question, I asked where he would travel to if I gave him a teleportation device during his work day and he could spend his break time anywhere in the world, and he responded:

> (Participant 18) I do like the park that's close by… any large park where there aren't too many people. It's really relaxing in the summer, trees, breeze… a change of environment helps you focus on different things.
>
> Even when I'm downtown, I think about that park.

It turns out that the park he mentioned is not close by: after our tour of his office building, I took a walk to the park he described, and it was at least a 15-minute walk.

On the other hand, two other interviewees had recently moved from offices that had better access to natural spaces, and noted the loss:

> (Participant 17) I liked [my previous office] better. Because the park is right there… all of us in general like to get outside, go for walks… we're not your stereotypical programmers, we do like to get out! Here it's very 'downtown'—you could still walk up [to the park] but it's a bit of a trek… it's also way more people, denser.

(Participant 4) I do feel a difference walking around here than walking around [my previous work location]. My location doesn't have a park. I don't feel like that emptying-out feeling [...] I like the depth of the trees in [that park]—the height of them.
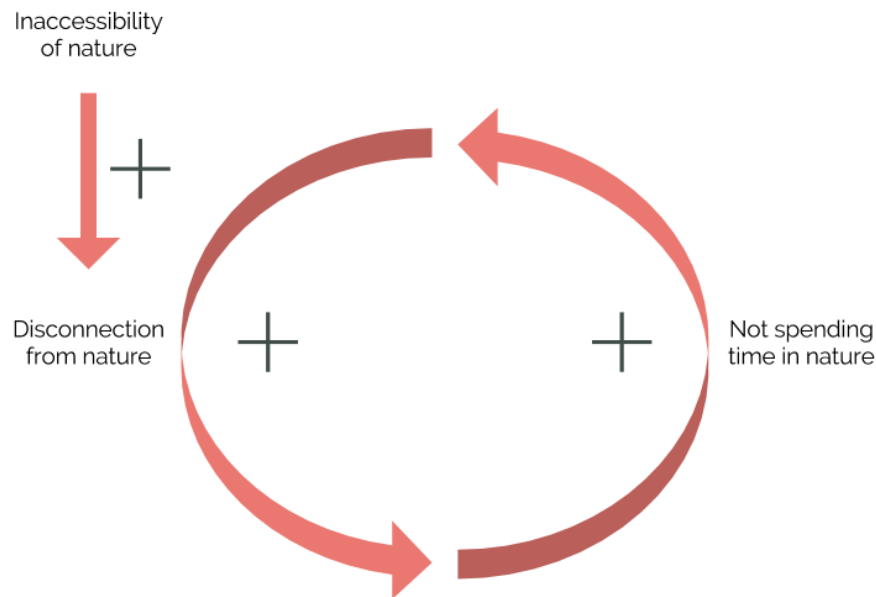


*Figure 28 Reinforcing loop: Disconnection from nature.*

From these conversations, it appears that when people are reminded of nature visually, through on-site biophilic elements, they are more likely to seek out these spaces when taking breaks from work. The visual cues help re-connect them to this intrinsic need.

For some, wellness messaging from the employer helps to promote more active breaks that incorporate nature. One employee noted that her employer encouraged staff to take walking breaks, and to actively seek out nature:

(Participant 6) The [employer] sent out an email... It said at least four times a week, take a walk for half an hour, towards nature… they said find a park, walk your dog, take your kids. And I was like, whatever, I'm going to use it [the break] anyway, so I can make sure I walk for half an hour a day.

Another employee noted that the employer supports broader wellness initiatives, including seminars on mental health:

(Participant 18) The employer has a lot of wellness articles, they've been having a lot of seminars, either in person or web focusing on mental health. Sometimes it's disclosure of prominent leaders to normalize it. In the building, usually for fundraising campaigns, we have exercise-related activities, for example dancing; there's actually a meditation thing today. And that's organized through employee engagement groups.

Finally, one of the interviewees who had moved from a large employer to a startup culture noted the difference between the two:

(Participant 53): The breaks were a lot more structured [in my previous organization], so we'd walk away from the office to get coffee instead of just running downstairs. For lunch, [the employer] insisted you took an hour-long lunch, so you'd get up from your desk and walked around, and did stuff, and then came back. None of that is the case in a smaller environment.

It therefore seems that two factors contribute to whether employees use the natural spaces available to them: proximity, or being a reasonable distance from their workplace (on-site, integrated features appear to be used frequently by interviewees), and employer-supported programming or messaging to reinforce their use.
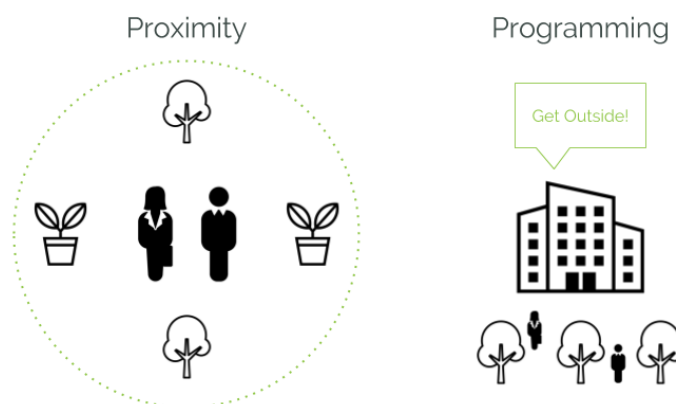


*Figure 29 Proximity and programming*

***Two factors would increase people's use of biophilic elements: ensuring the proximity of those elements or spaces are reasonable (within walking distance, or integrated in the workspace), and ensuring that people are made aware of those spaces and encouraged to use them via sustained employer or landlord communications.***

## 4.3 Work-Related Stress is Exacerbated by a Lack of Access to Nature

| Employees need natural sunlight (4 of 9 are in offices without access to natural light) | Employees feel disconnected from colleagues | Participants feel somewhat trapped in their offices |
| --- | --- | --- |
| "I can't go outside to [a park]. I need to have… maybe it's light." | "I think [the office is] very isolating. It siloes people, and this office, it's an older office, so it has that effect." | "We have our boardrooms, called 'the cave,' we hate being in there." |

*Figure 30 Work-related stress from nature deficit*

Employees have basic needs to feel comfortable and connected to their workplace. Both Gensler's WorkWell[sm] methodology (Siller, D., 2017) and Steelcase's six dimensions (including the Belonging and Vitality dimensions) emphasize the need for three elements, in particular: a connection to nature (especially in the form of natural light), and spaces that provide social connections to other people.

This best practice approach was validated in my interviews as well. For the most part, the workplaces that I visited are not designed to support wellbeing, and very likely contribute to work-related stress expressed by participants, as noted below.

### 4.3.1 Natural Light

Four participants that I interviewed had no access to natural light from their immediate work space, and described the spaces as follows:

> (Participant 17) Dull. Dingy. Dark. Dank. A lot of D words. It's really sad. We try so much to spruce it up a little bit, but it's what we have to work with. I definitely don't come to work for the space for sure; I come for the work, and I come for the people, and that's good, that's what makes it.

(Participant 25) The offices are pretty small… they're all cookie cutter. Some offices have windows which is nice, you can get some natural light in, but ours is enclosed. That's more design from the builder, trying to cram as many tenants in.



*Figure 31 Enclosed office lacking natural light*

*Figure 32 Office hallway with artificial lighting*

Participants without access to natural light expressed that they often lose track of time:

(Participant 25) Natural light really makes a difference. You get stuck in your enclosed bubble, it's nice to have that connection to the outside world, even if it's just through a window. Sometimes I'll be in the middle of an experiment, and be like, what time is it? And look at my watch or computer screen, and be like, 'oh it's 1 o'clock already!'

One of the seven elements that the WELL Building Standard requires from WELL certified buildings is light, either from natural sources, or "daylight modeling"—light technologies that emulate the natural circadian rhythms of sunlight. This corresponds directly to one of the biophilic design patterns proposed by Terrapin Bright Green, which describes a requirement for "dynamic and diffuse light" in the built environment to support productivity and wellbeing (Terrapin Bright Green LLC, p. 34).

It is apparent from my interviews, and the supporting evidence, that an absence of natural light would have a negative impact on the people I interviewed, and it is unsurprising that they are drawn to spaces at work—however small, like the break room described by Participant 4—that have a view to sunlight:



*Figure 33 Break room with sunlight pouring in*

> (Participant 4) If this [break room] didn't exist, we're not looking at nature, it's concrete, but I like it here. I'll go here for lunch. If this wasn't here I think I would be very unhappy. I can't go outside to [a park]. I need to have… maybe it's light.

### 4.3.2 Social Disconnection

While participants generally value autonomy and have roles that require independent work, the structural design of their spaces seems to reinforce a social disconnection that is more broadly experienced negatively as isolation: there is a strong desire for spaces that support more collaboration:

> (Participant 53) I think physical movement helps me to some degree: if you're up and moving around, you're not trapped in your own mind... That's probably fairly important and I'm not doing that, which is why I'm probably getting antsy. [...] The environment isn't set up to do the kind of work that I do. It's not set up for collaboration, for ideation or prototyping.

> (Participant 39) The first thing I would change would be more along the lines of working more collaboratively, I work very isolated. [...] It can be [a source of stress]. This is broader, but I'm not working as part of a larger team, or concentrated effort, and I think it's tiring.

> (Participant 17) The cubicles make it harder to be as collaborative within the team. But we're also pivoting. We're changing how we work very drastically, so I know that's causing stress for some people. [...] I think it'll be awesome, personally, but I'm new here, I don't have a say in

anything. […] I'd love sitting with my team when we need to collaborate, and then be able to go away, and get my work done.
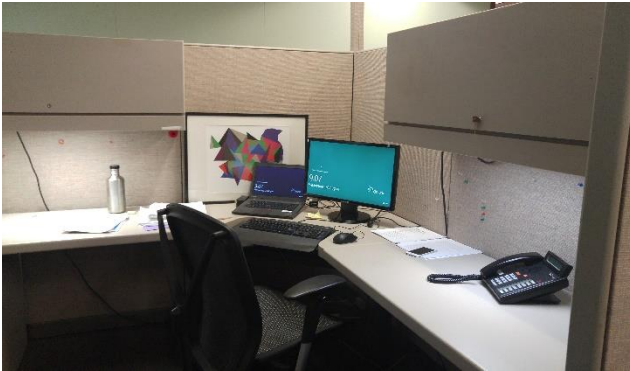




*Figure 34 Enclosed cubicle*                     *Figure 35 Cubicle decorated with potted plants*

In combination, this lack of access to natural light, and enclosed, disconnected spaces, leads many participants a feeling of being trapped, especially since seven of the nine people I spoke to largely spend their day at their desks:

> (Participant 39) When I'm inside all day, especially in this space, I find I can be more irritable, and I… make rash decisions, I don't know how to really explain it; my decision making and thought process is kind of cloudy. And then when I go outside, even for a little bit, it's almost like my brain is taking a breath, and I can kind of process what I'm feeling. And then it's like I relax. Physically, and mentally and emotionally as well. And I recognize that there's that difference in me so that's why I try to push myself to be outside, because otherwise, by the end of the day, I just feel like I'm a prisoner.

> (Participant 53) I am better off when I'm standing up and moving around… usually by 2 o'clock, I can *feel* my chair, I know the chair is there, and it's got grooves and stuff, I can feel every single one of those grooves… I'll notice I get antsy because I start to move my laptop a bit, and I'll move my chair, and I'm on weird angles because I need a variety of movements that I'm just not getting.

It is worth noting that while the desire for open, collaborative spaces is important, Steelcase, one of the design firms I interviewed with during my expert interviews, recently conducted a workplace survey of more than 37,000 North American Workers that demonstrates the need for places for employees to retreat (in *Wellbeing*, 2014, p. 19). For instance, 95% of survey respondents confirmed that they need

"quiet, private spots for confidential conversations," while 40% said they do not have access to these spaces; similarly, 91% say they need spaces where they can re-energize, and 51% have no places to do this.

It appears important to people to have a balance of shared spaces and spaces to re-energize (with access to natural light, in particular), and my interview participants seemed to lack both in their current offices.

## 4.4 Nature Matters to People

### 4.4.1 Nature is Healing; it "Resets" Us

While people's relationship to nature is generally strained, it became clear from my interviews that people value the time they do spend in nature, and being immersed in natural spaces provides a restorative, healing effect:

> (Participant 6) I like that idea that, the more you go away [in nature], it feels like your capacity has also grown to fill that space, and that's when you're like, 'ok all that stuff that was just cluttering up has moved out'.

> (Participant 4) I need breaks to not get so irritated within myself. Exercise and walking does that for me… I do feel a difference walking around here than walking around [the park I used to be close to]. My location doesn't have a park. I don't feel like that emptying-out feeling.

> (Participant 45) Walks, things with nature, are always just perfect, in a nearby park. I wouldn't go all the way there at lunch, it's a half hour, and I'm happy with just the little piece of green [space] at the side [of the building], that's enough. The visual environment associated with what causes stress, whatever that is, I just get away from it. So it could be a walk, a little ride [on his bike]. [...] Most of the people I work with never do that [go offsite], but because I have a bike, I kind of zip away.

It appears that people cope with stress at work by attempting to replicate the *emptying out* feeling in the natural spaces available to them; there seems to be a connection between taking mindful breaks, and taking those breaks in nature.

In her 2010 Master of Science thesis, San Martin-Feeney found similar results: the four ways that urban dwellers experience mental restoration in parks include the opportunity for people to connect to nature, and to themselves, while in those spaces (p. 61-64). This directly supports Wilson's biophilia hypothesis: people seem to be naturally drawn to green spaces, and the reason they seek them out is to self-reflect, "reset," calm their minds, and feel a sense of solitude. This latter point about connecting to nature for self-reflection is further described in my next finding.

### 4.4.2 Nature Connects People to Something Deeper

Nature is solitary for some, and for others, recognizing nature in their lives provides a spiritual, even religious, experience. Almost all participants described their sense of wonder, awe, and majesty when they have immersive experiences in nature:

> We forget how big nature can really be, how powerful it is, how strong it is, how beautiful it can be.

*Figure 36 Quote: "We forget how big nature can really be, how powerful it is, how strong it is, how beautiful it can be."*

> (Participant 4) I like feeling, a recognition that I'm so insignificant—I love myself, don't get me wrong—but in that moment, that's where I feel I get connected to my deeper spirituality, in terms of being a follower of Jesus, I recognize He's created all of this around me, and it's a different headspace.

> Here (in the downtown core), when I go for a walk, I don't have that same feeling of depth… I'm walking into concrete, and there's the depths of the building, but not quite the same feeling as God creating everything around me. Human beings created that, and yes, God created the human beings, but it's not the same thing. It's not the same as a spiritual experience, not in the least.

> (Participant 25) Maybe it's just because we live in an urban area, we forget how *big* nature can really be, how powerful it is, how strong it is, how beautiful it can be. If you're standing at the top of a cliff or a mountain, and you're looking out, over a large valley, that's pretty majestic. Seeing a picture is one thing, but being there, is a totally different experience.

The natural presence and sounds of water, such as rainfall or rivers or streams, seems like an intuitively relaxing experience for several participants:

> (Participant 17) It's always been relaxing (to me)... I like to sit by water. I don't like to be in water... but it's always a relaxing sound, whether it's rushing water, or rain.

> (Participant 6) Water is one of my favourite things to have access to. The fact that we are surrounded by so many lakes, and you can drive anywhere to be by a lake, is one of the most wonderful things about this country. Since they changed the waterfront, it's been lovely to walk around, there isn't a time when I haven't walked there and had to sit down, and think about this for a little bit. I just had to time out for a while and be like, 'oh my god.'

> (Participant 25) The majesty of real nature is probably the big difference (between urban replication). Seeing it and feeling it in person is a nice experience, you can feel the spray from the water rushing down, hearing the roar of how loud it is... an (indoor waterfall) is an urban substitute to connect yourself to that aspect of nature [using air quotes], it pulls from that element of actually hearing the sound of water. Instinctually it's relaxing.

My participants' responses, especially the qualitative descriptions they provide about how the sounds of nature have relaxing qualities, can be grounded in science. As with the more well-known biophilic elements mentioned previously (e.g., access to natural light, views of nature), evidence continues to build that sounds from nature have a restorative effect on people recovering from psychological stress. In a 2010 study, Alvarsson, Wiens, and Nilsson ran an experiment to measure people's recovery after given a mentally strenuous math problem when exposed to either natural sounds (like running water and tweeting birds), or unnatural sounds—such as high or low noise levels (from traffic), and ambient noise (from a city backyard). Forty participants took part in the experiment. Participants were given timed math tasks, from which they were provided short periods of recovery in between tasks, at which point they were immersed in the different kinds of sound. The results demonstrated that people were able to recover more quickly when exposed to the natural sounds.

Being immersed in truly natural spaces, like forests, would have an even greater impact if it were practical in an urban setting. Proponents of forest bathing—a practice originating from Japan known as *shinrin-yoku*—have produced evidence that spending time in forests boosts the body's immune system,

decreases blood sugar levels, and may help patients of depression or anxiety (Weintraub & Lawton, 2014).

It may not ever be possible to replicate the deeper feelings that people experience when immersed in larger natural spaces, like forests or conservations areas, with the use of any of the synthetic biophilic design patterns contrived by human beings. However, as the next section will illustrate, the design of workplaces to include natural features would not be lost on employees, and may even provide a competitive advantage for employers interested in creating not just healthy, but aesthetically pleasing spaces that are attractive to employees today.

## 4.5 The Green-Booted Office

### 4.5.1 Workspaces and Culture are Connected

People had diverse reactions to the photos of the Steelcase and Google offices; however, all participants agreed that spaces communicate a certain culture and intention:

> (Participant 14) Space sets an expectation about how you behave, and how you react. There's something to be said about surrounding yourself with things you think look good. Aesthetics matter. [...] Part of this is communication, not just utility. Even if we don't use it, I think this patio is beneficial. We have a patio, and that says, 'we're a company that has a patio!'

> (Participant 45) Somebody put a lot of thought into this… that would inspire more beautiful things if you're a designer or artist. It shows an intent that's positive and generous, he [the employer] doesn't have to do any of that stuff.

> (Participant 18) Different nature would stimulate different thinking. The desert floor might inspire clearer thinking.

It appears that the spaces we design, in an office context, would communicate deeper meaning for people; incorporating natural elements would need to be thoughtfully implemented. As noted earlier in my expert interviews and secondary research findings (see section 2.4), several dimensions of design would contribute to employees' overall sense of wellbeing in a workplace, which would include, but not be limited to, biophilic design.

In 2016, Steelcase conducted a global study to understand the elements that influence employee engagement, surveying 12,480 participants across 17 countries (Steelcase Global Report). Among their top findings, they found a positive correlation across all cultural contexts between employee engagement and the physical office

> " Employee engagement positively correlates with workplace satisfaction. "

*Figure 37 Quote: "Employee engagement positively correlates with workplace satisfaction."*

environment (p. 15-22). Furthermore, providing employees with choices matters (i.e., the ability to move in different office spaces to complete different tasks).

The results from Canada demonstrate a lower score against the global average for "highly engaged" workers (11% versus 13%), and Canadians are less likely to have choices in their offices about where to work (41% versus 51%) (p. 60-68). Another interesting finding from this study was the office layout: 46% of respondents said that their direct workstations are "open plan, assigned space," which is the highest score against the 17 countries. Notably, only two of the nine people I interviewed in phase 2 had this type of office layout, which may reflect the more traditional workplace cultures of the people I interviewed.

Indeed, An et al demonstrate the tangible impact of including natural elements in the workplace. As noted earlier, their study shows the direct link between employees' experiences on the job and their access to biophilic elements, concluding that employees whose workspaces include these elements could influence job satisfaction. This implication is noted in section 5.0 of this paper.

**4.5.2 People Think of Nature as "Real"**

Most participants defined "natural spaces" as green, open spaces that are relatively untouched by humans:

> (Participant 25) Being in nature is more large scale. Things like nature reserves, or large areas of land that really are allowed to be natural; minimal impact from humans.

> (Participant 53) I guess the first image for me is very 'enchanted forest', and the second is 'enchanted garden.' The first is fully green, and the other has a lot of bright colours.

(Participant 14) It's more the knowledge that you're there, you're interacting with something that's real… there isn't something inherently relaxing about hearing waves. It's not like I hear them, and I'm like, 'I'm so relaxed.' … a rainstorm is really relaxing when I'm inside, I love thunderstorms. It's a signifier of what's happening: I'm so cozy in my house, and dry, and I'm thankful I have somewhere to stay… it's more the meaning than the actual sound. If that meaning is divorced from the thing, it's of no use for me.

Overwhelmingly, participants believe if natural elements are to be incorporated in indoor spaces, they should be organic, even living. When shown photographs of an office with biophilic patterns more removed from nature (Steelcase), and an office with real trees and plants (Google Tel Aviv), the response was almost unanimously in favour of the latter:

(Participant 14) If it's not real (plants), I take back what I said—that's terrible… if you can do [live plants], do it. There's something terribly depressing about fake plants and trees.

(Participant 25) I was going to ask if they're real trees! If it's fake, why even bother? If you're going to put money into a room like that, better put some real trees in there!

(Participant 6) Here's what bothers me: you have this natural setting, and then you have these shadows, which tells me that there's artificial light on top. That would mess with my mind. I can't deal with the fact that there's artificial light and sunlight at the same time. [This was particularly important to this respondent, since she has light sensitivities and experiences migraines from unnatural light.]

(Participant 53) What's coming to me now, there's this equation of natural materials to natural space. Like if we somehow use wood or mimic wood, then that is equivalent to being in a natural space, and it's really not. It's like using the pieces and getting rid of the whole.

The sentiment that participants expressed has robust secondary research to validate it. One of the biophilic patterns noted in Terrapin Bright Green (2014) that has the strongest evidence base is a *nature in the space* pattern, the first highlighted in the paper: *visual connection to nature*. Having a view to nature is beneficial to human health, which one of the earliest papers by Roger Ulrich demonstrated in 1984. Since Ulrich's findings, the *visual connection to nature* biophilic pattern has been connected to all three categories of health benefits noted in Terrapin Bright Green's literature scan: stress reduction, cognitive performance, and emotion, mood, and preference (p. 12).

## 4.6 Designing for Different Needs and Roles

Another finding that arose from my research is the need to design workplaces that are appropriate for a variety of needs. For example, the finding about the need for a balance of "me" and "we" places (highlighted in Steelcase's research as well) implies different work styles for different job functions and tasks.

Based on a synthesis of the people I interviewed, and the survey data, three types of worker emerged as personas in my research. The descriptive categories provided aim to highlight, in the extreme, some of the characteristics of each "type" of employee that emerged from my research:

- **Work style**: degree to which interpersonal interactions are required to get the job done. This ranges from:
    - Head-down; near-total autonomy
    - A blend of independent work and interdependent work
    - Largely interdependent (team collaborates on final outcomes)
- **Stress triggers**: types of stress that participants define as atypical or unhealthy. This can be one or more of the following:
    - Pressure:
        - **Self-driven:** placing high expectations on themselves to produce quality work; perfectionism
        - **Externally-driven:** including unrealistic expectations, or an obligation to contribute to the success of the organization
        - **Time constraints**: including having a heavy workload in relation to the amount of time given to complete it
    - **Physical or environmental constraints**, including not having the right tools or spaces to work
    - **Administrative or bureaucratic obligations**, including work that feels tedious, redundant, or does not seem a meaningful use of time
    - **Interpersonal situations**, including small "p" politics between colleagues, conflicts, spending time mitigating conflict, and/or providing emotional support to colleagues for work or non-work related issues

- **Attitudes about nature**: the most prevalent role or purpose that nature plays in their lives, and perceptions about how nature should be included in workplaces. This can be one or more of the following:
  - **Functional/utilitarian**: nature is a nice-to-have; nature deficit is high for these types of people
  - **Contextualized:** nature is natural and free; these types of workers make time for nature outside of work and do not feel as much of a deficit as a result
  - **Integrated:** nature should be part of daily activity; interacting with nature helps these types of workers "refresh" throughout the day

### 4.6.1 The Pressure Cooker

| Work Style | Stress triggers | Attitudes about nature |
|---|---|---|
| Head-down; near-total autonomy | Self-driven pressure<br><br>Externally-driven pressure<br><br>Time constraint pressures | Functional/utilitarian |

*Table 8 Persona: The Pressure Cooker*

High-functioning, productive, and solitary, The Pressure Cooker does not generally take mindful breaks from their work. They exhibit a high attention to detail, and place an above-average level of pressure on themselves to perform. They are not necessarily aware of their disconnection from natural spaces: they perceive nature as a nice add-on to the workplace, and would likely be more drawn to the aesthetically pleasing and functional aspects of biophilic patterns rather than being attracted to the restorative nature of these elements.

The risk of burnout is high for this type of worker, and as a result, they would likely benefit the most from having convenient, accessible green spaces, as well as sustained messaging to remind them to take mindful, restorative breaks.

> (Participant 53) Honestly what I would love more than anything else is to have a couple of days where there's nothing hanging over my head.

(Participant 14) A way to get into a rhythm that's less structured. There are whole days where you really have nothing to do… a day without a plan, which is really nice.

(Participant 39) It feels like I've accomplished something. [hesitates] Getting home from a long walk, the physical exertion, feels good. It's like, OK, now I can relax, now I can sit down, and when I sit on the couch, it's like, I've been outside, I've gotten some air, I've experienced nature. Now when I put my feet up, I don't feel like a slob.

### 4.6.2 Get-er-done

| Work Style | Stress triggers | Attitudes about nature |
| --- | --- | --- |
| In between the head-down style, and a blend of independent and interdependent work | Time constraint pressures<br><br>Administrative or bureaucratic obligations | Balanced |

*Table 9 Persona: Get-er-done*

The Get-er-done persona works in a role that is mostly solitary, but is responsible for goals and expectations that are beyond their realm of influence; they are generally comfortable with this, and it does not cause above-average stress for them. Instead, stress is often triggered by unrealistic timelines to achieve certain work outputs, or administrative requirements set by their workplace that do not seem a meaningful use of their time. Their attitude towards work would be, "Just let me be free to do good work."

This type of worker is most aware of the role that nature plays in their lives, in terms of its healing and restorative qualities. They feel a deep connection in natural spaces, and take time to reconnect with those spaces on their own. Because they mindfully take time in nature outside of work (and, for those for whom it is available, at work), they might take the most advantage of biophilic elements in the workplace, but this would not have the same impact on their wellbeing as it would for other personas who are less connected to nature (like The Pressure Cooker).

(Participant 6) I'm very much drawn to green spaces. Anywhere I've lived, I make a point of being close to green spaces, in the top-five things I need. [...] I wouldn't make a career decision based on access to green space. That's a bit much.

(Participant 25) I'm more focused on coming to work, doing what I've gotta do, and heading

home. [...] If I ever get to the point where I feel the need, I can just go outside and take a walk in

the neighbourhood, that's easy enough to do on a regular basis.

### 4.6.3 Social/Extravert

| Work Style | Stress triggers | Attitudes about nature |
|---|---|---|
| In between a blend of solitary/interdependent work, and largely interdependent | Physical or environmental constraints<br><br>Interpersonal situations | Integrated |

*Table 10 Persona: Social/Extravert*

The Social/Extravert persona is creative, collaborative, and desires social interactions with colleagues in

the work setting. They are triggered most by interpersonal conflict: the small- or big- "p" politics that

often occur in workplace settings. They also feel most deeply the physical constraints of their workplace,

especially when it impedes their ability to work in a collaborative style that is most productive for them.

This persona has a lot of energy, and more conventional office designs are suffocating.

They are somewhat aware of the role of nature in their lives, and whether they recognize it or not, they

seek out natural spaces outside of a work context. They would likely be drawn to, and make use of,

more natural spaces in or near the workplace environment.

> (Participant 45) It's so distracting from the work… totally leaked into my personal life. You spend
>
> most of your time at work… interpersonal things cause a lot of stress, and you don't ever get
>
> used to it.

> (Participant 17) Often I don't move away from my desk as often as I should. [...] And this set up
>
> of the office, too, the cubicles make it harder to be as collaborative within the team.

These personas are preliminary, and would benefit from more primary research to develop them

further. They would be used by design consultants to better design spaces for various employee needs

and behaviours, and might even be used by employers to prototype wellness design strategies prior to

investing money into new programs.

As mentioned earlier in the paper, the research from my literature review (Alvarsson et al, 2010; Nieuwenhuis et al, 2014; and An et al, 2016) shows that exposure to natural elements are positively correlated with a feeling of wellness. However, the way these elements are executed in the design of the work environment matters, and different employees would have different needs.

The global employee engagement study conducted by Steelcase in 2016 demonstrates that 88% of employees who say they are "engaged" or "highly engaged" are in workplaces that allow them some flexibility over the use of the office space, depending on the need—for example, to switch between work spaces when they need to collaborate with colleagues, focus on independent work, or rejuvenate or give their minds a break (p. 29).

These personas are a starting point: more robust personas would help stakeholders more strategically incorporate biophilic elements depending on the behaviour of different types of employees so that they achieve an optimal impact on employee wellness. In the next section I consider the diverse needs of employees in my recommendations to stakeholders on how they might apply biophilic design elements in their practices.

# 5.0 Implications

I began my research project mostly curious about whether our disconnection from nature has a negative impact on our wellbeing, since we live in a culture where we spend almost all our time indoors. There is ample evidence that validates this: in fact, several existing studies make a strong case that access to natural spaces is linked to people's overall wellbeing. The hypothesis I started with was that introducing biophilic elements in the office setting could potentially have a positive impact on employee wellbeing.

Wilson's biophilia hypothesis is well supported by my findings: people seem to be drawn to natural spaces and feel good when they are immersed in them. Almost everyone I spoke to could picture themselves in natural settings, and reflected the calming, relaxing, and healing impact that nature had in their lives, and for some, even the spiritual connection they feel towards nature. Our office spaces could certainly use more natural elements, either inside the space, or made available to employees somewhere on-site. But as a design approach, the introduction of *nature in the space* features should be considered in combination with several other needs that participants expressed—things like access to

collaborative spaces, private spaces where people can focus, and having the right technology and tools for the job.

What was most surprising to me was how little people working in urban settings really thought about their disconnection from nature until they had learned about my study. A secondary outcome of my research may be where the real opportunity lies: how might we enhance people's awareness about the restorative aspects of being in natural spaces and motivate them to seek them out more frequently? This is a multi-layered problem which would require the participation of several stakeholders to tackle.

## 5.1 Stakeholder Considerations
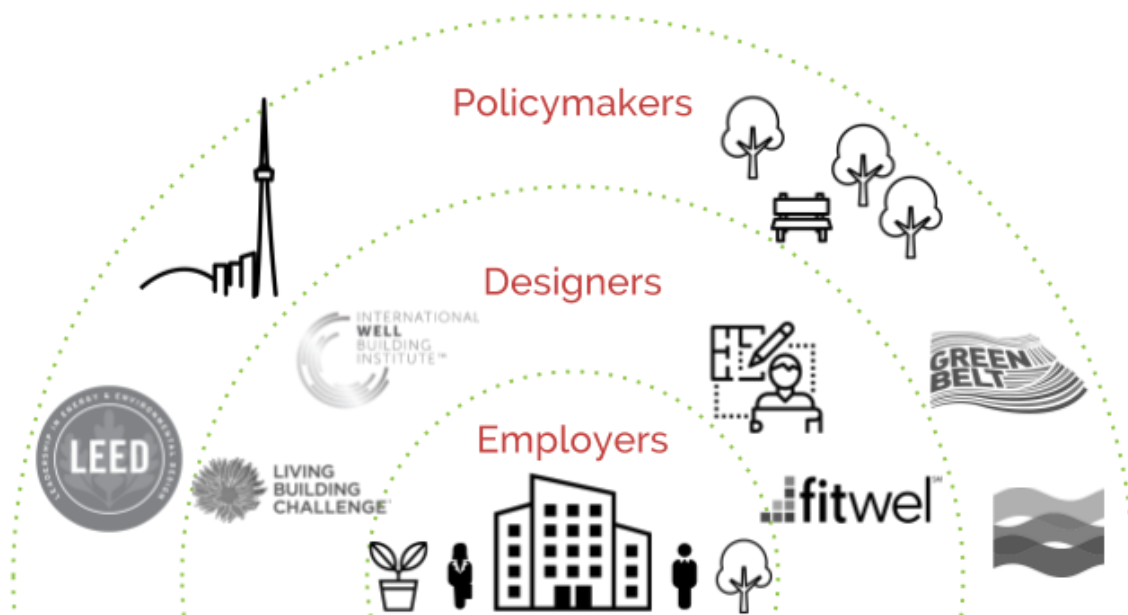


*Figure 38 Stakeholder map*

*This research would have implications on several stakeholders in the system, including employers and employees, designers (architects, developers, etc.), and policymakers.*

### 5.1.1 Employers and Employees

For employers, there is a clear incentive to begin thinking about how the workspaces they create impact the wellbeing of their employees. Chronic health conditions, including mental health issues, are a growing concern, given their impact on productivity and absenteeism (see Mental Illness and Addictions: Facts and Statistics, n.d., noted earlier).

In the 2016 [Sanofi Canada Healthcare Survey](), employers noted their desire for insurance providers to offer benefit plans that prevent illness and manage chronic diseases. In fact, this is a more significant problem than even employers estimate: the survey uncovered that 59% percent of employees reported having at least one chronic condition (this rises to 79% for older employees, aged 55-64). Another startling finding was that 19% of self-reported chronic illness are related to mental health, including illnesses like depression, and this is higher among younger employees (23% for those aged 18-34 versus 17% among older employees).

Employer-paid benefits to mental health services, like psychiatrists, or paramedical services, like massages and acupuncture, provide a potential source of treatment for people living with mental health illnesses; however, a more holistic wellness strategy is likely needed to provide more healthy environments, overall, for employees.

Employers may want to consider where investing in biophilic design elements, especially access to *nature in the space* features, may fit in relation to their broader health and wellness programming for staff. For smaller companies and startups that may not offer health benefit packages, providing group outings to nature reserves and parks in the city could be integrated into the culture from the ground up, and this might have an even greater impact on employee wellbeing, since it is really the immersion in nature that is restorative for health.

One participant who I interviewed noted that having access to green spaces within walking distance of his office was therapeutic for him:

> (Participant 18) We're pretty lucky in this location, there's the building itself, then there's a park close by that's very large. And there's a hydro corridor that there's a walkway to.

*Figure 39 Indoor, shared lobby with lots of living plants*



*Figure 40 Green, outdoor gardens*

*Participant enjoys a variety of indoor and outdoor gardens connected to the office building.*

One of my interview participants mentioned that having something as basic as a window view helps him to "zone out." I asked him what he meant by this, and what he described was a way to increase his ability to relax his brain and focus:

> (Participant 39) For me, it's time to just, I guess, re-center myself. If I'm working, sometimes I need to… maybe not decompress, but not think of anything. And I really don't like doing that in here because all that leads me to do is open up another internet tab. That's not healthy work wise, for me, at least. [...] I don't get the same recharge I get when I look out a window.

This "zoning out" that he described is backed by science. According to the report on *Human Benefits of Green Spaces* (Barton, 2008), "green spaces increase our ability to concentrate." This is because nature allows our minds to "refresh," to switch effortlessly from what is called "voluntary attention"—the focus that we need to stay on task throughout a work day—to "involuntary attention… [the] enjoyable awareness of sensory stimuli in the environment." This is also referenced in Gillis and Gatersleben's paper as Attention Restoration Theory, an environmental psychology theory (2015). More spaces with environmental stimuli, like green walls, would provide this sort of effect, as another participant described:

> (Participant 4) On the edge [of a building] they have this green wall. I think about this more since [seeing your tweet]. And I do have this moment of, I'm going to say 'peace,' and I'm cringing because it sounds so weird… I have this moment of 'reset,' I feel good right there. So I would want to see a sea of green, like that on the wall, or something like that. That would be really nice. And I would probably touch it as I walked by.

As mentioned earlier in the paper, sustained communication to raise awareness of these sort of interventions would tend to reinforce the message about spending time outdoors, and has a demonstrable impact on employee behaviour:

> (Participant 6) The newsflashes do help… because I'm not going to go seek it out, but the fact that it falls into my inbox... if it's a simple thing you can do, you know, I'll think about it. And in this case, I did it. Like, why not walk for half an hour a day, that's the least I can do.

Conclusions drawn by An et al (2016) further support the notion that investing in biophilic elements in the workplace would likely have an impact on employee wellbeing, and in addition, employee job satisfaction. Their study uniquely found a connection between depressed mood and job satisfaction, implying that biophilic elements that influence mood, especially direct exposure to sunlight, could have a tangible impact on employees' work experience overall.

The opportunity from an employer's point of view is to establish an integrated wellness approach that includes not just a benefits package for staff, but programming that supports overall employee wellness. As noted in the 2016 Sanofi survey by Lori Casselman, then Vice President of Integrated Health Solutions at Sun life Financial, "We have a tremendous opportunity to stop thinking about wellness and benefits as two separate things and to start thinking about an integrated health management plan." Biophilic design should be considered as part of such a strategy.

### 5.1.2 Design Consultants and Architects

Contemporary approaches to architectural design attempt to integrate buildings with the landscape and existing natural elements. In *Abstract: The Art of Design*, a Netflix series, an episode featuring Bjarke Ingels, a Danish architect, talks about not having to choose between sustainability and economics: "What if sustainability could be about *increasing* your quality of life?" Ingels talks about "hedonistic sustainability": he believes that sustainability need not be a sacrifice, that perhaps, we are asking the wrong question:

> The conversation about sustainability was drowning in this misconception that sustainability is a question of how much of our existing quality of life are we prepared to sacrifice in order to afford becoming sustainable. Almost like this Protestant idea that it has to hurt to do good. But sustainability can't be some sort of a moral sacrifice or political dilemma or a philanthropic cause; it has to be a design challenge (Bjarke Ingels: Hedonistic Sustainability, 2011)

One barrier that workplace consultants and designers have today is demonstrating the return on investment in incorporating biophilic elements. The field is still quite emergent, and as such, organizations like Steelcase and Gensler invest a lot of time and money to conduct in-house research, such as employee engagement and wellness surveys from clients, in order to build the evidence base for their design proposals.

Ultimately, however, "The person signing the cheque makes the decisions," says Lisa MacVicar, who I spoke to from Steelcase. "Designers don't have a loud enough voice today to have an influence… probably because [biophilic design] is new. They need to make a case for it. [...] The next generation of designers is more in tune with [biophilia], but they don't have influence yet."

The good news is that companies are starting to recognize the impact on employee productivity from incorporating biophilic design elements. For example, one call center that invested $1,000 in every work station to provide access to a window and outdoor view saw a 6% increase productivity (Clancy, 2014). As more companies start taking this approach, more evidence should build as well.

### 5.1.3 Urban Planners and Policymakers

A major challenge in a city like Toronto is our notable lack of green spaces in which to immerse ourselves. To visit natural spaces, most people working in offices would need to go out of their way to access them. A more systemic opportunity lies with our city officials and policymakers.

Investments in parks and recreational areas have been shown to generate sustained revenue through job creation, tourism, and economic activity. For example, Ontario's Greenbelt [generates more than $9.1 billion annually](#) (Spence, 2012), and the revitalization of Toronto's waterfront—an investment that all three levels of government contributed to—has generated [$3.2 billion to date](#) (Economic Growth, Waterfront Toronto, n.d.).

More importantly, building and protecting more green spaces is crucial in conserving natural ecosystems and biodiversity, and in responding to climate change. [A report published by the David Suzuki Foundation](#) provides evidence that Ontario's Greenbelt, the largest protected area of its kind in the world, stores more than double the amount of emissions released by transportation, which is the greatest contributor to greenhouse gases in Ontario (David Suzuki Foundation, 2012, p. 17).

The idea of biophilic cities was put forward by Beatley and Newman in the *Sustainability* journal (2013): they argue that "there is much value in fact in getting people out of buildings and to thinking more holistically about the natural qualities and conditions of the larger urban environments in which these buildings sit." They cite several examples of cities that have incorporated biophilic design into city planning, including things like restoring tree canopies to moderate air pollutants (New York); restoring wetlands to mitigate the impact of hurricanes and floods (New Orleans); and converting rooftops to green roofs to conserve energy and reduce urban temperatures (Toronto).

Access to parkland in the city should be a public benefit, and would likely have a positive impact on the wellbeing of all citizens. As one of my participants aptly put it:

> (Participant 6) It has to be for everyone; it shouldn't be a perk for employment. I would hate for large amounts of land and park property to be private that you can't get to because someone else paid for it.

The recent proposal for an 8.5 hectare park in downtown Toronto (dubbed the Rail Deck Park (What is Rail Deck Park, n.d.)) would be a much needed addition to the city and is a step in the right direction in terms of creating a more biophilic city.

On the other hand, in a city like Toronto, the politics around how to develop our spaces often leads to controversy: a group of developers claim that they owns the right to build condominiums in the air space above the park and are fighting the proposal (Pagliaro, 2017).

## 5.2 Existing Guidelines

It is not enough to provide the report, or promote parks to Canadians, and expect them to take it upon themselves to integrate outdoor activities into their everyday lives. The most challenging finding from my research is realizing that our disconnection from nature is so normalized that we perceive the act of spending time in nature as divorced from our regular routines. If our cultural mindsets about spending time in nature are entrenched, changing our behaviours will be extremely challenging.

A starting point would be for leaders in all sectors, public and private, to provide an evidence-based guideline to reintegrate nature into daily routines. Despite the evidence that spending time in nature has improved health outcomes, there are no specific guidelines from the Canadian government about spending time in nature.

A research study by the Canadian Parks Council provides a clear evaluation of the nature deficit that Canadians experience, and makes the case for Canadian parks to be part of the solution. The 2014 study, *Connecting Canadians with Nature*, synthesizes various scientific research studies, similar to the sources provided in my study, illustrating the positive impact that spending time in nature has for Canadians growing up in modern times. It summarizes some of the root causes leading to our current disconnection from nature, which are also highlighted in my own report: key drivers such as urbanization and a lack of access to nature; our indoor and sedentary lifestyle, noting that we spend more time indoors today than ever before; and busy lifestyles that get in the way of making time for nature. The paper concludes with a call to action: to reintegrate nature in our daily activities, with Canadian parks playing an integral role in reconnecting Canadians to nature. However, the report does not get into practical solutions or frameworks to imagine how nature might be reintegrated in our lives.

A publication by Statistics Canada in 2013 provides a breakdown of the types of outdoor activities in which Canadian households partake. This may give us some insight into the existing behaviours of Canadians, and the ways in which they may be more likely to spend time in nature. This can be used to identify potential leverage points. The good news is that about 75% of households say they do spend time in outdoor activities, and the most common type of activity is walking (52%) and bicycling (20%) (see CANSIM table 153-0153):

| Activity | % households |
|---|---|
| Walking | 54 |
| Bicycling | 22 |
| Jogging, running, rollerblading, cross-country running | 11 |
| Hiking | 11 |
| Other outdoor activities | 11 |
| Outdoor team sports Note 1 | 9 |
| Going to the beach, water activities | 8 |
| Golfing, croquet, lawn darts, lawn bowling, bocci | 4 |
| Boating | 4 |
| Skiing, snowboarding, telemark | 4 |
| Cross-country skiing, snowshoeing | 4 |
| Picnicking, barbecue | 4 |
| Go to the park/playground | 4 |
| Fishing | 3 |
| Camping | 3 |
| Skating | 3 |
| Ice hockey, broomball, curling | 2 |
| Badminton, tennis | 2 |
| All-terrain vehicle (ATV) | 1 |
| Snowmobiling | 1 |
| Hunting | 1 |
| Bird watching, photography | 1 |
| Exercise, tai chi, aerobics, yoga | 1 |
| Tobogganing, sliding | 1 |

*Table 11 Stats Canada CANSIM table 153-0153: Outdoor activities*

*Reproduced from Statistics Canada website, Chart 1*

However, looking at the highlighted activities—those that are more likely to be in natural, green spaces—a different picture emerges. Activities in nature, like hiking (11% of households partake in this

activity), boating (4%), going to the park (4%), fishing (3%), camping (3%), and hunting (1%), report very low participation percentages. As well, the analysis does not provide data on how frequently households participate in outdoor activities, nor does it take a position on what a healthy amount of outdoor time should be. It does mention that participation in outdoor activities correlates with household income: "from 56% for those with annual incomes of less than $20,000 to 88% for households with annual incomes of $150,000 or more." This is likely because many of the activities require an investment in equipment, licenses, or other fees that may be barriers to many households.

It seems that walking and cycling, as the more common activities, and relatively low-cost compared to other outdoor activities, might be where opportunity lies. If biophilic design could be integrated within the urban spaces where we walk and cycle, it could make a significant impact, and begin to reverse the reinforcing loop examined earlier:



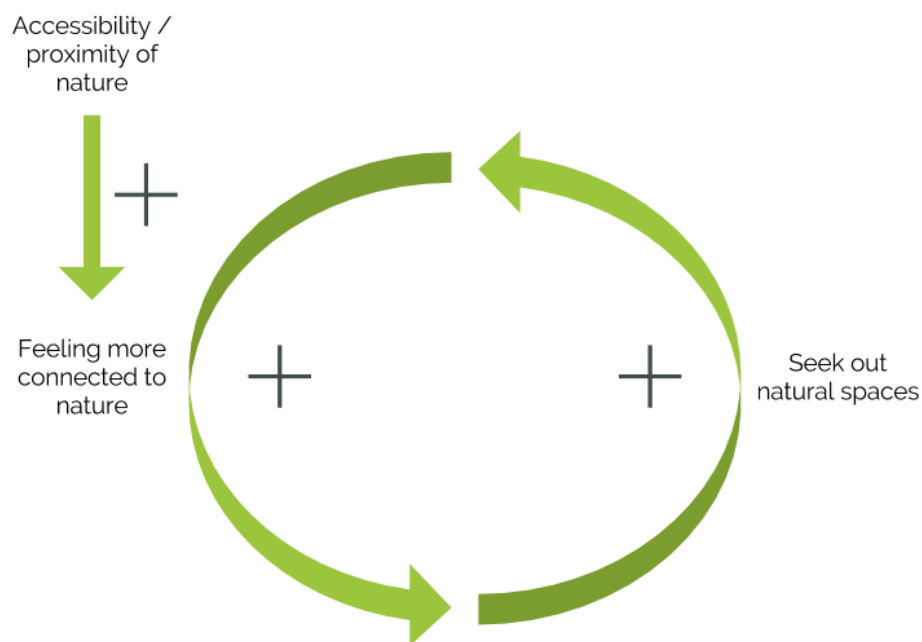*Figure 41 Reinforcing loop: connecting back to nature*

***Reversing the reinforcing systemic loop would require a systemic effort from various stakeholder levels to reintegrate nature into daily routines, such as walking and cycling activities.***

## 5.3 Recommendations

Two specific opportunities emerge from my primary and secondary research findings, related to my key finding that proximity (access to nature) and programming (sustained communications and wellness strategies) have an impact on behaviour (spending time in nature).

### 5.3.1 Opportunity #1: Nature at Work

**Opportunity Space:** How might we better integrate nature into our workspaces?

**Related Findings:**

- People spend more than 90% of their time indoors (Matz et al, 2014).

- Spending time in nature is perceived as its own activity, separate from work or day to day life.

- People think of nature as "real": they picture greenery, forests, trees, and plant life when asked to imagine natural spaces.

- People feel better when biophilic elements—especially sunlight and living plants—are part of the workplace design; this correlates with job satisfaction and how they feel about their employer (An et al, 2016).

- When there are on-site natural elements in the workplace, people are likely to make use of them during breaks.

| Opportunity #1: Nature at Work |
|---|
| **Employers** |

- Invest in, and maintain, plant life in the workplace (small trees, potted green plants) and/or water features (indoor waterfalls), making them a prominent feature of shared spaces and corridors, especially high-traffic areas (break rooms, meeting rooms).

- When considering leasing or buying new office space, look for spaces that include on-site biophilic features—like green walls, indoor gardens, and covered patios with green spaces—and spaces that are within close walking distance of parks (especially parks that have a tree canopy—tall trees that provide shade).

- As much as possible, ensure that employees have offices or workspaces with access to sunlight. If the space has a more conventional layout (e.g., single-person offices for managers

have access to windows, with workers in cubicles in the centre of a floor plan), consider investing in lower cubicle walls for staff, and cutouts in the cubicle walls for translucent glass panels to allow more natural light to flow through the space.

## Designers

- When winning bids that include biophilic design elements, create measurement frameworks (e.g., client and employee surveys) to evaluate which solutions have the most meaningful impact on employee wellness. Share ongoing research findings broadly among the design community and stakeholders.

- Building on the personas developed in this research paper, create design products and strategies that consider diverse needs and work styles. For example:

  - The *Pressure Cooker* type would benefit most from biophilic elements that are integrated in activities they are already engaged in—like in meeting rooms, or including nature in high-traffic areas in spaces where they visit frequently; they likely need reasons to seek out these spaces, and would also benefit from reminders. Designers should consider prototyping nature-in-the-space elements after implementing an office design to ensure that these elements are included in areas that are most frequented by this type of worker.

  - The *Get-er-done* persona would likely not require reminders to visit natural spaces, but would make the most use of them on their own; they might also need spaces to restore on their own, as they tend to be more solitary than other types. Designers should create strategies for clients that include bookable private spaces for this type of worker.

  - The *Social/Extravert* persona needs open, collaborative work areas, and more flexibility and choices, more so than the other two types of worker. They would gain the most from integrated wellness programs that provide sustained messaging about the benefits of taking mindful breaks in natural spaces. Designers should consider including visual "cues" within workspaces that would draw this type of employee into these spaces—for example, including different images of forests or other green spaces as floor-to-ceiling wall murals throughout the space so that there are a variety of work areas that produce different moods.

## Policymakers

- Make use of policy frameworks for new developments, such as [development charges](#), to raise money for infrastructure projects that create publicly accessible green spaces to citizens.

- Create incentive programs for building owners and employers to retrofit or update older buildings to follow international standards like LEED and WELL.

| Opportunity #1: Nature at Work |
|---|
| • Invest in more parks and green spaces, especially in high density areas (i.e., downtown core). Create multi-level government partnerships to expand green spaces in cities. |

*Table 12 Opportunity #1: Nature at work*

### 5.3.2 Opportunity #2: Enhanced Wellness Programming

**Opportunity Space:** How might we design strategies for employee wellness that include biophilic design?

**Related Findings:**

- People are more likely to walk or cycle, as an outdoor activity, than other activities (Canadians and Nature, 2015).

- People need the perception of choice and flexibility at work to feel engaged (Steelcase Global Report, 2016).

- People work in different ways, and have different needs from their workplaces; they need a balance of "me" spaces (restorative, private) and "we" (social, collaborative) spaces (A Holistic View: Body, Mind, Environment, 2014).

- Investing in biophilic elements in the workplace would likely have an impact on employee wellbeing, and in addition, employee job satisfaction (An et al, 2016).

| Opportunity #2: Enhanced Wellness Programming |
|---|
| **Employers** |
| • Include messaging in existing health and wellness strategies that encourages staff to spend time in nature during or after work, noting the benefits that are associated with those types of activities. If natural spaces are available on-site, encourage break-taking in these spaces, noting the restorative impact of taking more mindful breaks during the work day. |
| • Integrate outings to natural spaces as part of the workplace culture. For example, encourage managers to take "walking meetings" with staff to nearby parks or other green spaces in lieu of meetings inside boardrooms, whenever possible. Track this activity among managers to ensure it is built into the workplace culture. |

| Opportunity #2: Enhanced Wellness Programming |
|---|

- If natural spaces are not available within walking distance of the office, create special interest initiatives for *green-booting* the office space interior. For example, allocate part of the budget to providing resources (like do-it-yourself terrarium kits) to grow and maintain indoor plants, and allow and encourage staff to bring in their own desk plants.

- If shared spaces are available, allocate a time of day within one of those spaces for restoration—for example, at 3pm each day for one hour, a specific room will be booked on an ongoing basis as a "quiet room" or meditation room. Fill that space with plant life and play a soundtrack with sounds of nature in the background; if possible, choose a room with a window. Encourage managers and staff to use the room in email reminders, and in all-staff meetings.

| Designers |
|---|

- Train and certify in-house consultants in WELL Building Institute and/or Fitwel standards. Make the WELL standard, and other sustainable building standards (like LEED) part of your value proposition to all clients.

- Taking an evidence-based approach, create thought leadership pieces on contemporary practices in biophilic design, demonstrating the positive impact that results from integrating nature inside workspaces. Publish and share findings broadly among the design community and stakeholders.

- Work with clients to integrate health and wellness strategies when consulting on office design. Include this as part of the firm's design practice, not as an additional service or fee; maintain a repository of best practices research and approaches that can be provided to clients as an integrated part of the service.

| Policymakers |
|---|

- Building on Canada's physical activity guidelines (24 Hour Movement Guidelines for Children and Youth, 2016), provide a bulletin or update to the guidelines to include the minimum amount of time children, youth, and adults should spend in nature. According to research provided earlier in this paper, as little as 20 minutes in nature is restorative for our health (Gillis & Gatersleben, 2015; Terrapin Bright Green, 2014).

- Ensure that curriculum for schools teaches children about nature and the importance of spending time in natural spaces. Allocate part of the subsidies to schools to include field trips to natural spaces to apply learning from the classroom.

*Table 13 Opportunity #2: Enhanced wellness programming*

# 5.4 Ecosystem Impact

## 5.4.1 Stakeholder Matrix

To achieve maximum impact, biophilic design practices should be applied across the stakeholder ecosystem. The following matrix illustrates the interconnectedness among all stakeholders, and the need for a holistic approach:
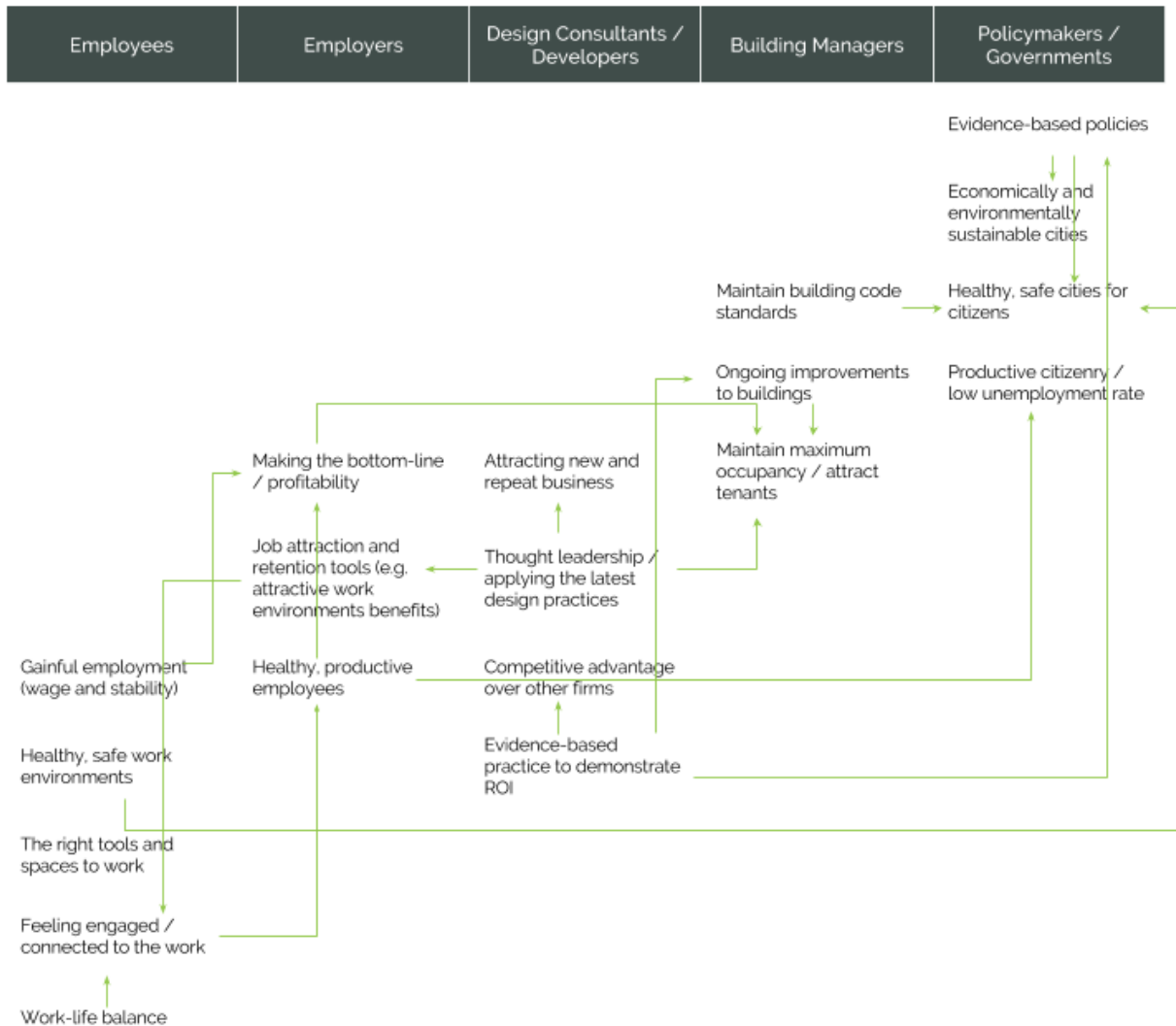


*Figure 42 Stakeholder matrix*

## 5.4.2 Future Outcomes

Given the interconnectedness among all stakeholders, if stakeholders begin to take steps to include evidence-based biophilic design practices in their sectors and industries, it would result in more systemic impacts over time.

The recommendations provided in this paper are preliminary and require other researchers build on the practical, actionable steps that all stakeholders can take to build the green-booted offices of the future. Looking across the stakeholder ecosystem, if an integrated approach is taken, several longer-term outcomes become possible:
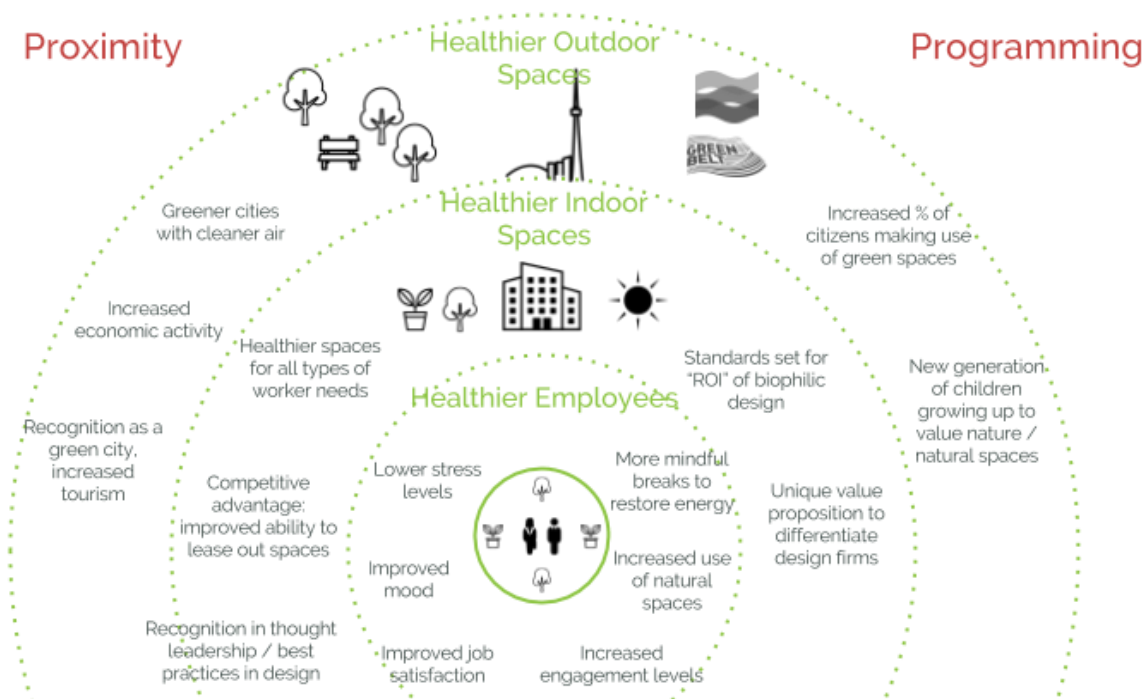


*Figure 43 Map of potential impact on stakeholders*

# 6.0 Recommended Future Research

## 6.1 Unanswered Questions

In this study, I attempted to build on existing research and provide primary research findings that took a Canadian perspective on the current experience of employees who work in urban office environments, and how we might design healthier spaces for them.

I include myself among my research participants: while my workplace is more contemporary than the spaces I visited and incorporates a few of the biophilic elements that support employee wellbeing, it still largely lacks access to green, natural spaces, indoor or out. Since undertaking this research, I found myself paying attention to how I take breaks, and being more mindful of seeking out green spaces during my longer breaks at work. I wonder whether having access to more of these spaces would improve how I feel at work, and whether I would access them more frequently if they were closer to the office. The evidence I gathered, in combination with my primary research, tells me that access to more green spaces would make a significant difference; the question that remains is, to what extent, and in what "doses," do people need access to these spaces to achieve the most impact?

Upon concluding this initial research, I am left with a series of more focused lines of enquiry to build on this exploratory work:

- Desirability questions:
  - How might we enhance people's awareness about the restorative aspects of being in natural spaces?
  - What might motivate people to seek out natural spaces more frequently?
  - What needs would people with different work styles and experiences have—The Pressure Cooker, the Get-er-Done, the Social/Extravert?
- Viability questions:
  - What's the optimal "ROI" on workplaces that include biophilic design elements? Which elements have the most impact on wellbeing, and in what situations?
  - How might the human and social impact of biophilic designed spaces be measured in a meaningful way to build a business case for it among employers, building designers, or policymakers?
- Feasibility:

- How much better might people feel if there were more access to nature during work days?
- How much nature do employees in urban offices need to have a marked impact on their wellbeing?
- How might spaces be optimally designed for various firms and workplace cultures (e.g., a law firm versus a government agency versus a technology startup)?
- Building biophilic spaces is not enough: What strategies can be used to encourage the use of natural spaces that are available? What would motivate people who might not otherwise be inclined to spend time in nature to change their behaviours?

## 6.2 Building on this Study

There is clearly an opportunity for more research on this topic. My study only begins to scratch the surface of the impact that biophilic spaces might have on employees living in cities. To build on my findings, I would recommend the following future research activities:

- Conducting periodic surveys to emulate the study conducted in the UK (White et al, 2013), measuring people's wellbeing and access to green spaces. I would add questions that are framed around our diverse seasons, which would fill a gap in the literature and existing evidence. When asked to describe "nature" or "natural spaces," almost all my interview participants described green gardens or forests. Would people's feelings about their connection to nature change during the winter months? Might they spend less time outdoors? Do outdoor spaces, when absent of greenery, have the same restorative impact during the winter as they do in warm seasons?
- Conducting workplace experiments, testing different biophilic elements and whether they have an impact on employee engagement, wellness, and satisfaction at work. For example:
  - Gensler tests the design of its office layouts and plans by prototyping different configurations first, and collecting data from the furniture itself, using embedded tracking devices to quantify how much, and in what ways the furniture is used.
  - In an earlier iteration of my research proposal, I had wanted to run an experiment emulating two studies I read from Australia, the UK, and the Netherlands (Gray & Birrell, 2014; Nieuwenhuis, Knight, Postmes, & Haslam, 2014) to test employees' knowledge retention when given a questionnaire in a room with *nature-in-the-space* elements, and

when given the same questionnaire in a regular boardroom. I decided not to pursue an experiment due to timing considerations, and not having access to employees to conduct the experiment.

- Conducting more primary research on employee experiences like this study. A significant gap in Canadian papers are deeper, ethnographic insights that would reveal more specific opportunities in this space. As mentioned in Section 3.7, a key limitation of my study is the small sample size of interviews. More in-context interviews to examine the current state of urban offices, perhaps speaking to lead innovators in this space (i.e., workspaces designed with the latest biophilic design practices), would be beneficial.
- Conducting a more thorough scan of current signals and trends in workplace design to uncover the critical uncertainties that will affect the futures of the workplace. I intended to develop some futures scenarios from my study, but time constraints hindered my ability to continue the work. Some critical uncertainties I uncovered were the following, and may be used by other researchers to launch their own research, if desired:
  - Will the idea of working in an office become a thing of the past, with more flexible work preferences, or roles that do not require a physical job site?
  - What will happen to the idea of work and workplace benefits, as a generation grows up in a world where contract work and freelancing is normalized?
  - Will our disconnection from nature persist to the point where a demand for more parks and green spaces decreases, and nature becomes a luxury or novelty experience?
  - Could climate change destroy all our natural spaces, making it unfeasible to conserve them, or alter them to the point where they are no longer "natural" and restorative?
  - Will technological substitutes become viable replacements for nature ([NaturePod$^{TM}$— Situation Lab](), n.d.), making this study irrelevant in the future?

I can reasonably interpret my findings to conclude that people are naturally drawn to green spaces and seek them out instinctively; feel good when they are immersed in them; and would value more access to these spaces within an urban context. Moreover, my revised hypothesis would be that if more employers invested in indoor spaces with biophilic elements, especially *nature in the space*, it would likely provide them with a competitive advantage in terms of attracting talent: people feel deep connections to nature, and if natural elements were more mindfully integrated within physical workplaces, I am confident people would benefit from their use.

All stakeholders would be wise to consider integrating biophilic design in their practice, as it becomes increasingly clear from the research the positive impact it has on the wellbeing of people working and living in cities.

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# Appendices

## Appendix A: Survey Questions

The survey in phase 1 of my research was used to collect data, as well as a recruitment tool to invite people to participate in phase 2 of the research (semi-structured interviews).

Below is a summary of the survey questions that I used in Phase 1 of the research, and a short rationale behind some of the questions:

General questions

1. Sex
   - My secondary research showed that men and women would experience biophilic spaces differently (Terrapin Bright Green, 2014); as well, I wanted to recruit a mix of men and women to phase 2 of the research, and needed to know people's sex for this reason.
2. Age
3. Home municipality
4. Home address
   - I asked people to provide the first three letters of their postal code and major intersection. I intended to use this data point to map where participants lived, and correlate this to their proximity to natural spaces.
5. Name of employer
6. Job title
7. Work municipality
8. Workplace address
   - I asked people to provide the first three letters of their postal code and major intersection. I intended to use this data point to map where participants worked, and correlate this to their proximity to natural spaces.
9. Time of employment with current employer/in your current career

Access and use of natural spaces

10. Proximity of workplace to natural spaces

- I provided a list of natural spaces, asking people to select all that applied to them, including:
  - Parks
  - Wooded areas
  - Conservation areas with walking trails
  - Outdoor gardens
  - Indoor gardens
  - Lakes, ponds, or rivers
  - Other (with option to write in)

11. Natural elements within the workplace (on-site features)
- I provided a list of indoor biophilic elements, asking people to select all that applied to them, including:
  - Green wall (a wall covered by living plants)
  - Fountains or other water features
  - Outdoor green spaces that include gardens, trees, and other natural landscaping (e.g. ponds, tree-covered courtyards)
  - Indoor gardens, solariums, or greenhouses
  - Other (with option to write in)

12. Frequency of using natural spaces at work
- I asked people how often they spent time in any of the natural spaces available to them while at work to understand whether people make use of the spaces available. In my analysis, I defined "frequent" as "every day," "almost every day," or "several times a week."
- The options they could select from were:
  - My workplace does not include any of the noted natural features
  - I don't usually spend time in the spaces available to me
  - A few times a year
  - About once a month
  - A few times a month
  - About once a week
  - Several times a week
  - Almost every day

- o Every day

13. Time immersed in natural spaces at work

- I asked people how long, on average, they spend in the spaces available to them at work to understand whether they were spending an adequate amount of time in these spaces. In my analysis, I defined "adequate" as "more than 60 minutes," "up to 60 minutes," or "up to 30 minutes," since my secondary research shows that as little as 20 minutes in these spaces has a restorative effect (Gillis & Gatersleben, 2015; Terrapin Bright Green, 2014).
- The options they could select from were:
  - o My workplace does not include any of the noted natural features
  - o I don't usually spend time in the spaces available to me
  - o A few minutes
  - o Up to 30 minutes
  - o Up to 60 minutes
  - o More than 60 minutes

14. Frequency of using natural spaces when not at work

- I asked people how often they spent time in nature outside of work to understand whether people spend time in natural spaces on their off time. In my analysis, I defined "frequent" as "every day," "almost every day," or "several times a week."
- The options they could select from were the same as question 12.

15. Time immersed in natural spaces when not at work

- I asked people how long, on average, they spend in nature outside of work to understand whether people seek out natural spaces on their off time. In my analysis, I defined "adequate" as "more than 60 minutes," "up to 60 minutes," or "up to 30 minutes," based on the secondary research mentioned in question 13.
- The options they could select from were the same as question 13.

Use of stress-reducing health benefits

16. Employer-paid benefits

- I asked people whether they were covered by group health benefits from their employer to get a sense of whether people used stress-relieving benefits (like massages). I wanted to correlate their use of benefits to their self-reported stress levels.

- The options they could select from were:
  - I do not have access to health benefits from my employer/not applicable
  - Prescription medication (subscribed by medical doctors)
  - Access to medical specialists (medical doctors specializing in specific health conditions)
  - Access to alternative health services (nutritionists, alternative medicine, acupuncture)
  - Massages
  - Other paramedical services (chiropractors, podiatrists)
  - Vision care (optometrists)
  - Dental care
  - Gym memberships or on-site gym
  - Other (with option to write in)

17. Frequency using employer-paid health benefits
    - I asked people how often they use each benefit listed in question 16 to get a sense of how often they needed stress-relieving benefits (like massages).
    - The options they could select from were:
      - I do not have access to this health benefit from my employer/not applicable
      - Never
      - Once every 2 years (or less)
      - About once a year
      - More than once a year (but less than once a month)
      - About once a month
      - More than once a month (but less than once a week)
      - About once a week
      - A few times a week
      - Almost every day
      - Every day

18. Frequency using out-of-pocket health benefits
    - I asked people how often they pay out of pocket for each benefit listed in question 16 to get a sense of how often they needed stress-relieving benefits (like massages).
    - They were provided the same options as in question 17.

19. Remote/flexible work

- I asked people whether their workplace allows them to work remotely or work from home to understand where they spend most of their time when at work (at home or in an office), since I was interested in recruiting people who worked in offices, specifically.

20. Frequency of working remotely

- The options they could select from were:
    - My workplace does not allow us to work remotely
    - About once a year
    - More than once a year (but less than once a month)
    - About once a month
    - More than once a month (but less than once a week)
    - About once a week
    - A few times a week
    - Almost every day
    - I always work remotely as part of my job

Self-reported health status

21. How would you describe your overall health?

- The options they could select from were:
    - Excellent
    - Very good
    - Good
    - Fair
    - Poor

22. How would you describe your mental health? (options were same as question 21)

23. Do you identify as having a visible or invisible disability?

- The reason I asked questions about ability were because, for the second phase of the research, I wanted to have a mix of people who live with visible or invisible disabilities so that I could better understand those experiences, and so that the study recommendations would be inclusive of people with diverse abilities.

24. What kind of disability do you live with?

- People could select more than one response. The options they could select from were:

- I do not have a visible or invisible disability
- Visual impairment
- Hearing loss/hard of hearing
- Physical disability
- Cognitive disability
- Anxiety
- Depression
- Option (with option to write in)

Stress levels

25. On an average work day, how would you describe the stress levels you experience in your current employment?
    - The options they could select from were:
        - Extremely stressful
        - Somewhat stressful
        - Neither stressful nor unstressful
        - Somewhat unstressful
        - Not at all stressful

26. What are some ways that you experience stress while at work? Select all that apply.
    - The options they could select from were:
        - Rapid heart beat
        - High blood pressure
        - Physical tension or pain
        - Difficulty breathing
        - Anxiety
        - Depression
        - I do not generally experience stress while at work
        - Other (with option to write in)

27. How often do you experience stress while at work?
    - The options they could select from were:
        - I do not generally experience stress while at work
        - About once a year

- More than once a year (but less than once a month)

- About once a month

- More than once a month (but less than once a week)

- About once a week

- A few times a week

- Almost every day

- Every day

28. On a scale of 1-10, where "1" means "not at all," and "10" means "an extreme amount," how much do you think that stress related to work affects your personal health? (Scale of 1-10 provided)

29. What are some ways that you manage your stress levels, work-related or other stress, in order to reduce it? Select all that apply.

- From this question, I was specifically trying to uncover how many people say they get massages because in an earlier iteration of my research question, I wanted to uncover the way people cope with stress. I later decided this was out of scope for my study as my research question evolved.

- The options they could select from were:

  - I do not do anything specific to manage my stress levels

  - Social activities (e.g., going out or spending time with loved ones)

  - Physical activity (e.g., going for walks, working out, etc.)

  - Relaxation techniques (e.g., deep breathing, meditation)

  - Time management (e.g., saying "no" to new projects)

  - Prescription medication

  - Drinking alcohol

  - Getting massages

  - Using health benefits provided by my employer

  - Taking paid time off (like vacation)

  - Taking unpaid time off

  - Taking paid sick days

  - Taking unpaid sick days

  - Other (with option to write in)

30. How would you describe, on average, how content you feel about your current employment?

- I asked this question to correlate people's self-reported health status, stress levels, and other data points.
- The options they could select from were:
    - Extremely content
    - Somewhat content
    - Neither content nor uncontent [sic]
    - Somewhat not content
    - Not content at all

31. Would you be interested in participating in Phase 2 of this research project? (yes/no)
- Participants could indicate interest in semi-structured, in-context interviews for phase 2. I provided the following description:
    - In phase 2 of the project, I will recruit participants who work within the Greater Toronto-Hamilton Area (defined as the City of Toronto, City of Hamilton, and Halton, Peel, York, and Durham regions). I will visit participants on-site at their place of employment. Participants will be interviewed individually for up to one (1) hour, and will be asked questions about the nature of their job and their day-to-day routine at work, and will take time (up to 30 minutes) to tour the office space and immediate environment around the work site. Participants will be required to provide written consent on behalf of their employer (if required) to participate in this phase.
    - Interviews will take place sometime between August and September of this year (2017), on a date and scheduled during a time that fits the participants' schedule. There will be no compensation to participate in the interview.
    - Potential Benefits or risks to Participants: There are no known benefits to participating in the interviews. By being part of this study, research participants could experience some psychological stress, as questions about their personal and mental health will be asked.

32. Would you be interested in participating in Phase 3 of this research project? (yes/no)
- Initially, I was planning to design a before-and-after experiment with people working in office environments. As the project evolved, I decided this was out of scope to achieve the outcomes I wanted.
- I provided the following description for this phase:

- In phase 3 of the project, I'm recruiting two groups of 15 participants to conduct a short, 30-minute, before-and-after experiment on-site at an urban office space in the City of Toronto. One group will be a test group, which may receive some health benefits from the experiment, and one group will be a control group, which is not anticipated to receive any benefits from the experiment. Details about the experiment will be shared closer to the experiment date, which will take place sometime between August and September of this year (2017).
- Potential Benefits or risks to Participants: By being part of this study, research participants could experience immediate positive impacts to their mood. There are no known risks to participate in either group.

Personal contact information

If participants were interested in phases 2 or 3 of the research, they were asked for the following:

33. Full name (first name, last name)
34. Personal email address

## Appendix B: Key Word Searches

For my secondary research and literature review, the keywords I used to search the topics were combinations of the following:

- Alternative measures for health
- Biophilia
- Biophilic design
- Built environment
- Employee wellbeing
- Forest bathing
- Green architecture
- Green space
- Health
- Measures of wellbeing
- Mental health
- Nature
- Natural spaces
- Sustainable cities
- Sustainable design
- Wellbeing
- Workplace design

# Appendix C: Icon Credits

All icons were provided from [The Noun Project website](#). I used icons from the following contributors:

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## Appendix D: Codified Responses

The following tables are codified responses from phase 2 of the interview—in-context, semi-structured interviews with nine participants.

**Attitudes, Definitions, and Motivations**

This tables provides a summary of lines of questioning about participants' attitudes towards nature (their definitions of nature, and how nature makes them feel), as well as their motivations for seeking out natural spaces.

| Relationship to Nature:<br>Attitudes, Definitions, Motivations | Total |
|---|---|
| Actively seeks nature outdoors | 9 |
| Experiences nature deficit at work | 5 |
| Disconnecting, being alone/solitary | 5 |
| Spiritual connection (religious or otherwise - sense of wonder/awe) | 4 |
| Nature is healing; helps me "reset" | 4 |
| Nature is *natural*, wild, little intervention from humans | 4 |
| Nature is relaxing | 3 |
| Feels largely disconnected from nature at the moment due to busyness | 3 |
| My research has triggered them to think about nature or their space more | 3 |
| Nature is open space, less density (i.e., people) | 2 |
| Nature is public, should be shared / enjoyed by all | 1 |

*Table 14 Codified responses: Relationship to Nature*

- Motivations for spending time in nature are mixed:
  - For five participants, being in nature is a way to disconnect from the world and be solitary. They do not necessarily spend time in nature with others, but seek to be alone.
  - For four participants, being in nature is healing and directly connected to helping them feel healthier, mentally or physically.
  - For four participants, being in nature is linked to spirituality, whether religious or not: there is something awe-inspiring about being in nature that they say they are naturally drawn to.

- Three participants noted that being busy gets in the way of them spending as much time in natural spaces as they might like; as a result, they noted that they feel quite disconnected from nature at the moment.

**Definitions of Stress**

This table provides a summary of lines of questioning around the ways participants experience stress at their current employer.

| Stress and the Office: Definitions of Stress | Total |
|---|---|
| Pressure to perform | 5 |
| Time pressure | 4 |
| Pressure to make the company successful/profitable | 2 |
| Interpersonal | 5 |
| Stress is experienced physically | 3 |
| Participant internalized other people's stress | 3 |
| Associates "normal" stress with resilience / recovery time | 3 |
| Bureaucracy / tedium / boredom | 2 |
| Uncertainty | 2 |
| Unrealistic expectations | 2 |
| Perfectionism | 2 |

*Table 15 Codified responses: Definitions of stress*

- Participants experience work-related stress in a variety of ways. The types of stress shared most prominently were the following:
  - Six participants noted that they feel pressure to perform in their current role. This manifests itself in terms of time pressure (meeting deadlines, ensuring high-quality work in short amounts of time), as well as a feeling of personal responsibility to the work (ensuring the work is something they can be proud of).
  - For two of the three participants working in startup cultures, they experience additional pressure to contribute to the company's success and viability (seeking clients, managing finances, etc.).
  - Five participants noted that most of the stress they experience at work is "normal"; generally, the types of stress that have an impact on their wellbeing is interpersonal:

managing conflict with coworkers, managing their leaders' expectations, and/or being a sounding board for coworker's problems.

## Current State Office Culture

This table provides a summary of lines of questioning around the current office culture.

| Stress and the Office: Office Culture (Current) | Total |
|---|---|
| Unstructured time / breaks / lots of flexibility | 9 |
| Generally works independently/solitary work | 9 |
| Autonomy | 9 |
| Workplace culture/environment has a notable influence on wellbeing | 7 |
| Spends most time in front of a computer | 7 |
| Lacks socialization / collaboration spaces | 5 |
| No access to natural light | 4 |
| Telework is an option | 4 |
| Doesn't generally take breaks | 3 |
| Likes challenges (mental stimulation, problem solving) | 3 |
| Creative work is desired | 3 |
| Standing desk is available | 2 |

*Table 16 Codified responses: Describing the current office environment/culture*

- Participants noted that the following physical characteristics of their office negatively impact their experience at work:
  - Notably, none of the participants indicated that they spent much time, or desired to spend time, with colleagues outside of the work environment. Five participants did note that collaborative spaces would be beneficial to the workplace culture, and having spaces and opportunities to socialize while at work would be welcome: in particular, participants said a lack of collaborative spaces leads to a feeling of isolation, or being "siloed," and they also feel as if their productivity is diminished as a result.
  - Four participants did not have access to natural light in their immediate work environment. All four said that this especially makes it difficult for them to be in touch with something as basic as the passage of time, and used words like "prison" to describe the feeling of being in these spaces.

- Seven participants noted that most of their day (five hours or more) is spent seated (or at a standing desk) in the office, working in front of a computer.
- In a few interviews, participants became emotional when sharing their perspectives (prior to starting the interview, participants were reminded that they might experience a mild degree of stress while participating in the interview, and could withdraw at any time). In addition, it was notable that:
  - Although almost all participants (seven of the eight who had responded to the Phase 1 survey) reported overall contentment or job satisfaction in the recruitment survey, it seemed that opening up a discussion digging deeper into their work experiences and environment affected them more deeply than they, themselves, knew.
  - Three participants noted that learning about my research had heightened their awareness about the topic: prior to having the interview with me, they had taken notice of how detached they are from natural spaces in their lives.
- All participants worked in environments with the following characteristics in common:
  - Participants felt like their employers afforded them a lot of flexibility around when they could take breaks, and how long those breaks could be (four participants have the option to work remotely).
  - Participants value the autonomy they are given at work, and generally work in solitary pursuits—that is, the majority of their day is spent working on projects on their own.

This table provides a summary of lines of questioning around the ways participants manage the stress they experience at work.

| Managing stress | Total |
|---|---|
| Self-aware (has coping mechanisms or outlets) | 7 |
| Getting up / walking away | 5 |
| Spending time with friends (outside of work) | 3 |
| Talking / venting to coworkers | 3 |
| Down time improves productivity | 3 |
| Being methodical | 2 |
| Prioritizing work | 2 |
| Employer wellness programming supports tactics to manage stress | 2 |
| Finding temporary distractions from the problem | 2 |

*Table 17 Codified responses: How people manage stress at work*

- Most participants had ways that they manage stress at work. The most common response was to get up, or walk away from the stressor.
- None mentioned that they specifically sought out natural spaces to alleviate stress, which reinforces the point that people see time spent in nature as a separate activity from work.

**Down time / Vacation / Breaks**

This table provides a summary of lines of questioning around what participants do in their down time, vacations, or breaks from work.

| Ideal Vacation / Down Time | Total |
|---|---|
| Being in natural spaces | 6 |
| Spending time with family | 4 |
| Being in urban spaces | 3 |
| Being active | 2 |
| Traveling to see the world, adventure | 2 |
| Unstructured time (not having anything to do) | 2 |
| Volunteering | 1 |

*Table 18 Codified responses: People's preferences for vacation or down time*

- In contrast to the previous table, people seek out natural spaces when they consider where to go on vacation, or when they are away from work.

**Future State Office Culture / Environment**

This table provides a summary of lines of questioning around participants' ideal workplace.

| The Green-Booted Office:<br>Ideal Office Culture / Environment | Total |
|---|---|
| Natural light | 9 |
| Real (not fake) biophilic elements preferred | 7 |
| Open space | 6 |
| Natural water sounds | 5 |
| Meeting / collaboration spaces | 5 |
| Being close to water | 4 |
| Functionality is a priority | 4 |
| The right technology / tools are important | 4 |
| Modular spaces, spaces that can be changed if needed | 1 |
| Aesthetics matter | 3 |
| Supports active lifestyles (e.g., amenities for people who bike to work) | 3 |
| Allows personalization / making the space their own | 3 |
| Close to home | 1 |
| "Nature of the space" (e.g., modern / synthetic office features) | 1 |

*Table 19 Codified responses: Ideal office environment*

- Participants had varied needs from their work spaces and offices; however, all mentioned that access to natural light is a necessity.

- Some other features that participants desired were as follows:
  - Six participants noted they would prefer offices with more open space. Four of these participants worked in particularly enclosed offices that had a more traditional layout, with cubicles that had high walls and very little access to natural light.
  - When shown photos of the two different types of offices, seven participants were emphatically drawn to the natural spaces and living plants in the Google Tel Aviv office. Several participants made the point that real plants should be used indoors rather than nature analogues, which seemed too metaphorical—too far removed from nature—to them.

- ○ Two participants liked the clean design and modern aesthetic offered by the Steelcase example.
- ○ Functionality is a key consideration for five participants, including having access to the right tools and technology at work. One person specifically mentioned the fact that their office was not set up for the kind of work that the team does, being a team that works on many digital projects.