Greening the City: Exploring Health, Well-Being, Green Roofs, and the Perception of Nature in the Workplace

by

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A thesis submitted in conformity with the requirements for the degree of Doctor of Philosophy
Department of Geography and the Centre for Environment
University of Toronto

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Abstract

This five-paper thesis explores office workers perceptions of green roofs and how this influences their health/well-being in Toronto and Chicago. Paper 1 examines the underlying paradigms and world-views of major research programs that look at the human relationship to nature and health/well-being, showing that despite some convergence between their methods and integration of different paradigms, continued differences and lack of clarity on the normative assumptions underlying each approach leads to confusion in the specification of ‘nature’ in health/well-being and place research. Paper 2 is a comparative analysis of the implementation of green roof policies in Toronto and Chicago. Paper 2 demonstrates the importance of ‘selling’ green roofs by linking them to larger environmental programs and of the municipal power structure that influences how and if environmental programs are implemented. Paper 3 examines the awareness, attitudes, and feelings towards green roofs by office workers with access to them (visual or physical) from their workplace in Toronto and Chicago. Using a phenomenological analysis of semi-structured interviews (n=55), Paper 3 shows that the hinterland, expectations of different kinds of ‘nature’ and aesthetics in the city, and access all influence perceptions of green roofs and sense of place. Paper 4 explores office workers awareness of and attitudes towards green roofs and the possible influence on their well-being in Toronto and Chicago from a large survey (n = 903). Participants showed a high literacy on the environmental benefits of green roofs. Chi-square analysis showed mixed results for health, but a significant association between visual access to a green roof and improved concentration. Paper 5 tests whether the relationship found in Paper 4, improved concentration with visual access, was still significant when other confounding variables were added to the model. Using a logistic regression on the same survey
population (subset n =505), results found that concentration was no longer significant but that there was a trend towards improved concentration.
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CHAPTER 1

1 Introduction

1.1 Greening the City

Green roofs offer new possibilities for designing and building the city by integrating built form and greenery. By placing a layer of vegetation on unused rooftops, green roofs have been shown to provide environmental benefits such as the reduction of stormwater overflow and the urban heat island effect (Hutchinson et al. 2003, Peck 2001). These benefits are in demand more than ever as cities face increasingly unstable environmental conditions from climate change. Numerous green roof projects have been undertaken in North America as an innovative solution or adaptation to these environmental problems (Rosenzweig et al. 2006, Post 2008, City of Toronto 2009a, City of Chicago 2006a). These projects also tend to embed the assumption that the public will benefit from additional greenspace (City of Toronto 2006a, City of Chicago: department of the Environment 2007). This assumption is supported by a strong Anglo-American narrative that idealizes nature (Muir 1997, Emerson 2003, Thoreau 2004). Most green roofs are being built downtown and are looked over by white-collar office workers; however, there is little research on how these urban greening projects are perceived by, or their potential to provide benefit for, those looking out on them.

My doctoral thesis examines the relationship between perceptions of urban nature and health and wellbeing in the context of urban greening initiatives. Though I am aware of the complexity of the word ‘nature’ (see Williams 1976), I have deliberately left nature unspecified here since a central part of my research centers on exploring what the literature and office workers understand by ‘nature.’ I am also following the World Health Organization’s more holistic
definition of health as “...a state of complete physical, mental, and social well-being and not just the absence of disease or infirmity” (World Health Organization 2006). I am not measuring physical health outcomes.

More specifically, this research looks at green roofs from the perspective of office workers with visual or physical access to them from their workplace, and explores: a) the attitudes and beliefs of these workers about urban nature and green roofs; b), their perceptions of their own health/wellbeing and sense of place; and c), the relationship between them. Understanding how we value and think about urban nature will contribute to our understanding of how perceptions of everyday places affect our wellbeing (Kearns and Moon 2002, Macintyre, Ellaway and Cummins 2002) as well as helping to develop green roof policies and initiatives. It also helps to unpack some of the more problematic assumptions about nature in the Anglo-American tradition that could impact the implementation, and success, of urban greening programs. This chapter introduces the general aims of the thesis, and then outlines how the case studies, methods, and content of each chapter address the general aims of the thesis.

1.2 Case Studies

Since the 1990’s, Toronto and Chicago have embarked on significant green roof implementation strategies. Following German examples of successful municipal leadership that encouraged green roof development (Keeley 2004, Koehler and Keeley 2003 ) (I. Wieditz, personal communication, January 13th, 2005), in 2000 both cities planted green roofs on their city halls (City of Toronto 2009c, City of Chicago: Mayor's Office 2006). Both cities have subsequently adopted policies and programs aimed at increasing green roof coverage (City of Toronto 2009a, City of Toronto 2008b, City of Chicago 2006a, City of Toronto 2011); by the end of 2011, their efforts have put them at the forefront of green roof implementation in North America. The City of Chicago
currently has over seven million square feet of green roofs built or planned as part of its efforts to become a US leader in the green city movement, with almost 534,507 square feet (49,657m²) installed in 2008 and more than 500,000 (49,657m²) in 2010 (Green Roofs for Healthy Cities 2009, Green Roofs for Healthy Cities 2011). This makes it the North American leader in green roof implementation for the seventh year in a row. This is all the more surprising given Chicago’s historical reputation as a gritty industrial town.

By contrast, Toronto, which has traditionally been known as a more environmentally-minded city, by 2010 had approximately 205 green roofs built or planned, equal to approximately 36,517 m² (119,775 ft²) (City of Toronto 2011). However, Toronto has also become the first North American city to pass legislation mandating green roofs for certain developments (City of Toronto 2009a, City of Toronto 2008b) and might soon catch up. Both the Toronto and Chicago face similar urban environmental problems such as poor air quality, and share similar geographies, climates, and population size\(^1\) (Gorrie 2007, City of Toronto 2007e, Rothblatt 1994, Wente 2007). This makes a comparative case study of the two cities particularly compelling. Furthermore, as green roofs are relatively new in North America, it is important to understand both the policies used to promote them as a means of dealing with environmental problems, as well as how office workers perceive and value them.

\(^1\) The central city population of Chicago is 2.8 million (US Census 2005), 9.4 million for the greater metropolitan area (Testa 2007), while the central city population of Toronto is 2.5 million and 8 million for the metropolitan region (golden horseshoe) (Neptis Foundation 2009).
1.3. Relevance of research to current debates on nature, health/well-being, and the workplace

This research is builds upon five broad themes within the literature: (1) the increasing importance of urban greening projects within the sustainable cities movement; (2) the recognition of the influence of place on health/wellbeing; (3) the broad body of literature linking contact with nature to health and wellbeing; (4) work from social constructionists on nature that argues that our understanding of ‘nature’ is mediated by historically specific cultural, social and economic factors; and (5), identification of the physical workplace as influential to worker health/wellbeing and productivity. Each theme, and its importance for this thesis, is outlined below.

Green roofs are an interesting and important link between these five areas, in that they are becoming an increasingly popular element of urban greening programs, and are often implemented on or near office buildings. They are therefore becoming part of the “place” of the workplace, blurring the boundaries between ‘nature’ and urban built form and challenging the traditional Anglo-American separation of ‘nature’ and the city. They do not have the traditional symbolism of trees or mountains, and so provide an opportunity to explore the assumptions, values, and symbols that characterize urban nature and inform current urban greening debates. Green roofs also provide an interesting and untested case study to look at the relationship between nature and health/well-being. Though not stated explicitly, the popular conception that people like and feel good around nature has been used to entice companies to include green roofs as part of their building design. However, there is very little research on perceptions of green roofs or their benefits to human health. This thesis builds on a small but growing body of research on people’s perceptions and attitudes towards green roofs, which has been done on people’s attitudes to green roofs (Lee and Koshimiz 2004), the possible restorative benefits of green roofs (White 2008), and suburban residents’ and landscape architects’ knowledge about the ecological benefits of green roofs (Kuper 2009, Calkins 2005, Smith and Boyer 2007). The only
study to use actual (versus photo elicitations of) green roofs looked at urban residents’ perceptions about accessible green roofs (Yuen and Hien 2005). No studies have looked at the workplace, addressed overall health and well-being measures, or done a more intensive qualitative analysis of the values and meanings urbanites have about green roofs. This research thus addresses gaps in current green roof research and links them to emerging issues in sustainable city, workplace, and health and nature research.

This thesis contributes to current research being carried out in health geography, environmental psychology, and health and workplace studies on the relationship between health and place. Research in health geography has seen a shift from a focus on risks to health from the environment to the examination of places that promote overall health and wellbeing (Gesler 2005, Kearns and Moon 2002, Frumkin 2001, Frumkin 2003, Jones and Moon 1987). This is consistent with a more holistic understanding of health as wellbeing (WHO 1985) that includes social, physical, and mental factors, many of which are related to place. This understanding that “place matters” (Kearns and Moon 2002) in health geography has enabled place, and the meanings we attach to it, to be seen as an important factor in researching health (Conradson 2005, Wakefield and McMullan 2005, Frumkin 2001).

In addition to research on health and place, numerous studies in environmental psychology on the relationship between nature and health/wellbeing have tested the popular conception that people like and feel good around nature (Kaplan and Kaplan 1989b, Hartig, Mang and Evans 1991, Ulrich 1984). This position has been challenged by many social scientists, who argue that ‘nature’ is socially mediated, constructed, and produced (Demeritt 1998). If our perception of nature is deeply mediated through culture (Smith 1996, Castree 2000), this calls into question Anglo-American claims about the innate benefits of contact with nature, and perhaps even our understanding of nature itself. While these studies in environmental psychology have been influential in supporting urban greening policies and in furthering our understanding of the human relationship to nature, they have generally left assumptions about nature unpacked. The
ambiguity over our valuation of urban nature is not merely academic – conflicting perceptions of nature have led to serious debate over urban greening projects in both Chicago and Toronto. Knowing how green roofs are perceived will help to reduce their potential for failure due to a lack of public support from conflicting valuations about nature in the city (Burgess, Harrison and Limb 1988). This is particularly important for Chicago and Toronto as both cities are implementing urban greening policies and providing leadership on new ways to approach urban environmental dilemmas. This knowledge is critical as cities are increasingly trying to find a balance between urban growth and greenspace preservation. Examining green roofs as potentially therapeutic, but also critically examining the values, associations, and symbolism around them thus helps to unpack some of the assumptions about ‘nature’ in the Anglo-American tradition while testing environmental psychology theories in a new context.

Finally, there is a renewed interest in environmental factors that affect health/well-being and productivity in the workplace (Romm 1999b, Building Design & Construction 2003, Leather et al. 1998). A small but growing literature looks at the impact of views of nature or plants in the workplace on office worker health, well-being, and productivity. These studies have found that views of nature or plants in the office improve office worker well-being (Kaplan 1993), and are preferred work environments (Dravigne et al. 2008, Kaplan 2007). Views of nature and plants have also been linked to better health (Fjeld et al. 1998) and less fatigue in academic environments (Khan et al. 2005). Most of the plant studies have looked at improvements in productivity and attention, or concentration (Larsen et al. 1998, Lohr, Pearson-Mims and Goodwin 1996, Shibata and Suzuki 2002, Raanaas et al. 2011). All of the studies using concentration or productivity measures used an experimental design, while the few studies using real-world office environments looked at aesthetics, comfort, and attitudes towards views of nature (Aries, Veitch and Newsham 2010, Kaplan 2007). This thesis is the first study to combine real-world world office environments with specific health/well-being and concentration measures on views of and physical access to green roofs.
The examination of green roofs as potentially therapeutic thus contributes to a multidisciplinary body of work that is looking at the role place, and nature within it, plays in perceptions of health/wellbeing. This thesis addresses repeated calls for further empirical study that will specify the role of place (Macintyre et al. 2002, Frumkin 2003), nature (Morris 2003, Taylor, Kuo and Sullivan 2001, Conradson 2005), everyday landscapes (Kearns and Moon 2002) and the health promoting aspects of the physical workplace (Danna and Griffin 1999a, Building Design & Construction 2003, Romm 1999a). This thesis also addresses a gap in the green roof literature, exploring the potential health effects of green roofs and applying them to the workplace, neither of which have been done before.

1.4 Methods

This thesis uses a mixed methods approach to address current gaps and tensions in research relevant to this project: the complexity of meanings around nature and place; the newness of green roofs; the lack of any research on office workers perceptions of and awareness around them; and the dominance of quantitative approaches in research on nature and health/well-being. In addition to being a means to ensure credibility through triangulation (Valentine 2001, Baxter and Eyles 1997), mixed methods allow for a more exploratory analysis as well as policy-relevant generalizations by testing the themes found through qualitative methods in a larger population (Barnes 2009). A mixed method addresses some of the current gaps in research on nature, health, and green roofs outlined above in the following ways.

First, the use of semi-structured interviews and a phenomenological analysis allows for a more nuanced exploration of the thoughts and feelings underlying individuals’ perceptions of nature and green roofs and their daily lived experience of place. This is useful when examining things that are taken for granted, such as our relationship to place (Relph 1976), the benefits of nature to
our wellbeing, or the concepts and categories about nature that are taken for granted in the Anglo-American context. Second, asking the same questions in a large survey to the same population allows for both triangulation and the testing of the generalizability of themes and concepts that came up in the interviews in a larger population. Specifically, using both qualitative and quantitative methods can allow for both the “...power of the general with the insight and nuance of the particular” to provide a larger context for the stories revealed in the qualitative interviews (McLafferty 1995 cited in (Philip 1998). Quantitative statistical techniques such as Chi-Square analysis and logistic regression allow for results to be tested and presented in ways that are both comparable to most of the current research on nature and health/well-being, as well as being more relevant for policy, which still tends towards a preference of quantitative data (Philip 1998). Lastly, the use of a comparative analysis, both of office workers in two different cities and countries, as well as green roof policies, allows for further triangulation as well as providing the social and political context for the thesis.

1.5. Thesis structure and contributions

The main body of this thesis is a compilation of five papers that broadly examine the relationship between place and health/well-being, specifically looking at the contribution of green roofs to improved wellbeing in the workplace. Each of the five papers addresses gaps in the literature, namely the tension between different research traditions on nature, health/well-being, and place; the lack of qualitative research on green roofs, specifically research that addresses larger health/well-being benefits; the context of the workplace; real green roofs versus simulations; and the lack of comparative policy analysis on green roofs. Chapters 2 and 3 provide the theoretical and political context of the research, while Chapters 4, 5, and 6 examine the results from the fieldwork.
Chapter 2, ‘nature’, Health, and Well-Being: A Review of Different Approaches, Tension, and Convergences, addresses the tensions and conflicts in both our academic understanding of ‘nature’ and health/well-being, as well as how these influence conflicts on the ground in the implementation of urban greening projects such as green roofs. It does this by reviewing the paradigms and worldviews underlying the following influential research programs on nature and health/well-being: two influential research programs in environmental psychology, and work in social constructionism. Each research program is reviewed on its approach to a) what ‘nature’ is and our relationship to it, and b), how it affects our health/well-being. In pointing out some of the tensions between psychometric and social constructionist approaches to nature and health/well-being, this paper contributes to bridging the gap between different theoretical and epistemological research methods in understanding nature and health/well-being that can complicate research. It also clarifies some of the limitations of combining paradigmatically opposed methods in research on nature and health/well-being, and discusses opportunities for promising new directions. This chapter provides the theoretical foundation for the rest of the thesis.

The third chapter, “Making ‘Green’ Happen: Evaluating Two Cities’ Approaches to Green Roof Implementation in North America,” addresses the political and social context of green roofs in Toronto and Chicago. In particular, this chapter examines and compares each city’s green roof policies, factors influencing their relative levels of success, and their chances of continued success. As there is currently no comparative study on municipal green roof policies, this chapter contributes to urban greening policy and provides a framework for the evaluation of new urban greening programs. In examining both the policies and the politics behind their implementation, Chapter 3 uses the social constructionist perspective discussed in Chapter 2 to understand how policies are made, as well as giving context for participants’ perceptions, knowledge of, and attitudes towards green roofs.
Chapter 4, “There’s a meadow outside my workplace: A Phenomenological Exploration of Place, Green Roofs, and Aesthetics in Chicago and Toronto,” addresses research from Chapter 2, namely social constructionist perspectives, environmental psychology, and sense of place that are relevant to understanding green roofs and health/well-being. The tension discussed in Chapter 2 between urban ‘nature’ and ‘wilderness’ can be seen in the growing trend to mimic the native habitat of a region in green roofs, thus juxtaposing prairie meadows and Oakland savannah with steel, glass, and concrete in central business districts. This challenges the values and associations around urban ‘nature’, such as traditionally-ambiguous responses to naturalized urban areas by residents (Spears 2005, Gobster 2000) and long-standing debates over what counts as ‘nature’ in the city, and where (Hough 2004b). Through a phenomenological analysis of fifty-five semi-structured interviews, this chapter asks a) what do participants think and feel about green roofs? and b), what can we learn about the human relationship with nature, especially as mediated by the city, through their responses? Specifically, this chapter examines the values, expectations, and assumptions underlying preferences and contradictory viewpoints expressed by participants about green roofs and ‘nature’ in the city. As there is little qualitative data using real world green roofs (rather than visualizations or proxies), this chapter contributes to our understanding how we value and think about urban nature and green roofs, and can be used by policy makers to inform green roof policies. This chapter also contributes to our understanding of how nature affects our daily-lived experience of place in cities as well as providing valuable empirical data on perceptions of real green roofs.

Chapter 5, “Green roofs and health/well-being: Exploring the Connection in Toronto and Chicago Workplaces,” tests whether the themes that arose from Chapter 4 were also present in a larger population. Using descriptive statistics and chi-square analysis, this chapter draws on a large survey conducted in Chicago and Toronto (n = 903) to explore office worker perceptions of, awareness of, and access to green roofs and how it influences their health/well-being. Specifically, this chapter examines general awareness about and perceptions of green roofs, as well as three outcome variables: general health status, general stress status, and ability to concentrate. As there is no research on what office workers think and feel about green roofs, or
the influence they may have on health/well-being, this chapter contributes much-needed empirical data that is both at a large scale and provides comparisons between two cities on the social and psychological aspects of green roofs.

Chapter 6, “Visual Access to a Green Roof and Office Worker Concentration,” tests whether one of the main relationships found in Chapter 5, that visual access to a green roof improved office worker concentration, was still significant when other possible confounding variables were taken into account. Using the same sample described in Chapter 5, a logistic regression model was used (the logistic regression subset was n = 505). Predictors covering socio-demographic variables, environmental attitudes and evaluation, physical and psychosocial workplace characteristics, and mental health were added to the model to test whether the positive relationship between the visual access to green roofs and improved concentration, the outcome variable, still held true. As this research is exploratory, a backward stepwise regression was used. In using quantitative methodology to test the themes and associations that came up in the interviews, this chapter triangulates the qualitative findings from Chapter 4. It also responds directly to most research on nature and health/well-being and makes the results more transferable and replicable for urban policy developers, researchers, and the green building industry. As there is no current research on green roofs and the workplace, and little on the factors that promote health/well-being versus reducing risks to health, this chapter contributes to the healthy workplace, green building, and health and nature literatures.

The concluding chapter, Chapter 7, offers a concise summary of the five chapters, a discussion of the conclusions of the thesis as a whole, a critical comment on the challenges of working with this data, several options for expanding this research, and directions for future research.
1.6. Summary

Green roofs offer possibilities for addressing the urban ecological challenges resulting from climate change and a tradition of working against natural ecosystems. In addition to their ecological benefits, green roofs are assumed to have similar health/well-being benefits as other types of urban greening. However, this is little evidence for these claims, and scant qualitative or quantitative research on the health/well-being benefits of green roofs to those who look out over them. There is also no research on green roofs and the workplace, despite the fact that most green roofs are built downtown and overlooked by thousands of office workers. Researching the potential health/well-being benefits of green roofs is complicated by the fact that the human relationship to nature is complex and carries many underlying assumptions and values behind aesthetic preferences and attitudes. By combining built form and greenery, green roofs challenge Anglo-American values and assumptions about nature and the city that have traditionally separated both and specified what kind of ‘nature’ belongs where, and are thus an interesting case study through which to explore the human relationship to nature.

The thesis begins to address these gaps by using a mixed methods approach to exploring and testing office workers’ awareness, attitudes and feelings about green roofs in Toronto and Chicago. By using qualitative methods this thesis addresses the social construction of nature criticisms about the complexity of ‘nature’ while contributing to our understanding of office workers’ lived experiences of place in downtown central business districts. It also provides valuable empirical data on office workers’ perceptions of and values around green roofs. By using quantitative methods this thesis tests the findings from the interviews in a larger population, triangulates the results, and provides much-needed empirical data for both policy makers and researchers examining the nature and health/well-being. Lastly, this thesis provides valuable comparative policy analysis of municipal green roof programs in North America that can be used as a tool for other cities considering implementing urban greening programs.
CHAPTER 2

2  Nature and Health/Well-Being: A Review of Different Approaches, Tensions, and Convergences

2.1  Introduction

There has been recent interest in the intersection of cities and nature, particularly as municipalities implement urban sustainability strategies. Many municipal policies now aim to increase urban vegetation to deal with urban environmental problems, including climate change, habitat loss, and storm-water management (Wilmeth 2008, City of Toronto 2007a). Yet despite assumptions that nature - often called the natural environment - is a positive influence on people’s health and well-being, many public projects have been fraught with disagreements over the value of nature, and the role of humans in relationship to it. Which sort of ‘nature’ counts as good, and which ‘nature’ is seen as dirty or unsanitary? Are new storm-water management ponds, wetlands that are good or swamps that are bad? Are naturalized lawns models of ecological responsibility, or weedy eyesores (Spears 2005)? Heated disputes erupted in Chicago, for example, over plans to restore oakland savannah which called for the destruction of existing trees (Throop 2000, Gobster 2000). While conflicts over nature in cities are particularly visible due to current urban environmental pressures, they in fact reflect much larger tensions about our understanding and valuation of nature generally and its relationship to our health/well-being (Hough 2004a, Gobster 1999).

These tensions are reflected in the extensive, and often conflicting, research on the human relationship with nature and nature’s potential influence on our health/well-being. This is partly
due to the fact that like place, ‘nature’ is a domain of research informed by multiple research traditions. The human relationship to nature has been studied, among others, by environmental psychologists (Dravigne et al. 2008, Hug et al. 2009), social scientists using a social constructionist paradigm (Prudham 2005, Castree and Braun 1998), phenomenologists (Stefanovic 1996, Schroeder 2007), psychologists interested in human behaviour and motivation (Stern 2000, Perrin and Benassi 2009, Vining et al. 2002), and health geographers (Pinder et al. 2009, Dennis et al. 2009). Researchers within these traditions have different, and often conflicting, paradigms and worldviews. Even when there has been movement towards incorporating other viewpoints, for example by bringing place-based understandings of nature into psychometric research\(^2\) (Kyle, Mowen and Tarrant 2004, Scannell and Gifford 2010), the vastly different paradigms and worldviews underlying each approach can mean an uneasy integration. As noted by Patterson and Williams in their discussion on place research, different underlying philosophical commitments can lead not only to different paradigms which then inform research programs, but to incompatible methodological objectives and meanings of the same terms (Patterson and Williams 2005). This makes it difficult to compare different research programs that study nature and well-being from a disciplinary or research methods perspective without examining the underlying values and assumptions of each approach.

Understanding these tensions in research on nature and health/well-being thus requires an understanding of the paradigms and world-views that inform their research programs. This paper addresses this gap by examining the three world-views and paradigms that underlie major research programs that explore nature and its relationship to health: *Attention Restoration Theory*

\(^2\) Here I am following Patterson and Williams’ (2005) distinction between psychometrics and positivism. While positivism has more often been used to describe research paradigms in environmental psychology, for example, versus phenomenological or social construction of ‘nature’ research paradigms, due to the influence of post-positivist philosophies on quantitative techniques, and the wide variety of methodology in areas such as environmental psychology, it is too broad and inadequate to describe the quantitative approaches that form the backbone of research commonly found, for example, in environmental psychology. Psychometrics - or the theory and technique of the measurement of attitudes, beliefs and personality traits - is more precise and refers to the methods and beliefs underlying the majority of quantitative research approaches.

These research programs come from disciplines ranging from geography to history to environmental psychology. While by no means exhaustive, these three research programs were chosen based on their level of influence within their discipline on shaping the current debate on nature and health/well-being research. Using Patterson and Williams’ macrostructure framework for epistemological traditions, which organizes different research approaches in relation to their research programs, paradigms, and worldviews (2005), this paper explores a) how each research program understands what ‘nature’ is and how we know it, and b), how ‘nature’ is understood to affect our health, if at all. Placing each research program within a paradigmatic framework also contextualizes the critiques of each research program, as these often stem from paradigmatic differences in approaches to research and knowledge. I argue that only with a clear understanding of the underlying assumptions and values behind the major research programs is it then possible to evaluate where each research program is addressing these critiques, where the differences are simply irreconcilable (and perhaps rightly so), and where there is possibility for productive learning from other paradigms. I use urban greening as a case study throughout as an example of how each approach has real-world implications. I conclude with a discussion about developments in the environmental psychology, social construction of ‘nature’, health and place research that offer promise for bridging the gaps in nature, health/well-being research.

2.2. Research programs, paradigms, and world-views

The following section outlines the ways in which research programs, paradigms, and worldviews will be explored in this paper. Following Patterson and Williams (2005), research programs are where theoretical concepts are developed and empirically tested and tend to follow disciplinary foundations, such as geography or environmental psychology. Different research programs within a discipline tend to congregate in different conceptual schools of thought. Informing
research programs are paradigms, which are comprised of normative philosophical beliefs. These guide the development and establishment of theories and contain normative assumptions about the nature of reality (ontology), the nature and process of knowing (epistemology), and the goals of science (axiology). Paradigms also do not necessarily align with disciplinary boundaries. Lastly, worldviews inform paradigms, and include larger debates around what validity means and how to ensure it, and the character of the relationship between theoretical concepts and empirical testing (Patterson and Williams 2005: 363). This framework will be used to explore the three research traditions outlined above and their approach to nature, health, and well-being (see Table 2.1).

2.3. Psychometric paradigms and nature: nature is out there, we just need to measure it properly

Research in environmental psychology has provided the most comprehensive empirical research to date on human relationships with nature, substantiating a widespread Anglo-American belief that people like and feel better around nature across a wide variety of settings. It is also perhaps one of the most diverse sub-disciplines, sometimes characterized more by its diversity of approaches, conceptual frameworks, and methods than by any single approach, a diversity which has been both criticized and praised as a strength (Giuliani and Scopelliti 2009, Gunther 2009, Gifford 2009). Despite this diversity, two of the most enduring research programs on the human relationship to nature, Stephen and Rachel Kaplan’s Attention Restoration Theory (Kaplan 1995, Kaplan and Kaplan 1989b), and in a similar vein, Roger Ulrich’s Psychophysiological Stress Reduction framework (Ulrich 1993, Ulrich et al. 1991) (see Table 2.1), have been remarkably consistent in their approach over the last thirty years. Their theories have been enormously influential in shaping research on nature in environmental psychology (Pals et al. 2009, Herzog et al. 2003), and have had considerable influence outside of the academy – results from these
research programs are often used as justification for urban greening projects, even when over thirty years old (City of Toronto 2004a).

2.3.1. The Psychometric Paradigm

The Attention Restoration Theory and Psychophysiological Stress Reduction research programs, like many psychology research programs studying human behaviour, values, and attitudes, are based in a psychometric paradigm. The psychometric paradigm entails particular epistemological (beliefs about the nature, methods, and limits of knowledge), ontological (beliefs about the nature of reality and human experience), and axiological (ultimate goals) assumptions and values (see Table 2.1). For example, the psychometric paradigm holds that it is possible to study social and psychological concepts such as emotions, preferences, and behaviour, but that they need to be measured in such a way that the empirical observations can eventually be quantified (Patterson and Williams 2005). This focus on measurement as a way to know the world is aligned with the dominant epistemological models of behaviour in psychology that are generally linear, individualistic, and reductionist (Uzzell and Rathzel 2009). Quantifying empirical data allows for statistical analysis, which is itself based on larger normative, or ontological, beliefs around the nature of reality. For example, the ontology underlying statistics holds that with large enough random samples a normal distribution of data will emerge, and has a very specific epistemology about methods to ensure validity, reliability, and generalization (Field 2009). Indeed, while the Kaplans’ original formulation of their Attention Restoration Theory was based on participants’ more open-ended responses and was much more qualitative, it is still a linear information-attitude-behaviour model (Uzzell and Rathzel 2009). Also, subsequent testing of the role that nature plays in well-being within this program has generally been limited to well-established categories and constructs, which will be seen below.
### PARADIGMS

<table>
<thead>
<tr>
<th>Psychometric</th>
<th>Social Constructionist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single, stable reality can be known through multivariate testing of behaviour, Dominant models of behaviour are linear, individualistic, reductionist</td>
<td>Deconstruction to reveal multiple, non-dominant voices and perspectives and challenge impartial ‘truths’, exclusions, power dynamics that make knowledge possible</td>
</tr>
<tr>
<td>Telic (end-state): goal is to find essential aspects of human relationships to environment that are generalizable, behaviour as satisfying underlying needs/goals</td>
<td>No single reality; perception is dependent on shifting individual realities over time. Hard constructivists argue that there is no objective world that we can know; soft constructivists argue there is an objective world but our knowledge is partial and biased.</td>
</tr>
<tr>
<td>Theoretical concepts and definitions need to be precise enough to be quantified and replicated to understand stable reality</td>
<td>Challenge assumptions underlying Western knowledge, assumptions of Enlightenment subject. Destabilize concepts that seem self-evident.</td>
</tr>
</tbody>
</table>

### Epistemology

**Methods, limits of knowledge**

- Nature of Reality, human experience

**Axiology**

- Ultimate, instrumental goals

### Ontology

- **Psychometric**
  - Psychophysiological Stress Reduction Theory (Ulrich et al. 1991)
  - Attention Restoration Theory (Kaplan and Kaplan 1989b)

- **Social Constructionist**

### Disciplinary Foundation

- Human, Behavioural Geography, Architecture, Medicine
- Psychology, Environmental Psychology

### Conceptual Domain

**Normative Commitments, Theoretical Foundations**

- Adaptive biological perspective – evolutionary basis for psychophysiological reactions to environment
- Adaptive biological perspective – Evolutionary basis for environmental preferences, cognitive information processing

### Methodological Domain

- Mostly experimental design; physiological and psychological testing; some real world experiments
- Experimental and real-world studies; structured interviews, observation, surveys, productivity proxy tests

### Substantive Domain

**Things studied**

- Reduction of stress responses from exposure to ‘nature’ (real or proxy); ‘nature’ is stable concept
- Restoration of directed attentional fatigue from viewing or experiencing ‘nature’; linked to well-being

### Research Programs

- Psychophysiological Stress Reduction Theory (Ulrich et al. 1991)
- Attention Restoration Theory (Kaplan and Kaplan 1989b)

### Table 2.1: Framework for understanding the epistemological foundations of research programs of ‘nature’ (adapted from Patterson and Williams 2005).

- Traditionally not very influential outside of academia except in social justice work; could be useful to understand how capitalism shapes our valuation (or lack) of ‘nature’, conflicting values over urban greening.
The psychometric paradigm has implications for what kind of knowledge about the world is possible. Following the scientific method of classical empiricism, the Attention Restoration Theory and Psychophysiological Stress Reduction research programs generally follow an ontology that holds that there is a stable world “out there” that exists and can be known through systematic observation and testing (i.e. measurement) that enables the construction of sound theories. As the world is knowable and stable, categories, psychological tests, and statistical controls are commonly used in order to simplify the world into a closed system for study, developing empirically testable theories, and using a priori categories of ‘nature’ (Herzog, Chen and Primeau 2002). The ontology of the psychometric paradigm is telic, or goal-oriented, with the goal being to understand and generalize human relationships with nature and to find the essential, or foundational, aspects of these relationships that are constant. The axiology of the psychometric paradigm, and the research programs within it, is to develop theoretical concepts and definitions that are precise enough to be quantified and replicated in order to understand the nature of reality.

Within the Attention Restoration Theory and Psychophysiological Stress Reduction research programs there are also specific theoretical foundations and normative commitments that are specific to these research programs (see Table 2.1). Both are based on a biological model of behaviour that posits there is an evolutionary basis for the human relationship to nature. Specifically, this evolutionary hypothesis argues because humans evolved in natural environments, they developed preferences for landscapes that would ensure survival and were passed on to subsequent generations (Ulrich 1993, Kaplan and Kaplan 1989b, Herzog et al. 2002). Aesthetic preference for calm open bodies of water, tall mature trees, and grassland are all argued to have helped to ensure early humans’ survival (Ulrich 1986), or provide the necessary information needed to support humans to behave in ‘reasonable ways’- i.e. well-adjusted, competent, and self-supporting (Kaplan and Kaplan 2009). This is echoed in Wilson’s
Biophilia, in which he argues that humans have an innate love of nature from having been in close contact with it for 99% of their history (McVay 1993, Wilson 1993).

2.3.2. Approaches to nature in the Attention Restoration Theory and Psychophysiological Stress Reduction research programs

The paradigms and normative beliefs underlying these two research programs (and related studies on aesthetic preference) have had a significant impact on how nature is understood. ‘Nature’ here is seen as a relatively constant, stable entity that does not need explaining or deconstructing: it just is (Uzzell and Rathzel 2009). This is closely aligned with popular perceptions of nature as a given (Williams 1976) and mimics the great Anglo-American writers on nature, such as Thoreau, Muir, and Leopold, who assumed that what constitutes nature is self-evidently whatever is not human (Leopold 1971, Muir 1997, Thoreau 2004). An important variant of this idea is the depiction of wilderness as ‘pure’ or ‘strong’ nature against which all other forms of nature can be seen as a ‘weaker’, though still very important, version for human health/well-being (Kaplan and Kaplan 1989b, Kuo 2001). For instance, Kuo writes:

…the empirical literature suggests that the rejuvenating effect of ‘nature’ extends to far less “pure” forms of nature than wilderness and that it results in systematically greater effectiveness on a wide variety of tasks. Thus…the availability of even relatively weak forms of nature could enhance residents’ effectiveness in the tasks they face. (Kuo 2001)

Similar to work by early landscape architects such as Olmsted, much of the early work by the Kaplans and others tested this popular conception of nature in urban areas in order to argue that even ‘weak’ forms of nature, such as parks and street trees, could have benefits for human health
and well-being. Within a psychometric paradigm, these environments need to be quantified, and so an integral part of this testing involved distinguishing between ‘natural’ and ‘unnatural’ (often urban) environments in order to test for preferences and possible links to health/well-being. In practice this meant getting participants to rate different scenes of ‘nature’ according to their level of perceived ‘naturalness’. Philosophical beliefs about the stable and self-evident character of nature can be seen in the use of simple categories of preference, photographs as substitutes for the ‘real thing,’ and a multitude of experiences of different types of natural environments as equivalent.

For example, photographs of natural scenes are routinely used in empirical studies as surrogates for nature (Kaplan and Talbot 1988, Ulrich 1981, Yang 1995, Herzog et al. 2003). Nature can also be viewing trees through a window (Tennessen and Cimprich 1995, Kaplan 2001, Kaplan 1993), plants in the workplace (Lohr et al. 1996, Larsen et al. 1998, Shibata and Suzuki 2002, Bringslimark, Hartig and Patil 2009), actively experienced in gardening (Armstrong 2000, Cimprich 1993), taking walks through urban parks (Hull and Michael 1995, Herzog, Chen and Primeau 2002a, Korpela et al. 2009), and going on wilderness excursions (Hartig et al. 1991b, Kaplan 1984, Martens, Gutscher and Bauer 2011). This wide variety of what counts as ‘nature’ is seen as positive proof of the strength of the human-nature relationship: Kuo (Kuo 2001) has written that “The diversity of methodologies employed in these studies (on nature) makes the persistence of positive findings particularly compelling…(e.g., naturalness of setting, frequency of contact with nature, total time spent in nature)” The argument that even ‘weak’ forms of nature give health benefits supports the urban greening advocacy engaged in by many environmental psychologists (Kuo, Bacaicoa and Sullivan 1998, Kaplan 2001, Kaplan 1983).
2.3.3. Nature and health/Well-being in Attention Restoration Theory and Psychophysiological Stress Reduction research programs: nature reduces stress and mental fatigue

Researchers in environmental psychology are strong proponents of a positive link between contact with nature and enhanced wellbeing. Though there is some work that looks at negative reactions to natural environments (Bixler and Floyd 1997, Nasar and Fisher 1993), particularly with regards to safety, the vast majority of research focuses on finding proof for the *Attention restoration Theory* (Kaplan 1995, Kaplan and Kaplan 1989b), and *Psychophysiological Stress Reduction* theory (Ulrich 1986, Ulrich et al. 1991, Korpela and Ylen 2007).

*Attention restoration Theory* (ART) draws on William James’ (1892) theory of directed attention, which argues for the importance of sustained attention for adequate human functioning. Kaplan and Kaplan argue that daily living, particularly modern urban living, is fatiguing and distracting. This causes a depletion of directed attention (i.e. Directed Attention Fatigue), and a host of negative consequences, such as irritability, reduced sociability, poor judgment, heightened aggression and reduced coping skills (Kaplan 1995, Kaplan 1987, Kaplan 1983). They argue that in order to restore our ability to focus, we need something that will hold our attention involuntarily but also be relaxing. Nature, they argue, possesses the attributes necessary to hold our attention in this way, and thus helps to reduce attentional fatigue.

Environmental psychologists following the Kaplans’ research program have set out to prove the Kaplans’ theory by showing that people experience improved cognition when they are in contact with nature (Tennessen and Cimprich 1995, Hartig et al. 1991b, Herzog et al. 2002a, Hug et al.
2009). They have also suggested that the presence of nature mitigates against some of the negative side effects of Directed Attention Fatigue, such as increased aggression and lack of focus. For example, they have compiled evidence that those living in public housing apartments with more nature tend to socialize better (Coley, Kuo and Sullivan 1997, Kweon, Sullivan and Wiley 1998, Sullivan, Kuo and DePooter 2004b), be more involved with play (Taylor et al. 1998), have better attention spans (Taylor et al. 2001, Wells 2000), have reduced incidences of aggression and violence (Kuo and Sullivan 2001, Kuo et al. 1998) and better overall coping skills (Kuo 2001). In addition, environmental psychologists have suggested that contact with nature helps participants with both their overall life coping skills as well as recovery from illness in therapeutic settings, conducting research with hospital patients (Ulrich 1984, Verderber and Reuman 1987, Cimprich 1992, Cimprich 1993, Sherman et al. 2005), health care staff or caregivers (Ovitt 1996, Canin 1991), or in controlled settings, such as prisons (Moore 1981, West 1985). Many of the studies employ a combination of psychological and cognitive tests and closed questionnaires, with the goal being to narrow the constructs sufficiently in order to be able to conduct statistical analysis.

*Psychophysiological Stress Reduction* theory (Ulrich, 1986) differs from *Attention Restoration Theory* in that the focus is on the capacity of exposure to nature to reduce stress and induce a sense of wakeful rest, rather than the restoration of cognitive abilities (Ulrich 1981, Hartig et al. 1991, Korpela and Ylen 2007). Most of Ulrich’s and subsequent colleagues’ work involves subjecting participants to a stressful film in a laboratory setting, and then showing half of them scenes of nature, and the other half urban scenes. Psychological, affective, and physiological tests are applied before, during and after to measure the participant’s stress levels. A large part of the testing looks at emotional or affective responses, arguing that negative emotions such as fear and anger will be reduced after being exposed to nature. Ulrich (1986) further argues that human reaction to nature is an affective response involving the amygdala and hypcamus, both of which are also involved in fight-or-flight, immediate responses (Parsons 1991, Ulrich 1986).
The two research programs described above have involved extensive empirical testing and have provided a huge amount of data indicating that contact with nature has a positive impact on human health/well-being. Their generally psychometric approach to research transfers well to public policy arenas, given the emphasis placed on quantitative information and “hard science” in these venues (Stone 1988), as well as the need to justify public expense for urban greening programs.

2.4. Social Constructionism: nature is relational, shifting, and constructed

2.4.1 The Social Constructionist Paradigm

Researchers using a social constructionist paradigm to examine nature are diverse and vary considerably, particularly between ‘soft’ constructivism and ‘hard’ constructivism (Robbins 2004) (see Table 2.1). Their research programs have been used to deconstruct Anglo-American ideas about wilderness and nature (Tuan 1990, Merchant 1995) or to argue that nature is a commodity in capitalist production (Smith 1984, Castree 2000). Both ‘soft’ and ‘hard’ constructivist paradigms have been influenced by discourse analysis. Following the French linguists and the cultural turn in general (Braun 2008), discourse is seen as not only representing the world, but also creating it. This has meant that discourse analysis, whether through language, signs, or concepts, has been privileged as a means of deconstructing hidden power structures and dynamics that shape the world. Following this epistemological privileging of discourse and deconstruction, the methods predominantly employed by social constructionists seek to explore the symbols, politics, and personal narratives of a particular situation, theme, or event through in-depth interviews, textual analysis, and/or case studies (Katz 1998, Braun 1997). Social constructionist paradigms adhere to a general ontology that there is no essential, stable reality to be discovered through systematic observation, but rather that knowledge and identity are plural,
partial, contested, and shifting, depending on who is in power and who is positioned as the subject, or knower (see Table 2.1). For ‘hard’ constructivists the axiological aim of deconstruction is to reveal that the environment is an invention of our imagination, and it is “…social context alone that conditions and determines our concepts for understandings the world, and so creates the world” (Robbins 2004: 114). For ‘soft’ constructivists the axiological aim of deconstruction is to reveal how our concepts of reality are biased and incomplete. A real empirical world is held to exist independently of our categorizations, but is filtered through a subjective perspective, i.e. decisions and beliefs about scientific methods or theoretical concepts and models (Robbins 2004). Regardless of whether researchers fall into the ‘soft’ or ‘hard’ constructivism category, their main aim is to destabilize any understanding of ‘nature’ as an unmediated given that is not influenced by cultural, economic and gendered factors.

2.4.2. Social constructionist research programs on nature and wilderness

Social constructionists’ discussions of nature have been very influential in the social sciences, to the point where the term ‘nature’ is rarely used by, for example, geographers, due to the complexity of meanings associated with it (Braun 2005). Researchers using a social constructionist approach implicitly reject the view common in psychometric research that our perception of nature is innate and constant across time, groups, and types of natural environments. For social constructionists, accepting the world as it appears is to leave unpacked the power dynamics, exclusions, and contested meanings that are behind its creation. From this perspective, it is impossible to separate nature from our perception of it. This is the fundamental difference between this paradigm and the psychometric paradigm.
Though there is considerable variation among the types of approaches taken by social constructionists their common aim is the destabilization of ‘nature’ as a self-evident concept and thing. Research programs in social constructionism tend to arise from a historical materialist perspective, i.e. how our understanding of ‘nature’ has changed through shifting historical relationships, and is therefore intimately linked to specific human-nature relations (Loftus 2007). One of the most influential social constructionist research programs on nature looked at the concept of ‘nature’ itself, deconstructing our perceptions of what we understand by ‘nature’ by asking which ‘nature’ we are discussing and unveiling the complexities surrounding the use of the term (Williams 1976). This is particularly important as our understanding of it is hindered by its association with what has long been regarded as unmediated and given (Olwig 1995: 380), and with the fact that it refers simultaneously to both the physical world around us and our cultural and historically-mediated understanding of it (Williams 1976: 184). More specifically, researchers using the social constructionist paradigm have stressed distinctions between wilderness and nature (Cronon 1995, Merchant 1995, Demeritt 1998, Williams 1976). That wilderness is a subject of cultural values has been made clear through deconstructions of its changing historical valuation (Tuan 1990, Nash 1982). For example, the way early European settlers perceived wilderness, which was often as a fearful ‘other’ to be battled (Nash 1982), contrasts sharply with current Anglo-American ideals of wilderness that is equated with leisure (White 1995, Duncan and Duncan 2001) and spiritual purity (Proctor 1995).

This is particularly relevant when public policy discussions are made about what counts as ‘nature’ and which parts of it should be saved, an increasingly pressing issue given the rate of urban expansion and discussions about how to ‘bring nature back’ into cities. It has also been instrumental in the critique, at least in academic circles, of the devaluation of urban nature versus sacred, untouched wilderness (Cronon 1995). For example, do street trees count as ‘nature?’ The complexity of our understanding of what counts as ‘nature’ can be seen in ecological restoration debates that raised the issue of which ‘nature’ to restore - the pre-European or pre-human forest (Gobster 2000, Elliot 2000). This debate has also highlighted how certain types of nature are viewed as appropriate only in certain places. For example, ‘wild’ nature, valued as a
refuge far from the city, has often been seen as dirty, unsanitary, and a symbol of neglect when it occurs in a city (Hough 2004b, Kaika 2006, Marvin and Medd 2006). This helps to explain much of the controversy over naturalized restoration programs in cities.

Researchers using a social constructionist paradigm also often examine the political, social and cultural problems that have arisen because of the ideology surrounding wilderness (Katz 1998, Braun 1997), critically asking who positions themselves as the managers or protectors of wilderness and the resources drawn from it, and who is excluded (Duncan and Duncan 2001). Central to this research program is the questioning of assumptions that separate humans from nature. Though mainly about the idealization of wilderness, this separation has also meant that nature in cities is seen as having less value than nature outside cities (Proctor 1995).

The second main research program for social constructionists is to look at the production of nature, examining how it is transformed and turned into a commodity under the processes of capitalist production (Smith 1984). It is argued that these processes give a false sense of separation from nature for workers, consumers, and urban dwellers (Talbot 1998), and lead to the reification of our relationship to nature (Talbot 1998, Williams 1973, Smith 1996). Reified nature is then used to sell goods by giving consumers the false impression that they are linked to a universal, unifying nature yet simultaneously separating them from it. Nature under a capitalist system thus becomes a resource for economic gain and is dominated by the values and language of capitalism (Keil and Graham 1998, Smith 1996, Braun 1997, Katz 1998). This domination of nature and our perception of it by capitalist modes of production form the basis of many aspects of this research program. At its most extreme researchers using this version of the social constructionist paradigm have taken a ‘hard’ constructivist approach, arguing that nature is actually something physically produced, as, for example, in the biotechnology industries (Katz 1998, Castree 2000).
2.4.3. Nature and health/well-being from a social constructionist perspective: Health for whom? Which nature?

Research programs using a social constructionist paradigm to understand nature traditionally have not explicitly considered the relationships between nature and health/well-being; these researchers have been far more interested in the deconstruction of our attitudes and perception of nature, particularly the Anglo-American narrative of wilderness (Cronon 1995, Katz 1998, Olwig 1995) or how nature is transformed under capitalist and neoliberal relationships (Prudham 2004). Nevertheless, these research programs do offer insights into the role of nature in fostering well-being.

Part of the Anglo-American narrative associates nature, and in particular, wilderness, with the spiritual and mental rejuvenation that directly benefits well-being and was extolled by Wordsworth, Thoreau, Emerson and others. This positive view is counteracted in the writing of some social constructionists who have emphasized that nature can also be threatening, a dangerous wasteland, or a place of exclusion (Tuan 1990, Merchant 1995, Nash 1982, Duncan and Duncan 2001). The idea that the preservation of wilderness is beneficial to all has been questioned in studies that note the exclusion of marginalized, and often non-Anglo-American, peoples from discussions about the use and rights to nature, particularly wilderness reserves (Katz 1998, Braun 1997, Guha 1989). If there is a benefit to contact with nature, it is viewed critically as limited to recreational use by a few wilderness explorers reliving the colonial dream of western expansion (Olwig 1995, Merchant 1995). This leads social constructionists to view claims about the innate benefits to people’s well-being from contact with nature with caution, even though many of the authors are self-proclaimed environmentalists (Cronon 1995, White 1995). This caution is sometimes well-founded, as narratives of wilderness preservation have
also been shown to hide class-based campaigns of exclusion (Duncan and Duncan 2001). Furthermore, from a social constructionist perspective, claims about the benefits of nature must be understood as mediated through culture, so it is impossible to know whether it is nature per se or our cultural understandings of it that are creating feelings of well-being. As such, the affective responses to nature identified by environmental psychologists are often regarded as little more than romantic indulgences that mask power dynamics and exclusion. Lastly, social constructionists warn that there is a risk of delving into essentialist positions, such as linking ‘traditional’ native groups with nature (Braun 1997), women with wilderness that needs to be tamed (Merchant 1995), or equating women with nature more generally - as has been done in ecofeminism - and thus best suited to primary, dirty, unpaid labour (Loftus 2007, New 1997).

2.5. Criticisms of psychometric and social construction research programs

As seen above, the main criticisms of the Attention Restoration Theory and Psychophysiological Stress Reduction research programs stem from researchers following a social constructionist paradigm, who contest the claim that there are innate human reactions to a stable, universal nature. These two research programs in environmental psychology have been unable to offer much explanation so far for the conflicts surrounding different conceptions of nature, conceptions that are influenced by underlying assumptions about which ‘nature’ is valuable and good for our health, and where this ‘nature’ should be. This has been particularly apparent in questions about what constitutes nature in cities. As has been seen both in the work of social constructionists and in conflicts over urban greening projects, what equals ‘nature’ can be simultaneously both self-evident and obscure; what is self-evident to one group may be rejected by another. For example, while grassland savannah is posited by environmental psychologists as an innate preference in most cultures, work in political ecology on the lawn, the ubiquitous ‘nature’ in cities, has shown the complex cultural, political, and economic forces that have
influenced its popularity in North America (Robbins and Sharp 2003, Fraser and Kenney 2000). This example highlights the need for a careful re-evaluation of some of these categories and assumptions. Similar arguments can be made for the need to examine larger socio-economic factors underlying the cultural preferences of different ethnic groups that are outlined by environmental psychologists (Kaplan and Herbert 1987, Kaplan and Talbot 1988, Parker and McDonough 1999).

Furthermore, important place-based and relational work on cultural, gendered and economic influences that have been shown to also impact health/well-being and relationships to place may not be easily integrated into psychometric models (Wilson 2003, Kearns and Moon 2002). Further exploration is needed of the values, associations, and connections between people’s health and nature that are embedded in these categories.

The social constructionist perspective has also been subject to critique. Some scholars have argued that it undermines both wilderness preservation (Waller 1998, Katz 2000b) and urban greening projects (Gobster 2000). If there is no one nature, and nature can be reduced to our cultural interpretation, which ‘nature’ (if any) do we bother to save? The social constructionist position that there is no stable, common world to be understood has made it difficult to make policy recommendations. As a consequence, social constructionist research programs on nature have been criticized for not helping to resolve current dilemmas such as the value and role of urban nature for health and wellbeing (Gobster 2000). Secondly, the social constructionist perspective has been criticized for giving no agency or power of influence to nature itself (Castree 2000), leaving it solely an empty canvas upon which humans project our economic, social, and cultural desires. This potentially ignores the power nature has to influence human society, perception, and economic activity (Prudham 2005), and has ethical implications for our interactions with the non-human (Whatmore 2002).
In addition to these criticisms, the social constructionist tendency to privilege representation (and its deconstruction) as the primary means through which nature is understood, as well as the continued domination of a political ecology framework, has two major implications for how social constructionists approach knowledge on nature and health/well-being. First, the focus in political ecology on power relations and nature under a capitalist system has meant that affective responses to nature are generally viewed with suspicion. This is partly due to the continued association of emotion with subjective, individualized experience that is separated from larger socio-economic and cultural forces. It is also likely due to the reluctance of even feminist scholars to work on emotion for fear of being marginalized (Bondi 2005). Thus, though there has been excellent work deconstructing masculine and feminine assumptions and associations with ‘nature’ (Merchant 1995), social constructionists have often privileged rational, intellectual experiences of nature over more relational, emotional, and affective experiences, a masculinist perspective that persists in academia and which feminist academics have worked hard to break down (Rose 1993, Bondi 2005, Massey 1994, Whatmore 2002). This means that though most of the evidence emerging from environmental psychology and place-based research points to affective responses as key to understanding the relationship between nature and health, social constructionist research programs are generally ignoring this aspect of the human relationship to nature.

Second, the privileging of educated, deconstructionist interpretations of nature has sometimes also created a professional versus layperson disagreement about what ‘nature’ means. The fallout of this privileging of educated perspectives was seen clearly in the ecological restoration debates in Chicago, in which well-meaning academics dismissed popular resistance to ecological restoration as ignorant and uneducated (Gobster 2000). Conversely, urban greening practices in poor neighbourhoods have been criticized as window-dressing, or as neo-liberal attempts to claim poor areas for the rich through beautification (Zimmerman 2007, Kamin 2007). While there is some truth in these critiques, a disturbing undercurrent is the implication that poor people have no real interest in and derive no benefit from proximity to nature (Kellert 1993b). This contrasts with environmental psychology research that suggests many positive benefits from

2.6. Responses to criticisms of the psychometric and social constructionist paradigms

How have researchers from the research programs reviewed above responded to these critiques? What are some of the new directions that may offer opportunities for addressing these gaps and limitations? The following section outlines the ways in which some environmental psychologists and social constructionists have begun to acknowledge critiques from other research programs, and in some cases, have begun to challenge some of epistemological traditions of their own programs. In reviewing these new directions it is important to distinguish where integration may be possible, and where it may not be possible, or even desirable, due to the fundamentally different paradigms underlying these research programs.

2.6.1. Responses from environmental psychologists

Some environmental psychologists who have been involved in the Attention restoration Theory and Psychophysiological Stress Reduction research programs (Yang 1995, Parsons and Daniel 2002), have acknowledged criticisms of their approach, particularly from social scientists who have charged that aesthetic preferences are cultural constructions that often run counter to ecological values (Gobster 1999). The reaction to this criticism is two-pronged. First, researchers have attempted to test the theories of environmental psychology with different ethnic, social, and economic groups (Kaplan and Herbert 1987, Tips and Savasdisara 1986, Yang 1995). On the basis of this and other research in cognitive science it has been argued that “...scenic
aesthetic preferences are neither superficial nor highly malleable socio-cultural constructions” (Parsons and Daniel 2002). This supports the dominant view among environmental psychologists engaged in *Attention Restoration Theory*, and even more so, *Psychophysiological Stress Reduction* research programs, that differences in the perception of nature across individuals, groups or cultures are outweighed by the ‘consensus assumption’ that people in general overwhelmingly respond favourably to nature (Van den Berg, Vlek and Coeterier 1998).

Not all researchers looking at nature and health/well-being have insisted on a strongly psychometric approach. As mentioned above, though psychometrics is the *dominant* paradigm in the domain of research that looks at the human relationship to nature, environmental psychology has a multitude of research practices. For example, there has been some incorporation of more qualitative, exploratory research on nature and health that blends different paradigms and assumptions, (Hartig 1993, Bourassa 1990, Ozguner and Kendle 2004). There has also been promising work that has used qualitative methodology and exploratory methods to explore larger themes such as nature, fear of nature and children’s sense of place (Milligan and Bingley 2007, Lim and Barton 2010). Some authors have also looked at the role that job type (Van den Berg et al. 1998) and rural versus urban residency (Yu 1995) play in preferences for different types of landscapes, with findings that support a socially-mediated preference for different landscapes. More recently, some studies (Sullivan et al. 2004b, Kaplan and Kaplan 2005, Korpela and Ylen 2007) have used more qualitative research methods, such as participant observation, interviews, or open-ended responses, and in fact have even called for more qualitative research and interdisciplinary collaboration (Kaplan and Kaplan 2009). Lastly, some environmental psychologists have begun to develop a more nuanced concept of nature and have argued for the need for qualitative work to help fully explain attachment and responses to certain natural areas, for example in the special places research by Korpela and colleagues (Korpela et al. 2008a).
2.6.2. Responses from social constructionists

There has also been progress in addressing some of the criticisms of social constructionist research programs on nature. For example, it has been recognized that in the attempt to unpack the nature-society divide nature was collapsed into culture; much recent work in geography has been focused on trying to fill in and explore the qualities, power, and attributes of nature that challenge human practices (for an excellent overview of some of these developments see Braun (Braun 2008)). This work has generally focused either on a) the properties of nature that resist, or have power, against human actions, or b), challenging the prioritization of representation as a way of knowing and exploring other ways of understanding nature. In the first vein, work in political ecology is recognizing the physical presence of nature that resists economic production and influences social and economic activities (Prudham 2005, Castree 1995). Some of this research has focused on a political ecology framing of urban nature(s), particularly the hybrid ‘nature’, or ‘socio-nature’, created by the interaction between capitalism, nature, and human labour in cities (Heynen, Kaika and Syngedouw 2006). Capek in particular has challenged the positioning of nature as something which is acted upon, and offers a promising vision of urban greening that incorporates the power and properties of nature (Capek 2010). There has also been a discussion about the vigour and inventiveness of the natural world (Kearns 2003), and its resistance to description or mastery due to its ‘ontologically unstable’ character (Thrift 2005).

2.7. Opportunities for new directions and ways forward

What are the possibilities and limitations for moving forward with research on nature, health, and well-being? Researchers working in the Attention Restoration and Psychophysiological Stress Reduction research programs have contributed to understanding of how humans react to nature and how this influences health/well-being. They have also been very influential in urban greening policies, but have not necessarily been helpful in explaining conflicts over nature that
may arise from unexplored values and conflicting ideas underlying them. This gap stems directly out of the psychometric paradigm that takes ‘nature’ as a stable category. Researchers looking at nature from a social constructionist perspective have contributed to understanding how conceptions of nature are influenced by a host of cultural, social, and economic factors that change over time. These research programs have, however, tended to hollow out nature in favour of culture, have generally shied away from looking at emotional or affective connections, and have thus missed opportunities for exploring how nature might influence human health/well-being. As suggested above, researchers working in both the psychometric and social constructionist paradigms have begun to respond to these criticisms. While a full integration of the research programs described here is probably impossible given their fundamentally different paradigms, there are opportunities for each research program to explore and incorporate some of the directions in nature and health/well-being research from other disciplines. The following section explores the limitations of integration as well as some promising areas that may enrich the research programs discussed above.

First, the new emphasis within some psychometric research programs on interdisciplinary and qualitative work (Kaplan and Kaplan 2009) could be further expanded. The work of Korpela et al (Korpela et al. 2008b, Korpela et al. 2009) looking at the role special places play in environmental preferences is an example of productively drawing from other research traditions. Though still operating from a psychometric paradigm, which some would argue is inherently contradictory to more place-based paradigms (Patterson and Williams 2005), this strand of work incorporates some of the relational and complex bonds between humans and natural places. The recognition by some environmental psychologists of the western bias on psychometric approaches in environmental psychology that may limit valuable work and perspectives from other cultural traditions is also promising to flesh out some of the concepts and categories of these research paradigms (Gunther 2009).
Even with these new directions, the underlying normative philosophic commitments to a psychometric paradigm requires theoretical definitions and concepts which are (or can be developed) to be narrow and precise enough to be both quantified and replicated (Patterson and Williams 2005). This means that the most productive way forward within this paradigm may be to draw on some of the qualitative work by other research programs and then to try to develop measures to test them. This would begin to take into account some of the unexamined values and assumptions around nature, but would not fundamentally challenge the underpinnings of the psychometric paradigm.

For social constructionists looking at nature, the acknowledgement of the constitutive power of nature to also influence culture is promising, as is the examination of experiencing nature other than through representation. For example, the exploration of performative, narrative-based experiences of nature (Thrift 2005, Lorimer 2008) is a welcome addition to the body of research. More direct, open-ended questioning and exploration of associations, experiences, and feelings towards nature might further strengthen this type of research. This would allow a link to some promising work that has connected experiences of nature with childhood experiences, symbolic associations, and affective responses to beauty. Addressing these would add a richness and depth to social constructionist approaches to understanding nature in general, and in particular, to understanding the relationships between nature and health/well-being. It might also soften current dismissals of academic explorations of the spiritual and awe-inspiring associations that emerge from participant experiences with nature which are still often accused of romanticizing the relationship between humans and nature (Braun 2008).

Furthermore, there is interesting research on nature and health emerging out of other, less dominant research programs. For example, a wide variety of methods, including phenomenological methods, are being used to explore how the interactions between people and environments affect health (Eyles and Williams 2008). One research program that has focused specifically on nature as possibly influencing health/well-being, and which offers promise for
both social constructionists and environmental psychologists, is Gesler’s therapeutic landscapes (Gesler 1996). In this program natural landscapes are understood as imbued with meanings that can enhance health. Specific research has explored health and wilderness (Palka 2000), pastoral landscapes (Bell 1999), declining industrial cities (Wakefield and McMullan 2005), and gardening (Milligan, Gatrell and Bingley 2004). This research on therapeutic landscapes bridges many of the gaps between psychometric and social constructionist perspectives through its more nuanced and relational understanding of how peoples’ health relates to place. However, despite the focus on natural landscapes in the therapeutic landscape literature, nature is generally not studied in itself, though there are some exceptions see (Wilson 2003). Further attention to nature within this research program would be a positive development.

2.8. Conclusion

The Attention Restoration Theory, Psychophysiological Stress Reduction, and social constructionist research programs have contributed greatly to our understanding of nature and health. However, as we have seen, these programs are embedded in different paradigms, with differing ontologies, epistemologies, axiologies, and methodologies (see Table 2.1). Being explicit about these world-views and paradigmatic differences is essential for advancing knowledge the relationships between nature and health.

What this review suggests is that a particularly promising approach to research on nature and health/well-being would be the use of qualitative, open-ended methodologies as a complement to the category and concept testing approach favoured by environmental psychologists. This has the potential to bring out threads that link childhood experiences, cultural influences, and attitudes towards use and sociability in individuals’ experience of nature, and should help to develop a more nuanced, place-based, and complex understanding of nature and health/well-being. This should be especially valuable as more cities implement urban greening projects that move away
from manicured parks to ecologically beneficial but messy projects - such as putting plants on walls and rooftops - that challenge traditional ideas of what constitutes ‘nature’ and how it relates to urban health/well-being.
CHAPTER 3

3 Making ‘Green’ Happen: An Evaluation of Two Cities’ Approaches to Implementing Green Roof Policies in North America

3.1 Introduction

As seen in Chapter 2, theory can have a significant impact on practice at the municipal level and influence how urban greening projects are perceived, what research is used to justify them, and how successful they are. This chapter builds on the theory outlined in Chapter 2 and examines the political and social context of two cities’ urban greening programs, setting the stage for the examination of office workers’ perceptions of green roofs in Chapters 4, 5 and 6.

An increasing number of cities in North America are adopting “green city” initiatives. Frustrated by a lack of federal leadership on urban environmental issues, many are adopting environmental standards and initiatives on their own, for example through increasing adoption of green building standards such as LEED (Leadership in Energy and Environmental Design) and climate change initiatives (Mayors Climate Protection Center 2007).

This paper focuses on one element of the green city movement (Platt 2004, Hough 2004a, Lofvenhaft, Bjorn and Ihse 2002) as being pursued in two cities, Toronto and Chicago. In
particular, it focuses on the process of the development of green roof policy in these two cities between 1990 and 2011. The difficulty of adding greenspace to urban areas has increased interest in green roofs, as these place vegetation on unused rooftops. Green roofs are valued for their ecological benefits such as reduced stormwater overflow, reduction of the smog and the urban heat island effect, and habitat creation (Peck 2001, Hutchinson et al. 2003, Brenneisen 2003, Spala et al. 2008, Berndtsson, Bengtsson and Jinno 2009). They are also garnering attention in the popular media as an innovative response to environmental problems (Strueck 2007, Novitski 2008, Associated Press 2008, Evans and Brown-Bowers 2005). Cities play an important role in moving green roofs forward, and municipal leadership is often needed to stimulate the development of a local green roof market (Fisher et al. 1999, Carter and Fowler 2008). This is mainly due to the upfront cost of green roofs, which can be about twice as expensive as conventional roofs (Peck 2001), and which therefore initially often require some kind of financial incentive to offset the higher capital costs. Stimulating a successful green roof industry also requires industry and municipal staff training, as well as the alignment of the planning and building codes that can be obstacles to green roof implementation. How successfully green roofs are adopted can be indicative of a city’s overall ability to implement environmental initiatives, as their benefits cross departmental jurisdictions and thus require economic, socio-political, and ideological buy-in by different departments in the city. Green roofs are thus an interesting bellwether for urban environmental initiatives as they are the kind of creative solutions needed to solve many current urban environmental problems.

Since the 1990’s, Toronto and Chicago have embarked on significant green roof implementation strategies. Following German examples of successful municipal leadership that encouraged green roof development (Keeley 2004, Koehler and Keeley 2003 ) (I. Wieditz, personal communication, January 13th, 2005), in 2000 both cities planted green roofs on their city halls (City of Toronto 2009c, City of Chicago: Mayor's Office 2006). Both cities have subsequently adopted policies and programs aimed at increasing green roof coverage (City of Toronto 2009a, City of Toronto 2008b, City of Chicago 2006a, City of Toronto 2011); by the end of 2009, their efforts had put them at the forefront of green roof implementation in North America. By 2010
Chicago had been much more successful, being classed a “runaway first among North American Cities of the Future” (Gorrie 2007). As of 2009 there were almost 7 million square feet of green roofs in Chicago that had been built or approved for development, equal to approximately 600 green roofs (Green Roofs for Healthy Cities 2008b)(M.Berkshire, personal communication, September 22nd, 2009). Many of these were award-winners, including city hall’s green roof, (American Society of Landscape Architects 2002). By contrast, in 2010 Toronto had approximately 234 green roofs built or planned, equal to approximately 113,093 m² (1, 217 322.920 ft²) (City of Toronto 2011)(J. Welsh, City Planning, City of Toronto, April 13th, 2011). While it has recently become the Canadian leader for green roof implementation, (City of Toronto 2009a, Green Roofs for Healthy Cities 2008b, City of Toronto 2011), Toronto’s green roof efforts for many years were not been perceived to be as successful as Chicago’s (City of Toronto 2007e, City of Toronto 2004a, Gorrie 2007).

This may change, as Toronto in the spring of 2009 passed new green roof legislation (City of Toronto 2009a, City of Toronto 2008b). Will Toronto experience similar levels of success as Chicago? Can Chicago maintain its momentum? This paper sets out to examine a) What factors have helped shape each city’s green roof policy trajectory; and b), What we can learn from these two case studies for cities seeking to undertake similar programs and initiatives. Though there have been a few studies discussing green roof policy generally in the U.S., Canada and Europe, (Carter and Fowler 2008, Lawlor et al. 2006), none have done an in-depth analysis comparing two cities on their green roof policy trajectory and identifying the range of factors influencing their relative levels of success. Understanding how policy gets implemented, and local factors that influence its success or failure, can help cities better evaluate the effectiveness of proposed policies and is thus a valuable research tool.

Toronto and Chicago face similar urban environmental problems such as poor air quality, their geography, similar climate, and similar population size (Gorrie 2007, City of Toronto 2007e,
Rothblatt 1994, Wente 2007). Though any comparison between American and Canadian cities should be done with caution given the traditionally higher levels of autonomy and revenue-raising power of most US cities over their Canadian counterparts (Rothblatt 1994), recent campaigns for increased fiscal and political autonomy have seen Toronto move closer to the level of power and autonomy seen in US cities (City of Toronto 2007c). In examining Toronto and Chicago’s green roof policy trajectory, this paper aims to understand the factors that have influenced each city’s relative level of success and speed of implementation, possible barriers to their long-term implementation, and implications for cities interested in developing their own green roof program. The following sections describe each case study city in turn, starting with a brief outline of their socio-political and geographical context, and followed by an examination of their green roof policies in relation to four common themes that emerged from the research: leadership, policy initiatives, incentives, and publicity and education. This is followed by a discussion of the factors that have influenced the relative levels of success in green roof implementation for each city and possible barriers to continued success. The paper concludes with possible ways forward for each city and lessons for other cities interested in implementing new urban greening programs.

3.2. Methods

In this paper I use a combination of analysis of public policy documents, local newspapers and green roof industry surveys with interviews with key public officials and green roof industry members in each city. For Toronto the main policy documents examined were Toronto’s Official Plan, thematic policy documents such as the Toronto Green Standard (2007) and Our Common Grounds (2004), staff reports and memos on relevant green roof policy and public consultations, and

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3 This thesis refers to the cities of Toronto and Chicago and not their greater region.
and web-based municipal policy documents. These were supplemented with informal interviews with key public officials involved in developing and implementing Toronto’s green roof policies and local members of the green roof industry. As Chicago’s land use development is guided by their zoning code and not an overarching comprehensive plan, analysis was based on thematic policy documents, such as their Environmental Action Agenda (2006), Stormwater Management Plan (City of Chicago: Department of the Environment 2007), Chicago Standard (2007), Landscape Ordinance (City of Chicago: Planning and Development 2000), Adding Green to Urban Design (City of Chicago 2008a) and web-based municipal material. Informal interviews with key public officials involved in Chicago’s green roof policies, as well as local activists familiar with Chicago’s naturalization history, supplement policy document analysis. As this paper is about both official policy, and the politics involved in creating and maintaining policy, informal interviews are an essential component in understanding both and have been widely used in municipal policy analysis (Leavitt, Morris and Lombard 2008, Jonas and McCarthy 2009). Furthermore, it is very difficult to estimate the exact numbers of green roofs in any city; it depends on city officials knowing about them, industry members promoting them, or both. To try to compensate for this ambiguity, I have tried to compare city official estimations with green roof industry survey counts where possible.

3.3. Green Roof Policies and Politics in Toronto

Located on the north western shore of Lake Ontario, Toronto is Canada’s leading business, educational and cultural hub and is known as one of the most culturally diverse cities in the world (Marlow 2008). With a central city population of 2.5 million and a metropolitan regional population of about 8 million (Neptis Foundation 2009) Toronto is Canada’s largest city. Like most Canadian cities, Toronto is a creature of the province and depends on the largesse of the province for funding and much of its power of governance (Sancton 2005). The downloading of provincial services to the City in the 1990’s has meant a constant budget shortfall. This significantly affects Toronto’s ability to both deliver basic services and fund initiatives like
public transit (Hume 2010). The situation was helped somewhat by provincial-municipalelations between the Liberal Premier of Ontario, Dalton McGuinty, and the now former Toronto
Mayor David Miller (2003-2010), which led to increased powers and recognition for Toronto,
specifically the 2006 City of Toronto Act (COTA) (City of Toronto 2007c). Premier McGuinty
also supported Mayor Miller’s call for a ‘strong mayor system’ which gave Toronto more power
(Vincent and Benzie 2008). Toronto has been considered a progressive and environmentally-
friendly city, having won over fifty awards between 2004-2007 for its initiatives (City of Toronto
2007d). The previous Mayor Miller was acknowledged as having had an enormous impact on
the pro-sustainability policies and direction the City took since his election in 2003 (Hollett
2009, Lewington 2009, Porter 2009). With the election of a new mayor in the fall of 2010,
Mayor Rob Ford, however, the city has been pushed in a far more conservative direction and the
fate of their green roof program, as well as other environmental initiatives, remains unclear.
Since all of Toronto’s green roof policy development happened before Mayor Ford’s election,
this paper will focus mainly on that time period (2000-2010), with some concluding commentary
about the future of green roof policy under the new mayor.

### 3.3.1. Timeline of green roof policy development in Toronto

Toronto’s green roof strategy has tended to be modeled on a consensus-based approach in which
the City has used cost-benefit studies, stakeholder workshops, and revisions to larger policy and
planning documents to move green roof policy forward (see Figure 3.1). The main impetus for
Toronto’s initial involvement in green roofs was intense lobbying from the Toronto-based North
American green roof industry association Green Roofs for Healthy Cities (GRHC) (S. Peck,
personal communication October 17th, 2003), further supported by a champion from inside City
hall – Deputy Mayor Pantalone. Deputy Mayor Pantalone helped keep green roofs on the agenda
during a leadership change, though it was still unclear for a few years which department would
be responsible for their maintenance and promotion. The potential for green roofs to help
mitigate against stormwater runoff and the urban heat island effect were of interest to the City,
however, and helped to keep them on their environmental agenda. This has continued to be their main policy focus, partly because these benefits are quantifiable in terms of cost savings, and partly due to the City’s commitment to climate change adaptation initiatives (City of Toronto 2007a). In examining Toronto’s green roof policies, four themes emerge as central to green roof implementation: leadership, policy tools, incentives and publicity and education. The next section outlines the City of Toronto’s green roof policies as they relate to these four themes.

3.3.2. Green Roof Leadership in Toronto

Though the development of green roof policy and programs (discussed below) also requires leadership, setting an example and “walking the talk” is an important aspect of promoting green roofs. Toronto has done this in two ways. First, the City partnered with GRHC and the National Research Council Canada (NRC) in 2000 to create two test plots- one on City hall, and one on a community centre (Deputy Mayor Pantalone and Burton 2006). The original 6,000 square foot city hall green roof cost approximately $120,000 and was funded through a combination of departments and a donation of labour and materials (Green Roofs for Healthy Cities 2000, Green Roofs for Healthy Cities 1999). These roofs were meant to show leadership and provide a test case for green roofs’ potential environmental benefits (Liu and Baskaran 2003). Though some research was done using the pilot plots, their ability to demonstrate leadership was hampered by ongoing maintenance issues, with many in the green roof community feeling the City hall green roof in particular was ill-maintained and an eyesore (Figure 3.2).

Furthermore, research from the test plots was not used effectively in either publicity campaigns on Toronto’s green roof initiatives, nor in the City’s green roof policy development process. In 2009 Toronto retrofitted the green roof on their City hall in time for the CitiesAlive international green roof conference (www.citiesalive.org) of which they were a co-host. This new green roof
is much larger and is featured on the CitiesAlive and Toronto’s green roof publicity materials, and may prove more effective as a publicity tool (see Figure 3.3).

Second, after a series of workshops with stakeholders, Toronto commissioned a report from Ryerson University on the potential benefits of green roofs for Toronto (Doshi et al. 2005), resulting in an internal City report encouraging green roof adoption (City of Toronto 2009a). Because of these recommendations, green roofs must now be considered for all new City buildings and roof replacements where technically feasible. This has resulted in three green roofs on City buildings between 2006-2007, nine in 2008/2009, and ten more under consideration (City of Toronto 2008c). As some of these green roofs are recipients of the pilot incentive program (described below), these have received some publicity and are featured on the City’s green roof website. Despite this progress, there remains the issue of maintenance. It is still unclear as to whether the City has resolved the maintenance issues around the upkeep of their green roofs. This is a particular concern given budgetary pressures and the new conservative climate from the new mayor.

3.3.3. Policy Tools used in Toronto

Like many cities that require some level of consensus to move policy forward, Toronto’s implementation of green roofs into policy has been a gradual and consultative process (see Figure 3.1) and can be broken down into three parts: a) the incorporation and support of green roofs in planning documents; b) the commissioning of research on green roofs and public and stakeholder consultation; and c) legislation enacted after the City of Toronto Act (COTA) January 1st, 2006.
Figure 3.1: Timeline of Toronto’s green roof policy development
First, Toronto’s green roof policy development began with the support, in least in theory, of green roofs in three major policy and planning documents. These documents govern the spirit of planning, development, and environmental policy in Toronto: the Environmental Plan (City of Toronto 2000), the Official Plan (City of Toronto 2006), and the Wet Weather Flow Master Plan (WWFMP) (City of Toronto 2004b). This support was continued with the integration of green roofs into the City’s green building policy, the Toronto Green Standard (TGS) (City of Toronto 2007e), and their Toronto Clean Air and Climate Change Action Plan (TCACCAP) (City of Toronto 2007a). While these documents are not implementation strategies per se (with perhaps the exception of the WWFMP), the inclusion of green roofs legitimized future inquiry and action by the City.

Second, the City held a series of public and stakeholder consultations. In combination with the Ryerson study commissioned by the city (Doshi et al. 2005), and legislative developments under COTA (see below), these consultations were instrumental in convincing the City that sufficient public support existed to implement green roof legislation. The stakeholder consultation also helped refine drafts of the green roof legislation and incentives and created green roof legislation that took into account developers needs and concerns.

Third is Toronto’s policy development. Though policy and development approval processes are some of the most powerful tools a city has to encourage green roofs (Carter and Fowler 2008, Berkshire 2006), this aspect has also been one of the most challenging for the City of Toronto, and reflects their relatively weak position vis-à-vis the province. Though the City had been able to approve fourteen green roofs through voluntary zoning by-law amendments and site plan control applications since 2006 (City of Toronto 2008c), legally it had not had the ability to require green roofs. This changed with the new City of Toronto Act (COTA), which gives the
City power to use municipal planning tools to encourage or enforce sustainable building practices for the first time in its history.

Figure 3.2. Original Toronto City hall Green Roof (photo credit Green Roofs for Healthy Cities)
Section 108 of COTA gives Council the authority to pass a by-law requiring and governing the construction of green roofs as an exception to the Ontario Building Code Act, 1992 (City of Toronto 2008c). This has allowed the City to adopt a by-law to require and govern the construction of green roofs in Toronto in the spring of 2009 (City of Toronto 2009a). Combined with their new Green Roof Construction Standards (City of Toronto 2008a), Toronto is the first and only city in North America with this kind of legislation.

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4 Municipalities in Ontario are not allowed to specify building codes that are more stringent than the Ontario Building Code.
This last component of Toronto’s green roof policy requires all new development over 2,000 square meters (21527.820 ft²) to install a green roof. Institutional, commercial and residential buildings can use a graduated coverage ranging between 20-60% of available roof space, while industrial buildings require a minimum of 10% coverage. The by-laws took effect January 2010 for all buildings except industrial, which was pushed back to January 2011 (City of Toronto 2009b). COTA also gives the City the ability to use other tools popular in implementing green roofs such as Tax Increment Financing, which is being considered to promote green building generally. Interestingly, density bonusing, where a development is allowed to increase the density of their project in return for some public good the local government is trying to encourage, and which is often used by cities to encourage green roof market development, is not being used in Toronto to incentivize green roofs. This is because green roofs, and in fact green buildings, do not officially count as a ‘public good’ that can be installed in return for density bonusing under Section 37, despite their unofficial encouragement as one for infill developments by the planning department (City of Toronto 2009c). Under Toronto’s Official Plan the ‘public good’ negotiable for density bonusing refers to services that would be required by the additional people, such as parks and daycare. If a Section 37 agreement is already in place, however, the City secures a green roof and its maintenance as a matter of convenience (J. Welsh, Department of Planning, personal communication February 17th, 2010).

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5 Tax Increment Financing (TIF) is a development tool that municipalities can use to generate money for economic development in specific areas -usually those that are blighted or underfunded- without which development would not usually occur. In designating an area as a TIF district a city can take all new property tax dollars from that area and re-invest it in that district for 23 years. As property taxes tend to rise from new development and investment in the area, this ‘tax increment’ is the future gains borrowed against by the city to finance public works or to provide incentives for private developers to invest in that district. Though credited with being an important development tool to spur investment in disadvantaged areas (Smith 2009, Smith 2006), it has also been criticized, particularly in Chicago, as lacking transparency and raising property taxes (Neighborhood Capital Budget Group 2003, Joravsky 2009, Lehrer 1999).
3.3.4. Incentives for Green Roof Development in Toronto

Despite their numerous environmental and energy savings benefits, green roofs cost about twice as much as conventional roofs. As such, financial incentives that reduce the initial capital investment can help to stimulate the green roof market and are a common municipal strategy. How much these incentives should be is a subject of debate, however, and Toronto’s experience is a case in point. Based on the recommendations of both the Ryerson study (Doshi et al. 2005) and public consultation, the City created an incentive program in 2006 to encourage the adoption of green roofs (see Figure 3.1). Funded by Toronto Water (due to the stormwater mitigation benefits of green roofs), the program offered $10/square metre ($1/square foot) for a minimum 50% green roof coverage. The total budget was $200,000, and resulted in 16 grants (City of Toronto 2009b). Due to criticisms from the green roof industry that this incentive was nowhere near high enough to offset the costs of a green roof, which average between $10-24 a square foot (Green Roofs for Healthy Cities 2008a), in 2007 the City increased the incentive to $50/square metre ($5 per square foot) up to a total of $100,000 per award (City of Toronto 2007b).

In 2008 the City also re-named this incentive program an Eco-Roof program. The Eco-Roof Program specifically targets properties in employment areas known for high levels of urban heat island (UHI) and stormwater runoff and provides incentives for green or cool (reflective) retrofits. The shift of targets also comes with a more concrete objective: the transformation of at least 10% of all ICI (Industrial, Commercial and Institutional) building stock in Toronto to an eco-roof by 2020. While potential recipients must include stormwater runoff measurements to apply for the Eco-Roof Incentive program, as the city currently does not charge for stormwater runoff, it is unclear whether or not companies will go further than 10% coverage and if this will have any measurable impact on stormwater runoff. The total budget for the Eco-Roof program is much higher than the initial incentive: $2.4 million budget over five years (2007-2012), with an additional $200,000 from Toronto Water for green roof projects (City of Toronto 2008b).
This is partly due to green roofs’ inclusion in Toronto’s climate change initiatives, whose multi-dimensional environmental goals enabled it to secure funding for five years (2007 to 2012).

3.3.5. Publicity and Education

While slow to start, Toronto has made great progress in the last few years on education and publicity surrounding its green roof initiatives. In 2005 the City set up a green roof website and has received 35,085 visits and 360 emails since being launched (City of Toronto 2008c). The website contains maps of green roofs across the city (Figure 3.4), information on policy, the incentive program, and related links, as well as links to their LiveGreen website which promotes the Eco-Roof Incentive program and other green initiatives. The City has hosted two green roof training sessions for about sixty staff, has spoken across Canada about their green roof initiatives, and has hosted an information session for Toronto’s school boards, one whose school is an award winner. Significantly, it has dedicated at least three staff members from different departments to oversee the green roof legislation, incentive program, and publicity. It also co-hosted the CitiesAlive International green roof conference in 2009 (www.citiesalive.org). In recognition of their efforts, in 2007 Toronto was awarded a Sustainable Community Award by the Federation of Canadian Municipalities (City of Toronto 2008c).

Where does this leave Toronto? In the first year of its inception, 71 green roofs were required (and are currently counted as ‘planned’). This is in addition to the 163 green roofs already built, for a total area of 89,093m² (958,989ft²). There were also 12,000m² (129,166ft²) installed through the eco-roof incentive program, and 24,000m² (258,333ft²) were voluntary (J. Welsh, City Planning, City of Toronto, April 13th, 2011), for a total of 113,093 m² (1,217 322.920 ft²).

One-third of the square footage for green roofs in Toronto is unknown, but will be rectified in the summer of 2011.
This has helped make Toronto the top Canadian city for green roof implementation (Green Roofs for Healthy Cities 2011). It is also the first Canadian city to make the top ten for North America (Green Roofs for Healthy Cities 2008b). As the first city in North America to both mandate and regulate green roof construction, Toronto seems to have pulled through and remained true to its reputation for environmentally-friendly leadership through a long process of consensus building and eventual legislation.

Figure 3.4: Green roofs in the City of Toronto (2009) (source: City of Toronto)
3.4. Green Roof policies and politics in Chicago

The City of Chicago is on the southwestern edge of Lake Michigan and has been known for much of its history as a booming industrial centre whose trade routes on the Chicago and Des Plaines rivers helped to transform the surrounding prairie plains into one of the breadbaskets of the U.S. (Cronon 1991). With a population of 2.8 million (US Census 2005) in the city itself and 9.4 million in the metropolitan area (Testa 2007), Chicago is the financial, business and cultural hub of the Midwest and ranked as an alpha city. It is also one of the most segregated cities in the U.S., with much of the city’s poverty concentrated among blacks and Hispanics (Peck and Theodore 2001). Like Toronto, most of the population growth in the region occurs outside of Chicago itself, and Chicago competes with its surrounding municipalities for growth and investment. Though buffered from the worst of the rustbelt decline seen in the rest of the Midwest through its more diversified industry and stock exchange, Chicago still carries the legacy of its industrial past, and much of the previous mayor’s reign was focused on attracting investment and a re-migration back to the city. Like many US cities, Chicago has a strong mayor system and is able to use planning tools such as TIFs to shape development and investment (Healy and McCormick 1999). Chicago has also been able to tap into generous funding from the federal government for transit and revitalization initiatives (Chicago Transit Authority 2008, City of Chicago 2008b), leaving it historically less vulnerable financially than Toronto.

Chicago is also well known, perhaps infamously, for its nepotism and corrupt politicking. All of Chicago’s green roof policies were developed under Mayor Richard J. Daley, who was in office for twenty-one years (1989-2010) until his surprising decision to not run again in 2010. During this time the mayor packed council with supporters and was able to develop long-term planning goals not available to mayors who need to seek re-election every three to four years. Chicagoans put up with this system and Mayor Daley, affectionately called a “benevolent dictator” (Gorrie 2007) and a “democratically-elected monarch” (Kamin 2007), as they felt that he “got things done” and did good things for the city. This means that traditionally, Chicago’s way of getting
things done often meant a top-down approach. This is particularly true for their environmental initiatives, which have garnered Chicago numerous environmental awards. Chicago is not immune to financial instability, however, and there was substantial criticism of Mayor Daley’s approach. It is unclear whether Daley’s decision to step down, and the subsequent election of Mayor Emmanuel (2010), is directly related to the serious budgetary crisis which have threatened municipal services and environmental policies (Dardick and Blake 2009, Spielman 2009). Lastly, despite the previous mayor’s goal of being “the greenest city”, this is a sharp departure from Chicago’s traditional approach: the City has long erased most evidence of the original prairie and Oakland Savannah that covered the region (Gobster 2000), and Chicagoland sprawls beyond the metropolis itself (Gorrie 2007). This makes Chicago an interesting comparison to the more traditionally “green” Toronto. Again, as all of Chicago’s green roof policies were developed under the former mayor, this paper will mainly focus on that time period (particularly 2000-2010), with some concluding commentary on the future of these green roof programs given the new mayor and Chicago’s fiscal crisis.

3.4.1. Timeline of green roof policy development in Chicago

Chicago’s green roof trajectory differs from Toronto’s in that it began, and continued to be, promoted primarily through strong mayoral commitment. After a disastrous heat wave in 1995 in which over to 700 people died (Klinenberg 2002) (see below), the City, and Mayor Daley in particular, began looking for ways to reduce the urban heat island effect (UHI). While a 1994 U.S. Department of Agriculture (USDA) Forest Service study (McPherson, Nowak and Rowntree 1994) made explicit the link between increased vegetation and reduced UHI for Chicago, it was a visit to Germany’s green roofs by Mayor Daley that was the main impetus for their development in Chicago. Though green roofs’ ability to reduce the urban heat island effect and stormwater runoff continues to be the City’s primary focus, they have also added beautification, habitat and other ‘soft’ benefits since beginning their green roof program. In examining Chicago’s green roof policies, the same four themes are interrogated: leadership,
policy tools, incentives and publicity and education. The next section outlines the City of Chicago’s green roof policies as they relate to these four criteria.

3.4.2. Leadership of Green Roof Initiatives in Chicago

“Chicago has become known nationally for its leadership in the environment. We’re especially well-known for green roofs. When we planted our first rooftop garden on City hall in 2000, it started a movement that is still going strong today.”

Mayor Daley (City of Chicago: Mayor's Office 2006)

Chicago has shown strong leadership in promoting green roofs through both policy development and direct leadership and example (see Figure 3.5). First, like Toronto, the City installed a green roof on their city hall in 2000, as well as twelve others on City buildings. The 38,000 square foot (3530m²) city hall green roof, which cost $1.5 million, was paid for out of a settlement with a local utility company after a series of blackouts in 1999 (Millet 2004). Like Toronto’s city hall green roof, Chicago also used the initial green roof for research, forming part of a five-city U.S. Environmental Protection Agency (EPA) study on the urban heat island effect (UHI) (Green Roofs for Healthy Cities 1999). The City also promoted research showing cooler temperatures on the green roof versus a neighbouring conventional roof. Unlike Toronto’s initial city hall green roof, however, Chicago’s green roof on their city hall is award-winning (see Figure 3.6) (American Society of Landscape Architects 2002), easily recognized, and highly promoted in all of their green promotional material. Furthermore, Chicago has chosen green roofs as a highly visible symbol of their commitment to becoming a green city. This choice of green roofs as a promotional tool has been respected by other cities as a way to promote the city as innovative and green (City of Toronto 2007e).
Figure 3.5: Timeline of Green Roof Implementation in Chicago

- **1995 Heat Wave**: Triggered search for ways to reduce UHI
- **Mayor Daley visits Europe; sees example of green roofs; 1998-1999**
- **US EPA Urban Heat Island Study; 1998-2002**
- **DOE Urban Heat Island Reduction Initiative; 1998: green roofs grants offered 2000**
- **Guide to Stormwater Best Management Practices; green roofs one option; 2003**
- **Green Roof Request for Information to develop industry standards; 2004**
- **City Hall green roof; green roofs on 12 other City buildings: 2000-2001**
- **Green Roof Grant Program begins; 2005**
- **Green Building Agenda; green roofs included; 2005**
- **Green Roof Improvement Fund for central loop; 2006**
- **Green Roof Website launched; 2005**
- **Stormwater Ordinance; large developments must manage stormwater on-site; green roofs one option; 2007**
- **Best Practices for Green Building report; green roofs one option; 2003**
- **Green Permit Program—waived fees and faster review for green projects; green roofs one option; 2005**
- **Chicago Climate Change Action Plan; green roofs significant part of strategy; 2008**
- **Doe Urban Heat Island Reduction Initiative; 1998: Green Roofs Grants Offered 2000**
- **Guide to Stormwater Best Management Practices; Green Roofs one Option; 2003**
- **Green Roof Request for Information to Develop Industry Standards; 2004**
- **City Hall Green Roof; Green Roofs on 12 Other City Buildings: 2000-2001**
- **Green Roof Grant Program Begins; 2005**
- **Green Building Agenda; Green Roofs Included; 2005**
- **Green Roof Improvement Fund for Central Loop; 2006**
- **Green Roof Website Launched; 2005**
- **Stormwater Ordinance; Large Developments Must Manage Stormwater on-Site; Green Roofs One Option; 2007**
- **Best Practices for Green Building Report; Green Roofs One Option; 2003**
- **Green Permit Program—Waived Fees and Faster Review for Green Projects; Green Roofs One Option; 2005**
- **Chicago Climate Change Action Plan; Green Roofs Significant Part of Strategy; 2008**
Mayor Daley’s top-down leadership on environmental issues meant that there was a strong incentive among departments to make green initiatives a prominent part of their agenda, fostering inter-departmental cooperation and performance targets for each department on environmental issues (City of Chicago 2006b). This has enabled green roofs to be a prominent part of green policies such as their Chicago Sustainable Development Policy, and their Chicago Climate Action Plan, with an ambitious goal of 6,000 green roofs citywide by 2020.
Lastly, Mayor Daley insisted on urban greening projects that were bold and visionary, and which incorporated larger urban revitalization goals. A prime example of this is Millennium Park. Opened in 2004, it is a highly ambitious, expensive, but ultimately very successful public park. Linking Lake Michigan with the downtown loop and covering commuter rail tracks and parking, Millennium Park, with its public artwork, theatre, year-round free festivals and combination of formal park landscape with native prairie vegetation (Guen 2006), is one of the largest green roofs in the world (24.5 acres) (Kamin 2007). It is credited with dramatically increasing tourism to Chicago, encouraging billions of dollars in associated real estate and tourism investment, and is immensely popular (Uhlir 2005, Goodman Williams Group 2005).

### 3.4.3. Policy Development and Implementation in Chicago

Chicago has some advantages in terms of their policy development on green roofs. While Toronto also is beginning to use green roofs as part of their green building policies, in Chicago green buildings, and green roofs, are considered a public and private benefit and can be encouraged with tools such as density-bonusing and TIF districts (M. Berkshire, Department of Planning, personal communication March 27th 2010). In fact, Chicago has the highest number of TIF districts in the US (Healy and McCormick 1999), many of them used to promote both green initiatives and urban revitalization. For example, through TIF negotiations almost all new schools have green roofs in Chicago and are LEED Silver (M. Berkshire, Department of Planning, personal communication September 22nd 2009). The Chicago Sustainable Development Policy, implemented after a series of consultations with the green roof industry in 2004 (City of Chicago 2006a) requires private developments seeking public assistance, such as TIF financing, zoning changes, or proximity to Lake Michigan or the Chicago River, to meet minimum green building requirements. Developers can choose from a menu of green options, one of which is a green roof. This has been Chicago’s most successful tool for promoting green roofs to date (Berkshire 2006), and has also given Chicago the highest number of green buildings
In the US (M. Berkshire, Department of Planning, personal communication September 22nd 2009), beating even more traditionally-green cities of Portland, OR and Seattle (Kamin 2007).

In addition to the Chicago Sustainable Development Policy Chicago has included green roofs as one option to reduce stormwater runoff. In 2007 Chicago passed legislation that requires large commercial and industrial properties to manage their stormwater on-site (City of Chicago: Department of Water Management 2007), thus giving teeth to their recommendations of green roofs as a stormwater management option. Lastly, Chicago is currently trying to shift its green roof policy, which is negotiated per case, into standardized legislation and practice. This is mainly to reduce the vulnerability of the policies under a change in leadership. Green roofs form an integral part of the action or mitigation strategies for all of these plans.

3.4.4. Incentives for Green Roof Development in Chicago

On the incentive side, Chicago has implemented two major policies. Like Toronto, Chicago started a Green Roof Grant Program in 2005 of $200,000, from which to draw 20 award recipients for small commercial and residential green roof projects (City of Chicago 2006c). The green roof grant program encouraged green roof uptake for small commercial and residential buildings and increased the popularity and visibility of green roofs. Chicago also implemented an area-specific green roof grant program: the Green Roof Improvement Fund offered through the central loop TIF district offered $500,000 to fund up to 50% of the development and installation costs of green roofs implemented in their CBD (City of Chicago 2006a). The Central Loop fund was meant to reduce the environmental impact of the highly-built up loop district, which affects both the Chicago River and the city’s UHI, as well as be highly visible to the densely populated

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7 The loop TIF ended in 2008 after a 24-year term and was not renewed due to the current success and revitalization of the loop area.
CBD. Combined with their Green Urban Design guidelines, which allows the planning department to negotiate the placement of green roofs in areas based on their ecological need, such as areas with poor drainage that are part of a river basin, or areas with little present greenspace (City of Chicago 2008a), Chicago is tailoring their green roof implementation plans to areas of strong environmental need. Green roofs are also often combined with an extensive program of tree planting and alleyway greening in areas particularly affected by the UHI (City of Chicago 2008b), thus making them an integral part of a larger greening program.

Despite this success, however, Chicago is not immune to political pressure and criticism that public money could be better spent in a city known for geographic economic disparities. This pressure helped lead to the discontinuation of the Green Roof Grant Program in 2008 (M. Berkshire, Department of Planning, personal communication September 22nd, 2009). Though most of the TIF districts are in impoverished areas, and green roofs are being built throughout the city (see Figure 3.7), Chicago’s reputation for nepotism and continued disparities and segregation mean that the City still faces criticism for environmental initiatives not seen as directly benefiting impoverished areas. As Chicago’s larger revitalization plans bring investment and environmental initiatives into deprived areas, however, this may help to foster long-term support and consensus for their greening programs and move the city closer to both ecological and social justice goals. Framing green roofs as one element of Chicago’s larger climate change action plan, and thus reducing the vulnerability of the poor during heat waves, is a prime example of a more inclusive approach that seems to be the direction Chicago is taking.

3.4.5. Publicity and Education

In addition to green roofs being featured in all of their environmental promotional material, the City of Chicago also has an interactive website with maps of green roofs and information on each roof in Chicago (Figure 3.7). The website includes a list of local green roof providers as
well as a green roof handbook for those who wish to install a green roof (City of Chicago: department of the Environment 2007). Chicago’s Centre for Green Technology, a LEED-Platinum retrofit that showcases different environmental technologies, including green roofs, hosts educational sessions. The City also partnered recently with the Museum of Science and Industry on their Smart Home exhibit, which featured an accessible green roof (July 2008-January 2009). All of these programs combined have been immensely successful: by the last count there are over 7 million square feet of green roofs built or planned in Chicago on public or private developments (M. Berkshire, personal communication September 22nd, 2009), with almost 534,507 square feet (49,657m²) installed in 2008 and more than 500,000 (46,451m²) in 2010 (Green Roofs for Healthy Cities 2009, Green Roofs for Healthy Cities 2011). This is more than all other cities combined in North America.

3.5. Discussion and Evaluation

As we have seen, both Toronto and Chicago have used a range of leadership initiatives, policy tools, incentives, and publicity and education to promote green roofs. Both have become national leaders in green roof implementation. Though both cities began their green roof promotion around the same time, Chicago has been much more successful so far in implementing green roofs. What can help explain the rapid success of Chicago’s green roof policies? Which policies have proven to be the most effective so far in each city, and what is the potential for the long-term success of each city’s green roof program? The next section will discuss the strengths and weaknesses of each city’s green roof program, factors influencing their speed of implementation, and lessons for cities interested in implementing similar programs.
Figure 3.7: Green Roofs in Chicago (2010) (source: City of Chicago)
3.6. Policy: what works

Evaluating Chicago and Toronto’s relative levels of success in their green roof implementation depends partly on how you measure success—either by number of green roofs, or total square footage. Though a higher number of green roofs might be considered more successful in terms of developing the local industry and building awareness and momentum, environmentally the more roof coverage there is (especially if required for each roof) the more benefits. This can be harder to encourage, however, given the higher cost. The amount of coverage also raises the issue of aesthetics and ecological goals. Green roofs that cover only a fraction of the roof, and are mandatory versus voluntary, may not be that aesthetically pleasing, ecologically beneficial, or well-maintained. As Germany and Chicago have experienced, poorly-maintained or designed green roofs can be seen as an eyesore and can reduce public understanding of and approval of green roofs (Stender Unpublished results, Eisenman 2004). As seen with other conflicts over urban greening projects, such as naturalized lawns being perceived as a weedy eyesore in Toronto (Spears 2005), having public support and understanding of new greening technologies such as green roofs may be essential for their longevity under budgetary pressure and officials keen to please their electorate. This needs to be kept in mind when requiring or mandating green roofs.

Chicago seems to be playing the middle ground in terms of square footage in requiring a minimum 50% coverage. Furthermore, linking green roofs to actual environmental data, such as UHI rates and stormwater runoff, as is being done with their GUD recommendations and Climate Change Policy, will help channel green roofs to where they are most needed ecologically (Berkshire 2007), particularly when combined with tree planting and other greening programs. Encouraging more than 50% coverage, particularly through linking green roofs as an option for green buildings, will further enhance environmental benefits. Though there were quite a few green roofs created through their incentive program, particularly for smaller businesses, their most successful policy has been their Chicago Sustainable Development Policy, which mandates
some green building feature on certain types of development. Relying on voluntary targeting does not seem to have been that successful with the private sector for Chicago. The Green Roof Improvement Fund did not create many green roofs in the loop (M. Berkshire, Department of Planning, personal communication, March 13th, 2008), though condo developers have begun to take up the slack by providing them as an amenity in within the loop. Depending on developers to put in more coverage than the minimum requirement also seems to be strongly linked to green roofs being perceived as a public benefit; i.e. where a green roof is linked to the perceived environmental goals of the developer. This requires buy-in from the public and development communities, and is linked to the publicity and education around green roofs. In this sense promoting green roofs overall as a positive environmental benefit for both the city and individual buildings - perhaps as part of a green building- combined with Chicago’s existing legislative power, might be the most effective at green roof implementation and thus ecological benefits. This is particularly true since their incentive programs did not pass the 2008 budget.

It is still early to tell how successful Toronto’s green roof legislation has been. Given Chicago’s example, however, their policy of requiring green roofs to be considered on all new or retrofitted municipal buildings, combined with the new by-law requiring green roofs on certain developments, is likely to be their most successful, and controversial. Like Chicago, Toronto is also playing the middle field in terms of percentage of green roof coverage. Toronto’s requirement of between 20-60 percent green roof coverage for institutional buildings, depending on the space available, follows common green roof practice. The difficulty of getting industry onside is reflected in the scant ten percent minimum coverage required of industrial sites under the new bylaw that the city was able to negotiate, and had to extend by a year, and it is questionable whether this minimum will have a significant effect on stormwater mitigation. While the flexibility of coverage may prove to be necessary for the by-law to work, it also means it is difficult to tell in advance how environmentally beneficial they will be. However, Toronto has shown itself to be flexible and responsive in their green roof policy development, and this may be addressed in the next period of policy implementation. It also remains to be seen whether or not their incentive program encourages an adoption of green roofs. Though the Eco-
Roof incentive program targets areas of ecological need, i.e. the ICI areas or employment lands, and is thus an effective use of resources, these industries have also been the slowest to adopt green roof practices. They are also unlikely to install green roofs as an amenity for their employees, as in the case with Chicago condo developers. However, their previous incentive program was very popular among community organizations and architects, so it might be a case of balancing ecological needs versus building momentum from early adopters. Despite these potential barriers, Toronto’s green roof policy trajectory so far can be considered fairly successful and an interesting case study for other cities. Furthermore, the success of Toronto’s other environmental initiatives, such as their recycling and composting, may bolster popular support for this latest initiative.

3.7. Implementing policy: barriers and opportunities

The process of implementing policy is often as important as the policy itself, and the contextual factors surrounding policy development often shape and determine the eventual policy outcome, as we have seen with Chicago and Toronto. While Chicago’s current leadership in green roofs may be due to its earlier adoption of green roof policy, understanding the causes behind the difference in the speed of implementation between Toronto and Chicago can help other cities understand their own political context.

3.7.1. Legislative power

As we have seen, Toronto’s initial slow progress on green roof implementation may be partly explained by its lack of power vis-à-vis the province. As the City surged ahead with green roof legislation after COTA, it may be that lack of regulatory power was one of the main reasons for the City’s mostly theoretical support of green roofs, versus concrete initiatives and programs,
until 2006. Chicago’s extensive use of TIF and density bonusing, on the other hand, meant that it already had the legislative power to implement green roof policies. Though Toronto now has the legislative power to mandate green roofs, the by-law will be a test of the City’s new powers. Toronto has a history of green initiatives; however the development industry has traditionally been very strong in Ontario and has repeatedly pushed for voluntary versus regulatory measures. Furthermore, though the green roof legislation cannot be appealed through the Ontario Municipal Board (OMB) - a regional planning and development body that has been notoriously pro-development and has previously ruled against the City (City of Toronto 2009b) - this is the first time the City will have mandated green building initiatives. Part of their success will hinge on the City being willing and able to stand up to developers in what could potentially be a long battle as the by-law comes into effect. This is even more acute given the conservative, anti-environment politics of the new mayor who has already asked for Toronto’s environmental programs to be looked into to see if they could be cut (Doolittle 2011). If Toronto becomes able to use planning tools like density bonusing for green roofs this would may strengthen their green roof policy implementation and provide a buffer against political changes in leadership.

3.7.2. Leadership

There is also a difference in leadership between the two cities, in terms of both the strength of the mayoral office and its commitment to green roofs. Despite recent legislative changes in Toronto, Mayor Daley had much more power than Mayor Miller. Mayor Daley could re-arrange the Department of the Environment to his liking to promote green roofs and was afraid of neither criticism nor getting voted out in a city known for its nepotism. This allowed Chicago to prioritize green roof implementation despite their relative novelty in the U.S. It also created a governance environment that set clear environmental benchmarks for interdepartmental collaboration and effectiveness in order to meet the Mayor’s green roof targets. While Mayor Daley’s popularity was tested by budgetary pressures and some unpopular measures (Associated
Press 2009), it is unclear if that contributed to his decision to step down, as he had weathered difficult political storms before.

In contrast, Toronto’s development of their green roof policy was slowed down by three leadership factors. First, there was a change in leadership shortly after the initial test pilot in 2000 that resulted in the tabling of green roof policies until a more solid organizational body was created. The election of Mayor Miller in 2003, who demonstrated a solid support of environmental issues, gave green roofs support both from the mayor’s office and a bureaucratic reorganization that consolidated environmental issues into one body. Toronto’s green roof policies really took off when Mayor Miller was re-elected to a second term and was in a better position for legacy-building and implementation, and thus willing to support the somewhat radical green roof by-law. Second, though there was a consistent green roof champion in City hall (former Deputy Mayor Pantalone) who bridged the election, he did not have enough power alone to push green roofs. Lastly, like many cities, Toronto had to follow a more traditional consensus building approach to policy development, which can be much slower when there are competing priorities.

What are Toronto and Chicago’s chances for continued green roof policy success given the relative strengths and limitations of their political structures? In the case of Chicago, the main reason for their success, i.e. a strong mayor, could also be their downfall. Chicago faces both serious budgetary pressures and increasing discontent over the ‘slush fund’ from TIF districts—some of which goes towards green roofs—and which is larger than the entire city budget. There is also a consistent popular perception that TIF district money goes towards already-wealthy areas (Guzzardi 2010), which may increase pressure to disband them. Given the seriousness of the budgetary crisis, it is unclear whether the new mayor will be as supportive of environmental policies, or if he will have the same level of power as Mayor Daley. Chicago bureaucrats have been aware of the weakness of linking green roofs too strongly with the former Mayor Daley, and have been trying to work towards solidifying the policies into legislation (M. Berkshire,
Department of Planning, personal communication, March 13th, 2008). Moving more slowly and developing consensus, an approach that has worked well in the Netherlands, for example, might get more buy-in from the local development industry, local communities, and the public, helping to create more longevity. This is particularly true in difficult budgetary times when green roofs, as with many environmental initiatives, may be seen as dispensable.

In the case of Toronto, a lack of initial strong Mayoral leadership on the green roofs may be a mixed blessing; solidified as policy through bureaucratic means, Toronto’s green roof strategy may weather the storm of the change in mayoral leadership. On the other hand, strong mayoral leadership might help to make green roofs a strong iconic symbol for both Torontonians and for an often-complex and convoluted bureaucracy, helping to keep them on the agenda even during difficult economic times. Though Toronto under Mayor Miller was very successful at implementing many environmental initiatives, it has been admitted that his administration was less successful at selling them to the public (Lu 2009). Environmental policies that are less understood, such as green roofs, may be difficult to maintain under a change in leadership given Toronto’s short history with a strong mayor system and the need to balance many competing interests.

3.7.3. Selling green roofs to the public

The political landscape in each city has also influenced the way green roofs are framed and ‘sold’ to the public in Toronto and Chicago. This seems to have impacted their popularity and prominence, and thus the speed of their adoption. In Chicago, Mayor Daley linked green roofs with larger urban greening and revitalization plans, notably green buildings and the very popular Millennium Park, making green roofs the symbolic figurehead of a larger environmental program. Urban revitalization and a focus on green building showcased Chicago as an innovative, green, and forward-thinking city in direct contrast to the declining rust-belt cities of
the Midwest. This has brought recognition and legitimacy to relatively unknown initiatives like green roofs. While any environmental initiative is vulnerable to budget cuts, the linking of green roofs with the former mayor’s larger program of revitalization, which is an important element of keeping Chicago competitive, may be able enough to weather the storm in times of fiscal hardship. It may also be linked with nepotism and overspending, however, and be jettisoned for being too closely associated with Mayor Daley. Given this change in political landscape and the current budgetary crisis, it will be interesting to see if Chicago’s green roof program will survive, and if they do, if there will be the political will to re-instate their green roof incentive programs.

In contrast, while Toronto is already seen as a relatively progressive, green city, green roofs are one of many environmental initiatives in Toronto and tend to get lost among other better-understood initiatives such as recycling, which is more visible. The success of Toronto’s green roof policies may require stronger public buy-in and a continued perseverance despite political and budgetary pressures. This might be done by better promoting local research on green roofs that would help Toronto justify their inclusion in public policy. The recent inclusion of green roofs under the larger umbrella of climate change initiatives, which Toronto has traditionally excelled at in terms of leadership, will also help legitimize green roofs. This gives green roofs the kind of holistic environmental power that was lacking when solely funded as a stormwater measure through Toronto Water. This may help keep Toronto’s green roof policy despite changes in leadership.

3.7.4. Funding

The speed of Chicago’s implementation may also be partly explained by a larger availability of funds for urban greening projects than Toronto. The power held by Mayor Daley, and the large settlement from the utility, means that Chicago was less involved in an extensive bargaining process to secure funding for green roofs common in a more consensus-based political approach.
Combined with a much larger parks and recreation budget generally (City of Toronto 2004a), an extensive use of TIF districts, and recent federal recovery and investment money (www.illinoisenergy.org), Chicago has had more money and legislative power to spend on urban greening projects like green roofs and incentive programs, thus speeding up their implementation. This is particularly true for their flagship green roof on city hall which features centrally in all their promotional material. While Toronto has responded to criticisms from the green roof industry and raised the amount available for green roof incentives, it has traditionally been more difficult for the City to allocate money for green roof initiatives. This may have been partially solved by linking green roofs with better-funded initiatives like climate change, which has helped Toronto increase green roof funding and initiatives. While the effectiveness of incentive programs may be limited in terms of the number of green roofs it produces, as a marketing tool it encourages more widespread adoption and popular support, particularly among small businesses and community groups.

3.8. Conclusions and moving forward

What does all this mean for cities attempting to adopt urban greening strategies as part of being a “green” city? Green roofs, as a new green technology, require a fairly high level of municipal leadership and cooperation for their implementation. In examining the case studies of Toronto and Chicago, both cities aiming to be green leaders, three things stand out.

To begin with, theoretically supporting green roofs in public policy documents does not seem to be adequate for moving green roofs forward. Both private and public institutions have been wary of green roofs due to their higher initial cost and the newness of the technology. Furthermore, the combined public and private benefits of green roofs means that few developers will see a strong return on their green roof investment based solely on privately accrued benefits. In this sense, strong leadership in terms of publicly visible, and preferably accessible, green roofs can
provide both the building industry and the public with education and examples on the new technology. This needs to be combined with policy tools that either provide an incentive that is valuable to developers, such as density bonusing, or force the development industry to consider green roofs for the larger public good, ideally giving them publicity and acknowledgement as compensation. This has been Chicago’s most successful tool for implementing green roofs, and may prove to be Toronto’s as well. Providing both education and leadership can help to build capacity and understanding in the local development industry while promoting green roofs as a green building, and thus popular, option.

As we have seen, however, political power and funding are necessary in order to move green roofs from theory to practice at a municipal level. The particular political structure of a city is highly influential on how urban greening initiatives are both framed and implemented, if at all. Understanding the limitations and peculiarities of a city’s political structure will enable a city to better understand how and where green roofs should fit into its urban greening program. As most cities do not have the political landscape of Chicago, Toronto may be a more realistic model for green roof policy implementation, and should be watched as the new legislation completes its first year anniversary. For cities without the funding available to Chicago, there are a few lessons to be learned. Creatively using other forms of funding, whether from utilities, state or federal governments, or other sources, will help pass initiatives in a tight budget climate.

What is clear is that municipal environmental programs are vulnerable to changes in leadership, and require, as much as possible, solidification in terms of by-laws and planning directives in order to ensure their survival during conservative leadership or budgetary crises. Furthermore, ensuring that environmental initiatives engage communities will help to lessen the either/or choice between environmental initiatives and social justice and equity issues, a critique that has clung to both Toronto and Chicago’s green roof initiatives. To be truly successful, they must. A great example of this is Majora Carter’s ‘Greening the Ghetto’ campaign that greened a depressed south Bronx, NY neighbourhood by training unemployed locals in green roof
installation (Carter 2009). Linking green roofs to food security issues would have similar power, and such connections are occurring in Toronto where green roofs have begun to get grassroots support from local community services such as the Toronto Food Policy Council (Etter 2009).

Lastly, the framing and “selling” of green roofs can have an enormous impact on their level of acceptance and popularity, both locally and internationally. In an age of competitive global cities, branding can have an enormous impact on the success of a city’s image. Chicago’s reputation for boldness in architecture is being transformed into boldness as a green city pushing environmental initiatives. Chicago still has many environmental problems, and is still a dirty city dependent on coal-fired power (Gorrie 2007), and yet it is now competing with very green cities such as Portland, Oregon and Toronto. Green roofs, though they form but one part of an effective city greening program, are highly symbolic, bold, and popular. Using green roofs as a symbolic figurehead, as Chicago has done, can help to promote other less understood initiatives, as well as more holistic ones that have multiple benefits. Branding a city as supporting green roofs can thus be an effective means of turning a city’s image around and developing a groundswell of support for environmental initiatives, even in a city not known for its environmental ethic (Aston 2008). For cities similar to Toronto with already well-established environmental initiatives, linking green roofs with larger environmental programs, particularly those that are viewed as beneficial to the public good and public health, can increase their acceptance and relevance. This linking can provide both financial and groundswell support for green roofs. Environmental initiatives may not always be understood by the general public, but visible initiatives such as green roofs, urban revitalization and street greening help convey the idea that they city is doing something environmentally friendly. If combined with strong leadership and symbolism, green roofs may be able to build both political and popular support, and thus begin to change the urban landscape and mitigate against environmental problems.
CHAPTER 4

4 ‘There’s a Meadow Outside my Workplace:’
Phenomenological Explorations of Place, Green Roofs, and Aesthetics in Chicago and Toronto

4.1 Introduction

This Chapter uses a qualitative methodology to address some of the gaps in specifying nature and sense of place outlined in Chapter 2. The results of this chapter informed the survey, and resulted in the inclusion of questions “are green roofs nature?” and a measure on the importance of nature in their work neighbourhood to the survey.

The current green roof trend in North America exemplifies the ambiguous values and perceptions we have about nature in the city. Green roofs reduce stormwater overflow and the urban heat island effect by placing a layer of vegetation on unused rooftops (Chih-Fang 2008, Bliss, Neufeld and Ries 2009), but they also raise complex questions about the role and character of ‘nature’ in the city. For example, while many of the first green roofs were sedum-based, there has been a growing inclination to mimic the native habitat of a region, juxtaposing prairie meadows with steel, glass, and concrete in central business districts. This is particularly interesting given the traditionally-ambiguous responses to naturalized urban areas by residents (Spears 2005, Gobster 2000), and long-standing debates over what counts as ‘nature’ in the city,

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8 Ground cover-like succulent plants often found in deserts or alpine regions; sedum is the generic name that covers many varieties
and where (Hough 2004b). In this sense green roofs, which lack the symbolism of lakes or forest, are an excellent lens through which to explore the human relationship to nature in cities. There is almost no research on how these urban greening projects are perceived, although they are often overlooked by thousands of workers. This paper seeks to fill this gap by exploring the human relationship to nature through office worker perceptions of green roofs in Toronto and Chicago, two cities which are leaders green roof implementation (Chapter 3). Through a phenomenological analysis of fifty-five semi-structured interviews, this paper asks a), What do participants think and feel about green roofs? and b), what can we learn about the human relationship with nature, especially as mediated by the city, through their responses? Understanding how we value and think about urban nature will help with the development of green roof policies as well as contributing to our understanding of how nature affects our daily lived experience of place in cities.

The first section of the paper outlines the different ways in which urban nature and green roofs have been studied, and introduces the case studies and methodology. The next section examines the human relationship to nature through office worker perceptions of green roofs using five themes that emerged from a phenomenological analysis of the research: fascination, aesthetics, green roofs and nature, green roofs and symbolism, and health/well-being. The last section discusses these findings in light of our current understanding of the human relationship with nature, with particular attention to the role that expectation, intention, and the hinterland play in mediating participant perceptions of green roofs. The paper concludes with implications for urban greening projects and urbanites' lived experience of downtown business districts. Toronto and Chicago are treated together unless the responses warrant separate treatment.
4.2. Current Research on nature in cities and green roofs

There are three main approaches to understanding the role of nature in cities. The ecosystems approach looks at how greenspace, and what types of greenspace, can be preserved or added to the city to reduce the urban heat island effect, stormwater overflow, cool the city, and provide habitat for urban wildlife, among other benefits (Ong 2003, De Ridd et al. 2004, Jim 2004). This approach underlies the policy impetus for urban greening programs such as green roofs, urban forest preservation, naturalization and habitat corridors.

The human benefit approach looks at the social, psychological, physical and economic benefits of greenspace in the city, such as the social and health benefits of parks (Gobster 1998, Chiesura 2004, Thompson 2002), greenways (Gobster 1995) and the urban forest (Westphal 2003, Tyrvainen and H. 1998). Most of this research demonstrates the psychologically restorative benefits of nearby nature for urban residents (Taylor et al. 2001, Kaplan 2007, Kaplan 1995, Kuo 2001). A subset of this research looks at aesthetic preferences for different types of nature (Kaplan and Kaplan 2005, Ulrich 1993), and argues that Anglo-Americans in particular tend to prefer large, mature trees, savannah-like grass, less ‘messy’ woodlands and bushes and large, open bodies of water. The underlying theoretical premise for most of this work on restorative nature and aesthetic preference is from an evolutionary biology perspective in environmental psychology, and hypothesizes that these preferences are primarily innate and helped to ensure our evolutionary survival (Ulrich 1993, Kaplan 1995). Integral to this approach is the idea that humans are drawn to and fascinated by nature through long contact with it during our evolutionary history, and that this explains the prevalence and persistence of nature and animal motifs in our cultural symbols and mythologies (Kellert 1993a, McVay 1993).

However, most social constructionists, - who have long argued that the human relationship to ‘nature’ is socially mediated and constructed - reject the argument that our reactions to nature are
innate. This third approach to the human relationship to nature has deconstructed Anglo-American idealizations of wilderness (Merchant 1995, Nash 1982, Talbot 1998), the nature-city dualism, (Cronon 1995, Williams 1973) and ‘nature’ itself (Braun 2008, Castree and Braun 1998, Smith 1996) and has proven helpful in explaining conflicts over ecological restoration and naturalization projects (Gobster 2000, Nassauaer 1995). Of particular relevance to this paper is the social constructionist understanding that ‘nature’ is a complex phenomenon, and that ‘bringing ‘nature’ back to cities’ first begs the question of ‘which nature, and where?’ This has been seen clearly in idealizations of ‘wildness’ outside the city, for example in cottage country, but the rejection of it as an aesthetic paradigm in the city, seen in naturalized lawns (Hough 2004b, Wilson 1991).

Research on green roofs has predominantly followed the ecology approach to studying urban nature. The vast majority of studies look at technical or biological characteristics of green roofs as they impact their thermal and acoustic performance (Alexandri and Jones 2007, Theodosiou 2009, Van Renterghem and Botteldooren 2009), their ability to reduce stormwater overflow (Czemiel Berndtsson 2009, Seters et al. 2009), and on plant selection and performance (Rezaei et al. 2005, Monterusso, Rowe and Rugh 2005). Only a handful of studies have looked at perceptions of green roofs. Two studies have used photos of green roofs, psychological metrics, and statistical analysis to assess respondents’ attitudes towards green roofs (Lee and Koshimiz 2004) and the possible restorative benefits of green roofs (White 2008), while three more surveyed suburban residents on their knowledge and of and desire to install green roofs (Calkins 2005, Kuper 2009, Smith and Boyer 2007). Smith and Boyer also found that residents often didn’t like the ‘messy’ look of green roofs that contrasted with the standard suburban lawn aesthetic, supporting some of the work by social constructionists. There is only one study that has used qualitative methodology (interviews and focus groups) to assess perceptions of residents about a green roof on the deck of their building, (Yuen and Hien 2005). This study is also the only one to use a real green roof versus images. None of the studies examined the workplace, and none have looked at perceptions of respondents who both look out at a green roof and/or can access it physically. Given the thousands of office workers who look out onto a green
roof in North America and the complex symbolism and meanings associated with nature, understanding how they think and feel about green roofs not only addresses the lack of qualitative work on green roofs, but is an interesting case study to examine the human relationship to nature in cities.

4.3. Research Design and Case Studies

Both Toronto and Chicago have been promoting green roofs since 2000. They are frequently compared for their urban greening policies given their similar population size, climate, great-lake environmental problems (City of Toronto 2007e, Gorrie 2007, Rothblatt 1994, Wente 2007) and green roof policies (Chapter 3). Though similar, they also have a few differences relevant to this research. Chicago’s architecture, extensive lakeshore parkland, and swimmable beaches\(^9\) make Chicagoans much more connected, symbolically and physically, to Lake Michigan than Torontonians are to Lake Ontario. Furthermore, the strong iconic presence of forested cottage country and a much-loved provincial park just north of Toronto, both classic symbols of Canadian wilderness, means that for many Torontonians ‘nature’ is generally imagined and valued as ‘up north’. This symbolic value of forest is quite different than that of long-lost prairies for Chicagoans, which despite attempts to make the prairie native again (Meine 2008), does not seem to have the same iconic power.

Toronto and Chicago’s green roof leadership and similarities were the main impetus for their selection as case studies. Specific green roofs were selected through the criteria of being overlooked by office workers in a downtown district, and of being accessible to the researcher as a result of contacts from work experience in the green roof industry. Determining which

\(^9\) Though Toronto does have a few Blue Flag beaches most of the population remains suspicious of Lake Ontario’s water quality and few residents swim in it.
buildings overlooked or had access to the green roofs was done by a combination of archival research (i.e. real estate databases) and site visits. The Chicago City hall green roof, which is well-known and directly overlooked by thousands of office workers, as well as a sedum roof also visible to office workers (161 N. Clark), was chosen as the Chicago case study (see Figure 4.1 and p. 111). In Toronto, the green roofs on the Mountain Equipment Coop, 401 Richmond, and 215 Spadina are reasonably well-known in their area, overlooked by office workers, and thus were chosen as case studies (see Figure 4.2 and p. 112). Three case studies were chosen in Toronto due to the smaller number and height of office buildings in an attempt at parity between the case studies. 401 Richmond and 215 Spadina are also accessible green roofs.

Figure 4.1: Chicago City hall and surrounding buildings
Participants were selected based on their access to one of the case study green roofs and were contacted using a snowball method that included listservs and direct contact. Recruitment continued until saturation was reached, with 26 participants in Toronto, 29 in Chicago, and approximately equal numbers of men and women. Though participants were sought across a representative stratum of income and ethnicity, the populations in each case study were predominantly white and middle to upper income, which is representative of these work neighbourhoods but less diverse and wealthier than Toronto or Chicago’s populations.

Figure 4.2: David Robinson on green roof on Mountain Equipment Coop, Toronto, and surrounding buildings
It was also difficult to get participants who did not have access to the green roof or who were less interested in urban greening, and thus the participant base may be somewhat more ‘green’ than the general population, particularly in Toronto where the offices tended to be non-profits and arts media.

The goal of the interviews was to allow participants to respond in their own words and draw out their narratives and lived experiences of nature, nature in the city, green roofs, and their health/well-being (see Appendix A). This paper focuses on participants’ responses around green roofs and builds on a phenomenological approach. Phenomenology looks at the world as we experience it in an everyday way and as things are experienced in themselves, not as we conceptualize or theorize it (Husserl 1970, cited in (Orbe 2000)). By attempting to get at the essence of the phenomena under study, phenomenology is well-suited to:

..render clear, explicit and complete those features of the phenomena that have been taken-for-granted and embedded in everyday practice without resort to the theoretical concepts whose meanings are ambiguous, contested, and serve only to conceal what is of the essence”

(McNamara 2005, Orbe 2000)

In practice this means drawing out what is underlying participants’ attitudes and influencing their perception, but which they may not have articulated to themselves. This is important when examining something as complex as our relationship to nature, which, as has been demonstrated by social constructionists, is replete with cultural, social, and historical values that may seem inherent and natural. Similarly, it is important for examining how participants experience the place of their central business districts- likes or dislikes are unlikely to help us to understand their daily lived experience of place (Relph 1976). From this analysis five main themes emerged: fascination, aesthetics, green roofs as part of ‘nature’ (or not), symbolism, and well-being. These five themes are explored in the next section.
4.4. Results

The following sections begin to answer the first research question, which is how participants felt and thought about green roofs. In general, most participants associated green roofs with some sort of environmental benefit, mainly due to the association of plants and greenery with the mitigation of air pollution. Green roofs were also generally thought to be a good idea. Importantly, participant responses were mediated by the scale or size of the green roof, the distance they were from it, and the aesthetics of the green roof. For example, those who looked out directly onto a green roof, particularly at eye level, indicated that the green roof made much more of an impact on their daily experience than if they could only see a small sliver in the distance. The environmental values of the participants also influenced their perception of the green roofs, though not always in the same way, as we will see. These mitigating factors influenced the responses and the themes that emerged from participant perceptions of green roofs that will be discussed below. All participants have been given pseudonyms to protect their identity.

4.4.1. Surprise and Fascination

The relative novelty of green roofs in the North American urban landscape was reflected in many participants’ surprise over the green roof when they first saw it, surprise in particular that vegetation could exist in a landscape of mostly glass, steel and concrete:

Well, it’s just like this piece of concentrated vegetation existing – like I don’t really – I see just looking out the window right now, I see a few trees, but mostly I just see concrete, metal, cars, buildings and stuff, but I don’t really see any vegetation out there, right? So it’s hard to believe that it can exist where there’s really no – what’s the word I’m looking for? It doesn’t seem this type of environment would be conducive for vegetation to exist.

(John, Toronto)
Many participants, particularly those who saw any sign of nature in the city as a sign of hope or progress, also viewed the green roof with delight:

> When I look… to the Mayor’s garden, it’s a positive experience. I just feel a certain sense of delight and a little bit of smugness that, here we are in the middle of the city and yet we get to see this green thing. So, I think psychologically it certainly is a positive thing. (Peter, Chicago)

On a daily basis many participants found themselves attracted to the green roof almost unconsciously. They would be chatting on the phone, or looking out over the cityscape, and would find their eyes drawn to the roof:

> What always will happen is when you’re on the phone and you have a chair that has wheels on it, just by force of habit, you’ll be – you know, your mind will be elsewhere, but you’ll happen to just kind of – when I find myself noticing it, I instinctually am drawn to it or continue to look at it without thinking about it, with my head completely somewhere else, but I will stay focused on it just out of some, I think, truly, just natural, instinctive pleasure that I derive from plants and nature. (Zsolt, Chicago)

This fascination and pleasure in viewing nature also meant that many participants actively sought the green roof out of curiosity—was anything different? Had anything changed? For many office workers, the green roof was one of the only cues to seasonal change from their windows. For those with close access to the green roof, the view proved particularly fascinating: “Even when it’s windy and raining, it’s - there’s something going on across the roof….just staring at it, it’s just beautiful, you know, and the colors.” (Jennifer, Chicago). An integral part of this fascination, this knowledge that something was going on, was the aesthetics of the green roof.
4.4.2. Aesthetics

All of the participants agreed that the green roof was preferable to looking out at a black tar or gravel roof, but there was considerable ambiguity on whether participants liked the aesthetics of the roof. Though the prairie is long-gone for most of the Midwest, except in neglected patches (Gobster 2001a), most Chicago participants recognized the city hall as a prairie aesthetic: “…this one gives the appearance of you’re driving down a country road and there’s that prairie and it’s completely overgrown and it’s very wild and very – it’s just very wild-looking.” (Zsolt, Chicago). The MEC green roof in Toronto also has a prairie aesthetic, but this was really only recognized by participants who had grown up in the prairies: “…but I’m sure every time that I see it subconsciously, it reminds me of a natural prairie setting.” (Tom, Toronto). While some participants found the prairie aesthetic wild, beautiful, and intriguing, many also found it messy, unkempt, and too ‘wild looking’:

It seems not very well maintained, not very well landscaped, but I’m no expert….This particular Green Roof it seems weedy, it seems almost like they’re just letting it grow naturally and not really putting a lot of care in it, but then who knows?...Just looking at it, it looks like a bit of an overgrown prairie that’s not being maintained properly. (Zsolt, Chicago)

This acknowledgement that the ‘natural’ aesthetic may be on purpose, but was not preferred, was very common among participants, especially in Chicago. The green roof in particular was contrasted less favourably with the bright colours and order of the median planters that were part of Mayor Daley’s urban revitalization in the loop business district. Here messiness, or a lack of order in the green roof, was linked to a lack of care and neglect. This may be in part to expectations participants had about what kind of ‘nature’ to expect in the city, and where. As one participant expressed about his dislike of the messiness of the Chicago city hall green roof:

And I suppose if I’m the wilds, I don’t expect – maybe it’s based on expectation. If I’m in the wilds, I don’t
expect to see a beautiful cultivated garden or plants or everything in perfect order…but I do love being out in the wilderness and in there, that’s what I expect…. In the city, I’m thinking more about what’s uniform and again, what I find to be beautiful flowers to look at and I don’t see that up there. (Mark, Chicago)

This idea of expectation also brought up the issue of control in the city:

I think there’s a lot of ways to control a city environment, and I think that’s one of the reasons why it’s not as conducive to clear thought because you’re always thinking, “If that person would just shut off their iPod then I’d maybe be able to focus on what I need to read, you know, here.”, or something like that. Where you don’t have any control over that cricket. You can’t turn off that cricket, so you accept it and it becomes part of your environment….If you accept that crickets have to be chirping and the stars have to be out and that the wind has to be blowing at whatever speed it’s blowing, then it just becomes part of you with what’s around you and essentially part of what you are. (Tim, Chicago)

Interestingly, participants who had physical access to a green roof with a similar aesthetic in Toronto, or who watched it over time, said that they started to understand why it was left natural, that they started to get it:

At first, I thought it was kind of weird that they don’t really… tend to it or have it like a garden and I’m like, “Well, I guess it’s not a roof then.”, like a Green Roof where…, but now I do understand. Letting it…It’s just more natural. (Jane, Toronto)

This raises the issue of the influence of access to the green roof on participants’ perceptions. Participants who were further away from the green roof could not see much detail, colour, or variation, resulting in surprise for those participants who subsequently visited the roof:
And then to come up and see all this diversity of plants and the ‘nature’ that’s using it, then it kind of connects for them. They go, “Oh, this is just like a wild lands in a park” or some cottage area where they go to or something. They can connect that. They see, “Oh, nature would use this as a stopping place to get to the lake or to continue on somewhere, bees for pollinating” and that sort of thing. (Robert, Toronto)

This direct experience of the variety of plant and animal life that existed on the roof usually resulted in more appreciation and understanding of the purpose and rhythm of the naturalized green roof, particularly if birds or bees used it as habitat. This appreciation was particularly apparent in participants who had a strong environmental awareness.

For participants who only experienced the green roof visually, the more manicured aesthetic more common to a sedum green roof, especially at a distance, was not found to be nearly as interesting or appealing, despite these same participants’ dislike of the messy quality of the ‘prairie’ green roof. The green roof on 161 N. Clark in particular was found to be half-finished, unappealing, and less intriguing:

“…it doesn’t entice you to dig further and deeper into it to understand the system. So for that Green Roof over on the parking garage, it doesn’t invoke anything. It’s just ‘eh’, where it just looks like someone spit up carpet or grass on a roof and that’s about it, whereas at least the one on City hall, yeah it’s not accessible, but from those that can view it, at least evokes something. (Bethany, Chicago)

Thus though the prairie aesthetic was not always understood or liked, participants found it much more interesting and engaging than a more manicured, or lawn, aesthetic, particularly if the green roof was understood to have its own logic or rhythm as habitat for wildlife in the city. Despite these attitudes towards the aesthetics of the green roof, those participants who assumed the green roof was installed purely for energy efficiency or stormwater management reasons also assumed
that the naturalized aesthetic had some environmental rationale and was not intended to be pretty. This was particularly true in Chicago where green roofs were more widely promoted as helping to reduce energy costs by the City. The aesthetics of the green roof were also instrumental in participants’ understanding of the green roof as part of ‘nature’ or not, which will be discussed below.

4.4.3. Green roofs = nature?

Though I asked this question directly, it was also a recurrent theme in many participants’ answers. Central to this question is the ambiguity many participants felt about green roofs as nature. While some felt that the presence of wildlife or plants, i.e. something ‘wild’, meant that it was nature—“Oh, of course! They’ve got bees!” (Melanie, Chicago), others felt that the obvious role of humans in creating a green roof moderated the ‘nature’ aspect of green roofs. This meant that green roofs were seen to be an attempt at nature, but not the real thing: “…um…..I want to say yes, but I feel it’s implemented nature.” (Judy, Toronto). Partly this reflects the ambiguity of ‘nature’ as both a place and a thing, or Nature versus nature:

Um….Is the Green Roof part of nature?... Yeah. I mean, it’s, it's trees and plants. It's not nature for me in terms of being my vision - when you say what does nature evoke visually for you, nature is the untouched world. If you say, "I'm going out into nature", that doesn't mean I'm coming out to the Green Roof. That means I'm going out into, you know, camping or out into the woods. If I'm coming out to the Green Roof, that's a man-made construct. That, um, it's nice. It's lovely. It's green and everything, but that, to me, isn't nature. (June, Toronto)

This also raises the issue of how humans experience, and thus understand, ‘nature’. For some participants, such as the participant quoted above, this meant that nature is something you immerse yourself in, can touch, smell, and experience more than visually, a sentiment echoed by
Joe: “...would I consider it part of nature? I think, you know what, if I went up there and sat down in the grass and read a book and enjoyed it, then yes, I would consider it part of nature.” (Joe, Toronto). For those participants who understood nature as a place, the juxtaposition of the green roof with buildings reduced its immersive, natural effect:

So, is that like nature? A little bit, but it’s hard for me to say, ‘Oh, yeah. I feel like I’m in a nature preserve.’ because I can’t look at that without seeing concrete all around me and buildings. (Mark, Chicago).

Though much of this confusion centers on the influence of scale and access, underlying many participants’ responses is an ambiguity around how they felt versus thought about the green roof:

It feels like it is (part of nature). I think that there’s this conscious separation for me that says it’s not specifically nature probably because I knew it was constructed and planned and put together rather than just happening on its own. But I think the end result feeling is that it’s a part of nature when it’s all done. (Dolores, Chicago)

This raises questions about how participants experienced or thought about nature in the city, which will be discussed below. Lastly, participants with strong environmental values either saw the green roof as mitigating or compensating for environmental damage wrought by humans, or as not nearly enough given the destruction of wilderness and habitat outside the city. In this sense green roofs became symbolic of larger environmental values, which we will see below.
Green roofs do not have the traditional symbolism or history associated with them as with more traditional forms of nature, such as forest or lakes. Instead, participants viewed green roofs as symbolic of the values and intention of the person or organization assumed to be responsible for their implementation. In Chicago, this was Mayor Daley, and the City hall green roof was often referred to as “…the Mayor’s garden.” (Anna, Chicago). This is due largely to the high level of publicity around green roofs as a mayoral initiative, but it is also due to the larger program of urban greening in Chicago promoted by the mayor, of which the green roof was assumed to be a part: “So when I saw the Green Roof, it just was another extension of what seemed like all these wonderful things that Chicago was doing to bring flowers and green and trees into the city.” (Dolores, Chicago). This greening was strongly associated with a sense of pride that the mayor was promoting environmental initiatives that improved both the public experience of the city and showcased city to the world as progressive and green:

And I think people are more proud today to be Chicagoans in no small part because of the greening of the city. I mean, it is a beautiful city….I think they enjoy the experience more because it's greener. I know I do. I know I, you know, I can't put my finger on the tangible effects of it, but you just feel different when you can run around the city and see these greening initiatives. It's, it’s great. People love to come here, and you want to be proud of your city as a Chicagoan. We've always been proud of Chicago as an architectural landmark and an architectural template in terms of buildings, and to be able to wed that to greenery that lives up to that standard of architectural integrity, architectural excellence is nice. It really makes Chicago a global city, and as a citizen, you always want to be proud of your city. (Donald, Chicago)

Green roofs and other greening initiatives thus became symbolic that someone cared about participants’ lived experience of the city, that it wasn’t all about money, that the city’s values reflected their own in this respect.
In Toronto green roofs were also associated with the organization assumed to be responsible for their implementation, in this case the MEC or the owners of 401 Richmond and 215 Spadina:

“...I thought that the MEC Building, which has, I guess, a Green Roof,... was something unique to them in that it was part of their, I guess, motif or branding to be environmentally friendly.”

(Matthew, Toronto). As in Chicago, participants saw the green roof as reflecting their own environmental values, and in particular as compensation and recovery for human destruction of the environment:

> Well, my understanding about Green Roofing and all of that is it’s a sustainability project that many cities have adopted, and it’s like a replacement….Because we are expanding our cities quite a bit and there is a lot of greenery that is being lost and, and/or not preserved within the city.

(Elaine, Toronto)

This association of green roofs with recovery, and pride in the values of the organization who installed it, reflects green roofs as placeholder for the environmental values of the participants. This was often linked to a sense of hope and well-being, which will be explored below.

### 4.4.5. Green Roofs and Well-being

Asking participants about the relationship between green roofs and their health is complicated by ambiguity over whether green roofs are part of nature and the differentiation between health/well-being. For those who felt that ‘nature’ needed to be immersive and large-scale to be beneficial, i.e. that nature was a place, green roofs were not generally viewed as affecting their health very much. These participants expressed the desire for the green roof to be accessible, and for the need for more green roofs, for any health benefits to be felt. Participants who felt this
way interpreted both health and green roofs in a very literal, scale-oriented way: one green roof will not clean the air as much as many green roofs, and clean air impacts my physical health. This physical interpretation meant that while many of the participants found the green roof made them feel better, they didn’t necessarily associate ‘feeling better’ with their health:

It made you feel better. I don’t want to say it influenced my health… But, yes, – if it reduces your stress, I guess it would affect your health. I never thought of it in those terms. But it definitely made you feel better. (Hugo, Chicago).

However, it is in these more qualitative, affective responses where some of the more interesting perceptions about green roofs and well-being emerged. For example, most participants found that the green roof broke up the monotony and hardness of the concrete city:

Breaking the grayness, the hardness of the city, … these rooftop gardens would be a part of that…So, I respond to aesthetics. Something that looks nice, something that breaks the monotony, something that is intriguing that’ll have me stop for a moment and look at something. (Peter, Chicago)

This softening of the city provided a balancing and release against the stress of the CBD: “It’s a balancing and kind of emotional release to look out and see a garden versus concrete everywhere” (Iris, Chicago). Participants also often mentioned the calming effect of the presence of the green roof: “I do believe that having Green Roofs, or having trees on top of buildings brings a bit of a calmness to people, and that reality check of not just buildings, and coldness, and corporate world” (Jackie, Toronto). Though participants who had access to the green roof found more stress relief, even looking out the window at the green roof provided an escape from the stresses of long hours at the office and numerous demands on participants’ time:

Um, It just kind of gives me just a sense, like a few minutes of quiet. I can, you know, – I find it easier to reflect looking at something, some tree or a plant or flowers, a field and that’s
kind of what it reminds me of. It reminds me of a meadow or something.  
(Elaine, Toronto)

This ability of the green roof to evoke other nature experiences, such as reminding them of a meadow, often brought participants back to a happier time, often in childhood:

I think that it exudes the same feelings of that I would’ve gotten when I went out into the woods when I was growing up. When I enjoy the Green Roof, when I enjoy the Chicago planters, it’s that same sort of happy, free spirit feeling that things are good, things are beautiful.  
(Dolores, Chicago)

Gazing out at the green roof also helped them gain perspective in their work and helped them to creatively solve problems. More than one participant mentioned that the green roof helped them to “…get back to basics” (Melanie, Chicago), put things into perspective (Maurice, Chicago) and clear their head to better approach their work (Jane, Toronto). Lastly, the presence of the green roof gave many participants a sense of hope about a re-balancing of the natural and human-made world: “But I feel hope. I guess I feel hope when I come up here. I think people are making an effort to try and reintegrate environmental considerations into our built world and that makes me feel hopeful.”  
(June, Toronto). These more affective, nuanced perceptions of the relationship between green roofs and participants’ health/well-being point to possible ways to understand the human relationship with nature in cities, which is the focus of the next section.

4.5. Discussion

What does this tell us about what participants think and feel about green roofs? What can we learn about the human relationship to nature, especially as mediated by cities, from participants’ perceptions about green roofs? Central to answering this question is the phenomenological
distinction between a more straightforward reporting what people have said and how this relates to the literature, and using what people have said to explore, in more depth, why they feel a certain way, and what common threads are influencing their feelings, ambiguities, likes and dislikes. For this reason, for each section below there will be a brief answering of the first question “what do participants think and feel about green roofs?” before using this as a point of discussion for what this might mean for our understanding of the human relationship to nature in cities, implications for designing the ecological city, and improving the lived experience of place in downtown central business districts.

4.5.1. Fascination and the natural world

A central theme in participants’ narratives is their fascination with green roofs, of being drawn to them almost inadvertently while thinking about something else. This is partly due to their novelty, and participants’ surprise that vegetation existed on top of buildings, but it is also, and fundamentally, due to the association of green roofs with some aspect of nature, shown by the preference by almost all respondents for any kind of green roof over tar or gravel roofs. This was true even when participants were unsure, or even disliked, the aesthetics of the green roof. Participant’s fascination with green roofs as linked to nature thus supports work in environmental psychology that argues that humans are not indifferent to the natural world and are drawn to it (Wilson 1993, Ulrich 1993). What can participants’ fascination with green roofs tell us about the human relationship to nature, especially as mediated by cities? To help answer this question, it is instructive to look at the responses of participants who had closer access to the green roof. Participants who watched the green roof over time and who were close enough to notice detail, change, and texture expressed this recognition of otherness, separate from the concrete and glass buildings. This was particularly true for the green roofs that mimicked a prairie aesthetic; the sedum green roofs were generally not found to be nearly as interesting. If animals or birds used the green roof as habitat, such as the bees on the Chicago city hall green roof, the fascination increased, as did the understanding that the green roof had a purpose and a rhythm that was outside of human control or understanding.
This kind of watching often led to a letting go of ideas about what the green roof should or should not be, what it should look like, what it should do; in short, to a letting the green roof be as it is. Understanding through watching and a letting go of assumptions and expectations parallels a more phenomenological way of understanding the world which tries to let things be in their presencing, in their own way of unfolding and being in the world, while letting the categories we impose on things fall away (Heidegger 1971). This kind of knowing has been called a meditative versus calculative way of thinking (Stefanovic 1991, Heidegger 1966), and is in direct contrast with much of the kind of thinking required by white-collar work. However, meditative thinking is conducive to creative work and problem solving as mentioned by some participants. Participants’ reactions to some of the green roofs therefore support some suggestions in phenomenology that nature can serve as a possible vehicle, or cue, to this kind of knowing and awareness (Stefanovic 1991). This kind of knowing and fascination, as triggered by aspects of nature, may be in short supply in central business districts, which with their concrete and steel leave urbanites without many cues to the natural processes, seasons, or habitat that survives in the crevices of the city and outside its boundaries.

4.5.2. Aesthetics

The aesthetics of the green roofs both challenged what type of nature was expected in the city, and where, for participants, whose responses ranged from appreciation over the ecological variation of the roof to dislike at its wildness and messiness. What do participants’ attitudes and feelings towards the aesthetics of the green roofs tell us about the human relationship to nature? If examined more closely, underlying participant responses are themes of the hinterland, expectation, and control. In the case of the prairie-style green roofs, though the prairie in Chicago is long gone, almost all the Chicago participants recognized the City hall green roof as prairie-like, and referred to experiences in the countryside either driving as adults or playing as
children. This is interesting since most of the land around Chicago has been long converted to farming, and prairie only really exists in small patches closer to the city that have been neglected by developers or agriculture (Gobster 2001b). In Toronto, only participants who were from the prairies, or had experienced the prairies, recognized the prairie-style green roofs as such, though participants still preferred them to sedum-style green roofs.

As expressed by the participants, however, recognizing the aesthetic of the green roof as linked to the hinterland does not necessarily mean that it is liked or appreciated. While many participants thought the wilder-looking prairie green roofs were beautiful, and reminded them of experiences in nature, just as many thought they looked unkempt, messy, and neglected. This association of ‘wildness’ in the city with neglect has been pointed out by Hough (Hough 2004b)(1984) and Nassauaer (Nassauaer 1995), and links back to Victorian ideas of public health and sanitation which tried to hide and direct out of the city the processes and messiness of nature (Kaika 2006). Straightened rivers, concrete embankments, and filled in wetlands are all urban legacies of the drive to ‘improve’ the messiness of nature with the knowledge and control of science (Olwig 1984). Though the ecological consequences of this kind of engineering is partly behind current urban greening goals to work more in tandem with local, natural processes, it would appear that the aesthetic of this type of city planning is not necessarily understood or appreciated by urbanities and directly conflicts with the messaging inherited from modernist city ideals of planning, beautification, and sanitation.

This legacy of controlling nature also influences what kind of nature is expected in the city, seen in one participant’s discussions of not expecting ‘wild’ nature in the city, but order, bright colours, and uniformity. This expectation of order and beautiful flowers extends to seasonality and plant behaviour during drought periods; for urbanites accustomed to green lawns regardless of the weather, and buildings that seem to be impervious to weather and time, seeing the Chicago City hall green roof turn brown during a dry summer signals neglect and death, not the normal changes of a grassland. In this sense the naturalized prairie aesthetic on a green roof challenges
the idea of ‘nature’ as ‘out there’, far away from here, and unchanging, a hyperreal frozen ideal that is more meaningful than our daily lived experience (Cronon 1995, Foster 2000).

Lastly, participant ambiguity over the wilder, more naturalized aesthetic brings up the idea of control in the city. As expressed astutely by one participant, the city may give the illusion to urbanites that we can control our environment, and that therefore we should, with the heightened stress of choice and responsibility that brings. This expectation of control may help to both explain some of the commonly expressed stress of being in the city by participants, as well as the calmness they expressed when losing themselves in gazing at the green roof.

4.5.3. Green Roofs and nature

Despite participant ambiguity over whether or not green roofs are part of ‘nature’, all participants recognized at some level the ‘naturalness,’ or non-human aspect of the green roof. What can we learn about the human relationship to nature from participant responses on green roofs and nature? Participant responses on this question center around an ambiguity on whether nature that has been manipulated by humans, in this case, planted on a roof, can count as real nature, as well as issues of wildness. This sensitivity to artifice mirrors ecological restoration debates which places some independent, wild origin as nature on the one hand, and nature as a changing, shifting entity that humans interact and develop a relationship with through labour on the other (Katz 2000a, Hull and Robertson 2000, Jordan 2000a, Elliot 2000). One reinforces the nature/city dichotomy, with real nature being found outside the city, ideally untouched by humans, (or at the very least preserved), while the other imagines a more reciprocal, active relationship between humans and nature through care, labour, and restoration. This raises questions for the larger philosophical goals behind urban greening and ecology programs, i.e. connecting urbanites to nature and promoting an ethic of care and restoration. If small pieces of
urban nature such as green roofs can evoke the hinterland for some participants, despite their knowledge of human intervention, then urban greening projects may be a possible link to an ethic of restoration, connection to nature’, and well-being as part of a daily-lived urban experience. If, however, participants view the urban greening project as an inadequate attempt, albeit a good one, to mimic a larger nature that is threatened out of the city, then this raises questions about the possibility of a meaningful relationship with nature through a daily-lived experience in the city, at least on the small scale of many urban restoration programs. Though seemingly academic, the privileging of wild untouched nature outside of the city, and the devaluation of nearby nature, has been argued to frame the first as sacred and the latter as profane and therefore not worth preserving (Proctor 1995).

Underlying these questions is the idea of nature as a place, or, as seems to be the case for some participants, as an experience. Central to the latter idea is the role of wildness. Wildness is the quality in nature recognized as beyond human control, the thing worth preserving against human intervention, whether aesthetically pleasing or not. In the case of green roofs, does human intervention negate the wildness in something? Certainly participants recognized the wild aspects of the prairie style green roofs even as they acknowledged that humans placed it there. Perhaps the quality of wildness is something less thought about as perceived on a more unconscious level. This was reflected in the struggle many participants had with their conscious, thought-out understanding of nature, versus their more affective, immediate perception of the green roof; to some it felt the same way in the end. If this is true, then it may not matter if participants categorized green roofs as part of nature or not, as long as they have close, constant access to them over time, as long as they can watch them unconsciously and start to understand them and their otherness. Participants who experienced the green roof this way were more likely to feel that the green roof influenced their health/well-being, and were more likely to associate green roofs with the sense of connection, calm, and a mental break commonly associated with larger experiences in nature (Hartig et al. 1991, Kaplan 1995, Krenichyn 2006). Though green roofs and other urban greening projects do not have the awe-inspiring scale of forests or mountains, there can also be awe and inspiration found in the hiddenness and minute details of ‘nature’ if
one takes the time to stop and watch (Wilson 1993). In this sense the experience of otherness, or wildness, in nature, may be the more central question in whether or not green roofs, or any urban greening projects, are ‘nature’ or not.

4.5.4. Green roofs: symbolism, collective well-being, and edges of possibility

In addition to be associated with the hinterland, green roofs were also linked to larger environmental values about the person or organization responsible for implementing them. Importantly, what seemed to be crucial was the intention behind the green roof. This is particularly poignant when one considers that almost all prairie left in the Chicago area, or forest in the ravines in Toronto, was either neglected remnants, or deliberately preserved. This is also true for nature generally in the city; as pointed out by one participant, all nature in the city is a sign that someone deliberately planted it or preserved it. This may help to explain why though the sedum green roof fit into participant expectations of control and order in the city, it was less liked due to the perception that not as much effort was put into it, that it was left unfinished. Even participants who thought the wilder aesthetic green roofs looked messy and neglected preferred them to the plainer, less interesting green roof, and all preferred a green roof to a view of black tar roofs and dead birds.

In this way green roofs were seen by some participants to be a symbol of restoration, hope, and care; that someone had thought about and put effort towards the quality of public life, public health, and larger environmental issues. This sense of hope and restoration, of pride in their city may not be directly linked to participants’ health, but is certainly linked to larger debates around the quality of life and public space in cities, of a collective well-being and sense of place. Participant responses also raise the issue of how downtown central business districts are experienced by office workers - particularly those working in tall buildings - where there is often
no quiet place to eat lunch outside, no place of respite. The fatigue of concrete, glass and steel, of long hours with little to no access to fresh air and greenspace, the neglect apparent in the view looking down of tar roofs, dead birds, and mechanical equipment, all reveal the context in which participants experience green roofs in the city, and how the unexpected presence of meadows in the sky can give them a sense of calmness, hope, and respite.

4.5.5. Design implications for the ecological city

Participant experiences of green roofs raise questions about the kind of spaces that are needed by urbanites for a moment of respite, of creative thinking, of being fascinated by the otherness of something for a moment during the workday which may lead to more creative problem-solving. They also raise questions about the possible use of urban greening projects to connect urbanites to a lost, or disappearing, hinterland. In this sense four ideas may be relevant here.

First, the association of green roofs with the hinterland raises interesting questions about the relationship between a city’s hinterland and urbanites’ experiences, or perceptions, of nature in the city. In this sense the phenomenological attention to absence and relations between things, rather than just what is visible and measurable, might be helpful in explaining the role urban greening can have. Can cues to a city’s hinterland in the form of urban greening such as green roofs connect urbanites to the native hinterland of their region and thus form part of a city’s larger ecological and educational goals? Can green roofs help with regional placemaking? This is certainly the goal of Chicago Wilderness, a local non-profit that aims to make the prairie native again to Chicagoans through projects such as ecological restoration and habitat development (Meine 2008). If green roofs could achieve this, this may offer possibilities to change the experience of the city and break the hard greyness of downtown business districts. It is unclear whether this would work for cities like Toronto, who have a hinterland that is associated with vast forests and lakes north of the city. Though Toronto does have tracts of forest
in their ravines, these are not generally part of the daily-lived experience of Torontonians, and certainly not part of their working experience in central business districts despite progressive urban greening plans by the city (City of Toronto 2004a). Addressing the role of the hinterland in mediating perceptions of green roofs might help policy makers to align local urban greening projects with larger ecological goals.

Second, green roofs may provide unique possibilities for creatively breaking the harsh edges of the modernist city, which participants found fatiguing. Specifically, the unexpected wildness and otherness of the green roofs may be more startling because it is juxtaposed with the order, control, and hardness of the modernist architecture. Edges can be places of possibility, creativity, and boldness (Chapman 2004). Wildness in this context challenges the expectations created by the order and control of the modernist aesthetic - it opens up slippery places of otherness and possibility, of creativity. As discussed in Chapman, wildness “…can inspire extraordinary experience, startling metaphors, unsettling thoughts.” (Bennett in (Chapman 2004)). Some participants were comfortable with this, some were not, but all of them found the wildness more interesting than only having the concrete straight lines of the city. This ability of wildness to inspire creative thinking was seen in participants’ descriptions of how gazing at the green roof helped them to gain perspective and problem solve during their workday.

Third, the ‘edginess’ of green roofs may well fit into Thompson’s discussion of ‘loose-fit places’ and be a model for urban greening programs in general. These are edge places, abandoned or derelict land, or wild spaces that were often explored during childhood and which invite play and possibility (Thompson 2002). Importantly, unlike most of the modernist downtown landscapes of North American cities, these spaces are unconstrained and open to a multiplicity of uses. In this sense they parallel the freedom of childhood exploration, fascination, and wonder that participants so often reminisced about when talking about nature, and which Richard Louv and others have discussed as an integral part of a being human (Louv 2006, Milligan and Bingley 2007). They also parallel the fascination and letting go of expectations that participants expressed when watching wilder green roofs over time. However, wilder spaces are also
sometimes viewed as unkempt, scary, and inhospitable for human activity. In this sense their juxtaposition with built form, and the knowledge that humans helped to create them, may help to make this wildness more palatable and inviting for urbanites. Like Nassauer’s Cues to Care concept, in which naturalized areas are more inviting when accompanied by signs of human care and deliberate attention (Nassauaer 1995), a wilder aesthetic when combined with the bold straight lines of modern buildings may signal a new ecological aesthetic, one which may signal a more hospitable relationship between nature and the city.

Lastly, there is the question of access. As seen in participant responses on the aesthetics of the green roofs, participants who were far away from the roof could not see much detail, colour, or variation, and were astounded at the variety of the green roof once they were closer. This raises interesting questions for green roofs since they are generally meadow-like or sedums, and usually inaccessible: how could they be designed to provide this kind of experience to urbanites while maintaining their ecological goals? Are more physically accessible green roofs possible? Even the texture of the Chicago City hall green roof, which is far more detailed than most green roofs, was lost to participants who were high up or far away. Perhaps some sort of compromise between a wild, natural aesthetic, and a more structured, colour-based design, may be most effective at balancing the two objectives. Adding more colour and cues that the aesthetic is on purpose may also help to lessen association of ‘messy’ nature with neglect and disease and increase their acceptance (Dunnett 2006). If possible, this new ecological aesthetic as seen in green roofs may provide hope for both ecological and human urban health.

4.6. Conclusion

What can we learn about the human relationship to nature from participant experiences of green roofs in Toronto and Chicago? First, though green roofs are a new form of nature in cities, participant experiences of them are highly mediated by previous experiences of nature and the narratives about the hinterland of a city. In Chicago, this meant recognizing the city hall green
roof as prairie-style, while in Toronto only participants familiar with the prairie recognized it as such. Such associations also carry values with them. For Chicago, the remnants of prairie outside of Chicago evoked both the unconstrained explorations of childhood and wild beauty as well as neglect, messiness, and a stubborn resistance to the narrative of progress, control, and cultivation of the Midwest. For Toronto, many participants viewed real ‘nature’ as up north, with forests and lakes and hills, and while many found the prairie-style green roofs beautiful, they were not seen necessarily as nature- i.e. a place they retreat to. This has implications for the public acceptance and appreciation of both green roofs and urban greening projects in general. It also, if done correctly, may open up possibilities for re-connecting urbanites with the native habitat of their region.

This raises the second issue, which is the role of expectation of the daily-lived experience of downtown central business districts. Certainly control of nature, and a lack of places to eat lunch, take a break, and reflect, can be read from the hardness of concrete, glass, and steel. The narrative is one of work and control, not comfort and rest. However, participants often spent eight to ten hours a day at work, and expressed the need for even a five minute mental break to help them be more productive and in a better head space at work. This reflects much of the research in environmental psychology, and in particular the Kaplans’ Attention Restoration Theory (Kaplan 1995), which speaks of the need for a soft fascination to help regain focus. Given participant expressions of gratitude and hope over the placement of green roofs within visual or physical access of their workplace, placing green roofs or other small greening projects that were visually appealing may signal care of the whole person, versus just the worker, and may start to change the lived experience of place in central business districts. This may be particularly relevant as many central business districts are experiencing condo booms and have people living in them for the first time in their history. These new residents will have different expectations of comfort and place than those just working in the neighbourhood.
Lastly, participant responses on green roofs raise the issue of access, scale, and distance. What kind of access to ‘nature’ is needed in the city for urbanites to feel connected, fascinated, and have a moment of respite from their workday? From participant responses, distance, scale, and physical versus visual access all influenced both participant perceptions of the aesthetics of the green roofs, but also the level of importance that the green roofs had in their workday. The sensual aspect of nature, whether through touch, smell, sound or visual cues, is an important part of the human experience with nature. If only the visual aspect is available to many urbanites in central business districts, then perhaps green roofs and other urban greening projects can be designed to maximize interest, a sense of play, and exploration found to be present in the wilder green roofs and in participant memories of childhood nature experiences. This has been known for a long time in garden design (Nassauaer 1995), but perhaps when mixed with a more ecological aesthetic, and juxtaposed with the built form of central business districts, may prove to be beneficial both ecologically and psychologically for the city and its workers.
CHAPTER 5

5 Green Roofs and Health/Well-Being: Exploring the Connection in Toronto and Chicago Workplaces

5.1. Introduction

This chapter addresses the environmental psychology literature that favours a psychometric approach, while testing some of the findings from the interviews in Chapter 4 in a larger population. The addition of quantitative approaches also supports the larger goal of triangulation of results for the thesis.

Faced with increasing environmental problems such as the urban heat island effect and stormwater overflow, many cities are looking for innovative means to mitigate the effects of the concrete jungle. Green roofs, with their innovative use of space and multiple environmental benefits, are increasingly popular in North American cities (City of Toronto 2006b, City of Toronto 2008c, City of Toronto 2009b, City of Chicago 2006c). In addition to these ecological benefits, there is an assumption that the public benefits from additional greenspace; this assumption is supported by a long established link between contact with nature and improved health/well-being (Chiesura 2004, Hartig et al. 1997, Kaplan and Kaplan 2005). However, most studies of the health and well-being benefits of nature have involved more traditional forms such as parks and greenways, and almost all have looked at nature that is accessible at ground level (Kuo and Sullivan 2001, Ulrich 2001). Green roofs are a new type of urban greening, without the symbolism and meanings associated with these more traditional forms of nature (Chapter 4). To date, there is little research detailing how these green roofs are perceived by, or their potential to
provide benefit for, those looking out on them. Understanding these perceptions and benefits is particularly important given the increasing inclusion of green roofs on green buildings and the surge of interest in healthy workplaces (Cole et al. 2008, Arsenault, Newsham and Thompson 2010).

In light of this gap in understanding, this paper will examine, first, what office workers in Toronto and Chicago who overlook (or who have physical access to) green roofs think and feel about them. Secondly, the paper will explore if and how access to a green roof influences office worker’s health/well-being. This paper is exploratory and aims to identify significant relationships for future research.

This paper is organized as follows. The first section outlines existing research on the human relationship to nature and health/well-being, as well as research on socio-psychological perceptions of green roofs. The next section outlines the study design, including selection of the two case studies, participant recruitment, and methods. Results from the study are then presented that a) outline participant’s feelings, thoughts, and awareness of green roofs, and b), explore the health/well-being and concentration impacts of having access to the green roof. The paper concludes with possible ways forward for health/well-being and green roof research.

5.2. Current research on nature, health/well-being, and green roofs

This research continues a long tradition of exploring the human relationship to nature and its benefits to human health/well-being. Of particular relevance are three main benefits cited from research on health and nature: improved cognitive functioning, health/well-being, and reduced stress from contact with nature. First, the Kaplan’s pioneering Attention Restoration Theory asserts that contact with nature improves cognitive functioning and overall well-being (Kaplan
and Kaplan 1989b, Kuo 2001). Specifically, nature triggers a ‘soft fascination’ that allows the mind to recover from directed attention, (or concentration) fatigue. For example, students in residences with a view of nature had better concentration, (Tennessen and Cimprich 1995), viewing images of nature has been associated with reduced fatigue (Berto 2005), and children who moved into areas with more greenspace had better cognitive functioning (Wells 2000). Second, contact with nature generally has been shown to improve health and well-being in numerous studies and different types of nature experiences (Kaplan 1995, Korpela, Kytta and Hartig 2002, Hartig 2003). Finally, Ulrich’s Psychophysiological Stress Reduction Theory has shown that contact with nature, even if only visual, reduces stress (Ulrich et al. 1991, Parsons and Daniel 2002, Ovitt 1996). Some of these studies evaluate the effects of looking out a window at scenes of nature (Ulrich 1984, Kaplan 2007) and are thus possibly analogous with visual access to green roofs.

Most of the studies on nature and health use a more holistic understanding of health, in which health is seen as well-being rather than simply the absence of disease, and includes social, physical, and mental factors (World Health Organization 2006). Given the consistency of positive improvements in overall health, concentration, and stress from contact with nature, this research uses these three aspects as outcome measures for health.

This research also builds on a small but growing body of research exploring people’s perceptions and understanding of green roofs. Lee and Koshimiz found that layout and distance influenced participant perceptions and associations of green roofs in downtown areas, who found them warm and harmonious or green and comfortable (Lee and Koshimiz 2004). In residential areas, images of houses with vegetation on them - particularly meadow-like green roofs- have been found to be more beautiful and mentally restorative, induce a more positive affect, and were preferred to houses with no vegetation (White 2008). Surveys in suburban neighbourhoods on residents’ knowledge of and attitudes towards green roofs however showed them to be neutral to having them in their neighbourhood and not sure of their ecological benefits (Kuper 2009, Smith
and Boyer 2007). Landscape architects also showed a low level of knowledge about the ecological benefits of green roofs in an industry survey (Calkins 2005). The only study to use an actual (versus photo elicitation) green roof used focus groups and interviews to assess perceptions about and reasons for using a residential green roof in Singapore (Yuen and Hien 2005). This last study found that residents associated the green roof with larger greening programs and environmental benefits in Singapore, and used the green roof as a place to relax, get close to nature, and a children’s play area.

While these studies help us begin to understand how people think and feel about green roofs, only Yuen and Hien (2005) used an actual (versus photo elicitation) green roof. In addition, none of the existing studies have looked at the workplace, despite the prevalence of green roofs in central business districts and a growing body of research that explores how environmental factors affect productivity (and sometimes well-being) in the workplace (Romm 1999b, Building Design & Construction 2003, Leather et al. 1998). Furthermore, only White (2008) looked at possible health or restorative benefits of green roofs, and didn’t look at stress or overall health measures. Lastly, none of the studies asked participants about whether they felt green roofs were part of ‘nature’. Given the newness of green roofs, and the lack of symbolism or meanings around them, understanding if participants feel that green roofs are part of nature is important in order to be able to compare them to research on nature and health/well-being. This research thus addresses some of the gaps in current green roof, workplace, and health/well-being and nature research by a) exploring office worker’s perceptions about and awareness of green roofs, b), exploring their associations of green roofs with nature and environmental attitudes, and c), testing whether access to a green roof, (visual or physical) influences health, stress, and concentration, or attention restoration, outcomes.
5.3. Case studies and participant recruitment

Toronto and Chicago are leaders in green roof implementation in North America and have been promoting green roof implementation through policy development since 2000. Given their similarities in population size, climate, and Great Lake environmental problems, they make good case studies for comparison and are often compared for their urban greening policies (Statistics Canada 2003, City of Toronto 2007e, Gorrie 2007). For this case study, green roofs were selected on the basis of their visibility to office workers from their workplace in a downtown district. In Chicago, the City hall green roof was chosen as a case study as it is well known and overlooked by thousands of office workers. The 20,300 sq ft. Chicago City hall green roof was completed in 2001 and was planted with mostly prairie plants native to the region (City of Chicago 2010) (see Figure 5.1). In Toronto, the green roofs on the Mountain Equipment Co-Op, 401 Richmond, and 215 Spadina (the Robertson Building) were chosen, as they were well known, overlooked by office workers, and the latter two accessible. The 4,000 sq. ft green roof on 215 Spadina was completed in 2004 and was designed to highlight biodiversity with Ontario native perennials (Robertson Building 2010). The 10,000 sq. ft. green roof on the Mountain Equipment Co-Op was also designed to mimic a prairie environment and was built in 1998 (Mountain Equipment Coop 2010). Since 1995, 401 Richmond has had some sort of accessible roof garden; the current 2,600 sq ft. extensive green roof, planted mainly with sedums, was added in 2005 (401 Richmond 2010) (See Figure 5.2).

A combination of visits to the green roofs themselves and to the buildings overlooking them was used to identify which buildings had visual or physical access to the green roofs; in turn, the study population was identified as those who had offices within the identified buildings. In one of these visits, another green roof, on the garage of 161 N. Clark in Chicago (181 N. Clark), was found to also be visible to office workers, and was included in the study. This 10,424 sq ft green roof was completed in 2004 and consists mainly of sedums (personal communication, M. Berkshire, Department of Planning, City of Chicago, August 2010).
Figure 5.1: Map of Chicago City hall green roof, green roof on 161 N. Clark, and sightlines of participating buildings who could see the green roof(s).
Figure 5.2: Map of Three Case Study Green Roofs in Toronto and Sightlines of Participating Buildings who could see the green roof(s)

Source for base photography: University of Toronto Map and Data Library, Airborne Sensing Corporation
http://maps.chass.utoronto.ca/cgi-bin/datainventory.pl?idnum=738&display=full&title=City+of+Toronto+Digital+Air+Photos
(Digital Air Photos City of Toronto, 2007; image PXL1JY20_24_1748; accessed June 17, 2011)
In total, seventeen buildings in Chicago and fourteen in Toronto were identified. Respondents were recruited through a combination of building manager cooperation, cold calling, or visiting businesses where possible. In-depth interview respondents (n= 55) from a related project were also used as contacts for their offices (Chapter 4). In all cases, an email describing the survey was sent to the main contact to forward to their offices and/or buildings. This email contained a link to the online survey. 903 respondents in total completed the online survey: 624 in Chicago and 279 in Toronto. Given the multiple constraints of working with numerous public and private companies in each building, it was impossible to fully assess the sampling frame and do a randomized sample. The researcher made every effort to obtain a stratified sample, particularly in drawing respondents fairly evenly from thirty-one buildings across two different cities. Despite this limitation, the distribution of occupations and industries represented in the sample (see below), as well as the dominance of white respondents, seems anecdotally fairly representative of the population in those offices. Furthermore, the goal of this research is exploratory and intended to identify significant relationships to inform further study. In light of the current gap in research on office worker perceptions of green roofs and health, exploratory research is valuable to do a broad sweep and look for areas that justify further research.

5.4. Methods

The online survey (see Appendix B and C) asked participants questions about their access to and awareness of green roofs, with access defined as visual, physical, or both; if they felt green roofs were beneficial to the city, and why; the importance of nature in their work neighbourhood and to their health; whether they associated green roofs with ‘nature’, and whether they felt green roofs influenced their health. The questions regarding respondents’ perceptions of the level and importance of ‘nature’ near their workplace was modified from a U.S. Forest Service instrument (Shinew and Stodolska 2006). Participants were also asked questions about their occupation and industry, length of time working for their employer, level of daylight in their office, and hours worked per day. Only industry and occupation were open-ended questions. In addition to standard socio-demographic questions, the following outcome measures were used for health,
stress, and concentration. Health status was measured through the validated health measure “how healthy would you say you are?” measured on a five-point Likert scale (Government of Canada 2002), while stress was measured by the question “how stressful would you say your life is?” adapted from the Canadian Community Health Survey and measured on a four-point Likert scale (Government of Canada 2002). The measure for concentration, “do you have difficulty concentrating?” was adapted from the work stress questions in the same survey and measured on a five-point Likert scale.

Basic trends in the distribution of demographics, access to the green roof, environmental attitudes, and knowledge and perception of the green roof in the sample population were identified and are described in the sections following. In addition, Pearson’s Chi-Square was used to explore possible significant relationships between access to the green roof and self-reported responses to the questions about health, stress, and concentration levels. Pearson’s Chi-Square was also used to test participants’ self-reported perception that the green roof influenced their health with green roof access. Finally, in order to test the relationship between the association of green roofs with environmental benefits to the city with whether green roofs were also associated with nature and participant’s health, Pearson’s Chi-Square was used to explore the relationship between all three variables. In cases where cell counts were lower than the accepted standard for Pearson’s Chi-Square, Fisher’s Exact test was also carried out to test if the relationship was significant. The results of these analyses are described below.

5.5. Results

5.5.1. Demographics, attitudes and awareness of respondents on green roofs

The sample populations in Chicago and Toronto were generally better educated than the general population in either city, with 43% having a university degree and 33% having a graduate or
professional degree, roughly twice the level of the general population (City of Toronto 2006c, U.S. Census Bureau 2010) (see Table 5.1). Unsurprising given their proximity to City hall, many respondents worked in legal, professional, or financial services. This combination of high education and occupational status was reflected in the average income of Chicago respondents, which was significantly higher than the city-wide average of $38,625 (1999) (U.S. Census Bureau 2010).

The average income in Toronto was slightly lower than the city average of $52,833 (Matthews 2006), likely due to the dominance of non-profit, arts, and media professions among respondents (see Table 5.1). The main groups of participant occupations for both cities were office and administration support (17%), legal (14%), management (12%), business solutions and development (11%), financial and real estate (9%), arts, design, entertainment, sports and media (6%), engineering, architecture and surveyors (6%), and sales and rental (5.5%). Both populations are overwhelmingly white, which does not reflect the demographics of either Toronto or Chicago, where close to 50% and 63% respectively are a visible minority (City of Toronto 2006d, U.S. Census Bureau 2010). However, anecdotally, these demographics are fairly representative of the population in these office buildings. The sample populations were fairly evenly distributed across ages typical of the workforce, with slightly more respondents aged 25-29 responding. Despite attempts to attain gender parity, approximately twice the number of women responded than men (64.9% versus 35.1%), which may be linked to stronger social networks of women in offices who forwarded the survey to their peers. The vast majority of respondents had worked in their office building for more than a year (73% total had worked in their office either 1-3 years or 4-10 years). They also overwhelmingly worked at least six hours per day and spent most of their time in the office (versus off-site or on the road). Respondents were almost evenly split between being very and somewhat satisfied with their jobs (42% and 45%).
Most respondents (65%) rated their health as excellent or very good, with most of the rest (30%) rating their health as good. Just over half the respondents rated their life as somewhat stressful (54%), with almost 30% rating their life as not too stressful and 14% as very stressful. Roughly half of the respondents expressed having difficulty concentrating at work sometimes (51%), while almost 40% did not have much difficulty concentrating at work (see Table 5.1).

Table 5.1: Sample Characteristics by city and combined

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual Characteristics</td>
<td></td>
</tr>
<tr>
<td>Age: under 24</td>
<td>Toronto: 36 (15), Chicago: 38 (7), Combined: 74 (9)</td>
</tr>
<tr>
<td>Age: 25-29</td>
<td>Toronto: 49 (20), Chicago: 123 (22), Combined: 172 (21)</td>
</tr>
<tr>
<td>Age: 30-39</td>
<td>Toronto: 81 (33), Chicago: 156 (28), Combined: 237 (17)</td>
</tr>
<tr>
<td>Age: 40-50</td>
<td>Toronto: 56 (22), Chicago: 129 (23), Combined: 185 (23)</td>
</tr>
<tr>
<td>Age: 50+</td>
<td>Toronto: 27 (11), Chicago: 112 (20), Combined: 139 (17)</td>
</tr>
<tr>
<td>Female gender</td>
<td>Toronto: 165 (66), Chicago: 360 (64), Combined: 525 (65)</td>
</tr>
<tr>
<td>White</td>
<td>Toronto: 186 (75), Chicago: 426 (77), Combined: 612 (76)</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>Toronto: 111 (45), Chicago: 238 (43), Combined: 349 (43)</td>
</tr>
<tr>
<td>Graduate or professional degree</td>
<td>Toronto: 68 (27), Chicago: 200 (36), Combined: 268 (33)</td>
</tr>
<tr>
<td>Average Income $35,000-$49,999</td>
<td>Toronto: 70 (29), Chicago: 89 (17), Combined: 159 (21)</td>
</tr>
<tr>
<td>Average Income $50,000-$74,999</td>
<td>Toronto: 57 (24), Chicago: 160 (30), Combined: 217 (28)</td>
</tr>
<tr>
<td>Average Income $75,000-$99,999</td>
<td>Toronto: 21 (9), Chicago: 106 (20), Combined: 127 (17)</td>
</tr>
<tr>
<td>Health characteristics</td>
<td></td>
</tr>
<tr>
<td>Reported health excellent or very good</td>
<td>Toronto: 158 (63), Chicago: 370 (67), Combined: 528 (65)</td>
</tr>
<tr>
<td>Reported life somewhat stressful</td>
<td>Toronto: 131 (53), Chicago: 302 (54), Combined: 433 (54)</td>
</tr>
<tr>
<td>Reported not too stressful</td>
<td>Toronto: 76 (31), Chicago: 153 (27), Combined: 229 (28)</td>
</tr>
<tr>
<td>Reporting difficulty concentrating at work: sometimes</td>
<td>Toronto: 131 (52), Chicago: 284 (50), Combined: 416 (51)</td>
</tr>
<tr>
<td>Reporting difficulty concentrating at work: rarely</td>
<td>Toronto: 62 (25), Chicago: 150 (27), Combined: 212 (26)</td>
</tr>
<tr>
<td>Length of time in building</td>
<td></td>
</tr>
<tr>
<td>Worked for employer less than six months or six months to 1 year</td>
<td>Toronto: 84 (33), Chicago: 89 (16), Combined: 173 (21)</td>
</tr>
<tr>
<td>Worked for employer 1-3 years</td>
<td>Toronto: 78 (31), Chicago: 177 (31), Combined: 255 (31)</td>
</tr>
<tr>
<td>Worked for employer 4-10 years</td>
<td>Toronto: 69 (27), Chicago: 174 (31), Combined: 244 (30)</td>
</tr>
<tr>
<td>Worked in building less than six months or six months to 1 year</td>
<td>Toronto: 91 (36), Chicago: 126 (22), Combined: 217 (26)</td>
</tr>
<tr>
<td>Worked in building 1-3 years</td>
<td>Toronto: 95 (37), Chicago: 204 (36), Combined: 299 (36)</td>
</tr>
<tr>
<td>Worked in building 4-10 years or over 10 years</td>
<td>Toronto: 68 (27), Chicago: 239 (42), Combined: 308 (37)</td>
</tr>
<tr>
<td>Work 6-8 hours per day</td>
<td>Toronto: 114 (45), Chicago: 162 (29), Combined: 276 (34)</td>
</tr>
<tr>
<td>Work 8-10 hours per day</td>
<td>Toronto: 121 (48), Chicago: 359 (63), Combined: 481 (59)</td>
</tr>
<tr>
<td>Spend almost all time in office</td>
<td>Toronto: 156 (62), Chicago: 322 (57), Combined: 479 (58)</td>
</tr>
<tr>
<td>Spend most of time in office</td>
<td>Toronto: 76 (30), Chicago: 152 (27), Combined: 228 (28)</td>
</tr>
</tbody>
</table>
5.5.2. Environmental attitudes and health

In terms of knowledge about green roofs, the majority of respondents both knew what a green roof was (90%) and felt that it was beneficial (84%) (see Table 5.2). Based on the author’s previous experience recruiting participants from the same population (Chapter 4), the high level of awareness among respondents is likely partially due to self-selection, as those who didn’t know what a green roof was were less likely to participate. Only 1% of respondents did not feel that green roofs were beneficial to the city, mainly because they thought that they were too expensive, were unsure about their effectiveness, or didn’t know enough about them to answer. Of those who felt green roofs were beneficial, three quarters thought green roofs were nice to look at, saved money for buildings that had them, and/or added greenspace to the city (see Table 5.2). Around 60% associated green roofs with the specific environmental benefits of cooling the city and reducing stormwater overflow.

Almost half of the respondents were aware of a green roof outside or on their workplace (48%). This number was far higher for the Toronto respondents than the Chicago respondents, and might be explained by the larger floor plans of the Chicago offices- workers on the opposite side of the building or in the centre offices may never see the green roof. Of those who were aware of a green roof (56% in both cities combined), far more respondents in Chicago (71%) than in Toronto (33%) could see the green roof from their workplace (see Table 5.2).

While Chicago’s green roofs were more visibly accessible to respondents, Toronto’s were more physically accessible: in the Toronto case study, 76% had physical access, compared to only 13% of Chicago respondents (see Table 2). Of those with visual access, almost half saw the green roof from a common area or colleagues’ office, with slightly fewer (35%) seeing it from their desk. Respondents who had physical access and went on the green roof used the roof for a
variety of reasons, such as to take a break from their desk, to relax, to show visitors, to clear their head, or to get a break from their desks (see Table 5.2).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number (%)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Variable</td>
<td>Toronto (n = 279)</td>
<td>Chicago (n = 624)</td>
</tr>
<tr>
<td>Knowledge and Perception of green roof</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Know what a green roof is</td>
<td>257 (94)</td>
<td>531 (87)</td>
<td>792 (89)</td>
</tr>
<tr>
<td>Do you feel that green roofs are beneficial to the city? Why?</td>
<td>252 (94)</td>
<td>507 (84)</td>
<td>766 (87)</td>
</tr>
<tr>
<td>- Cool the city</td>
<td>189 (74)</td>
<td>299 (59)</td>
<td>489 (64)</td>
</tr>
<tr>
<td>- Nice to look at</td>
<td>216 (85)</td>
<td>374 (73)</td>
<td>592 (77)</td>
</tr>
<tr>
<td>- Add greenspace</td>
<td>226 (89)</td>
<td>357 (70)</td>
<td>585 (76)</td>
</tr>
<tr>
<td>- Save money for buildings that have them</td>
<td>196 (78)</td>
<td>385 (75)</td>
<td>583 (76)</td>
</tr>
<tr>
<td>- Reduces stormwater runoff</td>
<td>173 (69)</td>
<td>266 (52)</td>
<td>440 (57)</td>
</tr>
<tr>
<td>- Good for the environment</td>
<td>233 (92)</td>
<td>464 (91)</td>
<td>699 (91)</td>
</tr>
<tr>
<td>Access to green roof</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aware of green roof outside/on top of workplace</td>
<td>185 (68)</td>
<td>278 (45)</td>
<td>466 (52)</td>
</tr>
<tr>
<td>See it from workplace*</td>
<td>61 (33)</td>
<td>198 (71)</td>
<td>261 (56)</td>
</tr>
<tr>
<td>See green roof from colleagues office*</td>
<td>13 (21)</td>
<td>98 (50)</td>
<td>113 (44)</td>
</tr>
<tr>
<td>See green roof from common area*</td>
<td>29 (48)</td>
<td>97 (50)</td>
<td>126 (49)</td>
</tr>
<tr>
<td>See green roof from desk*</td>
<td>25 (41)</td>
<td>66 (34)</td>
<td>91 (35)</td>
</tr>
<tr>
<td>Green roof accessible*</td>
<td>140 (76)</td>
<td>36 (13)</td>
<td>283 (62)</td>
</tr>
<tr>
<td>Why use the green roof?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To get a break from desk*</td>
<td>76 (58)</td>
<td>6 (24)</td>
<td>82 (52)</td>
</tr>
<tr>
<td>Place to eat lunch*</td>
<td>88 (67)</td>
<td>10 (40)</td>
<td>98 (62)</td>
</tr>
<tr>
<td>To show visitors*</td>
<td>82 (62)</td>
<td>13 (52)</td>
<td>95 (61)</td>
</tr>
<tr>
<td>To relax*</td>
<td>59 (45)</td>
<td>6 (24)</td>
<td>65 (41)</td>
</tr>
<tr>
<td>To clear head*</td>
<td>64 (49)</td>
<td>6 (24)</td>
<td>52 (33)</td>
</tr>
</tbody>
</table>

*subset of respondents who had physical access to green roof

Table 5.2: Participant knowledge, perception, and access to a green roof

5.5.3. Health, concentration and access to green roofs

A small majority (61%) of respondents felt that it was very important or important to have nature near their workplace, with 31% feeling it was somewhat important (see Table 5.3). Three-
quarters (78%) felt that there wasn’t enough ‘nature’ near their workplace, while the vast majority of respondents (80%) felt that having nature near their workplace influenced their health and well-being (see Table 3). 80% associated green roofs with ‘nature’, but just over half of the respondents felt that the green roof influenced their health (52%), while 34% were unsure (see Table 5.3).

The results of the chi-square analysis showed no significant relationship between the generalized health measure and access to a green roof, whether visual or physical (results not shown). The single question stress measure also showed no significant relationship to either visual or physical access to a green roof. However, concentration and the perception that green roofs influenced health both had significant relationships to green roof access (see Table 5.4). Specifically, there was a significant association between having visual access to the green roof and a higher than expected ability to concentrate ($\chi^2 (1) = 5.50, p < .05$). This trend held true whether the concentration variable was held as the Likert scale or grouped into a bimodal variable (with rarely and never grouped against sometimes, often, and very often), as well as whether visual access was compared against all respondents or just those who were aware of the green roof.

There was a significant association between physical access to the green roof and ability to concentrate ($\chi^2 (4) = 9.964, p < .05$), but only for the Likert scale concentration variable (see Table 5.4). Furthermore, the direction was negative, meaning that physical access to the green roof was associated with a decreased ability to concentrate. When visual and physical access to the green roof were combined, the relationship between access and concentration was not significant.
Variable | Number (%) | Number (%) | Number (%)
--- | --- | --- | ---
| Toronto | Chicago | Combined | Toronto | Chicago | Combined | Toronto | Chicago | Combined |
| n = 279 | n = 624 | (n = 903) | n = 279 | n = 624 | (n = 903) | n = 279 | n = 624 | (n = 903) |
‘nature’, green roofs, and health | | | |
Green roofs associated with ‘nature’ | 230 (86) | 475 (79) | 707 (81) | | | |
Important or very important to have ‘nature’ near workplace | 181 (73) | 310 (55) | 491 (61) | | | |
Somewhat important to have ‘nature’ near workplace | 54 (22) | 200 (36) | 254 (31) | | | |
Feel there is not enough ‘nature’ near workplace | 192 (77) | 441 (79) | 633 (78) | | | |
Feel ‘nature’ near workplace influences health and wellbeing | 206 (83) | 441 (79) | 647 (80) | | | |
Feel green roof influences health and wellbeing | 147 (60) | 272 (49) | 419 (52) | | | |
Table 5.3: Green roofs, ‘nature’, and health

The perception that green roofs influenced participant health was not significant for visual access but was significant for physical access ($\chi^2 (2) = 9.48, p < .01$). Specifically, respondents with physical access to the green roof were more likely to feel that the green roof influenced their health, while respondents lacking physical access were more likely to be uncertain of the green roof’s influence on their health (see Table 5.4). This relationship held true when testing whether it was access or awareness of the green roof that influenced the significance: higher than expected numbers of respondents with either visual or physical access to the green roof felt that the green roof influenced their health, while respondents who were aware of the green roof but lacked access to it were more likely to feel that the green roof did not influence their health ($\chi^2 (4) = 3.52, p < .001$). Those with no access or awareness of the green roof also tended to be uncertain of any influence of the green roof on their health.

There was a significant association between a respondent’s perception that green roofs were beneficial to the city and their belief that they influenced his or her health ($\chi^2 (4) = 3.31, p < .001$). That is, a higher than expected number of respondents who felt that green roofs influenced their health also felt that green roofs were beneficial to the city. In contrast, respondents who did not feel that the green roofs influenced their health were less likely to
associate the roofs with benefits to the city, and respondents who were unsure tended to be unsure on both counts. As there were very few respondents who felt that the green roofs neither influenced their health nor were beneficial to the city, there were two cells whose counts were less than 5. The relationship was still significant when Fisher’s Exact test was used ($\chi^2 = 31.283, p < .001$).

There was also a significant relationship between respondents who associated green roofs with ‘nature’ and a higher than expected count who also felt that green roofs influenced their health ($\chi^2 (4) = 7.90, p < .001$). Conversely, if respondents did not associate green roofs with nature, they were also more likely to feel that green roof did not influence their health. Additionally, a large percentage of respondents associated green roofs with nature but were unsure if the roofs influenced their health. The low numbers of respondents who felt that green roofs did not influence their health and also did not associate them with nature led to one cell count being less than 5, but the relationship was still significant under Fisher’s Exact test ($\chi^2 = 73.60, p < .001$).

Lastly, respondents who associated green roofs with ‘nature’ were more likely than expected to feel that the green roofs were beneficial to the city ($\chi^2 (4) = 5.52, p < .001$), though a large percentage of respondents who did not associate green roofs with nature still felt that green roofs were beneficial to the city. As very few respondents did not feel green roofs were beneficial to the city, three cells had a count of less than 5, but the relationship was still significant using Fisher’s Exact test ($\chi^2 = 37.09, p < .001$).
<table>
<thead>
<tr>
<th>Variable</th>
<th>Significance $p$</th>
<th>Chi-Square $\chi^2$ (df)</th>
<th>Fisher’s Exact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration (bimodal) x visual access</td>
<td>.019*</td>
<td>5.50 (1)</td>
<td>-</td>
</tr>
<tr>
<td>Concentration (Likert) x physical access</td>
<td>.021*</td>
<td>1.15 (4)</td>
<td>-</td>
</tr>
<tr>
<td>Concentration (bimodal) x physical access</td>
<td>.213</td>
<td>1.55 (1)</td>
<td>-</td>
</tr>
<tr>
<td>Concentration (bimodal) x visual and physical access combined</td>
<td>.227</td>
<td>1.46 (1)</td>
<td>-</td>
</tr>
<tr>
<td>Green roof influence health x visual access</td>
<td>.439</td>
<td>1.65 (2)</td>
<td>-</td>
</tr>
<tr>
<td>Green roof influence health x physical access</td>
<td>.009**</td>
<td>9.48 (2)</td>
<td>-</td>
</tr>
<tr>
<td>Green roof influence health x physical access and awareness</td>
<td>.000***</td>
<td>3.52 (4)</td>
<td>-</td>
</tr>
<tr>
<td>Green roof beneficial to city x green roof = ‘nature’</td>
<td>.000***</td>
<td>5.52 (4)</td>
<td>$\chi^2 = 37.09$ $p = .000***$</td>
</tr>
<tr>
<td>Green roof = ‘nature’ x green roof influence health</td>
<td>.000***</td>
<td>7.90 (4)</td>
<td>$\chi^2 = 73.60$ $p = .000***$</td>
</tr>
<tr>
<td>Green roof influence health x green roof beneficial to city</td>
<td>.000***</td>
<td>3.31 (4)</td>
<td>$\chi^2 = 31.283$ $p = 000***$</td>
</tr>
</tbody>
</table>

*Significant at $p<.05$

**Significant at $p<.01$

***Significant at $p<.001$

Table 5.4: Significant Results of Chi-Square Analysis for concentration, green roofs = ‘nature’, green roofs are beneficial to the city and green roofs influence health

5.6. Discussion and Conclusion

The results of the case study offer some insight into the knowledge, perceptions, and attitudes of office workers in two cities with significant green roof implementation policies. Surprisingly, only about half of the respondents were aware of the green roof, which may be a result of the typical floor plan of many office towers. This supports findings by Lee and Koshimiz (2004) that distance affected respondents’ perceptions of green roofs. Respondents who work in such a building may never actually visit the side with the view of the green roof, particularly given that many floors were subdivided into offices for different companies. Seeing the green roof from one’s desk should give the most visual contact, particularly given the long hours worked by
respondents; however, most saw the green roof from their colleagues’ office or from common areas. This limited level of visual access to green roofs raises questions about the possible benefits that office workers may gain from them. Workplace culture, including office layout and the extent to which collaborative work in common spaces is encouraged, may all influence workers’ access to a green roof. Similarly, respondents with physical access reported that seating arrangements and space for eating lunch or meeting colleagues affected the level of their use of the green roof. These considerations about how space is used by office staff have important implications for both designing green roofs and future research on their potential psychosocial benefits.

Respondents in both cities associated green roofs with some sort of environmental benefit, and three-quarters were able to identify specific environmental benefits such as stormwater management or the reduction of the urban heat island effect. This is in contrast to the findings from the green roof literature on knowledge and perceptions about green roofs, where respondents were unsure of or somewhat unaware of the environmental benefits of green roofs (Kuper 2009, Smith and Boyer 2007, Calkins 2005), but supports findings from Yuen and Hien (2005) who found that participants associated green roofs with larger urban greening programs. There may be three reasons for this. First, the association of environmental benefits with green roofs may be partly due to the respondent demographics - white-collar educated workers and women are both known to have stronger environmental values (Snelgar 2006, Ignatow 2006, Stern, Dietz and Kalof 1993). Second, both Toronto and Chicago have been promoting green roofs since 2000 (City of Chicago 2006a, City of Toronto 2009b), and Toronto’s green roofs were also implemented by environmentally-minded organizations. The high level of knowledge about the environmental benefits of green roofs may be partly as a result of years of publicity by both municipalities justifying their support of green roofs, and in the case of the Chicago case study, a strong message of municipal support by putting a green roof on their city hall. Third, 80% of respondents also associated green roofs with ‘nature’, and three-quarters felt they were constructed because they are “nice to look at”. This may indicate that green roofs, in many respects, are associated with other forms of urban ‘nature’, such as gardens, street planters, and
even potted plants on balconies, all of which are implemented deliberately: i.e. someone made a decision to either preserve or place them there, usually for some environmental or aesthetic benefit. People’s association of plants with nature, and thus of green roofs with nature, combined with the promotion of green roofs, may help explain the assumption that they are installed to achieve certain urban benefits.

The results of the chi-square analysis offer mixed support for the possible psychosocial benefits of green roofs to those looking out over them. Access to a green roof (visual or physical) was not related to any significant improvement in general health status or stress level, which is in contrast to studies which have shown that contact with nature reduces stress and improves overall health/well-being (Kuo 2001, Ulrich et al. 1991). However, the significant correlation found in this study between visual access to green roofs and improved concentration supports the extensive research in environmental psychology that shows improved attention restoration (or concentration) and cognitive functioning from access to nature, even when only visual access (Tennessen and Cimprich 1995, Kaplan and Kaplan 2005, Wells 2000). It also supports findings from White (2008) that found improved attention restoration from viewing images of houses with green roofs. Future research might test this correlation between visual green roof access and improved concentration to see if it still held true when other possible confounders, or influences on the relationship, are taken into account. This is particularly important given the context of the workplace and the particular stressors and demands placed on employees versus, for example, residential respondents that may influence this relationship.

It is unclear why respondents with physical access to green roofs had more difficulty concentrating than respondents without physical access. There may be other confounders influencing the relationship that have not been tested in this model, such as a subset of the sample population with physical access who have particular difficulty concentrating. Certainly this finding is in contrast to most of the environmental psychology literature that found that contact with nature improves well-being and attention restoration (Korpela et al. 2008a, Hartig
and Staats 2003). The negative significant relationship for physical access and concentration likely explains why significance was cancelled out when visual and physical access was combined in one variable. More research needs to be done to better understand how physical access to a green roof differs in terms of concentration outcomes from visual access.

Despite the lack of any change in participants overall health status, those with physical access to a green roof were more likely to feel that the green roof influenced their health. This may reflect the common association of health benefits with direct physical contact with nature, and raises questions about what kind of benefits can be expected from visual versus physical access to nature in cities. The difference in outcomes between feeling that the green roof influenced participants’ health, and the self-reported generalized health measure, may also have to do with the health measure itself. Given the focus on health and overall well-being in the health and nature literature (Kaplan and Kaplan 1989a, Korpela et al. 2008b), respondents may not associate ‘how healthy do you think you are’ with overall well-being, but with their physical health, and thus only with physical access to the green roof. Further research may want to test different outcome measures of health/well-being for both physical and visual access to green roofs.

Respondents who perceived that the green roof influenced their health also tended to believe that they were beneficial to the city and associated them with nature. This may reflect larger environmental values that any ‘nature’ in the city is good nature, or the general association of green roofs with environmental benefits. Interestingly, only 61% of respondents felt that nearby nature to their workplace was important, but 80% felt that nearby nature influenced their health, which may reflect limited expectations of nature in the city, especially in downtown central business districts. Furthermore, a large percentage of respondents were unsure if green roofs influenced their health or if they associated green roofs with nature. This may help to explain why 80% of respondents associated green roofs with nature and felt that nearby nature influenced their health, but only 52% felt that nearby green roofs influenced their health. This ambiguity may reflect the newness of green roofs and the limited access to them in most urban,
and certainly most workplace, settings. Further research is needed to test why there is a gap between participants’ perceptions of the benefits of nature, green roofs, and health.

The results of this analysis point to the possible benefits of green roofs to office workers’ ability to concentrate, and mixed results on their potential to influence office workers’ health and stress. The results suggest the need for a better understanding of the human relationship to nature in the city, and more specifically, in the workplace, given the large percentage of respondents who were unsure about the benefits of green roofs on their health, despite associating them with nature, and nature with improved health. This need is particularly pressing as green roofs are often added to buildings with the expectation that health benefits will be observed similar to those found in studies of other types of urban nature (Doshi et al. 2005, City of Chicago 2007), when the benefits may in fact be different or inconsequential. Comparative studies of office workers – possibly from the same company - with differing levels of access would be useful to further test some of the results from this study. In addition, testing new measures of concentration and well-being in different populations and types of workplace, as well as incorporating physiological measures, would deepen our understanding of the intersection of nature, health, green roofs and the workplace. Continued research in this field offers possibilities for better understanding how workplaces and downtown business districts can be designed to improve office worker health/well-being.
CHAPTER 6

6 Visual Access to a Green Roof and Office Worker Concentration

6.1 Introduction

This chapter tests whether one of the key findings from Chapter 5, that visual access to a green roof was significantly related to improved concentration, still holds true when other confounding variables are taken into account. It continues the themes set out in Chapter 2 that outlined the need for a variety of methods to address and examine the human relationship with nature.

There is a small but growing interest in the possible health/well-being and productivity benefits that could result from providing access to ‘nature’ in workplaces. Pushing this shift are three main trends. First, there is an increasing interest in workplace environments that promote health/well-being (Danielsson and Bodin 2008, Frumkin 2001, Heschong Mahone Group 2003, Heerwagen 2008). Moving beyond indoor air quality and chemical exposure, researchers and health agencies are trying to pinpoint ‘soft’ aspects of the built environment that enhance well-being and comfort, and reduce absenteeism (Cole et al. 2008, Aries et al. 2010). Second, there is an increasing incorporation of greenery into, on top of, or alongside buildings, such as green roofs and living walls. This greenery is being added to buildings mostly for environmental reasons, such a reduction in the urban heat island effect (Fang 2008, Theodosiou 2009) or stormwater runoff (Holloway, Werth and Schmidt 2009, Seters et al. 2009). However, this greenery is also assumed to provide ‘soft’ health/well-being benefits to those near them (City of
Third, underlying both of these trends is long-established research that links access to nature with improved human health/well-being (Arbogast et al. 2009, Korpela et al. 2008b, Kuo and Sullivan 2001, Ulrich 2001). Given the long hours worked by many employees, research that identifies improvements to the built environment that might improve worker health/well-being or productivity is increasingly in demand, particularly for building owners wanting a return on their investment for ‘green’ features. The problem is that these ‘soft’ benefits in the workplace are hard to measure, and research so far has been somewhat inconclusive (Raanaas et al. 2011). Measurement is also complicated because ‘nature’ has many symbolic meanings that are influenced by aesthetics (Hill and Daniel 2008, Gobster et al. 2007), experience (Milligan and Bingley 2007, Korpela et al. 2009), and context (Cronon 1995). This is particularly true for new types of ‘nature’ such as green roofs (Chapter 4), on which there is scant socio-psychological research. This study begins to address this gap. It emerged out of the findings of previous research (Chapter 5) that showed that office workers with visual access to a green roof had better concentration than those who did not. The goal of this exploratory study is to test this whether or not this relationship is still significant when possible confounding variables are added into a logistic regression model. This paper first outlines current research on nature, concentration, and the workplace, then describes the selection of case studies and participants, results from the logistic regression, and concludes with a discussion about the results and implications for future research.

6.1.2. Research on the workplace, nature, and health/well-being

Most of the research on office environments is management-oriented research that focuses on organizational and business trends and employee performance, and that views the office as a tool for increased productivity and efficiency (McCoy cited in (Danielsson and Bodin 2008). There is also considerable research on the impact of the psychosocial work environment on the health of employees, such as workplace stress (Wilkins and Beaudet 1998, Wang and Patten 2001), job
Far less attention has been paid to the influence of environmental factors on employee health/well-being. There are two main types of studies that investigate environmental factors. The first looks at the impact of some aspect of ‘nature’ in the workplace, usually the ambient environment, such as noise (Wallenius 2004, Ljungberg and Neely 2007), daylight (Winterbottom and Wilkins 2009), and natural ventilation (Veitch et al. 2007). The second looks more directly at access to nature, either through views of nature or plants in the workplace. Views of nature have been found to improve office worker well-being (Kaplan 1993), natural views and plants are preferred work environments (Dravigne et al. 2008, Kaplan 2007), and plants in the workplace have been linked to better health (Fjeld et al. 1998), less fatigue in academic environments (Khan et al. 2005), and better moods (Shibata and Suzuki 2004).

Most of the plant studies have looked at improvements in productivity and attention, or focus (Larsen et al. 1998, Lohr et al. 1996, Shibata and Suzuki 2002, Raanaas et al. 2011), with one study also looking at improvements in creative association (Shibata and Suzuki 2002). The results have been mixed: Shibata and Suzuki (Shibata and Suzuki 2001) found a positive effect of plants, but also found that it was moderated inconsistently by gender (Shibata and Suzuki 2002, Shibata and Suzuki 2004). Rich (Rich 2007) found that plants have no effect, while Larsen (Larsen et al. 1998) found that productivity was inversely related to the number of plants in the office. Almost all of the plant studies used specific tasks to imitate productivity and mental fatigue, such as sorting tasks, digit-scan-backwards, and recollection tests, and all were in experimental-type settings (i.e. not a real office environment with all of the messy demands and other influences that entails). While experimental settings are very useful and in many cases necessary in order to pinpoint cause and effect, there is some indication that these types of tests measure repetitive tasks best and may not be suited to the multidimensional and creative work
demanded of many white collar office workers (Larsen et al. 1998). The two studies using real office environments (Aries et al. 2010, Kaplan 2007) did not look at productivity or mental fatigue but focused more on aesthetics, comfort, and attitudes about views of nature.

The theoretical premise behind most of these studies is Attention Restoration Theory (ART) (Kaplan 1995, Kaplan and Kaplan 1989b) which states that contact with nature can be restorative. The theory draws on James’ 1892 model of directed attention, which argues that cognitively demanding tasks deplete one’s energy and focus. Nature is argued to trigger a soft attention, or focus, that can restore directed attention, or the ability to concentrate (Kaplan and Kaplan 1989b). Contact with nature, even looking out of a window, can provide brief moments of respite from cognitively demanding tasks and thus may provide ‘micro breaks’ for office workers (Kaplan 1993). Looking out of a window at a green roof, which is made up of plants, thus may provide a similar kind of respite from the cognitively demanding work of many office workers and thus improve concentration.

The Kaplans’ ART has been tested in numerous settings and circumstances, focusing on either well-being, improved cognitive functioning, or both. Restoration from contact with nature has been shown to improve overall well-being (Kaplan 1995, Kaplan 2001, Hartig and Staats 2003), improve functioning and well-being (Kaplan and Kaplan 2005), and reduce stress (Ulrich et al. 1991, Korpela et al. 2008a). Viewing images of nature has also been associated with reduced fatigue (Berto, Massaccesi and Pasini 2008, Berto 2005). Students in residences with natural views were found to have better directed attention (Tennessen and Cimprich 1995), and walks in natural rather than urban areas have been linked with better attention and increased positive affect (Hartig et al. 2003a). Children have been shown to have better cognitive functioning after moving into areas with more greenspace (Wells 2000), as have children with Attention Deficit Disorder (Taylor et al. 2001). Girls also exhibited more self-discipline and focus when they had views of greenspace (Taylor, Kuo and Sullivan 2002). A theme in many of these studies is cognitive functioning, an integral aspect of which is the ability to concentrate. Being able to
concentrate is also an important part of office work and productivity, as indicated by the focus on concentration in most of the nature and workplace studies so far. Thus, testing whether or not ability to concentrate is improved by access to green roofs would provide much-needed empirical data on the impact of nature in the workplace.

Despite strong and consistent associations between experiences of nature and improved well-being in a variety of studies (Kaplan 2001, Korpela et al. 2009), some socio-demographic and attitudinal factors could act as confounding factors in this relationship. For example, occupation and environmental values have been shown to be correlated with landscape preferences (Kaltenborn and Bjerke 2002, Schultz and Zelezny 1999), while culture has been shown to influence values and aesthetics about residential nature (Fraser and Kenney 2000). In addition, women have been shown to have a stronger connection to and affinity for the environment (Snelgar 2006, Stern et al. 1993), more concern about and perceptions of risk to the environment (Eisler, Eisler and Yoshida 2003), and better performance on productivity tests with the presence of plants in the office (Shibata and Suzuki 2002, Shibata and Suzuki 2004). Stronger environmental values have been associated with younger and more educated individuals and a greater appreciation for nature (Ignatow 2006). It is important that these possible mediating factors be taken into account when testing the relationship between concentration and visual green roof access.

6.2. Method

The goal of this paper is to determine if the relationship between visual access to a green roof and improved concentration in office workers found in a previous study (Chapter 5) is still significant when other predictor variables are included in a logistic regression model. A conceptual model to guide the research was developed and is visualized in Figure 6.1.
describes the independent variable of interest, green roof exposure, the dependent variable of interest, concentration, and possible predictors based on the literature; socio-demographic variables, physical and socio-psychological workplace characteristics, environmental attitudes, and stress and coping characteristics. The study design and methods are described below.

6.2.1. Research Design

This study involved a cross-sectional survey of occupants in office buildings in Toronto, Canada, and Chicago, U.S.A. Participants (n=903, logistic regression subset n = 505) completed an online questionnaire about their knowledge of and perceptions about green roofs, their health, attitudes to nature, and their workplace environment (Chapter 5).

6.2.2. Sites

Seventeen buildings in Chicago and fourteen in Toronto were visited. Buildings were selected for inclusion in the study based on their visual proximity to a green roof in a downtown business district in Toronto and Chicago. In Toronto, three prominent green roofs were chosen as case studies; one on top of an outdoor clothing and equipment shop, and two on top of retrofitted industrial buildings. The fourteen buildings in the Toronto case study range in height from five to eleven stories and all overlook or, in two cases, have physical access to one of the green roofs. In Chicago, two prominent green roofs were chosen: one on top of the city hall, and one on top of a parking garage. Both are in the Loop, the downtown business district, and are visible to the seventeen buildings chosen as case studies that ranged in height from twenty-five to seventy stories. More information on these green roofs is reported elsewhere (Chapter 5).
6.2.3. Survey participants

The author visited each site personally, and worked with the City of Chicago and the City of Toronto to identify and facilitate access to potential participatory buildings. Access to the buildings in Toronto was not restricted, which enabled the author to approach the office manager or other contacts established through preliminary fieldwork and ask if they would forward the survey link to their colleagues, with an incentive of a five dollar coffee card for doing so, as well as the chance to win dinner for two. In Chicago, many of the buildings were Class-A and restricted, so if personal access through a contact was not possible, office managers were approached by phone and asked if they would forward the survey link to their colleagues with the same incentive. Cooperation with building managers who sent the survey link to their building was also used to gain participation. Given the multiple constraints of working with numerous public and private companies in each building, it was impossible to fully populate the sampling frame and do a randomized sample, and therefore the respondents were a convenience sample based on willingness and availability to participate.

Despite this limitation, the survey population was fairly evenly drawn from across the thirty-one buildings. The distribution of occupations and industries represented in the sample, as well as the dominance of white respondents 612 (76%), anecdotally seems to be similar to the population in these buildings (Chapter 5). In total, 903 respondents completed the survey, 624 in Chicago and 279 in Toronto. Despite attempts to attain gender parity, roughly twice as many questionnaires were answered by females (65%) than by males (35%) (see Table 6.1). Only respondents who answered all of the predictor variable questions described below were included in the model, with the final subset being n = 505.
6.2.4. Questionnaire

Survey participants answered a 52-item questionnaire in English (see Appendix C). Participants were told that the objective of the study was to get their feedback about current municipal greening programs and how this affected them and their co-workers, with the larger goal of informing policies on urban greening and healthier workplaces. In addition to demographic variables, respondents were asked about their knowledge of and attitudes towards green roofs, their attitudes towards nature, the characteristics of their workplace and work environment, and their health. Data were collected using SurveyMonkey; the data were subsequently transferred to SPSS version 16.0 for analysis.

6.2.5. Measures

This paper reports on a subset of data collected in the larger survey. Predictor variables were included that were theoretically important or significantly related to the outcome variable of the ability to concentrate. Predictor variables were as follows:

*Socio-demographic variables* included gender, ethnicity, income, education, and age. Standardized categories were drawn from the Canadian Community Health Survey Cycle 1.2 from Statistics Canada (Government of Canada 2002). More detailed categories were collapsed when theoretically relevant or practically necessary (e.g., in cases where small cell counts would limit the utility of the data).

- *Work Environment Characteristics* included number of hours worked in office, (a measure to assess hours of possible exposure to the green roof, measured on a 5-point
Likert scale), level of daylight in office (based on individuals’ perceptions of how much daylight is in their office, measured on a 5-point Likert scale), whether respondents lived in Toronto or Chicago, whether they could see a green roof from their workplace, industry, and occupation. Industry and occupation were open-ended questions that were then coded into categories according to the labour categories of the U.S. Department of Labor (United States Department of Labor 2010). Again, more detailed categories were collapsed when theoretically relevant or practically necessary.

- **Work stress** was measured using a measure of work stress from the 1994/1995 National Population Health Survey (NPHS) from Statistics Canada, which consists of twelve statements that participants rank their responses to on a five-point Likert scale ranging from 1 (strongly agree) to 5 (strongly disagree). Following Statistics Canada (Statistics Canada 2002), questions 4, 5, 8 and 10 were reverse coded and the questions were then collapsed into six measures: *Workstress One: decision latitude/skill discretion* (questions 1, 2 and 4); *Workstress Two: Decision latitude/decision authority* (questions 3 and 9); *Workstress three: psychological demands* (questions 5 and 6); *Workstress four: Job insecurity* (question 7); *Workstress Five: Physical Exertion* (question 8); and *Workstress Six: Supervisor support* (questions 10, 11 and 12). Higher scales (except for Workstress Six) mean higher levels of work stress.

- The **Mental Health Inventory 5-item questionnaire (MHI-5)** is a five-question measure of mood or anxiety disorders. Respondents answered the question “*How much of the time in the past month have you felt...*” on a five-point Likert scale ranging from “all of the time” to “none of the time.” Questions 1, 3 and 5 were reverse coded so that all the questions were answered in the same direction, summed and multiplied by four to be a scale out of 100 (Rumpf et al. 2001). *Higher scores indicate better* mental health.
Figure 6.1: Conceptual map of relationships between office worker visual access to green roofs and ability to concentrate

- NEP score (New Environmental Paradigm) was used to measure environmental concern. This scale consists of 12 items with a 5-point Likert scale ranging from “strongly agree” to “strongly disagree.” Responses were summed and averaged (Stern et al. 1995, Dunlap et al. 2000).
Table 6.1: Descriptive Statistics: Socio-demographic and work Environment

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number (%) (n=505)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Socio-demographic</strong></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>49 and under</td>
<td>421 (83)</td>
</tr>
<tr>
<td>50+*</td>
<td>84 (17)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Female*</td>
<td>318 (63)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>405 (80)</td>
</tr>
<tr>
<td>Non-white*</td>
<td>100 (20)</td>
</tr>
<tr>
<td>Income</td>
<td></td>
</tr>
<tr>
<td>&gt;$24,000</td>
<td>15 (3)</td>
</tr>
<tr>
<td>$25,000-$34,999</td>
<td>35 (7)</td>
</tr>
<tr>
<td>$35,000-$49,999</td>
<td>100 (20)</td>
</tr>
<tr>
<td>$50,000-$74,999</td>
<td>148 (29)</td>
</tr>
<tr>
<td>$75,000-$99,999</td>
<td>88 (17)</td>
</tr>
<tr>
<td>$100,000-$149,999</td>
<td>62 (12)</td>
</tr>
<tr>
<td>$150,000+*</td>
<td>57 (11)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
</tr>
<tr>
<td>Less than bachelor’s Degree</td>
<td>94 (19)</td>
</tr>
<tr>
<td>Bachelor’s or Associate’s Degree</td>
<td>239 (47)</td>
</tr>
<tr>
<td>Graduate or Professional Degree*</td>
<td>172 (34)</td>
</tr>
<tr>
<td>City</td>
<td></td>
</tr>
<tr>
<td>Chicago*</td>
<td>396 (78)</td>
</tr>
<tr>
<td><strong>Work Environment</strong></td>
<td></td>
</tr>
<tr>
<td>Occupation</td>
<td></td>
</tr>
<tr>
<td>Office and Administrative Support</td>
<td>91 (18)</td>
</tr>
<tr>
<td>Arts, Design, Entertainment, Sports and Media</td>
<td>28 (5)</td>
</tr>
<tr>
<td>Management</td>
<td>57 (11)</td>
</tr>
<tr>
<td>Financial and Real Estate</td>
<td>56 (11)</td>
</tr>
<tr>
<td>Engineering, Architecture, Surveyors</td>
<td>40 (8)</td>
</tr>
<tr>
<td>Legal</td>
<td>100 (20)</td>
</tr>
<tr>
<td>Education, Human Resources Training, Library</td>
<td>15 (3)</td>
</tr>
<tr>
<td>Sales and Related</td>
<td>33 (7)</td>
</tr>
<tr>
<td>Business Solutions and Development*</td>
<td>54 (11)</td>
</tr>
<tr>
<td>Other</td>
<td>31 (6)</td>
</tr>
<tr>
<td>Industry</td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>34 (7)</td>
</tr>
<tr>
<td>Finance, Real Estate, Leasing, Insurance</td>
<td>90 (18)</td>
</tr>
<tr>
<td>Professional Services, Computer, Consulting, Law, Scientific</td>
<td>222 (44)</td>
</tr>
<tr>
<td>Business, Building Support Services, Corporate, Office Administration, Sales/Customer Service</td>
<td>17 (3)</td>
</tr>
<tr>
<td>Health Care and Social Assistance</td>
<td>30 (6)</td>
</tr>
<tr>
<td>Information, Culture, Recreation, Publishing, Design</td>
<td>57 (11)</td>
</tr>
<tr>
<td>Education, Accommodation, Food Services</td>
<td>16 (3)</td>
</tr>
<tr>
<td>Utilities, Manufacturing, Trade/Outsourcing, Transportation, Other Services</td>
<td>13 (3)</td>
</tr>
<tr>
<td>Public Administration and Human Resources*</td>
<td>26 (5)</td>
</tr>
<tr>
<td>Hours Worked in Office</td>
<td></td>
</tr>
<tr>
<td>Half the time or less</td>
<td>67 (13)</td>
</tr>
<tr>
<td>Most of the time</td>
<td>138 (27)</td>
</tr>
<tr>
<td>Almost all the time*</td>
<td>300 (59)</td>
</tr>
<tr>
<td>Visual Access to green roof</td>
<td></td>
</tr>
<tr>
<td>Yes Visual Access*</td>
<td>185 (37)</td>
</tr>
<tr>
<td>No Visual Access</td>
<td>320 (63)</td>
</tr>
</tbody>
</table>

* Denotes dummy category
Neighbourhood nature- the mean of two questions: responses to “Do you feel that there is enough nature near your workplace?” on a 4-point Likert scale ranging from “No, there isn’t much nature near my workplace” to “Yes, there is more than enough nature near my workplace” and the bimodal response to “Do you feel that nature near your workplace influences your health and well-being?” The scale was adapted from a previous neighbourhood nature scale (Gobster 2001b).

6.2.6. Logistic regression

Logistic regression was used to identify significant predictors of concentration. Logistic regression was an appropriate technique given that the dependent variable was dichotomized (i.e., difficulty concentrating or not). To ensure that the proposed logistic regression model would be an adequate description of the data, statistical procedures were carried out to check for multi-collinearity among the predictor variables. Residuals were also examined to identify any points for which the model fits poorly and to identify any points that exert an undue influence on the model.

6.3. Results

6.3.1. Descriptive statistics

Descriptive statistics for the socio-demographic and work environment variables are shown in Table 6.1. Descriptive statistics for the psychosocial work environment, psychological distress,
and environmental values variables are shown in Table 6.2. The distribution of means for the sample population for Work Stress is comparable to those found in other studies, with the exception of Job Strain (measured by Work Stress one, two, and three), which is lower for this population than found in other studies (.054 compared to .099), and social support, which is higher for this population (8.07 as compared to 6.02) (Wilkins and Beaudet 1998).

The environmental attitudes of the sample population, measured by the NEP scale, are slightly lower than that of the general population (3.24 versus 3.67) (Dunlap and Van Liere 1978, Schultz and Zelezny 1999), while the mental health status of the sample population (measured by the MHI-5 scale), is comparable to scores found in other western populations (75.04 versus 73.30) (Rumpf et al. 2001).

6.3.2. Logistic regression

To test whether or not visual access to a green roof was still significantly related to the ability to concentrate when the other predictor variables were included in the model, a logistic regression model was estimated. As this research is exploratory, a backward stepwise logistic regression was used. Self-reported difficulty concentrating, measured on a binary scale (0 = no; 1 = yes) was used as the outcome or dependent variable. For predictor variables with more than one category the indicator method of dummy coding was used, with one category as the reference category (see Table 6.1).

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10 Wilkins and Beaudet grouped their variables slightly differently; in order to compare this population’s responses to their numbers, the categories for Work Stress were similarly grouped post-analysis, which is why some categories (i.e. Job Strain and Social Support), have different numbers than shown in the table. This is a superficial change and does not change the analysis.
Table 6.2: Descriptive Statistics: Psychosocial Work Environment, Psychological Distress, Environmental Values Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Work Stress</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WS:1 Decision Latitude/Skill Discretion</td>
<td>505</td>
<td>7.97</td>
<td>1.77</td>
</tr>
<tr>
<td>WS:2 Decision Latitude/Decision Authority</td>
<td>505</td>
<td>5.34</td>
<td>1.60</td>
</tr>
<tr>
<td>WS:3 Psychological Demands</td>
<td>505</td>
<td>2.86</td>
<td>1.57</td>
</tr>
<tr>
<td>WS:4 Job Insecurity</td>
<td>505</td>
<td>2.59</td>
<td>.90</td>
</tr>
<tr>
<td>WS:5 Physical Exertion</td>
<td>505</td>
<td>3.04</td>
<td>.86</td>
</tr>
<tr>
<td>WS:6 Social Support</td>
<td>505</td>
<td>8.07</td>
<td>2.21</td>
</tr>
<tr>
<td><strong>Valid</strong></td>
<td>505</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Psychological Distress</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MHI-5</td>
<td>505</td>
<td>75.04</td>
<td>12.96</td>
</tr>
<tr>
<td><strong>Valid</strong></td>
<td>505</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Environmental Values</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEP</td>
<td>505</td>
<td>3.24</td>
<td>.29</td>
</tr>
<tr>
<td><strong>Valid</strong></td>
<td>505</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neighbourhood ‘nature’</td>
<td>505</td>
<td>3.84</td>
<td>.99</td>
</tr>
<tr>
<td><strong>Valid</strong></td>
<td>505</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following predictor variables were identified for inclusion in the model based on their significant relationship to the outcome variable: age, (over 50 years)\(^{11}\), ethnicity (non-white), income ($150,000 and above), education (graduate or professional degree), gender (female), occupation (business solutions and development), industry (public administration/Human Resources), daylight, hours worked in office (almost all time in office), City (Chicago), visual access to a green roof (access to a green roof), NEP, Workstress 1, 2, 3, 4, 5, 6, and MHI-5.

The data were then assessed for multi-collinearity. An examination of the correlations between the predictor variables showed that none had a correlation above 0.45. Second, there were no instances where VIF as greater than 10 and where the tolerance statistic was less than 0.1 (Field 2009). After examination of the residuals, it was found that 97.3% of the standardized residuals

\(^{11}\) Categories in parentheses are the reference category
range between -2 and 2. However, there were eight cases with a value outside the range -3 to 3. These cases were explored in more detail and all of them had DBeta values less than 1, leverage statistics close to the calculated expected value, and no unusually high values of Cook’s distance (Field 2009). This suggests that multi-collinearity among the predictor variables was not a serious concern.

All of the predictor variables were then entered into a backward stepwise logistic regression analysis. Table 6.3 shows the maximum likelihood estimates of the final logistic regression model, their standard errors, and the corresponding results of the Wald test. The Hosmer and Lemeshow’s pseudo-$R^2$ ($R_L^2$), Cox and Snell, and Nagelkerke pseudo-$R^2$’s are also presented. -2LL is an indicator of how much unexplained information there is after the model has been fitted to the data, and can therefore be used as a ‘goodness of fit’ statistic (Field 2009). The change in -2LL was 115.589, $df = 15, p = .000$. The significance of the final model shown above indicates that the predictor variables are significant predictors of difficulty concentrating. The Hosmer and Lemeshow goodness-of-fit test was also conducted (Field 2009). In this test, the null hypothesis is that the model adjusts well to the data, and this hypothesis was not rejected ($p = .592$). The Hosmer and Lemeshow measure ($R_L^2$) can also be interpreted “as similar to the $R^2$ value in linear regression in that it provides a gauge of the substantive significance of the model” (Field 2009). The Hosmer and Lemeshow value of .17 indicates that the predictor variables in the final model are somewhat useful in predicting the outcome variable. The predictive capacity of the final model is very reasonable for correctly predicting those who had difficulty concentrating at 81.8%, and less so for correctly predicting those who did not have difficulty concentrating at 57.4%. The overall percentage of correctly classified cases is 72.1%, as compared with the model with no variables, which correctly classified 60% of cases.

The values of $Exp(B)$ show the change in odds resulting from a unit change in the predictor variable. The results in Table 6.3 show that visual access to a green roof (our predictor variable of interest) was not a significant predictor of concentration at $p < .05$, though there is a trend at $p$
141. Compared to respondents with visual access to a green roof, the odds of having difficulty concentrating were 50% higher for those without visual access to a green roof (keeping all other variables constant). A stronger predictor of concentration is age. Keeping all other variables constant, those 50 and over were 3.7 times more likely to have difficulty concentrating. Workstress 3, *psychological demands*, is also a strong predictor of concentration and significant. For every one-unit increase in psychological demands, the odds of having difficulty concentrating is 18% lower (keeping all other variables constant), though as the odds ratio is close to 1, the effect is fairly small. Workstress 6, *social support*, is also a significant predictor of concentration; for every one-unit increase in social support, the odds of having difficulty concentrating are 12% lower (keeping all other variables constant), though again the effect is fairly small. Mental health significantly predicts concentration, though this effect is very small: for every one-unit increase in mental health (i.e. better mental health), the odds of having difficulty concentrating are .05% lower (keeping all other variables constant). The dummy variable for occupation was significant overall, and almost significant for the category of respondents working in finance and real estate. For those respondents, the odds of having difficulty concentrating were 53% lower than for the indicator category (*business solutions and development*), keeping all other variables constant.

6.4. Discussion and Conclusion

Green roofs are an increasingly popular greening option for both cities and building owners as they can provide environmental benefits without taking up valuable real estate. They can also provide additional greenspace in areas where land costs are prohibitive for creating parkland, such as in central business districts. As many green roofs are overlooked by office workers, and there is an increasing interest in workplaces that promote healthy, productive workers, the possibility that green roofs may promote these soft psychosocial benefits is appealing. The results from the final model show that in the context of other predictor variables, visual access to a green roof is not significantly related to the ability to concentrate, although results do suggest a trend wherein green roofs may help increase concentration. Socio-demographic factors such as
age and occupation, as well as several measures of work stress and mental health, were all significantly related to concentration, with younger individuals, those working in finance and real estate, those whose work is more psychologically demanding, who have more social support, and have better mental health experiencing less difficulty concentrating.

Some of the predictors in the final model are consistent with other research. Social support in the workplace has been linked to increased job satisfaction and psychological wellbeing for office workers (Lowe, Schellenberg and Shannon 2003). The most influential predictor on ability to concentrate is mental health, which again is not surprising and is consistent with the data of others; i.e. that better mental health improves one’s ability to concentrate (Hilton et al. 2009). What is surprising is that an increase in psychological demands is linked to better concentration, a finding that would seem to be counter-intuitive and which is different from the findings of others (Danna and Griffin 1999b). One possible explanation is that increased pressure at work also increases the pressure to focus and get one’s work done, or that this particular population tends to be more focused than the general population.

As for the relationship of interest, though not significant, results seem to indicate a positive relationship between visual access to a green roof and improved concentration. This is contrary to the findings of Larsen et al who found that productivity was inversely related to the number of plants in the office (Larsen et al. 1998). However, it supports findings from others who have generally found that the presence of plants improved concentration (Raanaas et al. 2011), and that visual access to nature had a beneficial effect on human psycho-physiological responses and improved well-being (Kaplan 1993, Chang and Chen 2005).
Table 6.3: Results of the Estimation of a Logistic Regression Model with Final Predictor Variables for Difficulty Concentrating

<table>
<thead>
<tr>
<th>Predictor Variable</th>
<th>β</th>
<th>Exp(β)</th>
<th>S.E.</th>
<th>Wald</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age: 50 years and older</td>
<td>1.307</td>
<td>3.694</td>
<td>.287</td>
<td>20.672</td>
<td>.000</td>
</tr>
<tr>
<td>Occupation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business Solutions and Development</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Office and Administrative Support</td>
<td>.276</td>
<td>1.317</td>
<td>.393</td>
<td>.492</td>
<td>.483</td>
</tr>
<tr>
<td>Other</td>
<td>-.214</td>
<td>.807</td>
<td>.496</td>
<td>.187</td>
<td>.666</td>
</tr>
<tr>
<td>Arts, Design, Entertainment, Sports and Media</td>
<td>.486</td>
<td>1.626</td>
<td>.559</td>
<td>.755</td>
<td>.385</td>
</tr>
<tr>
<td>Management</td>
<td>-.633</td>
<td>.531</td>
<td>.425</td>
<td>2.217</td>
<td>.137</td>
</tr>
<tr>
<td>Financial and Real Estate</td>
<td>-.767</td>
<td>.465</td>
<td>.423</td>
<td>3.289</td>
<td>.070</td>
</tr>
<tr>
<td>Engineering, Architecture, Surveyors</td>
<td>.392</td>
<td>1.479</td>
<td>.500</td>
<td>.614</td>
<td>.433</td>
</tr>
<tr>
<td>Legal</td>
<td>.437</td>
<td>1.547</td>
<td>.394</td>
<td>1.226</td>
<td>.268</td>
</tr>
<tr>
<td>Education, HR Training, Library</td>
<td>-.436</td>
<td>.646</td>
<td>.641</td>
<td>.463</td>
<td>.496</td>
</tr>
<tr>
<td>Sales and Related</td>
<td>-.185</td>
<td>.831</td>
<td>.496</td>
<td>.139</td>
<td>.709</td>
</tr>
<tr>
<td>Workstress 3: Psychological Demands</td>
<td>-.201</td>
<td>.818</td>
<td>.071</td>
<td>8.043</td>
<td>.005</td>
</tr>
<tr>
<td>Workstress 5: Physical Exertion</td>
<td>.414</td>
<td>1.513</td>
<td>.137</td>
<td>9.111</td>
<td>.003</td>
</tr>
<tr>
<td>Workstress 6: Social Support</td>
<td>-.128</td>
<td>.880</td>
<td>.050</td>
<td>6.534</td>
<td>.011</td>
</tr>
<tr>
<td>Mental Health Inventory (MHI-5)</td>
<td>-.048</td>
<td>.953</td>
<td>.009</td>
<td>25.831</td>
<td>.000</td>
</tr>
<tr>
<td>Visual access to green roof</td>
<td>.417</td>
<td>1.517</td>
<td>.217</td>
<td>3.684</td>
<td>.055</td>
</tr>
<tr>
<td>Constant</td>
<td>3.524</td>
<td>33.926</td>
<td>.960</td>
<td>13.484</td>
<td>.000</td>
</tr>
</tbody>
</table>

Hosmer and Lemeshow (2000) pseudo-$R^2 (R_L^2) = .17$, Cox and Snell = .21, Nagelkerke = .28.

It is also supports findings from interviews with the same population, who reported better perspective, focus, and calmness about their work because of visual access to the green roof (Chapter 4).

This has interesting implications for our understanding of the relationship between access to nature, green roofs, and well-being, as well as our understanding of the relationship between nature and concentration. Currently most discussions on health/well-being in buildings focuses on the building itself, not on the larger environmental or visual context of the building. While
attractive views have been shown to be linked to overall well-being (Kaplan 2007), improved health outcomes (Ulrich 1984), and reduced discomfort (Aries et al. 2010), no previous research has investigated the possible impacts of green roofs on productivity and well-being. Despite the fact that green roofs form a small part of the visual frame of office workers; i.e. most of their view could be classified as ‘unnatural’, the persistence of visual access to green roofs as influencing concentration points to the potentially powerful impact access to nature may have for office workers. It supports the numerous environmental preference studies that have consistently shown that participants prefer natural scenes over those that are less natural (Ulrich 1981, Herzog et al. 2002) and have higher rates of attention restoration in natural areas (Hartig et al. 2003b).

Given the severe lack of any greenspace in most central business districts, green roofs may be the only ‘nature’ available to many office workers. Given the increasing importance of work environments that support the productivity and well-being of office workers, the addition of greenspace on or near workplaces may help to provide some of these benefits.

Measuring concentration as linked to ‘nature’ in the workplace also presents particular challenges. The dependent variable, difficulty concentrating, may be qualitatively different than feeling restored and better able to focus after exposure to nature. This might be based on a perceived conflict between the soft focus and ‘daydreaming’ quality of staring out of a window at something natural discussed by the Kaplans and others (Ouellette, Kaplan and Kaplan 2005), and the demands of an office environment in which gazing out of the window is seen as procrastination, and therefore not being able to focus. Getting at this type of ‘focus’, however, is very difficult. Affective responses to nature are notoriously hard to measure in verbal survey questions, which have been found to evaluate cognitive responses even when trying to draw out affective qualities (Perrin and Benassi 2009). Measuring concentration while doing creative tasks, or even more varied office work, may be more difficult. Furthermore, some research has shown that more creative types of work are influenced by positive affect- i.e. the higher the mood of the participant, the more positively participants will rate not only their performance, but the attractiveness and comfort of their surroundings (Isen cited in (Larsen et al. 1998). Testing both different variables of concentration and restoration in future green roof, health, and
workplace studies may help to flesh out this relationship and take into account the nature of much white-collar office work.

The study is somewhat limited by the nature of the field sites. Measuring the exposure to green roofs is very difficult even in one building, much less 34 buildings and numerous green roofs. Some floors and buildings had excellent access to the green roof (i.e. at eye level and close by), some could only see a sliver of green roof in the distance, but the number of respondents in each category was too small to separate out in the model. This means that visual access to green roofs included those with lots of access and those with minimal access, which might weaken the predictive effect. Quantifying the benefits of access to nature is generally challenging; even in controlled studies on plants in the workplace there are issues with controlling for the level of exposure while keeping the interaction somewhat natural (Raanaas et al. 2011). Future research could try to use a more experimental research design to better control level of access.

Overall, this exploratory research suggests that visual access to green roofs has a positive impact on ability to concentrate, but not significantly so. By exploring this question, this paper contributes to a growing body of research that is beginning to explore the psychosocial aspects of access to green roofs and their potential benefit to urbanites. Given the increasing demand for innovative environmental solutions in cities, and the interest in workplaces that promote well-being, green roofs may offer possibilities for improved well-being, but further research is required to identify and quantify how they may contribute to improved well-being among office workers.
CHAPTER 7

7 Conclusion

7.1. Summary and Discussion of Findings

By adding vegetation to rooftops, green roofs can offer innovative solutions to urban environmental problems such as the reduction of stormwater overflow and the urban heat island effect. By adding greenspace to cities, green roofs are also assumed to provide benefits to the public such as improved health/well-being. This assumption of a positive effect is based in a strong Anglo-American narrative that idealizes nature.

Because green roofs are relatively new in North America, and because they blend built form and greenery, they both lack the symbolism associated with more traditional forms of nature (such as forests), and challenge the traditional separation of ‘nature’ and the city. This makes them an interesting case study through which to examine the human relationship to nature and how it impacts health/well-being and sense of place. Understanding this relationship is complicated by the lack of socio-psychological research on green roofs, the complexity of meanings and values associated with urban ‘nature’, and the difficulty of measuring the role of nature in health/well-being in the workplace. For example, while there is ample evidence from research in environmental psychology on the restorative benefits of access to nature and the importance of nature to favourite places and neighbourhoods, an uncritical assumption of the benefits of ‘nature’ does not help to explain the controversies, values, and assumptions about urban ‘nature’ within the Anglo-American tradition.
This thesis addressed the complexity of these relationships, and the difficulty of measuring them, by using a mixed methods approach. The qualitative segment of the thesis is grounded in a phenomenological understanding of the relationship between nature, place, and health/well-being (Chapter 4). Phenomenology, by making explicit what participants may not have articulated yet to themselves, is well-suited to addressing questions that may seem obvious - such as the benefit of ‘nature’ to office workers - but which in reality are more complex. Phenomenology also allows for a richness of detail and nuance that can then be tested through quantitative methods in a larger population. Using quantitative methods in addition to qualitative thus allows for triangulation of the findings from the interviews, but also helps illuminate what is not captured by the survey. This is important in exploratory research where previous metrics may not be adequate for new contexts.

The body of work presented in this thesis provides much-needed empirical data on these relationships. It contributes to our understanding of the human relationship to nature in cities, the role of ‘nature’ and green roofs in urbanites’ sense of place, and the potential health/well-being benefits of access to ‘nature’ through green roofs in the workplace. Furthermore, as green roofs are relatively new in North America, the way they are framed and implemented has the potential to influence urbanites’ understanding and awareness of them. The qualitative and quantitative explorations of office workers’ perceptions of green roofs also support policy makers by providing new, and much-needed, empirical data to support their urban greening programs.

More specifically, Chapter 2 - ‘Nature’, Health, and Well-Being: A Review of Different Approaches, Tensions, and Convergences - addresses some of the tensions and conflicts in the understandings of ‘nature’ and health/well-being that ground this research. This critical review provides a theoretical context for the rest of the thesis that informed the approach used for the interviews and survey, and their subsequent analysis. The chapter reviews current debates and trends in research on the human relationship to ‘nature’ and health/well-being, looking
particularly at the influence of research programs in environmental psychology and work in social constructionism with regard to a) what ‘nature’ is and our relationship to it, and b), how it affects health/well-being. The review suggests that there seems to be some convergence between their methods and integration of different paradigms. However, continued epistemological and ontological differences, a lack of clarity on the normative assumptions underlying each approach and the understanding of the term ‘nature’, and the tendency to ‘silo’ nature and health/well-being research leads to confusion in the specification of ‘nature’ in this research. This is seen most clearly in differing ideas about the universality of human responses to nature and the durability of the nature-health relationship. For environmental psychologists, the use of nature as a stable, self-evident phenomenon in research programs has provided a vast body of research linking contact with nature with improved human health/well-being, notably the restoration of concentration abilities and faster recovery from stress. But these research programs have been unable to explain conflicts around differing interpretations of ‘nature’, seen in this thesis in the ambiguous interpretations of the more naturalized aesthetic in green roofs despite the idealization of wildness outside the city. Research programs in social constructionism, on the other hand, have destabilized ‘nature’ as a self-evident phenomenon and thus largely dismissed any universal health/well-being benefits from contact with nature, since ‘nature’ is viewed as a historically-specific phenomenon that is mediated by a host of shifting, often conflictual identities of the knower. This deconstruction has been invaluable in explaining some of the conflicting values and assumptions underlying ‘nature’, seen again in this thesis in the privileging of ‘wild nature’ outside the city, but it has also tended to dismiss affective responses to nature.

The conclusions from this chapter argue that incorporating a more nuanced, qualitative understanding of ‘nature’ to inform psychometric testing may help to explain some of these ambiguities and strengthen research on the relationship between nature, health/well-being, and sense of place. Similarly, the general dismissal of emotional responses to nature limits potentially productive avenues for research from a social constructionist perspective. Though a full integration is impossible, and in many ways undesirable given the fundamentally different paradigms underlying these research programs, there is still room for dialogue between them and
the opportunity to productively use findings from each other. The results from this chapter provide the theoretical basis for the rest of the thesis and help to lay out why a mixed method approach is useful when studying green roofs and health/well-being.

Chapter 3, “Making ‘Green’ Happen: Evaluating Two Cities’ Approaches to Green Roof Implementation in North America,” provides valuable comparative empirical work on municipal green roof implementation in North America, and the socio-political context for the thesis. This chapter examines and compares each city’s green roof policies, factors influencing their relative levels of success, and their chances of continued success. Specifically it addresses the political and social context of green roofs in Toronto and Chicago. In so doing, it explores the social constructionist perspective that underlying policy development are values, politics, and power dynamics that can mean that similar policies can have different outcomes in different cities. Though both Toronto and Chicago have implemented similar green roof policies, the analysis argues that legislative power, leadership, the framing or “selling” of green roofs, and funding availability greatly influenced their relative levels of success. Furthermore, the chapter argues that the use of green roofs as a symbol for other urban greening initiatives taps into values and feelings towards ‘nature’ that influence the success and popularity of urban greening initiatives in Toronto and Chicago.

This paper enhances our understanding of how to get environmental initiatives on the table and implemented. It also discusses how different political systems and champions for green roofs may impact their continued success and longevity. Given the current economic climate (as well as recent electoral changes in both Toronto and Chicago), this understanding will be essential if these and other cities are to continue to adopt mitigation and adaptation strategies for climate change. This study of green roofs provides timely empirical data that can be used by municipalities interested in developing green roof policies as well as providing the socio-political context for Chapter 4.
Chapter 4, entitled “There’s a meadow outside my workplace: Phenomenological explorations of Place, Green Roofs, and Aesthetics in Chicago and Toronto,” provides much-needed empirical data on North American office workers’ perceptions of green roofs and ‘nature’ in the city. It builds on the socio-political context set up in Chapter 3, and explores the tensions and gaps in the understanding of ‘nature’ outlined in Chapter 2. It does this through a phenomenological exploration of office workers’ thoughts, feelings and associations about green roofs, urban ‘nature’, their health/well-being, and the ‘place’ of their central business districts. Though basic empirical data on office workers’ perceptions of green roofs is useful and much needed, the goal of this chapter was to move beyond the likes and dislikes of participants about green roofs. Rather, this chapter uses green roofs as a case study through which to understand the broader issues of the human relationship to nature, especially as mediated by the city. Results from this analysis suggest that whether or not participants like the aesthetics of the green roof, and whether or not they saw the green roof as ‘nature,’ they tend to be fascinated by them and prefer them to black tar or gravel roofs. This was particularly true for participants who had close access over time to the green roof, and for green roofs that had a ‘wilder’, more naturalized aesthetic, such as prairie-style green roofs. For participants who had this closer access, they often felt that the green roof influenced their well-being, and associated it with feelings of surprise, creative thinking, and memories of childhood experiences of nature. Participants were also sensitive to the role of human influence in implementing the green roof. This was seen in the association of green roofs with larger urban greening initiatives and the person or organization associated with their implementation, as well as ambiguity over whether or not green roofs were ‘nature’ since humans had clearly put them up. Underlying participants’ discussions was their daily-lived experience of place in downtown central business districts, where little access to nature left them fatigued and searching for some visual respite from the hard edges and concrete.

The results from this chapter also suggest that the word ‘health’ tends to be associated with physical health, and well-being with psychological and emotional health. As most of the benefits
of green roofs seem to be to overall well-being versus health, this distinction provides useful empirical data for future research on urban nature, green roofs, and health/well-being. This chapter concludes with implications for landscape architects, green roof designers, and municipal policy development on green roofs. One implication is that green roofs that are more ‘natural’ and ‘wild’ may not always be liked by urbanites, but they seem to be far more interesting to them than plain sedum green roofs. Echoing pioneering work by Nassauaer, the results of this chapter suggest that giving ‘cues to care’ (Nassauaer 1995) - i.e. making it clear (through signage etc.) that the “messy” aesthetics of the green roof are intentional, and have an ecological and habitat function - could increase the acceptance and appreciation of green roofs. The phenomenological understanding of place, green roofs, and health/well-being articulated here informed the quantitative analysis and interpretation described in Chapters 5 and 6.

Chapter 5, “Green roofs, health, and well-being: Exploring the Connection in Toronto and Chicago Workplaces,” set out to explore whether the findings from Chapter 4 - such as the linkage of green roofs with improved well-being - were also present in a larger, more statistically representative population. The findings from the interviews informed the format of the survey, and led to the inclusion of questions asking about the importance of neighbourhood ‘nature’, as well as a question asking whether participants associated green roofs with ‘nature’. Using an exploratory method involving descriptive statistics and chi-square analysis, this chapter presents results of a survey conducted in Chicago and Toronto (n = 903) to understand a) office worker perceptions of, awareness of, and access to green roofs, and b), how and if this influences their health/well-being. Results from this analysis show that unlike previous green roof studies on participant’s knowledge about green roofs, 75% associated green roofs with some kind of benefit to the city, and 60% with some specific environmental benefit. Respondents’ self-reported health status and stress level did not change with green roof access, but there was a significant association between visual access to the green roof and increased ability to concentrate.
There were also significant relationships between respondents’ access to the green roof and their perception that the green roof influenced their health/well-being; those with physical green roof access were more likely to also feel that the green roof influenced their health, though their health status did not change. Similarly, those who associated green roofs with nature or with a benefit to the city also were more likely to feel that green roof influenced their health. This highlights the complexity between whether participants felt that green roofs influenced their health versus any change in their self-reported health status. Interestingly, while 80% of participants felt that green roofs were part of ‘nature’, and 80% felt that ‘nature’ influenced their health, only 52% felt that green roofs influenced their health. This highlights the issue, expressed in Chapter 2, of the difficulty of capturing affective, more phenomenological understandings of ‘nature’, green roofs, and place in quantitative surveys and the difficulty of measuring the ‘soft’ benefits of ‘nature’ on well-being. The key finding that visual access to a green roof was significantly related to improved concentration was further explored in Chapter 6.

Chapter 6, “Visual Access to a green roof and Office Worker Concentration,” tested whether one of the main relationships found in Chapter 5, that visual access to a green roof improved office worker concentration, was still significant when other possible confounding variables were taken into account. This chapter used a backward stepwise logistic regression on the same population (n=903, logistic regression subset n=505). The model controlled for socio-demographic variables, environmental attitudes, and physical and psychosocial workplace characteristics to determine what factors might predict the ability to concentrate, and whether green roofs remained an important predictor in the context of other plausible causes. The results indicate that predictors like age, workplace stress, and mental health are important and significant predictors of concentration. Visual access to a green roof is no longer significantly related to concentration in the context of other variables in the model, but there is a trend that shows a positive relationship. Specifically, as compared to those with visual access to a green roof, those without visual access are 50% more likely to have difficulty concentrating. This chapter ends with a discussion of the limitations of using concentration as a measure of productivity and well-being. In particular, the tension between the restorative, soft attention aspect of ‘nature’ and well-
being, and the focused demands of the workplace, may mean that participants feel that they are less focused and have more difficulty concentrating when gazing out at the green roof, even if they are more productive and creative afterwards. This also points to a current limitation in the concentration and ‘nature’ studies which tend to measure very specific task-oriented forms of productivity, and which may or may not be reflective of the problem-solving, creative aspects of many white-collar occupations. The chapter concludes with a discussion of ways forward to further refine research and measurement on green roofs, health/well-being, and productivity in the workplace.

7.2. Implications for research on green roofs, health/well-being, and the human relationship to nature in cities

How do the results from this thesis help answer the primary research questions set out in Chapter 1, namely a) What do office workers know, think and feel about green roofs; b) do they feel that green roofs influence their health/well-being; and c) what are the implications for our understanding of the human relationship to nature in cities? The results from this thesis help answer these questions in three main ways. First, this thesis provides real empirical data on the knowledge, attitudes, and perceptions of green roofs and their relationship to the health/well-being of office workers who have access to them. Second, the results point to the importance of mixed methods in answering these questions. Third, the results indicate the complexity involved in understanding and measuring perceptions of health/well-being when influenced by similarly complex phenomena such as ‘nature’ in the city, sense of place, and green roofs.

In answering the first research question, “what do office workers know, think and feel about green roofs?” the use of different methods in each chapter gives a fuller picture of office workers’ perceptions and knowledge about green roofs. For example, due to the difficulty of getting interview participants to talk about green roofs who had no access to them, it was hard to
get an idea of how many people in each building had access to the green roof from the results from Chapter 4. From the survey results from Chapter 5, it was thus surprising to find out that only 56% of participants had access to a green roof, raising questions about how widespread possible benefits from green roof access can be in downtown central business districts. However, unlike previous studies on knowledge and perceptions about green roofs (Kuper 2009, Smith and Boyer 2007), results from Chapter 5 show that 90% of survey participants knew what a green roof was, and 60% associated it with a specific environmental benefit, such as improved air quality. While this may reflect the educated, and female-dominant demographics of the sample population who are known to have stronger environmental values (Snelgar 2006), or partial self-selection, it may also reflect the efforts in both cities to publicize their green roof policies. As seen in Chapter 3, both Toronto and Chicago have embarked on extended green roof policy implementation and, particularly in the case of Chicago, publicity. The effectiveness of this publicity campaign is reflected in the high level of awareness of participants in Chapter 5 about the environmental benefits of green roofs. It is also reflected in responses from interview participants in Chapter 4: in Chicago they routinely referred to the city hall green roof as “the mayor’s garden” and associated green roofs with the overall revitalization and renewal of their downtown; in Toronto they associated the green roof with the environmentally-minded organization responsible for putting up the green roof.

In addition to being associated with larger environmental initiatives and revitalization, almost all participants associated the green roof with some benefit to the city just by virtue of providing greenspace or being nice to look at. This reflects findings in both Chapter 3 and Chapter 4 on the symbolic quality of green roofs, and the symbolism of nature discussed in Chapter 2. What did not emerge from Chapters 3 or 5 was the complexity of participant associations on the aesthetics of green roofs, their ambiguity over whether or not they associated green roofs with ‘nature,’ and their fascination with them. These findings arose through phenomenological analysis in Chapter 4. While it would have been possible to include questions on likes and dislikes about the aesthetics of the green roofs in the survey, the responses would not have tapped into the larger values, expectations, and daily-lived experiences about the modernist city that influenced
participant likes and dislikes. In particular, what emerged from the interviews in Chapter 4 is that there may be a difference between what participants thought and what they felt about green roofs. This was expressed in their ambiguity about the ‘messy’ aesthetic of a prairie-style green roof, but their fascination with it over sedum-style green roofs and their almost unconscious feeling that it reminded them of other nature experiences. These findings are important because they may be an essential element in helping to explain the second research question: “Do office workers feel that green roofs influence their health/well-being?”

Results from Chapter 5 on the health/well-being benefits of green roofs are somewhat ambiguous. While health and stress status did not change with access (visual or physical) to a green roof, participants who had physical access felt that the green roof influenced their health. Concentration, which here is a stand-in for health/well-being (i.e. if you have better health you will be able to concentrate better), was 50% better for participants who had visual but not physical access to the green roof. This relationship was no longer significant in the context of other variables such as age, mental health, and work stress in Chapter 6, but there was a definite trend. However, other results from Chapter 5 on this question are somewhat puzzling; while 80% of participants associated green roofs with nature, and 80% felt that nearby nature influenced their health/well-being, only 52% thought the nearby green roof influenced their health/well-being. Those that associated green roofs with ‘nature’ and with some benefit to the city were also more likely to feel that green roofs influenced their health.

To help understand these questions four themes that emerged from Chapter 4 are helpful. First, given the traditional association of messiness in cities with neglect and ill-health, participants may have been uncertain whether these ‘messy’ prairie green roofs positively influenced their health. Second, participants distinguished between their health, which they associated with physical health, and their overall well-being. As seen in Chapter 4, it was feelings of well-being which were associated with access to a green roof. Furthermore, participants seemed unsure on how to evaluate the impact of green roofs on their health if they did not have physical access,
which could help explain the findings from Chapter 5. Third, participant ambiguity over thinking through whether green roofs were ‘nature’, but their feeling that they were in Chapter 4, may point to a fundamental aspect of health/well-being and access to ‘nature’ in cities. As seen in the discussion above, this feeling that green roofs were ‘nature’ was stronger when they had close access to them over time, when they were fascinated by them, and when they tended to have a ‘wilder’ aesthetic. If the green roof had these characteristics, it was more often linked to feelings of calm, perspective, and reduced stress found in research on nature and health/well-being (Kaplan and Kaplan 2005, Hartig et al. 2003b) in Chapter 2. This would seem to indicate the potential for green roofs to positively impact office workers’ well-being if linked to their almost unconscious association of the green roof with ‘nature’. This ‘soft fascination’ is similar to that discussed by the Kaplans in their attention restoration theory (Hartig and Staats 2003, Kaplan 1987), but is interesting here as it has not been tested in mostly ‘unnatural’ environments such as downtown business districts or the workplace.

The use of improved concentration (or attention restoration) as a research variable may be difficult in the workplace, however, and this may influence the results from Chapter 6. Most of the studies testing concentration in the workplace have done so with plants, and have not targeted restoration per se. Given the findings from Chapter 4 on the importance of the feeling of calm, fascination, and perspective, the term ‘concentration’ in the workplace may be associated with not looking out of the window and gazing at the green roof, even though this may help office workers to be more productive afterwards. Lastly, interview participants were sensitive to the symbolism of green roofs and felt that it impacted their well-being. Green roofs that hinted at the hinterland, and that seemed to have effort put into them, were associated with hope for the future, gratitude that someone cared about public spaces in the city, and pride. What is interesting is that these feelings may be linked to a more positive affect, which as discussed in Larsen et al (Larsen et al. 1998), is also linked to office workers rating their surroundings and their performance, such as concentration, more highly.
The use of different methods to ask the same questions in Chapters 4, 5, and 6 indicate that well-being may be a more relevant term to use in this type of research. Furthermore, the outcome variable concentration may need to be modified to include aspects of well-being, restoration from stress, symbolism and positive affect in order to take into account the findings from Chapter 4 and the full spectrum of influences on well-being. The combination of methods used in this thesis thus gives a more complete picture of the different factors involved in office workers’ perceptions and knowledge about green roofs.

What does the above tell us about our understanding of the human relationship to nature in cities, the third research question of this thesis? To being with, participant perceptions of green roofs and other ‘nature’ in the city mirrors the debates set out in Chapter 2. That is, participants both accepted what is ‘nature’ to be self-evident and used the word uncritically when describing experiences with nature, usually as children. This mirrors use by environmental psychologists, popular culture in North America, and classic nature’ theorists themselves, such as Thoreau, Emerson and Muir. As seen above, participants also reflected social constructionists’ positioning of ‘nature’ as a complex and culturally-mediated phenomenon in their uncertainty on whether they considered green roofs to be part of ‘nature’, and in their ambiguity over the ‘messy’ and ‘wild’ look of the green roof. This ambiguity centered on the distinction between nature as a place, such as wilderness outside of the city, and nature as a thing, such as plants, preferably untouched by humans. The sentiment that nature could not be touched by humans mirrors ecological restoration debates which pit those who feel humans are part of nature against those who feel nature can only be saved by removing humans from it (Elliot 2000, Katz 2000b, Rolston 2000).

What seems to be suggested by this thesis is a third option, which is nature as a feeling. As seen in Chapter 4, participants expressed knowing that humans put up the green roof, and therefore that it could not be ‘nature,’ but felt that it was. As discussed above, this was particularly true for participants who had close access to a green roof over time and who watched it through seasonal change. As emerged from the interviews, this watching often led to a letting go of expectations
of what it should be, a recognition of the ‘otherness’ of the green roof, memories and associations of other ‘nature’ experiences and feelings, and an overall feeling of calm, perspective, softening, and creative problem solving. All four responses give some insight into the human relationship to nature in cities.

First, through the use of phenomenology in Chapter 4, we can see that the expectations many participants had over what kind of ‘nature’ belonged in the city reflects the narrative of the modernist, rationalist city that has ‘weeded out’ wild nature from cities for the last hundred and fifty years as inappropriate and a sign of decay and neglect. Just as work in political ecology has looked at the intersection of cities and ‘nature’ (Heynen et al. 2006), this modernist narrative must be taken into account when examining perceptions of green roofs and urban nature as a case study for understanding the human relationship to nature in cities. At the same time, participants’ fatigue from the relentlessness of the hard edges and concrete of the modernist city, and participants’ gratitude at seeing something that appeared to be done for beauty and pleasure, or at the very least, larger non-profit making goals, means that the lived experience of place in these central business districts forms a particular backdrop against which to understand office workers’ perceptions of green roofs, ‘nature’ and their health/well-being.

Second, in Chapter 4 the recognition of the ‘otherness’ of the green roof as nature, particularly if it had a wilder aesthetic, reflects the contrast of what participants perceived to be ‘nature’ against the narrative of control, progress and concrete of the modernist city. Regardless of David Harvey’s claim that “…there is nothing unnatural about New York city” (Harvey 1996), for participants it may be this otherness of nature - here in the form of a ‘wilder’ green roof - that that is an integral part of the feeling that green roofs could be part of nature. This otherness did not seem to make participants feel left out or alienated, but was recognized to have a rhythm and logic that was separate from them, particularly if the green roof was known to provide habitat for animals and insects.

Third, if the green roof was felt to contain this otherness as part of nature, it often reminded interview participants of larger nature experiences, particularly experiences they had as children, as well as the hinterland in the case of the Chicago prairie. In this sense the wilder aesthetic of
the green roof became symbolic of wilder ‘nature’ outside of the city, and it may be this element of wildness that is central to the feeling of otherness that participants associated with nature and some green roofs. Green roofs that were plain sedums and that looked like grass, for example, were not as likely to be associated with this otherness or the feeling that they were ‘nature.’ It may be this element of wildness contained in the naturalized prairie green roofs that seemed to fascinate participants and challenge the narrative of the modernist city. As discussed by Thoreau and Chapman, wildness can spark wonder, surprise and new ideas (Thoreau 2004, Chapman 2004), a sentiment echoed by participants in their discussion of a better perspective and creative thinking from contact with the green roof. This also parallels the inventiveness and vitality of nature discussed in more recent work by social constructionists (Lorimer 2008, Kearns 2003).

Fourth, the calm mentioned by participants was also linked to a ‘letting go’ of their expectations of what the green roof should look like, and may be explained by the knowledge that ‘nature’ has its own rhythms that carry on regardless of human worries and deadlines. The reminder of participants’ childhood experiences in nature, when they were freer and more likely to live in the present, also may influence this calmness. This may help to explain the increase in concentration with visual access to a green roof in Chapter 6, and the association of green roofs with well-being in Chapter 4.

In summary, though participants in Chapter 4 did not have a single definition of what ‘nature’ was to them, many unconsciously recognized an element of wildness and otherness in some of the green roofs that gave them similar feelings of well-being and calm that are associated with more traditional ‘nature’ experiences. The conclusions from this thesis indicate that though these feelings were certainly still influenced by cultural ideas about what kind of ‘nature’ belongs where, they cannot be entirely dismissed as socio-cultural constructions. In particular, the qualities of wildness and otherness seem to be central to whether or not participants felt something was ‘nature’ over and above human influence, supporting some of the discussions by ecological restorationists (Attfield 2000, Jordan 2000b). Furthermore, the primacy of participants’ feelings versus thinking about nature and the impact this had on their well-being, points to the need even in social constructionist research to acknowledge and explore the role that affective responses have in the human relationship with nature. Lastly, the change in
participants’ feelings over time, and the role that close watching had on their perceptions of nature, the green roof, and their health/well-being, point to the need to evaluate responses to nature over time and to closely examine the role, type, and level of access urbanites have to nature.

7.3. Design and Policy Implications for the Ecological City

What do these conclusions mean for green roof designers and policy makers? From the discussion above, a few conclusions can be drawn.

First, while using ‘nature’ to describe green roofs or other urban greening projects is fraught with conflicting values, the word is far more symbolic than greenery, or vegetation. ‘Nature’ still has connotations of the ‘ghost in the machine’, that vitality and wildness that participants in Chapter 4 found so fascinating, and which impacted their health/well-being and sense of place. Carefully using the word ‘nature,’ particularly in overarching policy documents that govern the spirit of development, may thus have important policy implications. As seen in Chapter 3 with the connection of green roofs with overall goals of revitalization in Chicago, green roofs, and the ‘nature’ associated with them, are strongly symbolic and can be used to promote larger environmental goals.

Second, ‘nature,’ however this is defined, seems to be felt more when it contains elements of wildness, is evocative, and urbanites have close access to it over time. As seen in Chapter 4, design goals that incorporate different kinds of access, colour, texture and a sense of play may begin to address these needs and begin to soften the harshness of many central business districts. Thompson’s discussion of ‘loose fit’ places that evoke the freer time of childhood in vacant lots and fields behind developments may be a good example of this kind of urban greening.
(Thompson 2002). However, given the difficulty of convincing the public to accept a wilder, more naturalized aesthetic for urban greening projects may mean that the public may need to have cues that the naturalized aesthetic is on purpose and beneficial. As discussed in Chapter 4, using Nassauaer’s Cues to Care (Nassauaer 1995), or signs that the ‘messiness’ is on purpose, combined with better access, may help to ‘sell’ these urban greening projects. Adding in colour and some straight lines to the design can also make the wildness of a green roof more appealing and less threatening. Given the symbolism of nature in general and green roofs in particular, carefully using this new ecological aesthetic may improve public acceptance of green roofs, increase their potential to impact urbanites well-being and sense of place, and promote other less-visible environmental initiatives.

Third, as discussed in Chapter 4, the link between green roofs and their hinterland is an important part of the symbolism and ‘daydreaming’ quality of green roofs. This poses particular challenges for cities where the ‘hinterland’ is cottage country and northern forests, seen in Chapter 3 for Toronto. Given that it is expensive and difficult to put trees on green roofs, the challenges to connect urbanites with their hinterland in forested areas like Toronto are significant. This also applies to very dry areas where ‘nature’ is not green and lush, such as the U.S. southwest. However, if done in conjunction with education and ‘cues to care’, urban greening projects like green roofs have the potential to connect urbanites with the place of their own region and ecology. This was moderately successful in Chicago with prairie-style green roofs seen in Chapter 3. A more place-based ecology for green roofs has the potential to be far more powerful than a generalized aesthetic for green roofs, such as all prairie, or all sedum, and can impact environmental attitudes and development at a much larger scale. It can do this by connecting urbanites to the place of their region, a concept long discussed in ecology as central to changing development patterns (McHarg 1995, Hough 2004b). Combining regionally specific imitations of ecosystems on green roofs with educational programs, particularly for children, may help to promote this connection and provide improved environmental benefits.
7.4. Challenges and Expanding Current Research

The challenges set out in Chapter 2 around the complexity of understanding and measuring ‘nature’, health, and well-being were attempted to be addressed by a mixed methods approach in this thesis. This allowed both for triangulation of the results of the thesis, and the tailoring of methods for the needs of each topic. Chapter 3 used a comparative policy analysis method to provide the social and political context of the thesis as well as providing insight into the role the hinterland played in participant perceptions of green roofs. Chapter 4 used a phenomenological approach to unpack the complex ideas and values around urban nature and green roofs in order to address some of the gaps in the environmental psychology literature that left nature unexplored. This allowed for the themes of expectation, wildness, the hinterland, and the lived experience of place to emerge that informed participants’ attitudes. Finally, Chapters 5 and 6 used statistical analysis to test whether the themes that emerged from the interviews were also present in a larger population. While the use of mixed methods is more comprehensive than only one method, there were challenges in using both qualitative and quantitative methods given their fundamentally different paradigms.

First, the measurement of the relationship between ‘nature’ and health was difficult. This reflects current difficulties and debates in measurement in the environmental psychology and health and place literature in general. For example, Patterson and Williams (Patterson and Williams 2005) point out the limitations of psychometric testing of fundamentally qualitative phenomena like sense of place and nature. Perrin and Benassi (Perrin and Benassi 2009) argue that verbal survey questions tend to engage more ‘thinking’ aspects of the human relationship to nature versus emotional aspects, even when trying to measure the latter. The use of mixed methods in this thesis, and in particular a phenomenological approach in the interviews that informed the survey, tried as much as possible to ensure that the questions in the survey accurately reflected the more nuanced, and sometimes conflicting, values and feelings around green roofs and ‘nature’ that came up in the interviews. However, given the complexity of associations around urban ‘nature’, and in particular newer forms of ‘nature’ such as green roofs, more research is needed to fine-
tune how quantitative questions should approach the ‘soft’ benefits of nature. This is doubly applicable to complex psycho-social and physical environments such as the workplace.

Furthermore, participants may not have articulated to themselves how they feel about green roofs, nature, and their health/well-being, and so this may not be well captured in the survey.

Second, the research conducted for this thesis aimed for a broad understanding of trends and perceptions in the sample population rather than a controlled study. As it is the first of its kind, this was preferable to a smaller limited study. This approach also had limitations, however, particularly with regards to the quantitative segment of the research. While every effort was made to have equal representation in different buildings, job types and socio-demographic variables, it was extremely difficult to get access to many of these buildings, particularly in Chicago. Conducting research in a workplace also meant that there were many gatekeepers at each stage of gaining access, as well as the need in many cases to get supervisor approval, or at least indifference, towards the project. This also meant that it was very difficult to know the total population of each building, since it consisted of many different companies, not all of whom were easily searchable through other means. For these reasons it was impossible to get a randomized sample, which limits the generalizability of the findings from chapters 5 and 6.

Expanding this research might involve testing the trend of improved concentration from Chapters 5 and 6 in a more controlled sample. This could be in a building with only one company, for example, which would make it much easier to get a randomized sample. In particular, getting more gender parity and, if possible, a more ethnically diverse sample, might yield interesting results, particularly given some of the culturally-specific findings on aesthetics discussed in Chapter 2.

Third, while the wide variety of visual and physical access to the green roof(s) is good for an exploratory study, future research may want to compare those with physical access, close visual access, and distant visual access if possible. This may yield interesting results given the consistent comments from the interview participants about wanting physical access, and a place
to eat their lunch, despite findings from the thesis that showed it was visual rather than physical access that improved concentration. This inconsistency may point to potentially fruitful avenues for future research. This may be difficult for the workplace, but may be easier for residential buildings given the upsurge in green roofs as amenity space in condo developments.

Lastly, measuring the exact number of green roofs in a city is an imprecise science at best. It depends on municipal policy makers being aware of the number of green roofs resulting from their policies, as well as voluntary submissions. This count often does not include small green roof installations that did not require re-zoning or other municipal involvement. These other green roof projects may be partially identified in industry surveys that ask companies to identify new green roofs such as the one conducted by Green Roofs for Healthy Cities, but they may also be identified in design magazines and architectural and landscape architect conferences. There is currently no sound way of making sure that the current estimated count from industry surveys and municipal departments responsible for green roof implementation do not overlap or are comprehensive. Centralizing databases of projects in North America, particularly as green roofs become more important as a means of promoting the global competitiveness of cities, will be necessary in order to better evaluate the effectiveness of green roof policies.

7.5. Future Research

Two areas of future research on green roofs, health/well-being are particularly intriguing. First, the results of this thesis point to the need to use both qualitative and quantitative methods in explorations of nature, health/well-being, and green roofs. If we take into account social constructionist and phenomenological understandings of nature, health/well-being, and sense of place, which I argue we must, then this requires a more nuanced use of quantitative testing of these concepts. This means that there is a need for work that challenges the current privileging of
psychometric approaches in nature, health/well-being, and workplace studies over more qualitative work. As discussed in Chapter 2 and above, the current questioning by some environmental psychologists of purely psychometric testing, which privileges visual and thinking experiences of the world over sensory and physical experiences, may lead to both better psychometric measures of emotional connections to nature, for example, and other types of mixed methods. For example, filling out terms like ‘nature’ and concentration may involve creating and testing new quantitative measures to try to access the values of fascination, aesthetics, and symbolism of green roofs that came up during the interviews. This may help to fill the gap between participants’ perceptions of nature, green roofs, and their health/well-being and contribute to a fuller understanding of the human relationship to nature in cities, and more specifically, in the workplace.

This may mean moving away from a testing that privileges thinking about nature over other forms of experience. Examples of what this may look like may involve researching volunteer experiences of tending a green roof, school children’s hands-on learning about the flora and fauna of a green roof as part of their curriculum, or the development of new measures to capture the affective and fascination aspects of different types of green roofs. New avenues for research may also involve longitudinal research over time about urbanites’ experiences of green roofs, thus incorporating the important element of seasonality and change. While this type of research is challenging to implement in environments such as the workplace, the newness of green roofs in North America, and the legacy of values and symbolisms that have separated ‘nature’ from cities, means that assumptions about green roofs, ‘nature’, and health/well-being need to be challenged and explored. If approached with openness to the complexity of the human relationship to nature, research in this field has the opportunity to greatly improve office worker health/well-being, and sense of place.

Second, green roofs are but one type of urban greening. Green, or living walls, are increasingly popular both in and outside of buildings, and offer new avenues for research to explore the
symbolism, values, and meanings associated with them. This is also true for examining different types of urban greening in different climates, such as desert climates where ‘green’ is not necessarily associated with ‘nature’. Exploring the connections between different types of urban greening projects, human health/well-being, and sense of place will be timely as cities look for innovative ways to deal with climate change, bring people back to live in downtown central business districts, and make the city liveable and ecologically sustainable.

7.6. Conclusion

Green roofs, by blending built form and vegetation, offer a promising avenue to address some urban ecological problems. They blur the traditional Anglo-American separation of humans, cities, and ‘nature’ and offer opportunities to better understand our relationship to nature in cities and how this influences our health/well-being and sense of place. The rise in popularity of both green roofs and green buildings in North America, as well as the huge gap between claims about the health benefits of green buildings and green roofs and actual empirical data, means that research examining the relationship between green roofs, health/well-being, and green buildings is timely, relevant, and much-needed. As seen above, previous to this thesis, there was very little research on the socio-psychological aspects of green roofs, only one using real green roofs versus images (Yuen and Hien 2005), and none looking at health/well-being and the workplace. This is despite the increasing implementation of green roofs in cities (Norquist 2008, Alliance 2009) and a renewed call for a better understanding of the factors which promote office worker health/well-being versus merely reducing risks to health (Danna and Griffin 1999b, Heerwagen 2008). The lack of research is particularly acute for green buildings (of which green roofs are increasingly a part) that claim to be healthier.

This is also important as ‘natural’ aspects of green buildings are far less popular and less studied than the physical building itself, such as ventilation, chemicals in furnishings, and energy
savings. This might be changing somewhat, as green roofs are often a very public way for a company to announce that their building is ‘green,’ and are also increasingly implemented as amenity space in downtown ‘green’ condominiums. The recent initiative to develop guidelines for Sustainable Sites, which can be combined with green building site selection, may also offer promising avenues for collaboration for green roofs and green buildings (American Society of Landscape Architects, Lady Bird Wildflower Center and United States Botanic Garden 2010). These recent development may help to keep ‘nature’ part of a green building, but further research is needed to understand possible health/well-being benefits.

The qualitative and quantitative methods used in this thesis provide valuable empirical data about the values and symbolism of green roofs that are seen from workplaces, as well as how workers perceive the influence of those green roofs on their health/well-being. The main conclusions of this thesis are that:

a) Power relations and context greatly influence the success and timeline of municipal green roof implementation;

b) Given the need to integrate many different departments together in order to implement green roof policy, green roofs may be used as a bellwether for urban environmental attitudes and practices;

c) The symbolism of nature should not be underestimated in promoting green roofs as part of a larger urban greening program and can be used to link urbanites to their hinterland and other environmental initiatives;

d) Office workers in cities with extensive publicity over their green roof implementation programs have a high degree of knowledge about the environmental benefits of green roofs;

e) Perceptions of green roofs are influenced by culturally mediated values around aesthetics and the narratives of control in the modernist city;
f) ‘Wilder’ green roofs can cue office workers to the hinterland, larger experiences of ‘nature,’ and a fascinating otherness may have positive implications for both office workers sense of place and a new ecological aesthetic;
g) The felt awareness of wildness and otherness of some green roofs may hold the key to providing urbanites with micro-experiences of ‘nature’ in the city that can positively impact their health/well-being;
h) Health and Stress status were not affected by access to a green roof, though participants with physical access felt that green roofs influenced their health;
i) Green roofs seemed to only impact concentration from visual access, and this was not statistically significant in the context of other variables, though there was a trend;
j) Given the above, quantitative measurement of complex and contested phenomena such as ‘nature,’ health/well-being, and sense of place needs to take into account phenomenological and social constructionist understandings of these concepts.

These findings provide a useful starting point for better understanding the human relationship to nature, green roofs, and sense of place in cities. This thesis can provide useful information for urban policy makers, green roof designers, the green building industry, and researchers who explore the human relationship to nature and health/well-being. This thesis also opens up promising avenues for future research on healthy, liveable cities and offers a glimpse of an alternative vision to the concrete legacy of the modernist city.
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