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Organizational Perceptions and Responses to the Natural Environment

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ORGANIZATIONAL PERCEPTIONS AND RESPONSES TO THE NATURAL ENVIRONMENT

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by

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ABSTRACT

In 2005, the Millennium Ecosystem Assessment reported that two-thirds of the world's ecosystems were being exploited well beyond sustainable levels. Given that many firms across sectors rely on natural resources to conduct business, it is surprising that many have failed to make their business practices more sustainable. I believe this occurs not because companies are acting in their own enlightened self-interests, but because they are unable to perceive the severity of such issues. The key is that perceptual deficiencies are not the result of blatant disregard, but of systemic incompatibility. That is, most companies do not choose to ignore environmental harm, but their orientation is such that they often overlook it.

The goal of this dissertation is to offer an in-depth conceptualization and analysis of the role that geographic space plays in shaping a firm's relationship to the natural environment. To do so, I develop three distinct but compatible essays that collectively answer the question, *what affect does geographic space have in influencing a firm's attention and response to environmental issues?*

In the first essay, I develop a comprehensive theory of *scale* within the context of environmental issues, to highlight how organizational attention is constrained by scale such that when there is fit in scale between the organization and environmental issue, organizational attention will be enhanced and will result in better corporate environmental performance.

In the second essay, I go forward and empirically test the organizational dimensions of scale, which I define as *geographic orientation*, with the prediction that certain scale characteristics can impede a firm's ability to perceive important environmental issues. The analysis reveals that the *spread* and *concentration* of a firm's assets affects its environmental performance.

For the third essay, in the context of chemical emissions, I explore whether the *environmental materiality* of an issue affects a firm's environmental performance. The results support the general proposition that the spatial characteristics of the issue affect a firm's environmental performance through time.

Taken as a whole, this dissertation sheds some light on possible ways to identify and potentially mitigate unsustainable corporate behavior.

Keywords: Business Sustainability, Environmental Issues, Organizational Attention, Spatial Scale, Geographic Orientation, Environmental Performance, Environmental Materiality, Toxic Emissions.

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CHAPTER 1

INTRODUCTION

In the corporate culture of recent decades, natural resources and their underlying ecosystems continue to be exploited beyond sustainable limits, yet business has been slow to recognize the severity of the issue. This research seeks to uncover the reasons behind this lack of response. In 2007, the findings of the Intergovernmental Panel on Climate Change's (IPCC) stood as unequivocal: Human activities were dramatically changing the chemical balance of the atmosphere, resulting in an increase in both the magnitude and frequency of natural disturbance events, such as forest fires, hurricanes, and droughts. In the same year, researchers with the United Nations Environment Program (UNEP) found that the impact of climate change on freshwater sources and global food supply make it increasingly difficult to provide for an ever-growing human population (UNEP, 2007), expected to top nine billion by 2050 (UNDP, 2004). Yet, despite this knowledge, business continues to operate as if the Earth's ecological systems and resources are limitless.

There are some examples of firms changing the way they do business in response to these potential threats and recognizing the opportunities of doing so. Most notably, Interface, a carpet manufacturing firm, has reinvented the way it does business by reducing the impact of its manufacturing processes and rethinking its entire business model, all with a view towards embracing the strategic opportunity that sustainability represents (Porter & Kramer, 2006). Other firms, such as Patagonia, Procter & Gamble, Honda, and DuPont, have also recognized the strategic opportunity of sustainability and the fact that it presents a meaningful way to manage the risk associated with the looming threats of reduced access to natural resources. For the most part, however, the vast majority of firms remain reluctant or unable to deliver meaningful change. This lack of response raises the question, Are some firms simply not able to see these threats and opportunities? And if not, why?

Recently, I was inspired by a Technology, Entertainment, and Design (TED) talk, given by Richard Dawkins (originally delivered in 2005) and drawing on the work of Haldane (1926). Dawkins refers to the notion of “middle world” to illustrate how size represents a significant factor in directing our attention, which in turn influences how we perceive our world. Dawkins argues that gravity has shaped our collective attention because of the constraints it imposes on people as we navigate our world. For example, as a key biophysical property to master, gravity stands out as central in our collective attention, while other biophysical properties, such as the surface tension of water, fail to capture our attention because they do not significantly constrain our actions. Yet, surface tension, not gravity, would certainly be of primary interest for a water strider – an insect that lives on the surface of still water – since the properties of water shape that insect’s ability to survive. Different species live in different perceptual worlds due to the constraints imposed by biophysical properties. Could these differences in perceptual worlds explain in part why firms have not responded in a more concerted way to sustainability-related issues? That is, a firm’s perspective, either by default or when deliberately chosen, will shape its understanding of phenomena, and this understanding will result in the firm placing greater emphasis on some features while choosing to neglect others, despite the underlying negative effects.

In this dissertation, I argue that firms operate in different perceptual worlds from those that recognize the threats and opportunities of living beyond sustainable limits. The goal of this dissertation is to offer an in-depth exploration of the role that geographic space plays in shaping a firm's attention and perspective, which in turn influences and motivates its response to environmental issues. To do so, I develop three distinct but compatible essays that collectively answer the question, *What effect does geographic space have in influencing a firm's attention and response to environmental issues?*

I build the argument that organizational responses to environmental issues – such as climate change or the overexploitation of natural resources – are shaped by a firm's attention, which is affected by the scale of the firm relative to the issue (essay 1), by the geographic orientation of a firm's assets through physical space (essay 2), and by the differences in the material characteristics of issues they encounter (essay 3). Taken together, this body of work provides a better understanding of the central role that geographic space plays in shaping organizational attention and response to environmental issues, which manifest when organizations interact with the natural environment.

This chapter proceeds through a review of the emergence of sustainable development and the business case for sustainability. I then develop the argument that our conceptualization of sustainability (through the three pillars model, which is discussed in the next section) has removed the importance of geographic space in our theoretical models. The chapter closes with an outline of each essay.

Sustainable Development

In 1987, the World Commission on Environment and Development (WCED) released its report entitled *Our Common Future*, which introduced the concept of sustainable development as a means of bringing economic growth in balance with ecosystem processes in order to alleviate poverty. The WCED defined sustainable development as "meet[ing] the needs of the present without compromising the ability of future generations to meet their own needs" (1987, p. 43). That is to say, sustainable development represents the intersection between social, environmental, and economic value, which together contribute to the overall well-being of society (Barbier, 1987). Acknowledging that global ecosystems are finite, vulnerable to human actions, and limited in their regenerative and assimilative capacities is essential to the realization of a sustainable future (Gladwin, Kennelly, & Krause, 1995), since natural capital and social capital are not indefinitely replaceable by human capital and built capital (Costanza, 2008). These arguments also apply to business, wherein there exists a compelling argument for shifting the current business mindset towards one of sustainability.

Sustainable development has emerged in response to a preoccupation with economic growth, which is to blame for environmental degradation. This is not something new. Early in the 20th century, Gifford Pinchot, co-founder of the American conservation movement, observed that byproducts of industrial processes were being wasted, and air and water pollution were having a serious impact on neighboring communities (Pinchot, 1910). Pinchot believed there was a need for greater forethought with respect to our choices and the resulting consequences of growth. He believed that a mental shift could be realized through conservation, which "recognizes fully the right of the present generation to use what it needs and all it needs of the natural resources now available, but it recognizes equally our obligation so to use what we need that our descendants shall not be deprived of what they need" (Pinchot, 1910, p.80). This statement captures the essence of sustainable development, as defined in *Our Common Future* almost 80 years later, and yet these same problems still persist in the present day.

Management theory, in general, has evolved with a fractured understanding of the relationships between natural and human systems, thereby fostering behaviors that undermine the environment (Gladwin, Kennelly, and Krause, 1995). Economists such as Friedman (1970) argue that the social responsibility of business is to make money, which propagates a mindset that encourages a singular focus on financial performance at all costs. Economic logics of net present value and cost discounting encourage the exploitation of natural resources now in order to avoid their devaluation through time, a point of view that is argued to be incongruent with sustainability (Carson & Roth Tran, 2009). Some contend that the economic improvements in emerging markets like China and India have been estimated to be much smaller than growth rates would suggest, once environmental impacts and human health effects have been factored into the growth equation (Costanza, 2008). Therefore, in order to realize a sustainable future, sustainability needs to make sense for business.

Business Case for Sustainability

Transitioning from a "business as usual" approach represents a significant opportunity to develop new markets in response to changing environmental constraints (Hart, 1995; Porter & Kramer, 2006; Russo & Fouts, 1997). Practically, a firm following the tenets of business sustainability evaluates the costs and benefits of business decisions based on the goal of simultaneously generating economic prosperity and social equity, and enhancing environmental integrity (Bansal, 2005). Hart (1997) suggests that large corporations are the only organizations with enough resources, technology, global reach, and motivation to achieve sustainability. The question therefore becomes: If business has the incentive, the means, and the moral imperative to create meaningful and significant change toward realizing a sustainable future, why have firms been so slow to respond?

I propose an answer to this question: The reason firms have been slow to respond in a more concerted way to embrace the tenets of sustainability is because society has oversimplified the complex nature of business-society-environment relationships, as represented through the three-pillars model. Barbier's (1987) three-pillar Venn diagram represents the interconnectedness between economic, social, and environmental systems. The label "three pillars," although seemingly benign at first, invokes the mental image of a destination, one that is permanent, unmovable, unwavering, and stands the test of time. Yet, economic, social, and ecological systems are integrated, dynamic, complex and evolving forces (Folke *et al.*, 2002), a concept that corresponds more closely to a process than a destination. Thus, by representing sustainability as a destination and not as a process, we have inadvertently removed the importance of space and time in our understanding of business sustainability. Therefore, new theories are needed to explore the importance of these concepts in shaping sustainable behavior.

Recent research in the field of business sustainability has sought to address this disconnect by exploring the importance of time (Slawinski, 2010; Wang & Bansal, 2012) and local knowledge (Whiteman & Cooper, 2000, 2011) in shaping sustainable behavior. These burgeoning streams of research hold promise because they seek to reintegrate the importance of context into conceptual and empirical models that more closely reflect the interactions between business and the natural environment. Organizational attention literature acknowledges the importance of context in shaping firm actions (Ocasio, 1997), and I argue that organizational attention can itself provide a foundation upon which to build new theory.

Organizational Attention to Issues

Attention is defined as the noticing, encoding, interpreting, and focusing on issues and answers (Ocasio, 1997). Assuming that managers are unable to attend to all cues in the environment (Barnett, 2008), attention thus emerges as a rare and valuable resource (Cyert & March, 1992). In light of these limits, some argue that the greater the quantity of attention an organization can direct to a given issue, the better will be its understanding of that issue (Barnett, 2008).

Evidence suggests that managerial attention can affect the actions of firms (e.g., Daft & Weick, 1984; Dutton & Jackson, 1987), all of which ultimately affects firm performance (Garg, Walters, & Priem, 2003). This finding is important because it highlights the fact that individual-level actions can affect firm behavior. It is also true, however, that firm structure can act to constrain firm attention (Thomas & McDaniel, 1990). Thus, it is not only individual-attention factors that affect action but also those at the organizational level.

Some scholars have explored how a firm's focus on internal factors, such as headquarters' attention to subsidiaries (e.g., Bouquet & Birkinshaw, 2008; Ambos & Birkinshaw, 2010), can influence organizational actions and performance. Focusing attention on competitor actions has also been found to influence the focal firm's actions (Levy, 2005). Together, these findings suggest that a firm's actions remain inextricably linked to the causes to which the firm directs its attention.

Prior work in the area of social and environmental management has been found to contain a cognitive element. For example, Sharma's (2000) analysis of firms within the Canadian oil and gas sector found that the framing of environmental issues either as threats or as opportunities affected the firm's strategic actions, thereby reinforcing the link between cognitive elements (i.e., interpretation) and organizational actions. Alignment between organizational values and individual concerns for environmental issues has been shown to affect a firm's response to environmental issues (Bansal, 2003). Some suggest that when managers are embedded in the local environment, they become more attuned to subtle changes in the ecosystem and can therefore respond more effectively (Whiteman & Cooper, 2000). When managers are not as geographically proximate, the stakeholders and the media often become the messengers that convey the salience of a given environmental issue to a firm (e.g., Bansal & Clelland, 2004; Kassinis & Vafeas, 2006). Together, these studies reveal that in the context of social and environmental responses, the link between cognition and action has already been made.

With a clearly established link between cognition and response, a further link can then be assumed to exist between geographic space and organizational responses to environmental issues. Supporting this link, Folke and colleagues (2007) state that:

> *There are time lags, spatial-diffusion processes, and convoluted transformations of broad-scale socioeconomic and biophysical signals. One task is to identify these time lags and diffusion processes, in itself a gargantuan task—but the further task is to specify the many variations that can invert, buffer, amplify, or otherwise transform driving forces into landscape signatures* (p.12).

This dissertation explores the importance of geographic space (by way of scale, geographic orientation of the firm, and the material characteristics of issues) in shaping organizational understanding of the natural environment.

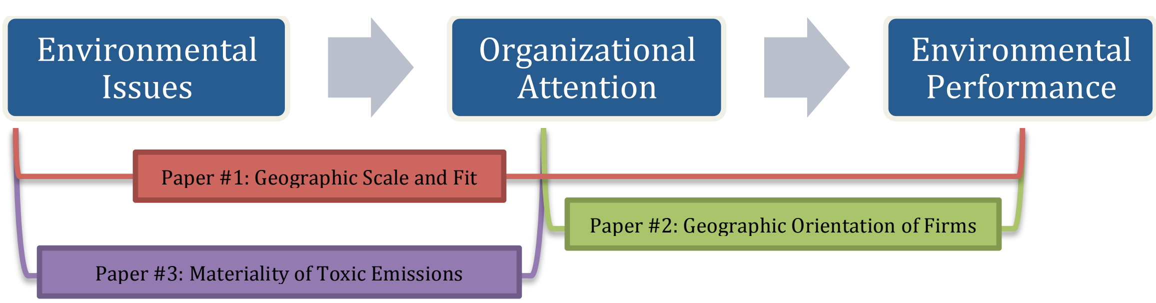
It is important to state that for the purposes of this dissertation, I have deliberately adopted an egocentric position, assuming that human actions contribute to the environment and are affected by the environment (e.g., Post & Altman, 1994). This positioning points to a much broader debate among scholars – that is, whether an egocentric or ecocentric orientation constitutes the best way to understand environmental phenomena (Purser, Park, & Montuori, 1995). An ecocentric orientation is one in which environmental issues are attended to for their inherent ecological value, apart from human value judgments (Purser, Park, & Montuori, 1995). I have chosen an egocentric position for reasons that are more pragmatic than philosophical. Because my interest lies in exploring how organizations attend and respond to cues and issues, an egocentric lens allows me to focus attention on the "use-value" of the natural environment. I argue that organizations are more likely to respond to issues that affect their value, versus the intrinsic value posited by the ecocentric perspective (Purser, Park, & Montuori, 1995).

Dissertation Outline

Figure 1 illustrates the conceptual structure of the dissertation and how each essay fits together.

FIGURE 1

Conceptual Model of the Dissertation



Essay 1. In the first essay (Chapter 2), entitled, *Do you see what I see? The role of spatial scale in perceiving environmental issues,* this conceptual paper explores the effect of spatial scale on organizational attention to environmental issues. Current conceptualizations of scale in the management literature (either within- or between-firms size comparisons) have oversimplified the scale construct and failed to consider scale relationships beyond the competitive environment. Scale has been used to represent between-firm size comparisons that result in a competitive advantage in the context of strategic decisions (Nutt, 1998), production (Taymaz, 2005), outsourcing (Willcocks & Currie, 1997), operations (Imbun, 2007), competitor perceptions (Chen, Su, & Tsai, 2007), and project management (Pitsis *et al*., 2003). Scale has also been used to represent within-firm size effects in the context of R&D investment (Macher & Boerner, 2006), strategic alliances (Pangarkar, 2007), managerial attention (Bansal, 2003), and organizational capital (Bercovitz & Mitchell, 2007). Absent from this literature is not only a consideration of the importance of scale in the context of natural systems, but also a more in-depth conceptualization of scale and its effects on perception and performance. This essay seeks to answer the question, *How does an organization's scale affect its attention to environmental issues?*

The recent literature in ecosystem and regional science emphasizes scale as having two fundamental dimensions: one spatial and one temporal (e.g. Cash et al., 2006; Holling, Gunderson, & Peterson, 2002; Steele, 1998). That is, there is the need to identify where we are and when we acted or lived. For the purposes of this dissertation, I focus exclusively on the spatial dimension (i.e. geographic space) of scale in building my theoretical apparatus. I explore the tensions between business and ecological processes and environmental issues in order to develop theory that explains how scale affects the organization's perception of environmental issues. Cumming and colleagues (2006) suggest that the scale chosen to observe a phenomenon will directly affect what characteristics will appear most salient to the firm. When the scale of the organization matches that of the environmental issue, issues can be detected, whereas those that do not match the organization's scale fail to garner the firm's attention. By systematically failing to identify certain issues, firms take the risk not only of undermining their own organizational performance but also of undermining the function of the global ecosystem.

This essay contributes to the extant literature by developing the scale construct and providing a theoretical framework not only to identify differences in scale between organizations and natural environment, but also to highlight the importance of fit in enabling cue identification, in turn fostering attention to related issues.

Essay 2. In the second essay (Chapter 3), entitled, *Out of sight, but not out of mind: How geographic orientation shapes MNEs' environmental performance***,** I empirically test whether the organizational dimensions of scale – that is, *geographic orientation*, defined as the spatial distribution of organizational assets – affects a firm's ability to identify and respond to environmental issues.

In the context of international business, prior research has explored the relationship between headquarter-subsidiary distance and firm performance, but the results of this work have been mixed. On one hand, distance is understood as a barrier to globalization (e.g., Barkema, Bell, & Pennings, 1996; Delios & Henisz, 2003), which imposes a "liability of foreignness" (Hymer, 1976; Zaheer, 1995). On the other hand, remote locations can also serve as a source of unique knowledge (Burt, 1992). With evidence suggesting that distance can both help and hinder firm performance, this essay seeks to answer the question, *How does a firm's geographic orientation affect its environmental performance?*

I build theory to explain that differences in environmental performance are driven by the effect of spread and concentration of firm assets through geographic space. We test the hypothesized relationships on a sample of 140 firms operating 3,862 facilities though a geographic information system (GIS) analysis. The analysis includes visualizations through the creation of maps and then spatial statistical analysis. The results from this study reveal that a firm's environmental performance is affected by its spread and concentration through geographic space.

Essay 3. In the third essay (Chapter 4), entitled, *The materiality of chemical emissions and their effect on environmental performance,* I explore whether the physical characteristics of chemical emissions and the resulting salience of those emissions affect how noticeable they are to the public eye. The central thesis of this work proposes that firms tend to focus on chemical emissions that are most noticeable to stakeholders (Kassinis & Vafeas, 2006) while overlooking those that are less obvious. This paper seeks to answer the question, *What effects do the material characteristics of toxic emissions have on firms' environmental performance?*

I theorize the relationship between chemical emissions and the social processes that enable their detection, and I empirically test whether differences in *environmental materiality* (defined as the physical, tangible characteristics reflected in a chemical's *diffusion* and *vividness*) can predict differences in firm-level environmental performance. Drawing toxic emissions data from the National Pollutant Release Inventory (NPRI), I test hypothesized relationships on a panel dataset of firms that operate Canadian facilities (across four industries) from 2003-2010. The results from this analysis reveal that firms respond to emissions that are broad-reaching, especially when those emissions are more obvious.

This dissertation explores the interface between business and the natural environment in order to shed light on the possible ways, both theoretical and practical, to identify and potentially mitigate environmental harm. With better understanding of the importance of geographic space in enhancing or impeding a firm's ability to perceive changes in the environment, structural changes to a firm's attentional resources could be taken to overcome these shortcomings, in turn redirecting firms' attention to considering more explicitly the potential impacts of their actions. By doing so, firms will be able to reduce their impacts on the natural environment, with the added benefit of becoming more resilient to environmental change and to the pending challenges associated with a decline in global ecosystem function.

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CHAPTER 2

Do You See What I See? The Role of Spatial Scale in Perceiving Environmental Issues

INTRODUCTION

The limits to global ecosystem function are being tested by means of a natural experiment. Growing evidence suggests that human demand for natural resources is pushing these systems to a breaking point. In an effort to identify and mitigate this decline in ecosystem function before it's too late, many stakeholders, such as governments and environmental groups, have focused their attention on corporations, claiming that their myopic focus on profits stands out as the main driver of this issue. Yet, most firms depend on natural resources to conduct their business, either for processing their products or for the actual products themselves. If access to these resources were to become limited, or if systems were to collapse altogether, this would pose a significant risk to the survival of the firm. Then why is it that organizations have been slow to make their operations more sustainable? It is our contention that firms are not willfully ignoring these pressing environmental issues, but instead that the scale of the organizations is such that it hampers their ability to recognize the severity of such issues. Therefore, we seek to answer the question, *How does an organization's scale affect its attention to environmental issues?*

The Athabasca oil sands make an important contribution to Canada's economy but also a highly controversial one, since the method used to extract oil from bitumen depends heavily on water use. Once steam has been injected into the bitumen, oil is captured and wastewater is diverted to tailing ponds. Although the system recycles water throughout its processes, the concentration of toxins and heavy metals increases with each pass. This is where the controversy arises: To date, no economically feasible method exists for treating this contamination, and the long-term impacts to health and the environment remain unknown (Schindler, 2010).

Despite these concerns over public health and the environment, the long-term plans proposed by oil-sands producers for dealing with tailing-pond waste involve developing ponds of a magnitude never before attempted. These mega-ponds are known as end pit lakes. To give some sense of their physical size, the current tailing ponds are, on average, five meters in depth, whereas the proposed end pit lakes will be, on average, 27 meters deep and more than 3.7 km.[2] Although the proposed end pit lakes are large, relative to the global context in which firms operate, their size is relatively small – so small, in fact, that the potential risk to the surrounding ecosystems might go unnoticed.

In order to address issues like this one, which are related to resource use, business sustainability emerges in an attempt to move beyond the narrow conceptualization of performance (Gladwin, Kennelly, & Krause, 1995). Business sustainability is guided by the central tenets of *sustainable development*, a concept that is defined as "meet[ing] the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development [WCED], 1987, p. 43). In order to achieve this end, sustainable development provides a framework through which society seeks to build value across social, environmental, and economic systems (Barbier, 1987). In response, organizational performance has broadened its parameters to consider social, environmental, and economic measures simultaneously (Bansal, 2005), resulting in value creation not only for shareholders but also for stakeholders (Porter & Kramer, 2006).

While a firm's commitment to the principles of business sustainability is an important first step, achieving sustainability stands out as a much more challenging goal. Cash and colleagues (2006) suggest that the challenge stems from the fact that sustainability issues are inherently scale-dependent, and when management decisions fail to incorporate scale as a central characteristic, then sustainability becomes unattainable. Cumming, Cumming, and Redman (2006) agree with this assessment and state that "many of the problems encountered by societies in managing natural resources arise because of a mismatch between the scale of management and the scale(s) of the ecological processes being managed" (p. 2). Therefore, scale represents an important concept to explore and may provide insights that explain why sustainability remains elusive to date.

Surprisingly, scale has been largely overlooked in the organizational literature, often being confused with or used interchangeably with size (e.g., Bansal, 2003; Chandler, 1990; Nickerson & Zenger, 2008). Absent from the existing literature is an in-depth conceptualization of scale and its dimensions. In response to this gap, our paper develops the dimensions of scale in the context of environmental issues to highlight the way organizational attention remains constrained by scale.

We frame this discussion within the organizational attention literature (Ocasio, 1997). By broadening scale comparisons to include environmental issues, organizations will become better equipped to identify important signals that would otherwise be overlooked. As a result, organizations will become more effective in their efforts to achieve sustainable development. We hope that this paper can contribute to constructive change in the form of improved environmental sustainability.

Scale is a construct that requires context. Thus, in order to develop this multidimensional construct, we explore scale within the context of environmental issues. The following section explores environmental issues and explains why firms should be concerned with them. We then introduce the scale construct and explore various conceptualizations across literatures. Grounded in the organizational attention literature, the next section reviews the way firms perceive signals. Propositions are then presented for each of the dimensions of scale and their effect on organizational attention, all within the context of environmental issues. The paper closes with a discussion of our findings and a call for further theoretical development and empirical corroboration.

ORGANIZATIONS AND THE ENVIRONMENT

An environmental issue is marked by an abnormal variability in an ecological process – measured by the magnitude of the movements beyond a threshold for what is considered normal. This variability is induced by humans and affects a variety of social systems, including organizations and, more broadly, society (Berkes & Folke, 1998). Such issues can include water pollution, air pollution, deforestation, and wetland destruction.

Environmental issues are important to organizations because they can pose both threats and opportunities. The rising costs of waste handling and disposal, public pressure for environmentally friendlier products, and government regulations have all been empirically shown to be threats to organizations (Groenewegen & Vergragt, 1991). Threats arise in the form of the costs and complexities that come with the adoption of new technologies (Russo & Fouts, 1997), which are particularly salient for organizations operating in high-polluting industries (Hart & Milstein, 2003). As BP’s 2010 oil spill in the Gulf of Mexico illustrates, the disruption of activities from such disasters, the clean-up of emissions or spills, and the resulting impact to reputation all deliver additional threats to the organization. The environment also presents certain opportunities for organizations, however, through, for example, using recycled feedstock (Groenewegen & Vergragt, 1991) to reduce costs and increase efficiencies, thereby yielding a competitive advantage (Florida, 1996).

Environmental issues are important to business because, currently, many ecosystem services and products upon which business relies are virtually, if not actually, free (Millennium Ecosystem Assessment [MEA] 2005). This kind of easy access to natural resources taxes the environment to ever-increasing degrees, with the result that environmental issues have begun to play a more prominent role in organizational life. For example, in 2007, the *Intergovernmental Panel on Climate Change* (IPCC) predicted that climate change will contribute to a decline in ecosystem health and to an increase in the frequency and intensity of natural disasters, such as hurricanes and forest fires (IPCC, 2007). When coupled with the findings that two-thirds of the world's ecosystem services, such as water, wood, and soil, are being exploited well beyond sustainable levels (MEA, 2005), this information raises global concerns about the future availability of natural resources.

Recent compelling evidence supports the accuracy of these scientific predictions, such as those by the IPCC. For example, the National Oceanic and Atmospheric Administration (2011) reported that the mean global temperatures for 2005 and 2010 represented the warmest years on record, leading in turn to increased incidences of flooding and tornados. Droughts have increased in frequency and severity and are threatening community livelihoods, leading to land-use change as a means of adapting to degraded ecosystems (World Wildlife Fund [WWF], 2010). Agricultural practices in many parts of the world rely on greater-than-ever inputs of fertilizers and pesticides to cope with declining soil fertility and increased pest persistence (WWF, 2010), ultimately driving up operating costs as a result. In both a local and global context, the natural environment appears to be changing rapidly, which represents significant risk to firms due to the resulting limited availability of material resources and the increased costs. Should global ecosystems continue to deteriorate, the natural environment will become one of the most important factors shaping business policy and practice.

WHAT IS SCALE?

Scale in Management

The most common conceptualization of scale in the organizational literature derives from notions of size – either overall magnitude or proportional size. Scale as magnitude often refers to the size of the firm's overall operations. Chandler's (1990) interest in exploring firm-level efficiencies and the ability to gain market share through firm size provides the grounding for much of the existing research on the subject of scale as magnitude . A firm's operating capacity – that is, the size of its operations – is argued to impose an impact on performance and firm survival because of the economies that come with scale, since fixed costs become distributed over larger variable costs (Chandler, 1990). Relatedly, size has also been argued to affect a firm's absorptive capacity, that is, its ability to identify, assimilate, and commercialize knowledge in order to capture a competitive advantage (Bercovitz & Mitchell, 2007; Cohen & Levinthal, 1990; Lane, Koka, & Pathak, 2006). In most cases, firm size, as magnitude, is assessed relative to other firms.

Proportional size, on the other hand, considers within-firm comparisons – in other words, the size of a set of the firm's activities relative to its full repertoire of activities. This within-firm size comparison often becomes salient in the context of organizational change. Nickerson and Zenger (2008), for example, show that based on social comparisons to other firms, organizations will change their size, which in turn affects the organization's structure and boundaries. Similarly, in the context of managing organizational responses to emergent issues, scale has been used to refer to the proportion of resources devoted to addressing a given issue (Bansal, 2003). In each case, within-firm size relates to the resources a firm devotes to a particular issue or activity, relative to its other activities.

Conceptualizing scale as either magnitude or proportional size has limited its theoretical development. However, we can draw on the geography and ecology literatures to broaden the notion of scale and explain organizational attention to environmental issues, which shapes the organization's ability to address risk or explore opportunities.

Scale in Geography and Ecology

Drawing on existing literature, we define *scale* as the spatial dimension used to measure and study any phenomenon (Cash *et al.*, 2006). Scale is fundamental to understanding phenomena, because of its relationship to space, place, and time (Holling, Gunderson, & Peterson, 2002; Sheppard & McMaster, 2004), which could explain why there has been a high degree of conceptual convergence across fields (Sayre, 2005). The existing literature argues that environmental issues manifest across different spatial scales such that some issues are more local than others (e.g., Ziegler, Pereira, & Brown, 2004). Land use and water quality, for example, are generally considered more local because of their acute effects on communities, whereas ozone depletion and climate change stand as global issues because of their widespread effects (Morrison, 1991).

Similarly, the field of ecology explores the characteristics of scale in order to better understand the processes and functions that shape species' densities and community composition (O'Neill & King, 1998). For example, at a small scale, predator-prey populations appear to be negatively correlated with each other. As the population of the predator increases, the population of the prey species decreases, and vice versa. Using a small-scale analysis, the connection seems clear: predators kill their prey. Yet, at a large scale, the analysis reveals a different relationship and shows that the population of predators and prey are positively correlated (Rose & Leggett, 1990). Predators and prey are generally kept in balance, so that a high predator population often implies a high prey population. Therefore, the scale of the analysis can yield different findings, which is not simply a characteristic of size.

The rich theoretical and empirical insights in both geography and ecology have shown that dominant processes and characteristics change between the different spatial scales of environmental issues (e.g., local to global). Environmental issues vary based on their spatial scale because of the complexity of the systems in which they are embedded (e.g., Meentemeyer, 1989), and such complexity can make it difficult to identify the mechanisms related to specific environmental issues (Wolf & Allen, 1995). Consequently, it is important for researchers to understand scale in order to identify the signals that organizations will perceive (Levin, 1999).

The characteristics of biophysical processes are not consistent across scales. O'Neill and King (1998) state that "if you move far enough across scale, the dominant processes change. It is not just that things get bigger or smaller, but the phenomena themselves change" (p. 5-6). Drawing once again on the example of a predator and its prey, what we see when we make an examination using a small scale becomes quite different when we zoom out to view the population of predators and prey through a broader lens. The biological processes of each species operate somewhat independently, although they are nested within the larger predator-prey interaction process.

Ecological Processes and Signaling Environmental Issues

A signal conveys information about an issue and can be generated both within and outside the organization. For this paper, we focus on signals that manifest outside the organization, particularly those related to ecological processes.

Signals have both ontological and epistemological characteristics. The ontological characteristics carry information about the material aspects of the object, such as its mass and physical dimensions; however, these signals are subject to the epistemological characteristics of perception and interpretation. An object's size reflects its ontological characteristics, whereas a label of "big" or "small" represents the object's epistemological characteristics and reflects the receiver's perceptions and interpretations. It is important to recognize that scale also has an objective characteristic (i.e., ontological moment) that helps to define phenomena, yet it is also open to subjective interpretation (i.e., epistemological moment; Sayre, 2005). Although ecological processes exhibit ontological characteristics, we are influenced by our perceptual capabilities or the technology we deploy to measure or observe the process (Levin, 1992). Making the distinction between objective and subjective is critical because analyzing the same phenomena at different scales yields different outcomes (Wiens, 1989). Therefore, in trying to decipher environmental issues, it is important to remain mindful of the signals and the material characteristics of the ecological process, as well as of our interpretation of these signals and their observation across scales.

Since every objective ecological process conveys signals, the number of signals becomes virtually limitless (Barnett, 2008). Organizational attention, however, is considered a rare and valuable resource (Cyert & March, 1992), shaped by both diverse and evolving processes (Rerup, 2009). March (1994) contends that:

> *Time and capabilities for attention are limited. Not everything can be attended at once. Too many signals are sent. Too many things are relevant to a decision, because of these limitations, theories of decision-making are often better described as theories of attention or search than as theory of choice. They are concerned with the way in which scarce attention is allocated* (p.10).

Thus, the organization must select the signals and, therefore, the processes and issues to which it attends. The greater the attention an organization directs to a given process, the better its understanding of that process and the better its ability to identify issues as they emerge (Barnett, 2008). In what follows, then, we assume that some processes do exist, but an organization's perception of those processes may not be complete or accurate.

Objective signal strength is related to either the magnitude of movement or to the pace of movement beyond an established variance threshold for what might be considered normal (or naturally occurring) for that ecological process. When signals of ecological processes move beyond established variance patterns, environmental issues materialize (Rockstrom *et al.*, 2009; Hoegh-Guldberg & Bruno 2010). A small change in patterns generates a *weak signal* that could either be missed or chalked up to a statistical aberration. A sustained large movement creates a *strong signal*, which allows actors to more easily identify significant and sustained objective changes in the variance of ecological processes (Parker & Pickett, 1998).

From an organization's perspective, strong signals clearly communicate an issue, such as the reporting of subsidiary performance in an annual report (Bouquet & Birkinshaw, 2008); vague signals are considered weak (Vaughan, 1996) and are often mistaken as noise relative to strong signals (Haeckel, 2004). Yet, focusing only on the strong signals and thereby missing important weak signals can result in lost opportunities (Cockburn, Henderson, & Stern, 2000) and can increase the chances of a crisis occurring (Rerup, 2009). Some suggest that only when performance is at risk do organizations tend to search for and respond to weak signals (Sheaffer, Richardson, & Rosenblatt, 1998).

A weak signal could actually be a strong signal of an issue nested within in a higher order issue. In focusing only on issues of a certain scale, some signals might, inevitably, be misinterpreted or missed altogether (Cash *et al.*, 2006). For example, when attention is directed toward a global issue such as climate change, precipitation (i.e., the process) may appear to be relatively normal; that is, it deviates only slightly from what is expected – say, a modest decline, which would be considered a weak signal of drought (i.e., the issue). Yet, changes in local rainfall could deviate significantly from what is expected, resulting in extreme drought within specific regions, such as in the U.S. Midwest in the summer of 2012. Therefore, the ability to perceive signals of associated issues depends directly on keen observation of the underlying processes and a related ability to recognize when there is cause for concern.

Prior work on organizational attention offers some insights into the factors that enable or impede signal detection. *Attention* is defined as the organization's noticing, encoding, interpreting, and focusing on issues and answers (Ocasio, 1997). The attention-based view posits that firm behavior can be best explained by understanding how firms regulate and distribute their attention to issues (Ocasio, 1997).

Ocasio (1997) names three factors that explain how organizations identify and interpret signals. The *focus* of the organization's attention ensures that it picks up the correct signals, thereby reducing errors (Durand, 2003) and improving firm performance (Yu, Engleman, & Van de Ven, 2005). *Situated attention* highlights the importance of context in influencing the likelihood, intensity, and duration of an organization's attention to events (Hoffman & Ocasio, 2001). Signals have been shown to be context-dependent (Rerup 2009), and, when divorced from context, they become difficult to interpret (March, 1981). The *structural distribution* of attention includes the rules, resources, and relationships that regulate and control the distribution of attention (Ocasio, 1997). Yu and colleagues (2005) found that organizational attention was constrained following a merger, a situation that limited the organization's ability to identify emerging signals.

Across these three factors of the attention-based view, there is an implicit spatial element that has yet to be explicitly considered. In order to increase our understanding as to how geographic space can affect an organization's attention to issues, we must first understand the dimensions of scale.

Phenomena become more easily discernible when they can be divided into segments that can be measured (Rykiel, 1998). Prior researchers have explored the spatial scale of land-based environmental issues by their grain and extent (e.g., Parker & Pickett, 1998). Phenomena can be discriminated by the precision needed to observe the issue (i.e., grain) and the range (i.e., extent) over which the phenomenon should be observed (Gibson, Ostrom, & Ahn, 2000). Small-scale phenomena are generally associated with a finer grain and narrower extent, whereas large-scale phenomena have a coarser grain and wider extent (Sayre, 2005).

Sayre (2005) illustrates the difference between grain and extent by using the analogy of a meter stick. Grain is a millimeter (i.e., the smallest unit of measure), while extent is the range over which the measure is taken, in this case, a meter stick. Using a meter stick to measure a table is appropriate, but it would be inappropriate to use it to measure a farm field (i.e., millimeter is too fine) or microchips (i.e., millimeter is too coarse). The smallest unit of measure being observed must match the smallest ecological process that signals the presence of an environmental issue. Because issues can change across scales (O'Neill & King, 1998), in order to be able to perceive signals and understand that an issue has materialized, observation of multiple processes might be necessary in order for the issue to become clear. The notions of grain and extent motivate our propositions and are described in more detail below.

Environmental Grain

Grain is commonly defined as the smallest unit of measure that can be used to describe an environmental issue, and it is measured along a continuum from fine to coarse (Gibson, Ostrom, & Ahn, 2000; Sayre, 2005). Specifically, grain identifies and measures the variability of an ecological process (e.g., the carbon cycle). Drawing on Sayre's (2005) assertion that scale has both an ontological and an epistemological moment, we argue that there must also be two types of grain: inherent grain (i.e., the ontological grain of the issue: the measure *best suited* to observe the process) and the observational grain (i.e., the epistemological grain of the issue: the measure *used* to observe the process).

Each type of grain affects the organization's ability to perceive issues, so we motivate a proposition with each.

Inherent grain. The inherent grain reflects the objective aspects of an ecological process. Each process contains within it a number of relationships and interactions among elements of the natural world, including land, air, water, and living organisms. The geographic scope of the interactions shapes the inherent grain, which can range from coarse to fine. The greater the geographic area over which the interactions occur, the coarser the grain. The coarser the grain, the greater the complexity of the environmental issue, since the nesting of issues within issues increases the number of potential linkages among processes (Levin, 1999). Increased complexity makes it more difficult to understand cause-and-effect relationships within these increasingly complex systems, such as understanding the effect of climate change on marine ecosystems (Hoegh-Guldberg & Bruno, 2010). Although it may be difficult to unpack cause and effect within a coarse grain, it is possible to detect shifts in variability at that same grain. As we argued before, shifts in the variability of ecological processes at a coarse grain are not necessarily consistent with shifts at a fine grain.

Climate change has a very coarse inherent grain (e.g., 500 kilometers; Easterling, 1997). The signals associated with climate change include increased rising sea levels and an increasing global mean temperature (IPCC 2007). Short-term changes in weather, such as an abnormally high number of hurricanes and tornados, high rainfall, or high or low temperatures, does not necessarily signal climate change. Some argue that, in fact, it is virtually impossible to attribute variability in ecological processes with variability in climate (Parmesan *et al.*, 2011). Although it is possible that variability in weather may be attributable to climate change, changes in weather may also be attributable to such causes as solar activity, volcanic eruptions, or *El Nino* (Haigh, 2003). Based on the description above, we propose that:

Proposition 1: The signals associated with coarse-grained environmental issues are more likely to conflict among processes as compared to signals associated with fine-grained issues.

Observational grain. Organizations perceive signals through the *observational grain*, and it is this grain that allows them to identify environmental issues. Very fine observational grains reveal more detailed signals, so much so that these signals could appear stochastic or random, whereas coarse observational grains yield broad patterns, so much so that it is impossible to detect anything. Levin (1992) states that "we trade off the loss of detail or heterogeneity within a group for the gain of predictability; we thereby extract and abstract those fine-scale features that have relevance for the phenomena observed on other scales" (p. 1947).

Meentemeyer (1989) argues that spatial patterns of ecological processes are more likely to be detected when an appropriate level of resolution is selected – that which maximizes spatial variability. In Figure 2, we use the example of a waterfall to illustrate the challenges in trying to identify and interpret fine- and coarse-grain processes using fine- and coarse-grain observation. A fine-grained issue (i.e., the waterfall) observed through a fine-grained lens will reveal a waterfall. A fine-grained issue observed through a coarse-grained lens will likely just reveal a blur of signals, because the variation is muted. Hence, the coarse observational grain fails to reveal the needed variability (Pereira, 2002; Sayre, 2005).

FIGURE 2

Inherent Versus Observational Grain of Environmental Issues

Observational Grain

Fine **Coarse**

Inherent Grain

Fine

Coarse

Figure 2, also reveals that a coarse-grained issue (the sunset) observed through a fine-grained lens will result in conflicting signals, so it is difficult to see the sunset. There are many weak signals, not all of which are important to understanding the issue, and, as a result, important features are difficult to discriminate from noise (Gibson, Ostrom, & Ahn, 2000). When viewed through the appropriate coarse lens, the sunset shines through.

By using the appropriate observational grain, organizations can better identify the most proximate and relevant processes that are revealing the issue. Selecting an appropriate observational grain will enable the firm to establish a variance threshold for what is considered normal for that process and thus be able to accurately identify abnormal variance signaling an environmental issue. Therefore, we conclude that,

Proposition #2: Processes with a coarse inherent grain, observed through a fine lens are more likely to result in conflicting signals than if observed through a coarse lens. Processes with a fine inherent grain, observed through a coarse lens are more likely to yield too few signals than if observed through a fine lens.

In what follows, we argue that the spatial configuration of the organization will affect its observational grain. We contend that the spatial configuration of the organization – what we call *geographic orientation,* as reflected through the spread and concentration of organizational assets through geographic space – will influence the firm's observational grain and thus affect which environmental issues get noticed.

Geographic Orientation

On the one hand, it is important to identify the grain associated with an issue and the lens by which the organization observes the ecological process. On the other hand, it is also important to recognize the limitations of the organization in observing the issue, which pertains to organizational characteristics. Here, we argue that the organization's *geographic orientation* affects its ability to identify environmental issues.

Geographic orientation is defined as the spatial distribution of firm assets through geographic space. It is most easily conceptualized as the spatial boundary of the firm's operations and the density of its assets. Included within this boundary is the firm's head office, regional offices, plants, shipping terminals, subsidiaries, etc. – any physical installation where the firm's employees are located. Prior work has shown that the distribution of a firm's physical assets affects the distribution of knowledge, as well as access to markets and resources (Nachum, Zaheer, & Gross, 2008). Others have found that geographic proximity among organizational subsidiaries plays a significant role in accelerating the rate of diffusion of innovation (Folta, Cooper, & Baik, 2006).

Weick (1995) suggests that the act of assigning meaning to signals relies heavily on context and therefore requires a broad focus. However, if the context becomes too large, some organizations (a) will lose the ability to detect the right signals because the signals have become too weak (Vaughan, 1996) or (b) will be able to prioritize only those that are most familiar among many signals (Haeckel, 2004). At the same time, if the geographic orientation is too narrow, the firm will not have sufficient context in which to see the variance and will therefore be unable to detect it. As a result, the ability to perceive signals regarding environmental issues remains dependent on a firm's geographic orientation and will affect which issues appear most salient.

Geographic orientation is characterized by the organization's spread (i.e., its breadth) and concentration (i.e., its density). In what follows, we argue that the spread and concentration must match the inherent grain of the ecological process (or perhaps multiple processes with varying inherent grains) in order to accurately perceive the signals of an associated environmental issue.

Spread. We define *spread* as the physical dispersion of the firm through geographic space. Organizations with assets distributed over a broad area would be considered high spread, whereas organizations whose assets are less dispersed would be considered low spread. Because our interest lies in exploring a firm's structure and its effects on perceiving processes and issues, we believe the aggregated average distance between all units would adequately reflect the spread of the firm.

Spread is often measured by the geographic distance from the capital city of the home country to that of the host country (Doh, Bunyaratavej, & Hahn, 2009) or between host countries (Hutzschenreuter, Voll, & Verbeke, 2011). Some researchers weight this measure by the dollars invested in the regional cluster (Gaba & Meyer, 2008), which more accurately predicts the knowledge transferred between offices (Keller, 2002). Others argue that geographic distance raises coordination costs (Delios & Beamish, 1999).

As argued in the previous proposition, when a high accord exists between the observational grain and the inherent grain, signals are more likely to be perceived. However, even if the grains match, *per se*, signals could still be missed or disregarded because the magnitude of variance may represent a statistically possible aberration. Therefore, even where observational grain and inherent grain match, signals can still be overlooked.

Organizational spread provides subsidiaries with multiple perspectives on the same ecological processes. This process of triangulation – using multiple reference points to identify signals of a given phenomena (Jick, 1979) – allows one office to validate its impressions of an environmental abnormality with other offices. It is sometimes difficult to assess whether a signal has exceeded variance thresholds with one set of data from one location.

Often, processes are observed and assessed within a regional or national perspective (i.e., single perspective), and as a result, when considered on a relative basis, the signals of these processes seem disparate (Cash *et al.*, 2006); depending on the firm's location, different yet related signals may be overlooked. As Burt (1992) argues, remote locations can provide a source of unique information that can enhance a firm's overall understanding of complex phenomena. For example, climate change is experienced in different ways at different locations. A firm operating only in the Southern United States might observe record heat waves, but that information alone may be dismissed when the temperatures fall or when comparing temperatures in different parts of the country. A more dispersed firm can validate the information in the Southern United States with temperature aberrations in other areas.

Further, there is high variability in the scope of environmental issues: some are restricted to only a limited geographic area while others are more global in nature (WWF, 2010). Less common issues may occur only in those areas where the conditions enable the problem to manifest, such as arid agricultural environments that rely on irrigation for growing crops, giving rise to increased soil salinity. Thus, spread enables the firm to appreciate the geographic breadth of the issue and to direct its attention accordingly in order to monitor the issue. For these reasons, we propose that:

Proposition #3: High spread increases the likelihood that the complexity of coarse-grained environmental issues will be understood, whereas fined-grained issues are more likely to be overlooked.

Concentration. *Concentration* is defined as the spatial proximity of a firm's assets relative to each other. Concentration is conceptually distinct from the concept of *clustering*, which is defined as an "aggregation of competing and complementary firms that are located in relatively close geographical proximity" (Birkinshaw & Hood, 2000, p. 142). Concentration reflects the proximity of within-firm assets, whereas clusters reflect between-firm spatial relationships. Clusters have been considered to be as broad as state boundaries (Shaver & Flyer, 2000) or as narrow as metropolitan areas (Folta, Cooper, & Baik, 2006). Clusters have been argued to represent a key factor in facilitating knowledge transfer and organizational innovation (Saxenian, 1994) because they allow information and knowledge to flow more easily (Cantwell & Janne, 1999; Rosenkopf & Almeida, 2003). For this reason, clusters are important since knowledge spillovers have been shown to have a positive impact on firm performance (Shaver & Flyer, 2000). Most of this prior research investigates knowledge spillovers between firms; however, a recent study of subsidiaries in the information and communication sector in Brazil found that firms that fostered strong exchange links for their within- and between-firm knowledge experienced greater innovation success (Figueiredo, 2011).

Firms that are more densely concentrated are more likely to detect more signals in a specific area, thereby gaining richer information about ecological processes and environmental issues. Richness offers multiple descriptions or explanations for the same issue (Weick, 2007) and thus enables opportunities to change understanding (Daft & Lengel, 1986). Because spatial proximity enhances signal detection (Gaba & Meyer, 2008), firms that are more spatially concentrated will be able to gather more data and corroborate each others' data if issues seem to be emerging. Concentrating organizational attention within a given context decreases the chances of missing signals (Birkinshaw & Hood, 2000).

Weick (2007) suggests that richness also enables comparison between like signals. He uses the example of an original masterpiece compared with a miniature print of the masterpiece to illustrate that it is the difference between the two pictures that captures our attention and in turn highlights the uniqueness of each picture. Concentration enables richness by allowing comparisons of like and related signals.

In the absence of organizational concentration, a subsidiary may condone the clearing of a rainforest in order to harvest wood products. If other organizations (e.g., for-profit or not-for-profit) were located in the same area, they might be able to detect, for example, the damage to surface water (through increased soil run-off) that results from deforestation. Based on these arguments here, we propose that:

Proposition #4: High concentration increases the likelihood that fine-grained environmental issues will be observed, whereas the complexity of course-grained issues is more likely to be overlooked.

DISCUSSION

At the outset of this paper, we sought to answer the question, *How does an organization's scale affect its attention to environmental issues?* We claimed that organizational scale, as reflected in a firm's geographic orientation, affects its ability to perceive environmental issues. We drew our insights on scale from the fields of geography and ecology, and we applied insights from organizational attention (Ocasio, 1997) to illuminate this question.

Because environmental issues have an inherent grain (i.e., coarse to fine), we proposed that issues must be observed within the same grain in order to correctly interpret any abnormalities or signals. If they are not, the signals of fine-grain issues will be too weak, and coarse-grain issues will result in conflicting signals. The result: environmental issues will be missed.

The geographic orientation of the firm, marked by its spread and concentration, enable its ability to perceive issues. Broadly dispersed organizations are more likely to appreciate the breadth of an environmental issue, while tightly clustered organizations will appreciate its richness. Broadly dispersed, tightly clustered organizations are most likely to perceive environmental issues.

Together, these propositions highlight the central importance of understanding ecological processes in order to recognize the point at which environmental issues become salient. Thus, it remains critical for organizational attention to match management systems to the grain of the environmental issue that the organization seeks to address (Cash & Moser, 2000). Otherwise, in the absence of fit, signals will be missed and environmental issues will persist.

Extending Prior Literature

Corporate environmental management. The corporate environmental management literature explores the ways that firms can reduce their impact on the environment. A substantial body of research has been developed in this area, identifying the factors that affect a firm's environmental performance. (For a comprehensive review see: Etzion, 2007.) Most of this work focuses on firms operating in "dirty" industries, such as the chemical industry (e.g., King & Shaver, 2001), and in resource-extraction industries, such as forestry, mining, oil, and gas (e.g., Bansal, 2005). Much of this work lumps all environmental issues together and does not discriminate between them. For the literature that *does* discriminate between issues, most issues are widely acknowledged, such as recycling and waste reduction (e.g., Bansal, 2003) and pollution control and prevention (e.g., Lenox & King, 2004). This prior work on corporate environmentalism cannot, however, explain why firms have not responded to the water-use issue in the Athabasca oil sands (Schindler, 2010), for example, or to issues such as biodiversity loss (Rockstrom *et al.*, 2009), despite the underlying threat of these concerns to the economic position of the firm (MEA, 2005).

Massive environmental issues such as climate change, biodiversity loss, and over-exploitation of resources still persist, yet for the most part, environmental issues beyond those that are covered heavily by the media (often because of activist actions) regularly go unnoticed by firms. The failure of firms to respond to the wide range of environmental issues to which they contribute is not necessarily deliberate, but might instead represent firms' failure to identify the issues because of their scale relative to the scale of the issue itself. This work can explain why firms fail to respond to issues, even when the issues may yield resources that are critical to the firm's operations.

In this paper, through the construct of scale, we have developed the theoretical apparatus that will allow issues to be discriminated along important and predictive dimensions. In discerning the grain of issues, we provide an explanation for why some issues fail to be addressed, despite their underlying significance to organizations and, more broadly, to society. By exploring the epistemological (i.e., observational grain) and ontological (i.e., inherent grain), researchers could identify the characteristics of environmental issues that would provide a new and interesting explanation for why some firms respond to certain environmental issues while others do not.

Sustainability. As an area that stands adjacent to corporate environmental management, *business sustainability* argues that firms should build social, environmental, and economic value simultaneously. The dynamic, complex, and overlapping nature of these three imperatives have made it difficult for most firms to understand and practice sustainability (Bansal, 2005). Thus, in order to move beyond this confusion and establish a balance between human and natural systems, we need to link natural and economic systems explicitly (Cumming, Cumming, & Redman, 2006). Yet, we are challenged in doing so, largely because human and natural systems operate at different scales (Gibson, Ostrom, & Ahn, 2000).

When the organizational scale fits with the scale of the environmental issue, systems function effectively (Wolf & Allen, 1995). We have argued that resolving sustainability issues – such as the need for fossil fuels and the methods for extracting them – is possible when fit can be achieved between the organization's geographic orientation and the grain of the environmental issues. Failing to achieve that fit has resulted in "[t]he separation of humans and nature, [which] has alienated society from its dependence on functional ecosystems and the support that they provide" (Folke *et al.*, p. 12). In order to achieve fit between natural processes and organizational processes, it is necessary to move away from sector-by-sector analysis of relative sustainability (Rockstrom *et al.*, 2009), and, as we argue above, focus instead on how scale affects signal detection. Therefore, we argue that scale operates as a central construct in reconciling this separation between humans and their environment.

Organizational structure, location and attention. A broad body of literature has emerged that focuses specifically on location selection (Cantwell, 2009) in response to calls that spatial issues had been largely neglected in international business research (Dunning, 1998). This body of work assumes that the geographic location to which the firm is expanding is virtually limitless. The firm's decisions are often shaped by institutional considerations, such as the host country's culture (Leung *et al*., 2005), cross-national distances (Berry, Guillen, & Zhou, 2010), environmental frameworks (Rugman & Verbeke, 1998), and distance-to-market (Rugman & Verbeke, 2004). However, the physical aspects of the location itself, such as topography, weather, and climate, have been virtually ignored, in spite of the fact that they vary considerably. These geographic and environmental considerations can be quite central to the firm's operations and to its future success, especially as environmental considerations gain greater traction among host communities. Our research points to the need to include such spatial considerations in location decisions.

In this paper, we argue that a firm's ability to attend to issues is influenced by its organizational structure. Prior work in international business has focused its attention on the relationship between the head office and subsidiary (e.g., Bartlett & Ghoshal, 1989; Bouquet & Birkinshaw, 2008). Concepts such as multinationalism and transnationalism have shaped this landscape. In this paper, we introduce the notion of geographic orientation, defined by the degree of concentration and spread, both of which shape the firm's ability to identify issues.

Exploring the within-firm characteristics of geographic orientation enhances the ability of the firm to attend to certain issues while at the same time impeding its ability to attend to others. For example, Bouquet and Birkinshaw (2008) argued that both the weight and voice of the subsidiary affected the head office's attention to that unit. These authors found that spatial distance moderated the relationship between voice (i.e., initiative-taking and profile-building) and head office attention. Considering a firm's geographic orientation could provide an additional explanation for why some subsidiaries get greater attention from head office over others.

Scale influences several aspects of organizational attention, and these aspects are particularly evident with environmental issues (Wolf & Allen, 1995). In a world that is fraught with increasing uncertainty related to the intensity and frequency of extreme weather, coupled with the increase in demand for natural resources, organizations must face the emerging reality that *business as usual* may not constitute a sufficient strategy for survival (MEA, 2005). As scale changes, organizational complexity changes as well, to the point where coordination problems manifest, and hence, the need for changes to structure emerge (Bartlett & Ghoshal, 1989).

When faced with complexity, it has been argued that organizations rely on routines (Nelson & Winter, 1982), which have been shown to have an impact on performance (Adler, Goldoftas, & Levine, 1999). However, reliance on the same routines in the face of uncertainty has also been argued to give rise to problems, such as the inability to identify threats (McMullen, Shepherd, & Patzelt, 2009). Therefore, organizations that develop an ability to perceive signals related to emerging issues will be better equipped to cope with uncertainty and will therefore respond by adapting their organizational structures.

CONCLUSION

In this paper, we have focused our attention on the identification of issues in the natural environment. We believe that in the current social climate, environmental issues present some of the greatest challenges to human health and dignity.

The importance of scale transcends the natural environment and can be extended to all aspects of organizational life. Firms cannot absorb and process all the signals in the environment under the constraint of limited attentional resources. Recognizing that an organization's scale, as manifested through its organizational concentration and spread, could influence its perceptions stands out as an important insight that could have wider implications to the study of organizations. We hope this article will inspire researchers to consider a richer description of organizational scale, beyond size, in order to more fully explore the implications of scale on organizational life.

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CHAPTER 3

Out of Sight, But Not Out of Mind: How Geographic Orientation Shapes MNEs' Environmental Performance

INTRODUCTION

International business is often seen as a blight on the natural environment. Some researchers assert that multinational enterprises (MNEs) make strategic decisions to locate their operations in countries with weak environmental laws in order to export high-polluting activities (Crandall, 1993), a process commonly labeled as the *pollution haven hypothesis* (Birdsall & Wheeler, 1993).

There exists an alternative perspective. Large MNEs are more likely to manage their environmental impacts because of the higher scrutiny they experience from stakeholders, the greater need to standardize their practices and policies, and the greater opportunity to learn from other contexts and build important resources and capabilities (Bansal, 2005; Christmann, 2000; Christmann & Taylor, 2001).

Both competing perspectives consider environmental performance across international borders, while overlooking the direct effects of geographic distance itself. This approach suggests that when a firm operates across international borders, its environmental performance remains independent of the distance between the home and host countries. We contend that multinationality confounds the effects of geographic distance and can explain these competing perspectives. In order to explain differences in environmental performance, within-firm geographic distribution of assets must be explored explicitly.

We argue in this paper that the two perspectives can be reconciled if we account for the geographic distribution of a firm's assets, what we call the MNE's *geographic orientation*. For example, firms with wide geographic spread or high concentration of facilities in close proximity are more likely to have better environmental performance. In this research, we seek to answer, *How does a firm's geographic orientation affect its environmental performance?*

We frame our arguments within the organizational attention literature, specifically, the attention-based view (Ocasio, 1997), which posits that a firm's ability to identify issues is shaped by the focus of its attention, the context in which it is embedded, and its organizational structures. We argue specifically that two aspects of organizational structures, which are important to geographic orientation – spread and concentration – influence a firm's environmental performance. Spread is reflected in the distance between a facility and its headquarters, and concentration is reflected in the distance between facilities within a region.

We position our work in the Canadian context. In particular, we draw from a sample of 140 MNEs with 3,862 facilities. We test our hypotheses using both visualization (i.e., maps) and hierarchical ordinary least squares (OLS) regression in ArcGIS, a Geographic Information Systems (GIS) software package that allows for the explicit testing of spatial relationships. We find strong support for our hypotheses: the MNE's environmental performance is affected by its spread and concentration.

THEORY DEVELOPMENT AND HYPOTHESES

Spatial Analysis and International Business

Spatial analysis in international business has been undertaken both within firms and between firms. Within-firm analysis evaluates how firms can overcome and manage distance. Prior research that explores the relationship between headquarter-subsidiary distance and firm performance has yielded mixed results. On one hand, distance is seen as a barrier to globalization (e.g., Barkema, Bell, & Pennings, 1996; Delios & Henisz, 2003). Distance, especially cultural and institutional distance, is argued to impose a "liability of foreignness," so that firms doing business abroad incur costs and potentially risk failure (Hymer, 1976; Zaheer, 1995). On the other hand, remote locations can also be a source of unique information that enhances a firm's overall understanding of complex phenomena (Burt, 1992). Access to geographically distant information has been shown to positively influence organizational learning (Audia, Sorenson, & Hage, 2001) and innovation (Cantwell & Janne, 1999; Rosenkopf & Almeida, 2003). Together, these two sets of evidence suggest that distance can both hurt and help firms.

There is little doubt that the location of assets, markets, and resources plays some role in shaping firm behavior, which is why location selection has long been of central interest to international business scholars (e.g., Bartlett & Ghoshal, 1989; Rugman & Verbeke, 2004; Cantwell, 2009). However, most prior work has conceptualized these location effects as distance, described as physical, institutional and cultural. Distance, however, is a relatively simple construct that does not fully reflect the spatial distribution of a firm's assets. For example, a single subsidiary in a distant country may experience one set of outcomes, but several facilities in the same country will experience a different set of outcomes. Therefore, we argue that, as an overarching description of the firm's distribution of assets, the MNE's geographic orientation is more relevant in explaining firm-level outcomes than is the mere distance of the headquarters from the subsidiary.

Most prior work that has explored the distribution of assets in space does so between firms, not within firms. This work argues that agglomerations or clusters can offer a strategic benefit for firms because of the concentration of skilled labor, access to markets, and resources (Marshall, 1920). Geographic concentration has been argued as a key factor in facilitating knowledge transfer and organizational innovation (Saxenian, 1994) because intense concentration allows an easy flow of information and knowledge (Cantwell & Janne, 1999; Rosenkopf & Almeida, 2003), thereby increasing the likelihood of knowledge spillovers (Shaver & Flyer, 2000; Alcacer & Chung, 2007). Most of this prior research has explored knowledge spillovers between firms.

Surprisingly, even though the geographic distribution of assets has been explored *between* firms, it has not yet been explored *within* firms. There are some indications that the spatial orientation of a single firm's operations, assets, and relationships remain underexplored (Ghemawat, 2001) and yet are critical for understanding firm behavior (Dunning, 2009; Nachum & Zaheer, 2005). To better understand the spatial orientation of MNEs, we investigate their actions in relation to environmental performance.

Environmental Performance and Spatial Characteristics

Environmental performance is defined as the cumulative efforts of a firm to reduce the negative environmental impacts of its operations (Klassen & McLaughlin, 1996). Efforts to reduce environmental impacts include pollution control, such as end-of-pipe solutions (Russo & Fouts, 1997), or technological and design changes to processes that influence resource use at the beginning-of-pipe (Klassen & Whybark, 1999). The main thrust of this work emphasizes the central role of technological solutions to reduce pollution.

Building on this body of information, others have explored external factors that can lead to better environmental performance. Although voluntary initiatives have been found to be ineffective in improving environmental performance (King & Lenox, 2000), they have been shown to increase the diffusion of better environmental management throughout the MNE (e.g., Christmann & Taylor, 2001). Some contend that environmental performance is heavily influenced by managerial access to information, often with diverse sources of information resulting in better environmental performance (Lenox & King, 2004). External sources of information could include stakeholders, which have been found to influence environmental management strategies (Sharma & Henriques, 2005). Together, these results suggest that external factors shape environmental performance; yet, consistent across these studies is the fact that their accompanying spatial characteristics have been largely overlooked.

Removing firm-specific (attribute) data from its spatial context removes the effects of that location relative to other locations in the MNE, and, as a consequence, provides only half the story in explaining environmental performance. Plummer (2010) argues that the importance of spatial dependence must be considered in any research context that might experience spatial influence, since considering within-firm heterogeneity can provide new insights as to the locational effects that shape firm behavior (Rugman & Verbeke, 2004). Therefore, in the following section, we develop the construct of *geographic orientation* and build hypotheses related to each of its dimensions – spread and concentration.

Geographic Orientation

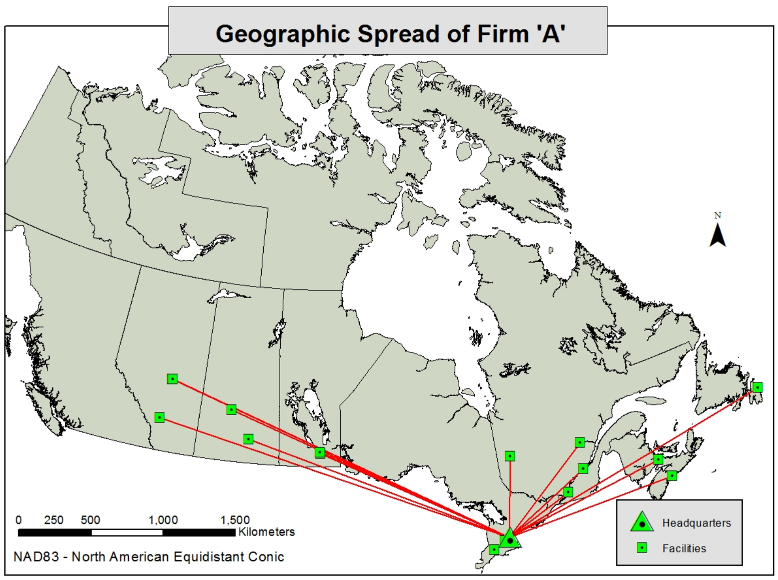
Geographic orientation is defined as the distribution of firm assets through geographic space and is shaped by both the spread of the firms' activities and their concentration. The assets include any physical installation, including headquarters, regional offices, plants, shipping terminals, subsidiaries, etc.

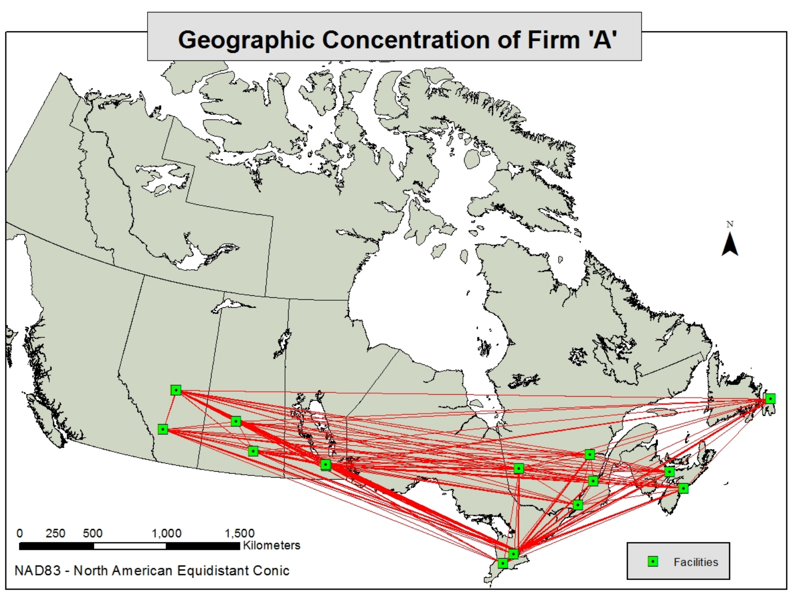
The firm's geographic orientation shapes the issues to which it will pay attention. An organization whose assets are distributed more sparsely over a broad geographic area may be as global as a firm whose assets are distributed more densely over the same geographic area, yet the former firm's ability to identify and respond to local issues likely differs. The framework established by the distribution of assets shapes the issues that will focus the firm's attention. Firms with more globally distributed assets are likely to have more of a global mindset and be more aware of global issues (e.g., Bouquet, Morrison, & Birkinshaw, 2009), such as those associated with environmental performance. In contrast, firms with more locally concentrated assets are likely to be more locally embedded. The relative distribution of assets, as reflected by the firm's geographic orientation, affects its structure and, ultimately, its attention.

We operationalize geographic orientation through two dimensions: 1) *spread*: the distance between the firm's headquarters and its facilities; and 2) *concentration*: the distance between those facilities in geographic space. Figure 3 illustrates these different dimensions of geographic orientation.

FIGURE 3

Dimensions of Geographic Orientation





In the next section, we argue that the firm's geographic orientation affects its organizational attention, which ultimately affects the way it manages its relationship with the natural environment.

Organizational Attention and Distance

Most early work on organizational attention explored the impact of individuals' attention on organizational responses (e.g., Daft & Weick, 1984). For example, Garg and colleagues (2003) found that a CEO's attention to internal and external factors influenced firm performance. Relatedly, Thomas and McDaniel (1990) found that a CEO's attention to and interpretation of an issue was affected by a firm's strategy and its information-processing structure.

More recently, management scholars have begun to explore in greater depth the organizational level factors of attention and the influences of these factors on organizational actions, especially in the context of international business (e.g., Bouquet & Birkinshaw, 2008). Some scholars have explored how within-firm factors, such as headquarters' attention to subsidiaries (Ambos & Birkinshaw, 2010; Bouquet & Birkinshaw, 2008), can influence organizational actions. Others have explored how the effects of attention on between-firms factors, such as competitor actions, can influence the focal firm's behavior (Levy, 2005). Together, these findings suggest that a firm's actions are inextricably linked to where they direct their attention and how they manage it (Bouquet, Morrison & Birkinshaw, 2009).

Attention is defined as the organization's noticing, encoding, interpreting, and focusing on issues and answers (Ocasio, 1997). The attention-based view posits that firm behavior is best explained when the regulation and distribution of a firm's attention is understood (Ocasio, 1997). Barnett (2008) contends that firms are exposed to a virtually limitless number of signals, and for this reason, the challenge for the organization then becomes the allocation of attentional resources (e.g., managerial attention) in order to capture important information (Bouquet & Birkinshaw, 2009; Hansen & Haas, 2001). Thus, attention is considered a rare and valuable resource (Cyert & March, 1992).

Ocasio (1997) suggests three factors that can best explain how firms identify and interpret information on a given issue. *Focus* of the organization's attention ensures that it picks up the correct signals, thereby reducing errors (Durand, 2003) and improving performance (Yu, Engleman, & Van de Ven, 2005). *Situated attention* emphasizes the importance of context in likelihood, intensity, and duration of an organization's attention to events (Hoffman & Ocasio, 2001). Because signals are context-dependent (Rerup, 2009), when removed, they become more difficult to interpret (March, 1981). *Structural distribution* of attention manifests through a firm's rules, resources, and relationships that regulate and control the distribution of attention (Ocasio, 1997). Together, these three factors – particularly as they relate to how the flow of knowledge and information within a firm affects its strategy (e.g., Ocasio & Joseph, 2005) – can explain the relationship between a firm's geographic orientation and its environmental performance.

Geographic spread. Spread is defined as the geographic distance between a firm's headquarters and its facilities (Rugman & Verbeke, 2009; Tallman & Yip, 2009). Firms with wider spread have physical resources distributed over a wider geographic area compared to firms with more narrow spread.

Spread has been shown to increase the complexity in interpreting environmental issues because organizational actors are exposed to more tacit elements of the issue (e.g., Whiteman & Cooper, 2000). For example, climate change is experienced in different ways, depending on the spread of the firm. A firm operating only in the southern United States might experience heat waves, but it will not understand the magnitude of the changes to the climate until it experiences a wider set of weather events in different parts of the country. Thus, the closeness of the firm to a given issue defines the organization's context and shapes its attention (e.g., Sharma, 2000).

Signals are associated with specific contexts (Weick, Sutcliffe, & Obstfeld, 1999) and influence the likelihood, intensity, and duration of attention paid to a particular issue (Hoffman & Ocasio, 2001). Headquarters located close to certain facilities are more likely to focus attention on issues related to the nearby locations as compared to issues raised by facilities located farther away. Headquarters' proximity to issues will affect the issues on which they focus their attention. The headquarters thus anchors one perspective on an issue, and the information gathered by the subsidiary anchors the other. Therefore, firms with wider spread are more likely to have a wider perspective on an issue and will be better able to identify anomalies.

Prior work has shown that the distribution of a firm's physical assets affects the distribution of knowledge and the firm's access to markets and resources. Nachum and colleagues (2008) showed that distance to knowledge and markets shaped the selection of MNEs' location, whereas distance to resources did not. Distance has been found to affect the degree to which knowledge is transferred between offices (Keller, 2002), which, in the context of MNEs, increases the liability of foreignness and the costs associated with operating in foreign markets (Zaheer, 1995). As geographic spread increases, the flow of information between distant offices becomes constrained, thus increasing the likelihood that signals could be missed. To combat this problem, firms with significant geographic spread are likely to develop management systems and structures that will help them cope with potential deficiencies that arise over greater distances. Stated formally,

Hypothesis 1. The wider an MNE's spread, the better its environmental performance.

Geographic concentration. The mean average distance between facilities reflects the MNE's geographic concentration. The closer the MNE's facilities are to each other, the greater their concentration will be. Prior work in management has explored the effects of clusters, defined as "aggregation of competing and complementary firms that are located in relatively close geographical proximity" (Birkinshaw & Hood, 2000: 142). The clusters literature focuses primarily on the relationships *between* organizations, whereas our interest lies in concentration of assets *within* organizations, thus warranting conceptual distinction and use of the term geographic orientation.

A firm with high concentration of subsidiaries is more likely to be able to identify issues. When multiple subsidiaries exist within a region, they are likely to be more embedded in the local community, and as a result, they are able to share information both with members of the community and with members of their organization. In doing so, they will be able to confirm suspicions of an environmental issue. Whiteman and Cooper (2000) argue that managers embedded in the local environment are more attuned to subtle changes in the natural environment and can respond more effectively to emerging issues. The importance of embeddedness within the firm itself has also been argued to increase the chances of identifying issues before they turn into crises (Rerup, 2009). With greater attention directed to the contexts in which issues could arise, we would expect firms whose facilities are closer together to have better environmental performance.

The number of managers in an area will increase the number of perspectives for viewing particular issues, resulting in better environmental performance. Through the process of identifying and labeling issues, organizational members often debate and contest issue dimensions (Hoffman & Ocasio, 2001). As the number of members focusing on an issue increases, the more perspectives will enter into the debate. Triangulation – using multiple reference points to identify signals of a given phenomenon (Jick, 1979) – allows one facility to validate its impressions of an emerging environmental issue with other offices, whereas multiple descriptions or explanations of the same issue yield a more holistic picture of the issue at hand (Weick, 2007), thus resulting in better environmental performance. In contrast, when few perspectives are included in the process, a less complete picture of the issue will manifest, which will be reflected in poorer environmental performance. We know that a greater number of middle managers presenting a potential threat to a top manager increases the likelihood that the issue will be addressed (McMullen, Shepherd, & Patzelt, 2009). When a greater number of managers keep headquarters informed about issues relating to the environmental impact of their processes, headquarters is more likely to respond. In such cases, we can expect that the firm's response will take the form of improved environmental performance.

Further, through increased pollution and higher demand for natural resources, firms with higher concentration exert a greater impact on the local environment. As a result, these firms come under a significant degree of pressure to improve their environmental performance. Stated formally,

Hypothesis 2. The greater an MNE's concentration*, the better its environmental performance.*

METHODS

Sample

In order to test these hypotheses, we needed precise data for each facility's location, specifically the latitude and longitude coordinates. The National Pollutant Release Inventory (NPRI) provides precise latitude and longitude coordinates of Canada-based facilities. As a Government of Canada-sponsored endeavor, the NPRI tracks toxic releases by facility. We selected the most current year of data (i.e., 2010) from which to draw our sample of facilities and yielded a raw sample of 9,175 Canadian facilities.

The NPRI tracks all toxic releases that exceed a prescribed toxicity threshold. For example, the reporting threshold for sulfur dioxide (SO_2) is 20 tonnes, whereas for mercury (Hg), the threshold is 5 kilograms. This discrepancy is due to the relative toxicity of the chemicals to human health. The facilities used in this analysis all exceed at least one pollutant threshold. The limitations of the dataset imply that this study is likely missing facilities that are located in low-polluting sectors and have low emissions because they are small or particularly clean. The boundary conditions of our results are discussed at the end of this paper.

The sample of 9,175 facilities in 2010's NPRI dataset was matched to the firms tracked by Sustainalytics, a global provider of investment data relating to environment, social, and governance (ESG) measures; NPRI provided the data for our dependent variable (discussed below). This matching process resulted in an overall sample of 152 firms. Twelve were dropped from our analysis due to missing control variable data, which resulted in a final sample of 140 firms, operating 3,862 facilities in Canada.[1] Seventy-one of these firms were headquartered in Canada, and the balance (i.e. 69 firms) were headquartered elsewhere.

The average firm age was 64 years. The oldest firm was Akzo Nobel NV, a firm in the materials sector, which had been operating for 364 years. The youngest firm in the sample was Birchcliff Energy, an oil and gas firm, which had been operating for five years. The average firm size at the end of 2010 was USD$42 billion in assets. The largest firm was General Electric, which held USD$752 billion in assets. The smallest firm, Vermillion Energy Trust, held USD$24 million in assets. Firms from the energy sector constituted the largest sub-group in our sample (31%), followed by materials (24%) and industrials (13%).

We mapped the headquarters for all 140 firms in our sample in Figure 4. Most firms in our sample were headquartered in North America, Europe, Asia, and Australia. Figure 5 maps all 3,862 facilities that relate to the firms in our sample. The high concentration of facilities in Western Canada reflects the significant oil and gas sector in this region.

[1] In addition to the NPRI data, corporate websites were also consulted to confirm the number of facilities and their locations; however, not all firms in our sample publicly disclosed this information.

FIGURE 4

Location of Firm Headquarters

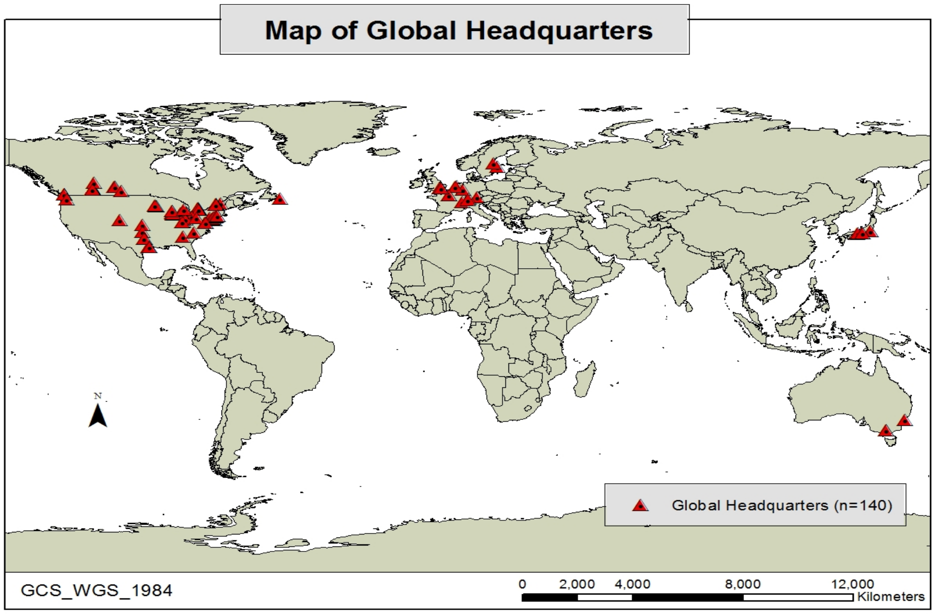
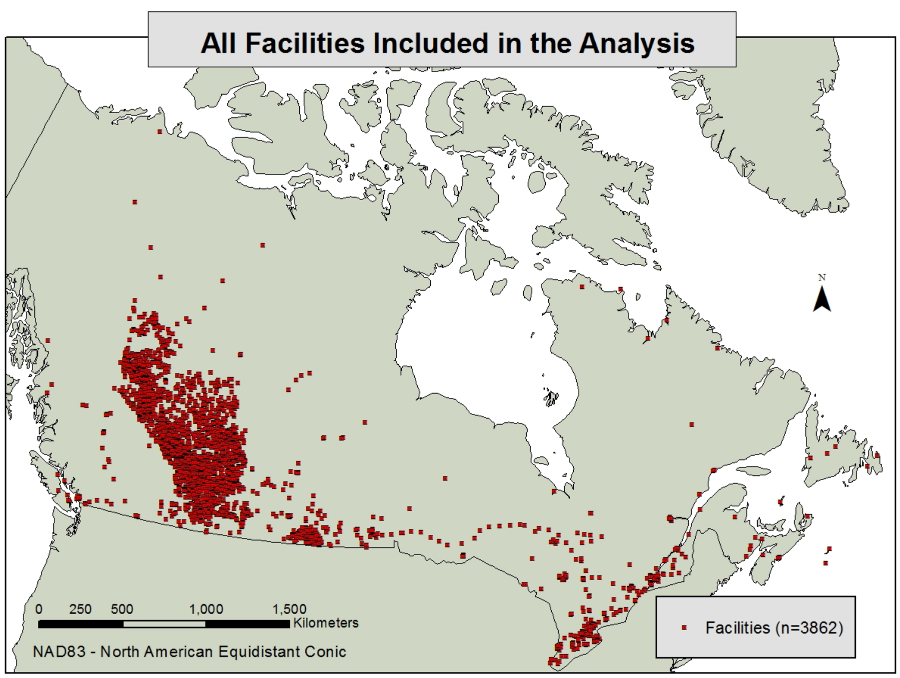


FIGURE 5

Map of Canada Showing the Location of Facilities



Dependent Variable

Our firm-level dependent variable, *environmental performance,* was drawn from the Sustainalytics database for 2010 and matched to the facilities data from NPRI. We chose this data source over other such data sources (e.g., Kinder, Lydenberg, Domini, and company; KLD) because Sustainalytics offered more fine-grained information on firms' environmental performance and had received recent attention in the literature as a reliable measure of environmental performance (Hebb, Hamilton, & Hachigian, 2010; Surroca, Tribo, & Waddock, 2010). Sustainalytics' environmental performance measure was constructed of both core indicators and sector-specific indicators. Core indicators were those that remained common across sectors, while sector-specific indicators were those that were used for evaluating only those firms within a given sector. For example, core indicators, of which there were 15 in total, included *third-party certification of environmental management*. Sector-specific indicators (total n = 41), of which, on average, seven applied per sector, included measures such as *programs to reduce air emissions*, and were therefore applicable to firms in both the energy and materials' sectors. All indicators were categorical, and each had a maximum score of 100. Sustainalytics then aggregated the indicators to an overall continuous variable, environmental performance, which was used in our analysis. Using the aggregated measure was consistent with previous research in this area (e.g., Godfrey, Merrill, & Hansen, 2009; Waddock & Gaves, 1997).

Independent Variables

Geographic spread. This construct was operationalized as the average distance between all Canadian facilities and the firm's global headquarters. Others have used geographic measures of distance, most often the great circle method, which measures the distance from the capital city of the headquarters' home country to the capital city of the subsidiary's host country (e.g., Doh, Bunyaratavej, & Hahn, 2009). Some researchers have offered more precise measures of distance by calculating the distance between cities (e.g., Bouquet & Birkinshaw, 2008); however, this approach would have been difficult in our case, given that many of the facilities in our sample were located in rural areas, combined with the vastness of Canada's geography. We addressed these issues by geo-referencing (i.e., identifying the latitude and longitude) the headquarters' addresses using a postal code locator function in ArcGIS for firms in North America, and by using street addresses for firms outside North America. In both cases, headquarters' addresses were retrieved from Dow Jones *Factiva* and from Bloomberg.

We calculated the Euclidean distance from headquarters to each facility using the Pythagorean theorem (i.e., $a^2 + b^2 = c^2$), which yields the distance, "as the crow flies." Once the distance between each facility and its headquarters had been calculated, we calculated the average of these distances to yield the average distance between facilities from the headquarters for each firm. This variable was not normally distributed, and therefore the natural logarithm was used in our analysis.

Geographic concentration. This construct was operationalized as the average distance between a firm's Canadian facilities, thus providing a variable that captured the location of a firm's facilities relative to each other. Drawing on the latitude and longitude coordinates in the NPRI data as well as on corporate websites (where available), each firm's concentration variable was analyzed independently. First, the mean center was calculated for each firm's facilities (i.e., the average X and Y coordinates of all facility locations). Then, using the Pythagorean theorem, the mean center was used to calculate the distance between the center of the cluster and each facility. Once the distance between the mean center and each facility had been calculated, the average distance between a firm's facilities was calculated.

Control Variables

Firm-level variables. Since past performance constitutes a well-known predictor of future performance, the model was run with a lagged dependent variable (*environmental performance for 2009*) as an independent variable to control for any omitted variables and to further enhance our causal argument (King & Lenox, 2002; Rowe *et al.*, 2005). Controlling for the effects of *firm size* was important because smaller firms might have shown higher average costs than larger firms when implementing social and environmental initiatives (McWilliams & Siegel, 2001), such as better environmental performance. We collected data on *firm size*, operationalized as the natural logarithm of total assets for 2009 (Bansal & Clelland, 2004), and we included a variable to control for the *number of facilities in Canada*, which has been shown to increase complexity in managing environmental impacts (King & Shaver, 2001). *Firm age* was calculated by subtracting the year of incorporation from 2009; data for this process was accessed through Dow Jones *Factiva*. Firms with superior financial performance could have greater financial resources available to pursue better environmental performance. To control for *financial performance,* we selected Return on Assets (ROA) because of its reliability and prominence in the literature (Combs, Cook, & Shook, 2005). Relatedly, *slack resources* have also been shown to affect a firm's ability to respond to sustainability-related issues (Bansal, 2005), such as the environmental impacts of its operations. The natural logarithm of current ratio (current assets/current liabilities) was used to capture the variance associated with slack and was calculated at the end of 2009. Data for these two financial measures were retrieved through Bloomberg. In addition, eight indicator variables were used to account for nine industrial sectors.

Country-level variables. In order to explore the effects of geographic orientation on environmental performance, we made a deliberate effort to control for country-related differences. Hung (2005) suggests that attention is affected by the institutional context of the country in which the firm is headquartered. Some countries – and, by extension, firms headquartered within those countries – might be more apt to mitigate the potential impacts of their activities on the natural environment. Drawing on the Global Leadership and Organizational Behavior Effectiveness project (GLOBE; House *et al.*, 2004), we selected two country-specific variables that seemed most appropriate to environmental issues: *uncertainty avoidance* and *future orientation*. Firms headquartered in countries that rated highly in these two dimensions might be more likely to attend to the environmental impacts of their operations. Therefore, we included these two variables to control for this potential confound in explaining environmental performance. Previous research has also shown that home-country wealth affects environmental performance (e.g., Madsen, 2009). By extension, we assumed that firms headquartered in wealthy countries would be more likely to face pressure in terms of their environmental performance, no matter where they operated. Again, controlling for this potential confound, we accessed data through the World Bank and included *GDP per capita* for 2009 as our measure of home country wealth (Doh, Bunyaratavej, & Hahn, 2009).

Data Analysis

Using the variance inflation factors (VIF), we checked for multicollinearity between the variables specified in our model and found that they were all between 1 and 2.7, well within accepted limits (Aiken & West, 1991; Paetzold, 1992). In order to test for first-order autocorrelations, we could not use the Durbin-Watson test because we had included a lagged dependent variable as an independent variable in our models (Dougherty, 2006). In such circumstances, the Durbin *h* test is recommended, but there can be problems running the test when the sample size is not very large (Dougherty, 2006), which was the case with our data. Therefore, the Breusch-Godfrey test was used to assess first-order autocorrelations (Godfrey, 1978). The results from the test failed to reject the null hypothesis of no autocorrelation ($Chi^2 = 1.36$, $p = .244$).

We also tested our model for heteroskedasticity using both White's test (White, 1980) and the Breusch-Pagan test (Breusch & Pagan, 1979). Results from White's test revealed that heteroskedasticity was not a problem ($p = .34$), whereas results from the Breusch-Pagan test suggested that it was ($Chi^2 = 9.63$, $p < .01$). Because of these mixed results, we used the robust standard errors (Huber, 1967) in calculating the significance levels for our coefficients. With three key issues resolved (multicollinearity, autocorrelation, and heteroskedasticity), we were confident that OLS regression was appropriate for conducting our analyses.

RESULTS

The descriptive statistics and correlations are presented in Tables 1 and 2, respectively. First, we ran a baseline model (i.e., Model 1) with all control variables (both firm- and country-level) to assess the degree of variance explained by our independent variables. We then ran separate models (i.e., Models 2 and 3) to test each hypothesis independently.

TABLE 1

Mean, Standard Deviation, Minimum, Maximum, and Variance Inflation Factor

Variable	Mean	Std. Deviation	Minimum	Maximum	VIF
Env. Perf.	54.68	12.62	25.71	80.71	-
Lagged Env. Perf	51.38	11.00	28.20	83.70	1.84
Firm Size[1]	9.40	1.77	3.18	13.53	1.91
ROA	3.36	6.01	-20.59	21.42	1.31
Slack Resources[1]	0.30	0.60	-1.00	2.68	1.87
Number of Facilities	27.56	65.00	2	460	1.54
Age	63.41	55.86	5	364	1.56
GDP	39,798.76	6554.895	6526.25	61,741.30	1.31
Future Orientation	4.31	.20	3.34	4.80	2.65
Uncertainty Avoidance	4.47	0.33	3.74	5.42	2.54
Spread[1]	6.87	1.49	1.79	10.06	1.48
Concentration	254.37	249.87	0.01	1254.10	1.14

N = 140
Transformation: [1] = natural logarithm

TABLE 2

Correlations (*two-tailed test)*

	Env. Perf.	Lag Env. Perf.	Firm Size	ROA	Slack	Facilities	Age	GDP	Future Orientation	Uncertainty Avoidance	Spread	Concentration
Env. Perf.	1											
Lag Env. Perf.	.543**	1										
Firm Size	.450**	.436**	1									
ROA	.213*	.086	.184*	1								
Slack	.101	.330**	-.065	-.025	1							
Facilities	-.223**	-.226**	.077	-.061	-.270**	1						
Age	.434**	.431**	.376**	.162	.092	-.222**	1					
GDP	.288**	.138	.276**	.019	.016	-.118	.252**	1				
Future Orientation	-.176*	-.049	-.192*	-.201*	-.102	.111	-.063	.111	1			
Uncertainty Avoidance	-.004	.083	-.031	-.071	-.028	.022	.084	.115	.714**	1		
Spread	.420**	.351**	.427**	.122	.115	-.180*	.348**	.143	-.083	.127	1	
Concentration	.193*	.129	.003	.023	.049	-.008	-.018	.027	.111	.086	.098	1

**$p < .01$; *$p < .05$; $N = 140$

The results of our OLS regression analysis are presented in Table 3. Unstandardized coefficients and robust standard errors have been reported in our regression table and were used to calculate the significance level. Also, the significance of the change in F-values has been reported and indicates whether the addition of our independent variables had a significant effect on our model.

TABLE 3

Hierarchical OLS Regression Results

Variable	Model 1	Model 2	Model 3
Constant	41.21 (19.83)*	35.34 (21.08) [t]	42.99 (18.95)*
Lag Env. Perf.	.395 (.093)**	.374 (.098)**	.354 (.088) **
Firm Size[1]	1.04 (.650)	.603 (719)	.681 (.703)
ROA	.125 (.153)	.113 (.157)	.112 (.155)
Slack[1]	-1.53 (2.74)	-1.98 (2.58)	-1.91 (2.55)
Facilities	-.012 (.012)	-.005 (.012)	-.008 (.013)
Age	.024 (.013) [t]	.018 (.013)	.021 (.013)
GDP	.000 (.000) [t]	.000 (.000) [t]	.000 (.000) [t]
Future Orientation	-9.26 (6.17)	-7.17 (6.02)	-8.57 (5.77)
Uncertainty Avoidance	3.34 (3.17)	1.65 (3.08)	1.87 (3.03)
H1: Spread[1]		1.50 (.653)*	1.37 (.650)*
H2: Concentration			.006 (.003)*
F Statistic	*F*(17, 122) = 9.76**	*F*(18,121) = 11.09**	*F*(19, 120) =10.79**
R^2	.461	.484	.499
Adjusted R^2	.386	.407	.419
ΔR^2	-	.021*	.012*
Industry Effects	Yes	Yes	Yes
N-Observations	140	140	140

Note: ** = $p < 0.01$; * = $p < 0.05$; [t] = $p < 0.10$ (two-tailed tests).
Transformation: [1] = natural logarithm

Dependent variable is *Environmental Performance*. Unstandardized coefficients are reported with robust standard errors in parentheses. Dummy variables for industrial sector were included but are not reported in the table.

Base model: Model 1. We first report on the overall analysis associated with Model 1, our base model, with all control variables.

Lagged environmental performance (β = .395, p <0.001) was found to be significant, indicating that prior environmental performance did influence future environmental performance. Firm age (β = .024, p <0.10) was found to be moderately significant, suggesting that older firms have better environmental performance. GDP was also found to be moderately significant, suggesting that home-country wealth does affect firm environmental performance. Overall, our model was effective in explaining 39% (i.e., Adjusted R^2) of the variance in environmental performance (F = 9.76, p <0.01).

Geographic spread: Model 2. The results from our analysis revealed that a significant relationship exists between spread (β = 1.50, p <0.05) and environmental performance, thus supporting Hypothesis 1. This model was effective in explaining 41% of the variance in environmental performance (F = 11.09, p <0.01). The 2% change in the variance explained, attributable to spread, was also significant (p <0.05). This finding suggests that the greater the geographic spread of the firm, the more likely the firm is to have better environmental performance. Thus, we found support for our argument that firms might be gaining a broader perspective on complex environmental issues and are therefore better able to translate that knowledge into improved environmental performance.

Geographic concentration: Model 3. While spread remained significant (β = 1.37, p <0.05), results from the OLS regression revealed that concentration was significantly related (β = .006, p <0.05) to environmental performance, supporting our Hypothesis 2. This model was effective in explaining 42% of the variance in environmental performance ($F = 10.79$, $p < 0.01$). The change of 1% in the variance explained, attributable to concentration, was also significant ($p < 0.05$). This finding suggests that it is not only the distance between headquarters and facilities that matters but also the distance between the facilities themselves. Thus we found support for our argument that firms whose facilities are closer together possess greater awareness of environmental issues (as reflected in better environmental performance), which we attribute to the concentration of activities and to greater managerial attention.

Together, these results lend support to our arguments that an MNE's geographic orientation, as reflected by its spread and concentration, contributes to better environmental performance.

Robustness Check

Three different tests were run in order to assess the robustness of the results. First, it was important to assess whether the location of headquarters (i.e., foreign or domestic) drove the results reported above. The model was run with a dummy variable for domestic headquarters, which yielded no substantive difference in the results.

Second, we assessed whether the statistical results from the regression were correlated in geographic space (Doh & Hahn, 2008). As the test for spatial autocorrelation, *Moran's I* was used to determine whether the residuals from the OLS regression were clustered, which would violate the randomness assumption. Results from the *Moran's I* analysis were not significant ($p = .77$); thus we concluded that our observations were indeed random.

Third, the specified model was also run using a geographically weighted regression (GWR). The main difference between the OLS regression and the GWR is that the latter calculates the local importance of each explanatory variable specified in the model. The GWR model was run to assess the robustness of the OLS model, and not for testing our model directly. It allowed us to assess whether our measures of spread and concentration captured the variance that was explained by the spatial distribution of assets. If the GWR yielded the same results as an OLS regression, we would know that our variables supported our theoretical arguments.

An OLS regression is best conceptualized as a stationary 'global' model in which the explanatory variables are used to find a model of best fit for all cases (i.e., firms) in the dataset. For example, an OLS regression is specified generally as:

$$y = \alpha + \beta_1 X_1 + \beta_2 X_2 + .. \beta_{\mathrm{i}} X_i + \epsilon$$

In contrast, a GWR is a non-stationary 'local' model that seeks to capture the variance explained between differences in observations that are near versus far. In order to do so, a regression equation is calculated for each case and receives a weight (w), depending on its relative position to the center of the study area. For example, a GWR model is specified as follows:

$$y(w) = \alpha(w) + \beta_1(w) X_1 + \beta_2(w) X_2 + .. \beta_{\mathrm{i}}(w) X_i + \epsilon$$

Following the GWR, OLS output is then compared to the GWR output to see whether any additional variance can be explained by allowing the effects of the explanatory variables to vary through space.

In order to assess whether a local model would account for greater variance in explaining environmental performance, we compared the Akaike Information Criterion (AICc) from our GWR to that of the OLS regression. The AICc assesses the goodness of fit and allows for the comparison of results from each method. Should the AICc value from the GWR be smaller than that of the OLS regression, and should the difference be greater than four, we could conclude that we had improved our model (Burnham & Anderson, 2002; Fotheringham, Brundson, & Charlton, 2002). However, our analysis revealed that the difference between models was less than four; thus we failed to improve our model using the GWR.

In conclusion, we find that our OLS regression analysis was effective in capturing sufficient variance associated with environmental performance. Even when allowing the explanatory variables to be weighted based on their geographic location (in the GWR), we found that there was virtually no difference from the OLS model. This finding suggests that our measures of spread and concentration were effective in extracting variance that is normally missed when analyzing a global model.

DISCUSSION AND CONCLUSIONS

In this study, we set out to answer the question, *How does a firm's geographic orientation affect its environmental performance?* Building arguments consistent with the attention-based view (Ocasio, 1997), we hypothesized that both geographic spread and geographic concentration were positively associated with a firm's environmental performance. The results of our analysis supported our hypotheses, suggesting that within-firm distance – represented by geographic orientation – is related to a firm's environmental performance and is independent of whether the firm is operating within or across international borders. This study raises important issues for consideration in future research.

The context in which MNEs operate requires explicit consideration of the effects of distance in order to better understand and explain firm behavior. The international business literature tells us that a firm's decisions are often shaped by issues such as distance-to-market (Rugman & Verbeke, 2004) and institutional considerations, such as the host country's culture (House et al., 2004). Although spatial elements have been included in empirical analyses of MNE behavior, such as its effects on entry mode (e.g., Doh et al., 2009), its centrality as a causal factor in predicting firm behavior has been underdeveloped. Recognizing this deficiency, the international business community has recently focused on the role of distance in shaping firm behavior (Dunning, 2009).

Prior work has argued that a firm that crosses an international border will have worse environmental performance compared to a firm that operates domestically (e.g., King & Shaver, 2001). Our analysis of an aggregated sample of foreign and domestic firms revealed that spread and concentration were both significantly related to environmental performance, suggesting that it is not the border that matters but, rather, the distance itself. Contrary to the pollution haven hypothesis (Birdsall & Wheeler, 1993), we find that distance from headquarters actually leads to a better environmental performance, rather than to a lesser one. Our findings are also inconsistent with the work of King and Shaver (2001), who found that, compared to their domestic counterparts, foreign firms generate more waste. Our findings are, however, more consistent with a learning and resources and capabilities hypothesis (e.g., Christmann, 2000). In fact, we find that facilities that are farther from their headquarters are more likely, rather than less likely, to manage their environmental impacts.

Prior work on clusters has focused on the strategic benefits of locating close to competitors (Saxenian, 1994), since firms benefit from knowledge spillovers (Shaver & Flyer, 2000) and base their location selection on the potential for such spillovers

(Alcacer & Chung, 2007). Building on this prior work, we also find that the positive benefit between firms extends within firms. Firms that have subsidiaries that are close together are more likely to have better environmental performance compared to those firms whose subsidiaries are far apart. It is likely that these firms are better able to identify issues, but there may also be positive benefits related to knowledge spillovers.

We have argued that a firm's environmental performance is shaped by its geographic orientation. Prior work has acknowledged the importance of distance between headquarters and their subsidiaries on firm-level outcomes, especially concerning the flow of knowledge (Cantwell, 2009). However, previous work has not yet conceptualized the distribution of firm assets in geographic space. We show here that the geographic spread of a firm's operations and the concentration of its facilities are related to its environmental performance practices. Greater spread and concentration raise the firm's awareness of issues and motivate it to better manage environmental issues. Because facilities are out of sight, better systems are needed to ensure that MNEs conscientiously manage natural the environment in order to avoid failures or disruptions. Understanding the within-firm structural configuration can provide new explanations for why some systems succeed while others fail.

In addition to developing the construct of geographic orientation, we also contribute methodologically through our application of GIS modeling. In contrast to prior research in international business, which has primarily measured distance by physical distance (e.g., great circle distance) or cultural distance (e.g., GLOBE), our methods account for spatial positioning, which is more precise than prior methods. GIS modeling allowed us to input latitude and longitude coordinates for each facility and headquarters in our dataset. We believe this greater precision, to within one kilometer, is necessary to account for the effects of geography on the firm (Ghemawat, 2001) and is essential for understanding, particularly, the location selections made by MNEs (Dunning, 2009). This precision allows not only for the degree of accurate statistical analysis that accounts for spatial variation but also for visualization of the data through maps. Maps are by no means a replacement of statistical analysis, but they offer an important complementary analysis. These maps facilitated our ability to detect the importance of spread and concentration. We expect that visualization of spatially referenced data will reveal new insights in international business, especially in terms of the importance of local context.

In addition, it is important to note that not only would such modeling be used in theory that relates to space and location, but it also has the potential to inform other types of research questions. For example, this type of modeling could inform research on the influence of host-country variables – such as culture, institutions, and demographics – on MNE decisions. In particular, this type of analysis not only accommodates spatial considerations, but it also implicitly controls for levels of analysis, such as subsidiary, MNE, and country. Hence, this work has contributed insights into the importance of geographic orientation to environmental performance, and it has also demonstrated the value of GIS analysis in supplementing other statistical methods.

This research is not without limitations. First, our dataset was limited to large, public MNEs that operated facilities in Canada, and only to those that are tracked by the NPRI dataset, reported on corporate websites, and tracked by Sustainalytics. Applying these methodologies to different datasets of geographically referenced firms and subsidiaries or facilities could provide additional empirical insights beyond those made in this paper. Second, our analysis was cross-sectional and did not consider the relationships between variables through time (beyond that of our lagged models). The addition of such relationships could provide another interesting vector for future research.

It is our belief that future work could explore the effects of geographic orientation on environmental performance under different ownership structures, as well as the ways a firm changes its geographic orientation through time, and the effect that a firm's geographic orientation has on facilities' environmental performance (e.g., air pollution). We hope this study will stimulate future research in this area. Furthermore, we hope that the methodologies described and the application of GIS will provide complementary tools to existing methodologies (e.g., mixed linear modeling) for analyzing MNEs' behavior.

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CHAPTER 4

The Materiality of Chemical Emissions and their Effect on Environmental Performance

INTRODUCTION

Organizations release chemical emissions that are known to be harmful (i.e., toxic) to human health and the environment. In response, firms, industry associations, and governments have sought to reduce chemical emissions in multiple ways. Firms have deployed better technologies for reducing their chemical emissions (e.g., Shrivastava, 1995), industry associations have developed programs such as the Responsible Care in the chemical sector (e.g., King & Lenox, 2000), and governments have developed regulations that legislate better monitoring and reporting of chemical emissions, such as the U.S. Environmental Protection Agency's Toxic Release Inventory (TRI) or Canada's National Pollutant Release Inventory (NPRI). Yet the toxicity of emissions remains hard to detect by most stakeholders (e.g., Kassinis & Vafeas, 2006). Stakeholder pressure, therefore, often comes from the degree to which a stakeholder can sense a firm's emissions and not from the actual amount of its emissions. For this reason, thick plumes of steam spewing out of a smokestack may represent a significant issue to stakeholders, even if the toxicity of the emission is quite low.

The relationship between stakeholder pressure and corporate environmental performance has been explored both theoretically and empirically (Henriques & Sadorsky, 1999; Bansal & Roth, 2000; Buysse & Verbeke, 2003; Murillo-Luna, Garces-Ayerbe, & Rivera-Torres, 2008; Sprengel & Busch, 2011). Together, this body of work suggests that improvements in environmental performance can happen as stakeholders exert pressure on the firm to enact them. Stakeholders tend to focus on those issues that are most obvious, and, as a consequence, will pressure firms into action to reduce emissions, for example. Empirical evidence suggests that stakeholder pressure can lead to a reduction in chemical emissions (Kassinis & Vafeas, 2006; Busch & Hoffmann, 2007; Kolk & Pinkse, 2008). However, prior work does not differentiate between different types of emissions. Conceivably, firms could be reducing emissions that are noticeable to stakeholders, while neglecting emissions that are less noticeable but equally – or more – toxic.

In this research, we attempt to identify the physical characteristics of chemical emissions that are more salient to firms: those that are more noticeable, or those that are more toxic. The central thesis of this work proposes that firms will tend to focus on those chemical emissions that are most noticeable to stakeholders and overlook those that are less obvious, thereby exposing the firm to significant risk from stakeholders and media (e.g., Bansal & Clelland, 2004; Henriques & Sadorsky, 1999; Sharma & Henriques, 2005; Kassinis & Vafeas, 2006). Therefore, this paper seeks to answer the question, "*What effect do the material characteristics of toxic emissions have on firms' environmental performance?*"

Although substantial research has been undertaken to explore the theoretical and empirical relationships between stakeholder pressure and corporate environmental performance, Pinske and Kolk (2010) suggest that more research is needed in order to understand the contextual factors that shape firms' responses to environmental issues. Relatedly, Etzion's (2007) systematic review of the environmental management literature revealed that "conceptual limitation stems from the fact that environmental issues have great implications for our well-being, but there is profound variety in the degree to which these issues influence (or do not influence) the framing of research (p.655)." In other words, not all issues are equal.

Acknowledging the importance of considering the differences between issues, we apply the logic of materiality (Barad, 2003; Leonardi & Barley, 2010; Orlikowski, 2007; Suchman, 2005; Whiteman & Cooper, 2011) to theorize the relationship between chemical emissions and the social processes that enable their identification and to empirically test whether differences in *environmental materiality* can predict differences in environmental performance at the firm level. Environmental materiality is defined as the physical, tangible characteristics reflected in a chemical's *diffusion* and *vividness*. Drawing on emissions data from the NPRI, which are accessible through Environment Canada, we test hypothesized relationships on a panel dataset of firms that operated Canadian facilities (across four industries) from 2003-2010. Empirical results provide evidence that, all else being equal, firms respond to emissions that are broad-reaching, particularly when those emissions are obvious to the public eye.

THEORETICAL DEVELOPMENT AND HYPOTHESES

Environmental performance, defined as the impact of a firm's processes or products on the natural environment (Azzone & Noci, 1996), has been measured by a variety of metrics, including waste reduction, material and energy use efficiency (Hart & Ahuja, 1996), and pollution prevention (King & Lenox, 2000; King & Shaver, 2001; Russo & Fouts, 1997), especially relating to chemical emissions.

The environmental management literature has, for the most part, focused on the environmental performance implications of firm- and/or industry-level factors that can translate into some sort of strategic benefit. Firm- and industry-level factors have been explored using theories such as institutional theory (e.g., Bansal & Roth, 2000), transaction cost economics (e.g., King, 2007), the resource-based view (e.g., Hart, 1995), and stakeholder theory (e.g., Darnall, Henriques & Sadorsky, 2010). In the context of stakeholders, defined as individuals or groups who significantly affect an organization's behavior (Freeman, 1984), various theoretical frameworks have been developed that discern between types of stakeholders and their ability to influence firm behavior (e.g., Buysee & Verbeke, 2003; Henriques & Sadorsky, 1999; Murillo-Luna et al., 2008). Responses to stakeholder pressure (Henriques & Sadorsky, 1999; Buysse & Verbeke, 2003) can range from proactive to reactive corporate behavior (Hart, 1995). For example, Murillo-Luna and colleagues (2008) provide a framework that leverages four proactive response strategies for addressing the environmental issues of passivity, attention to legislation, attention to stakeholders, and total environmental quality. Building on this recent work, we seek to explore how differences in corporate environmental performance might be explained by the ability of stakeholders to notice different physical characteristics of chemical emissions and, in turn, exert pressure on the firm to address those emissions.

Some suggest that management scholars tend to neglect insights from fields beyond their own (Folke *et al*., 2002; Goodall, 2008; Shrivastava, 1994). It is perhaps in response to this criticism that there has been a thrust in recent years towards a more systematic approach to understanding the relationship between environmental issues and organizational response (e.g., Marcus, Kurucz, & Colbert, 2010; Slawinski & Bansal, 2009; Wang & Bansal, 2012; Whiteman & Cooper 2000, 2011). Much of this recent work has been inspired by insights from the fields of geography and ecology.

Scholars working in this area have sought to broaden the theoretical perspectives by which mainstream management represents the organization-environment interface. We have drawn on these recent advances – specifically on research that considers the materiality of objects and its effects on the interpretation of issues (e.g. Whiteman & Cooper, 2011) – in order to ground the theoretical model.

Materiality and Chemical Emissions

The literature on materiality explores how the material aspects of an object affect and reinforce an understanding of the organizational context (Barad, 2003; Leonardi & Barley, 2010; Orlikowski, 2007; Suchman, 2005; Whiteman & Cooper, 2011). This body of work has emerged to analyze the role that objects and space play in shaping social processes, such as organizing (Barad, 2003). More specifically, this work has argued that the collective understanding in organizations is shaped through the internal interactions between social behaviors and material objects, such as the way work changes for employees as a result of new technologies (Orlikowski, 2007). This conceptualization of materiality has provided some fruitful insights into the mechanisms that shape internal organizational social processes.

More applicable to the current research context, however, is the work by Whiteman and Cooper (2011), which moves beyond the walls of the organization to consider the materiality of the natural environment and its role in shaping firm behavior. In their ethnographic study, these authors developed the concept of *ecological materiality*, defined as "the interaction of dynamic biological and biophysical processes and organic and inorganic matter over space and time" (Whiteman & Cooper, 2011, p. 892). They argued that an inability to make sense of cues relating to the ecological materiality of the local environment increases vulnerability. Through a comparison between an expert (i.e., a resource manager, who is highly dependent on the contextual knowledge embedded within the local environment) and a lay person (i.e., the researcher, who has only a surface-level understanding of the local environment), these authors found that a depth of knowledge concerning the ecology in which the actors are embedded, combined with an ability to sense subtle cues in the environment, served to dramatically improve the actors' ability to not only make sense of those cues but also to respond effectively to prevent a crisis (Whiteman & Cooper, 2011). They concluded that the ability of managers to make sense of the emerging issues in the natural environment decreases risk.

For the most part, the environmental management literature has focused exclusively on one material dimension of chemical emissions: toxicity. *Toxicity* is defined as the degree of impact a chemical has on the environment, specifically in regards to the impact on plants, animals, and ecosystems (Bare *et al*., 2003). Chemicals are rank-ordered based on their impact on the environment or human health in accordance with their acute or persistent effects, reactivity, and solubility (Bare *et al.*, 2003; Toffel & Marshall, 2004).

The ability to perceive toxic emissions has not been explored to date, but it could explain differences in corporate environmental performance. If a chemical that has been released to the environment is easy to see (e.g., fluorescent green liquid) or smell (e.g., sulfur), then the emission will be noticeable and thus more likely to attract the attention of the firm, either directly (by managers sensing the issue firsthand) or indirectly (through the media and other stakeholders) (Henriques & Sadorsky, 1999; Kassinis & Vafeas, 2006). That is, when a firm releases a chemical into the environment, there is a certain materiality associated with the chemical itself that interacts with the social environment and affects whether or not the chemical emission is noticed and attended to. For example, a stakeholder might see two smokestacks, one emitting thick steam and the other emitting what appears to be nothing. The first smokestack could be emitting water vapor, which is not toxic. The second smokestack could be emitting a concentration of volatile organic compounds (VOCs), which will have far-reaching impacts on the environment and human health. Stakeholders might not detect the emissions coming from the second smokestack, whereas emissions from the first smokestack can be easily detected. Thus, firms will give high priority to the first emission, simply because it is noticeable. In response to stakeholder pressure, firms could be directing their attention toward emissions that are more noticeable while overlooking emissions that are less noticeable but potentially more toxic.

In developing the hypotheses below, we argue that the dimensions of *environmental materiality* (specifically, diffusion, and vividness) influence stakeholders' ability to perceive toxic emissions, and, when these emissions are noticed, stakeholders will pressure firms to reduce their emissions.

Diffusion of Toxic Emissions

Diffusion is defined as how far (spatially) a chemical emission will spread, relative to where it is released. An emission of high diffusion is one that is dispersed broadly (e.g., globally), whereas an emission of low diffusion is much more spatially restricted (e.g., locally). Compared to a chemical release to water or land, a chemical emission released to air reaches a higher state of diffusion,[2] since air emissions are more easily dispersed through the atmosphere and thus can spread over a larger area more quickly; emissions to water or land take much longer to disperse. As time passes, any pollutant will diffuse to the surrounding environment in an effort to reach equilibrium, and the area surrounding a facility would be considered an area of high concentration for that chemical, relative to the surrounding environment. The pollutant will disperse through the given sink (i.e., air, water, or land) to find equilibrium and can do so most easily through the air. This is one main reason why firms elect to build taller smokestacks to deal with chemical emissions. A pollutant emitted higher into the atmosphere will disperse easily and travel far from the original release point. The problem arises from the fact that, due to the expansiveness of the dispersion, a much larger area is affected.

The greater the area affected by toxic emissions, the greater the number of stakeholders that are likely to perceive those impacts. As toxic emissions disperse through the environment, their impacts can be far-reaching. In the case of chemical releases to air, the impacts of those emissions tend to be global. For example, chlorofluorocarbons (CFCs), a once prolific refrigerant and cleaner in the electronics industry, have imposed significant impacts on the ozone layer, which protects the Earth from harmful ultra-violet rays. A thinning of the ozone layer was at one time considered the most important global chemical emission issue and, as a result, inspired the Montreal Protocol (Haas, 1992), an international treaty designed to protect the ozone

[2] Air refers to the atmosphere; water refers to bodies of water such as streams, rivers, lakes or oceans, as well as groundwater; and land refers to the pollution of land. All else being equal, a pollutant emitted to the air will diffuse much farther than the same pollutant emitted to water, and a pollutant emitted to water will diffuse much farther than the same pollutant emitted to land.

layer from further depletion by toxic substances. In this example, greater awareness on the part of many stakeholders had the effect of pressuring policy-makers and business leaders to reduce the impacts of their operations through the use of alternatives (Lenox & King, 2004). In contrast, toxic emissions to water or land tend to be local and attract the attention of fewer stakeholders, whose concerns – such as pollution of the Athabasca River (e.g., Schindler, 2010) – fail to become issues of high priority to firms (Buysse & Verbeke, 2003; Mitchell, Agle, & Wood, 1997). Therefore, toxic emissions of high diffusion are more likely to affect a larger physical area and, in turn, are more likely to attract the attention of a greater number of stakeholders.

The greater the number of stakeholders who pressure firms to respond to toxic emissions, the more likely firms are to perceive those pressures and respond through reduced emissions. Empirical evidence proves that stakeholders' pressure is positively related to environmental behavior (Murillo-Luna et al., 2008). For example, addressing stakeholder concerns has been shown to help manufacturing firms to reduce their use of products and processes that impose a significant environmental impact (e.g., Buysse & Verbeke, 2003; Henriques & Sadorsky, 1999). This kind of firm-level response stems from the fact that a firm is more likely to act on an issue when the media and other stakeholders expose that issue to the public eye (Henriques & Sadorsky, 1999; Sharma & Henriques, 2005; Kassinis & Vafeas, 2006). These situations are further exacerbated when firms are highly visible since, due to their size and reputation, they often face greater scrutiny from stakeholders (Bansal & Roth, 2000; Brammer & Millington, 2008). Therefore, the greater the stakeholder pressure on firms to reduce their toxic emissions, the more likely firms are to respond.

Toxic emissions released by a firm's facilities to air (as compared to water or land) are more likely to affect a larger area and in turn attract the attention of more stakeholders. A greater number of stakeholders will in turn be able to exert more pressure on the firm to reduce its emissions. Stated formally,

Hypothesis 1: There is a negative relationship between diffusion and change in toxic emissions.

Vividness of Toxic Emissions

Vividness is the ease with which a chemical emission can be sensed (i.e., through sight, smell, and touch). Chemical emissions with high vividness are more easily identified (e.g., have an odor), whereas emissions of low vividness are less obvious (e.g., odorless) and thus are more difficult to identify. For example, a community member would be more likely to notice an issue if she expected to see a colorless, odorless liquid coming out of a discharge pipe from a manufacturing facility in her community, but instead she saw a colored liquid with a pungent odor. The stakeholder would be able to see there was something wrong not only because the effluent differed from what was expected (Fiske & Taylor, 1991; Sutcliffe & Huber, 1998) but also because it was more easily sensed. Although such changes in color or smell signal a change in the chemical composition of the effluent, they do not always accompany a change in chemical composition. Thus, a change in chemical composition without a change in color or odor would be less likely to be noticed and perhaps detectable only through an in-depth chemical analysis. This evidence suggests that the vividness of an issue will have a direct effect on what stakeholders notice.

The more vivid a toxic emission, the easier it is for stakeholders to identify the emissions. Focusing on certain issues over others depends on how easy it is to identify the associated cues. Evidence suggests that cues from the environment are not attended to until firms are able to notice them (Dutton, Fahey & Narayana, 1983), thus increasing the attention given to the associated issue (Nadkarni & Barr, 2008). When an issue is vivid, there is little doubt that something out of the ordinary is occurring (Fiske & Taylor, 1991; Sutcliffe & Huber, 1998) since it is this variability in the natural environment that enables stakeholders to actually detect the issue. When highly vivid toxic emissions are released, stakeholders are more likely to notice them and will raise the alarm that something is wrong.

The more vivid the toxic emissions, the more likely a firm is to respond to them through increased stakeholder pressure. Once stakeholders have perceived the emissions, they will exert pressure on the firm to respond in order to mitigate the issue (e.g., Henriques & Sadorsky, 1999; Bansal & Roth, 2000; Buysse & Verbeke, 2003). Firms are motivated to respond to media or other stakeholder pressure (Henriques & Sadorsky, 1999; Sharma & Henriques, 2005; Kassinis & Vafeas, 2006) largely because addressing such concerns has been found to positively influence financial performance (Hillman & Keim, 2001). Therefore, when toxic emissions are highly vivid, stakeholders are more likely to perceive the emissions and in turn exert greater pressure on the firm to reduce them. In contrast, toxic emissions that are less vivid will be harder for stakeholders to notice, resulting in less pressure on the firm to reduce its emissions. Stated formally,

Hypothesis 2: Vividness moderates the negative relationship between diffusion and change in toxic emissions such that the relationship is stronger for emissions that are more vivid.

METHODS

Data

In order to explore the link between *diffusion and change in toxic emissions* (Hypothesis 1) and *the moderation of vividness on the relationship between diffusion and change in toxic emissions* (Hypothesis 2), we have drawn on data in the Canadian context to test the hypothesized relationships. Most research that has explored the link between drivers of firm (and facility) behavior and their chemical emissions has done so by drawing on emissions data from the United States (e.g., Kassinis & Vafeas, 2006; King & Shaver, 2001; King & Lenox, 2002; Lenox & King, 2004). More recently, researchers have begun to explore similar relationships by drawing data from other jurisdictional contexts (e.g., Aguilera-Caracuel *et al*., 2012, Cormier & Ledoux, 2011).

Following this trend, a panel dataset was built drawing on chemical emissions data from the National Pollutant Release Inventory (NPRI) database, which was made available through Environment Canada and which provided a publicly available dataset of pollutant releases (recorded separately for air, water, and land), disposals, and transfers for recycling. This Canadian database was modeled on the U.S. Environmental Protection Agency's Toxic Release Inventory ([TRI]; VanNijnatten, 1999) and, as a result, used similar reporting protocols. The Government of Canada legislated that all facilities operating in excess of 20,000 person-hours per year must complete annual reports to the NPRI if they use or handle quantities of chemicals in excess of thresholds established by Environment Canada (NPRI, 2011).

Facilities' emissions were matched across years in order to build our dependent variable, *change in toxic emissions*. The NPRI data provided a parent-company identifier file that allowed for the merging of facility-level toxic emissions data with firm-level financial performance and other demographic data to be used as control variables.

The time frame for this study was 2003-2010. We chose 2003 as the start year because of major changes to the reporting criteria in 2003. Sixty-two new chemicals were added to the listed chemicals, which increased the number of facilities from 4,708 in 2002 to 8,397 in 2003, most of which were facilities in the oil and gas sector (an increase from 133 facilities in 2002, to 3,085 in 2003). We chose 2010 as the end year because it was the last one available at the time of this data analysis.

Sample

All public firms that released at least one of the listed chemicals beyond the reporting threshold in two consecutive years during the study period (i.e., 2003 to 2010) were included in the initial sample. Over the seven-year study period, an unbalanced panel of 160 firms with 792 firm-year observations was used in the analysis.

The average firm size at the end of 2010 was US$37 billion in assets. The largest firm was General Electric, which held US$748 billion in assets; the smallest firm, Bellatrix Exploration, held US$99 million in assets. The industries represented in the sample included oil and gas extraction (NAICS 3-digit: 211; 52%), chemical manufacturing (NAICS 3-digit: 325; 35%), wood products manufacturing (NAICS 3-digit: 321; 10%), and petroleum and coal product manufacturing (NAICS 3-digit: 324; 3%).

Dependent Variable

Change in toxic emissions. This continuous variable measured the change in emissions by firm, year over year, from 2003-2010. In order to construct this variable, each firm's facilities' emissions (for each chemical for which data were available) were aggregated to the firm level. Aggregation from facility to firm was made possible through the use of a combination of identifiers –specifically, Dun & Bradstreet's firm data and the firm name, which were recorded in the NPRI. Once the emissions data for each chemical emitted by each facility had been aggregated to the firm, the variable was calculated as follows (for firm *i* at time *t*):

$$\Delta Toxic\ Emissions_{it} = \left(\frac{(total\ toxic\ emissions)_{it} - (total\ toxic\ emissions)_{it-1}}{(total\ toxic\ emissions)_{it-1}}\right)$$

Prior research has argued that comparing chemicals based solely on the volume of chemical released is insufficient for assessing the magnitude of impact on human health and environmental systems (Toffel & Marshall, 2004) and that weighting chemicals based on their toxicity allows for a more accurate representation of the importance of the chemical (e.g., Delmas & Toffel, 2008; King & Lenox, 2000; King & Shaver, 2001). However, because the current study explicitly analyzes the materiality of chemical emissions and *not* the impact on human health or the environment, the raw emissions (i.e., not adjusted for toxicity) were aggregated from the facility- to firm-level of analysis.

Independent Variables

Diffusion. The NPRI data tracks emissions that are made to air, water, and land. This construct was operationalized as the proportion of emissions to air (i.e., those emissions that were more global to the firm and thus of higher diffusion) relative to total emissions by the firm. The natural log of this variable was taken since its distribution was found to be negatively skewed. This continuous variable was calculated as follows (for firm *i* at time *t)*:

$$Diffusion_{it} = \ln\left(\frac{(emissions\ to\ air)_{it}}{(total\ emissions)_{it}}\right)$$

Vividness. Data on chemical odor and color were available through the International Labour Organization (ILO), which provides safety information through its International Chemical Safety Cards (ICSC); an example is shown in Appendix A. Data pertaining to the odor and color for each chemical was accessed through the corresponding ICSC.[3] The proportion of emissions with either a color or an odor relative to a firm's total chemical emissions was calculated as follows (for firm *i* at time *t)*:

$$Vividness_{it} = \frac{(total\ emissions\ of\ chemicals\ with\ an\ odor\ or\ color)_{it}}{(total\ emissions)_{it}}$$

Control Variables

Firm size has been shown to affect the adoption of social and environmental initiatives (McWilliams & Siegel, 2001). Larger firms are also more likely to attract

[3] It is important to note that not all chemicals tracked by the NPRI (approximately 360 chemicals) have a corresponding ICSC. Only those chemicals for which an ICSC was available were included in the analysis, thus resulting in a total sample of 143 chemicals. A complete list is provided in the Appendix B.

attention from media and stakeholders (e.g., Bansal & Roth, 2000). This variable was operationalized as the total number of full-time employees (Darnall, Henriques, & Sadorsky, 2010), which was retrieved through Bloomberg.

The relative importance of each firm's Canadian facilities (i.e., those included in this study) relative to its overall operations could explain differences in the salience of stakeholder issues (Mitchell, Agle, & Wood, 1997; Buysse & Verbeke, 2003). If the proportion of facilities for a given firm is small, then stakeholder pressure could be missed at the firm level. Therefore, *proportional size* of the facility relative to its total operations was included in the analysis and was operationalized as proportion of the firm's Canadian employees (available through NPRI, by facility) divided by the total number of employees worldwide (available through Bloomberg).

The *number of facilities* has also been shown to increase complexity in managing environmental issues (King & Shaver, 2001) and was therefore included as a control variable. The number of facilities was available in the NPRI dataset.

Controlling for differences in *slack resources* (i.e., current ratio) is important because slack has been found to have an impact on the likelihood that a firm will respond to environmental issues (Bansal, 2005). This variable was calculated using data available through Bloomberg.

In order to account for the variance explained by firms responding to chemical emissions that are most toxic and not those that are most noticeable, it was also necessary to control for the *toxicity* of emissions. There are a variety of different methods for assessing chemical toxicity, each with its own strengths and deficiencies. (For a comprehensive review, see Toffel & Marshall, 2004.) Following the findings of Toffel & Marshall (2004), the U.S. Environmental Protection Agency's (EPA) *Tool for* *the Reduction and Assessment of Chemical and other environmental Impacts* (TRACI) was used to control for the toxicity of each firm's emissions.

Analysis

The maximum likelihood estimation of generalized estimating equations (GEE) was used to test the hypothesized relationships. GEE is a form of generalized linear models whose estimates remain consistent with those of ordinary least squares when the assumption of no correlation in responses and the assumption of normality are not violated (Ballinger, 2004; Zeger & Liang, 1986). Following recent work in strategy research (e.g., Ndofor, Sirmon, & He, 2011), GEE offered two main advantages for use in this study. First, GEE is robust and consistent when variables included in the model are not normally distributed (Ballinger, 2004). In this study, in the case of the dependent variable, with large decreases in the toxic emissions from one year to the next, the value will approach -1 but will never reach it, whereas large increases in the emissions are infinite. This condition is known as a *limited range dependent variable* (Harrison, 2002) in that the distribution of the dependent variable is not normal. A common remedy is to undertake a power transformation, such as taking the natural logarithm of the variable, yet this approach is considered suboptimal compared to selecting a model that suits the data structure (Ballinger, 2004).

Second, by estimating parameters and standard errors that are derived from the within-firm residuals (Ballinger, 2004), GEE takes into account within-firm correlations, thereby correcting for correlations between unobserved fixed- and random-effects (Hardin & Hilbe, 2003), and is thus more robust and consistent (Zeger & Liang, 1986). Although we account for changes in profitability, slack resources, and firm size across years that could affect a firm's change in toxic emissions, it is conceivable that other firm-specific factors remained constant across years and were not included in the model, thus violating the assumption of independence. For these reasons, the testing of the hypothesized relationships was undertaken using GEE.

Dummy variables were also included in the model. Differences in chemical emissions have been shown to be industry-dependent (King & Shaver, 2001), and for this reason, industry dummy variables were also included in the model. Time dummy variables were included in the model as well, as per Certo and Semadeni's (2006) recommendation. The full model takes the following form:

$$\Delta Toxic\ Emissions_{it} = \alpha_0 + \alpha_1 * \text{Firm Size}_{it} + \alpha_2 * \text{Proportional Size}_{it} + \alpha_3 * \text{Current Ratio}_{it} + \alpha_4 * \text{Number of Facilities}_{it} + \alpha_5 * \text{Toxicity}_{it} + \alpha_6 * \text{Diffusion}_{it} + \alpha_7 * \text{Interaction}_{it} + \alpha_T * \text{Year\#} + \alpha_I * \text{Industry\#} + \upsilon_{it},$$

where υ_{it} is the error term.

RESULTS

Table 4 reports the descriptive statistics, while Table 5 reports the correlations for all variables used in the study. There appeared to be no problem with multicollinearity since the variance inflation factor (VIF) values were all below 1.94. Table 6 presents the results of the regression analysis in which *xtgee* in STATA/SE11.2 was used to test our model. The *xtset* group variable was *individual firms* (n = 160). Model 1 in Table 6 includes only the control variables; Model 2 adds *diffusion*; Model 3 adds the interaction term to test the moderator *vividness*.

TABLE 4

Mean, Standard Deviation, Minimum, Maximum, and Variance Inflation Factor

Variable	Mean	Std. Deviation	Minimum	Maximum	VIF
Δ Toxic Emissions	1.00	6.12	-.99	92.22	-
Firm Size	16,922.16	36,456.79	13	327,000	1.20
Proportional Size	0.14	0.20	0.00	1	1.24
Slack	1.55	2.02	-9.49	33.80	1.04
# of Facilities	15.84	33.03	1	256	1.17
Toxicity	95,539.77	497,696.60	0	4,812,199	1.21
Diffusion	-0.01	0.13	-3.20	0	1.94
Vividness	0.41	0.37	0	1	1.14

N = 792

TABLE 5

Correlations *(two-tailed test)*

	Δ Toxic Emissions	Firm Size	Proportional Size	Slack	# of Facilities	Toxicity	Diffusion	Vividness
Δ Toxic Emissions	1							
Firm Size	.039	1						
Proportional Size	-.038	-.270**	1					
Slack	-.005	-.044	.003	1				
# of Facilities	-.041	-.064	.059	-.118**	1			
Toxicity	-.030	.063	.213**	-.040	.082*	1		
Diffusion	-.156**	.015	-.015	.006	.020	-.143**	1	
Vividness	.059	.116**	-.058	-.038	-.094**	-.127**	-.016	1

**p < .05; **p < .01; N* = 792

TABLE 6

Results of GEE Regression Analysis

Variable	Model 1	Model 2	Model 3
Constant	1.03 (.464)**	.828 (.484)*	.598 (.467)
Firm Size^{t}	.291 (.705)	.448 (.702)	.542 (.694)
Proportional Size	-.214 (.626)	-.246 (.600)	-.334 (.655)
Slack Resources	-.005 (.047)	-.006 (.046)	.001 (.047)
Number of Facilities	-.005 (.022) *	-.004 (.002) *	-.004 (.003)
Toxicity^{t}	-.024 (.009)***	-.055 (.021)***	-.120 (.056)**
Vividness	-	-	1.08 (.614)*
H1: Diffusion	-	-7.05 (.814)***	-15.86 (6.71)**
H2: Diffusion*Vividness	-	-	-1.47 (.700)**
Wald Chi-square	21.20*	274.04***	1338.93***
Observations	792	792	792

Note: *** = p < 0.01; ** = p < 0.05; * = p < 0.10 (two-tailed tests).
Transformation: ^{t} = coefficient divided by 100,000

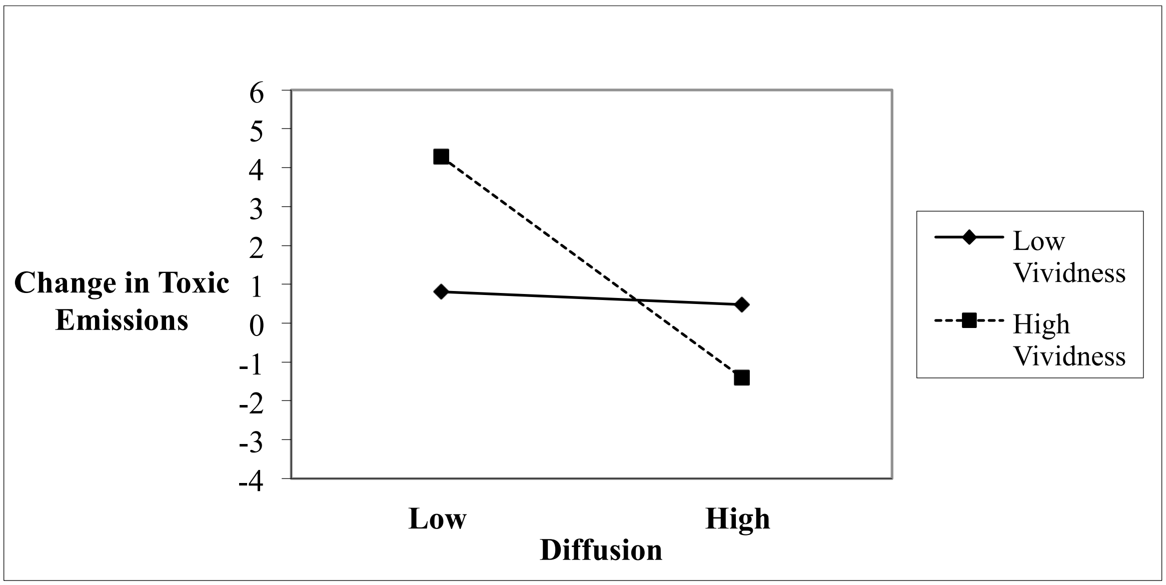
Dependent variable is *Δ Toxic Emissions*. Unstandardized coefficients are reported with robust standard errors, which were used to calculate significance levels. Time and industry dummy variables were included in the models but are not reported in the table.

Model 2: Hypothesis 1 predicted that firms are more likely to reduce their emission of chemicals of high diffusion. Table 6 shows a negative and significant relationship (β = -7.05, p<.001) between diffusion and change in toxic emissions, which supports Hypothesis 1.

Model 3: The interaction term was added to test the moderation effect of vividness on the relationship between diffusion and change in toxic emissions (Hypothesis #2). While diffusion remained negative and significant (β = -15.86, p<.05), the interaction term was both negative and significant (β = -1.47, p<.05), which supports our hypothesis. In order to interpret the moderation effect, the relationship between diffusion and change in toxic emissions was plotted (Aiken & West, 1991). All variables were standardized so that the scale on the dependent variable was interpretable. Figure 6 reveals that the effect of diffusion on change in toxic emission is dependent on the vividness of the emissions, with higher levels of vividness making the relationship more negative, supporting our prediction.

FIGURE 6

Illustration of Interaction Effect



Theoretically, we argued that chemical emissions of high diffusion are more likely to attract the focus of stakeholders and result in a greater change in toxic emissions, especially when those emissions are highly vivid. This is because, with greater diffusion of toxic emissions, the more stakeholders will become aware of the issue and will, in turn, exert greater collective pressure on the firm to reduce its emissions. This relationship is exacerbated when the toxic emissions are more easily sensed.

DISCUSSION

Following Gavetti and colleagues' (2007) call for a better understanding of how cognitive, environmental, and intraorganizational forces shape firm behavior, this study set out to answer the question, "*What effect do the material characteristics of toxic emissions have on firms' environmental performance?*" Grounded within the environmental management literature, we argued that the materiality of chemical emissions (specifically, diffusion and vividness) could explain changes in corporate toxic emissions through time. In the context of toxic emissions and corporate environmental performance, the findings from this study reinforce the concept that geography matters. More specifically, this study provides empirical evidence that the spatial characteristics of toxic emissions matter, particularly when emissions are easier to notice. As both hypotheses were supported, this paper makes important contributions to multiple literatures.

This research joins a stream of literature that seeks to understand factors that can explain differences in corporate environmental performance (e.g., King & Lenox, 2002; King & Shaver, 2001; Kassinis & Vafeas, 2006). The current study provides evidence that the environmental materiality of toxic emissions affects firm behavior through time, such that firms are more likely to reduce toxic emissions that affect a greater area (i.e., high dispersion), especially when those emissions are easier to sense (i.e., high vividness). These findings are consistent with prior work by Kassinis and Vafeas (2006) but with added nuance. Their multi-level analysis of toxic emissions in the U.S. revealed that facilities were more likely to have lower toxic emissions when population density was higher within the county in which the facility was located. They argued that greater population density increases the pressure that stakeholders can exert on the facility to improve its environmental performance. But stakeholders could be pressuring firms to respond to specific toxic emissions that also happen to be more easily sensed. Therefore, including the material characteristics of toxic emissions in their model could reveal relationships that were previously overlooked but that could also be affecting the public's ability to perceive changes in toxic emissions.

This paper also makes a contribution to the broader literature on materiality (Barad, 2003; Leonardi & Barley, 2010; Orlikowski, 2007; Suchman, 2005) by developing the theoretical construct of environmental materiality. It was argued that changes in firms' toxic emissions were dependent on the material characteristics of the emissions themselves. This current work complements recent work on ecological materiality (Whiteman & Cooper, 2011) and highlights the importance of understanding the physical, tangible characteristics of toxic emissions that are at interface with the natural environment. Further, it highlights the role stakeholders' play in facilitating the enactment of issues to which a firm will respond. Considering the material characteristics of toxic emissions – as well as other issues that manifest at the boundary between the built and natural worlds – could reveal new relationships that have been overlooked to date but that could explain differences in organizational behavior through time.

This project contributes more broadly to managers in exposing a new vector through which to understand stakeholder behavior. In acknowledging that the material characteristics of issues has the effect of making some issues more obvious than others, firms could be focusing on issues that are most obvious to stakeholders as opposed to those that matter most. Increased awareness of what drives stakeholders to care about one issue over another will enable firms to further refine and prioritize the allocation of scarce resources for improving their overall environmental performance by considering issues beyond those about which they are being pressured to respond.

No research is without limitations. An assumption made in this study was that decisions as to the processes (e.g., manufacturing or refining processes) that create chemical emissions are selected at the firm level and subsequently standardized across a firm's facilities. Yet, there could be greater variability between facilities as to the processes they use and the resulting toxic emissions they generate; variability that is lost when facilities' emissions data is aggregate to the firm. This could explain why recent work in the field of environmental performance has tended to focus on facility-level factors (e.g., Kassinis & Vafeas, 2006; King & Shaver, 2001). However, there is a precedent that aggregating emissions from the facility to the firm level of analysis could be done (e.g., King & Lenox, 2002). This precedent is further justified theoretically and empirically since evidence suggests various firm-level factors, such as firm size (Darnall et al., 2010), number of facilities (King & Shaver, 2001) and slack resources (Bansal, 2005), affect a firm's environmental performance. Yet, the major downside of aggregating chemical emissions data from facilities to the firm comes in the form of a significant loss in variance. For example, the 792 observations in the study panel correspond to more than 12,000 facility-level observations over the eight-year study period. Therefore, future research could explore facilities-level chemical emissions data as opposed to aggregating to the firm level to assess whether the effects of environmental materiality differ at the facilities level.

In this study, we argued that changes in toxic emissions are affected by stakeholders' perceptions of issues and by the pressure stakeholders exert on the offending firm to respond to those issues. Although this hypothesis was grounded within established arguments in the literature, the mechanisms (e.g., stakeholder perception and pressure) were inferred. Future work could attempt to measure levels of stakeholder perception of issues. Exploring a specific case, such as the controversy surrounding the Athabasca oil sands or "fracking" for natural gas in western North America, could serve to directly assess the validity of the inferences made in this study.

Another potential avenue for future empirical investigation involves assessing how different organizational structures might affect toxic emissions (e.g., Delmas & Toffel, 2008) more specifically, ownership. Toxic emissions data provided through NPRI track both public and private firms. Although this information was available, due to the need to add control variables (as specified above), private firms were excluded from the current analysis. However, by relaxing the need for the inclusion of certain control variables and undertaking an analysis of the complete sample of firms (both public and private), future research could potentially reveal connections between the independent and dependent variables that were otherwise obscured.

Finally, this panel included firms from four industries. Intuitively and empirically (e.g., King & Shaver, 2001), industry greatly affects the chemical emissions of a facility. Including a broader sample of industries might reveal that environmental materiality has a greater affect in predicting changes in toxic emissions in some industries, perhaps industries that receive greater attention from stakeholders, in comparison to others. Therefore, further investigation could expose important predictors of environmental performance that have yet to be revealed.

CONCLUSION

The purpose of this study was to test whether the material characteristics of toxic emissions exert an effect on corporate environmental performance through time. The results from the panel data analysis revealed that toxic emissions that are highly diffused are more likely to garner a response over time, especially when those emissions are highly vivid. Once stakeholders perceive toxic emissions, they in turn exert pressure on firms to reduce those emissions. The contribution of this study lies in showing that, all else being equal, corporate environmental performance is affected by how easily such emissions can be sensed. It is our hope this study will inspire others to explore the factors that shape organizational responses to issues that affect the natural environment.

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CHAPTER 5

GENERAL CONCLUSIONS

This dissertation aimed to offer an in-depth exploration of the role that geographic space plays in shaping the way organizations perceive and respond to environmental concerns. The overarching research question for this work was, *What effect does geographic space have in influencing a firm's attention and response to environmental issues?* To answer this question, three complementary essays were developed, each one making a unique contribution to a greater understanding of the important role that geographic space plays in shaping organizational behavior.

Essay 1 (Chapter 2) of this dissertation focused on developing the scale construct to explore the effect of spatial scale on organizational attention to environmental issues. A review of the management literature determined that management scholars have oversimplified the scale construct, which is often used synonymously with size. Absent from the existing literature is an in-depth conceptualization of scale and its dimensions. In response to this gap, this dissertation first explored the characteristics of environmental issues (i.e., grain and extent) and then argued that fit between the scale of the issue and the scale of the firm represents an important factor in enhancing firms' ability to accurately perceive cues from the natural environment in determining the presence and magnitude of an environmental issue. It was then argued that fit is enabled (impeded) through the geographic orientation of the firm and will enhance (constrain) a firm's ability to recognize cues that relate to environmental problems. Therefore, by considering the spatial scale of environmental issues relative to the firm and by developing an ability to perceive such issues before they evolve into crisis situations, organizations not only reduce the risk associated with the uncertainty of a changing environment, but they also reduce the potential impact of their operations on global ecosystems.

Essay 2 (Chapter 3) built theory to explain that differences in environmental performance are driven by the spread and concentration of firm assets through geographic space. Grounding this work in the context of international business, prior research has provided evidence to show that distance can both help and hinder firm performance (Burt, 1992; Hymer, 1976; Zaheer, 1995). It was argued that as the spread of the organization through geographic space increases, headquarters become more keenly aware of the challenges associated with managing across great distances and, in response, will develop systems to improve their management of distant facilities, which translates into better environmental performance for the firm. It was then argued that as the concentration of facilities increases, the number of managers in a given area that are able to focus on a particular issue also increases, which translates into a richer understanding of the problem. Next, tests were conducted to assess whether the geographic orientation of the firm affects its environmental performance. Spatial modeling and statistical analysis produced results that supported our predictions that a firm's environmental performance is affected by its spread and concentration, such that greater spread or greater concentration serve to increase a firm's environmental performance.

Essay 3 (Chapter 4) tested whether the material characteristics of toxic emissions have an effect on corporate environmental performance through time. The central argument stated that firms tend to focus on those chemical emissions that are most noticeable to stakeholders but overlook those that are less obvious. Essay 3 theorized that the greater the diffusion of toxic emissions through geographic space, the greater the number of stakeholders who would be able to perceive those emissions and who in turn could exert greater pressure to reduce emissions through time. Further, this work theorized that the vividness of emissions moderated that relationship, resulting in a greater reduction in toxic emissions through time. The results from the analysis supported the predictions that the greater the diffusion of toxic emissions, the more likely they will be to decline through time, especially when those emissions are easily sensed.

Contribution

This dissertation has theoretical, practical, and methodological contributions, which, when taken together, shed some light on possible ways to identify and potentially mitigate environmental harm.

Theoretically. From a theoretical perspective, and in line with recent research in the field of business sustainability (e.g., Slawinski, 2010), this dissertation contributes both theoretical arguments and empirical evidence concerning the importance of geographic space in shaping organizational perception of and response to environmental issues. First, the scale construct provides new insights to explain why firms are effective in perceiving cues and attending to certain environmental issues but not others. It also highlights the importance of fit in enabling cue identification, thereby fostering attention to related concerns. These theoretical arguments can provide a foundation upon which to more deeply explore the processes that enhance or constrain a firm's ability to identify and respond to emergent issues.

Second, this research shows that a firm's geographic orientation affects its environmental performance, which provides new evidence that within-firm spatial configurations should be explicitly considered when trying to explain firm behavior.

Although geographic space has been included in theoretical and empirical analyses to explain MNE behavior (e.g., Bartlett & Ghoshal, 1989; Rugman & Verbeke, 2004), prior work has not conceptualized the distribution of firm assets in geographic space as a key predictor of firm behavior. Explicit consideration of spatial effects could reveal relationships that, to date, have been taken for granted or overlooked completely.

Third, the materiality of toxic emissions was found to affect firm behavior through time, with evidence that firms are more likely to reduce toxic emissions that affect a broader area, particularly when those emissions are easily sensed. These findings suggest that when theorizing and testing factors that affect environmental performance, it is important to tease apart the nuances of context at the interface between the firm and the natural environment in order to gain a richer understanding of the drivers of firm behavior.

Practically. From a practical perspective, across each study, the evidence suggests that regardless of whether organizations are trying to reduce their impact on the natural environment in order to mitigate environmental issues or as a way to reduce the potential for stakeholder actions, the need to consider geographic space remains important. The findings from this research suggest that the geographic orientation of the firm affects its ability to attend to issues and perceive cues in the natural environment, which is reflected in the firm's environmental performance. These insights could encourage firms to explore the means by which to overcome any blind spots that result from spatial misfits between the organization and the issue.

This research also found that the spatial characteristics of toxic emissions *do* matter, particularly when those emissions are easy to sense. It was argued that firms might be focusing on the issues that are most obvious to stakeholders at the expense of focusing on the issues that matter most. Understanding the factors that drive stakeholder behavior can help firms to allocate scarce resources to ensure they are not inadvertently overlooking issues that could pose significant risk to the firm in the future.

Methodologically. From a methodological perspective, the use of GIS was shown to be effective in modeling spatial relationships explicitly as opposed to merely controlling for the variance associated with geographic space in statistical models. To date, advanced spatial analysis has received little attention in the mainstream management literature, yet this tool could reveal new causal relationships, which, under current methods, remain undiscovered. In addition to the precision associated with the use of latitude and longitude data, GIS software offers the added bonus of being able to create visualizations (i.e., maps) of the spatial relationships being modeled. The creation of maps can complement existing statistical reporting of results, thereby presenting a more holistic story of the spatial relationships that manifest in the data. It is our hope that others will see the value of this method and pursue its application in management research.

Limitations

The contributions made in this dissertation must be viewed in light of the limitations associated with its research. First, the location and toxic emissions data for facilities were drawn from the National Pollutant Release Inventory (NPRI) dataset, which publishes data on facilities that exceed the reporting threshold. For this reason, some firms and facilities were likely missed altogether from our analysis. Second, the data used in both empirical studies were limited to large, public multinationals; therefore, the generalizability of the findings to other types of firms (e.g., smaller, domestic firms) remains questionable. Third, because NPRI reports facilities-level data from a Canadian context only, the results may not be generalizable to firms operating facilities in different countries. Finally, this research aggregated facilities-level data to the firm in order to control for firm-level factors (e.g., slack resources), which have been shown to affect a firm's ability to respond to environmental issues (Bansal, 2005). By aggregating data to the firm, the variance between facilities becomes lost, which could, as a result, mask important causal relationships that have not been explored in this work.

Future Research

This dissertation provides several trajectories for future research. First, in Study 1, theory was built to explain that a firm's ability to respond to environmental issues depends on the fit between the scale of those issues and the scale of the organization. While this study used examples of differences in the spatial scale between fine-grained issues (e.g., water use) and coarse-grained issues (e.g., climate change), future work could develop a comprehensive list that illustrates and explains differences in environmental concerns along a continuum from fine- to coarse-grain, revealing the way issue identification changes in relation to the geographic orientation of the firm.

Second, two interesting streams for future research could stem from (a) exploring the effects of geographic orientation on environmental performance within different institutional contexts, and (b) examining how changes in geographic orientation affect a firm's environmental performance. Such work could not only lend support to the generalizability of the findings from this dissertation, but it could also potentially reveal other drivers of environmental performance that currently remain unknown.

Third, exploring whether differences in ownership affect environmental performance could serve as another interesting stream for future academic inquiry. In

Studies 2 and 3, samples were drawn from large, public multinationals operating facilities in the Canadian context. It would be interesting to explore whether environmental-performance patterns exist that are attributable to public firms versus private ones. Research could also examine whether the mechanisms that affect environmental performance in large MNEs also drive similar behavior in small and medium-sized enterprises.

Finally, measuring the effect of geographic orientation in relation to stakeholders constitutes a worthy pursuit. For example, considering the proximity to populated areas, population affluence, and population density in relation to the location of firm facilities could reveal interesting patterns such that pollution patterns might vary based on differences in population.

Business sustainability, guided by the tenets of sustainable development, has increased in popularity during recent years. This trend stems from the significant degree of concern among populations around the globe that, collectively, we are fundamentally and irreversibly altering our planet to a point where we are beginning to experience significant challenges in accessing natural resources. In light of these challenges, business not only has a vested interested in reducing its risk, but it also has the means and the moral imperative to affect meaningful change. Business scholars can contribute to constructive change by exposing the mechanisms that enable or constrain a firm's ability to make its operations more sustainable. This dissertation hopes to contribute to these efforts by exposing the centrality of geographic space in shaping sustainable behavior.

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APPENDIX A

A Sample of an International Chemical Safety Card

International Chemical Safety Cards

METHANOL **ICSC: 0057**

METHANOL
Methyl alcohol
Carbinol
Wood alcohol
CH_4O/CH_3OH
Molecular mass: 32.0

CAS # 67-56-1
RTECS # PC1400000
ICSC # 0057
UN # 1230
EC # 603-001-00-X

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Highly flammable.	NO open flames, NO sparks, and NO smoking. NO contact with oxidants.	Powder, alcohol-resistant foam, water in large amounts, carbon dioxide.
EXPLOSION	Vapour/air mixtures are explosive.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Do NOT use compressed air for filling, discharging, or handling. Use non-sparking handtools.	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE		AVOID EXPOSURE OF ADOLESCENTS AND CHILDREN!	
• **INHALATION**	Cough. Dizziness. Headache. Nausea.	Ventilation. Local exhaust or breathing protection.	Fresh air, rest. Refer for medical attention.
• **SKIN**	MAY BE ABSORBED! Dry skin. Redness.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer for medical attention.
• **EYES**	Redness. Pain.	Safety goggles or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**	Abdominal pain. Shortness of breath. Unconsciousness. Vomiting (further see Inhalation).	Do not eat, drink, or smoke during work.	Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Evacuate danger area! Collect leaking liquid in sealable containers. Wash away spilled liquid with plenty of water. Remove vapour with fine water spray (extra personal protection: complete protective clothing including self-contained breathing apparatus).	Fireproof. Separated from strong oxidants, food and feedstuffs. Cool.	Do not transport with food and feedstuffs. F symbol T symbol R: 11-23/25 S: (1/2-)7-16-24-25 UN Hazard Class: 3 UN Subsidiary Risks: 6.1 UN Packing Group: II

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0057 Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities © IPCS CEC 1993

International Chemical Safety Cards

METHANOL **ICSC: 0057**

I M	**PHYSICAL STATE; APPEARANCE:** COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation and through the skin, and by ingestion.

APPENDIX B

List of Chemicals Included in the Analysis

Chemical name	CAS Number	Chemical name	CAS Number
0 aniline	62-53-3	Bis(pentabromophenyl) ether	1163-19-5
0 tetraethyl lead	78-00-2	Bisphenol a	80-05-7
0-acetaldehyde	75-07-0	Butyl acrylate	141-32-2
1-butanol	71-36-3	Butyl benzyl phthalate	85-68-7
1-chloroethane	75-00-3	Butyraldehyde	123-72-8
1,1-dichloro-1fluroethane	1717-00-6	Cadmium	7440-43-9
1,1,1,2-tetrachloroethane	630-20-6	Carbon disulfide	75-15-0
1,1,2-trichloroethane	79-00-5	Carbon monoxide	630-08-0
1,1,2,2-tetrachloroethane	79-34-5	Carbon tetrachloride	56-23-5
1,2-dichlorobenzene	95-50-1	Catechol	120-80-9
1,2-dichloroethane	107-06-2	Chlorine	7782-50-5
1,2-dichloropropane	78-87-5	Chloroacetic acid	79-11-8
1,2,4-trichlorobenzene	120-82-1	Chlorobenzene	108-90-7
1,2,4-trimethylbenzene	95-63-6	Chlorodifluroethane	75-68-3
1,3-butadiene	106-99-0	Chlorodifluromethane	75-45-6
1,4-dichlorobenzene	106-46-7	Chloroform	67-66-3
1,4-dioxane	123-91-1	Chromium	7440-47-3
2-butanol	78-92-2	Cobalt	7440-48-4
2-ethoxyethyl acetate	111-15-9	Copper	7440-50-8
2-mercaptobenzothiazole	149-30-4	Cumene hydroperoxide	80-15-9
2-mercaptoimidazoline	96-45-7	Cyclohexane	110-82-7
2,4-dinitrotoluene	121-14-2	Cyclohexanol	108-93-0
2,4-toluene diisocyanate	584-84-9	Di(2-ethylhexyl) phthalate	117-81-7
4,4'-methylene bis(2-chloroaniline)	101-14-4	Dibenzo(a,h)anthracene	53-70-3
4,4'-methylenedianiline	101-77-9	Dibutyl phthalate	84-74-2
Acenaphthene	83-32-9	Dichlorodifluoromethane	75-71-8
Acetonitrile	75-05-8	Dichloromethane	75-09-2.
Acetophenone	98-86-2	Dichlorotetrafluoroethane	76-14-2
Acrolein	107-02-8	Dicyclopentadiene	77-73-6
Acrylamide	79-06-1.	Diethanolamine	111-42-2
Acrylic acid	79-10-7.	Diethyl phthalate	84-66-2
Acrylonitrile	107-13-1	Dimethyl phthalate	131-11-3
Allyl alcohol	107-18-6	Dimethylamine (aqueous solution)	124-40-3
Anthracene	120-12-7	Dioctyl adipate	103-23-1
Benz(a)anthracene	56-55-3	Diphenylamine	122-39-4
Benzene	71-43-2	Epichlorohydrin	106-89-8
Benzo(a)pyrene	50-32-8	Ethyl acrylate	140-88-5
Benzyl chloride	100-44-7	Ethylbenzene	100-41-4
Biphenyl	92-52-4		

Chemical name	CAS Number	Chemical name	CAS Number
Ethylene	74-85-1	N-methylolacrylamide	924-42-5
Ethylene glycol	107-21-1	N,n-dimethylformamide	68-12-2.
Ethylene glycol monobutyl ether	111-76-2	Naphthalene	91-20-3
Ethylene glycol monoethyl ether	110-80-5	Nickel	7440-02-0
Ethylene glycol monomethyl ether	109-86-4	Nitric acid	7697-37-2
Ethylene oxide	75-21-8	Nitrilotriacetic acid	139-13-9
Formaldehyde	50-00-0	Nitroglycerin	55-63-0
Formic acid	64-18-6	Nonyl phenol (mixed isomers)	25154-52-3
Hexachlorobenzene	118-74-1	O-phenylphenol	90-43-7
Hexachloroethane	67-72-1	P-phenylenediamine	106-50-3
Hydrazine	302-01-2	Pentachloroethane	76-01-7
Hydrogen chloride	7647-01-0	Phenol	108-95-2
Hydrogen fluoride	7664-39-3	Phthalic anhydride	85-44-9
Hydrogen sulfide	7783-06-4	Propionaldehyde	123-38-6
Hydroquinone	123-31-9	Propylene	115-07-1
Isobutanol	78-83-1	Propylene oxide	75-56-9
Isophorone diisocyanate	4098-71-9	Pyrene	129-00-0
Isopropyl alcohol	67-63-0	Pyridine	110-86-1
Isopyrene	78-79-5	Quinoline	91-22-5
Lead	7439-92-1	Styrene	100-42-5
Maleic anhydride	108-31-6	Sulfuric acid	7664-93-9
Mercury	7439-97-6	Sulphur hexafluoride	2551-62-4
Methanol	67-56-1	Tert-butanol	75-65-0
Methyl acrylate	96-33-3	Tetrachloroethylene	127-18-4
Methyl bromide	74-83-9	Thiourea	62-56-6
Methyl chloride	74-87-3	Toluene	108-88-3
Methyl ethyl keytone	78-93-3	Trichloroethylene	79-01-6
Methyl isobutyl ketone	108-10-1	Trichlorofluorometha ne	75-69-4
Methyl methacrylate	80-62-6	Trithylamine	121-44-8
Methyl tert-butyl ether	1634-04-4	Vinyl acetate (monomer)	108-05-4
Methylene bisphenyl isocyanate	101-68-8	Vinyl chloride	75-01-4
N-hexane	110-54-3	Vinylidene chloride	75-35-4
N-methyl-2-pyrrolidone	872-50-4	Zinc	1314-13-2

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Bachelor of Arts and Sciences (BAS): Biology & Geography 2006

RESEARCH INTERESTS

Sustainability
Geographic Scale
Environmental Management
Decision-Making
Psychological Distance

PUBLICATIONS & PROCEEDINGS

Book Chapter:

- Bansal, Pratima, & Michael O. Wood. 2010. Building Sustainable Value Through Cross-Enterprise Leadership. In M. Crossan, J. Gandz, & G. Seijts (Eds.), *Cross-Enterpise Leadership: Business Leadership for the Twenty-First Century*: 173-194. Mississauga: John Wiley & Sons Canada, Ltd.

Manuscripts Under Review:

- Wood, Michael O., Theodore J. Noseworthy, & Scott R. Colwell, "The Impact of Psychological Distance on Seemingly Unethical Decision-Making and the Power of Having the Option Not To Choose," under second round at *Journal of Business Ethics*.

Refereed Presentations:

- Wood, Michael O., Theodore J. Noseworthy, & Scott R. Colwell (2012), "Psychological Distance and Seemingly Unethical Decision-Making," Academy of Management Annual Meeting, (August) Boston.

- Wood, Michael O., & Pratima Bansal (2012), "Attenuating the Link Between Geographical Orientation and Environmental Management," Academy of

Management Annual Meeting, (August) Boston. *Best Paper Proceedings* (O.N.E. Division).

- Wood, Michael O., & Pratima Bansal (2012), "Do You See What We See? The Role of Spatial Scale in Perceiving Environmental Issues," *GRONEN* Research Conference in Marseilles, France.

- Wood, Michael O., (2011), "The Constraining Effect of Scale on Organizational Attention," *Academy of Management* (AOM), (August) San Antonio.

- Wood, Michael O., (2011), "Finding Fit: Spatial and Temporal Scale Effects on Organizational Attention," *Administrative Sciences Association of Canada* (ASAC), (July) Montreal.

Invited Presentations:

- "The Role of Psychological Distance in Enabling Socially Irresponsible Decision-Making," *I-O Psychology Research Seminar*, Department of Psychology, University of Guelph, 2011.

Selected Trade Publications:

- McKnight, Brent, Michael Wood, Chethan Shrikant, & Pratima Bansal (July 2011), "Getting to Know Your Food: The Search for Clarity in Our Food Supply Chains." Centre for Building Sustainable Value, Ivey Business School.
- McKnight, Brent, Michael Wood, & Pratima Bansal (February 2011). "Rolling out the Green Carpet: Sustainability in the Media Industry." Centre for Building Sustainable Value, Ivey Business School.
- McKnight, Brent, Michael Wood, & Pratima Bansal (December 2010). "Dreaming of a Green Christmas? Sustainability and the Retail Sector." Centre for Building Sustainable Value, Ivey Business School.
- McKnight, Brent, Michael Wood, & Pratima Bansal (October 2010). "Sustainability Trends in the Construction and Real Estate Industries." Centre for Building Sustainable Value, Ivey Business School.
- McKnight, Brent, Michael Wood, & Pratima Bansal (July 2010). "Oil and Gas Producers: Should we Paint an Entire Industry with the 'BP' Brush?" Centre for Building Sustainable Value, Ivey Business School.
- McKnight, Brent, Michael Wood, & Pratima Bansal (March 2010). "International Agreements for Banks' Lending Practices Not Yet Working." Centre for Building Sustainable Value, Ivey Business School.

SCHOLARSHIPS & AWARDS

- Best Paper Award, 2012 Academy of Management Annual Conference (O.N.E. Division) for "Attenuating the Link Between Geographical Orientation and Environmental Management" (with Pratima Bansal)

- Best Paper Award, 2012 *GRONEN* Research Conference for "Do You See What We See? The Role of Spatial Scale in Perceiving Environmental Issues," (with Pratima Bansal)
- Western University: 2008-12 Plan of Excellence Doctoral Fellowship
- Western University: 2009 S. Chum Torno Doctoral Scholarship

PROFESSIONAL AFFILIATIONS

- Academy of Management (AOM)
- Centre for Building Sustainable Value (CBSV)
- Group on Organizations and the Natural Environment (GRONEN)
- Network for Business Sustainability (NBS)