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Review

Explaining the links between capacity and action in response to global climate change: A local-level climate response shift

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Although, the development and implementation of a global greenhouse gas reduction regime has dominated policy debates before the advent of the Kyoto Protocol (and remains a critical element of effective mitigation, communities have both direct control of critical sources of emissions and are the scale at which the potentially catastrophic impacts of climate change will play out). As this paper shows, communities face a unique set of challenges as they navigate through the uncertain future presented by climate change. Even so, communities bring to the task of climate change adaptation and mitigation a unique set of tools and proficiencies that are often absent at the national and international scales. It was the ultimate aim of this paper to enhance this tool kit so that communities might effectively employ the various forms of capacity they possess to rise to the challenge presented by climate change.

Key words: Climate change, risk, adaptation, capacity, action, response, Kyoto protocol.

INTRODUCTION

The implications of unsustainable patterns of development are nowhere as evident as in the challenges presented by global climate change. The potential impacts cross generational and geographical divides to permeate ecological and human systems alike, while the causes cut to the core of our economies and shake the foundations of politics at all levels. The scale and nature of the transformation that may be required to adequately respond to this challenge appears to have defied comprehension, but climate change has risen to dominate policy agendas and drive innovation at unprecedented rates (Lorenzoni and Pidgeon, 2006; Reiner et al., 2006; Olowa, 2003).

Early debates surrounding climate change were characterized by heated discussions regarding the accuracy and relevance of temperature and impacts models (Shackley et al., 1998), which even periodically called into question the most fundamental assumptions of climate scientists (Lindzen, 1994). More recently, the public and policymakers alike have shifted their focus towards the design and implementation of policies that will address the problem, driving a wide array of actions to be taken around the globe (for example, Gupta et al., 2007), and even more extensive host of propositions for policies that have been found (Böhringer and Vogt, 2004; Buchner et al., 2002). This increase in awareness among the public and policymakers has been paralleled by a dramatic shift within the scholarly climate change discourse. Firstly, perhaps partly because of the difficulty of regulating climate change at the global level, some scholars are beginning to consider the implications of climate change at ever smaller scales (Bai, 2007; Adger et al., 2005). This has been accompanied by a growing demand for action at the local level and the growth of sub-national climate change response initiatives (Bulkeley and Betsill, 2005; Betsill, 2001).

Secondly, novel efforts are being made to link previously disparate categories of climate change responses, such as adaptation and mitigation, within a framework of sustainable development (Klein et al., 2007; Wilbanks et al., 2007; Robinson et al., 2006; Smit et al., 2001). This new approach will assist in the development of local-level climate response strategies that consider inevitable trade-offs, and potentially attractive synergies, between responses that may influence the ability of a group to follow a sustainable development path. Finally,

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increasing attention is being given to the underlying characteristics of a community or society that either help or hinder responses to climate change. Among social scientists, the concept of capacity (Adger et al., 2004; Tompkins and Adger, 2003; Yohe, 2001) and its influence on action in response to climate change, is especially important to these discussions. Although, the adaptive and mitigative capacity literature does not claim that building capacity will necessarily lead to improved responses to the climate change risk; little work has been done to explicate the wide variation in responses to climate change among nations and groups with similar levels of capacity. Analysis of the complex relationship between capacity and action in response to global climate change represents a significant gap in the climate change literature, and influences the ability of climate policies to build effective mitigation and adaptation strategies. From the multitude of intervening factors (ranging from the quality of political and technical leadership on the issues to the structure of the organization that has been tasked with addressing it) that can immediately be identified as influencing this relationship, it is clear that the issue of climate change, the analysis of which has grown from scientific and quantitative roots, would benefit from a more interdisciplinary approach. This paper builds on a rich tradition of integrated approaches to planning and decision-making as they relate to climate change. Since the mid 1990's, the enhanced greenhouse effect and global climate change have become issues around which much public debate has centred. Initially, this debate was characterized by heated discussions regarding the precision and relevance of temperature and impacts models, even periodically calling into question the most fundamental assumptions of climate scientists. More recently, dramatic shifts have occurred within the climate change discourse itself, quite separately from the increased prominence of climate change as a political issue in jurisdictions around the world. First, perhaps partly because of the difficulty of regulating climate change at the global level, many scholars are beginning to consider the implications of climate change at ever smaller scales. Local and regional responses to climate change, such as the US Mayors Climate Protection Agreement and Lagos state climate change initiative in Nigeria, have become more common in the time since the negotiation of the Kyoto Protocol to the United Nations Framework Convention on Climate Change (Jones et al., 2007; Olowa, 2003; Betsill, 2001; Wilbanks and Kates, 1999).

This review will address this issue in detail, with the goal of further elaborating the nature of the complex relationship between capacity and action. To this end, the network of interactions that connect a group's underlying development path with the resultant mitigation and adaptation will be considered, and important factors that mediate these interactions will be identified. Specifically, theories of risk perception will be drawn upon to provide insights into just one of the many socio-cultural patterns that will influence our ability to address the risks associated with climate change.

CAPACITY AND THE CLIMATE CHANGE PROBLEM

A central component of recent discussion regarding the human dimensions of climate change is the concept of capacity. This section will introduce adaptive and mitigative capacity. The evolution of these concepts within the climate community will be considered, and a way in which adaptive and mitigative capacity can be more carefully defined to assist in the explication of the links between capacity and action in response to climate change will be proposed. Finally, this section will introduce response capacity as a useful idea through which adaptation and mitigation can be integrated in the context of sustainable development.

Adaptive and mitigative capacity

As the science of the climate change risk becomes more established, and greater consensus is reached among climate system experts around the world, attention has been shifted to the issue of responding to climate change. Responses are typically grouped into two categories: Climate change mitigation, which reduces emissions or increases capture of greenhouse gases in order to reduce the magnitude of the future risk, and adaptation, which consists of adjustments in structures, practices, or processes, to respond to changing climate conditions (IPCC, 2001). Recent literature in the field of climate change response argues that, adaptation to and mitigation of climate change takes place within the context of adaptive and mitigative capacity, respectively (Brooks et al., 2005; Tompkins and Adger, 2005; Yohe, 2001). This paper takes as its starting point the definitions proposed by the IPCC Third Assessment Report, which defines adaptive capacity as the ability to adapt to the impacts of climate change. A more recent definition of mitigative capacity was adopted which describes it as the ability to reduce greenhouse gas emissions that lead to global climate change (Winkler et al., 2007).

The concept of capacity only emerged with the IPCC's Third Assessment Report, and was a significant development in the path towards a more nuanced explication of responses to climate change. Prior to the Third Assessment Report, most analyses of human responses to climate change were limited to estimations of specific climate change impacts and proposals for mitigation and adaptation responses, rather than investigations into the socio-political and institutional precursors to these responses. This focus was

established in the First and Second Assessment Reports of the intergovernmental panel on climate change (IPCC), a collaborative effort between the United Nations Environment Program and the World Meteorological Organization. Published in 1991 and 1995, these reports captured the focus of the research on climate change that had taken place during the preceding decade, and dealt heavily with issues of modelling the potential impacts of anthropogenic climate change, greenhouse gas reduction through mitigation, and issues of the cost-effectiveness or efficiency of mitigation policies (Banuri et al., 2001). This reflected the natural science-driven and somewhat technocratic views of the climate change community at that time (Cohen et al., 1998). The assumption made was that, science could be used to fill the knowledge gaps that plagued studies of climate change, and that policy makers could simply rationally apply this knowledge to the development and implementation of effective response strategies (Jasanoff and Wynne, 1998; Irwin and Wynne, 1996; Irwin, 1995). A recognition of the limits of this approach led to an attempt by the IPCC, in the Third and Fourth Assessment reports, to pay significantly more attention to questions about the need for consideration of more human issues, such as the social, cultural, political, or institutional constraints on responses to climate change (Banuri et al., 2001). An example of this new focus was the introduction of the concept of adaptive and mitigative capacity in the Third Assessment Report (Banuri et al., 2001; Smit et al., 2001). Even after this introduction occurred, however, the research response within the climate change community remained limited. As such, the concept of capacity, and its implications for climate change mitigation and adaptation, is only now emerging into prominence. In arenas other than that of traditionally natural science-dominated climate change research, however, the question of capacity for behaviour change has been investigated extensively. Early framing of the climate change problem, embodied in the first two assessment reports of the IPCC, underestimated the contributions of social sciences such as cultural anthropology, sociology, and social psychology for "understanding the processes by which societies recognize new threats to their security or well-being, formulate responses, and act collectively upon them," (Jasanoff and Wynne, 1998).

Some have argued that, in the arena of climate change, the rather unsettled relationship between the natural and social sciences arises out of the very different epistemological roots from which these disciplines grow. The traditional, natural science-based climate change discourse was somewhat reductionist in nature, attempted to mould the climate change problem to suit the requirements of scientific analysis, and mostly ignored the political, social, and cultural dimensions of the problem (Cohen et al., 1998). The human-centred social science discourse, on the other hand, sought to explain the drivers of climate change in a more politically sensitive and geographically appropriate manner, but was often considered analytically vague by more quantitatively-oriented scholars (Cohen et al., 1998). It was out of this more human-centred approach that the concepts of adaptive and mitigative capacity have arisen. The concept of adaptive capacity was first brought to the climate change community because of its use in the field of ecology (Hawley, 1986). The ability of a system to withstand and adapt to external stresses had long been a subject of study in the scientific community, but the resilience of human communities and economic systems was not initially part of this analysis. Over the last several decades, however, a large literature has been developed that investigates adaptive human responses in the realm of ecosystem management (Folke et al., 2002; Yohe, 2001; Berkes et al., 2000a, 2000b; Holling, 1986; Holling, 1978). These elements were eventually added to the consideration of adaptive capacity in the climate change community, and articulated by Yohe (2001). Yohe suggested that adaptive capacity was determined by the following group-level characteristics:

1. The range of available technological options for adaptation;
2. The availability of resources and their distribution across the population;
3. The structure of critical institutions and the derivative allocation of decision-making authority;
4. The stock of human capital, including education and personal security;
5. The stock of social capital including the definition of property rights;
6. The system's access to risk spreading processes;
7. The ability of decision-makers to manage information, the processes by which these decision-makers determine which information is credible, and the credibility of the decision-maker themselves;
8. Public perception of attribution (Yohe, 2001).

In parallel to adaptive capacity, mitigative capacity refers to the ability of a system to undertake climate change mitigation. It is typically human-centred, but is connected to natural systems through the accumulation of carbon in these systems, and is determined by a variety of characteristics of the socio-technical system within which mitigation takes place. The work of Gary Yohe (2001) again assisted in the initial elucidation of these determinants, and posited that essentially the same set of characteristics help to determine the mitigative response to climate change (Yohe, 2001). Yohe adds that acknowledgment of the determinants of both adaptive and mitigative capacity may lead to more effective research and policies to deal with the responses to the climate change risk (Yohe, 2001).

The wide acceptability of the hypotheses put forward by Yohe is demonstrated by their integration in the Third Assessment Report of the intergovernmental panel on

climate change, and their reiteration and further development by numerous climate change experts (Adger et al., 2004; Moss et al., 2001). A more integrated approach to the analysis of adaptation and mitigation is currently gaining momentum, leading to preliminary policy recommendations (Jones et al., 2007; Winkler et al., 2007).

Response capacity

As aforementioned, recent research supports the view of Yohe that adaptive capacity and mitigative capacity are essentially driven by the same factors (Tompkins and Adger, 2005). These factors, or determinants, however, operate at a very high level of abstraction and seem to apply only to very large groups. Furthermore, these determinants yield little insight into crucial aspects of climate responses; namely: What party is initiating the response action, and how is that action carried out? In other words, more information is required about the institution or agency, and the resultant policies and programs, which are geared towards adaptive and mitigative responses to climate change, if the factors that engender effective and ineffective climate change responses are to be articulated. For these reasons, it may be fruitful to consider the broad determinants of capacity, as outlined by Yohe and others, to be part of a more general, development-related, pool of resources called response capacity. A slightly different framing of the term response capacity has been proposed by Tompkins and Adger (2005), who suggested that response capacity can be thought of as the human ability to manage both the generation of greenhouse gases and the consequences of their production (Tompkins and Adger, 2005).

Put differently, response capacity, according to this framing, represents simply the confluence of adaptive and mitigative capacity. This concept may be broadened, however, in order to represent the broad pool of resources that can be utilized to address any risk or challenge faced by human society. The value of this broadening is that it allows response capacity to be connected to the underlying socio-economic and technological development path of a given society or community and thus provide a new focus for attempt to understand how capacity can effectively be translated into action. Response capacity, according to this view, is time and context specific, and culturally and regionally specific. It consists of a broad set of resources, many of which have previously been described as the determinants of adaptive and mitigative capacity. For instance, stocks of human and social capital, which are pools of resources that may be used in a multitude of ways, are elements of response capacity. In addition, the presence of technological innovation and economic strength of a nation contribute to its store of response capacity. As a result, response capacity is to some extent an approximation of a nation's development level, and thus, is rooted in a nation's development path. On the surface, the concept of response capacity may appear to represent a further step towards the analytical vagueness that has plagued the concepts of mitigative and adaptive capacity in the past. Response capacity, however, draws our attention to a very important set of processes and dynamic interactions between various technological, institutional, and cultural trajectories which are fundamentally rooted in the underlying development path. In other words, the resources which contribute to response capacity represent potentially path dependent systems of rules, institutional structures, and habitual practices, which may be the precursors of significant barriers to action. As we shall see, these underlying institutional, socio-technical, and cultural trajectories fundamentally constrain the way that mitigative and adaptive capacity play out in practice. Thus, the concept of response capacity simultaneously allows for the greater specification of mitigative and adaptive capacity, and reveals the importance of deeper socio-cultural trajectories that form the context within which action may occur. The examples of the inter-relationships between response capacity, adaptive capacity, and mitigative capacity that are discussed in this section serve to illustrate this claim. The generalized pools of resources that constitute response capacity might be utilized to produce an institution or policy that is geared toward mitigation of, or adaptation to, climate change, which represents the formation of adaptive and/or mitigative capacity out of the pool of response capacity resources. For instance, generalized institutional capacity, in the form of government budgetary capacity and jurisdiction, might be activated in the creation of an agency or institution that is geared towards carrying out emergency measures in response to severe climate events. Similarly, a corporate social responsibility or environmental division of a large corporation might be formulated out of pre-existing institutional capacity and human capital, which then goes on to design effective policies geared towards the reduction of greenhouse gas emissions. In this case, it is unlikely that the embodiment of response capacity in a form of adaptive capacity will do much to build or enhance mitigative capacity. Similarly, the presence of technological innovation that has grown out of a socio-technical system might result in technologies that are applicable only to the reduction of greenhouse gas emissions, but contribute nothing to the adaptation to climate change impacts. This clearly implies that tradeoffs may exist in the way that general response capacities are transformed into more specific mitigative or adaptive capacities. For example, to the extent that climate change policy responses in general have available to them only a finite amount of resources within a given governmental policy framework, adaptive and mitigative measures may compete for these resources

even if they are not substitutes in terms of their effects.

Two important dimensions of the relationship between response capacity and adaptive/mitigative capacities require further elaboration, and speak to the fact that response capacity resources may be manifested in a form of mitigative capacity that has implications for adaptation, or a form of adaptive capacity that influences mitigation goals. First, once response capacity is transformed into either mitigative capacity or adaptive capacity, it may or may not serve the other function. For instance, response capacity in the form of human and financial capital, which may contribute to the development of alternative energy technologies, can be instantiated in the form of an agency and policies geared towards decentralized renewable energy generation. This is more likely to result in cases where fewer technological, economic, and institutional path dependencies exist in the energy system, which arise out of the underlying development path. Although, not the driving purpose of such an agency and its policies, this form of mitigative capacity also has important implications for adaptive capacity insofar as it enhances resilience and diminishes the vulnerability associated with centralized power generation. In this way, the instantiation of response capacity in the form of mitigative capacity yields unintended benefits for adaptive capacity as well. Similarly, resources that are part of response capacity may be utilized to produce a municipal agency with the mandate of designing and implementing sustainable urban growth or densification policies. One aspect of these policies might be the design of urban forms that simultaneously consume less energy than current forms, reduce storm-water runoff and the resulting need for water treatment, which may lead to urban systems that are more adaptable to climate extremes and energy security issues. In this way, response capacity has been transformed into an agency which embodies both adaptive and mitigative capacity.

Tradeoffs may also exist in the translation of response capacity into adaptive and mitigative capacity. For instance, response capacity may be utilized to form a flood protection and dike management agency, geared explicitly towards implementing adaptation measures. This is likely in an area that has accumulated technical expertise to deal with such issues, constructed an institutional framework to support these actions, and entrenched flood protection responses in a system of policies and mandates. Not only does this necessarily take resources away from mitigation-oriented measures, but the construction and management of dikes will likely consume fossil fuels that actually contribute to the climate change problem (and thus, the need for mitigation). Again, it is clear that the underlying technological, institutional, and socio-cultural trajectories fundamentally shape the way that response capacity is transformed into mitigative and adaptive capacities, as well as into action. Recent work on the part of climate change by scholars has begun to explore a more comprehensive framework for the consideration of interactions between adaptation and mitigation, as well as their respective capacities (Wilbanks et al., 2007; Wilbanks and Sathaye, 2007; Yohe and Strzepek, 2007; Dang et al., 2003; Beg et al., 2002). It is clear that the ways in which response capacity is transformed into adaptive and mitigative capacity are manifold, creating layers of interaction leading to very different climate response outcomes.

The relationships among response capacity, mitigative and adaptive capacities and actual mitigation and adaptation proposed here are illustrated in Figure 1. First, the schematic shows that all factors that contribute to human responses to climate change are embedded in the underlying development path. In other words, socio-cultural, technological, and institutional trajectories fundamentally shape the quality and quantity of response capacity resources, which are then available for mitigative and adaptive activities. Next, adaptive and mitigative capacity are shown to arise out of these response capacity resources, in the form of institutions and policies that are geared toward one or both of these responses. Finally, adaptive and mitigative capacities are utilized to produce adaptation or mitigation in response to the climate change risk.

TRANSLATING CAPACITY INTO ACTION

The discussion aforementioned, which provides a proposed clarification of the concepts of response capacity, and adaptive and mitigative capacity, lays the groundwork for addressing the central question, often left unasked, with regard to human responses to climate change: Does a group with larger stocks of capacity necessarily respond more effectively that a group with less? More generally, one must ask: What influences the relationship between capacity and action? This section will first consider criticisms of, and additions to, the traditional formulation of the determinants of adaptive and mitigative capacity, which provide the roots of the capacity/action question. Next, the translation of capacity into action will be considered, and one important factor which may shapen this relationship will be introduced.

Although, the determinants of capacity, as laid out by Gary Yohe, have come to be widely accepted in the IPCC and global climate research circles; recent work has suggested that Yohe's list of determinants is incomplete. Haddad (2005), for instance, suggested that the traditional measures of adaptive capacity do not consider the normative or motivational context of adaptation. Specifically, Haddad examines the effect of national goals and aspirations on adaptation choices. Teleological legitimacy, procedural legitimacy, and norm-based decision rules are the three broad categories of goals that Haddad argues might lead nations to make different decisions in response to the climate change risk

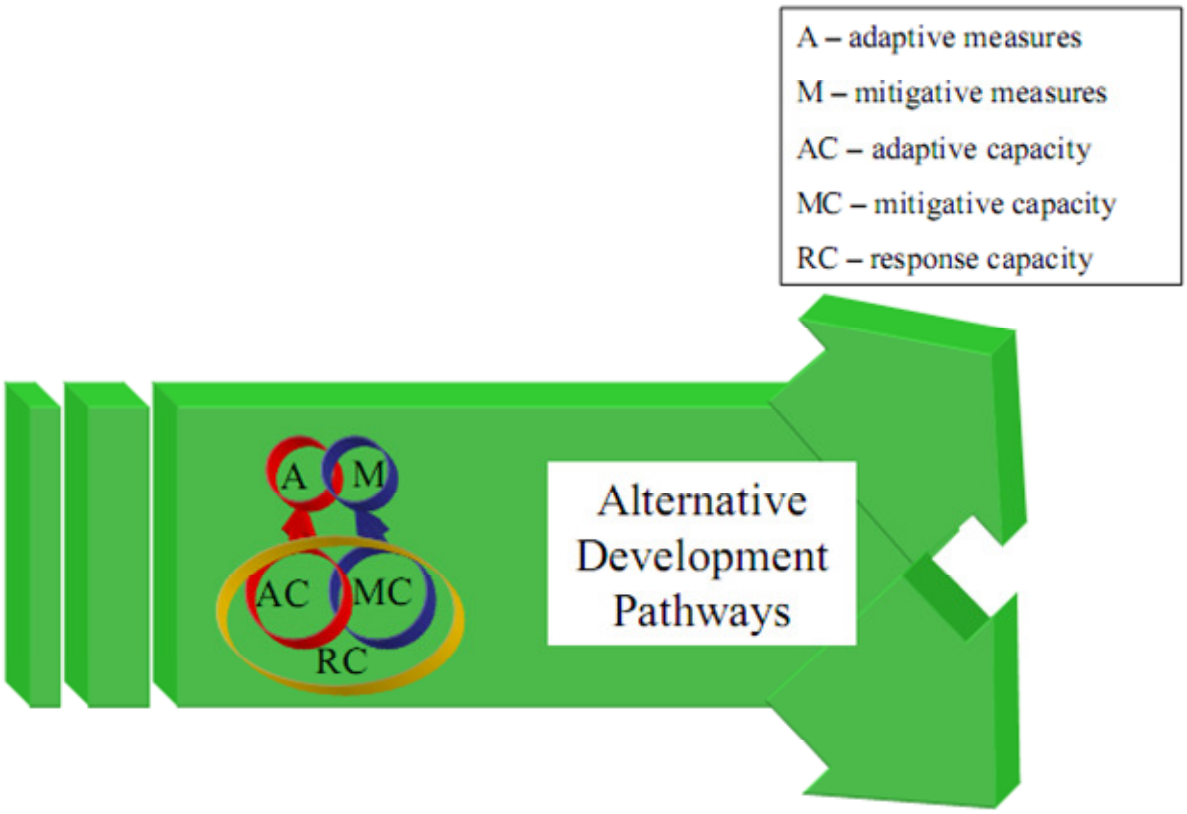

Figure 1. The process of transformation of response capacity, which is a generalized set of resources rooted in the development path, into mitigative and adaptive capacity, and finally into action (mitigation and adaptation).

(Haddad, 2005). Although, he deals specifically with adaptation and makes no claims about the effects of national aspirations on mitigative responses to climate change, one might argue that the motivational context behind mitigation is equally important. But from the point of view of the approach taken in this paper, these factors have more to do with the process of turning capacity into action than with expanding the list of determinants of capacity.

Grothmann and Patt (2005) stressed the need for an examination of responses to climate change that, instead of considering resource constraints as the most significant determinant of adaptation, separates out the psychological steps that precede action in response to perception of the climate change risk. A large literature pertaining to human decision-making and action, traditionally outside of the climate change realm, suggests that both motivation and perceived abilities are important determinants of action (Kollmuss and Agyeman, 2002; Stern, 2000; Dietz et al., 1998). Thus, both risk perception and perceived adaptive capacity, for instance, may enhance or inhibit adaptive responses to climate change (Grothmann and Patt, 2005).

These criticisms of, and additions to, Yohe's determinants of adaptive and mitigative capacity point to the need to revise the previously deterministic view of capacity and action, and to consider more carefully the intricacies of human behaviour. They suggest the need to relate adaptive and mitigative capacity to the concrete institutional and socio-technological contexts in which these capacities are embedded. To the extent that these capacities are part of a trajectory of decisions and behaviours that prioritize or even make conceivable only certain forms of action, then proposals for policy responses that are incompatible with such a trajectory are much less likely to succeed or even be seriously considered. An example of such path dependence might be policy regimes that subscribe to a strongly market-oriented approach to policy formation. In such regimes, response capacity is much more easily mobilized for forms of adaptive or mitigative responses that reflect such priorities (for example, market-based instruments) than for forms of response characterized by more traditional command and control policies. In this way, the development pathway may strongly condition the types of responses considered legitimate.

Although, the adaptive and mitigative capacity literature does not claim that building capacity will necessarily lead to improved responses to the climate change risk, little work has been done to explicate the widely noted

variation in response to climate change among communities and nations with similar capacities. For instance, Canada and Sweden are remarkably similar according to a variety of economic, demographic, and geographic indicators. Canada's GDP per capita is $29,000 (US 2004 dollars), while Sweden's is $26,000 per capita, Canada and Sweden face similar northern hemisphere climates, and are currently passing through similar stages of their demographic transitions, marked by aging populations and slow growth (CIA, 2004). Canada and Sweden also possess similarly high literacy rates, similar distributions of GDP by sector, and so on. These two nations are exposed to the same internationally-endorsed climate change science, through the IPCC, and have access to essentially the same mitigative and adaptive technologies via open markets and international trade. Such similarities indicate that Canada and Sweden possess very similar levels of response capacity. These two countries, however, have very different levels and types of climate change-related institutions and policies (adaptive and mitigative capacity), and very different success in reducing greenhouse gas emissions. Canada, despite having ratified the Kyoto Protocol, has experienced a 24.2% increase in emissions since 1990, while Sweden has managed to reduce its emissions by 2.3% (UNFCCC, 2005). This variation in response and the potential influence of varying perceptions of risk reveal that capacity is a necessary, but not sufficient condition for mitigative action (Winkler et al., 2007). Clearly, additional factors are influencing the complex and non-linear relationship between response capacity and behaviour change.

In order to tease out some characteristics of the relationship between capacity and action in climate change, one factor risk perception will be provided as an example of a context-specific, culturally-variable factor that may play some role in variance in climate change responses among countries.

RISK PERCEPTION AND VARYING RESPONSES TO CLIMATE CHANGE

Studies of the perception of risk offer considerable insight into common patterns of behaviour that the individuals and groups might follow in response to a risk such as climate change. Although, most of the work in this area has been carried out to explain technological disasters (such as chemical spills or nuclear disasters) however, it is strictly not sufficient condition for mitigative action (Winkler et al., 2007). Clearly, additional factors are influencing the complex and non-linear relationship between response capacity and behaviour change.

Natural disasters (such as an earthquake or a tsunami), has much to offer any explanation on nations' or groups' policy responses to climate change. Research dealing with the perception and characterization of risk can be grouped into two approaches: Psychological or psychometric, and socio-cultural. Each of these will be addressed below. Although, scientific experts have often considered the responses of policymakers and the lay public to risk to be irrational, key scholars in the sub-field of psychological or psychometric studies of risk perception argue otherwise (Lowe et al., 2006; Kempton, 1997; Wynne, 1992). Rather than responding to some "true" level of risk that is inherent in changing climate, this literature posits that the lay public creates perceptions of risk that are based on different criteria and thus may differ from those of the experts. These perceptions are still rational, however, are based on two factors, each of which is made up of a combination of characteristics (Slovic, 1992). In particular, these scholars posit that perceptions of risk are derived essentially from feelings of dread (resulting from a risk that is perceived to be severe, catastrophic, or uncontrollable), and the unknown (often resulting from risks that are perceived to be unfamiliar, unobservable, or new to science) (Slovic, 1992). These perceptions are individual, however, and are therefore strongly affected by the socio-economic standing of the individual perceiving the risk. It has been found, for instance, that economically and socially disadvantaged populations, such as visible minorities and women, are likely to perceive risks to be greater than their more empowered counterparts (Satterfield et al., 2004). These disadvantaged groups possess much less power in their socio-political surroundings, and thus have less reason to believe that they can control or recover from a risk. It has often been noted that less-wealthy and minority communities are less likely to receive protection from harm (Bullard, 1994), and are more likely to be located in environmentally unstable or unsafe locations, such as cliffs or low-lying areas prone to flooding and inundation. Climate change may prove to be a very real risk to these groups, who, as the victims of environmental injustice, are least likely to be well-served by the political and economic services that are at the disposal of others. Thus, the groups that have the highest concerns about risks related to climate change may be least empowered to translate those concerns into policy, leading to a systematic under-representation of risk concerns. Risks related to climate change are especially susceptible to variation in perception, in part because of the scientific controversy discussed previously and in part because of the geographical variation in vulnerability, provision of scientific information, and economic stability. As such, a community (Group A) that is economically resilient, with few marginalized groups, high education and literacy levels, and minimal risk of extreme exposure to the impacts of climate change, might associate low levels of dread and unknowable to climate change. This group might perceive the risk of climate change to be relatively minor, thereby carrying out few adaptation or mitigation options. Group B, on the other hand, might be

characterized by groups that are economically or socially disadvantaged, privy to conflicting information about the potential risks of climate change, and physically vulnerable. This group, according to Slovic's psychometric factor space, would perceive the risks from climate change to be much greater. If this group possesses considerable response capacity, then it may be more likely to carry out adaptive or mitigative actions. One could easily imagine communities with a mixture of these characteristics as well. For instance, Group C might be highly vulnerable (a low-lying small island state), leading to high estimations of the severity and fatality of climate change, but might also consider climate change to be a familiar and observable risk. Group D, alternatively, experiences low levels of dread in relation to the climate change risk, but regards climate change as a mysterious and unobservable force that is unknown and new to science. The levels of mitigation in these latter, more ambiguous groups might depend more strongly on other factors such as political structures, political will and capacity.

The groups aforementioned, however, clearly represent idealized versions of reality. Since most jurisdictions consist of mixtures of these groups, power and representation become the resources that most directly influence the responses of a group to climate change. For instance, the risk perception of the less-empowered majority may not be the risk perception that characterizes the more affluent or empowered minority. As a result, the response of the group as a whole may be far from representative of the majority.

Social theories of risk also lend considerable insight into variation in perceptions of the climate change risk that might lead to different mitigative behaviours. Some scholars in this field argue that perceptions of risk are formed in the context of a range of social, cultural, and political factors. Wynne (1992), for instance, demonstrated that conflict between experts and the lay public may result from competition or clash between their respective cultures. Wynne showed that because scientists have been socialized to evaluate phenomena empirically and claim objectivity, they are not receptive to the contributions of local 'experts' that may lack traditional academic credentials. Local lay people, in turn, view scientists as agents of those in power, and do not trust their methods. As a result, conflicts arise appear to be about knowledge, when the catalyst for the conflict is actually threatened identities (Wynne, 1992). As climate change researchers begin to learn the value of local knowledge, similar conflicts may arise between scientists who may be viewed as capitalizing on the recent explosion of interest in the climate change issue, and local individuals who want to preserve for instance, agriculture in vulnerable areas. Although, as mentioned, weather patterns may not be indicative of broader climate patterns, local and traditional knowledge may provide valuable insights into the nature of varying perceptions of the climate change risk, and varying responses. This knowledge, however, and the concerns of those who possess it, is often devalued by expert-driven cultures and thus under-represented in policy. Added to this rational or analytical way of interpreting risk is an intuitive or affective layer of response, which has been termed the 'experiential system' (Slovic et al., 2004). This more rapid, mostly unconscious evaluation of risk is thought to operate in parallel with more logical assessments of risk, and the two systems fundamentally guide and inform one another (Slovic et al., 2004). This role affect the thinking and information processing as visibility gained in the risk community (Kahneman and Frederick, 2002; Slovic et al., 2002), and draws our attention to the ways in which rationality and emotion are inextricably linked. This complicated relationship may shed some light on varying responses to the risk of climate change (of which few of us have experienced) and may help explain why, in cases such as this, where consequences are new or unexpected, the 'affect heuristic' fails to enable us to be rational actors. Psychological and socio-cultural models of risk perception and response point to the fact that varying responses to climate change might indeed be rational. Incorporating local and lay knowledge, addressing concerns of environmental injustice and social inequity, formulating programs that account for variation in social hierarchies and group integration might help to resolve part of the controversy that arises from different mitigative behaviour, and help to close the apparent gap between capacity and action in response to climate change.

Risk perception, whether defined through psychological or socio-cultural models, is not incorporated into the current definition of response capacity, but can clearly influence behaviour. A high perception of the risks associated with global climate change, for instance, might provide the foundation of interest in climate change adaptation or mitigation and knowledge of the benefits of adaptation or mitigation that is needed to effect behaviour change. Similarly, a community that perceives a high level of risk might also utilize the social forces that encourage and reinforce adaptive or mitigative behaviour.

CONCLUSIONS AND RECOMMENDATIONS

This paper has introduced the concept of response capacity, and traced its links to adaptive and mitigative capacity, and ultimately action or behaviour change in response to climate change. This complex and dynamic set of relationships is deeply embedded within the underlying development path, pointing to the need to consider integrated adaptive and mitigative responses. Risk perception has been presented for illustrative purposes, as only one of many socio-cultural characteristics that may influence the relationship between capacity and action, and thus, shape responses

to climate change. It is necessary to further elaborate upon other factors that may also fundamentally alter human responses to this risk, in order to stimulate sufficient greenhouse gas reduction and adaptation strategies. For this, one must look to the literatures of institutional genesis and change, socio-technical systems, social movements, collective behaviour change theory, etc., to shed light on the underlying development paths which influence both capacity and action.

Similarly, from the point of view of policy, and moving more readily from capacity to action, the concept of response capacity, socio-economic and technological development pathways (such as capacity) is embedded within, thus, it suggest the need to consider carefully the socio-technical context within which climate policy responses must be undertaken. Actions inconsistent with development path trajectories are likely to face greater hurdles in implementation and may indeed not be given serious consideration. Whether adaptive, mitigative measures and actions are likely to compete for resources or else reinforce each other likewise will depend in part, on the nature of the development path within which they are expressed.

The extent, at which climate change policies are increasingly framed in terms of sustainability goals, reveals that the arguments presented in this paper suggest a crucial consideration that must be the question of how it may be possible to make a transition from currently dominant development paths to sustainable ones. This in turn, not only shifts the focus of concern somewhat from climate policy to sustainability policy (Robinson et al., 2006; Swart et al., 2003) but also suggests the importance of investigating and developing effective means by which perceived barriers can be overcome at the municipal, regional, national and international scales.

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