Psychology and Global Climate Change:
Addressing a Multi-faceted Phenomenon and Set of Challenges

A Report by the American Psychological Association's Task Force on the
Interface Between Psychology and Global Climate Change

Members

Janet Swim, PhD, Chair
Pennsylvania State University

Susan Clayton, PhD
College of Wooster

Thomas Doherty, PsyD
Sustainable Self, LLC

Robert Gifford, PhD
University of Victoria

George Howard, PhD
University of Notre Dame

Joseph Reser, PhD
Griffith University

Paul Stern, PhD
National Academies of Science

Elke Weber, PhD
Columbia University

* A final version of this report, including images and formatted as a booklet, will be available in the fall of 2009 on the APA website http://www.apa.org/science/.

TABLE OF CONTENTS

Executive Summary

Addressing climate change is arguably one of the most pressing issues facing our planet and its inhabitants. In bio and geophysical terms, climate change is defined as changes over time in the averages and variability of surface temperature, precipitation, and wind as well as associated changes in Earth's atmosphere, oceans and natural water supplies, snow and ice, land surface, ecosystems, and living organisms (Intergovernmental Panel on Climate Change [IPCC], 2007b). What is unique about current global climate change, relative to historical changes, is the causal role of human activity (also called anthropogenic forcing) and the current and projected dramatic changes in climate across the globe.

Our primary aim in our report is to engage members of the psychology community (teachers, researchers, those in practice, and students) in the issue of climate change. To this end, this American Psychological Association (APA) task force report describes the contributions of psychological research to an understanding of psychological dimensions of global climate change, provides research recommendations, and proposes policies for APA to assist psychologists' engagement with this issue.

Research review and recommendations

This APA Climate Change Task Force Report considers psychology's contribution to climate change by addressing the following six questions:

Section 1: How do people understand the risks imposed by climate change?

Long term climate is a phenomenon not easily detected by personal experience, yet one that invites personal observation and evaluation. Concern about adverse consequences of climate change (e.g., extreme weather events like droughts or floods) is low on average in places such as the United States, in part because small probability events tend to be underestimated in

decisions based on personal experience, unless they have recently occurred, in which case they are vastly overestimated. Many think of climate change risks (and thus of the benefits of mitigating them) as both considerably uncertain and also as being mostly in the future and geographically distant, all factors that lead people to discount them. The costs of mitigation, on the other hand, will be incurred with certainty in the present or near future. Emotional reactions to climate change are likely to influence perceptions of risk. Yet, emotional reactions to climate change risks are likely to be conflicted and muted because climate change can be seen as a natural process and global environmental systems perceived as beyond the control of individuals, communities, and quite possibly, science and technology. There is, however, significant variability in people's reactions to climate risks, much of which is mediated by cultural values and beliefs.

Section 2: What are the human behavioral contributions to climate change and the psychological and contextual drivers of these contributions?

Human actions that influence climate change include pressures due to population growth and region-specific types and patterns of consumption. Psychologists can help conceptualize and better understand psycho-social predictors of these driving forces. Psychologists can provide behavioral analyses of consumption by focusing on behaviors that contribute the most to climate. Individual predictors of consumption include ability (e.g., income, skills) and motivation (e.g., connection to nature, perceptions of needs versus a luxuries, core psychological needs) to engage in consumption. Contextual predictors of consumption, often mediated by individual level predictors, include the opportunities and constraints afforded by contexts (e.g., physical infrastructure, climate driving characteristics of where one lives) and motivators of consumption

primed by contexts (e.g., social and cultural norms, consumerism, cultural and societal orientation toward time and nature).

Section 3: What are the psychosocial impacts of climate change?

Although they cannot be described with certainty given current research, the cumulative and interacting psychosocial effects of climate change are likely to be profound. Heat, extreme weather events, and increased competition for scarce environmental resources, compounded by preexisting inequalities and disproportionate impacts among groups and nations, will affect interpersonal and intergroup behavior and may result in increasing stress and anxiety. Even in the absence of direct impacts, the perception and fear of climate change may threaten mental health. However, there is reason to believe that positive consequences are also possible, as people take collective responsibility for a shared problem.

Section 4: How do people adapt to and cope with the perceived threat and unfolding impacts of climate change?

Adapting to and coping with climate change is an ongoing and ever changing process that involves many intrapsychic processes that influence reactions to and preparations for adverse impacts of climate change, including chronic events and disasters. Psychological processes include sense making, causal and responsibility attributions for adverse climate change impacts, appraisals of impacts, resources, and possible coping responses, affective responses, and motivational processes related to needs for security, stability, coherence, and control. These processes are influenced by media representations of climate change, formal and informal social discourse that involving social construction, representation, amplification and attenuation of climate change risk and its impacts. These processes reflect and motivate intrapsychic responses (e.g., denial, emotion management, problem solving) and individual and community behavioral

responses. Individual and cultural variation influences all aspects of the process, providing

context, world views, values, concerns, resilience, and vulnerability.

Section 5: Which psychological barriers limit climate change action?

Many structural and psychological barriers stand in the way of behavioral changes that

would help limit climate change. Many people are taking action in response to the risks of

climate change, but many others are unaware of the problem, unsure of the facts or what to do,

do not trust experts or believe their conclusions, think the problem is elsewhere, are fixed in their

ways, believe that others should act, or believe that their actions will make no difference or are

unimportant compared to those of others. They may be engaged in token actions or actions they

believe are helpful but objectively are not. They have other worthy goals and aspirations that

draw their time, effort, and resources, or they believe that solutions outside of human control will

address the problem. Some or all of the structural barriers must be removed but this is not likely

to be sufficient. Psychologists and other social scientists need to work on psychological barriers.

Section 6: How can psychologists assist in limiting climate change?

Psychology can improve understanding of the behaviors that drive climate change by

building better behavioral models based on empirical analysis, providing deeper understanding

of individual and household behavior, and applying evaluation research methods to efforts to

develop and improve interventions. One of psychology's unique contributions is to

understanding behavior at the individual level. It has already broadened understanding of the

interactive roles of various personal and contextual factors in shaping environmentally

significant behavior and in understanding why people do and do not respond to the variety of

intervention types, including the use of persuasive messages, information, economic incentives,

and new technologies. It can contribute more in this area by helping to design more effective

interventions. Psychology can also help by illuminating the psychological factors affecting behavioral change in organizations, as well as cultural and policy change.

Topic specific research recommendations follow from our illustrations of how psychologists can help address these questions. These recommendations come at the end of each section. In many cases, research recommendations involve testing the generalizability of information derived from related areas to the context of global climate change. In other cases, the research recommendations highlight places where more research is needed to fully understand particular topics highlighted within each section.

Policy recommendations

A second aim of our report was to make policy recommendations for APA. We formulated recommendations to assist and encourage psychologists' engagement with climate change issues as researchers, academics, practitioners, and students, and to foster the development of national and international collaborations with other individuals and associations inside and outside of psychology. We also make recommendations to encourage APA to "walk the talk" by addressing our professional organization's contribution to greenhouse gas emissions and to be a role model for divisions within psychology.

Discussion

We conclude by summarizing the value of a psychological approach to studying climate change and research contributions. We discuss the importance of being attuned to diversity of human experiences in climate change analyses because various understandings of and responses to climate change will be influenced by one's worldview, culture, and social identities. We also discuss how APA ethical standard provide motivation for psychologists' engagement in climate change issues and challenges. Finally, we recommend that psychologists adopt the following

principles to maximize the value and use of psychological concepts and research for understanding and informing effective responses to climate change thereby maximizing their contribution to the science of climate change:

1. Use the shared language and concepts of the climate research community where possible and explain differences in use of language between psychology and this community;

2. Make connections to research and concepts from other social, engineering, and natural science fields;

3. Present psychological insights in terms of missing pieces in climate change analyses;

4. Present the contributions of psychology in relation important challenges to climate change and climate response;

5. Prioritize issues and behaviors recognized as important climate change causes, consequences, or responses. Be cognizant of the possibility that psychological phenomena are context dependent;

6. Be explicit about whether psychological principles and best practices have been established in climate-relevant contexts;

7. Be explicit about whether psychological principles and best practices have been established in climate-relevant contexts;

8. Be mindful of social disparities, ethical and justice issues that interface with climate change.

Preface

The mission of the American Psychological Association (APA) Climate Change Task Force was to report on the interface between psychology and global climate change, formulate research recommendations, and write policy recommendations for psychological science. In this report we summarize research illustrating a psychologically informed understanding of global climate change and its impacts, mitigation, and adaptation. We also identified areas for future research and policy recommendations. The following paragraphs provide some background on our task force report.

Our first challenge was to determine our audience. We believe that psychology has a crucial contribution to make to multidisciplinary and transdisciplinary efforts in the context of global climate change, both nationally and internationally—a view that was shared by the external reviewers of this report. Further, psychology can assist policy makers, funding agencies, public and private organizations, local and regional government bodies, nongovernment organizations, and the general public. Yet, we also believe that it is important to more fully engage the psychological community (teachers, researchers, practitioners, and students) in issues related to global climate change. Given the instruction to formulate policy and research recommendations for psychological science, we decided that our primary target audience should be members of the psychology community. It is hoped that this report can help psychologists become more knowledgeable about how their field can inform the discourse on climate change. A deeper engagement would be to incorporate the urgency and challenges of global climate change into psychology research; to inform students about the psychological aspects of climate change; and to incorporate climate change considerations and public concerns in psychological interventions. For instance, psychologists in the community can help address

environmental worries and anxieties or assist communities and organizations in their efforts to address causes and consequences of climate change. While psychology has already contributed much to collaborative efforts addressing climate change, we believe that psychologists can do much more. We also would be very pleased if this report inspires a greater appreciation of psychology's contributions to understanding and addressing climate change, and facilitates collaborative initiatives with others outside of psychology.

Two overriding considerations guided the writing of the report. First, based upon our understanding of scientific evidence, we strongly believe that global climate change impacts constitute a significant threat and challenge to human health and well being and that human behaviors are a primary driver of climate change. We believe that people from all walks of life need to work together to prevent future harm. We recognize that psychologists address a number of important issues. We do not mean to imply that addressing global climate change is more important than other work psychologists do and do not see them as mutually exclusive. At a professional level, some psychologists may choose to focus on climate change in their practice, research, or teaching; others may consider ways in which their work and basic research can inform and be informed by research on global climate change. Still others may simply learn more about what others in their field are doing.

The second consideration was the critical need for informed decision making. In our report, we sought, wherever possible, to identify psychological knowledge derived from and clarified by climate-relevant empirical research. In areas where there was a dearth of climate change-relevant research we identified findings that could be applied and evaluated in a climate change context. Our goal was to provide a review of psychological research that would be a

resource for psychologists (teachers, researchers, and practitioners) and students of psychology (undergraduate, graduate, and post-doctoral fellows).

We review psychological research within the context of central themes (i.e., causes, impacts, and responses—including adaptation and mitigation) that characterize current discourse within climate change science and the human dimensions of global change literature. These themes were chosen, in part, to assist psychologists in their interactions with others studying climate change and to structure the report given the very diverse nature of relevant psychological research. Based upon these themes, we framed plain language questions that psychologists are currently addressing and could more fully address in the future. At the end of each section answering each question, we provide research recommendations. One to three task force members took responsibility for each section of the report as well as the preface, introduction, and conclusion. We did not identify authors for each section because there was much collaboration in the development, writing, and revision of each section.

As noted, we sought to identify psychological research and practice that has been specifically applied and tested in the arena of climate change. As may be expected, this led us to begin with research and practice in environmental and conservation psychology, the literature on natural and technological disasters, and clinical perspectives associated with ecopsychology. Our committee was novel in that it included social, counseling, cognitive, and clinical psychologists in addition to environmental psychologists and those specializing in global environmental change. It also included representation from several countries (the United States, Canada, Australia, and one member with dual citizenship in the United States and Germany).

Global climate change is a complex and multifaceted phenomenon that can be understood from a number of perspectives. In our report, we were unable to give full attention to all

potentially relevant areas of research and practice. This includes the literature on place attachment and identity, the restorative benefits of natural environments, and the effectiveness of environmental education programs. In addition, a number of existing psychological theories and interventions could be effectively applied in the arena of climate change. Again, we focused our report on findings that were empirically supported in a climate-relevant context.

 Finally, we formulated recommendations to assist and encourage psychologists' engagement with climate change in their roles as researchers, academics, practitioners, and students. We also sought to foster the development of national and international collaborations with individuals and associations inside and outside of psychology. We also made recommendations to the governing body of the APA to consider environmentally relevant behavior in the organization by examining the association's contribution to green house gas emissions and to provide leadership on climate change-related activities for the special-interest divisions within the organization.

We would like to express our appreciation to all the staff at APA that helped us develop this report. This includes Nicolle Singer, our primary staff assistant, Howard Kurtzman, Deputy Executive Director of the APA Science Directorate, Steve Breckler, Executive Director of the APA Science Directorate, and Bob Steward and Dean Pawley who made our virtual meetings and sharing of documents possible. We would also like to thank the support and encouragement we received from APA presidents Alan Kazdin, 2008, and James Bray, 2009.

We would like to thank the reviewers who helped improve the form and content of this report. This includes the following reviewers who were members of APA Boards and committees: Judith Blanton, Art Blume, Eve Brank, Ronald Brown, David DeMatteo, Michael Edwards, Pamela Ebert Flattau, Sue Frantz, Ron Hambleton, Laura Johnson, Kathy McCloskey,

Kevin Murphy, Kurt Salzinger, Richard Velayo, and Maria Cecelia Zea. It includes the

following psychologists with expertise on environmental psychology and related topics: Lisa

Aspinwall, Timothy Kasser, Ellen Matthies, Paul Slovic, Linda Steg, David Uzzell, and Deborah

Winter. It also includes the following experts from fields outside of psychology: Anne Ehrlich,

Paul Ehrlich, Susan Moser, Melissa Payne, and Brent Yarnal.

Introduction

>The long-term good health of populations depends on the continued stability and functioning of the biosphere's ecological and physical systems, often referred to as life-support systems. We ignore this long-established historical truth at our peril: yet it is all too easy to overlook this dependency, particularly at a time when the human species is becoming increasingly urbanized and distanced from these natural systems. The world's climate system is an integral part of this complex of life-supporting processes, one of many large natural systems that are now coming under pressure from the increasing weight of human numbers and economic activities.   (McMichael, 2003)

Climate change is more than changes in weather. Climate Change is defined by the Intergovernmental Panel on climate change (Intergovernmental Panel on Climate Change [IPCC], 2007b) as "any change in *climate* over time, whether due to natural variability or as a result of human activity." Changes in climate refer to changes in means and variability of, for instance, temperature, precipitation, and wind over the course of months to millions of years. More broadly, climate refers to changes in atmosphere (gaseous envelope surrounding the earth), hydrosphere (water on the surface of the earth), cryosphere (snow, ice, and permafrost on and beneath the surface of the earth and ocean), land surface, and biosphere (ecosystems and organisms living in the atmosphere, land, and oceans). Global climate change is fundamentally a biophysical phenomenon. However, the recent and accelerating warming of the earth's climate is largely attributable to human activity, and its impacts are mediated by psychological and social processes and can be limited primarily by human activity.

This American Psychological Association (APA) task force report describes how psychology can help better understand the causes and consequences of climate change and can contribute to humanity's response to the continuing process of global climate change. Psychologists as members of an intellectual and practice community have relevant skills for understanding why and how humans act in ways that contribute to climate change; the

psychosocial impacts of climate change; and ways to assist society in responding to current and anticipated impacts of climate change via both adaptation strategies to lessen impacts and actions to reduce greenhouse gas emissions. To effectively contribute, psychologists need to communicate with other disciplines in the social and natural sciences and develop more widely shared understandings of relevant human phenomena associated with climate change that can be integrated with understandings and frameworks of other disciplines.

The most recent major international scientific consensus evaluation concluded that human activities are changing the climate at a planetary level, that many geophysical and biophysical impacts are already evident, and that further such effects are inevitable (IPCC, 2007c). The present report, following the lead of other climate change summaries (e.g., Confalonieri et al., 2007; Gilman, Randall, & Schwartz, 2007) works from the findings of the Intergovernmental Panel on Climate change (IPCC) Working Group II's conclusions about the high probability (67 to 95 percent likelihood) that climate change will result in the following:

- Higher maximum temperatures leading to increased heat related deaths and illnesses and heat-related impacts on livestock, wildlife, and agriculture.

- Higher minimum temperatures contributing to an extended range of some pest and disease vectors.

- More intense precipitation events leading to increased floods, land and mudslides, and soil erosion.

- Increased summer drying and drought associated with decreases in crop yields and in water resource quality and quantity and increased risk of forest fire.

- Increase in tropical cyclone wind and precipitation intensities leading to increased risk to human health, risk of infectious disease epidemics, coastal erosion and damage to coastal

infrastructure, and damage to coastal ecosystems.

The projections for effects of climate change typically are through 2050 or 2100. It is important to note, though that some believe climate change impacts are already occurring and the impacts will last for next millennium and beyond. Yet, continued research is needed to be able to identify the time course of various impacts. The precise timing and intensity of these events are unknown because, for instance, they are dependent upon how people respond, there are likely unpredictable impacts due to interdependence of biophysical phenomena, and there are likely different time courses for different events.

Although other environmental concerns are also pressing, climate change deserves concerted attention because irreversible changes in earth systems due to climate change (on a 1000 year time frame) will require profound adaptation (IPCC, 2001, 2007c; Solomon, Plattner, Knutti, & Friedlingstein, 2009) and because preventing even more severe changes will require significant alterations in individual and collective behavior.

Some have argued that the impacts of climate change will not be universally negative; there will be both "winners" and "losers"; some regions may benefit by, for instance, being able to increase agricultural production, having access to oil reserves in previously inaccessible areas (such as Siberia), supporting human inhabitants in areas (such as Northern Canada) that were previously inhospitable to humans, and greater good to all with increase in wealth due to the above changes and distribution of positive consequences of wealth to others (Easterbrook, 2007). Yet, this implies that the presence of winners negates concern about "losers." It neglects the interdependency among people and assumes that the misfortunes of some will have little or no negative impact on those who have benefitted. Further, it does not take into account the full range of predictions about climate change and the potential for feedback loops. The greater the

increase in temperatures, the fewer "winners" there will be and ironically, if "winners" contribute to climate change with high levels of emissions perhaps due to their improved life circumstances, many may become losers as the magnitude of changes increases. Further, attending to the adverse impacts of climate change is consistent with psychological ethical principle of avoiding harm and ensuring human welfare and psychologists work with marginalized groups who are most apt to experience negative impacts. For reasons such as these, we focus on the risks and negative impacts of climate change.

This report considers psychology's contribution to understanding and responding to climate change by focusing on psychological dimensions of climate change. We do this by reviewing what psychological research can tell us about perceptions and conceptions of global climate change, human activities that drive climate change, the psycho-social impacts of climate change, barriers to responding to climate change, and human responses to climate change via adaptation and mitigation. After a review of the literature, we recommend ways that the APA can: 1) Encourage psychologists to become involved in understanding human and psychological dimensions of global climate change; 2) Create effective outreach programs that assist the public in understanding of climate change, mitigating its human causes, and adapting to climate change impacts, and facilitate international, cross-disciplinary, trans-disciplinary collaborations that address a climate change; and 3) Address the organization's environmental impacts that contribute to global climate change.

Addressing climate change: Psychology's contribution

There are a number of qualities associated with Psychology that position psychologists to provide meaningful contributions to addressing climate change and its impacts. These qualities can be found in other fields as well, particularly other social sciences. Yet, they point to the

types of contributions that Psychological can make, the necessity for those in the social sciences, including psychology, to contribute for progress on addressing climate change, and why some have argued that psychologists have a responsibility to contribute to efforts to address climate change (e.g., Clayton & Brook, 2005; Miller, 1969).

First, psychologists' provide a theoretically and empirically based understanding of human behavior at the individual level. This level of analyses is relevant for understanding the human-causes of climate change because it is the collective impact of human behaviors that are contributing to climate change (Clayton & Brook, 2005; Gifford, 2008). An individual level of analyses is relevant for understanding the impacts of climate change and the ways individuals adapt to climate change because impacts and coping responses include psychological responses (e.g., anxiety), psychological processes (e.g., denial , emotion regulation) and individual and interpersonal behavioral processes (e.g., seeking social support, civic engagement). Further, efforts to encourage mitigation and structural changes for adaption to climate change will need to attend to the decision makers and members of the general public and social groups. The effectiveness of various policies (e.g., cap and trade) requires the involvement and support of people. Psychologists can help by providing links between environmental policies and individuals by attending to the ways that individuals and communities may or may not be receptive to or even react against environmental policies developed by government officials including whether their reaction to policies are function of the policies themselves or other factors such as their relationship to government and their preferences for nongovernmental solutions (Gifford, 2008; Spence, Pidgeon, & Uzell, 2009).

Second, psychologists, along with other social science disciplines, have long recognized the importance of the proximal (e.g., the presence of others, structures of neighborhoods) and

distal (e.g., cultural and economic) contexts for determining behaviors and this is important for environmental behaviors as well (Clayton & Brook, 2005; Wapner & Demick, 2002). The ability to attend to both individual level analyses and contexts is necessary to fully address human behavior in multiple contexts. Further, a defining feature of environmental psychology has been attention to the relationships individuals have with their environments.

Third, psychologists have uncovered individual, interpersonal, and social forces capable of changing human behavior that are not otherwise clearly or widely understood. Although people seem able to articulate their opinions, beliefs, and preferences accurately, they are notoriously poor at recognizing the causes of their behavior (Nisbett & Wilson, 1977). In the realm of energy consumption, for example, people will frequently misinterpret the true causes of actions that facilitate or retard their climate control efforts (Nolan, Schultz, Cialdini, Goldstein, & Griskevicius, 2008). Through behavioral-investigations employing experimental and non-experimental methodologies, psychologists can identify the actual determinants of energy consumptive behaviors, many of which are psychological in origin, and can highlight them in communication campaigns to encourage people to behave in more sustainable ways and to promote energy conservation.

Fourth, there are many current and predicted intrapersonal, interpersonal, and intergroup consequences of climate change. Psychologists are well-positioned to design, implement, and assess interventions to ameliorate the psychosocial impacts of climate change. This has been illustrated through important service provided to victims of extreme weather events such as Hurricane Katrina (Professional Psychology: Research and Practice, 2008). Intergroup rivalry and ethical concerns about environmental justice are likely to become more salient as environmental problems are interpreted through the lens of climate change (Clayton & Brook,

2005; Spence et al., 2009). Psychologists' understanding of how ideologies, values, and beliefs manifest on individual and group levels can help explain and address emotional reactions to the social justice issues inherent in climate change impacts (Spence et al., 2009).

Mobilizing the diverse field of psychology to address climate change

While environmental psychologists have contributed much of the work on environmental sustainability, there are opportunities for the broad field of psychology to contribute to humanity's response to climate change. The sub-discipline of environmental psychology began early in the 20th century and its focus on environmental degradation increased in the 1960's. It was not until the 1980's, however, that research in this area expanded to take on large-scale environmental problems. As Gifford (2007) notes: "Instead of trying to understand territoriality in the office or values as they influence the perception of landscapes, the goals of some became trying to understand and solve resource dilemmas, traffic problems, urban blight, and crimes against nature" (p. 200). Gifford describes several themes in environmental psychology that have emerged over the last 50 years that are relevant to climate change: 1) an interest in how environmental psychology can inform and aid public policy; 2) attention to technology both as a contributor to environmental problems and as a means to improve sustainability; 3) a tendency to value and benefit from multi-disciplinary collaborations and theories from other fields, 4) expansion of interests to include multiple levels of analyses from small scale studies of individuals and small groups to larger scale issues of sustainability, issues facing nonhuman biological world, and large sale ecological problems such as the impending world water crises.

The multiple current and potential impacts of climate change on individuals' psychological health and functioning indicates that psychology's involvement in addressing global climate change should not be left only to an environmental sub-discipline of psychology.

The expertise found in a variety of fields of psychology adds to the discipline's ability to contribute solutions to many problems associated with climate change. This includes mobilizing psychologists to address issues ranging from coping with perceived threats of climate change to trauma stemming from experience of climate-related weather disasters. Experts in community, business, and organizational behavior can address changes necessary at the systemic and human behavioral levels as businesses and nonprofit organizations adapt to a changing environment. Other psychologists provide an understanding of how people across the lifespan can adapt to climate change. Psychologists can also design effective methods to integrate an environmental focus into psychology and other curricula. Experts in international and peace psychology can intervene as intergroup conflicts develop due to decreasing resources and forced migrations associated with a changing climate. These are just a few of the ways that psychologists' knowledge and techniques interface with global climate change.

<div align="center">**Background information**</div>

Fundamentals of climate change

Earth's temperature and climate have fluctuated over the course of millions of years. Over the past century or so, however, human activities have driven Earth's climate out of the temperature range within which human civilization developed during the past 10,000 years—and further warming is inevitable because of the physical properties of the climate system (IPCC, 2007c).

This climate change, recent in geological terms, is a result of several changes in human activities that accelerated with industrialization in the 19th Century and increased exponentially since. These activities, sometimes called driving forces (National Research Council, 1992), have produced rapid increases in climate forcing factors, chiefly releases of greenhouse gases (GHG)

and land cover changes that alter Earth's albedo, or reflectivity of energy coming from the sun.

The most important GHG are carbon dioxide (CO_2; from fossil fuels, manufacturing,

deforestation, and decaying plants), methane (CH_4; from production and transport of fossil fuels,

livestock and other agricultural practices, and decay of organic waste in municipal solid waste

landfills), nitrous oxide (N_2O; from agricultural and industrial activities, combustion of fossil

fuels, and solid waste, and fluorinated gases from industrial processes (U.S. Environmental

Protection Agency, 2009).

Climate models simulate the impact of greenhouse gases and other forcing factors on

climate characteristics (e.g., average world temperature). Longer-term projections rely in part on

scenarios of future drivers, based on assumptions about factors such as the size of future human

population, future economic growth, and extent and success of mitigation efforts. The IPCC

estimated that global mean temperature at the end of the 21st century would be between 0.3 and

6.4 degree C higher than 1980 to 1999 conditions (IPCC, 2007c). Other more recent models

indicate greater likelihood of more extreme temperature changes (e.g., 90% probability of 3.5 to

7.4 degree C changes by 2100; (Sokolov, et al., in press). It is important to note that climatic

change affects factors other than temperature (e.g., precipitation patterns, ecosystem functions,

and fresh water supplies, to name just a few). In addition, the temperature changes can vary

substantially from the global mean value and are projected to be considerably higher than

average over land and in high latitudes.

The IPCC report outlines several domains in which consequences are occurring or are

expected from climate change. Figure 1 shows anthropogenic drivers, impacts, and responses to

climate change. It identifies effects on average precipitation, temperatures, and sea levels, and

extreme events that in turn affect ecosystems, food supplies and security, water supplies, and

human health and settlements. Human responses to these changes and threats are usually

classified as mitigation (human interventions to reduce anthropogenic drivers of climate systems)

and adaptation ("adjustments in natural or human systems in response to actual or expected

climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities"

(IPCC, 2007b). Finally, the drivers, impacts, and responses are all affected by socioeconomic

changes, such as in patterns of production and consumption, government policies, and use of

technology.
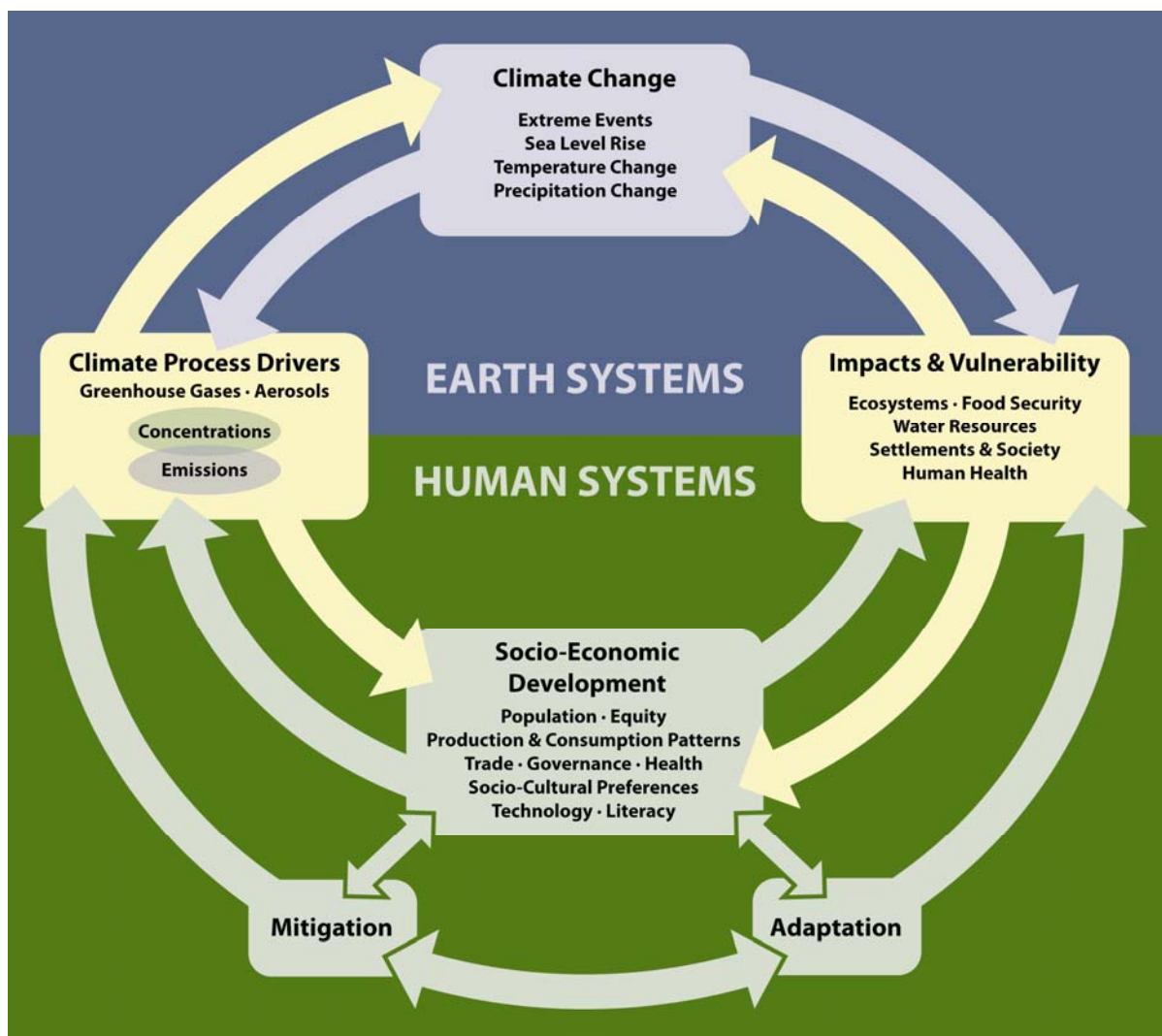
Figure 1: Schematic framework of anthropogenic climate change drivers, impacts, and responses

(from IPCC, 2007a).

Human dimensions of climate change

Human interactions with climate change include human drivers or causes (e.g., fossil fuels, land use and land use change), human impacts or consequences (e.g., changes in the intensity and frequency of natural disasters, in water supplies, in food production, and threats to public health), and human responses (e.g., individual and group attempts to mitigate climate change or adapt in ways that reduce damage from climate change that were not avoided). These interactions occur at multiple levels involving individuals, households, organizations, governments, and societies. There is also a temporal dimension to human dimensions of climate change. Human contribution to climate change has changed over the course of history as people alter Earth's surface and use technologies that release GHG. The connections between humans and climate change are inseparable from their connections to other animals and the rest of nature, though the extent to which people attend to this interaction various across individuals, societies, cultures, and time. Psychologists and other social scientists are working to develop better understanding of these human dimensions of climate change.

Psychological dimensions of climate change

Psychology can provide insights into the meanings of climate change to individuals and societies. For example, people do not directly experience climate change. They experience representations of climate change that are presented to them via various media and educational sources and personal interactions and, influenced by such presentations, they may interpret certain events they do experience, such as hurricanes or wildfires, as manifestations of climate change.

Generally, people's understandings of climate change underlie their willingness to act, and to support public policies, in response to it. As described below, achieving an appropriate

understanding is difficult for many reasons. The effects of climate are uncertain and the effects that are known are difficult for lay people to discern. Climate change is not a hazard per se, but a potential driver of many different hazards. Many impacts are place-specific due to variation in effects regionally, nationality due to geographic differences as well as differences in resources available for adaptation. We can also expect to be surprised by climate-driven events, possibly including having to experience events that science has not yet even warned about. Many of our expectations about climate may be outmoded because global temperature is moving outside the range within which it has fluctuated throughout recorded human history. Climate change is also accelerating and does not necessarily following linear trends, so recently experienced events may be bad guides as to what to expect. While many current effects are urgent and consequential, some of most serious impacts will come far in the future, beyond the planning horizons of most individuals and organizations. Finally, the world will be changing as climate changes, making confident anticipation even more difficult.

Figure 2 elaborates the human dimensions of climate change and suggests what psychology can contribute to climate change analyses and discussions. At the top of the model is climate change. Although climate change is a physical process, it is driven by social processes and understood through social processes, including interpretations of events presented in the mass media. Human behavioral contributions to climate change (on the left side of the model) occur via the use of goods and services that directly influence the environment (environmental consumption), which is linked to economic consumption (expenditures on goods and services). The impacts of climate change (noted on the right side of the model) go beyond the biological, physical health, and changes in human settlements. Climate change impacts may also include individual and social perceptions of the risks, psycho-social well-being, aggression, intergroup

outcomes, and community building. Individuals and communities vary in their vulnerability to climate change and capacity to adapt, and these variations can raise ethical issues. The impacts of climate change affect and are affected by the ways that individuals and communities adapt (as noted in the bottom right hand corner of the figure). Adaptation includes a range of coping actions that individuals and communities can take, as well as psychological processes (e.g., appraisals and affective responses) that precede and follow behavioral responses.

Efforts to mitigate climate change (noted on the bottom left hand corner of the figure) can both decrease the human contribution to climate change and improve individual's psychological well-being. However, mitigation policies can also meet resistance. A number of institutional, cultural, and individual influences (as noted on the bottom center of the figure) influence patterns and amount of consumption, the impacts of climate change on individuals and societies, adaptation processes, and attempts at mitigation. The review of research that follows this background section elaborates on all of these points.
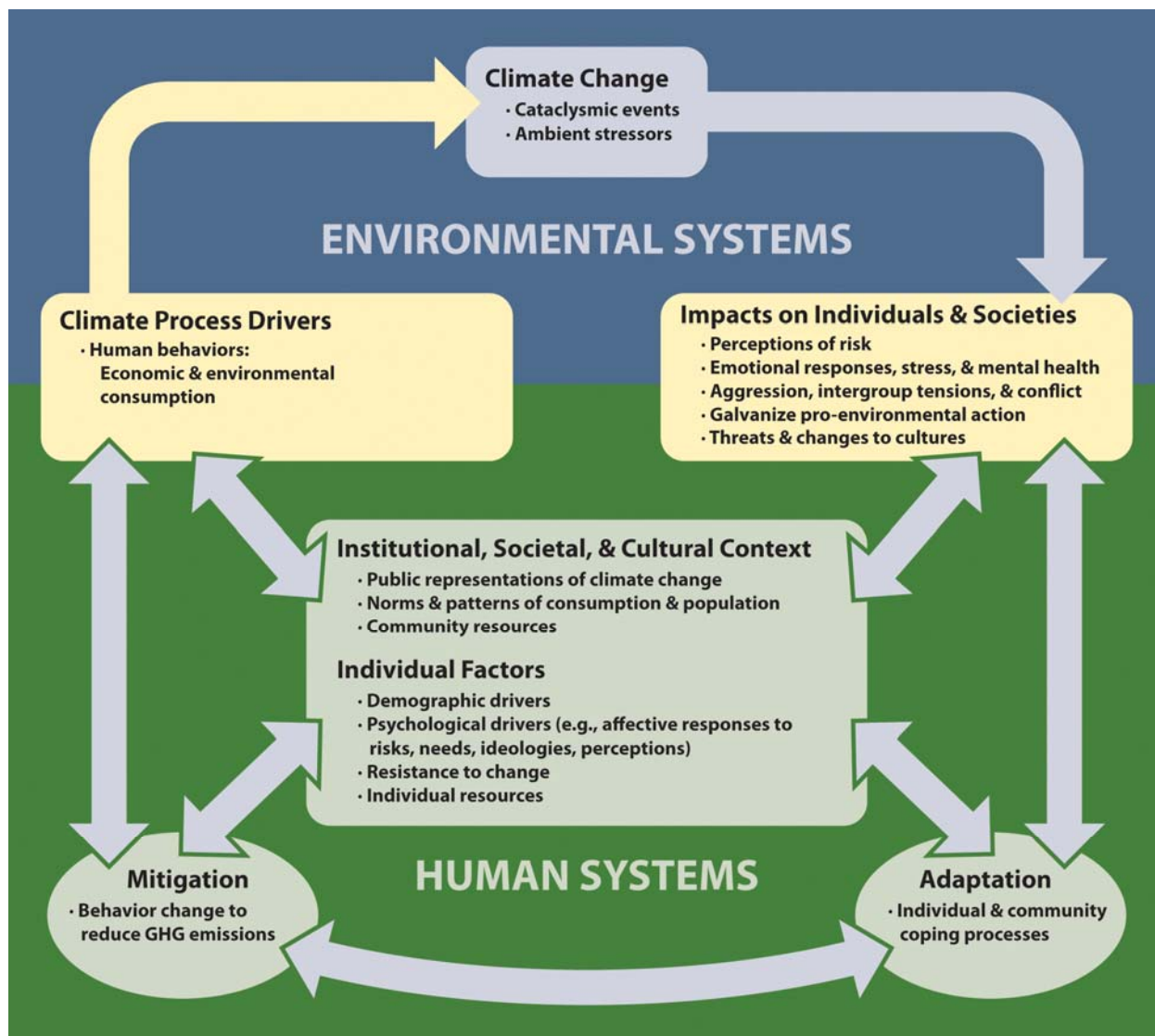
Figure 2: Psychological perspectives on anthropogenic climate change drivers, impacts, and responses.

Literature review

In the literature review that follows, we discuss what current psychological research can tell us about human understanding of climate change, human behavioural contributions to or drivers of climate change, psychological aspects of the impacts of climate change, and responses and lack of responses to the anticipation and experience of climate change. We do this by addressing the following six questions:

1. How do people understand the risks imposed by climate change?

2. What are the human behavioral contributions to climate change and the psychological and contextual drivers of these contributions?

3. What are the psychosocial impacts of climate change?

4. How do people adapt to and cope with the perceived threat and unfolding impacts of climate change?;

5. Which Psychological Barriers Limit Climate Change Action?

6. How Can Psychologists Assist in Limiting Climate Change?

These questions follow mental models of hazards that include identification of the problem, causes, consequences, and controls or solutions (Bostrom & Lashof, 2007).

The first question examines psychological processes that influence answers to the remaining questions. The second question addresses psychological understanding of human causes or drivers of climate change. The third question addresses a psychological understanding of the impacts of climate change. The remaining questions address psychological responses to climate change via adaptation (question 4) and mitigation (question 5 and 6). Together these questions inform the psychological dimensions of climate change.

Although climate change is global, much of the relevant psychological research has been done in North America, Europe, and Australia. There are notable differences among these countries, for instance, in the extent to which impacts of climate change have been salient. Perhaps more importantly, though, are possible differences among these and other countries in extent of economic development and associated wealth. Other potentially important differences emerge when one considers different culture views about nature across countries and within countries. Little psychological research, however, has addressed these types of differences.

When we are aware of research that has done so, we mention it. However, it is a limitation of

the literature review.

Section 1: How Do People Understand The Risks Imposed By Climate Change?

The understanding of climate change, both in its causes and in its likely effects, by the average citizen across different regions of the world is limited. Psychological research has started to examine reasons for this shortcoming. Analogies from failures to fully understand and take action in other domains provide hypotheses about cognitive and motivational challenges that need to be overcome, but tests of these hypotheses applied to climate change are only starting to emerge, and much work remains to be done to illuminate the special questions and challenges that the proper understanding and its action implications bring.

Detection of climate change

Climate is a statistical and thus technical concept and is described by the distributions of such variables as temperature and precipitation in a region, collected over time. The average person is rarely concerned about the climate in her region, but thinks a lot about the weather. However, climate information is sometimes used for planning and decision making, as for example, when a farmer decides which crop variety to plant or a student considers average March temperatures in different regions of the world to determine where to go for spring break.

While a region's climate and changes in its climate obviously determine its weather patterns, weather events—even extreme ones—are not necessarily diagnostic of changes in the climate. Climate change is a trend in averages and extremes of temperature, precipitation, and other parameters that are embedded in a lot of variability, making it very difficult to identify from personal experience. People often falsely attribute unique events to climate change and also fail to detect changes in climate.

Expectations of either change or of stability play a large role in people's ability to detect trends in probabilistic environments, as illustrated by the following historic example

(Kupperman, 1982, as reported in Weber, 1997, and NRC, 1999). English settlers who arrived in North America in the early colonial period assumed that climate was a function of latitude. Newfoundland, which is south of London, was thus expected to have a moderate climate. Despite repeated experiences of far colder temperatures and resulting deaths and crop failures, colonists clung to their expectations based on latitude, and generated ever more complex explanations for these deviations from expectations. In a more recent example, farmers in Illinois were asked to recall salient temperature or precipitation statistics during the growing season of seven preceding years (Weber & Sonka, 1994). Those farmers who believed that their region was undergoing climate change recalled temperature and precipitation trends consistent with this expectation, whereas those farmers who believed in a constant climate, recalled temperatures and precipitations consistent with that belief. Both groups showed similar degrees of error in their weather event memories, but farmers' beliefs and expectations biased the direction of the errors.

Because climate change is so hard to detect from personal experience, it makes sense to leave this task to climate scientists. This makes climate change a phenomenon where people have to rely on scientific models and expert judgment, and/or on reports in the mass media, and where their own personal experience does not provide a trustworthy way to confirm the reports. For most people, their exposure to and experience of "climate change" has been almost entirely indirect and virtual, mediated by news coverage and film documentaries of events in distant regions (such as melting glaciers in Greenland) that describe these events in relation to climate change.

A long tradition of psychological research in risk communication (e.g., DiMento & Doughman, 2007; Leiserowitz, 2004, 2006; Moser & Dilling, 2007a; O'Connor, Bord, Yarnal, &

Wiefek, 2002) has included studies of often apocalyptic risk messages about impending and unfolding climate change impacts. Social representations of environmental threats can themselves have dramatic psychosocial impacts, and the psychological and interdisciplinary literature on risk communication and on risk appraisal and response is providing important pointers to the nature of such media impacts (Bartsch, Vorderer, Mangold, & Viehoff, 2008; Gifford et al., 2009; Pidgeon, Kasperson, & Slovic, 2003; Slovic, Finucane, Peters, & MacGregor, 2006; Weber, 2006). These research findings suggest further research on how media coverage and other risk communications can affect individuals' and communities' understandings of climate change and their responses to the risks, including coping, social amplification, and willingness to embrace social, lifestyle, and technological changes (Reser, 2009).

The distinction between personal experience of possible outcomes and statistical description of possible outcomes has received much recent attention because the ostensibly same information about the consequences of decisions and their likelihoods can lead to different perceptions and actions, depending on how the information is acquired (Hertwig, Barron, Weber, & Erev, 2004). Decisions from repeated personal experience with outcomes involve associative and often affective processes, which are fast and automatic (Weber, Shafir, & Blais, 2004). Processing statistical descriptions, on the other hand, requires analytic techniques that need to be learned and require cognitive effort. People's choices can differ dramatically under the two information conditions, especially when the small-probability events are involved, which is certainly the case with climate risks. The evaluation of risky options under repeated sampling follows classical reinforcement learning models that give recent events more weight than distant events (Weber et al., 2004). Such updating is adaptive in dynamic environments where

circumstances might change with the seasons or according to other cycles or trends. Because rare events have a smaller probability of having occurred recently, they tend (on average) to have a *smaller* impact on the decision than their objective likelihood of occurrence would warrant. But when they do occur, recency weighting gives them a much *larger* impact on the decision than warranted by their probability, making decisions from experience more volatile across respondents and past outcome histories than decisions from description (Yechiam, Barron, & Erev, 2004).

For most people in the United States, perceptions of the risks of climate change that rely on personal experience will lead to the judgment that the risks are low. The likelihood of seriously and noticeably adverse events as the result global warming is bound to be small for the foreseeable future for many regions of the world. Even individuals whose economic livelihood depends on weather and climate events (e.g., farmers or fishers) might not receive sufficient feedback from their daily or yearly personal experience to be alarmed about global warming, though recent surveys conducted in Alaska and Florida (two states in which residents in some regions have increasingly been experiencing climate-change driven changes personally) show that such exposure greatly increases their concern and willingness to take action (Arctic Climate Impact Assessment, 2004; Leiserowitz & Broad, 2008). Climate scientists have experience-based reactions to the risks of climate change. However, by virtue of their education and training, they can also be expected to place greater reliance than members of the general population on their analytical processing system, and their consideration of statistical descriptions and model outputs will thus make them more likely to consider global climate change to be a more serious risk than typical nonscientists.

Concern about climate change

Human perceptions and judgments about climate change are important because they affect levels of concern and, in turn, the motivation to act. Public opinion data in the United States indicate that climate scientists are more concerned about the possibly severe effects of climate change on human populations, ecosystems, and infrastructures than average citizens and governmental officials (Dunlap & Saad, 2001). One national representative opinion poll shows that 47% of people polled view global warming as a "very serious" problem, and another 28% view it as a "somewhat serious" problem (Pew Project, 2006). This level of concern—75% of people in the U.S. assessing global warming as a "very" or "somewhat" serious problem—is similar to the level in Russia (73%) and lower than that in many other nations: 87% of Canadians, 81% of Mexicans, 95% of French, 88% of Chinese, 97% of Japanese, 96% of Brazilians, and 94% of Indians assess global warming as a "very" or "somewhat" serious problem. Regardless of the stated level of concern however, few people in the U.S. see climate change as an immediate risk and tend to rank it as less important than many other social issues like the economy and terrorism (Krosnik, Holbrook, Lowe, & Visser, 2006; Leiserowitz, Kates, & Parris, 2005). This comparative lack of concern about climate change consequences is strongly related to political ideology (Dunlap & Saad, 2001) and poses a problem for effective communication about these risks (Comeau & Gifford, 2008; Marx et al, 2007).

(Not) feeling at risk

Evidence from cognitive, social, and clinical psychology indicates that risk perceptions, in a broad range of domains, are influenced by associative and affect-driven processes as much or more than by analytic processes (Chaiken & Trope, 1999; Epstein, 1994; Sloman, 1996). Our associative processing system is evolutionarily older, automatic, and fast. It maps experienced uncertain and adverse aspects of the environment into affective responses (e.g., fear, dread,

anxiety) and thus represents *risk* as a *feeling* (Loewenstein, Weber, Hsee, & Welch, 2001).

Analytic processing, on the other hand, works by algorithms and rules (e.g., the probability

calculus, Bayesian updating, formal logic, and utility maximization) that must be taught

explicitly. It is slower and requires conscious effort and control. The perceptions of climate

change and its risks by climate scientists are based in large part on analytic processing, as these

experts have been trained as scientists in the necessary analytic tools and have the necessary

information required by them. Nonscientists, on the other hand, typically rely on the more

readily available associative and affective processing. If risk perceptions were driven mostly or

exclusively by analytic considerations of consequences, they would not be influenced by the way

a particular hazard is labeled. Yet, reports about incidences of "mad cow disease" elicit greater

fear than reports about incidences of bovine spongiform encephalitis (BSE) or Creutzfeld-Jacob

disease, the more abstract, less affect-laden scientific labels for the same disorder (Sinaceur,

Heath, & Cole, 2005).

The two types of processes typically operate in parallel and interact with each other.

Analytic reasoning cannot be effective unless it is guided and assisted by emotion and affect

(Damasio, 1994). In cases where the outputs from the two processing systems disagree,

however, the affective, association-based system usually prevails, as in the case of phobic

reactions, for which people know perfectly well that their avoidance behavior is at best

ineffective and possible harmful to them, but cannot suspend it (Loewenstein et al., 2001).

Global climate change appears to be an example where a dissociation between the output of the

analytic and the affective system results in less concern than is advisable, with analytic

consideration suggesting to most people that global warming is a serious concern, but the

affective system failing to send an early warning signal (Weber, 2006).

Psychological or affective risk dimensions strongly influence judgments of the riskiness of physical, environmental, and material risks in ways that go beyond their objective consequences (Slovic, Fischhoff, & Lichtenstein, 1986; Holtgrave & Weber, 1993). People's judgments of the similarities between pairs of different health and safety risks can be placed into a two-dimensional space (shown in Figure 1) that has been replicated across numerous studies in multiple countries (Slovic, 1987). The first dimension of this space, "dread risk," captures emotional reactions to hazards like nuclear weapons fallout, nuclear reactor accidents, or nerve gas accidents that speed up people's heart rate and make them anxious, because of perceived lack of control over exposure to the risks and due to consequences that are catastrophic. The second dimension, "unknown risk," refers to the degree to which a risk (e.g., DNA technology) is new, with unforeseeable consequences not yet tested by time. How much is known about the hazard and how easily are exposure and adverse consequences detectable?
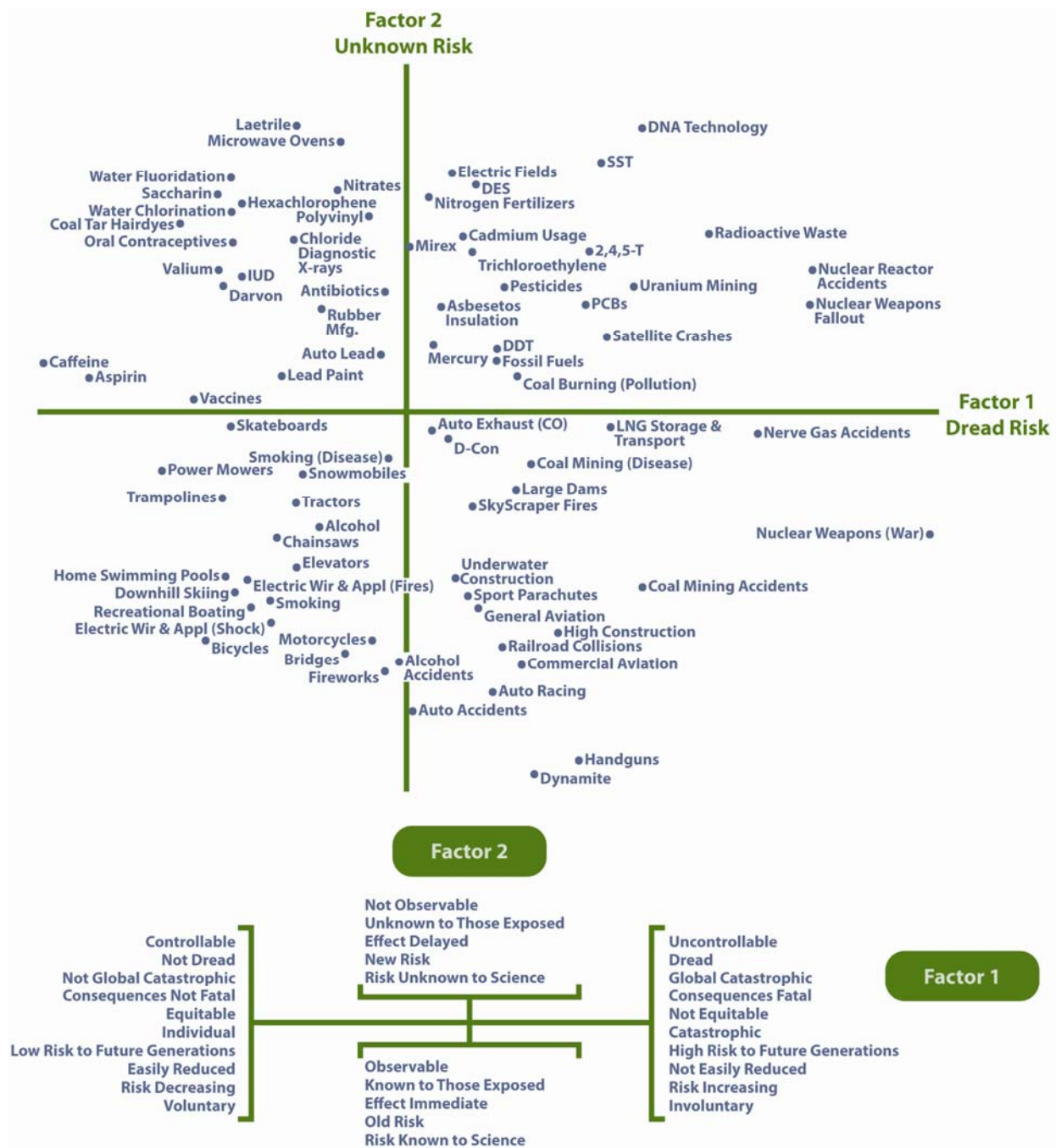
Figure 3: Location of 81 hazards in a two-dimensional space derived by factor analysis from the intercorrelations of 15 risk characteristics. Each factor is made up of a combination of characteristics, as indicated by the lower diagram (Slovic, 1987).

To the extent that individuals conceive of climate change as a simple and gradual change from current to future values on variables such as average temperatures and precipitation, or the

frequency or intensity of specific events such as freezes, hurricanes, or tornadoes, the risks posed by climate change would appear to be well-known and, at least in principle, controllable and therefore not dreaded ("move from Miami to Vancouver when things get too hot or dangerous in Florida"). Of course, in most cases, people do not move away from hazards even when they are aware of them, as the November, 2008 devastating fires in southern California demonstrate (a very similar destructive fire occurred 30 years earlier, and almost every resident knew about that. In fact, at least one resident lost his home in both fires. One driver of this inaction may be place attachment (Gifford, 2007), i.e., continued attachment to family, job, and community, a goal that can be more salient in the aftermath of adverse events, when fears have faded, than the goal of avoiding a small-probability future disaster. However, status quo biases or change inertia have been documented in many other situations (e.g., for organ donations; Johnson & Goldstein, 2003) and insurance decisions (Johnson, Hershey, Meszaros, & Kunreuther, 1993), where they have been shown to have cognitive rather than motivational causes.

The perceived ability or inability to take corrective action is an important determinant of emotional reactions. Potential catastrophes from climate change (of the kind graphically depicted in the film "The Day after Tomorrow") have the ability to raise visceral reactions to the risk (Leiserowitz, 2004). Climate change that is construed as rapid is more likely to be dreaded. Perceived behavioral control and its absence can both work against behavior change. That is, it fosters the (probably unwarranted) belief that one would move from the hazard zone, and thus need not fear the hazard. At the same time, when people believe that they have no control over climate change, it facilitates such mechanisms as denial (e.g., Gifford, Iglesias, & Casler, 2008).

While analogies about the role of psychological risk dimensions in people's feeling of being "at risk" are suggestive, these conjectures about possible causes for the absence of a

widespread sense of alarm about climate change will need to be tested in a direct fashion and across a range of cultures.

Discounting the future and the remote

Most of the risks of climate change and thus the benefits of mitigating it lie many years into the future and are distant also geographically (see Section 2 of this report). Economic analysts typically discount future and distant costs and benefits by some amount (e.g., by the current rate of interest offered by banks) as a function of the time delay, a mechanism that is described mathematically by an exponential discount function. In contrast, people often apply sharp discounts to costs or benefits that will occur in the future (e.g., a year from now) relative to experiencing them immediately, but they discount much less when both time points are in the future, with one occurring farther in the future than the other (e.g., two years versus one year in the future and even six versus five years into the future) and show other deviations from rational-economic discounting (Ainslie, 1975; Loewenstein & Elster, 1992).

Two theories related to preference construction attempt to understand the reasons and mechanisms for these inconsistencies in discounting and the large impatience when immediate rewards are an option. Trope and Liberman (2003) suggest that people construe future events differently from events in the present. In particular, events in the distant future (an invitation to give a paper at a conference two years from now, or the prospect of coastal flooding 30 or 50 years from now) are construed in abstract terms, whereas events closer in time (the upcoming trip on Monday to attend the long-scheduled conference, or the prospect of a major hurricane passing through town tomorrow) are construed in more concrete terms. One difference between the abstract versus concrete representation of the consequences of possible actions lies in the discrepancy in their affective strength and impact. Abstract representations of consequences in

the distant future usually lack the concrete associations connected to present or near-present events and thus may not be feared as much, although this may not hold in the case of environmental risks (Gifford et al., 2009). While the costs of mitigating actions are incurred immediately, their uncertain and future benefits get discounted, making the deliberative consideration of such actions unlikely to arrive at socially-responsible and long-term sustainable behavior.

Differences in the usual representation of current and future events can have implications for how people respond to climate change. This difference in the richness and concreteness of the representation of temporally close versus distant consequences may well lie at the root of observed problems of self control, whether they are impatience and impulsivity in obtaining desirable outcomes (Mischel, Grusec, & Masters, 1969; Laibson 1997) or procrastination with undesirable tasks (O'Donoghue & Rabin, 1999). Protective or mitigating actions against global climate change require the sacrifice of concrete, immediate benefits for the sake of abstract, distant goals. The strong negative affect associated with the concrete, immediate costs and sacrifices may well drive ecologically damaging consumption decisions and actions. However, this tendency is moderated by the way that people think about changing their consumption. When asked to delay consumption, people first generate arguments for the status quo, immediate consumption, and only then latter generate arguments for delaying consumption. Yet, argument generation for the first action considered (e.g., immediate consumption) tends to interfere with the subsequent generation of arguments for other action (Johnson, Johnson-Pynn, & Pynn, 2007). Weber et al. (2007) succeeded in drastically reducing the intertemporal discounting in people's choice by prompting them to first generate arguments for deferring consumption, followed by a prompt to generate arguments for immediate consumption. Social norms and/or positive or

negative affective reactions to a choice options typically determine which option is considered first. Thus, Hardisty, Johnson, and Weber (2009) found that 65% of Republicans were willing to pay a CO_2 emission reduction fee on such purchases as airline tickets when the fee was labeled as a carbon offset (and first generated arguments for purchasing it), but that this percentage dropped to 27% when the fee was labeled as a carbon tax, a label that generated negative visceral reactions in this group and led them to first generate arguments for not purchasing it.

Analogies can perhaps be drawn to the slowly but steadily changing perceptions of and attitudes on the risks of smoking, which have similar characteristics to climate change risks in the distant future of ill-health and premature death, and in immediate sacrifices for the sake of future and uncertain benefits. In the case of smoking, it has seemed possible to motivate behavior choices (quitting smoking) that have overcome the strong tendency to discount. To the extent that people's assessments of the future risks of climate change can be changed to become similar to those of smoking (with the aid of educational efforts or the reframing of choice options), people might become more willing to undertake lifestyles changes that lead to mitigation. As for other analogies used to motivate research hypotheses or possible intervention strategies, the devil is undoubtedly in the details of such translations, and research is needed to work out such details.

The role of culture in climate change understanding and reactions

The assumption that risky decisions can and should be reduced to a probability distribution of possible outcomes and that no other characteristics of the decision context are relevant has rightly been criticized (Goldstein & Weber, 1995). Instead, hazards have been shown to interact with psychological, social, institutional, and cultural processes in ways that may amplify or attenuate public responses to the risk (see Section 5). Social and cultural

amplifications of risk (Kasperson et al., 1988) by the scientists who communicate the risk assessment, the news media, cultural groups, interpersonal networks, and other groups and institutions occur in the transfer of information about the risk and in the protective response mechanisms of society (Weinstein, Lyon, Rothman, & Cuite, 2000; Taylor, 1983). Evidence from the health literature, the social psychological literature, and the risk communication literature suggests that these social and cultural processes serve to modify perceptions of risk in ways that can both augment or decrease response in ways that are presumably socially adaptive.

Several lines of research implicate fundamental worldviews in shaping how people select some risks for attention and ignore others. For example, Douglas and Wildavsky (1982) identify five distinct "cultures" (labeled hierarchical, individualist, egalitarian, fatalist, and hermitic, respectively) that are said to differ in their patterns of interpersonal relationships in ways that affect perceptions of risk. Hierarchically arranged groups, they claim, tend to perceive industrial and technological risks as opportunities and thus less risky, whereas more egalitarian groups tend to perceive them as threats to their social structure (see also Dake, 1991). Leiserowitz (2006) provides evidence for the value of this approach to understanding differences in perceptions of the risks of global warming, following earlier work by O'Connor, Bord, and Fisher (1998, 1999) that showed that differences in worldview affected perceptions of the risk of climate change. Other researchers associate such differences in risk perceptions with differences in fundamental value priorities, following the work of Schwartz (1992, 1994) or worldviews such as adherence to the New Ecological Paradigm (Dunlap & Van Liere, 1978, 1984).

Differences in experience, as a function of cultural roles, seem to affect risk perceptions by moderating people's affective reactions. Familiarity with a risk (e.g., acquired by daily exposure) lowers perceptions of its riskiness, with the result that technical experts, all other

things being equal, perceive the risk of such technologies as nuclear power generation to be much lower than members of the general public (Fischhoff, Slovic, Lichtenstein, Read, & Combs, 1978). Numerous studies report differences in risk perception between men and women, with women judging health, safety, and recreational risks (Slovic, 1987) and also risks in the financial and ethical domain (Weber, Blais, & Betz, 2002) to be larger and more problematic than men. This gender difference in perceived riskiness reverses only in the social domain, in which women arguably have greater familiarity (Weber et al., 2002). Thus greater familiarity with climate change and its risks, unless accompanied by alarmingly large negative consequences may actually lead to smaller rather than larger perceptions of its riskiness. Psychologists' roles may also have influenced their perceptions of risks. For a number of reasons, members of the psychological community have traditionally not seen themselves as having a central role in addressing environmental issues (see Kidner, 1994; Gifford, 2008) despite having many skills and roles that create opportunities for influencing pro-environmental behaviors (Doherty, 2008).

Public policy tradeoffs between present and future costs are strongly affected by the rate at which future costs and benefits are discounted (Weitzman, 2007), and the choice of discount rate is in large part an ethical judgment. Ethical issues also arise over which principles of fairness to apply to distributive decisions, how to define ingroup and outgroup membership, how to trade human against non-human welfare, and how much value to place on the well-being of animals, plants, and ecosystems.

Identification with sub-cultural groups may also influence perceptions of the risk posed by climate change. For example, group affiliations (e.g., ranchers and environmentalists) are likely to predict opinions and beliefs about environmental risks and interventions (Opotow &

Brook, 2003). Similarly, Leiserowitz (2007) describes several distinct "interpretive communities" (p.51) within the U.S. public who share mutually compatible risk perceptions, affective imagery, values, and sociodemographic characteristics. Risk perceptions are socially constructed with different communities predisposed to attend to, fear, and socially amplify some risks while ignoring, discounting or attenuating others. Leiserowitz distinguished climate change naysayers, who perceived climate change as a very low or non-existent danger, and climate change alarmists, who held high-risk perceptions and extreme images of catastrophic climate change. These groups held significantly different values and beliefs on social and political issues and necessity of individual behavior change and governmental intervention. People in the U.S. who are climate change naysayers have substantially lower risk perceptions than the rest of U.S. society. For example, political affiliation is strongly related to attitudes and beliefs about climate change: belief in the existence and relative threat of climate change has shown an increasing relationship to political party affiliation in the U.S. (Dunlap & McCright, 2008).

Research suggestions

Below are examples of types of research questions that could be addressed:

- Research is needed to test the applicability of psychological risk dimensions such as perceived controllability to the domain of climate change;

- Research is needed to better understand discounting of environmental costs and benefits relative to the discounting of economic or social costs and benefits;

- Research is need on the finite pool of worry effect, i.e., interactions between perceptions of other classes of risk (e.g., economic decline or national competitiveness) and perceptions of environmental risks like climate change;

- Research is needed to assess the effects of climate change risk perceptions on the perception of the risks and benefits of energy-generation technology options like coal or nuclear power and on carbon-capture and sequestration technology.

Summary

Feeling (or not feeling) vulnerable and at risk in the face of climate change seems to be instrumental in moving (or not moving) people to action (see section 4), and thus the sources of these feelings are in need of further study. Research in cognitive psychology suggests that certain perceived characteristics of climate change (e.g., that it is "natural," not new, and in principle controllable) may lead citizens as well as policy makers to underestimate the magnitude of the risks. Other psychological research provides additional hypotheses related to emotional reactions to climate change such that the absence of feeling at risk may be a psychodynamic reaction (see section 3), the result of psychic numbing or denial in the face of overwhelming and uncontrollable risk (see section 4 and 5). These explanations are not necessarily mutually exclusive, though sometimes contradictory in elements of their hypotheses (e.g., is climate change seen as a controllable or uncontrollable risk?). Such contradictions need to be resolved by empirical investigations.

The ability of different educational interventions in shaping perceptions, attitudes, and action related to climate change should also be a topic of empirical research (see section 6). Existing knowledge about the relative impact of direct personal experience vs. more abstract statistical information on the perceptions of risk in domains like financial decisions or with the relative effectiveness of emotional vs. analytic processes in prompting protective action can guide the design of different educational interventions about likely climate change scenarios and

their repercussions and about the pros and cons of different courses of adaptation to climate

change and/or mitigation of greenhouse gas emissions.

This section of the report provided a psychological understanding of how people perceive

the risk of climate change. The next section of the report examines a psychological

understanding of human actions that influence climate change by examining psycho-social

predictors of two anthropogenic drivers of climate change: population growth and consumption.

Section 2: What are the human behavioral contributions to climate change and the

psychological and contextual drivers of these contributions?

Much data support the argument that current levels of human consumption, in combination with growing population, are having a significant negative impact on the natural environment and are contributing to climate change (Dietz & Rosa, 1994; Myers & Kent, 2003; Dietz, Rosa, & York, in press; Stern, Dietz, Ruttan, Socolow, & Sweeney, 1997). Continuing the current rate of emissions is expected to yield a great variety of undesirable consequences, increasing over time (IPCC, 2007c). Holding per capita emissions constant, population increases expected in the next half century would increase the global emissions rate by about half. A much larger increase would result if per capita emissions from energy consumption in developing countries, 2.2 metric tons of CO_2 in 2005, increased to the U.S. level of 19.5 metric tons (International Energy Agency, 2007). Psychology can help understand what drives population growth and consumption and clarify the links from population and consumption to climate change while attending to global and regional inequities.

Ethical concerns. A number of ethical concerns emerge when discussing population and consumption. With respect to population, these include concerns about reproductive rights and choices (how many children to have, whether to use contraceptives, and whether to have abortions), an unborn child's right to life, and an elderly individual's right to die. Moreover, concerns are raised when solutions to population growth target poor countries that are producing few GHG emissions and when solutions fuel anti-immigration rhetoric (Hartmann & Barajas-Roman, 2009). Other concerns surrounding population growth and distribution involve the rights of human and ecological communities that are detrimentally affected by the increasing size

and spread of human populations. Dilemmas emerge when these rights are framed as being in competition with each other.

With regard to consumption levels, ethical concerns arise from unequal well-being across the globe and within regions of the world associated with different levels of energy consumption. Efforts to curb consumption, depending on how the reductions are distributed, can maintain or exacerbate existing inequalities. Many low-income countries and regions want, and some say should have the right to, develop economically in ways that rely on industry and that have always increased emissions in the past. Technological solutions that provide energy's services without using fossil fuel might maintain affluent lifestyles and raise well-being for poor people, while simultaneously decreasing greenhouse gas emissions. However, technological solutions are not without problems. Not all are able to afford the solutions. Even if people can afford technological solutions, these solutions, while decreasing GHG emissions can still negatively impact the environment directly in other ways, for example, from the processes and environmental impacts required to create the solutions, or indirectly by encouraging human habitats to encroach upon natural habitats. The benefits may also be counteracted by increases in population or economic activity.

The presence of such issues makes it more imperative to understand how people make decisions that influence climate change through their behaviors and their support for policies influencing population and consumption, and to examine the values underlying behavior and policy support. Increasing population size and consumption represent classes of behaviors that explain the ways that human behavior contributes to climate change. These classes of behaviors are embedded in larger contexts that influence them. In order to understand and address the links from population and consumption to climate change, it is useful to understand psychological,

social, and cultural drivers of population and consumption and to understand what it is about

population and consumption that influences climate change.

 Overview. We first present quantitative models that provide evidence of the link from

population and consumption to climate change. After establishing this link, we examine

characteristics and predictors of population growth. Much of this research has been done outside

of psychology, for example, by demographers; we suggest ways in which psychology could

contribute more to this discussion. The link between population and climate change flows

through the collective impact of environmentally significant patterns of consumption. Therefore,

after discussing population growth, we provide a psychological analysis of consumption via a

model that includes predictors and consequences of environmental consumption. We then

elaborate on the model by first disaggregating consumption behaviors into those that have direct

(environmental consumption) and indirect (economic consumption) impact on climate change.

Then we illustrate what psychology can contribute to understanding psychological and cultural

predictors of consumption while recognizing structural, economic, and physical constraints on

consumption decisions. By providing examples of predictors of population size and

consumption and the means by which population and consumption influences climate change,

we illustrate how psychology has and could further our understanding of human contribution to

climate change via population and consumption.

Quantitative models

 Varying quantitative models describe and predict the impact of population and

consumption on the environment. A widely known formula from the 1970's is I= PxAxT, where

I = Impact, P = Population, A = Affluence per capita, and T = Technology (Ehrlich & Holdren,

1971; Commoner, 1972; Holdren & Ehrlich, 1974). Although T has been used to refer to

technology, in practice, it served as an error term, representing all sources of impact not captured

by P and A. Other details have been included in other versions of the formula. For instance,

population has been disaggregated into both number of individuals and households (Dietz &

Rosa, 1997; Liu, Daily, Ehrlich, & Luck, 2003) and the IPCC version of the formula makes

specific reference to greenhouse gas (ghg) emissions: (*Population*) x (*per capita GDP*) x

(*Intensity$_{ghg}$*) = *Emissions$_{ghg}$* (Blodgett & Parker, 2008; Yamaji, Matsuhashi, Nagata, & Kaya,

1991). A particularly noteworthy new formula is STIRPAT (stochastic impacts by regression on

population affluence, and technology; Dietz, Rosa, & York, 2007). It employs advanced

statistical methods that can take into account the probabilistic nature of the variables in the

equation.

Across the different models, a consistent finding is that growing consumption and population are major contributors to the impact of humans on the environment and on CO_2 levels in particular. This can be seen by examining results from STIRPAT analyses (Dietz & Rosa, 1997). The results illustrate that countries with larger populations (see Figure 4) and greater per capita consumption (see Figure 5) have greater CO_2 emissions.
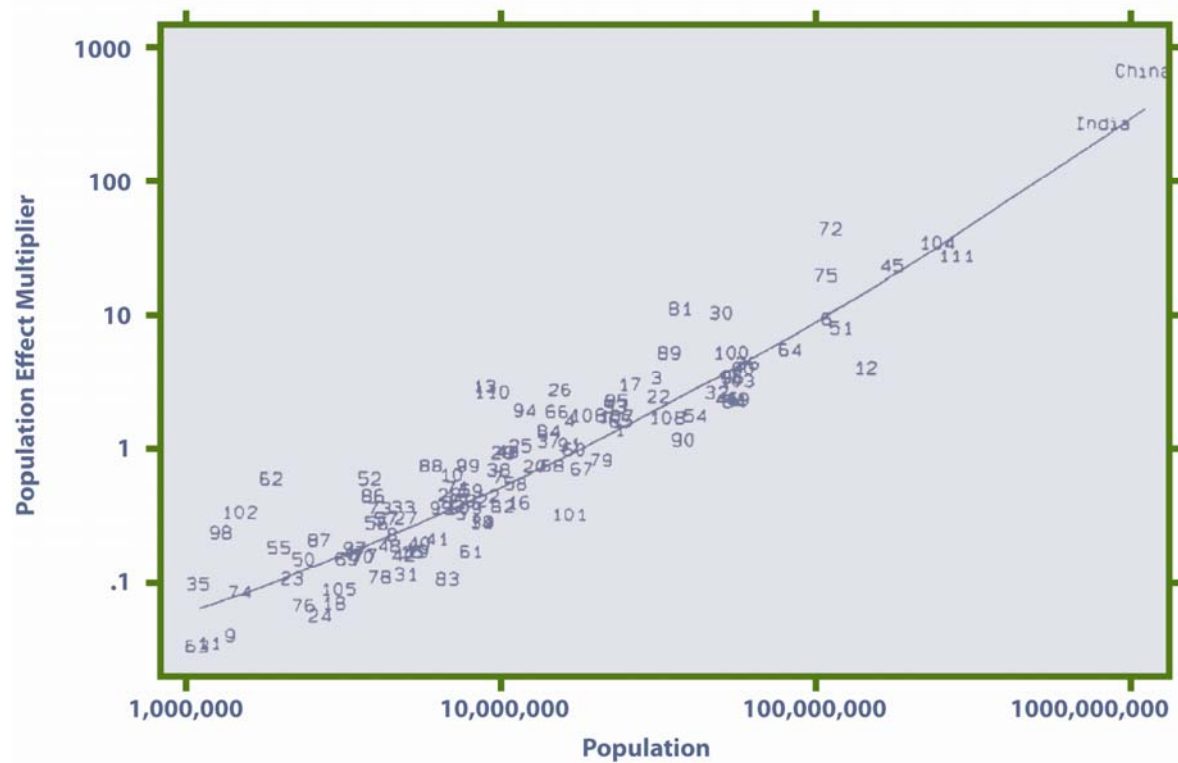
Figure 4: The relation between population and CO_2 emissions. Numbers in the graph represent countries used in the analyses (Dietz & Rosa, 1997).
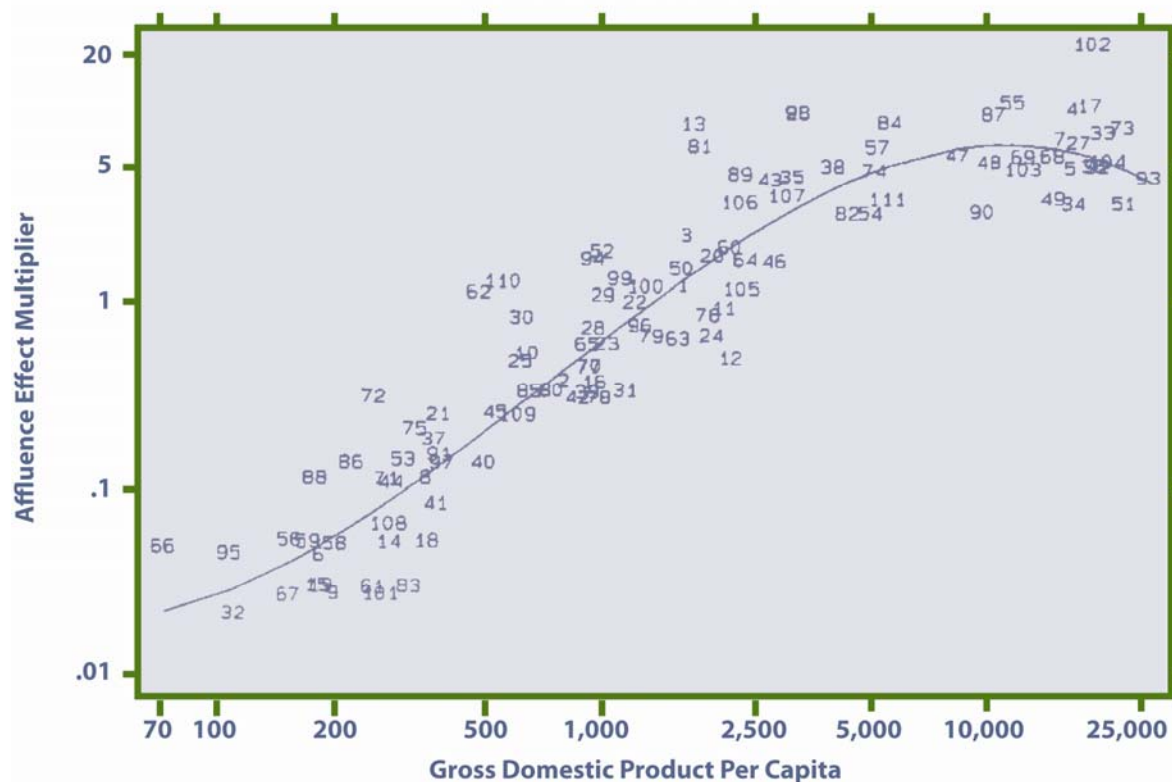
Figure 5: The relation between per capita affluence and CO_2 emissions. Numbers in the graph represent countries used in the analyses (Dietz & Rosa, 1997).

  The relations with affluence are important to consider in more detail. Figure 2 illustrates a commonly found U-shaped relation between affluence and outcomes (Hanley, 2008). This pattern has been used as evidence of a delinking of carbon dioxide emissions and economic growth at higher levels of income. Proposed explanations for this pattern include the possibility that places with greater per capita GNP: spend more on services than goods, are invested more in energy efficiency, live in more energy efficient urban areas, and relocate their contribution to emissions to other parts of the world via trade that decreases industrialization in their own countries (Hanley, 2008; Dietz & Rosa, 1997).

  The above illustrate that more is needed to better understand the relation between affluence and CO2 emissions. Further, individual level analysis is also necessary to know why

there is a relation between consumption and emissions. Psychology can help clarify mechanisms by which population and affluence influence climate change by providing a behavioral analysis of different types of consumption behaviors that people choose to engage in and the reasons why people select particular behaviors.

Population

Concerns about population include concerns about population size, distribution, and density. Here we consider population size because of the demonstrated relation between size and greenhouse gas emissions. Population distribution and density are also relevant to environmental impact, but the relationship is more complicated.

The size of the human population has grown exponentially over the last 100 years (see Figure 6). It required hundreds of thousands of years to go from the first handful of humans to a population of 3 billion. A second 3 billion person increase occurred in only 33 years (from 1960 to 1993). We now have approximately 6.6 billion humans on the planet and we are still growing. Yet, it is also important to consider variation in population growth rates which reflect combinations of birth and death rates. The rate of increase in population growth in the United States is decreasing and the world's population growth rate is projected to be less than one percent by 2020 (U.S. Census, 2008). Also, population change is not consistent across regions. Fertility rates are currently lowest in Europe, East Asia and the Pacific with about 2.1 children or less per woman, and the highest in Sub-Saharan Africa with about 5.2 children per woman (Lule, Singh, & Chowdhury, 2007).
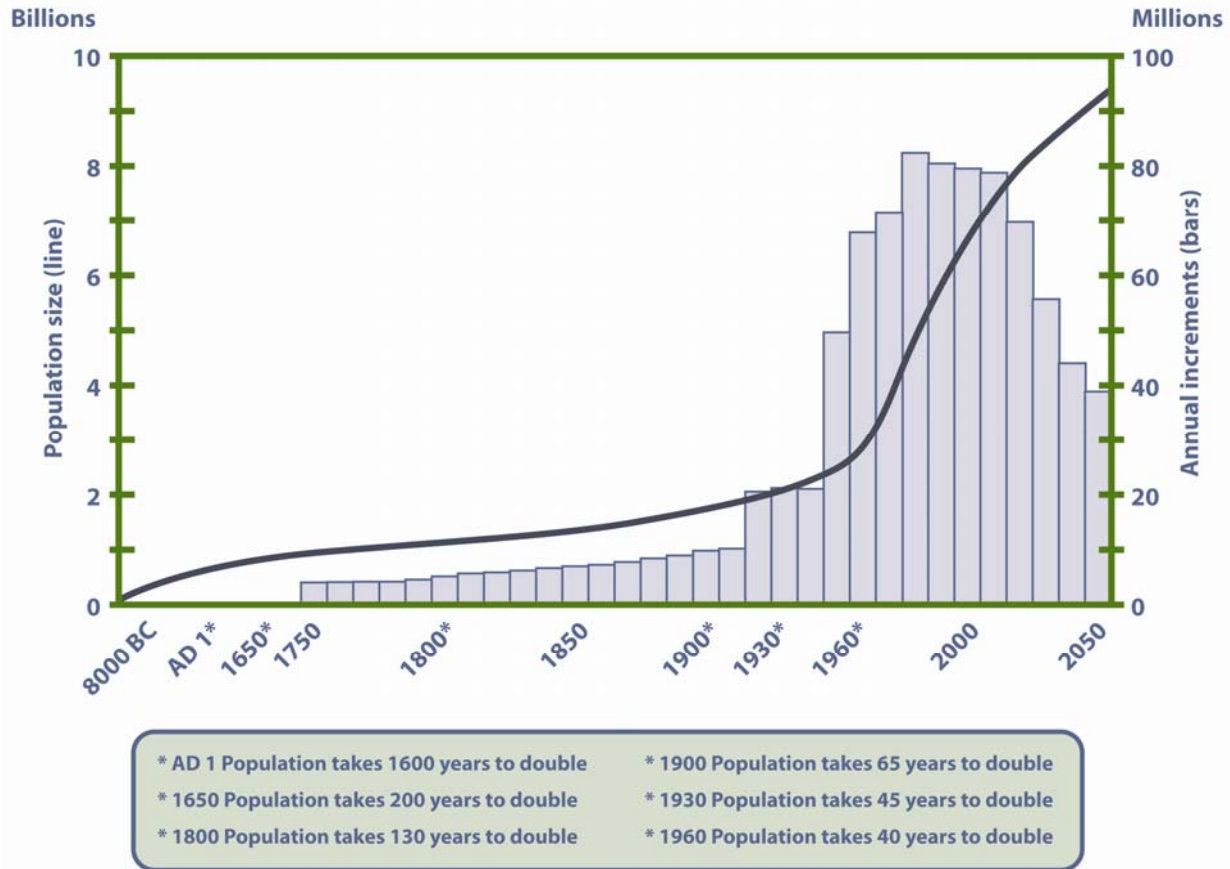
Figure 6: World population size and annual increments: 8000 BC to 2050 AD (projections based on medium fertility assumption; United Nations, 1998).

With regard to climate change, the effect of population growth is much greater in countries with high per-capita emissions (World Energy Outlook, 2007; 2008). For example, Africa has the some of the highest population growth rates, but the lowest regional per capita green-house gas emissions. Projected increases in energy use in Africa in the next 25 years are expected to result in much smaller total emissions than in other regions. The United States now produces seven times more CO_2 emissions than Africa, and in the next 25 years, is projected to contribute about five to six times more emissions than Africa. Although most of the world's increase in energy demand projected over the next 25 years comes from developing countries, led by China and India, the United States is still projected to continue to contribute the most per capita at about two to three times more per person than China. Many argue that increases in per

capita energy consumption are necessary for economic development in places such as Africa, China, and India.

Thus, decreasing population or population growth does not address climate change in any straightforward way. Decreasing population growth could have much greater effect on the climate in regions and in populations that have high per capita GHG emissions. Yet, population decrease does not guarantee decrease in emissions. In the United States, average household sizes are decreasing, but households are living in larger homes, which use more energy (U.S. Home Size, 2007; Whipps, 2006). Given considerations such as these, some have argued that it is more important to focus on decreasing consumption rather than population (Diamond, 2008). Yet, while arguably of less immediate importance, stabilizing or reducing population size can be an important element in efforts to mitigate GHG emissions because population is one driver of GHG emissions.

Psychologists can contribute to understanding predictors of population growth by understanding links among psychological, social, and cultural forces that influence birth and death rates while attending to justice issues (e.g., Booth & Crouter, 2005; Folbre, 1983; Harmann & Baragas-Roman, 2008; Lesthaegh & Surkyn, 1988; Sen, 2003). Individual and cultural religious beliefs, beliefs about gender roles, beliefs about individual versus government control of reproduction and health care are intertwined with decisions that influence reproductive decisions (such as when to start having children, how many children to have, and time between children, infant mortality, and longevity). The importance of social and cultural forces on reproductive decisions is implied by evidence that women often have more children than what they report ideally wanting (Lule, et al., 2007). Culture and immediate social context influence women's procreation choices through mechanisms such as norms (e.g., local norms about family

size and acceptability of contraception and abortion, value of educating women), policies (e.g., access to contraceptives, abortion, and recovery from abortion), and laws (e.g., restrictions on number of children allowed, financial incentives to have more children). There may also be implicit or explicit beliefs that a growing population is desirable because it indicates that a society has access to food and adequate healthcare (Livi-Bacci, 2007) and because of concerns about inverted pyramidal distributions where the elderly outnumber the youth (Booth & Crouter, 2005). The benefits to individuals and cultures of increased population growth alongside the costs to human and ecological communities have been described as a type of commons dilemma (Hardin, 1968; Gardner & Stern, 2002). In commons or social dilemmas, many cultural and psychological factors influence decisions about whether individuals pay attention to their personal benefits or a group's costs (Ostrom et al., 2002; Gifford, 2008).

Psychologists' knowledge about beliefs and how they influence individual and policy decisions, causes of and ways to address social dilemmas, decision making in interpersonal relationships, and a variety of gender related belief systems could all provide useful information for discussions that involve individual and social decisions that influence population size. For instance, restrictive gender roles that define women's status by the number of children they have, limit women's access to alternative roles, give others control over women's decisions to have children, and devalue female children creating greater demand for more children to ensure having male children, have been implicated as causes of population growth in India (Bhan, 2001; Sen, 2003). Psychological research into beliefs about sexuality, the acceptance of birth control, masculinity and male dominance, and psychologists' expertise on the increasing sexualization of girls, the effects of abortion on women's well-being and various types of subtle and implicit sexist beliefs are relevant to discussions about population.

It is also important to consider region specific causes for variation in population size. Regions vary in cultural and social beliefs, patterns of immigration and emigration, and extent of destabilizing influences such as feminine, spread of diseases such as AIDS, wars and ethnic conflicts that result in genocide and rape. Psychologists' knowledge about acculturation and treatment of immigrants could aid in understanding variation regional population growth (Sam & Berry, 2006). Peace psychology can contribute to our understanding and addressing the impact of war and conflict on deaths and pregnancy via rape (Costin, 2006).

Consumption

The term "consumption" has multiple meanings in different disciplines and intellectual communities (Stern, 1997). The IPAT and STIRPAT formulations operationalize it in monetary terms, with a measure of aggregate economic activity or aggregate consumer purchases. However, a full understanding of how consumption contributes to climate change requires a more detailed theory. Figure 7 presents a conceptual model that helps illuminate predictors of consumption, differentiates between consumption defined in terms of money spent versus consumption defined in terms of environmental impact, and the mechanisms by which consumption influences climate change.
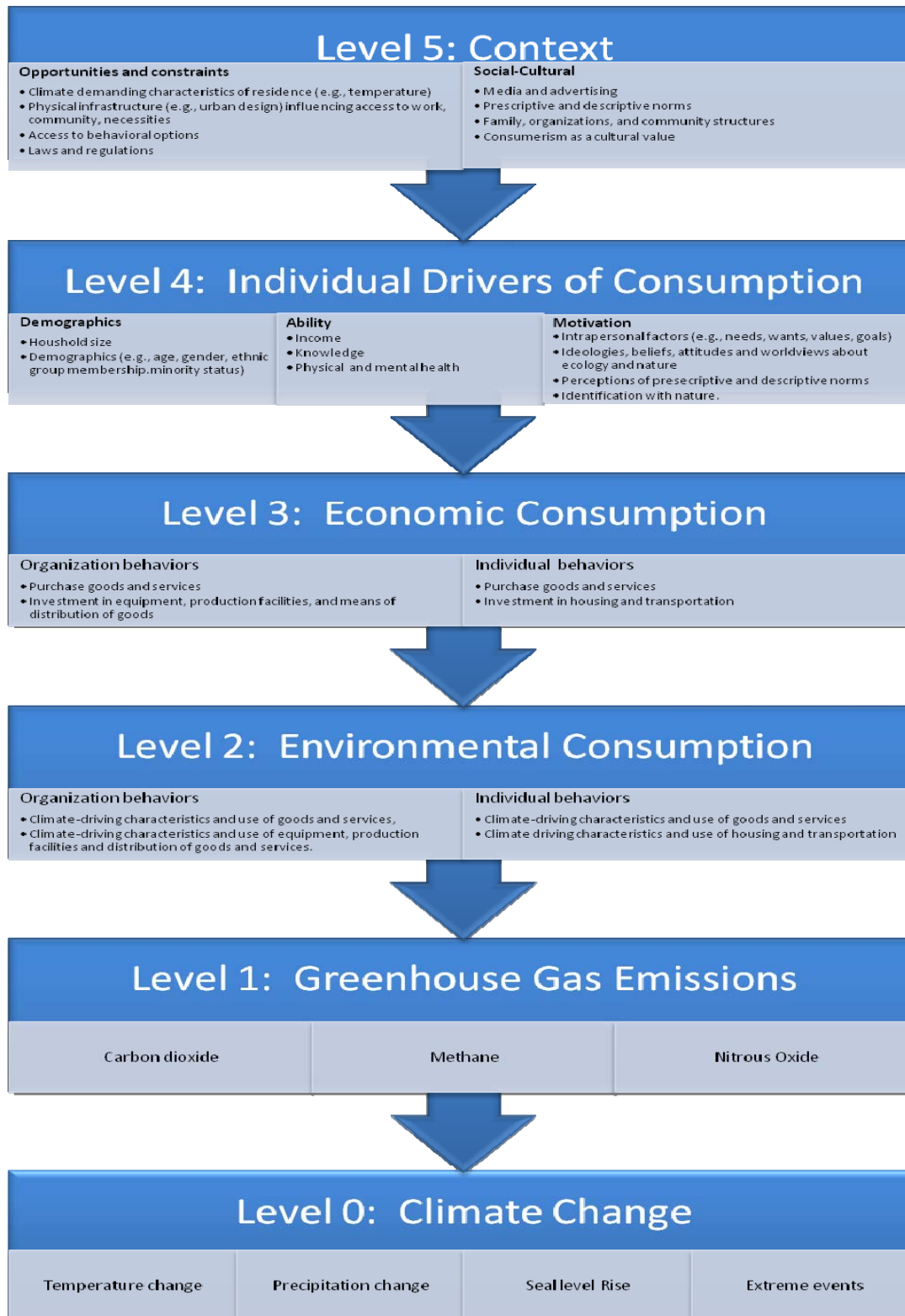
Figure 7: Examples of predictors and climate change relevant consequences of environmental consumption.

Each level illustrated in Figure 7 can affect variables at the other levels, either directly or indirectly, but it is important to recognize the distinctions among them. Level 5 sets the context for individual behaviors and decisions, sometimes encouraging and directing behaviors and other times constraining behaviors. Level 4 includes characteristics of individuals that influence their ability and motivation to engage in consumption including many psychological constructs related to environmental consciousness, such as attitudes and values, which have been the focus of much research on predictors of environmentally responsible behaviors. Contexts (level 5) can influence individual drivers of consumption (level 4). Cultural practices influence psychological factors, for instance, by defining what is considered "needs" versus merely "desires" and making particular behavioral options possible, feasible, and desirable. Individual consumption decisions can be made alone or within groups (e.g., families or boards of directors representing particular contexts for decisions; level 5). Level 2 and 3 represent two different aspects of consumption. Economic consumption is the money individuals and organizations spend; it is represented by per capita GNP used in the quantitative models described above. Level 2 represents environmental consumption—"human and human-induced transformations of materials and energy" (p. 20, Stern, 1997). Economic and environmental consumption are correlated but separable. A person can spend money on a famous painting which would cost a lot more than the gas paid to drive to the point of purchase but the latter will have more of an environmental impact. Choices about how to spend money, for instance the choice to spend money on a low rather than a high mileage car (economic consumption), also influence environmental consumption. However, environmental consumption is also affected by other factors, such as driving distances.

Some analyses examine only certain levels in this model. For instance, researchers using the IPAT and STIRPAT formulations go directly from 3 to 1, without examining the links that provide critical mediators. Psychology can help: (a) understand the relationships among and between variables in Level 4 and 5; (b) explain the links from Level 4 to Levels 3 and 2; and (c) explain how interventions (incentives, information, persuasion, etc.) directly affect behavior at Levels 3 and 2. These links are also important psychologically because consumption choices may reflect people's knowledge or concern about links between environmental consumption (level 2) and greenhouse gas emissions (level 1), for example if they try to buy products that use less energy or use their products in more energy-efficient ways. A lot of the psychological research agenda is in the links and the mediating processes.

Behavioral analyses of economic and environmental consumption (levels 2 and 3). As noted above, evidence of the impact of consumption on the environment and specifically on GHG emissions is typically assessed with national-level data on each country's gross domestic product. This makes sense, for example, from a life-cycle analysis of a product, with money being invested at all stages of production, from "cradle to grave" (Lovins, Lovins, & Hawkens, 1999). A problem for a behavioral analysis is that GDP aggregates a wide variety of different types of consumption behaviors. Disaggregation of these behaviors into specific types of behaviors can help clarify which behaviors contribute the most to climate change and which behaviors can, therefore, be most effectively targeted for reduction of emissions. Great effort can be put into doing behaviors that have little effect (Gardner & Stern, 2008; Vandenbergh, Barkenbus, & Gilligan, 2008). Moreover, individuals who lack knowledge about the relative contribution of behaviors to emissions may prioritize a relatively ineffective behavior over a more effective one (see Section 5 of this report). Disaggregation can also help to understand the

factors that encourage or discourage particular behaviors. Some behaviors may be motivated by hedonic reasons and others by social norms (Lindenberg & Steg, 2007). Further, some behaviors may be more difficult than others perhaps because they require more skill, more money, or they are not available to people.

Yet, behavioral analyses need to consider more than individual actions that directly emit greenhouse gases. First, actions can be interdependent. Changing one behavior can lead to changes in other behaviors (e.g., Switching to hybrid cars may encourage people to drive farther, which could neutralize emissions reductions). Second, indirect effects of behavior can be very important. Using a product may use little energy but its production and distribution may require considerable energy (McKibben, 2007). For example, consuming food obtained from supermarkets or restaurants uses considerably less energy than producing, transporting, packaging, and distributing it). Similarly, using the internet requires more energy than that required to run one's computer. Third, individual behaviors that have little effect may add up to a lot across behaviors and across individuals (e.g., putting electronics on standby uses minuscule amounts of energy, but energy used across devices and households can be considerable, Vandenbergh et al., 2008). Fourth, behaviors can influence not just the emission of GHG, but their absorption and the direct reflectivity of Earth (e.g., changes in land use, such as through deforestation, can decrease absorption of green house gases (Millennium Ecosystems Assessment, 2005). This analysis points to the need to understand individuals' choices among behaviors, and their overall patterns of consumption, especially the total effects in climate terms. We start by examining types of consumption behaviors (levels 2 and 3), then consider individual drivers of consumption (level 4), and end with a consideration of broader influences (level 5) on consumption decisions.

Types of consumption behaviors. Researchers have proposed different classifications of consumption and consumption-reducing behaviors. One classification distinguishes investment in equipment and technology, management of the equipment, and its use (cf Kempton, Darley, & Stern, 1992; Kempton, Harris, Keith, & Weihl, 1985). The first of these represents economic consumption that drives energy use while the latter two represent more direct environmental consumption. Orthogonal to these categories are specific domains of energy use such as transportation, space heating and cooling, and household appliances and electronics (see Table 1 for examples). It is also important to distinguish the above behaviors, which affect direct energy use in the household, from consumer behaviors with indirect effects on energy use through the investment, management, and choices made by those who supply consumer products and services. For instance, recycling and reusing materials reduces emissions because it reduces the need to process and transport virgin materials. However, these effects are not entirely within the consumer's control because the choice to replace virgin materials with recycled goods is made by manufacturers. Finally, behaviors that influencing the emission of greenhouse gases can be, distinguished from those that influence the absorption of emissions or that change Earth's albedo. Through these types of behavior, economic and environmental consumption—adoption, management, and use of equipment and technology affect the net forcing of climate change.

Various differences among behaviors may influence the likelihood that individuals, households, or organizations will engage in them. Perceptions of the effectiveness of different behaviors for reducing emissions may be important, even though they often do not match the research data (Kempton et al., 1985; De Young, 1986). Perceptions of and actual ability to engage in the behaviors also influence whether people engage in these behaviors (Sia, Hungerford, & Tomera, 1985). Investments, which require only very infrequent actions (e.g.,

insulating one's home) face financial and other barriers that do not exist for management and use actions. However, they generally save more energy than changes in management or use of equipment, which usually require repeated efforts (Stern & Gardner, 1981; Gardner & Stern, 2008).

It can also be important to examine patterns of behaviors. For example, evidence is inconclusive at best about whether engaging in one type of environmentally friendly behavior predisposes one to engage in other types of environmentally friendly behavior (Crompton & Thøgerson, 2009). Further research is needed to understand such patterns.

	Investment in equipment & technology	Management of equipment & technology	Intensity of equipment & technology use
Transportation	Number and fuel efficiency of personal & public transportation vehicles.	Number of people in vehicles; engine maintenance.	Miles traveled in vehicles.
Heating and cooling of buildings	Size of buildings, efficiency of furnaces & air conditioners; amount of insulation.	Maintenance of furnaces; caulking of windows.	Temperature settings.
Household appliances & electronics	Energy efficiency of water heaters, televisions, refrigerators.	Cleaning freezer coils; reducing standby power use.	Amount of hot water used; time spent with television on.

Table 1: Types of behaviors and examples

Individual drivers of consumption (Level 4). There is much individual variation in patterns of consumption. Some variation is due to differences in the context in which individuals

live (Level 5). Other variation is due to differences in ability and motivation (Level 4). Ability can be influenced by income available to afford different consumption behaviors, knowledge about how to act to change the climate impacts of consumer behavior, and physical and mental health. Motivation can be influenced by many possible psychological drivers, which we focus upon below. Demographic differences such as household size and family life cycle also influence consumption patterns because of their association with different context, their association with abilities (e.g., gender and minority status can influence income) and sometimes their association with motivations (e.g., ethnic group membership can help explain individual differences in world views).

Financial incentives are important motivators of environmental consumption. Incentives can create or help overcome financial barriers to investment in energy-efficient equipment and technology and can favor products and services that contribute either more or less to greenhouse gas emissions, thus motivating behavioral changes. Other drivers of consumption can potentiate or attenuate the effects of economic influences. Psychological factors such as needs, wants, goals, values, ideologies, beliefs, attitudes, world views, perceptions of prescriptive and cultural norms, and identification to nature may also affect consumption. For instance, research has shown positive associations between engaging in some environmentally responsible behaviors and various measures of environmental consciousness (e.g., pro-environmental beliefs; Milfont, Duckitt, & Cameron, 2006). However, researchers have not always differentiated among types of environmentally responsible behaviors. In terms of relevance to climate change, it is important to assess the extent to which these relationships involve consumption behaviors with significant effects on GHG emissions or other climate.

A considerable body of psychological literature on predictors of consumption focuses either implicitly or explicitly on economic consumption, usually without regard to the environmental consequences. This literature is relevant to understanding human contributions to climate change because of the general association between economic consumption and greenhouse gas emissions (as illustrated above with research on GDP) and because non-environmental product attributes are important to consumption decisions that affect GHG emissions.

A frequently studied psychological predictor of consumer behavior is the presumed happiness that purchasing products will provide. Many advertisements promise to bring various personal and social rewards including self-satisfaction, fun, and praise from others. Thus, individuals may seek happiness via consumption. Yet, the presumed relation between consumption and happiness is not fully supported by data, particularly in wealthier countries where consumption is already high. If the relation was straightforward, then those who have more should be happier than those who do not. Subjective well-being is higher in wealthier countries, but within countries, there is little relation between increasing GDP over time and subjective well-being (Diener & Biswas-Diener, 2002). In economically developed countries, there is only a small positive correlation between individual income and self-reported subjective well-being (Diener & Biswas-Diener, 2002) and income is only weakly related to daily mood (Kahneman, Krueger, Schkade, Schwarz, & Stone, 2006). Relative income is more strongly associated with self-reported happiness than actual income (Clark, Frijters, & Shields, 2008), and the relation between income and well-being is stronger in poorer countries. This suggests that once basic needs are satisfied, increasing income and associated increases in economic consumption are less relevant for happiness.

Research indicates that rather than promoting well-being, materialism—that is, prioritizing acquisition and possession of material objects—hinders well being and is more detrimental to the environment than alternative aspirations. Those who endorse materialistic values (such as believing that financial success is important) are more likely to score poorly on measures of subjective well-being including global adjustment, social productivity, and behavioral disorders (Kasser, Ryan, Couchman, & Sheldon, 2004; Kasser & Ryan, 1993). Further, U.S. adults and adolescents who do not endorse materialistic values consume less energy by some measures, such as riding bicycles, using both sides of the paper, turning off lights in unused rooms, etc. (Richins & Dawson; 1992; Kasser, 2005). Finally, cultural values aspiring toward mastery and hierarchy (which include specific values relevant to consumerism) are correlated with higher levels of $CO2$ emissions, even after controlling for GDP (Kasser, in press).

Core psychological needs such as, relatedness, competence, and autonomy, may also drive consumption (Deci & Ryan, 2000; Ryan & Deci, 2000). Consumption affects self-concepts and public identities because products are imbued with meaning, often facilitated by marketing, and that meaning is then transferred to the consumer (McCracken, 1986). The clothes we wear, the cars we drive, the way we decorate our homes, and the gifts we give others allow us to fit in with social trends, raise our status, carve out our own unique subcultures and individual identity, and display our group membership. Thus, products may provide a sense of belonging and self-esteem. Finally, consumption can also be promoted as a way to satisfy a need for autonomy, competence, and to reach one's individual potential (i.e., become self-actualized; Berger, 2006; Curtis, 2002; Lavine, 2006). For instance, target marketing that focuses on psychographic characteristics (one's lifestyle, values, aesthetic styles, and life visions) has been

described as a way that companies make connections between a particular product and one's personal ambitions (Cheon, Cho, & Sutherland, 2007; Vyncke, 2002).

Research like that done examining happiness and materialism can more fully illuminate relations between core psychological needs and consumption. Research on intrinsic and extrinsic goals suggests that consumption would be a poor means of satisfying many core psychological needs. Extrinsically oriented goals (e.g., popularity and having an appealing appearance), including materialism, relative to other goals (self-acceptance, personal growth, intimacy and friendship, societal contributions) share a greater focus on looking for a sense of worth outside of oneself by focusing on rewards and praise from others. Focusing on extrinsic goals can interfere with other goals that are more likely to lead to more favorable subjective well-being. For instance, one reason for the lack of correlation between income and well-being is that people with incomes greater than $100 K spend less time on leisure activities (Kahneman et al., 2006). Still, economic consumption may also be driven by intrinsic goals (Vargas & Yoon, 2006). For instance, spending money to obtain life experiences rather than obtaining material goods is associated with greater happiness (Vanboven & Gilovich, 2003).

From the standpoint of the need to reduce environmental consumption in countries such as the United States, it is important to consider how psychological needs can be satisfied with less than current levels of such consumption. Some research suggests that rather than pursuing materialistic goals and passive forms of entertainment (e.g., watching television), people would be better served to work on tasks that require greater engagement, particularly those that lead to flow experiences (e.g., experience that are so engaging one loses track of time while doing them) (Csikczentmihalyi, 2004; 2006). Some evidence indicates that engaging in ecologically

responsible behavior is associated with higher subjective well-being and endorsing more intrinsic and less extrinsic values (Brown & Kasser, 2005).

Thus, although psychological needs drive consumption, consumption may be a poor method of satisfying those needs, particularly subjective well being. More research is needed to fully understand the relations among different types of motives for consumption and well-being and relations among different types of psychological needs, such as relatedness, autonomy and control, and different types of consumption behaviors. A key research need concerns identifying ways to satisfy psychological needs through behaviors that have less effect on the climate.

Context and consumption (Level 5). As noted in Figure 7, a number of contextual features (level 5) influence individual drivers of consumption (level 4). Behavioral options are shaped by whether individuals live in temperate vs. very hot or cold environments, physical infrastructure that affects the options for travel or the energy efficiency of homes, and various laws and regulations. Behavior is also affected by marketing of consumer goods and services and producers' choices of which goods and services to make available. Further there are a number of social-cultural features of contexts that direct behaviors. It is the latter that we will consider in more detail.

Social and cultural contexts can influence consumption in many ways. For instance, social and cultural norms identify appropriate and desirable behaviors and social structures influence and regulate individual and group behaviors. Economic and environmental consumption in the United Sates need to be understood within a wealthy, individualistic, and capitalistic culture (Kasser, Cohn, Kanner, & Ryan, 2007). A particularly important contextual feature is the extent to which cultures value consumerism. Whereas environmental consumption is the use of resources and energy and economic consumption is spending money to acquire

goods, consumerism is "a belief and value system in which consumption and acquisition rituals (e.g., shopping) are naturalized as sources of self-identity and meaning in life, goods are avidly desired for non-utilitarian reasons such as envy provocation and status seeking, and consuming replaces producing as a key determinant of social relations" (p. 231; Zhao & Belk, 2008). Consumerism can sometimes help satisfy basic psychological needs, but it also contributes to choices that drive climate change. Consumerism is widely associated with the United States, but it is becoming global. It has become a part of Chinese culture, with some arguing that it is overpowering communism (Zhao & Belk, 2008). There has been little psychological research on how consumerism and related cultural belief systems influence environmental consumption (see Heath & Gifford, 2006, for an exception).

Cultures can affect consumption by influencing perceptions of what is a necessity versus a luxury. This boundary can shift over time. For instance, in 1996, 32% of people in the U.S. thought that a microwave was a necessity, whereas in 2006, 68% believed this (Pew Research Center, 2006). These perceived needs vary across different demographic groups. In particular, the more income a person has the more likely he or she will view the items examined in the survey (clothes dryers, home and car air-conditioning, microwaves, television sets, etc.) as necessities. Although we know of no specific research on cultural factors that influence these perceptions, it seems likely that culturally defined reference points are important for establishing these perceptions. For instance, if a certain level of consumption is seen as normal, consumption levels below this may be perceived as insufficient. Reductions in this norm would be seen as losses, rather than as gains from a state of no possessions (reference prospect theory). Further, upward social comparisons with those who consume a lot ("the rich and the famous") likely

encourage people to consume more and lead them to perceive their current state as relatively deprived (cf. relative deprivation theory).

Culture can also create real needs. Products that were once luxuries, such as cars, have become necessities for many people because human settlements have developed in ways that make it very difficult to engage in necessary activities, such as getting food and employment, without a car.

A cultural attribute that may influence consumption of resources is the perception of time. Research has documented differences in perceptions of time across cultures and the implications of perceptions of time for norms about how people interact with and treat each other (Levine, 1997). On the one hand, future time perspective, a perspective often held in western cultures (Jones, 2003), is associated with endorsing the need for environmental preservation (Milfont & Gouveia, 2006). On the other hand, western culture is built to a great extent on treating time as a resource that is maximized at the expense of natural resources. Energy is used to improve efficiency (e.g., to decrease time on any particular task and increase our ability to multi-task) and expand time so that we can have activities occurring around the clock (Stephens, 2002). Increases in the investment of time may be required to reduce our use of natural resources. These changes can be impractical for individuals to make on their own and may require a more general cultural shift in perceptions of needs and the value of time and how we use it (Kasser & Brown, 2003; Kasser & Sheldon, 2009).

It may be useful to consider the ways that different features of cultures influence actual and perceived needs and the implications of these cultural features for consumerism and patterns of consumption. Possible important cultural considerations include variation in how members of different cultures orient towards, experience, and perceive time and how they understand and

assess rhythms of behaviors within time periods (Jones, 2003). Given these considerations, it is likely important to examine the role that identification with particular social groups (e.g., ethnic groups) and internalization of cultural world views has on consumerism and patterns of consumption.

Counter-consumerism movements. Individuals and groups of people have made efforts to alter their lifestyles as a way to what they see as the problems with consumerism and a culture that they perceive supports it. For instance, some people join voluntary simplicity movements, promote efforts to allow people to take "take back their time," join community supported agricultural groups, and participate in "freecycling groups" (Bekin, Carrigan, & Szmigin, 2005; Craig-Lees & Hill, 2002; Thompson & Coskuner-Balli, 2007). When undertaken voluntarily, the activities of these movements may contribute to well-being, which they may not if they are experienced as asceticism, self-deprivation, or done for involuntary reasons (Lavine, 2006). The extent to which these movements ultimately influence climate change will depend upon how widespread they become and the extent to which their altered patterns of consumption reduce GHG and other climate drivers.

Yet, this is a phenomenon worth exploring more because of its relationship to patterns of consumption. Many individuals who have become "downshifters" (estimated in 1998 to be 19 percent of the U.S. population; Schor, 1998, and in 2003 to be about 25 percent in Britain; Hamilton, 2003) are simplifying their lifestyles by repairing, reusing, sharing, and making their own goods and changing their focus to fulfilling roles such as civic engagement including using the consumer culture to fight the culture by boycotts and "buycotts" (Elgin, 2000). Many of their behavioral choices involve less environmentally taxing patterns of consumption that include behaviors that produce less greenhouse gases. It is argued that individuals joining these

movements have found ways to satisfy their needs for esteem, autonomy, and belongingness that still make them happy—perhaps even better than consumerism does, although that is a question for further research. Brown and Kasser (2005) provide evidence of this. They found that, relative to a matched group of mainstream people in the U.S., self-identified Voluntary Simplifiers were significantly happier and living more ecologically sustainably.

Research suggestions

Below we list a few, of many possible, research directions that follow from the above review. Some of the suggestions build off what we already know, for instance, about people's tendency to engage in environmentally responsible behavior, others challenge researchers to attend to the environmental outcomes of consumption behaviors they examine, and particularly those environmental outcomes that are related to human drivers of climate change, and still others test areas that have received little attention within psychology.

1) Psychologists could contribute to research about population size, growth, regional density, etc. Psychologists have examined research on population in terms of crowding. However, psychologists could contribute more to the area given the importance of topics such as gender roles and relations to this domain. Further, a number of beliefs systems may influence evaluation and support for population policies.

2) Examine economic consumption at the individual and household level and environmental consumption, particularly energy use, as these types of consumption relate to the social contexts of households and household members' values, psychological needs, goals, and subjective well-being. Conduct this research comparatively across countries and sub-cultural and demographic groups in the United States.

3) Conduct research on people's judgments of the effects of various modes of decreased environmental consumption on their ability to satisfy their needs, goals, and motivations.

4) Develop a better understanding of characteristics of cultures (e.g., beliefs about time, consumerism, personal space, continuity, community, and views on nature) that may affect patterns of environmental consumption.

5) Develop better understanding of counter consumerism movements: motivations for joining them, the short and long term psycho-social consequences of involvement, and the extent to which the movements ultimately influence environmental consumption.

From causes to impacts

Human actions that influence climate change include pressures due to population growth and region-specific types and patterns of consumption. The present section described ways that psychological can help understand these causes of climate change by identifying specific types of consumption and researching individual and contextual predictors of consumption. The next section examines consequences of climate change by examining psychological impacts such as emotion reactions and mental health implications and social and community impacts including aggression and intergroup conflict as well as positive consequences gained from people take collective responsibility for a shared problem.

Section 3: What are the psychosocial impacts of climate change?

The potential impacts of climate change on human health and well-being have received considerable attention (Climate Change Science Program, 2009; IPCC, 2007c). Less attention has been given to potential psychological and social impacts of global climate change and to factors that moderate and mediate those impacts. Although some localized and/or immediate consequences, such as injury or stress resulting from more extreme weather events, may be perceived to result from climate change, most psychosocial effects are likely to be gradual and cumulative, and the connection to global climate change may be less clear in the minds of those affected. These include heat related violence (Anderson, 2001), conflicts over resources (Reuveny, 2008), threats to mental health (Fritze, Blashki, Burke, & Wiseman, 2008) and anxiety and despair (Kidner, 2007; Macy & Brown, 1998; Nicholson, 2002). In addition, climate change is likely to have disproportionate impact on those of less economic privilege or social status (Agyeman, Bullard, & Evans, 2003; Kasperson & Dow, 1991), and thus, like other environmental issues, has social justice implications that demand consideration (Bullard & Johnson, 2000).

Available research suggests that the psychosocial impacts of climate change are likely to be moderated by a number of individual and contextual factors that increase or decrease the severity of the impact as well as the perception of the impact. Moderators of impacts may include proximity to climate-related events (Neutra, Lipscomb, Satin, & Shusterman, 1991) and sources of vulnerability and resilience (Brklacich, Chazan & Dawe, 2007; Bullard, 2000; Peek & Mileti, 2002). An individual's perceptions of climate change impacts can be moderated by social norms (Cialdini, Reno, & Kallgren, 1990; Leiserowitz, 2005) and by their environmental identity (Clayton & Opotow, 2003). The impacts of climate change are also likely to be mediated by

various types of cognitive appraisals, such as estimates of personal risk and attributions of responsibility (Leiserowitz, 2007), as well media representations of health impacts (Dunwoody, 2007; Reser, 2009).

In human terms, the most salient aspects of global climate change may be extreme biophysical environmental events—generally framed as 'disasters' or catastrophes (e.g., hurricanes, tornados, floods, fires, drought, tsunamis). Multiple studies examine psychological and social impacts across the spectrum of natural and technological disasters (see Bell, Greene, Fisher, & Baum, 2001; Gifford, 2007; Reyes & Jacobs, 2006). The disaster research literature has developed methodologies, measures, an interdisciplinary orientation, and many models and tools potentially useful in researching the psychology and climate change. Of particular salience are recent sources addressing hurricane Katrina, the past decade of natural disasters in North America, and the Asian Tsunami (e.g., Adeola, 2000; Bourque, Siegel, Kano, & Wood, 2006; Daniels, Kettle, & Kunreuther, 2006; Elrod, Hamblen, & Norris, 2006; Gheytanchi et al., 2007; Haskett, Scott, Nears, & Grimmett, 2008; Norris et al., 2002; Waugh, 2006). These large scale regional disaster impacts (particularly in psychological, social and societal terms) are increasingly seen and discussed as prognostic of the world which climate change is ushering in. The literature describing impacts of other well-publicized disasters (such as Three Mile Island nuclear accident) and of environmental hazards in general (e.g., living in proximity to toxic waste sites) is also of relevance (e.g., Bell et al, 2001; Baum, 1987; Haskett et al., 2008; Neutra et al., 1991; Reyes & Jacobs, 2006).

The impacts of global climate change should also be situated in the context of other environmental challenges. Resource depletion and loss of biodiversity are probable consequences of climate change (IPCC, 2007c), and related issues such as overpopulation and

environmental pollution will combine with climate change to accelerate the trend toward increased competition for decreased environmental resources. Given research evidence on the beneficial effects of restorative natural environments (De Vries, Verheij, Groenevegen, & Spreeuwenberg, 2003; Maas, Verheij, Groenewegen, de Vries, & Spreeuwenberg, 2006; Takano, Nakamura, & Watanabe, 2002; Kuo & Sullivan, 2001; Kuo, Sullivan, Coley, & Brunson, 1998; Krenichyn, 2004; Maller, Townsend, Pryor, Brown, & St. Leger, 2006; Shinew, Glover, & Parry, 2004), decreased access to thriving ecosystems may also have psychological consequences.

Finally, there is the potential for psychological benefits from taking action about climate change including opportunities for positive coping (Kates, 2007) and enhanced personal meaning and satisfaction from engaging in climate change mitigation or adaptation activities (DeYoung, 1996; Johnson, Haeuble, & Keinan, 2007).

Psychosocial and mental health impacts of climate change

The psychosocial and mental health implications of climate change have gained attention in the context of disaster recovery from extreme weather events (Few, 2007). Fritze and colleagues (2008) note that direct impacts, such as extreme weather events, are likely to have immediate effects on the prevalence and severity of mental health issues in affected communities as well as significant implications for mental health services; vulnerable communities will experience ongoing disruptions to the social, economic and environmental determinants that promote mental health in general; and finally climate change as a global environmental threat may create emotional distress and anxiety about the future.

Emotional reactions are critical components of information processing and also have a direct relation to physical and psychological health (Dillard & Pfau, 2002 in Moser, 2007; Slovic, Finucane, Peters, et al., 2004; Groopman, 2004). It is hypothesized that certain strong

emotional responses such as fear, despair, or a sense of being overwhelmed or powerless can inhibit thought and action (Macy & Brown, 1998; Moser, 2007; Nicholson, 2002). As Moser and Dilling (2004) illustrate, well-meaning attempts to create urgency about climate change by appealing to fear of disasters or health risks frequently lead to the exact opposite of the desired response: denial, paralysis, apathy, or actions that can create greater risks than the one being mitigated. For an example of a general review of research on emotional responses to informational messages about climate change, see Moser (2007).

Mental health issues associated with natural and technological disasters. Personal experience of extreme weather events can lead to psychological and mental health outcomes associated with loss, disruption and displacement, as well as cumulative mental health impacts from repeated exposure to natural disasters (Few, 2007; Peek & Mileti, 2002). These outcomes include acute and posttraumatic stress disorder; other stress related problems such as complicated grief, depression, anxiety disorders, somatoform disorders, and drug and alcohol abuse; higher rates of suicide attempts and completions; elevated risk of child abuse: and increased vulnerability of those with pre-existing severe mental health issues (For a review see Fritze, et al, 2008).

Stress and emotional outcomes associated with natural and technological disasters. In a review of mental health treatment guidelines for victims of natural and human caused disasters, Stein and Meyers (1999) note that psychological responses to disasters involve distinct phases characterized by symptoms changing over time. This includes feelings of disbelief, shock, denial, or outrage immediately following the event, as well as altruistic feelings associated with saving lives and property. Emotional support and optimism for the future has the potential to give way to disillusionment, intrusive thoughts and images, anger, and disappointment as long-

term implications and emotional impacts of the event become apparent. This disillusionment phase may last months to years and is most likely associated with autonomic (stress) arousal and physical and psychological complaints (e.g., headaches, fatigue, gastrointestinal symptoms, posttraumatic stress disorder, and cardiac symptoms).

Stress related impacts associated with actual or perceived environmental threats can be long lasting. Studies at the site of the Three Mile Island nuclear accident taken a year and a half after the original accident found that individuals living near the site demonstrated higher levels of norepinephrine and some impairment in cognitive ability (as measured by effectiveness at proofreading) compared to individuals living near another nuclear plant, a coal fired plant, or an area with no energy plant at all (Baum, Gatchel, & Schaeffer, 1983). The indirect effects on stress due to disruption of the community and social support networks may last for years or decades (Stein & Meyers, 1999).

Lessons from Hurricane Katrina. The experience of mental health professionals intervening in the aftermath of Hurricane Katrina confirmed evidence that providing assistance with basic needs and psychological first aid are the optimal intervention in the immediate aftermath of a disaster. In general, these interventions focus on individual needs and functional recovery rather than psychopathology. Interventions include contact and engagement, stabilization, information gathering, practical assistance, information on coping, and connection with collaborative services *(*Gheytanchi et al., 2007; Haskett et al., 2008).

The disproportionate impact of the Hurricane Katrina's effects on the poor, largely Black communities of New Orleans's Ninth Ward confirmed that race and socioeconomic factors should be considered in psychological response and prevention efforts. As a group, these residents lacked access to quality education, housing, and employment opportunities available in

surrounding communities. These disparities were associated with a lack of essential resources, shelter, transportation, and information about evacuation plans during the storm *(*Gheytanchi et al., 2007). A survey of Hurricane Katrina's impacts on physical and mental health revealed that elderly people were substantially overrepresented among the dead and that the preexisting circumstances of the evacuees made them particularly vulnerable to a high level of psychological distress that was exacerbated by severe disaster exposure and lack of economic and social resources (Bourque, Siegel, Kano & Wood, 2006).

　　　Differentiating between normal and pathological worry regarding climate change. There are challenges measuring anxiety related to climate change and differentiating between normal and pathological worry regarding climate change impacts. Traditionally, in areas such as environmental medicine (Rabinowitz & Poljak, 2003), "environmental anxiety" (p. 225) has been characterized as obsessive and potentially disabling worry about risks that are actually not significant (e.g., compared to well-recognized hazards such as motor vehicle accidents and smoking). In this case, clinicians have been instructed to communicate the relative importance of such risks in the context of other health priorities. Given the unfolding evidence about potential human health impacts of climate change and the diffuse nature of those impacts, especially on emotions and mental health, what constitutes an appropriate level of worry remains in question.

　　　In clinical terms, anxiety is a future-oriented mood state associated with a sense that events are proceeding in an unpredictable, uncontrollable fashion. It is accompanied both by physiological arousal and by a number of cognitive responses including hypervigilance for threat and danger; and, at intense levels, fear and panic (Barlow, 2002). The principal function of worry is to prepare to cope with future threats. Thus, worry is a normal, adaptive process unless

it is so driven by anxiety that becomes intense and uncontrollable. It is in this sense that worry

can become chronic and maladaptive (Barlow, 2002). Media accounts of "eco-anxiety" about

climate change describe symptoms such as panic attacks, loss of appetite, irritability, weakness

and sleeplessness (Nobel, 2007). Though anecdotal, these symptoms are remarkably similar to

those reported in controlled studies of symptoms reported by those living in proximity to

hazardous waste sites and are likely to have a genesis in autonomic stress responses and

behavioral sensitization. For instance, research on responses to hazardous waste sites and

perceived environmental toxins indicates that symptom complaints are likely to be subjective and

mediated by autonomic stress responses, behavioral sensitization and confounding factors such

as environmental worry (Neutra et al., 1991). Extrapolating from current diagnostic guidelines

(American Psychiatric Association, 2000), differentiating between normal and pathological

worry regarding climate change would include examining the content and pervasiveness of

climate-related worries, interference with functioning as a result of worry, and the degree of

perceived control over the worry process.

    Uncertainty and despair. Fritze et al., (2008) discuss how, "at the deepest level, the

debate about the consequences of climate change gives rise to profound questions about the long-

term sustainability of human life and the Earth's environment" (p. 9). These questions may, in

turn, promote a sense of hope or despair for future generations and impact a sense of individual

and collective meaning and purpose for individuals in the present day. In this vein, Kidner

(2007) has described the loss of security in the future engendered by uncertainty about the health

and continuity of the larger, natural world. Furthermore, as Kidner notes, the impact of these

emotions tends to under-appreciated due to the lack of recognition of subjective feelings of

environmental loss in traditional scientific or economic frameworks. Macy and Brown (1998)

have proposed a set of common barriers that prevent individuals from expressing emotions and concerns related to environmental degradation that may be useful in a climate change context. These barriers include fears of being seen as morbid, unpatriotic, or lacking in information.

Research on climate change-related emotions. In a qualitative study using an existential-phenomenological framework, Langford (2002) identified responses to the risks posed by climate change including: 1) active denial associated with a strong reliance on rationality over emotion and lack of tolerance for scientific uncertainty; 2) disinterest associated with external locus of control and fatalism; and 3) engagement associated with a preference for emotion and intuition to justify opinions and actions, a sense of empowerment and personal responsibility, and belief in communal efficacy. Maiteny (2002), along similar lines, identified three responses to chronic anxiety about ecological and social problems: 1) An unconscious reaction of denial in which individuals stave off anxiety by seeking gratification through continued and perhaps increased material acquisition and consumption; 2) a "green consumer" response (p. 300) that reflects greater concern for the environment (e.g. by shopping in a way that is more thoughtful about potential environmental impacts of product choices), but without major changes in lifestyle; and 3) heightened conscience and feelings of connectedness with wider ecological and social processes, leading individuals to take responsibility for lifestyle changes and stimulate change and awareness in others.

Numbness or apathy. Environmental problems have long been associated with numbness or apathy (e.g., Macy & Brown, 1998; Gifford, 1976; Searles, 1972). Moser (2007) differentiates numbness as a secondary reaction following realization of the magnitude of climate change threats and perceived inability to affect their outcomes. Apathy is seen as a primary emotional response that prevents individuals from learning about the threat and forming a more informed

reaction. The apathy is likely to stem from a "drumbeat of news about various overwhelming environmental and societal problems" (p. 68) as well as the demands of daily life. Speaking from a psychoanalytic perspective, Lertzman (2008) has countered that the public's apparent apathy regarding climate change is actually paralysis at the size of the problem. Lertzman reframes the issue in terms of psychological defense mechanisms such as denial and splitting (i.e., retaining intellectual knowledge of the reality, but divesting it of emotional meaning), both strategies to manage and cope with such experiences by defending against them. Apparent apathy regarding environmental issues may also be a function of adaptation to existing conditions. In a process Kahn (1999) has called "environmental generational amnesia," people tend to make their experience a baseline for environmental health, and thus fail to recognize, over years and generations, the extent to which the environment has degraded.

Guilt regarding environmental issues. Guilt is the emotional response to a self-perceived shortfall with respect to one's own standards of conduct, and people who feel guilty are motivated to make amends or feel a moral responsibility to behave differently (Moser, 2007). The issue of "eco-guilt" has received coverage in the popular media (e.g., Foderaro, 2008). However, attempts to shame individuals into adopting pro-environmental behaviors can be ineffective in changing behaviors particularly when they to lead to rationalizations of behavior and rejection, resentment, and annoyance at such perceived manipulations (O' Keefe, 2002, in Moser, 2007). Research in other areas as well as a recent research on reactions to "guilt appeals" indicate that it is important to make distinctions between messages that lead to feelings of guilt versus shame with the former resulting from reflections on one's behavior and the latter resulting from reflections on personal characteristics (Tangney, 2003; Lickel, Schmader, Curtis, Scarnier, & Ames, 2005), distinctions between people feeling guilty for their own behavior versus the

behavior for their group's behavior (Mallett, 2009; Mallett & Swim, 2004), and distinctions among the recipients of messages with some being more receptive and others more defensive (Brook & Graham, 2009; Mallett, 2009; Mallett, Huntsinger, Sinclair, & Swim, 2008). Moreover, it is possible that people may not like messages that make them feel guilty but the messages may nonetheless be effective (Czopp, Monteith, & Mark, 2006).

Social and community impacts of climate change

Heat and violence. Climate change is most concretely represented in the public mind as "global warming." The warming that is predicted is likely to have some direct impacts on human behavior. Based on extensive research, both experimental and correlational, Anderson (2001) has concluded that there is a causal relationship between heat and violence. He argues that any increase in average global temperature is likely to be accompanied by an increase in violent aggression. Indeed, he suggests that current models predict a rise of about 24,000 assaults or murders in the U.S. every year for every increase of 2 degrees Fahrenheit in the average temperature.

Intergroup relations. Global climate change is also likely to have an effect on intergroup relations. Diminishing resources set the stage for intergroup conflict, either when two groups directly compete for the remaining natural resources, or when ecological degradation forces one group to migrate out of its own territory and become an immigrant into another group's territory (Reuveny, 2008), thus competing for rights and ownership of the space. The Intergovernmental Panel on Climate Change has estimated that by 2030, as much as 42% of the world population will live in countries with insufficient freshwater for their agricultural, industrial and domestic use, setting the stage for conflict over how to allocate water supplies. The Pentagon and other institutional members of the intelligence community have begun to attend to the destabilizing

effects of climate change on domestic stability as well as international tensions (e.g., Yeoman, 2009).

Displacement and relocation.   Loss of connection to place and sense of belonging associated with displacement from ones home place can also undermine mental health (Fullilove, 1996). Communities are already being forced to relocate because of current or anticipated climate changes (Agyeman, Devine-Wright, & Prange, 2009). Such forced relocations can involve a severing of emotional ties to place, as well as disrupting existing social networks. These disruptions of geographic and social connections may lead to grief, anxiety, and a sense of loss, particularly among those with a strong place identity.

Reactions to socioeconomic disparities. The growing recognition that some (primarily Western) countries have contributed more than their "share" to a global crisis that will be most strongly felt by other, less-developed countries will also exacerbate intergroup tensions. One consequence of climate change may be an increase in the disparity between the "haves" and the "have-nots" both within and between nations. Because the have-nots are more likely to be ethnic minorities (Bullard & Johnson, 2000), this disparity may increase ethnic tensions and intergroup hostility. Intergroup relations suffered in the aftermath of Hurricane Katrina, for example, when African Americans were more likely than Whites to interpret the government's response as indicating racism (Adams, O'Brien, & Nelson, 2006); the loss of key resources due to the storm highlighted group differences in financial and geographic security. Issues of justice become more relevant when a resource is limited, and a threat to one's group identity—such as may be represented by a loss of homeland, or a reduction in the environmental resources needed for survival—tends to increase derogation of the outgroup (Hogg, 2003).

Social justice implications. As Moser and Dilling (2007b) note, the ethical implications of sharing one atmospheric commons are that some regions are disproportionately affected by climate change, and societal vulnerability to those negative impacts is also highly uneven due to differential levels of exposure and sensitivity to the risks and differential ability to cope and adapt. Nations that benefit most from the status quo and perceive themselves to be less severely impacted have less incentive to push for action on climate change (Agyeman et al., 2003; Kasperson & Dow, 1991), while other, more vulnerable nations recognize that their very existence is threatened by the possibility, e.g., of rising sea levels. The result is that response to climate change may be seen as not fairly allocated on the basis of responsibility for the change.

Moderators of climate change impacts

Proximity. Psychosocial moderators are those variables that affect the intensity or strength of climate change impacts. Personal experience with noticeable and serious consequences of global warming is still rare in many regions of the world. Proximity can be a moderator of climate change impacts when one directly experiences an extreme weather event (Few, 2007). Extrapolating from on earlier research regarding perceived environmental hazards (e.g., research on individuals living in sight of a hazardous waste facility; see Neutra et al., 1991), proximity to visual or sensory cues of climate change impacts may moderate physiological and psychosocial impacts. However, it is also likely that the time-delayed, abstract, and often statistical nature of the risks of global warming will not evoke strong visceral reactions (i.e., worry) and thus diminish alarm and urgency about risk management (Weber, 2006). The role of media narratives as mediators of the psychosocial impacts of climate change is discussed below and in the Adaptation section of this report.

Vulnerabilities and resilience. A research framework on social vulnerability to global environmental changes can begin with lessons learned from social vulnerability research in areas of famine, environmental hazards and public health (Brklacich et al., 2007). Social vulnerability can be defined as a lack of capacity within individuals and communities to respond to (e.g. cope with, recover from, and adapt to) external stresses placed on their livelihoods and well being. Vulnerability is inherent in all human systems and it is exposed rather than caused by external stressors, with repeated impacts increasing future vulnerabilities. Social vulnerability is differentiated within and between places and groups and is linked with broader issues of social, economic, and political inequality.

While frameworks guiding climate change policy frequently articulate a dichotomy between mitigation or adaptation (as is discussed in other sections of this report), Brklacich et al. (2007) assert that a social vulnerability perspective encourages an understanding of the relationship between exposure to stresses and capacity to respond as well as recognition of the common drivers of both. They argue that the same processes that position some people and groups in harm's way (i.e. living in marginal, low-lying areas and having precarious, resource based livelihoods) also limit their option for avoiding adverse outcomes. When determining those most vulnerable to psychosocial impacts of climate change, previous research on disaster intervention has identified groups likely to be at greater psychosocial risk including children, the elderly, rural and urban poor, racial and ethnic minorities, those with a previous history of emotional disability, and, in general, those with a marginalized pre-disaster existence (Gheytanchi et al., 2007; Bourque et al., 2006; Peek & Mileti, 2002).

Social norms. Social responses to climate change can also be considered a type of moderator. A sense of impact or alarm is likely to be moderated by social referents and local

social norms. For example, some groups perceive that society will be able to adapt to any adverse changes related to climate change once they arrive (Moser, 2007). Knowing that people believe this could alter other people's responses to climate change.

Psychosocial mediators of climate change impacts

Mediators such as cognitive appraisals or media representations explain why climate change can have psychosocial impacts on individuals and communities that have not experienced direct physical impacts; that is, the effects of climate change occur because of its impact on the mediating variables.

Relative risk appraisals. Relative risk constitutes an individual's assessment of the degree of threat and harm they perceive from climate change and the assessment of their individual and social resources they have to deal with the perceived threat or harm. As in the development of the terrorism-related fears following the September 11 attacks (Marshall et al., 2007), perception of personal risk is likely to mediate how individuals experience impacts of climate change. Sense of risk or empowerment regarding the impacts of climate change may also be mediated by attributions of responsibility (Leiserowitz, 2007).

Mental models. Individuals' pre-existing frames of reference or mental models will also affect their understanding, perception, and reaction to information about climate change (Kempton, 1991). For example, climate change impacts framed as weather disasters in media images may trigger a "weather" frame. Since weather is generally seen beyond as humans' control, this in turn may lead to a sense of helplessness or resignation about climate change (Bostrum & Lashof, 2007). Because climate change is not typically experienced directly, its effect is mediated through this interpretive model.

Media Representations. Media representations are a powerful and arguably primary mediator of climate change impacts for most individuals. Reser (in press) stresses that what people are experiencing and responding to in the context of climate change are principally indirect and virtual media representations of climate change—not changes in global weather patterns or ongoing environmental impacts, per se. Further, Stokols, Misra, Runnerstrom & Hipp (2009) describe how continual exposure to information engendered by modern technologies (e.g., vivid and instantaneous internet images) raises the salience of global crises and can engender anxiety or passivity in the face of seemingly overwhelming threats.

Past responses to media portrayals of crises illustrate the way in which public alarm and media attention can play a role in psychosocial impacts. For example, investigations into the aerial spraying of malathion during the Mediterranean Fruit fly (Medfly) crisis in California in the 1980's found that reports of anxiety and physical symptoms were higher before the spraying began and no chemical agent was present and decreased significantly after the spraying began and attention by the public and media subsided—suggesting that the media attention rather than the spraying was the primary cause of the health effects (Jackson, 1981, in Neutra et al., 1991). More recently, investigators have documented strong positive associations between and anxiety and PTSD symptoms related to the 9/11 bombings and exposure to television coverage of the disaster in persons across the US not directly exposed to the attacks (Marshall et al., 2007). Media representations are likely to remain a useful variable for understanding the psychosocial impacts of climate change as various framings and the messages regarding the issue are presented (Dunwoody, 2007).

Anxiety. Although anxiety is a possible outcome of climate change, as noted above, it is also can be a mediator to the extent that it leads to other outcomes. For example, individuals

living in sight of a hazardous waste site or sensitive to odors perceived to emanate from the sites

report a variety of physical symptom complaints associated with perceived environmental

pollution (e.g., nervousness, headache, sleeplessness, fatigue, dizziness, nausea) even when the

presence of health problems (e.g., toxic exposure, higher rates of cancer or birth defects) are not

borne out by careful study (Neutra et al, 1991). This finding suggests that the environmental

cues stimulated anxiety which in turn led to physical symptoms.

Global climate change in context of other environmental challenges

Global climate change is generally discussed in the context of other environmental

challenges. Some of these are causally connected to climate change, such as resource depletion

and loss of biodiversity; others, like overpopulation and pollution are more separable from

climate change, but will combine with it to accelerate the trend toward increased competition for

decreased environmental resources.

In terms of human health and wellness, an underappreciated consequence of climate

change may be the opportunity costs represented by decreased access to thriving ecosystems.

The rapid pace of change poses a threat to biodiversity and ecological health (Wilson, 2002), and

an accumulating body of research suggests that nearby nature has positive effects on physical

and mental health (De Vries et al., 2003; Maas et al., 2006; Takano et al., 2002) as well as on

social functioning (Kuo & Sullivan, 2001; Kuo et al., 1998; Krenichyn, 2004; Maller et al., 2006;

Shinew et al., 2004).

Climate change may be associated with a reduction in the health of various green spaces

including public parks as ecosystems decline and there is increased demand for the resources

required to maintain them. Importantly, one recent study (Fuller, Irvine, Devine-Wright,

Warren, & Gaston, 2007) found that psychological benefits were positively correlated with the

biological diversity represented in local parks. Access to nature may be particularly important for those who are most vulnerable, Kuo and Faber Taylor (2004), for example, found that parents of a nationally representative sample of children with ADHD reported that their children showed reduced symptoms after activities in natural settings as compared with indoor and built outdoor settings. Unfortunately, minority and low SES citizens are less likely to live near parks, and may find it more difficult to reach them. A side effect of environmental degradation is likely to be increased inequality, not only in exposure to environmental hazards, but in access to environmental benefits.

Psychological benefits associated with responding to climate change

The challenges of climate change "may galvanize creative ideas and actions in ways that transform and strengthen the resilience of and creativity of community and individuals" (Fritze et al., 2008, p. 9). A positive scenario is that a number of factors will combine to accelerate public action on climate change mitigation and adaptation: vivid focusing events, changes in public values and attitudes, structural changes in institutions and organizations capable of encouraging and fostering action, and creation of practical and available solutions to the problems requiring change (Kates, 2007).

Evidence of the impacts of climate change on health and wellbeing may increase pro-environmental behavioral norms and personal responsibility for action (for a mechanism see: Stern, Dietz, Abel, Guagnano, & Kalof, 1999; Stern, 2000). From the perspective of stage models of behavior change (Prochaska, DiClemente, & Norcross, 1992), individuals and organizations may progress from contemplation to action regarding pre-environmental and sustainable behaviors (Doppelt, 2008). As De Young (1996) has noted with regard to recycling, there are intrinsic benefits to be gained from pro-environmental behavior, including a sense of

frugality, participation, and competence. Finally, there may be potential for enhanced personal meaning, and satisfaction regarding effective efforts at climate change adaptation or mitigation. Research on some youth conservation programs has shown preliminary evidence that participants gain in self-efficacy, social competence and sense of civic responsibility (Johnson et al., 2007). As noted above, qualitative analyses by Langford (2002) and Maiteny (2002) suggest that some individuals respond to the threat of climate change with an increased emphasis on collective engagement and associated positive emotions. We emphasize, however, that these psychological benefits of involvement derive from actions that people believe address the climate problem—even if the actual effect on climate is minimal or nonexistent.

Research on psychosocial impacts of climate change

We need further research that is explicitly directed at addressing individual and societal responses to the reality of climate change – the anxieties, the extreme weather events, the dislocations, and the increased social inequality. While this report highlights many areas of existing knowledge (e.g., psychosocial impacts of natural disasters and attitudes and behaviors toward perceived environmental threats), the challenge is to test theory and interventions in the domain of climate change. Research questions can include:

- How is the response to environmental problems that result from climate change similar to the response to natural disasters, e.g. involving the same distinct phases? Are there differences due to the perceived human causality and/or ongoing nature of the problem?
- What is the effect of environmental disasters on sense of place and place attachment?
- How are different cultures likely to be affected by climate change, in ways that are both concrete (loss of homeland) and more abstract (changes in cultural practice and values)?
- What are the complex interrelationships between individual and personality variables (e.g.,

openness to experience, optimism, neuroticism) and psychological processes including coping and defense mechanisms (e.g., denial, avoidance), psychopathology (e.g., pre-existing mental or emotional disorders), socio-economic vulnerability, group norms, and media and cultural messages regarding climate change?

- What are the specific impacts of *perceptions* of climate change on individual responses of anxiety, fear, and guilt?

- What is the impact of climate change and associated scarcity of natural resources on intergroup relations?

- How does climate change affect perceptions of justice, and how do these perceptions mediate other consequences?

- What are the most effective therapeutic interventions targeting individual and community health impacts of climate change? In particular, we should attend to the possible differential reaction to the interventions by members of different racial, ethnic, and gender groups and communities.

- How can educational interventions promote positive responses such as empowerment, involvement, and efficacy?

The relationship between psychosocial impacts and coping

While this section of the review has addressed the *impacts* of the threat and unfolding physical environmental effects of global climate change, such impacts cannot in fact be separated from adaptation or coping. How individuals and societies make sense of climate change, and how the nature and threat of climate change are appraised in the service of managing anxieties, both constitute an important aspect of the psychosocial impact of global climate change. Similarly individual and collective psychological responses to the threat and to

the physical environmental impacts of climate change can dramatically influence the ongoing psychosocial impacts of global climate change. Yet, it is important to examine impacts separately from adaptation and coping processes in order to bring clarity to the construct and processes of adaptation in the context of climate change. The next section will situate responses to climate change in terms of a model of coping that emphasizes internal appraisals of the problem and of one's own ability to cope. Such appraisals will moderate the impact on both individuals and societies.

Section 4: How do People Adapt to and Cope with the Perceived Threat and Unfolding

Impacts of Climate Change?

Adaptation to the threat and unfolding impacts of climate change has become pressing

and urgent, given the alarming rapidity with which predicted climate changes are taking place. It

is important not only to ensure the safety and security of human and nonhuman populations in

many regions of the world, but to ensure that immediate and pressing needs do not derail the still

vital climate change mitigation initiatives and progressively stringent policies that are either in

place or are being finalized nationally and internationally.

The IPCC defines adaptation as "adjustment in natural or *human systems* in response to

actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial

opportunities" (IPCC, 2007b). According to this IPCC definition, adaptation may include

responses made in anticipation of climate change impacts, responses that are a result of

deliberate policy decisions based upon awareness of current or upcoming changes, and

"autonomous" or "spontaneous" responses that represent unplanned responses "triggered by

ecological changes in natural systems and by market or *welfare* changes in *human systems*"

rather than by conscious awareness of changes and specific adaptation plans. Adaptation in the

climate change science context is often used in reference to structural changes (such as building

new structures or providing ways to get access to fresh water to address the physical impacts and

impending physical impacts of climate change) and in terms of micro and macro system

adjustments, such as those relating to households, communities, institutions, regions, and

countries.

Psychological forms of adaptation are very infrequently addressed in the current climate

change adaptation literature. Adaptation as a construct has been used in a variety of ways in

psychology. Like evolutionary biologists, evolutionary psychologists have used adaptation to

refer to characteristics that have increased human survival and reproduction (e.g., features that

influence mate selection in humans; Halberstadt, 2006). Beyond this, adaptation has been used

to refer to specific psychological responses such as sensory habituation to various stimuli (e.g.,

noise) or specific types of coping responses individuals can make to changes in their physical

environments, including natural disasters (e.g., Bell et al., 2001; Holahan, 1982). However,

adaptation is also commonly used to refer to adaptation processes that involve, for instance,

accommodating, assimilating, or adjusting to various contexts and new or difficult life

circumstances (e.g., work situations, Hulin, 1991; new cultures; Rudmin, 2003; adoption, Tan,

Marfo, & Dedrick, 2007; chronic disease, Stanton, Revenson, & Tennen, 2007). This more

encompassing set of meanings for adaptation is consistent with a psychological environmental

stress approach to understanding people's responses to difficult situations (Evans & Stecker,

2004; Stokols, 1978). Here, adaptation refers to a wide range of responses individuals can make

to difficult circumstances including initial understandings, affective responses to situations,

behavioral responses to situations, the process of selecting responses, and the reciprocating

impacts of responses on individuals, communities, and the physical environment (e.g., Gifford,

2007; Stokols, Clitheroe & Zmiduidzinas, 2000). What is distinctive about psychologists' use of

the term adaptation, particularly when used to refer to adaptation processes, is that it includes a

focus on intra-psychic conditions (e.g., appraisals of situations, affective responses, and

motivations) and social processes (e.g., sense making, social comparison, social construction,

and social amplification of risk) that influence how individuals and communities respond to

challenging circumstances and includes a variety of types of psychological responses as adaptive

responses (e.g., cognitive reappraisals, disengagement, and emotion management).

An environmental stress perspective on the adaptation demands of global climate provides much value. It brings an environmental and human ecological perspective to the complex phenomenon of climate change. It includes the requisite multiple levels of analysis needed to adequately frame the adaptation challenges of dramatic climate change impacts and to strategically address planning considerations and interventions for enhancing individual and community adaptations. It brings in research on disaster preparedness, response, and recovery (e.g., Reyes & Jacobs, 2006). Disaster research is useful because many of the projected upcoming impacts of climate change will take the form of disasters and, as noted below, climate change can be understood straddling technological and natural disasters. Finally, an environmental stress perspective also makes connections to research on stress and coping which delineates individual level psychological processes and has been extended to community level coping as well (Baum & Fleming 1993; Holahan & Wandersman, 1991; Lazarus & Cohen, 1977). The usefulness of stress and coping models, which have most frequently been examined in health psychology, become more evident when considering the emphases on human health consequences of climate change that have been highlighted by groups such as the World Health Organization (Climate Change and Human Health, 2009).

The model illustrated in Figure 8 provides an organizational framework for the material presented in the remainder of this section of the report. It derives from a number of related and convergent psychological models (e.g., environmental stress, stress and coping models, protection motivation theory, and the health belief model [e.g., Glanz, Rimer, & Lewis, 2002; Lazarus & Folkman, 1984; Rogers, 1975; Rogers & Prentice-Dunn, 1997]). We first provide an overview of the model and then go into more detail about each element of the model.

Threat Appraisal
(aka primary or risk appraisals)

Assessing whether Impacts on Self, Family, Community, Cultures, & Society Exceed Resources
· Perceived probability of risk
· Perceived severity
· Perceived vulnerability & resilience

Direct, Indirect, & Mediated Experience with Stressors

Cataclysmic events

Chronic events including ambient stressors

Coping Appraisal
(aka secondary appraisals)

Assessing Anticipated Effects of Possible Responses & Capacity to Respond
· Self-efficacy
· Response-efficacy
· Costs & benefits
· Situation constraints
· Strength of community

Attributions

Affective Responses
(e.g., Fear & Hope)

Motivational Processes

Proactive & Reactive Coping Responses

Intra-psychic Responses
examples
· Environmental numbness
· Cognitive reappraisal such as altering risk assessment
· Emotion regulation

Behavioral Responses
examples
· Seeking information
· Seeking interpersonal or community social support
· Compensatory behavior such as changing structure of habitat
· Mitigation
· Civic participation

Impacts on Individuals & Communities

Examples of Moderators of Each Step in the Process

Characteristics of Individual
· Resilience & vulnerability
· Being sensitive to stressors
· Being an optimist

Characteristics of Incident & Physical Environment
· Severity & intensity of impacts
· Region-specific biophysical impacts

Characteristics of Community
· Social capital & social networks
· Media representations
· Construal & reactions by others
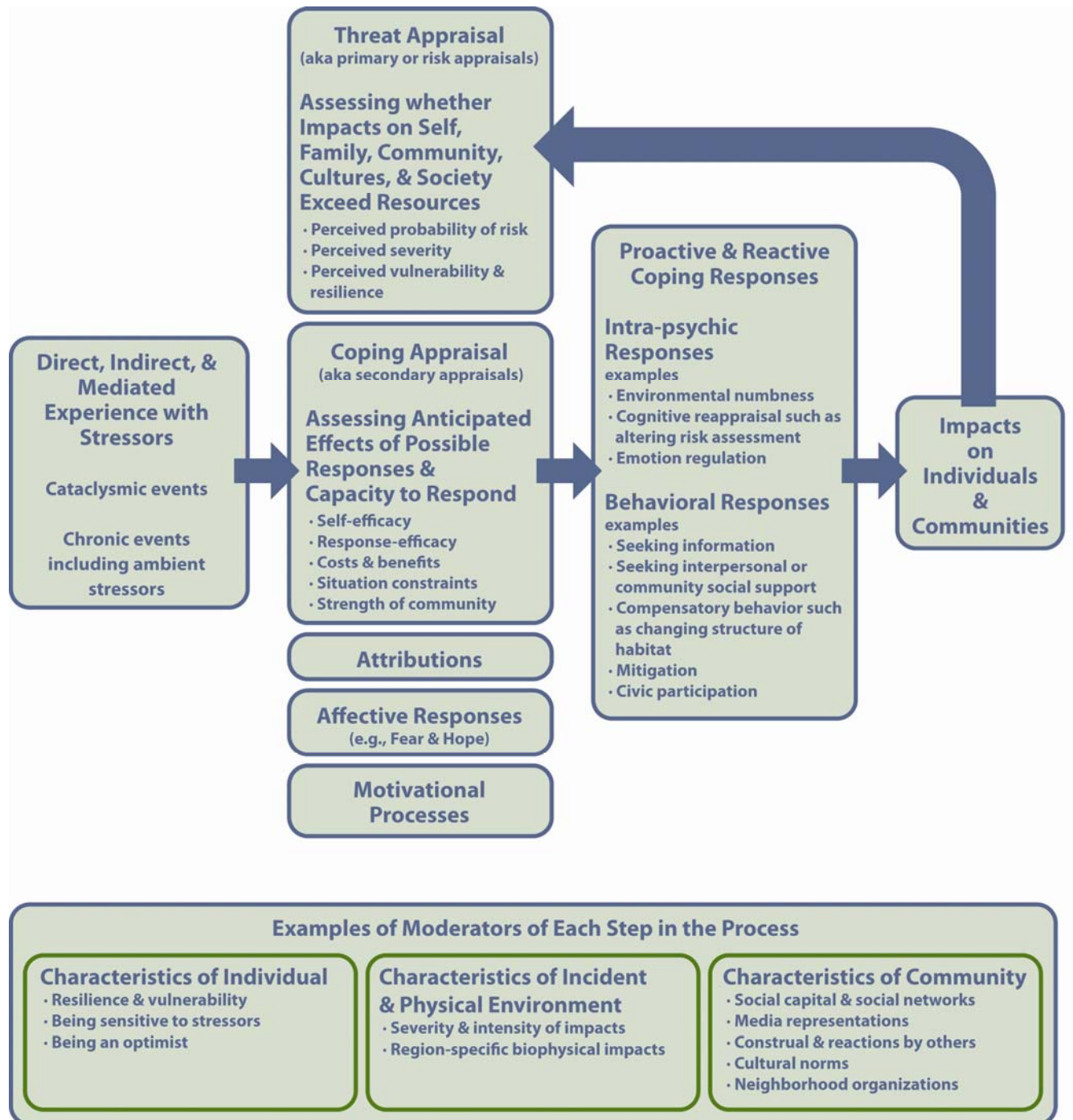· Cultural norms
· Neighborhood organizations

Figure 8: Psychological processes that influence coping with climate change.

The initiators of the adaptation process, noted on the far left of the figure, are conceptualized as stressors and in this context they include direct, indirect, and mediated

experiences with the impacts of climate change. Initial responses to these impacts include cognitive responses in the form of appraisals of the impacts relative to resources (threat appraisals) appraisals of possible responses (coping appraisals), attributions for events, affective responses such as fear and hope, and the activation of motivational processes such as self-protection motives and uncertainty reduction. For instance, individuals who anticipate that they live in a region where sea levels will rise may assess the probability of the event and the extent to which they and their family will be affected by rising sea levels and whether they have resources to respond to the rising sea levels (threat appraisals). They may also assess what they think they could do about rising sea levels and whether what they can do would make a difference (coping appraisal). Their affective responses, such as anxiety, fear, or worry and their attributions for the causes of the rising sea levels will likely influence their appraisals (see section 1). Further, a desire to reduce uncertainty about the likelihood that they will be effected (a motivational process) cold be activated.

These initial responses influence each other as well as the selection of intra-psychic and behavioural responses at both the individual and community level which in turn effect individual and community impacts. For instance, greater perceived threat can lead to more worry. Together these responses can lead to affect regulation or denial (intapsychic responses) or participation in civic action to encourage their community to develop protections from rising sea levels (behavioural response). Different coping responses result in different types of impacts on individuals and communities. Section 3 describes the psychological impacts of climate change so we will not elaborate on them in this section. The impacts feed back into appraisals, affective responses, attributions, and motivations already mentioned. For instance, civic engagement may effectively address the perceived threat. Yet it may also be insufficient which would then result

in other coping responses. As the example illustrates, adaptation processes can change over time

for instance, as particular problems are addressed or as coping resources diminish (e.g., Lepore

& Evans, 1996). Finally, many moderators can influence each step in the model and examples

are listed at the bottom of the figure. For instance, individuals and communities with fewer

resources are likely to be more vulnerable and less resilient to climate changes due to, for

instance, the inability to engage in effective coping responses.

In what follows we extrapolate from research on environmental stress to the context of

global climate change and refer to research from areas of disaster preparedness, response, and

recovery and research employing stress and coping models. Arguably, the disaster literature is

particular relevant to this domain because of the types of impacts projected for climate change.

Yet, it must be kept in mind that the multifaceted nature of climate change makes it distinct from

other stressors and disasters because of its global scope and magnitude, a duration which may

encompass many generations if not centuries, and the unprecedented character of these global

changes in known human history.

Climate change threat and environmental impacts as stressors

Stressors are often understood as the events or circumstances that initiate the stress and

coping process. Here the stressors direct, indirect, and mediated experiences with global climatic

patterns and region specific physical environmental impacts. While some, such as those living in

Alaska, Northern Canada, and Northern Europe (Kolbert, 2006), are currently responding to their

direct contact with current physical environmental impacts of climate change, many are

responding to their understanding of the global climatic patterns, as mediated, for instance,

through media representations of climate change and through social communication about

climate change. Much of the media coverage of the recent bush fires in Australia, and indeed

disasters around the world are being discussed, framed, and explained as manifestations of climate change (e.g., Matthews, 2009). This suggests that the public in many parts of the world increasingly understands and sees such disasters as dramatic, symbolic, and unfolding manifestations of climate change. Those who directly experience the biophysical environmental impacts of climate change will likely experience stress due both to their immediate personal experiences with climate change as well as their expectations about future impacts of climate change.

Stressors can manifest themselves in many different ways including as discrete or chronic events and as natural or technological disasters. Further, different manifestations can be anticipated. As described next, these different types of stressors can potentially be generalized to different manifestations of climate change. Distinctions among types of stressors have implications for the rest of the stress process. Therefore, it is possible that different types of stressors can potentially explain various ways that climate change is experienced and a variety of anticipatory and preparatory responses. Further, this suggests that the different ways that media portrays climate change and the way climate change is discussed in everyday discourse can have implications for immediate and anticipator responses to climate change impacts.

Types of stressors. Stressors range from discrete events to continuous events (Wheaton, 1996; 1999). The former represent sudden traumas or life changing events, including cataclysmic events, such as hurricanes, that occur with little or no warning and impact a large number of people, and personal stressors (also known as stressful life events), such a death and illness, that affect fewer people and may or may not be anticipated (Bell et al., 2001; Evans & Cohen, 1991). In the disaster literature, researchers point to both natural and technical (human made) disasters which are types of cataclysmic events (Bell et al., 2001).

In contrast, continuous events represent chronic stressors and nonevents. Ambient stressors are a type of chronic stressor particularly relevant to environmental stressors (Bell et al., 2001). Ambient stressors can represent regional conditions of the environment, such as pollution or toxicity, that effect a large number of people but may not be considered acute because they are like low level background noise and may go unnoticed either because they are subtle or because people habituate to them (e.g., Adeola, 2000; Edelstein, 2002).

Climate change can be experienced as and anticipated to be both discrete and continuous. For instance, as discrete events, climate researchers have warned of more frequent and severe weather-related incidents including the increased frequency and heightened intensity and severity of natural disasters such as storms, hurricanes, tornadoes, floods, bush fires, and other rapid onset and largely unpredictable events. At the other end of the stress continuum, climate researchers have projected chronic conditions, for instance, in the form of drought and other more incremental and persistent environmental changes such as soil loss and erosion, salination, and gradual environmental toxification. Climate change can be understood as an ambient stressor because the changes are often in the background due to, for instance, the change being embedded in natural variations in climate, the patterns being difficult to detect, the relatively slow progression of the changes which can lead to a normalized habituation and expectancy, or the effects being perceived to relevant more for future generations than one's own generation (see section on perceptions of climate change in this report).

Natural and technological disasters. An important distinction exists in the disaster literature between natural and technological disasters (e.g., Baum, 1987; Baum, Fleming, & Davidson, 1983; Baum & Fleming, 1993; Bell et al., 2001; Quarantelli, 1998). Natural disasters are more sudden, cataclysmic, uncontrollable, acute (as distinct from chronic), and characterised

by enormous destructive power and magnitude. Technological disasters are attributed to human behaviour (not the product of natural forces) and are less predictable, typically accompanied by no warning, often chronic, often having no visible manifestation, less familiar, more likely to threaten feelings of control, more likely to have complex impacts, less likely to elicit supportive and cohesive community response, more likely to foster anger, frustration, resentment, felt helplessness, and blame, etc (see Bell et al., 2001 for a summary).

Global climate change straddles this classification in a number of ways, as the human forcing of naturally occurring climate change is largely the product of *technological* processes and products, though the consequent meteorological and climate change phenomena manifest as *natural* disasters. Indeed, climate change elicits some of the same responses found in the case of technological disasters, including distrust of government, corporations, regulatory authorities, and indeed science itself (e.g., Earle, 2004; Earle & Cvetkovich, 1995; Lang & Hallman, 2005). Global climate change is also unique in that it presents multifaceted global impacts that will be chronic over a dramatic time frame, and not amenable to conventional national or jurisdictional agencies, or 'disaster' policies and procedures (Marshall et al., 2007). A number of authors have suggested that framing global climate change in *global disaster* terms provides a clearer and more realistic picture of the interacting processes and impacts, their true magnitude and extent, the nature and scale of human impacts, and the imperative to take immediate disaster mitigation and preparedness measures (e.g., Spratt & Sutton, 2008; Reser et al., in press).

Mediating relations between stressors and coping responses

Threat appraisals. Stress and coping models highlight the role that cognitive processes play in individuals' selection of coping responses. One cognitive process identified in these stress models focuses on appraising or evaluating the stressor and its impact on oneself and those

important to oneself (e.g., friends, family members, colleagues). These appraisals include assessing the perceived risk of events, the severity of current or future damage, and who is vulnerable to the risks (see Section 1 of this report). It is important to note that appraisals include assessing perceived psychological as well as physical consequences of events. For instance, environmental stressors can influence people's perceived ability to predict and control the environments in which they live. A perceived lack of personal environmental control being one of the most ubiquitous determinants of aversiveness, anxiety, and distress (e.g., Evans & Cohen, 1991; Shapiro, Schwartz & Astin, 1995). Climate changes can also be appraised as threatening because of their broader environmental impacts on all life on the planet (e.g., Hall et al., 2004).

It is important to note that not all appraisals of upcoming incidents need to result in feelings of threat. Some appraisals will result in people feeling challenged (Tomaka, Blascovich, Kelsey, & Leitten, 1993). Threat appraisals result when anticipated adverse impacts are perceived to exceed one's resources whereas challenge appraisals results when one's resources are perceived to be able to address the anticipated adverse impacts. Although threat versus challenge responses have not been studied in the context of climate change, the difference between threat and challenge appraisals may have important implications for instance, whether individuals avoid versus approach problems.

Risk perception and appraisal are influenced by social factors. Much information about the world and potential threats and problems comes mediated via a social world (e.g., Berger & Luckmann, 1967; Gergen, 1985), through interactions with friends, overheard conversations, observations of others, media coverage, and specific risk communications from health professionals and climate change scientists—with these risk messages also being communicated

through and edited by journalists and media organizations (e.g., Carvalho, 2007; Danesi, 2002), and via information technologies including the internet (e.g., Olson & Rejeski, 2005; Pettenger, 2007). Such vicarious social learning includes the individual and cultural learning of adaptive practices and competencies with respect to risk, danger, and uncertainty (e.g., Bandura, 1999; Douglas & Wildavsky, 1982).

Social construction, social representation, and social amplification processes are three theoretical frameworks describing the complex factors which mediate and substantially influence the public's appraisals of risk, environmental threat, and global environmental change (e.g., Bauer & Gaskell, 2002; Flynn, Slovic & Kunreuther, 2001; Pidgeon et al., 2003). These perspectives help explain variation in understandings of and responses to climate change across cultures, regions, and communities and across environmental and policy experts, journalist, scientists, and laypeople.

Social construction as a process refers to how people collectively and through social interaction impose meaning and order on their world, how they perceive and interpret, construct and shape, their shared reality (e.g., Berger & Luckman, 1966; Burr, 1995; Gergen, 1985). Social constructions are also understood as consensual understandings and operating constructs and classifications, thoughts and ideals, shared by members of a society which emerge through everyday conversation and transactions with each other and with the environment and world they share and are a part of. Such entities as 'nature', 'the environment', 'environmental problems', 'natural' and 'technological' 'disasters', 'sustainability' and "climate change" itself are viewed by many theorists and researchers as, in substantial part, social constructions and are of particular relevance to climate change, (e.g., Jagtenberg & McKie, 1997; Macnaughten & Urry, 1998; Pettenger, 2007; Robertson et al., 1996). A considerable body of research helps us understand

the nature and dynamics of such socially constructed and media disseminated environmental threat representations and understandings (e.g., Adam, 1998; Johndon-Cartee, 2005; Lupton, 1999; Slovic, 2000; Vaughan, 1993; Weber, 2006). Hence this is an encompassing perspective of particular relevance to adaptation and coping, and public understandings of and responses to 'climate change'.

Social *representations* are shared assumptions and understandings about the social and physical world. They include material culture expressions, images, texts, other information technology products and information and built environments which invariably capture and reflect a particular world view. They provide a framework for interpreting and communication our experiences. It is through these commonly shared and collectively elaborated social representations that we make sense of the world and communicate that sense to each other (e.g., Deaux & Philogene, 2001; Flick, 1998; Moscovici, 2000). Social representations of 'climate change' include media images, articles, books, magazine covers, documentary and popular culture films, research findings and public discourse and shared understandings about 'climate change' and its nature, causes and environmental and human consequences. Many studies have been undertaken in North America and Europe which examine public risk perceptions of climate change (see section1 of this report), but fewer studies have undertaken in-depth investigations of the nature of media representations of climate change, or the underlying risk domain of climate change vis-à-vis other known risks, or how or why climate change might be quite different from other risks in representation and with respect to risk appraisal and psychological responses.

Social processes can both amplify and attenuate understandings of climate change (e.g., Flynn et al., 2001; Pidgeon et al., 2003; Sjoberg, 2006). "The social amplification of risk framework holds that, as a key part of that communication process, risk, risk events, and the

characteristics of both become portrayed through various risk signals (images, signs, symbols), which in turn interact with a wide range of psychological, social, institutional, or cultural processes in ways that intensify or attenuate perceptions of risk and its manageability" (Kasperson et al., 2003, p. 15). The research challenge has been to distil what these research findings and past policy applications of evidence-informed risk management principles have to say about how individuals and communities might best prepare themselves for what will be, for many, a very changed environmental and regulatory landscape in the context of climate change.

Coping appraisals. A second cognitive response to experienced and anticipated stressors focuses on evaluating the response one might make to the stressor. This includes assessing one's ability to engage in a behavior (i.e., self-efficacy), the likelihood a behavior to result in the desired outcome (i.e., response efficacy), constraints on response options, and the relative perceived costs and benefits of responses. The costs and benefits, for example, are often unknown and therefore reflect a type of risk assessment (see Section 2 of this report). Other coping appraisals involve assessing characteristics of one's immediate social community such as the strength of one's social networks and neighborhood organization (Holahan & Wandersman, 1991). Coping responses to various climate change impacts are likely influenced by appraisals of the specific impacts experienced or anticipated, and public appraisals of the adaptation and mitigation responses they can make to these impacts. Social processes and media portrayals are very likely to influence coping appraisals.

Attributions. How individuals respond to the perceived threat of climate change is also likely influenced by the causal and responsibility attributions they make for climate change. Psychological research shows that people's willingness to restore or prevent damage is driven by their perceptions of the causes of the damage. These attributions can influence appraisals of the

impact of events. For example, an important dimension is whether the harm is seen as having been caused by natural vs. human-made processes (Brun, 1992; Slovic et al., 1986). The distinction between natural and human-made causes may appear irrational in the face of consequential considerations, but it plays a crucial role in considerations of ethical responsibility and accountability. These attributions could also potentially influence motivation to respond. While not the only ethical consideration that comes into play in the context of climate change, the principle "if you break it, you fix it" has currency in a wide range of cultures. Moreover, even if people agree climate change is anthropogenic, they may not take personal responsibility for responding to either the current impacts or for preventing future impacts. Indeed research findings suggest that they may see that global and distant others are responsible for the global and largely distant problem, thereby abnegating personal responsibility (e.g., Uzzell, 2000; 2004). Finally, attributions influence coping appraisals by, for instance, by suggesting whether coping responses should be directed at changing the self or changing the situation. Research is need to specifically examine such interrelations in the context of global climate change and how they might relate to assessing blame and accountability for disasters.

Affective responses. Affective responses, or lack of responses, to climate change are likely to influence responses to climate change (see Sections 1 and 3 of this report). Societal emotional responses to media images and coverage of less specific but menacing threats, such as radiation and cataclysmic future scenarios, both imbue and reflect strong affective and symbolic responses, informed by culturally elaborated risk domains (Adam, 1998; Eckersley, 2008; Edelstein & Mackofske, 1998; Whitfield, Rosa, Dan, & Dietz, 2008). While only limited research (e.g., Townsend, Clarke, & Travis, 2004) has considered the nature and status of climate change as a risk entity, it is of particular importance to ask how emotional and symbolic aspects

of climate change risk appraisals and sense making are influencing the nature and levels of public concern and underlying protection motivation processes (e.g., Weinstein, 1989; Bohm, Nerb, McDaniels, & Spada, 2001; Bohm, 2003).

Perhaps the most frequently studied affective response to stressful events relates to anxiety, fear, and worry, though other emotions could be examined. Worry is an important psychological impact of climate change (see section 3) and it can also influence other parts of the adaptation process. Fear, for instance, in Protection Motivation Theory, is conceptualized as a response to and a predictor of one's evaluation of the stressor (Hass, Bagley, & Rogers, 1975; Rogers, 1975; Rogers & Prentice-Dunn, 1997). Fear and anxiety, while adaptive responses to threat, can often 'get in the way' of clear thinking and very necessary adaptive responding in the context of imminent natural disaster warning situations (Reser, 2004). Other affective responses, such as hope, may act like optimism, by encouraging the likelihood that individuals will select coping that engages one with the situation (Snyder, 2002).

Motivational processes. Most stress and coping models assume that the reduction of appraised threats motivates individuals to select coping responses. However, other motivational processes can also come into play. A fundamental aspect of adaptation and coping processes in general has to with the functions served and benefits achieved. The very meaning of 'adaptive' in an evolutionary or ecological context is that a particular and adventitious change confers a survival benefit or advantage. Such adaptive programming finds strong expression in human motivational systems, with the survival prerequisites and advantages of safety, security and defense being fundamental and overriding, particularly in the face of uncertainty, threat, or environmental demands. Motivational considerations in the context of risk or threat have received substantial psychological attention, in the context of instinctive fight or flight

responding, psychoanalytic defense mechanisms, and various articulations of protection motivation, whether through attitudinal stance, value expression, avoidance, defensive pessimism or unrealistic optimism (e.g., Taylor & Brown, 1988; Reser & Smithson, 1988; Weinstein & Kline, 1996; see Section 4 of this report). Other basic research on motivations could potential inform people's selection of coping responses such as research on core psychological needs or research on goal setting.

The field of risk perception and appraisal, including the social and cultural construction of risk (e.g., Johnson & Covello, 1987; Slovic, 2000; O'Riordan, 1995) and individual differences (e.g., Yates, 1992), is clearly of direct relevance to climate change response and impacts, with the perception and appraisal of risk including not only the perceived probability and personal consequence of an event, but its meaning(s), cause(s), acceptability, voluntary exposure, uncertainty, and perceived control or 'management' options (Arnold, 1970; Lazarus, 1966; Paterson & Neufeld, 1987; Taylor, 2006). The health belief model, in turn, is premised on the assumption that people are prepared to undertake preventive behaviour(s) as a function of their appraisal of the severity of a threat, the perceived benefits of a recommended health action, and the perceived barriers to taking such action (e.g., Becker, 1974; Janz & Becker, 1984). Cognitive adaptation approaches (e.g., Aspinwall, 2004; Lehman & Taylor, 1987; Taylor, 1983; Taylor & Shepperd, 1998; Taylor & Stanton, 2007) and protection motivation approaches in general (e.g., Milne, Sheeran & Orbell, 2000; Rogers & Prentice-Dunn, 1997; Weinstein, 1988; Weinstein et al., 2000) are premised on the kinds of cognitive and emotional appraisal processes and coping processes which are elicited in the context of health and other risks which contain implicit or explicit threats and induce fear (Fiske & Taylor, 2008).

In the area of environmental psychology (e.g., Bell et al., 2001; Bonnes & Bonaiuto, 2002; Gifford, 2007), a central emphasis over the past several decades has been that of environmental concern, and the role which this risk appraisal process and outcome, and motivational state, plays in adopting pro-environmental behaviours and possibly mediating psychological distress (e.g., Edelstein & Makofske, 1998; Gifford et al., 2009; Hansla, Gamble, Juliusson, & Garling, 2008; Schmuck & Schultz, 2002). This focus on concern has also been very typical of popular culture coverage and debate with respect to the human impacts of climate change (e.g., Carvalho, 2007; Kluger, 2006a; b; Moyers, 2006; Lowe et al., 2006).

These convergent literatures are routinely drawn upon by psychologists when addressing environmental risks and natural and technological hazard preparedness and response (e.g., Cvetkovich & Earle, 1992; O'Riordan, 1995). Such psychological considerations and research findings are often not recognized or utilized in interdisciplinary considerations and discourses, with climate change being a particularly salient case in point. More recently a number of psychology research teams have begun to systematically compare and contrast public risk perceptions, appraisals and psychological response to global climate change as contrasted with nuclear energy facilities (e.g., Pidgeon, Lorenzoni & Poortinga, 2008; Spence, Pidgeon & Uzzell, 2008). This research draws on an extensive research base compiled since 1979 in the wake of Three Mile Island (TMI) and other nuclear power station accidents (e.g., Baum & Fleming, 1993; Baum, Fleming & Davidson, 1983) and has since directed to many technological and natural environmental threats (e.g., Bell et al., 2001). The research with nuclear facilities and accidents, such as that at TMI has conclusively shown that information itself about technological risks can be threatening and anxiety-inducing, leading to very real mental and physical health impacts. In this context, for example, emotionally focused coping strategies were

associated with less stress than problem-focused coping and denial. In this and in many large scale disaster contexts, being able to anticipate and manage one's risk perceptions and psychological response in the context of largely uncontrollable external events and consequences, confers very real and psychologically adaptive benefits (e.g., Taylor, 1983; Aspinwall & Taylor, 1997; Reser & Morrissey, 2008).

Types of coping responses

Coping responses include actions or inhibitions of single, multiple, and repeated behaviors done by individuals or groups such as communities as well as intrapsychic responses to climate change. These responses can proactive (also known as anticipatory adaptation and psychological preparedness) made in anticipation of an event, or reactive made after an event (Aspinwall & Taylor, 1997; Reser, 2009). The two merge when responses are made to an event in order to diminish the impact of an event while and prevent the occurrence of future events. For instance, an individual who rebuilds their home after a natural disaster may be adapting to changes that have occurred as well as simultaneously increasing protection from future disasters. Nonetheless, the differentiation is useful when thinking about coping with climate change because many people may not be responding to currently occurring events attributable to climate change but are instead responding to anticipated events. Thus, addressing successful coping in the context of global climate change requires a serious consideration of prevention and preparedness (e.g., Ball, 2008; Feldner, Zvolensky, & Leen-Feldner, 2004; Keim, 2008; Nelson, Lurie & Wasserman, 2007).

Different literatures emphasize different types of coping responses. The stress and coping literature has emphasized individual coping responses. Intra-psychic responses to experienced or anticipated experiencing include such as denial, environmental numbness, or

cognitive reappraisals, and or emotion regulation (Carver & Sheier, 1998; see section 5 in this report). Other individual responses are behavioral such as seeking information, seeking social support or engaging in problem solving by changing one's habitat to adjust to climate changes, or engaging in mitigation. In contrast research on environmental stressors and natural disasters has been more likely to include community level responses (e.g., Gow & Paton, 2008; Peek & Mileti, 2002). Community responses to stressors include, for instance, volunteerism and helping neighbors cope with lack of water or destruction of one's home. It is not uncommon for groups to emerge after disasters that help communities cope with crises (Holahan & Wandersman, 1991; Gow & Paton, 2008; Voorhees, 2008). These community responses may be particularly important to consider when considering coping with the impacts of climate change given the breadth and duration of the impacts. When considering climate change, additional specific types of individual responses that have not typically been examined in past research may need to be addressed such as such as abandoning social or moral order, reliance on dogmatic beliefs, or rejecting consumer driven lifestyles (Eckersley, 2008).

There is a large and growing literature on *preparedness* and in particular 'psychological preparedness' in the disaster and public health literatures which is arguably relevant to pro-active coping responses (e.g., 'Being prepared' and keeping a 'weather eye' on potentially serious future threats simply makes good sense and is sound advice across many life situations and circumstances. In challenging life circumstances this salutary advice takes on more specific meaning in terms of just what one should do 'to be prepared' for emergency situations that may be particularly hazardous, extremely stressful or even life-threatening. In the disaster context, 'preparedness' is an essential component of all disaster management models and frameworks, but typically focuses exclusively on what *household preparations* and *actions* one should take to

protect oneself and family and to prevent or mitigate damage and human and financial costs and loss. *Psychological* preparedness differs from household or physical preparedness in that what is referred to is an intra-individual and psychological state of awareness, anticipation, and readiness - an internal, primed, capacity to anticipate and manage one's psychological response in an emergency situation (e.g., Morrissey & Reser, 2003). Psychological preparedness for emergency situations and disaster threat can be enhanced through procedures such as stress inoculation, emotion management, and stress reduction (e.g., Australian Psychological Society, 2007; Meichenbaum, 1996). The Australian Psychological Society, for example, has developed a number of disaster preparedness brochures and tip sheets which use a stress inoculation approach to assist individuals to *prepare themselves* as well as their households for disasters (e.g., Morrissey & Reser, 2007).

Moderators of coping process

Many personal and contextual variables have been theorized and tested as predictors of individuals' and community coping responses and many of these ate likely to be important predictors or responding to climate change. Several examples are listed in Figure 8. . Sometimes these variables predict appraisals and preferences for coping responses, such as when optimism predicts the tendency to use problem-focused coping in reaction to a stressor (Scheier, Weintraub, & Carver, 1986). At other times the constructs will moderate relations between the variables in the model such as when the constructs predict the impact of these appraisals on the coping response (i.e., moderates of the impact of appraisals on coping responses) and when the construct predicts the consequences of coping responses (i.e., moderate the relations between coping responses and outcomes; the latter are discussed in the previous section in this report on psychological consequences of climate change). For instance, neuroticism has been shown to

influence not only the choice of coping responses but also the impact of coping responses on wellbeing (Bolger & Zuckerman, 1995).

Two constructs often discussed in the climate change literature are resilience and vulnerability. In this literature resilience typically refers to the adaptive capacity of "resilient social-ecological systems" (e.g., Nelson et al., 2007). Within psychology, in the case of individuals, the construct of 'resilience' typically refers to inner strengths and coping resources for necessary adaptation to situational demands. In the case of communities, it refers to social strengths of a community such as in the form of pooled resources, knowledge, social supports, and social capital (e.g., Bonanno, 2004; Haggerty, Sherrod, Garmezy, & Rutter, 1994; Luthar, 2003; Masten, 2001; Rutter, 1987, 1999; Schoon, 2006). 'Resilience' has, of course, become the principal theme in the APA's web-based help line and brochures relating to psychological advice and guidance in the context of disasters and terrorism (e.g., American Psychological Association, 2007; Newman, 2005).

Vulnerability refers to the extent to which systems and individuals are susceptible to, and unable to cope with, adverse effects of climate change. Vulnerability is a function of the characteristics of climate change impacts (e.g., its magnitude and rate of change) and variation in systems and individuals (e.g., degree of exposure to climate change impacts, individual and community adaptive capacity, and connectedness to communities).

Consideration of social group membership illustrates how variation in resilience and vulnerable can influence the entire adaptation processes. Adaptive responses to climate change would be expected from differences in risk appraisals in part due to actual difference in vulnerability for different populations (see section 3). One would expect lower status groups to appraise impacts differently because they are objectively more likely to be impacted by climate

change impacts because of where they live, the resources in their communities, and the roles that they occupy (see section 1). Differences in appraisals may not just be a function of characteristics associated with low status groups but also characteristics of higher status groups. Although higher status groups are less likely to be vulnerable to climate change impacts, they could overestimate the extent to which this is true and under-prepare for impacts.

Groups would also be expected to have different coping appraisals for several reasons. Lower status groups may have lower self-efficacy due to less adaptive capacity and the roles they occupy. Plus, their lesser power and status may result in exclusion from intervention plans this could result in less control over their outcomes. On the other hand, high status groups, though they may objectively have more self-efficacy and control, may overestimate the extent to which this is true.

Finally, group differences may impact the last stage of the model illustrated in Figure 8. That is, not only is it possible that individuals would have different adaptive responses the individual and community impacts of adaptive responses could be different for (Hartmann & Barajas-Roman, 2009).

Interventions

Psychology can help facilitate adaptive responses to climate change by attending to the processes that inform those responses. As an example, interventions to aid adaptation could be improved not only by attending to actual differences in impacts and responses between groups but also to groups' appraisals of impacts and responses. Interventions may be planned to address actual group differences. Assessing appraisals can reveal gaps between the intended effects and actual effects. Further, perceived group differences in impacts, independent of the extent to

which they are true, could create differences in adaptive responses, thus it is useful to understand and address the perceptions.

Research on factors that impede pro-active coping can potentially improve the success of adaptive responses because, for many, adaptive responses are a result of anticipation of climate change impacts. For instance, it can potentially be useful to assist individuals in setting small, achievable, and specific goals and to highlight how alternative goals may an expectedly interfere with proactive coping goals (Thoolen, deRidder, Bensing, Gorder & Rutten, 2008).

Recommended adaptation responses, including policy recommendations, can also be improved by attending to the target audiences via social processes and networks that establish and maintain two-way communication between all stakeholders. By being inclusive, psychologists can help generate information and recommendations that are salient, credible, readily understandable and acceptable by its intended users (e.g., Mertens, 2009). This can be critical when there are group differences in appraisals of incidents and responses, affective responses and motivations, and impacts of responses, as is true when considering the influence of gender, minority status, and poverty on adaptation process.

Summary

We have attempted in this section to provide a multifaceted consideration of adaptation and adaptation processes that illustrates the contributions that psychology can make in the context of global climate change. Much of the material in the successive IPCC Reports and in climate change science is framed in terms of adaptation. Yet this coverage and discourse, and emergent initiatives and policy deliberations, reflect very little input from psychology. Many of the prevailing understandings of adaptation in this arena do not tend to encompass psychological perspectives, considerations, or variables described above. Yet it is also the case that much of

the psychological literature and research noted above has not been specifically framed in terms of climate change, though research such as that on disasters is closely related and pertinent. Psychology can play a crucial and much-needed role in contributing to multidisciplinary efforts to address the adaptation challenges of climate change and this need has provided a very strong impetus for this current review.

Research recommendations

- In depth understanding public understandings of and responses to the threat of global climate change that go beyond current research on "what the public thinks about climate change or global warming,"

This research would examine how individuals are making sense of climate change and how this sense making influence adaptation processes. Accurate documentation of these public understandings is crucial to genuinely helpful and effective adaptation advice and assistance to individuals and communities, and to effective and strategic mitigation policies and interventions.

- Establish comprehensive data bases in differing impact regions and policy jurisdictions relating to the above.

This data base would refine a suite of sensitive and strategic indicator measures, and initiate a monitoring program which can report on important changes and impacts taking place in the human landscape in the context of climate change (commensurate with and in collaboration with ongoing climate change science monitoring) and which can assist in the evaluation of the relative success of various climate change policy and intervention initiatives.

- Examine how risk perceptions and psychological responses to the threat of global climate change influence and/or mediate taking actions or initiatives related to adaptation and engaging in environmentally significant behaviors.

- Determine the extent to which it is possible to generalize from existing research reviewed above, to the threat and unfolding impacts of climate change

When doing this, researchers should attend closely to spatial and temporal dimensions and the natural and technological threat status of climate change. It may be particularly be productive to determine this with respect to research from both natural and technological disaster phenomena.

- Document the mediating role of media coverage in public risk perceptions and associated social processes such as social construction, social representation and social amplification and attenuation relative to direct exposure in the adaptation process.

- Research contextual as well as dispositional and life history factors that foster resilience and self-efficacy, as well as proactive coping, and indeed the effectiveness of such initiatives as APA's 'Road to Resilience' program of individual and community advice and assistance, in the context of the global climate change threat and impacts.

- Examine the interrelations between adaptation processes and mitigation decisions and actions in the context of global climate change.

This may well be one of the most important areas of contribution that psychology can make, as these two processes have become the prevailing framework for climate change scientists and human dimensions of global change researchers in their addressing of climate change challenges.

From adaptation to mitigation

The above review addressed the ways that past psychological research on stress and coping and research on responding to disasters can contribute to understanding the ways that individuals and communities adapt to or cope with current and impending impacts of climate change. Adaptation and mitigation are related as illustrated by including mitigation efforts as type of coping responses. The relation becomes more complicated via the feedback loops

included in the process. Individual's efforts to cope with climate change will change as the

impacts of climate change occur and change due to the impacts of their coping responses. Thus,

the impacts and responses to climate change represent an unfolding process. Having said this,

however, there is value in taking a close look at what psychologists know about inducing action

to limit climate change and barriers to these changes which are the topics of the next two

sections of this report.

Section 5: Which Psychological Barriers Limit Climate Change Action?

Just as one might puzzle over the collapse of vanished regional civilizations like the Maya of Central America, the Anasazi of North America, the Norse of Greenland, and the people of Easter Island (Diamond, 2005), future generations may find it incomprehensible that people, particularly in industrialized countries, continued until well into the 21st century to engage in behavior that seriously compromised the habitability of their own countries and the planet. This section considers psychological reasons people do not respond more strongly to the risks of climate change by changing the behaviors that drive climate change.

Although some people in every society are changing their behavior in response to climate change, humans in the aggregate continue to produce greenhouse gases in quantities that drive further change. Psychology can help explain this pattern of behavior. This section focuses on a number of important psychological barriers or obstacles that may hinder behavior change that would be adaptive or would help to mitigate climate change, without meaning to diminish the major role that structural barriers play. Among these are institutional barriers that include split incentives in which one actor pays the costs of action while another gets the benefits (energy efficiency retrofits in rental housing is a classic example) and regulatory restrictions (as when an electric utility cannot get credit for investments in energy efficiency and must instead suffer a loss on revenue). A typical cultural barrier to change is the widespread social expectations in some countries and communities about what kind of house or car one must have to be seen as successful. Barriers in the physical environment include the difficulties of reducing home heating in a cold climate, of avoiding car use in a sprawling suburb, and of increasing the energy efficiency of certain older buildings. Economic barriers include the difficulty low-income households and small businesses have in getting the capital needed for retrofitting their homes

and offices. In addition, obtaining useful information about how most effectively to reduce

emissions in an individual's or organization's specific situation (a particular building, for

example), can be difficult. These and other structural barriers to change (that is, barriers that

exceed a person's influence) can restrict the ability to engage in actions that would mitigate

climate change.

In addition to these structural barriers, and sometimes combining with them, are barriers

that are completely or largely psychological. As discussed further in the next section, both

structural and psychological obstacles need to be removed for significant behavioral change to

occur. The fabled gap between attitude ("I agree this is the best course of action") and behavior

("but I am not doing it") is caused by both structural and psychological barriers to action. Many

of the psychological barriers to climate change behaviors are less well documented than the

structural ones. However, evidence for many of them exists in the context of other pro-

environmental behaviors, so they may also operate in relation to limiting climate change.

The psychological obstacles to adequate (carbon-neutral) climate-change adaptation are

described in a broad sequence that begins with genuine ignorance through increasing awareness

and intention to act which, however, are hampered by one psychological process or another, to

tentative, incomplete adaptation choices that are subject to social and other obstacles. This

sequence has not been tested. Like other proposed psychological sequences, they may not

always occur in the same order, and they may not operate the same way in every culture or

context. We use this sequence as a way to organize and provide structure to the list of barriers.

General sequence of psychological barriers

Ignorance. For a proportion of the population, ignorance of climate change may be a

barrier to action, just as people often are unaware of other aspects of their surroundings (e.g.,

Gifford, 1976). The poll (Pew Research Center, 2006) described earlier showed that in many

countries respondents answer "don't know" to questions about climate change. In the United

States and some other countries, significant minorities of the population do not see climate

change as a significant problem and many of these people may simply remain unaware of the

issue. This proportion of the global population is not likely to take actions aimed at ameliorating

climate change.

A second dimension of ignorance is a lack of knowledge about which specific actions to

take. Most people in most countries are not ignorant of the problem, in the sense of the previous

paragraph, but many or even most of those who are aware of the problem may not know which

specific actions they can take. Taking this a step further, a very large number of people may not

know which actions will have the most beneficial impacts.

Uncertainty. Experimental research on resource dilemmas demonstrates that perceived

or real uncertainty reduces the frequency of pro-environmental behavior (e.g., de Kwaadsteniet,

2007; Hine & Gifford, 1996). Participants, perhaps acting in short-term self interest, tend to

interpret any sign of uncertainty, for example in the size of a resource pool or the rate at which

the resource regenerates, as sufficient reason to act in self interest over that of the environment.

Uncertainty about climate change probably functions as a justification for inaction or postponed

action related to climate change. Moreover, presentations of level-of-confidence phrases from

the most recent IPCC assessment led many individuals to interpret the phrases as having a lower

likelihood than the IPCC report intended (Budescu, Broomell, & Por, 2009). Thus, well-meant

efforts by climate-change experts to characterize what they do and do not know led to systematic

underestimation of risk. Yet a certain degree of uncertainty is an inescapable element of any

honest climate model. Scientists are left with the problem of how to present the risk honestly while not promoting misguided optimism and justifying inaction.

     Mistrust and reactance. Ample evidence suggests that many people distrust risk messages that come from scientists or government officials (e.g., MacGregor, Slovic, Mason, Detweiler, 1994). Moreover, reactance, the reaction against advice or policy that seems to threaten one's freedom, is based in part on a lack of trust of those who give the advice or set the policy (Eilam & Sulieman, 2004). Testing scientific models can be difficult because in many cases they make predictions about the distant future. Moreover, certain organized interests seek to promote mistrust of the scientific consensus on climate change and create opposition to mitigation (cf. McCright, 2007). Psychologists can help by increasing understanding of the bases of mistrust of scientists and scientific information and by helping to craft messages that address concerns. Trust, on the other hand, is important for changing behavior, particularly when a person believes that change involves a cost. Behavior change requires that one trusts others not to take advantage and that the change is effective, valuable, and equitable (e.g., Brann & Foddy, 1987; Foddy & Dawes, 2008).

     Denial. Uncertainty, mistrust, and reactance easily slide into active denial (as opposed to denial in the psychodynamic sense of the term). This could be denial of the existence of climate change and human contribution to climate change, and could include more specific denial of the role that one's behavior or one's group's behaviors has in harming others. Polls vary, but a substantial minority of people believes that climate change is not occurring, or that human activity has little or nothing to do with it. In the case of climate change, some people actively deny that climate presents any problem. For example, a news story in *USA Today* about several environmental presentations at APA 2008 in Boston (Jayson, 2009) drew 115 reader responses.

A content analysis of the comments showed that about 100 of the responses essentially denied that a problem existed; two typical explanations were that climate change is a problem invented by "scientists who are pursuing a phantom issue," and that they are ignoring research that clearly shows that the problem is overestimated or does not exist. One reader's comments are typical of the emotional intensity experienced by some deniers:

"It figures that a bunch of psychologists need to mess with people's heads to get them to fall in line with this 'eco-friendly' nonsense… 'News stories that provided a balanced view of climate change reduced people's beliefs that humans are at fault.' Yep, there ain't nothing more that enviro-crazies hate than balanced news reporting."

Obviously, this sample of 115 comments is not representative of the whole population, but it does represent that of a voluble segment of US society. How does a more representative sample think? Many say that climate change is important, but when asked to rank it against other issues, they assign it low importance. Vasi (2009) characterizes public support for sustainable development and the actions and sacrifices necessary to curtail climate change as "a mile wide, but an inch deep," adopting a phrase first used by Smillie & Helmich (1999) to describe public support for foreign development assistance. This is consistent with the results of the two Pew Project polls mentioned earlier: As many as 75%-80% of U.S. respondents say that climate change is an important issue, yet they place it 20th out of 20 compared to other issues. In sum, many US citizens "don't seem to mind addressing the economic cost of climate change, as long as it doesn't come out of their own pockets" ("Warming to the topic," 2009, p. 4).

The ideas of terror management theory (e.g., Goldenberg, Pyszczynski, Greenberg, & Solomon, 2000) suggest that people may deny the problem because it is a reminder of one's mortality and enhances efforts to validate one's beliefs and efforts to bolster self-esteem.

Research applying this to concerns about the environment illustrated that increased mortality salience resulted in decrease concern about protecting the environment among those who did not derive their self-esteem from the environment and had the opposite effect on those who derived their self-esteem from the environment (Vess & Arndt, 2008).

Better knowledge about the emotional element to some people's rejection of climate risks is needed (see Section 1 of this task force report) and reasons for denial. It should help in the design of more effective ways to characterize these risks (Comeau & Gifford, 2008; Moser & Dilling, 2007a).

Judgmental discounting. Discounting in this sense means undervaluing future or distant risks (see Section 1 for reasons for this process). In the current context, it means discounting the importance of climate change in temporal and spatial terms. A study of over 3000 respondents in 18 countries, showed that environmental conditions are expected by everyday individuals to become worse in 25 years than they are today (Gifford et al., 2009). This trend held in every country except two. Although this belief corresponds to scientific assessments of the impacts of climate change, it can also justify inaction because of a belief that changes can be made later. The same study found that individuals in 15 of the countries believed that environmental conditions are worse in places other than their own. This study and others (e.g., Uzzell, 2000) demonstrate that temporal and spatial discounting of environmental problems occurs. Although conditions often may be objectively worse in other areas of the globe, this tendency occurs even in places that are objectively similar, such as among inhabitants of English villages a few kilometers apart (Musson, 1974). If conditions are presumed to be worse elsewhere, individuals might be expected to have less motivation to act locally.

Place attachment. Individuals may be more likely to care for a place to which they feel attachment than for one they do not. If so, weaker place attachment should act as an obstacle to climate-positive behavior, and populations with a history of geographic mobility would be expected to care less for their present environments. The evidence is mixed: place attachment is not always associated with pro-environmental behavior (Clayton, 2003; Uzzell, Pol, & Badenas, 2002; Gifford et al., 2009). The role of place attachment is likely to be complex, but probably acts as an impediment to action in some populations, as is perhaps indicated by local opposition to wind farms in some areas, even where there is strong support for other pro-environmental policies.

Habit. Individuals exhibit what might be called behavioral momentum. William James (1890) called habit the "enormous flywheel of society," although he viewed this stability of action in positive terms; in terms of climate change, current habits are less benign. Habit may be one of the most important obstacles to the mitigation of climate change impacts (e.g., Hobson, 2003).

Many habitual behaviors are extremely resistant to permanently change (e.g., eating habits), and others are slowly changed (e.g., use of seat belts) (Maio et al., 2007). Ensconced habits do not change without a substantial push; priming and even attitude change often do not lead to behavioral change. For some people, behaviors that form part of the human contribution to climate change (e.g., the use of cars) are habitual and difficult to change (e.g., Aarts & Dijksterhuis, 2000; Bamberg & Schmidt, 2003; Klöckner, Matthies, & Hunecke, 2003; Loukopoulos, Jakobsson, Gärling, Meland, & Fujii, 2006), although not impossible (e.g., Matthies, Klöckner, & Preissner, 2006). For example, temporarily forcing car drivers to use alternative travel modes has induced long-term reductions in car use (e.g., Fujii & Gärling,

2003). For many people, of course, car use is nearly essential because of the structure of human settlements, but very large numbers of people do a have choice, and choose not to purchase a low-carbon car or to take alternative transportation. For others, simple habit is the barrier to change.

Perceived behavioral control. Because climate change is a global problem, many individuals understandably believe that they can do nothing about it. This is the well-known collective action problem (Olson, 1965). Stated in psychological language, people sometimes do not act because they perceive that they have little behavioral control over the outcome. For example, perceived behavioral control can be a very strong predictor (r = .50-.60) of whether or not a person chooses to take public transportation instead of a private car (e.g., Heath & Gifford, 2002; Kaiser & Gutscher, 2003).

Perceived risks from behavioral change. What might happen to individuals who decide to consider changing their behavior as a step toward reducing their greenhouse gas emissions? Potentially, changing behavior of any sort holds at least six kinds of risk (Schiffman, Kanuk, & Das, 2006). First, functional risk refers to whether the adaptation will work: if one purchases, for example, a plug-in electric vehicle (PHEV) it may, as a new technology, have battery problems. Second, physical risk refers to the danger that one might face: Is this PHEV as crash-safe as the SUV traded in to buy the PHEV? Third, financial risk refers to the potential for costs that are not outweighed by benefits: the PHEV's purchase price includes a premium over equivalent gas-powered vehicles; will money buying and operating it be lost? Fourth, social risk refers to potential damage to one's ego or reputation: if one buys a PHEV, will friends laugh? They may invoke any of the first three risks as my failure to reckon carefully. The fifth risk, which follows the fourth closely, is the psychological risk. Once rebuked, teased, or criticized by one's

significant others, one's ego may suffer some damage. Sixth, time (lost) can be a risk. If the time spent planning and adopting the adaptation does not result in personal or environmental benefits, it would be wasted.

Tokenism and the rebound effect. Once individuals move from environmental numbness, denial, discounting, and habit toward impactful changes because they believe that they do have some behavioral control and sense that their own community, to which they feel some attachment, might be threatened and the risks of behavioral change are not overly threatening, they may begin to engage in some behavioral changes. Apart from the fact that some climate-change-related behaviors are easier to change than others, but have little useful import. Some people will favor these actions over higher-cost but more effective actions. This has been called the low-cost hypothesis (e.g., Diekmann & Preisendörfer, 1992; see also Kempton et al., 1985). Some will undertake low-cost actions that have relatively little effect in terms of mitigation. Pro-environmental intent may not correspond with pro-environmental impact (Stern, 2000). A further problem is the rebound effect, in which after some saving or effort is made, people erase the gains. For example, persons who buy a fuel-efficient vehicle may drive further than before, when they owned a less-efficient vehicle. The phenomenon has been called the Jevons Paradox (Jevons, 1865) and the Khazzoom-Brookes Postulate (Brookes, 1990; Khazzoom, 1980).

Social comparison, norms, conformity, and perceived equity. People routinely compare their actions with those of others (Festinger, 1954), and derive subjective and descriptive norms from their observations (e.g., Heath & Gifford, 2002) about what is the "proper" course of action. This phenomenon has been recognized in the theory of planned behavior (Ajzen, 1991), and applied to pro-environmental interventions (e.g., Cialdini, 2003). It can create a barrier to action. For example, in experimental resource dilemmas, when any sort of inequality or inequity

(real or perceived) exists, cooperation declines (e.g., Aquino, Steisel, & Kay, 1992). The many criticisms of Al Gore's large residence, rooted in social comparison, have been employed as a justification for inaction by others.

Similarly, peer norms are a strong influence. For example, when homeowners are told the amount of energy that average members of their community use, they tend to alter their use of energy to fit the norm (Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007), increasing or decreasing their energy use accordingly. The increases can be prevented by giving low energy users positive feedback about using less energy.

Conflicting goals and aspirations. Everyone has multiple goals and values (e.g., Schwartz, 1992; Lindenberg & Steg, 2007), and goals that involve more production of greenhouse gases can trump goals that support using less. For example, many parents drive their children to school to protect them, when walking is an option. Many people want to relax and rest, and do so after flying to an attractive vacation spot. The common goal of "getting ahead" often means engaging in actions that run counter to the goal of reducing one's climate change impacts: buying a very large house, or flying frequently by choice.

Belief in solutions outside of human control. Some people take no climate-related action because they believe that one of the traditional religious deities or Mother Nature either will not let them down or will do what he/she/it wishes anyway. For example, interviews with Pacific Islanders who live on very low-lying atolls found that one group is already purchasing higher ground in Australia, while another trusts that God will not break the Biblical promise never to flood the Earth again after the flood that Noah and his entourage endured (Mortreux & Barnett, 2009). One also hears more secular beliefs expressed by some people that Mother Nature will take a course that mere mortals cannot influence.

Summary

Many structural and psychological barriers stand in the way of behavioral changes that would help limit climate change. Many people are taking action in response to the risks of climate change, but many others are unaware of the problem, unsure of the facts or what to do, do not trust experts or believe their conclusions, think the problem is elsewhere, are fixed in their ways, believe that others should act, or believe that their actions will make no difference or are unimportant compared to those of others. They may be engaged in token actions or actions they believe are helpful but objectively are not. They have other worthy goals and aspirations that draw their time, effort, and resources, or external factors beyond human actions or control will address the problem. Some or all of the structural barriers must be removed but this is not likely to be sufficient. Psychologists and other social scientists need to work on psychological barriers.

Research suggestions

1. Many of these barriers are derived from studies of pro-environmental behavior, resource management studies, or sustainability studies, rather than specifically in climate-related studies, which are still not numerous in the psychological literature. Each barrier should be studied in the climate context.

2. The section presumes or proposes that the barriers occur in a broad sequence. To what extent do the barriers occur in sequence? What sequence? How does this vary for different population segments, particular behaviors, and in various cultures?

3. Are the barriers cumulative? That is, if a person is faced with more of the barriers, is he or she less likely to engage in climate adaptation and mitigation?

4. Which approaches will be most effective in overcoming each barrier? For which segments of the population, which particular climate-related behavior, in which cultures? These approaches

might include various policy incentives, policy disincentives, modeling, and communication strategies.

5. Outright denial of the problem remains the position of a small but vocal segment of US and other societies. What is the basis of this denial? How is it best dealt with?

6. How can perceived behavioral control, which is understandably low for this problem, be increased?

7. A paradox exists in that scientific assessments must, to have integrity, be couched in terms that include some measure of uncertainty, while laypersons have a tendency to interpret uncertainty broadly enough to justify inaction. How can this uncertainty paradox be resolved so that needed actions are undertaken by laypersons?

8. Changing behavior often is perceived as risky, at least socially or financially. How can climate-related behavior changes be made to seem (and to *be*) less risky?

9. Mistrust of science and government is not uncommon, and often leads to reactance. How can trust be built?

10. Behavior change in the climate context often is presented and viewed in terms of needed sacrifices. Which behavior changes, presented in which ways, might be viewed in more positive terms, as personal gain for self and society?

From barriers to change

Although there are extensive structural and psychological barriers to change, psychologist, sometimes alone but often and in collaboration with others, have done much research and participated in many interventions designed to encourage environmentally significant and responsible behaviors. Often knowledge of the barriers noted above can help overcome them. The next section reviews ways that psychologists can assist in limiting climate

change by encouraging encourage environmentally significant and responsible behaviors, one

important element of mitigating of climate change.

Section 6: How Can Psychologists Assist in Limiting Climate Change?

Climate change now occurring globally is driven by a variety of human actions. The proximate causes include burning fossil fuels, clearing forests, raising cattle, and other actions that release greenhouses or change the reflectivity of Earth's surface. These actions in turn result from other human activities, including government policies, population increases and migrations, economic development activities, and the behavior of individuals and households as consumers, members of organizations, and citizens—and in turn from underlying human attitudes, predispositions, social and economic structures, and beliefs. Psychological science would seem indispensible for understanding and finding ways to change at least some of these human behaviors. Nevertheless, psychologists have rarely been consulted by climate policy decision makers. This section discusses what psychology can contribute to changing the human activities that drive climate change, briefly summarizes what psychology has learned and sets out a list of research activities through which psychological science can be useful.

What psychology can contribute

Psychology can contribute by improving the implementation of each of the major approaches to changing environmentally significant behavior. The following typology, based on the work of Kauffman-Hayoz and Gutscher (2001), suggests the possibilities:

- Command and control (e.g., environmental regulations; appliance and automotive fuel efficiency standards)

- Economic instruments (e.g., energy taxes, solar energy tax credits)

- Infrastructure instruments (e.g., new energy-efficient technology, mass transit, zero net energy building design)

- Institutional arrangements (e.g., establishing markets for emission permits, certification or labeling systems, public-private agreements)

- Communication and diffusion techniques and methods (e.g., providing information, persuasion, advertising, person-to-person contact)

Psychology is a major source of insight into the ways communication and diffusion instruments work, and it can also potentially offer insights into the ways people, especially individuals and households, respond or fail to respond to the other kinds of policy approaches. For instance, it can illuminate the sources of citizen support of or opposition to regulations; taxes, and new energy technologies; help estimate the market penetration of new consumer technologies and building designs and help in making them more useful and attractive; identify behaviors that could facilitate or frustrate new institutional arrangements. Before summarizing what psychology has learned and could learn, we note three general kinds of contributions the discipline can make to mitigating anthropogenic climate change.

1. Better models of behavior based on empirical analysis. All the above policy approaches embody implicit theories of behavior change (e.g., that people can be counted on to follow regulations, that they do what is economically most advantageous, that useful technologies are readily adopted, etc.). Policies are often undertaken based on implicit assumptions that one or another of these theories adequately captures behavioral reality. Although they all contain grains of truth, none is nearly complete, and they can mislead (see, e.g., Stern, 1986; Wilson & Dowlatabadi, 2007; Lutzenhiser, 2009). For example, economic policy instruments such as changes in energy prices or financial incentives for investing in energy-efficient appliances or motor vehicles do change behavior in the expected directions, but the effect is usually much smaller than economic models predict. This so-called energy

efficiency gap—the difference between actual behavior and what a simple economic theory of cost minimization would predict—is quite large (McKinsey, 2007), and also varies widely with the behavior (e.g., which appliance is being purchased; Ruderman, 1985). Psychology can help explain this phenomenon because many of the possible explanations for it involve cognitive and affective processes (see below). In addition, research methods from psychology are useful for understanding the choice processes. Policy makers are increasingly coming to recognize that the dominant physical-technical-economic model of energy use is incomplete and are turning to behavioral scientists for better conceptual models and for advice on how to implement them so as to make policies and programs more effective (Wilson & Dowlatabadi, 2007; Darnton, 2008; Lutzenhiser, 2009).

Psychology can help develop both descriptive models and models of behavioral change. Descriptive models of individual behavior delineate the role of internal factors (e.g., knowledge, feelings, values, attitudes) and external factors (e.g., physical and technological infrastructure; political, social and cultural factors; economic incentives; social influences and models) in environmentally significant behavior (e.g., Black, Stern, & Elworth, 1985; Kollmuss & Agyeman, 2002; Gardner & Stern, 2002; Guagnano, Stern, & Dietz, 1995). Descriptive models of behavior in groups may explicate the conditions under which groups will or will not provide public goods or fall prey to the commons dilemma (e.g., Messick & Rutte, 1992; Williams, Harkins, & Karau, 2003).

Models of change can address the effects of efforts to influence behavior in individual or group settings. For example, responses to persuasive messages depend in part on characteristics of the individuals receiving them. For instance, "guilt appeals" (information that indicates that a person or one's social group have caused harm to the environment) have different affective

consequences dependent upon the extent to which the environment is important to the recipients (Mallett, 2009) and can even backfire for individuals whose self-esteem is not dependent upon their impact on the environment (Brook & Graham, 2009).

Generally, when psychological constructs are included in models of change, they can show how the effects of policy interventions depend on social influences on behavior and by characteristics of the target actors, including their motives, values, beliefs, and cognitive and affective processes. Psychology can thus increase the practical usefulness of empirical analyses. It can help replace simplistic assumptions with empirically supported ones (Gardner & Stern, 2002; Nolan et al., 2008) and uncover important opportunities for intervention that have not been revealed by the dominant policy theories. For example, empirical analysis of incentive programs for home weatherization has shown that although the size of the incentive makes a difference, the effect of a particular incentive is strongly affected by the way the incentive program is marketed and implemented (see below).

2. *Better understanding of individuals and households.* While much national policy is focused on the behaviors of large organizations such as power and manufacturing companies, individuals and households are a major source of environmental damage, and account for nearly 40% of direct energy consumption in the United States through activities in homes and non-business travel (Vandenbergh, 2005; Gardner & Stern, 2008), and an additional share indirectly through their purchases of non-energy goods and services that take energy to produce and distribute. Implicit theories of behavior change that may apply well to large corporations may not apply so well to individuals and households for various reasons, such as individuals' affective responses to available choices and the relatively high cost to individuals of getting actionable information compared to the potential benefits. For example, it may cost almost as

much in time and effort to find competent professionals to retrofit a home for energy efficiency as it does for a large commercial building—but the energy savings from the improvements will be much greater in a large building.

Attention to individuals is important because the effectiveness of interventions may depend on the match with characteristics of individuals and households. There are a variety of important individual and household differences: income; household size and life cycle stage; geographical relationships between home and travel destinations; home ownership status; and cognitive, affective, and personality differences, among others. Market researchers are among those who think about such individual and household differences. Psychological research can refine market research categories by investigating which of these differences matter most for changing which behaviors and how social, economic, and technological contexts affect behavior.

Better understanding of individuals also matters because their behavior in organizations, as citizens (e.g., political action), and as participants in cultural changes can have effects beyond their individual use of energy. Psychology, along with other social science disciplines, can contribute to understanding these sorts of actions. For example, public acceptance can be a serious barrier to the deployment of new technologies to limit climate change (e.g., nuclear and wind energy, "geoengineering" planetary systems). On the other hand, pro-environmental values and worldviews regarding protection of the environment or responsibilities to future generations that are held by individuals or shared within cultural or subcultural groups can provide a basis for support of policies and technologies for limiting climate change.

3. Evaluation methods. Psychologists have pioneered evaluation methodology. Program evaluation involves the systematic way of testing the effects of programs and their implementation on intended and unintended outcomes. Recent developments in evaluation

research, such as logic models (e.g., http://meera.snre.umich.edu), allow for analysis of

interventions through a full chain of events, from available resources to outcomes, considering

planned and desired activities, targeted audiences, outputs, and outcomes, in relation to short,

intermediate, and long-term objectives (e.g., changes in knowledge in the target audience,

increases in the number of homes taking targeted actions, and decreases in energy consumed).

Evaluation can be applied at each step in a model.

Evaluation methods can help those designing interventions to avoid pitfalls and learn

from past experience. Reviews of interventions in public health can provide useful insights

because of what has been learned about community based interventions (e.g., Merzel &

D'Afflitti, 2003) and because some of the behaviors (e.g., biking rather than driving) are relevant

to climate change (e.g., Sallis, Bauman, & Pratt, 1998).

What psychology has learned

More than a century of psychological research has considered a great variety of

intrapsychic factors, such as values, motives, emotions, personality traits and states, cognitive

styles, which might explain variations in environmentally significant behavior (ESB). Numerous

interpersonal factors have also been identified, including social norms, social comparison,

affiliation, and interpersonal persuasion. Some researchers have emphasized the roles of external

rewards and punishments. Still others use combinations of these types of explanatory factors.

Many of these variables have potential explanatory value for ESB (see Wilson & Dowlatabadi,

2007; Darnton, 2008).

A body of research since the 1970s has focused on developing and testing theories of pro-

environmental behavior. Much of this work can be grouped under two broad rubrics that

emphasize the role of individualistic and of altruistic motives. Theories based on individualism

presume that individuals maximize their material welfare, subjective well-being, or utility. Early psychological research in this mode applied operant conditioning theory to household energy use (e.g., Geller, Winett, & Everett, 1982; for a recent review, see Lehman & Geller, 2004). More recently, psychologists have applied the Theory of Reasoned Action, later developed into the Theory of Planned Behavior (Ajzen, 2005; Ajzen, & Fishbein, 1975; 1980). Altruism-based theories often proceed from the observation that the global environment is a commons in which pro-environmental actions generally present greater costs than benefits to the individual, suggesting that motives beyond individualism may be necessary to engage such behavior. These approaches focus on variables such as environmental consciousness (e.g., the New Ecological Paradigm; Dunlap & Van Liere, 1978; Dunlap, Van Liere, Mertig, & Jones, 2000), prosocial moral norms (Schwartz, 1992), and self-transcendent values (e.g., the Value-Belief-Norm theory proposed by Stern et al., 1999). These two perspectives are not mutually exclusive. Some definitions of utility are expansive enough to include internalized altruistic concerns. In fact, a recent meta-analysis found that variables from both types of theories had unique explanatory value across a set of ESBs (Bamberg & Möser, 2007).

Many other models of behavior are also of potential value for understanding the adoption of new ESB. Some of these investigate the roles of the full set of human values and social motives as defined in value theory (Schwartz, 1992) and in research on social value orientation (e.g., Van Lange, Rusbult, Semin-Goossens, Görts, & Stalpers, 1999; Van Lange & Joireman, 2008). Some emphasize social normative influences (Cialdini, 2003; Goldstein, Griskevicius, & Cialdini, 2007). Some focus on stages of intentional behavioral change (e.g., pre-contemplation, contemplation, preparation, action, maintenance, termination, see Pallonen, Prochaska, Velicer, Prokhorov, & Smith, 1998). Others apply social network and innovation-diffusion theories that

describe how ideas and actions spread through populations (e.g., Rogers, 2003), model processes

of change in habits (Hobson, 2003; Maio et al., 2007), and elaborate systems theories that model

transformational and incremental changes that may be often prompted by encountering problems

(Darnton, 2008).

Much research has been empirically focused on particular types of ESB or on ESB in

general, without necessarily testing theory. Although some of these analyses presume that ESB

is a single coherent entity (e.g., Kaiser, 1998; Kaiser & Gutscher, 2003), considerable evidence

points to the value of distinguishing subclasses of ESB that have different determinants (e.g.,

Black et al., 1985; Stern, 2000). In this discussion, we distinguish four topics that have been

studied separately: (1) the determinants of aggregate environmentally significant consumption by

households; (2) the determinants of variation in adoption of environmentally significant

behaviors (ESB), and particularly in behaviors that reduce greenhouse gas emissions by

individuals and households; (3) responses to interventions to change these behaviors; and (4) the

determinants of support for organizational actions, public policies, and cultural changes. The

available evidence suggests that these distinctions matter, in the sense that psychological

constructs that are enlightening in some of these areas sometimes have little explanatory value

for others.

1. Determinants of environmentally significant consumption. The overall level of

environmentally significant consumption in households is largely determined by non-

psychological factors such as household income, size, and geographic location, which in turn

affect other major determinants of overall consumption, such as home size and ownership of

motor vehicles and appliances (Gatersleben, Steg, & Vlek, 2002; Hunecke, Haustein, Grischkat,

& Böhler 2007). Psychological factors can affect overall consumption levels—there are

households that lead much "greener" lives than their neighbors because of strong environmental values commitments—but at present, these households are not numerous enough to affect national analyses (Abrahamse, Steg, Vlek, & Rothengatter, 2005). At present, the main value of psychological explanatory constructs lies in the following areas.

2. *Variations in environmentally significant behaviors (ESB).* As already noted, some researchers study ESB as a single class while others consider different types of ESB separately. Many studies have focused on specific in-home energy use behaviors, travel behaviors, investments in home weatherization, and other ESBs. We observe that the amount of research attention given to ESBs has related more closely to ease of measurement than to the environmental importance of the behavior. Consequently, some behaviors that make major contributions to a household's carbon footprint, such as choices of home location and size, motor vehicles, and major appliances, have received very little attention in behavioral research.

A great many studies have demonstrated the explanatory value of various psychological constructs for various climate-related behaviors. For example, a recent meta-analytic review of 57 datasets (Bamberg & Möser, 2007) found that proenvironmental behavioral intentions were strongly and independently predicted by perceived behavioral control, attitude, and personal moral norms. Effects on self-reported behaviors were indirect, and weaker than effects on intentions. The review did not specify the behaviors covered in the datasets. Some research has attempted to develop models that can be applied to integrate across multiple behavioral types (e.g., Black et al., 1985) or to incorporate multiple theoretical perspectives (e.g, Harland, Staats, & Wilke, 2007; Klöckner, Matthies, & Hunecke, 2003; Wall, Devine-Wright, & Mill, 2007). Considering that some very important ESBs have been rarely studied, it is premature to draw conclusions about the relative importance of variables or theories for explaining ESB generally.

There is evidence that the importance of psychological and psycho-social (sometimes called personal) variables is behavior specific. Black et al. (1985) presented evidence that the more strongly constrained an energy-saving behavior is by household infrastructure, financial cost, or other contextual variables, the weaker the explanatory power of personal factors. In a refinement of that argument, Guagnano, Stern, and Dietz (1995) concluded from evidence on recycling that contextual constraints can push behavior strongly in either pro- or anti-environmental directions, and that personal factors such as values, beliefs, and norms have the greatest explanatory power when external constraints are weak in either direction. In this view, the explanatory value of psychological variables is context-dependent, and the greatest explanatory value of these factors is likely to be found in niches where behavior is relatively unconstrained by stronger forces (Gardner & Stern, 2002). The issue remains open for further research. Psychological constructs are also relevant for understanding environmentally important citizenship actions, such as public support for, opposition to, and activism about environmental policies (see below).

In sum, many psychological constructs have been shown to have explanatory value for at least some ESBs. However, this does not demonstrate their explanatory value for differences in GHG emissions. Many of the most GHG-intensive consumer behaviors have been little studied, and they may be strongly affected by contextual factors. We do not yet know how much explanatory value psychological constructs can add in explaining these behaviors beyond the explanatory value of contextual variables. Thus, it is important for psychological research to expand its focus to include more studies of environmentally important behaviors.

3. Responses to interventions. Psychological research on interventions has focused mainly on communication and diffusion instruments such as information and persuasive appeals,

and secondarily on financial incentives. Knowledge about how communication and diffusion instruments work—or fail to work—is important because mass media persuasion and information campaigns have been notably ineffective as they have normally been employed. Information effects have been studied in residential energy consumption (e.g., Abrahamse et al., 2005) and travel mode choice (e.g., Bamberg & Möser, 2007). Studies generally find that information techniques increase knowledge but have minimal effects on behavior. However, immediate or frequent (e.g., daily) energy-use feedback has yielded energy savings of 5-12% in homes, often lasting 6 months or more (Fischer, Greitemeyer, & Frey, 2008). This kind of information is believed to be more effective because it is specific to the individual's situation and is conducive for learning how to achieve the savings. The behavioral psychologists who pioneered feedback research in the 1970s (Geller et al., 1982) emphasized that it links the financial consequences of energy use more closely to behavior by showing the costs immediately or daily, rather than via the delayed consequences represented in a monthly energy bill. The fact that feedback effects are observed very quickly suggests that they are achieved by changes in the use of household equipment rather than by the adoption of more energy-efficient equipment.

Psychologists have also studied interventions that employ social motives, for instance by modeling energy-conserving behavior (Winett et al., 1982; Aronson & O'Leary, 1983), using messages from friends (e.g., Darley, 1978), employing social marketing techniques (e.g., McKenzie-Mohr & Smith, 1999), and making appeals to prosocial goals (Krantz & Kunreuther, 2007) or social norms (e.g., Cialdini, 2003). Such studies have demonstrated effects in controlled field settings with frequently repeated energy-using actions, but have not been studied as potential influences on actions that account for large portions of household energy budgets.

Knowledge of the processes that determine the effects of communication instruments can help design these interventions. For instance, an information campaign may be assumed to work by increasing the sense of self-efficacy in those receiving information. If the intervention fails, empirical analysis could determine whether the campaign failed to build this self-efficacy or because changes in self-efficacy were insufficient to change behavior. Knowing which part of the process failed can help in designing a more effective campaign.

Psychologists and other researchers have also studied the effects of interventions that change financial incentives, for example, by time-of-use electricity pricing, rewards for reduced energy use, and financial incentives for investments in residential energy efficiency (e.g., Heberlein & Baumgartner, 1978; Staats, Harland, & Wilke, 2004; Abrahamse et al., 2005). An important contribution of this work has been to improve on simple economic models that presume a constant response to changes in financial cost (i.e., price elasticity) regardless of their form or implementation. In fact, price responses vary with the particular choice (e.g., which appliance is being purchased; Ruderman, 1985) and with the ways incentive programs are implemented. Household responses adoption of home weatherization measures in response to incentives commonly varies by a factor of 10 or more for the same incentive depending on program implementation (Stern et al., 1986). Among the non-financial factors that account for this variation are the convenience of the program and the degree to which it reduces cognitive burdens on households, such as those imposed by the need to find a competent contractor (Gardner & Stern, 2002).

Perhaps the highest-impact contribution to limiting climate change that has been observed from the kinds of nonfinancial interventions psychologists typically consider was achieved by combining them with financial incentives in home weatherization programs. Multi-

pronged interventions that combined strong financial incentives, attention to customer convenience and quality assurance, and strong social marketing have led to weatherization of 20% or more of eligible homes in a community in the first year of a program—results far more powerful than achieved by the same financial incentives without strong nonfinancial program elements (Stern et al., 1986; Hirst, 1987).

Behavioral research on intervention suggests that the barriers to household behavior change vary with the behavior and the individual. The most effective interventions, therefore, are those that are tailored to the target individual or household or that address all the significant barriers that matter in a target population by combining intervention strategies, such as information, personal communication, mass-media appeals, convenience, financial incentives, and other strategies as the situation requires (Gardner & Stern, 2002; McKenzie-Mohr, 2006; Stern, 2008). Many of the shortcomings of policies based on only a single intervention type, such as technology, economic incentives, or regulation, may be surmountable if policy implementers make better use of psychological knowledge. Similarly, the shortcomings of communication and diffusion instruments can be addressed by combining them with other policy instruments. It is possible to plan effective interventions on the basis of the multiple-barriers principle and context-specific knowledge of barriers to a target behavioral change (e.g., Matthies & Hansmeier, 2008).

4. Organizational, policy, and cultural change. Psychologists have not yet conducted much empirical research related to reducing greenhouse gas emissions resulting from organizational actions or on psychological factors affecting change at the levels of policy and culture that can mitigate climate change. However, individual attitudes, beliefs, values, and emotional reactions can affect organizational and collective actions in firms, communities, and

governments and have been shown to affect acceptance of policy measures and technologies (e.g., Jakobsson, Fujii, & Gärling, 2000; Clark, Kotchen, & Moore, 2003; Schade & Schlag, 2003; Nilsson, von Borgstede, & Biel, 2004; Steg, Dreijering, & Abrahamse, 2005; Matthies, 2008). In the longer term, various formal and informal educational experiences may also contribute to cultural changes and increased public support for policies to limit climate change.

Only a few psychological studies so far have been examined energy conservation in organizations (e.g., Siero, Bakker, Dekker, & Van Den Burg, 1996; Daamen, Staats, Wilke, & Engelen, 2001; Griesel, 2004; Matthies & Hansmeier, 2008). However, a growing body of research concerns the effects of values, attitudes, beliefs, and worldviews on public support for and activism about environmental policies. These studies show that public support for policies to limit climate change is associated with environmental values and worldviews (Dunlap & Van Liere, 1978; Dunlap et al., 2000; Stern et al., 1999) and suggest that efforts to frame the climate problem in terms of widely held supportive values might increase policy support.

A large body of psychological research on risk perception is also relevant to the public acceptance of technologies that may significantly limit climate change (Slovic, 2000; see Section 1 of this task force report). Past research on perceptions of the risks of nuclear power and other technologies (e.g., Fischhoff et al., 1978; Slovic, Flynn, & Layman, 1991), can shed light on potential public acceptance of large wind energy projects, "geoengineering" proposals, bioenergy projects, and other policy proposals for limiting climate change. Attitudes, beliefs, and values also may underlie, as well as be influenced by, cultural changes such as the development of green communities, which can create social norms that shape individual behavior (e.g., Knott, Muers, & Aldridge, 2008).

Emotional reactions to the threat of climate change may also affect policy support, either positively or negatively. Scientists' warnings about the dire consequences expected from unchecked climate change can generate affective responses (fear, guilt, despair, self-directed and other-directed anger, hope, pride) that can in turn affect willingness to act on the information. The responses to affect may not always be as intended, for instance, when fear appeals backfire (ref). Messages about the climate problem may also be framed in ways that activate various goals and may indirectly affect climate-relevant behavior (e.g., a hedonic goal of feeling better right now, a gain goal of maximizing personal resources, or a normative goal of acting appropriately; Lindenberg & Steg, 2007). Such framing effects may influence willingness to act both to limit and to adapt to climate change.

What can psychology do to be helpful?

The above discussion of what has been learned suggests a long agenda for future research. A few promising research directions are listed below:

Developing behavioral understanding of ESBs:

- Analysis of the household-level behaviors that can have the greatest impact for limiting climate change. Generally, the highest impact behaviors involve investments in energy-efficient equipment, particularly fuel-efficient vehicles, home insulation, and energy-efficient appliances (Gardner & Stern, 2008). However, the highest-impact behaviors are different in different populations and communities (climatic regions, urban vs. rural, etc.).

- Analysis of variation in, and barriers to change in, individual and household purchase decisions with major climate effects (e.g., purchases of homes and energy-efficient vehicles and appliances).

- Analysis of the barriers to changes in the use of personal and household equipment that could yield sizable emissions reductions, such as lowering driving speeds and slowing acceleration from stops; resetting thermostats on heating and air conditioning systems and water heaters; and replacement of furnace filters.

- Behavioral studies of the determinants of choices by the suppliers of consumer products that have important indirect effects of climate (e.g., appliance retailers and installers, home builders and developers, home repair contractors, automobile dealers). Psychological research can clarify how the attitudes, beliefs, knowledge, incentive structures, and social and organizational relationships of these people affect their choices and, working with others, use this knowledge to inform interventions to change behavior among these important actors.

- Studies to quantify the climate effects of household actions that affect climate indirectly through the production and distribution of food and other household products. Existing carbon calculators need improvement (Padgett, Steinemann, Clarke, & Vandenbergh, 2008). Psychologists can help in classifying behaviors and with understanding their determinants and the barriers and possibilities for change.

- Studies to improve understanding of the bases for public support of and opposition to technologies and policies proposed for limiting climate change.

  Developing and testing interventions to limit climate change:

- Testing information and communication campaigns for changing household equipment use and travel behavior (e.g., feedback mechanisms and tools, appeals to social and personal norms, community-based programs)

- Studies exploring the most effective uses of communication and diffusion instruments and program implementation methods to improve the effectiveness of financial incentives for energy-efficient investments

- Studies to explore human factors design options for improving the attractiveness to users of energy efficiency and energy information technologies

- Intervention studies aimed at important under-studied individual behaviors (e.g., travel mode choice, appliance purchases, vehicle driving behavior)

- Studies of community-based efforts to diffuse climate-friendly technologies and practices and to establish and enforce social norms

- Evaluation research addressed to intervention programs to limit climate change

Working with others. Many of these lines of research would involve psychologists in work with government agencies, utility companies, and technical experts in designing and evaluating specific practical interventions (e.g., human factors design for feedback devices and displays; designing and testing better rating and labeling systems for energy efficiency and carbon footprint for consumers; designing the implementation of incentive programs). Psychologists can be involved as consultants and as members of evaluation teams. There is increasing interest in these kinds of collaborations among government agencies in the United States and Europe.

Psychology can help in the development and implementation of new technologies that can reduce GHG emissions by improving energy efficiency, providing GHG-free energy sources, and redesigning human settlements. A few examples illustrate the possibilities. So-called smart meters are being designed mainly to meet needs of energy supply companies, but they could also provide very valuable energy-use feedback to consumers if they had the appropriate displays and

human factors design. Zero-energy buildings are now being developed and tested for their engineering characteristics, but if they are to approach their technical potential, they need to be designed so that occupants will not counteract the engineering, as many households now do with programmable thermostats. Similar issues arise with the design of "green" communities, if they are ever to become attractive to more than committed environmentalists. Psychology can help with these design issues, which require an interdisciplinary approach for optimal effect.

On the energy supply side, psychology has already contributed to understanding the bases of public reactions to nuclear power development (e.g., Slovic et al., 1991) and green electricity (Clark et al., 2003), as well as to developing processes to better inform decisions about risky or hazardous technologies (National Research Council, 1989, 1996, 2008). Similar issues are sure to arise in coming years over the many proposals being advanced to address the climate problem by expanding nuclear power production, building large wind and biomass energy systems, capturing emissions from coal burning and sequestering them in geological formations, engineering new organisms to capture carbon dioxide from the air and turn it into fuel, and so forth. Psychologists can work with other scientists to anticipate public concerns and develop processes by which society can conduct informed debate about whether and how to proceed with such proposals and how to weigh their risks and benefits (National Research Council, 2009).

Psychology can also help with focused research related to longer-run strategies for limiting climate change. Two examples will illustrate. California and some other states are beginning to mandate that new buildings will use "zero net energy" technologies (commercial buildings by 2020; residential by 2030). Engineers and architects are designing buildings to have the desired energy properties, but they will not become the norm unless people will want to buy and occupy them. Psychologists can work with building design professionals to study

people's reactions to designs and prototypes and develop designs that will be attractive as well as technologically advanced. Similar opportunities arise with designs at the community level to reduce the need for motorized travel in new communities, with potential benefits for public health as well as the environment. These designs will require numerous changes in people's daily routines and perhaps in their social relationships, and these changes could be made more or less attractive by design choices. To make new designs practical and attractive, research is needed on people's responses to a new geography of communities.

In addition to the above research areas focused on fairly specific questions, there remains a need for more fundamental psychological research related to limiting climate change. For example, it is commonly remarked that a culture of consumption underlies demand for energy-using goods and services—but a much more nuanced understanding of consumption is needed to inform change. As noted above, economic consumption is not the same as environmental consumption—$500 spent on computer software has a much different effect on the climate than $500 spent on an airline ticket—even though they are the same in economic accounts. People's wants—to visit their families, heat their homes, impress their neighbors, and so on—are related to energy use only indirectly, through the technologies available to fulfill them. Psychological research can help unpack the idea of consumption and can eventually help identify ways to satisfy people's needs while reducing GHG emissions. It may also help by building fundamental understanding of how people's desires change—a line of knowledge that may become critically important in the longer run.

Summary and Discussion

Psychology has important contributions to make toward understanding, limiting, and coping with climate change. These contributions can be developed from knowledge and concepts in many subfields of psychology and enhanced by collaborations with psychologists worldwide and with a number of potential stakeholders, including community members, policy-makers and colleagues from other fields, including the natural and social sciences. Below we summarize some characteristics associated with psychology and the research that has been conducted that are useful for progress to be made on climate change, discuss the importance of attending to cross-cultural issues and other forms of human diversity, and discuss ways that psychologists can maximize their ability to meet the challenge of climate change.

Psychological approach to studying climate change

There are several qualities associated with psychological approaches to understanding and approaching social problems and issues that make them valuable for advancing society's ability to address the global problem of climate change and its effects. These qualities include, but are not limited to the following: Psychology provides a theoretically and empirically based understanding of human behavior at the individual level of analysis. Psychologists, along with other social science disciplines, have long recognized the importance and interrelations among proximal (e.g., the presence of others, structures of neighborhoods) and distal (e.g., cultural and economic) predictors of behaviors. Psychological research methods uncover individual, interpersonal, and social forces capable of changing human behavior that are not otherwise clearly or widely understood; Psychologists are well-positioned to design, implement, and assess interventions to ameliorate the psychosocial impacts of climate change. These qualities have resulted in literature and research that is already of use by others, though more could be done.

Psychology's research contributions

This report illustrates many ways that psychologists can contribute to understanding and responding to global climate change.

- Psychology can help illuminate how people form understandings of the risks of climate change and how those understandings affect individual's concerns and responses.

- Psychologists can help clarify and identify interrelations among individual (e.g., beliefs, skills, needs) and contextual (e.g., structural, social, cultural) predictors of population growth and of economic and environmental consumption.

- Psychologists can describe behaviorally-based links between population growth, consumption and climate change.

- Psychologists can identify psychosocial impacts of climate change including: a) emotional, cognitive and behavioral responses to anticipated threats and experienced impacts, b) mental health outcomes, and c) social and community impacts.

- Psychologists can explain how stress and coping responses moderate and mediate the psychosocial impacts of climate change and the ability of individuals and groups to respond adaptively.

- Psychologists can help identify structural, cultural, institutional, cognitive, and emotional barriers inhibiting behavioral change and propose methods for overcoming them.

- Psychologists can provide empirically supported models of behaviors that drive climate change and help design effective and culturally relevant behavior change programs.

- Psychologists can help understand public and organizational behavior that contributes to effective societal responses to climate change,

- Psychologists can assist in the design of effective technologies and information systems for responding to climate change by applying their knowledge of cognition, communication, and human factors engineering.

Culture and human diversity

An important consideration in a review paper such as this is to reflect on the representativeness and selectivity of both the authors and the research covered. We come from diverse areas of psychology and represent four countries. We have tried very hard to retain a more global focus and cross-disciplinary collaborative orientation, given our focus on global climate change and the need for psychology to have a more collaborative involvement in addressing the challenges of climate change. Yet, it can be argued that the document is primarily representative of research from North America and Europe and shares general worldviews and assumptions from these perspectives.

It is important that continued research in this domain be inclusive of the diversity of human experiences. Various understandings of and responses to climate change will be influenced by one's worldview, culture, and social identities. Much research in other disciplines has taken place in regions of the world such as Africa, Asia, the Andes, and Alaska, where climate change impacts are far more evident and salient. Local populations in these areas have cultural vantage points, economies, and lifestyles far-removed from the modal, largely urban-based, highly industrialized, human settings of much of North America and Europe. The influence of the mass media and contemporary information technologies vary considerably across regions of the world. There is also diversity within all countries that is important to consider that reflect demographic group membership social identities, and intersectionality of identity group membership. Intersections between groups are important to attend to because, for

instance, gender differences in experiences with climate change and climate change responses

can vary by race, ethnicity, age, disabilities, religion, etc..

In the contexts of both climate change adaptation and mitigation, cultural contexts and

differences may prove to be one of the most important considerations to be addressed in the

human dimensions of global climate change. For example, cultural considerations will be

critical in providing suitable interventions and resources for communities experiencing dramatic

upheavals, such as population relocations, as a result of global climate change. Further, different

cultural groups are likely to have strengths and insights that can potentially advance our

understanding the human drivers of climate change, its impacts, and means of responding to it.

Cross-cultural psychology is can contribute to collaborative initiatives that inform responses to

climate change with cultural understanding.

Psychology and climate change: Ethical considerations

Recognition of the psychosocial impacts of climate change prompts a consideration of

potential ethical imperatives for psychologists and psychological policy. APA ethical standards

provide a framework for understanding motivations for psychologists' involvement in this topic.

As with other topics on which the APA has taken a stand (e.g., poverty, discrimination), climate

change becomes a concern for psychologists because it is likely to have profound impacts on

human well-being and because the anthropogenic causes of climate change mean that human

behavioral change is required to address it. In addition, the magnitude and irrevocability of

climate change demands our attention if we are to continue to study and promote healthy

psychological functioning.

The ethics code of the American Psychological Association sets the standard of

professional conduct and training for psychologists and contains aspirational guidelines as well

as enforceable standards (Barnett & Johnson, 2008). While the code serves "to guide and inspire psychologists toward the very highest ethical ideals of the profession" (American Psychological Association, 2002) there is no explicit reference in the ethics code to the natural environment or the influence of ecological and biosystemic variables on human health. The code's general ethical principles, however, reveal potential guidelines for psychologists' involvement in the topic of climate change. For example:

- Ethical Principle A: Beneficence and Nonmaleficence, recognizes a core value of the profession, that psychologists strive to benefit those with whom they work and take care to do no harm. Because the process of global climate change presents both direct and delayed threats to individual and community health, including mental health, we recommend that climate change be considered an appropriate arena for psychological examination and intervention.

- Ethical Principle B: Fidelity and Responsibility, highlights the professional and scientific responsibilities of psychologists to society and to the specific communities in which they work, and thus the need to consider the psychological and social implications of climate change as a focus of intervention, policy, and research.

- Ethical Principle D: Fairness and justice reminds us that all persons are entitled to access and benefit from the contributions of psychology and provides a basis for addressing social justice issues, such as disparities and the potential for intergroup conflict, inherent in climate change impacts. This principle also stresses that psychologists exercise reasonable judgment and recognize the boundaries of their competence—essential in dealing with novel and complex interdisciplinary issues like global climate change.

- Ethical Principle E: Respect for People's Rights and Dignity recognizes the potential need for special safeguards to protect the rights and welfare of persons or communities who may be most vulnerable, in this case recognizing that some are particularly vulnerable to climate change impacts. Principle E also mandates attention to cultural and individual differences regarding perspectives on human-nature relations, livelihood and basic needs, and proper behavior toward the natural environment.

Maximizing psychology's contribution to the science of climate change

Specific research recommendations can be found at the end of each of the literature review sections above. Here we discuss the issue of how psychologists can maximize their contribution to the broader science of climate change. Psychologists can be dramatically more effective if they connect psychological work to concepts developed in the broader climate research community and collaborate with scientists from other fields. Although psychologists have been doing work on climate change and related subjects for decades and the discipline has a unique perspective and body of knowledge to contribute, the relevance of psychological contributions is not yet established or widely accepted. We recommend that psychologists adopt the following principles to maximize the value and use of psychological concepts, research, and perspectives for understanding the causes and impacts of climate change and informing effective responses to climate change:

1. Use the shared language and concepts of the climate research community where possible and explain differences in use of language between psychology and this community. Anthropogenic climate change is an interdisciplinary issue with a developing interdisciplinary language. For example, in this document we use language climatologists have used to discuss human interactions with climate change in terms of human contributions or drivers, impacts or

consequences, and responses. Being knowledgeable of and sensitive to language and concepts used by others and using this language and concepts when appropriate and possible can aid communication. Thus, we advise adopting current usage of others' terms when possible to aid in communication.

However, differences between psychologists' and other fields' usages of certain terms and constructs can also be critical. If a psychologist believes that reliance on the usual language of climate research would result in confusion or a loss of meaning or clarity, it is important to be explicit about differences in usage. Further, attending to language differences can help reveal differences in assumptions and approaches to understanding climate change. For example, the term *adaptation* is one that has varying usages across disciplines that reflect different understandings of human responses. Clarifying such differences is one way psychologists can help improve overall understanding of climate change, communication between disciplines, and their own approaches to climate change.

2. *Make connections to research and concepts from other social, engineering, and natural science fields.* The effects of psychological variables sometimes depend on variables that are more thoroughly understood in other fields, and vice versa. For example, the effectiveness of information and persuasion on GHG emitting behaviors depends on the costs of energy and the technical properties of energy-efficient equipment. Further, a thorough understanding the potential of psychological contributions to research and responses to climate change should take into account knowledge from other social sciences, such as sociology, political science, communications research, and economics, as well as those from engineering, consumer product manufacturing and distribution, and other fields. For example, individuals' understandings of climate change depend on the operation of psychological processes on

information presented by mass media, and are best understood by combining concepts from psychology, communications research, and other social science fields. By the same token, understanding human drivers of climate change, the impact of climate change on humans, and the effectiveness of instruments that are central to other disciplines cannot be fully understood without an appreciation of psychological and social processes.

3. Present psychological insights in terms of missing pieces in climate change analyses. Psychologists can provide climate researchers from other disciplines with psychological constructs that are relevant for understanding problems those other disciplines already recognize and can correct misunderstandings and misuse of psychological constructs when these are encountered. For instance, they can describe how psychological processes of risk perception and stress management may alter people's willingness to make anticipatory adaptations to climate risks. As another example, disciplines vary in their tendency to focus on different levels of analyses. Psychologists can provide insights into the usefulness and importance of including individual level of analyses that identify psychological constructs and theories into to climate change analyses.

4. Present the contributions of psychology in relation important challenges to climate change and climate response. Within psychological research, findings are typically presented in terms of statistical significance or effect size in behavioral terms (the percentage of people whose behavior changed or the amount of that change in frequency or duration). What matters for the interdisciplinary climate issue is the strength of effects or causes in environmental terms. For example, a good indicator of the importance of psychological variables for understanding human contributions to climate change is the amount of GHG emissions they can explain. This depends on the combined effects of behavior explained and the impact of the behavior on emissions. A

good indicator of the importance of psychological variables for understanding human consequences of climate change is the extent to which major or widespread human consequences can be linked through these variables to the anticipation or experience of specific aspects of climate change. A good indicator of the importance of psychological variables for affecting climate responses is the amount of GHG emissions or impact reduction that can be achieved by interventions that manipulate or affect those variables.

5. Prioritize issues and behaviors recognized as important climate change causes, consequences, or responses. For example, in developing and describing psychological contributions to efforts to mitigate climate change, emphasis should be placed on changes that have large potential effects on emissions (e.g., reducing greenhouse gas emissions from personal travel) in preference to changes that have smaller potential effects (e.g., recycling household waste). If findings about lower-impact kinds of behavior are deemed important, the importance should be described in terms of the implications for climate change overall, perhaps by making the case that a principle established in studies of low-impact behaviors is generalizable to higher-impact behaviors. Similarly, in studying psychological consequences of climate change, psychologists should be prepared to indicate the broader importance and relevance of these consequences. For instance, the importance of emotional or affective responses may need to be explained to those outside of psychology. This could potentially be done in terms of how these responses influence risk perceptions and subsequent willingness to change behaviors or support policies, how debilitating mental health outcomes affect preparation for or response to the impacts of climate change, or how the magnitude of these outcomes compares to the magnitude of other social phenomena.

6. Be cognizant of the possibility that psychological phenomena are context dependent. Psychological principles are often established in narrowly defined contexts: laboratory experiments, small-scale field experiments, surveys of particular populations, and so forth. To apply these principles to climate change, one needs to take seriously a set of questions about external validity, such as whether the principles are applicable in other cultures or economies, in places with very different physical infrastructures or government regulations, or in vastly changed technological contexts that might appear a generation in the future. For example, studies have demonstrated the effectiveness of interventions to change commuting behavior and energy use among college students. Without further research and analysis, it is not possible to know how much these findings are a function of the intervention alone as opposed to an interaction of the intervention and the context (e.g., dormitory living, low income, young single population, availability of mass transit, etc.). Wider social contexts, such as the country or cultural in which research is conducted can also potentially influence findings. Psychologists should be careful not to claim that their findings have general applicability without evidence or strong theory to support such claims.

7. Be explicit about whether psychological principles and best practices have been established in climate-relevant contexts. As an example, the foot-in-the-door effect has been established in many psychological experiments. Inducing a small behavioral change often sets in motion changes in attitude or self-perception that lead, over time, to larger behavioral changes. The phenomenon has some generality, and it has been argued on that basis that efforts to change behaviors with small environmental impacts (e.g., recycling) will therefore lead to change in more environmentally consequential behaviors (e.g., travel mode choice). But this is reasoning by analogy that has not been tested empirically with the behaviors mentioned, and available

evidence raises questions about such "spillover" effects (Crompton & Thøgerson, 2009). It is important to be explicit about the extent to which psychological phenomena being discussed have been shown to operate in climate-relevant contexts and, if this has not been shown, about the kinds of extrapolation that are being made from contexts in which the phenomena have been established. In considering the psychological consequences of climate change, extrapolation is usually necessary because, except for the consequences of warnings about climate change, the most significant consequences lie in the future. Such extrapolations should be explicit about their evidence base and its likely applicability to projected future events.

*8. Be mindful of social disparities and ethical and justice issues that interface with climate change. C*limate change, adaptation, and mitigation responses have the potential to have different impacts on different populations (e.g., demographic and cultural groups). Further, different populations may have different social constructions of the meaning of climate change. Different cultural meanings and social justice concerns are important to address in order to recognize the limits of one's research and to be able to speak to and be heard by different populations. Further, attending to social and cultural differences can potentially further research by suggesting new ways of thinking about basic psychological processes and new ways of addressing climate change.

In sum, a psychological perspective is crucial to understanding the probable effects of climate change, to reducing the human drivers of climate change, and to enabling effective social adaptation. By summarizing the relevant psychological research, we hope not only to enhance recognition of the important role of psychology by both psychologists and non-psychologists, but also to encourage psychologists to be more aware of the relevance of global climate change to

our professional interests and enable them to make more of the contributions the discipline can

offer.

References

Aarts, H., & Dijksterhuis, A. (2000). The automatic activation of goal-directed behaviour: The case of travel habit. *Journal of Environmental Psychology, 20*, 75-82.

Abrahamse, W., Steg, L., Vlek, C., & Rothengatter, T. (2005). A review of intervention studies aimed at household energy conservation. *Journal of Environmental Psychology, 25*, 273-291.

Adam, B. (1998). *Timescapes of modernity: The environment and invisible hazards.* London: Routledge.

Adams, G., O'Brien, L., & Nelson, J. (2006). Perceptions of racism in Hurricane Katrina. *Analyses of Social Issues and Public Policy, 6,* 215-235.

Adeola, F. (2000). Endangered community, enduring people: Toxic contamination, health, and adaptive responses in a local context. *Environment and Behavior, 32,* 209-249.

Agyeman, J. Bullard, R. & Evans, B. (2003). *Just sustainabilities: Development in an unequal world.* London: Earthscan/The MIT Press.

Agyeman, J., Devine-Wright, P., & Prange, J. (2009). Close to the edge, down by the river? Joining up managed retreat and place attachment in a climate changed world. *Environment and Planning A, 41,* 509-513.

Ainslie, G. (1975). Specious reward: A behavioral theory of impulsiveness and impulse control. *Psychological Bulletin, 82*, 463-496.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*, 179-211.

Ajzen, I. (2005). *Attitudes, personality, and behavior* (2nd ed.). Milton-Keynes, England: Open University Press/McGraw-Hill.

Ajzen, I., & Fishbein, M. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research.* Reading, MA: Addison-Wesley.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior.* Englewood Cliffs, NJ: Prentice-Hall.

American Psychological Association. (2002). Ethical principles of psychologists and code of conduct. *American Psychologist, 47,* 1597-1611.

American Psychological Association. (2007). The Road to Resilience. Retrieved June 15, 2009, from http://www.APAHelpCenter.org/resilience

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text revision). Washington, DC: Author.

Anderson, C. A. (2001). Heat and violence. *Current Directions in Psychological Science, 10*(1), 33-38.

Aquino, K., Steisel, V., & Kay, A. (1992). The effects of resource distribution, voice, and decision framing on the provision of public goods. *Journal of Conflict Resolution, 36*, 665-687.

Arctic Climate Impact Assessment (2004). *Impacts of a Warming Arctic.* Cambridge University Press.

Arnold, M. (1970). Perennial problems in the field of emotion. In M.B Arnold (Ed.), *Feelings and emotions: The Loyola Symposium* (pp. 169-186). New York: Academic Press.

Aronson, E., & O'Leary, M. (1983). The relative effectiveness of models and prompts on energy conservation: A field experiment in a shower room. *Journal of Environmental Systems*, *12*, 219-224.

Aspinwall, L. G. (2004). Dealing with adversity: Self-regulation, coping, adaptation, and health. In A. Tesser & N. Schwarz (Eds.), *Blackwell handbook of social psychology: Intraindividual processes* (pp. 591-614). Oxford: Blackwell Publishing.

Aspinwall, L. G., & Taylor, S. E. (1997). A stitch in time: Self-regulation and proactive coping. *Psychological Bulletin, 121*(3), 417-436.

Australian Psychological Society. (2007). *Preparing for and coping with the threat and experience of natural disasters*. Melbourne: APS

Ball, M. (2008). Prevention – psychology's forgotten mission. *The Psychologist*, *21*, 602-603.

Bamberg, S., & Schmidt, P. (2003). Incentives, morality, or habit? Predicting students' car use for university routes with the models of Ajzen, Schwartz and Triandis. *Environment and Behavior, 35*, 264-285.

Bamberg, S., & Moser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *Journal of Environmental Psychology, 27*, 14–25.

Bandura, A. (1999). Social learning. In A. S. R. Manstead, M. Hewstone, S. T. Fiske, M. A. Hogg, H. T. Reis & G. R. Semin (Eds.), *The Blackwell encyclopedia of social psychology* (pp 576-581). Oxford, UK: Blackwell Publishing.

Barlow, D. H. (2002). *Anxiety and its disorders* (2nd ed.). New York: The Guilford Press.

Barnett, J. E., & Johnson, W. B. (2008). *Ethics desk reference for psychologists.* Washington, DC: American Psychological Association.

Bartsch, A., Vorderer, P., Mangold, R., & Viehoff, R. (2008). Appraisal of emotions in media use: Toward a process model of meta-emotion and emotion regulation. *Media Psychology, 11*(1), 7-27.

Bauer, M. W. & Gaskell, G. (Eds). (2002). *Biotechnology: The making of a global controversy*. Cambridge, UK: Cambridge University Press.

Baum, A. (1987). Toxins, technology, and natural disasters. In G. R. VandenBos & B. K. Bryant (Eds.), *Cataclysms, crises, and catastrophes* (pp. 5-53). Washington, DC: American Psychological Association.

Baum, A., Fleming, R., & Davidson, L. M. (1983). Natural disaster and technological catastrophe. *Environment and Behavior, 15*, 333-354.

Baum, A., & Fleming, I. (1993). Implications of psychological research on stress and technological accidents. *American Psychologist, 48*(6), 665-672.

Baum, A., Gatchel, R., & Schaeffer, M. (1983). Emotional, behavioral and physiological effects of chronic stress at Three Mile Island. *Journal of Clinical and Consulting Psychology, 51,* 665-572.

Becker, M. H. (1974). *The health belief model and personal health behaviour*. Thorofare, NJ: Slack.

Bekin, C., Carrigan, M., & Szmigin, I. (2005). Defying marketing sovereignty: Voluntary simplicity at new consumption communities. *Qualitative Market Research: An International Journal, 8*(4), 413-429.

Bell, P. A., Greene, T. C., Fisher, J. D., & Baum, A. (2001). *Environmental psychology* (5th ed.). Fort Worth: Harcourt College Publishers.

Berger, A. A. (2006). *Media & society: A critical perspective* (2nd ed.). New York: Rowman and Littlefield.

Berger, P. L. & Luckmann, T. (1967). *The social construction of reality*. Hammondsworth: Penguin.

Bhan, G. (2001). *India gender profile: Report commissioned for Sida.* Retrieved April 26, 2009, from the University of Sussex Institute for Developmental Studies Web Site http://www.bridge.ids.ac.uk/reports/re62.pdf

Black, J. S., Stern, P. C. & Elworth, J. T. (1985). Personal and contextual influences on household energy adaptations. *Journal of Applied Psychology, 70*, 3-21.

Blodgett, J., & Parker, L. (2008). *Greenhouse gas emissions drivers: Population, economic development and growth, and energy use*. Congressional Research Service report for congress, (Order Code RL33970).

Bohm, G. (2003). Emotional reactions to environmental risks: Consequentialist versus ethical evaluation. *Journal of Environmental Psychology, 23*, 199-212.

Bohm, G., Nerb, J., McDaniels, T., & Spada. (Eds). (2001). Environmental risks: Perception, evaluation, and management [Special Issue]. *Research in Social Problems and Public Policy, 9*, xi-xx.

Bolger, N., & Zuckerman, A. (1995). A framework for studying personality in the stress process. *Journal of Personality and Social Psychology, 69*(5), 890-902.

Bonanno, G. A. (2004). Loss, trauma, and human resilience: Have we underestimated the human capacity to thrive after extremely aversive events? *American Psychologist, 59*, 20-28.

Bonnes, M., & Bonaiuto, M. (2002). Environmental psychology: From spatial-physical environment to sustainable development. In R.B. Bechtel & A. Churchman (Eds.), *Handbook of environmental psychology* (pp. 28-54). New York: Wiley.

Booth, A., & Crouter, A. C. (Eds.). (2005). *The new population problem: Why families in developed countries are shrinking and what it means*. The Penn State University family issues symposia series. Mahwah, NJ: Lawrence Erlbaum.

Bostrom, A. & Lashof, D. (2007). Weather or climate change? In S. C. Moser & L. Dilling (Eds.), *Creating a Climate for Change: Communicating Climate Change and Facilitating Social Change* (pp. 31-43). Cambridge, MA: Cambridge University Press.

Bourque, L. B., Siegel, J. M., Kano, M. & Wood, M. M. (2006). Weathering the storm: The impact of hurricanes on physical and mental health. *Annals of the American Academy of Political and Social Science, 604*, 129-151.

Brann, P., & Foddy, M. (1987). Trust and the consumption of a deteriorating common resource. *Journal of Conflict Resolution, 31*, 615-630.

Brklacich, M., Chazan, M., & Dawe, A. (2007). Vulnerabilities of societies under Global Environmental Change (GEC). In H. Tiessen, M. Brklacich, G. Breulmann & R. S. C. Menezes (Eds.), *Communicating global change science to society* (pp. 73-88). Washington, DC: Island Press.

Brook, A. T., & Graham, A. (2009). Effects of ecological footprint feedback and environmental contingency of self-worth on environmental behavior. Manuscript under review.

Brookes, L. (1990). The greenhouse effect: The fallacies in the energy efficiency solution. *Energy Policy, 18*, 199-201.

Brown, K. W., & Kasser, T. (2005). Are psychological and ecological well-being compatible? The role of values, mindfulness, and lifestyle. *Social Indicators Research, 74*, 349-368.

Brun, W. (1992). Cognitive components in risk perception: Natural versus manmade risks. *Journal of Behavioral Decision Making, 5*, 117-132.

Budescu, D. V., Broomell, S., & Por, H. (2009). Improving communication of uncertainty in the reports of the intergovernmental panel on climate change. *Psychological Science, 20*, 299-308.

Bullard, R. (2000). *Dumping in Dixie: Race, class, and environmental quality*. San Francisco: Westview Press.

Bullard, R., & Johnson, G. S. (2000). Environmental Justice: Grassroots activism and its impact on public policy decision-making. *Journal of Social Issues, 56*, 555-578.

Burr, V. (1995). *An introduction to social constructionism*. London, UK: Routledge.

Carvalho, A. (2007). Ideological cultures and media discourses on scientific knowledge: Re-reading news on climate change. *Public Understanding of Science*, *16*, 223-243.

Carver, C. S., & Scheier, M. F. (1998). *On the self-regulation of behaviour*. New York: Cambridge University Press.

Chaiken, S., & Trope, Y. (1999). *Dual-process theories in social psychology*. New York: Guilford.

Cheon, H. J., Cho, C., & Sutherland, J. (2007). A meta-analysis of studies on the determinants of standardization and localization of international marketing and advertising strategies. *Journal of International Consumer Marketing, 19*(4), 109-147.

Cialdini, R. B. (2003). Crafting normative messages to protect the environment. *Current Directions in Psychological Science, 12*(4), 105-109.

Cialdini, R. B., Reno, R. R. & Kallgren, C. A. (1990). A focus theory normative conduct: Recycling the concept of norms to reduce littering in public places. *Journal of Personality and Social Psychology, 58,* 1015-1026.

Clark, A. E., Frijters, P., & Shields, M. A. (2008). Relative income, happiness, and utility. *Journal of Economic Literature, 95*, 115-22.

Clark, C. F., Kotchen, M. J., & Moore, M. R. (2003). Internal and external influences on pro-environmental behavior: Participation in a green electricity program. *Journal of Environmental Psychology, 23*, 237-246.

Clayton, S. (2003). Environmental Identity: A Conceptual and an operational definition. In S. Clayton & S. Opotow (Eds.), *Identity and the natural environment: The psychological significance of nature* (pp.45-65). Cambridge, MA: MIT Press.

Clayton, S., & Brook, A. (2005). Can psychology help save the world? A model for conservation psychology. *Analyses of Social Issues and Public Policy (ASAP), 5*(1), 87-102.

Clayton, S., & Opotow, S. (Eds.) (2003). *Identity and the Natural Environment*. Cambridge, MA: MIT Press.

Climate Change and Human Health (2009). World Health Organization. Retrieved June 15, 2009, from http://www.who.int/globalchange/climate/en/

Climate Change Science Program (2009). *Thresholds of Climate Change in Ecosystems: A report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research.* D. B. Fagre, C.W. Charles, C.D. Allen, C. Birkeland, F. S., Chapin III, P. M. Groffman, G. R. Guntenspergen, A. K. Knapp, A. D. McGuire, P. J. Mulholland, D. P. C. Peters, D. D. Roby, & G. Sugihara (Eds.). Reston, VA: U.S. Geological Survey. Retrieved June 15, 2009, from http://www.climatescience.gov/Library/sap/sap4-2/final-report/

Commoner, B. (1972). The environmental cost of economic growth. In *Population, Resources, and the Environment* (pp. 339-363). Washington, DC: U.S. Government Printing Office.

Confalonieri, U., Menne, B., Akhtar, R. et al. (2007). Human health. In M.L. Parry, O.F. Canziani, J. P. Palutikof et al. (Eds.), *Climate change 2007: Impacts, adaptation and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the*

Intergovernmental Panel on Climate Change (pp. 391–431). Cambridge, UK: Cambridge University Press.

Costin, A. (2006). The feminist approach. In H. H. Blumberg, A. P. Hare, & A. Costin (Eds.), *Peace Psychology: A comprehensive introduction* (pp. 37-45). Cambridge University Press.

Craig-Lees, M., & Hill, C. (2002). Understanding voluntary simplifiers. *Psychology & Marketing, 19*(2), 187-210.

Crompton, J., & Thøgerson, J. (2009). *Simple and painless? The limitations of spillover in environmental campaigning*. Godalming, Surrey, UK: World Wildlife Federation. Retrieved June 15, 2009, from www.wwf.org.uk/strategiesforchange

Csikszentmihalyi, M., & Csikszentmihalyi, I. S. (Eds.). (2006). *A life worth living: Contributions to positive psychology*. New York: Oxford University Press.

Csikszentmihalyi, M. (2004). Materialism and the evolution of consciousness. In T. Kasser, & A. D. Kanner (Eds.), *Psychology and consumer culture: The struggle for a good life in a materialistic world.* (pp. 91-106). Washington, DC: American Psychological Association.

Curtis, A. (Producer/Director/Writer). (2002). *Century of the Self* [Television Broadcast]. United Kingdom: BBC Four.

Cvetkovich, G. & Earle, T. C. (Eds.). (1992). Public responses to environmental hazards. *Journal of Social Issues, 48*(4). [Entire Issue].

Czopp, A. M., Monteith, M. J., & Mark, A. Y. (2006). Standing up for a change: Reducing bias through interpersonal confrontation. *Journal of Personality and Social Psychology, 90*(5), 784-803.

Daamen, D. D. L., Staats, H., Wilke, H. A. M., & Engelen, M. (2001). Improving environmental behavior in companies: The effectiveness of tailored versus nontailored interventions. *Environment and Behavior, 33*(2), 229-248.

Dake, K. (1991). Orienting dispositions in the perception of risk: An analysis of contemporary worldviews and cultural biases. *Journal of Cross-Cultural Psychology, 22*, 61-82.

Damasio, A. R. (1994). *Descartes' Error*. New York: Avon Books.

Danesi, M. (2002). *Understanding media semiotics*. London: Arnold.

Daniels, R. J., Kettle, D. F. & Kunreuther, H. (2006). *On risk and disaster: Lessons from Hurricane Katrina*. Philadelphia: University of Pennsylvania Press.

Darley, J. M. (1978). Energy conservation techniques as innovations and their diffusion. *Energy and Buildings, 1,* 339-343.

Darnton, A. (2008). Reference report: An overview of behaviour change models and their uses. UK: Government Social Research Behaviour Change Knowledge Review.

Deaux, K, & Philogene, G. (Eds). (2001). *Representations of the social*. Oxford, UK: Blackwell Publishers.

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11,* 227–268.

de Kwaadsteniet, E. W. (2007). *Uncertainty in social dilemmas.* Unpublished doctoral dissertation: Leiden University, The Netherlands.

De Vries, S., Verheij, R., Groenevegen, P., & Spreeuwenberg, P. (2003). Natural environments-healthy environments? An exploratory analysis of the relationship between green space and health. *Environment and Planning A, 35*, 1717-1731.

DeYoung, R. (1986). Some psychological aspects of recycling: The structure of conservation – Satisfactions. *Environment and Behavior, 118,* 435-449.

De Young, R. (1996). Some psychological aspects of reduced consumption behavior: The role of intrinsic satisfaction and competence motivation. *Environment and Behavior*, *28*(3), 358-409.

Diamond, J. (2008, January 2nd). What is your consumption factor? *The New York Times* Opinion Editorial. Retrieved June 11, 2009, from http://www.nytimes.com/2008/01/02/opinion/02diamond.html

Diamond, J. M. (2005). *Collapse: How societies choose to fail or succeed*. New York: Viking.

Diekmann, A., & Preisendörfer, P. (1992). Personliches umweltverhalten: Diskrepanzen zwischen anspruch und wirklichkeit. *Kölner Zeitschrift Für Soziologie Und Sozialpsychologie, 44*, 226-251.

Diener, E., & Biswas-Diener, R. (2002). Will money increase subjective well-being? *Social Indicators Research, 57*(2), 119-169.

Dietz, T., & Rosa, E. A. (1994). Rethinking the environmental impacts of population, affluence and technology. *Human Ecology Review, 1*, 277–300.

Dietz, T., & Rosa, E. A. (1997). Environmental impacts of population and consumption. In P. C. Stern, T. Dietz, V. Ruttan, R. H. Socolow and J. Sweeney (Eds.), **Environmentally Significant Consumption: Research Directions** (pp. 92-99). Washington DC: National Academies Press.

Dietz, T., Rosa, E. A., & York, R. (2007). Driving the human ecological footprint. *Frontiers in Ecology and the Environment, 5*(1), 13-18.

Dietz, T., Rosa, E. A., & York, R. (in press). Human driving forces of global change: Dominant

    Perspectives. In E. A. Rosa, A., Diekmann, T. Dietz, & C. Jaeger (Eds.), *Human*

    Footprints on the Global Environment: Threats to Sustainability. Cambridge, MA: The

    MIT Press.

DiMento, J. F. C., & Doughman, P. (Eds.). (2007). *Climate change: What it means for our*

    children, our grandchildren, and us. Cambridge, MA: MIT Press.

Doherty, T. J. (2008, August). The psychologist as a community resource for sustainability.

    Paper presented at the American Psychological Association Annual Conference, Boston,

    MA.

Doppelt, B. (2008). *The power of sustainable thinking.* London: Earthscan.

Douglas, M., & Wildavsky, A. (1982). *Risk and Culture: An essay on the selection of*

    technological and environmental dangers. Berkeley: University of California Press.

Dunlap, R., & McCright, A. (2008). A Widening Gap: Republican and Democratic Views on

    Climate Change. *Environment*, *50*(5), 26-35.

Dunlap, R. E., & Saad, L. (2001). *Only one in four Americans are anxious about the*

    environment. Gallup News Service.

Dunlap, R. E, & Van Liere, K. D. (1978). The new environmental paradigm: A proposed

    measuring instrument and preliminary results. *Journal of Environmental Education, 9*,

    10-19.

Dunlap, R. E., & Van Liere, K. D. (1984). Commitment to the dominant social paradigm and

    concern for environmental quality. *Social Science Quarterly, 65*(4), 1013-1028.

Dunlap, R. E., Van Liere, K. D., Mertig, A. G., & Jones, R.E. (2000). Measuring endorsement of
the new ecological paradigm: A revised NEP scale. *Journal of Social Issues. Special
Issue: Promoting Environmentalism, 56*(3), 425-442.

Dunwoody, S. (2007). The challenge of trying to make a difference using media messages.
In S. C. Moser & L. Dilling (Eds.), *Creating a climate for change* (pp. 89-104). New York:
Cambridge University Press.

Easterbrook, G. (2007, April). Global warming: Who loses—and who wins. *The Atlantic*.
Retrieved June 15, 2009, from http://www.theatlantic.com/doc/200704/global-warming

Earle. T. C. (2004). Thinking aloud about trust: A protocol analysis of trust in risk management.
Risk Analysis, *24*, 169-183.

Earle, T. C. & Cvetkovich, G. (1995). *Social trust: Toward a cosmopolitan society*. Westport,
CT: Praeger.

Eckersley, R. (2008). Nihilism, fundamentalism, or activism: Three responses to fears of the
apocalypse. *The Futurist, January-February,* 35-39.

Edelstein, M. R. (2002). Contamination: The invisible built environment. In R. B.Bechtel & A.
Churchman (Eds.), *Handbook of environmental psychology* (pp. 559-588). New York:
Wiley.

Edelstein, M. R., & Makofske, W. J. (1998). *Radon's deadly daughters: Science, environmental
policy, and the politics of risk*. Lanham, MD: Rowman & Littlefield.

Ehrlich, P. R., & Holdren, J. P. (1971). Impact of population growth. *Science, 171*, 1212–1217.

Eilam, O., & Suleiman, R. (2004). Cooperative, pure, and selfish trusting: Their distinctive
effects on the reaction of trust recipients. *European Journal of Social Psychology, 34*,
729-738.

Elgin, D. (2000). Voluntary Simplicity and the new Global Challenge. In J. B. Schor & D. B. Holt (Eds.), *The Consumer Society Reader*. New York: The New Press.

Elrod, C. L., Hamblen, J. L. & Norris, F. H. (2006). Challenges in implementing disaster mental health programs. *Annals of the American Academy of Political and Social Science, 604*, 152-170.

Epstein, S. (1994). Integration of the cognitive and the psychodynamic unconscious. *American Psychologist, 49,* 709-724.

Evans, G. W. & Cohen, S. (1991). Environmental Stress. In D. Stokols & I. Altman (Eds.), *Handbook of Environmental Stress*. (Vol. 1: pp. 571-610). Malabar, FL: Krieger.

Evans, G. W. & Stecker, R. (2004). Motivational consequences of environmental stress. *Journal of Environmental Psychology*, *24*, 143-165.

Feldner, M. T., Zvolensky, M. J., & Leen-Feldner, E. (2004). A critical review of the empirical literature on coping and panic disorder. *Clinical Psychology Review, 24*(2), 123-148.

Festinger, L. (1954). A theory of social comparison processes. *Human Relations, 7*, 117-140.

Few, R. (2007). Health and climatic hazards: Framing social research on vulnerability, response and adaptation. *Global Environmental Change, 17,* 281-295.

Fischer, P., Greitemeyer, T., & Frey, D. (2008). Self-regulation and selective exposure: The impact of depleted self-regulation resources on confirmatory information processing. *Journal of Personality and Social Psychology, 94*(3), 382-395.

Fischhoff, B., Slovic, P., Lichtenstein, S., Read, S., & Combs, B. (1978). How safe is safe enough? A psychometric study of attitudes towards technological risks and benefits. *Policy Sciences, 9*, 127-152.

Fiske. S. T. & Taylor, S. E. (2008). *Social cognition: From brains to culture*. New York: McGraw-Hill.

Flick, U. (1998). Everyday knowledge in social psychology. In U. Flick (Ed.), *The psychology of the social* (pp. 41-59). Cambridge, UK: Cambridge University Press.

Flynn, J., Slovic, P., & Kunreuther, H. (Eds.). (2001). *Risk, media and stigma: Understanding public challenges to modern science and technology*. London: Earthscan.

Foddy, M., & Dawes, R. M. (2008). Group-based trust in social dilemmas. In A. Biel, D. Eek, T. Gärling, & M. Gustaffson (Eds.), *New issues and paradigms in research in social dilemma* (pp. 57-71). New York: Springer.

Foderaro, L. W. (2008, October 9). Pint-size eco-police, making parents proud and sometimes crazy. *The New York Times*. Retrieved on June 15, 2009, from http://www.nytimes.com/2008/10/10/nyregion/10green.html

Folbre, N. (1983). Of patriarchy born: The political economy of fertility decisions. *Feminist Studies, 9*, 261-284.

Fritze, J. G., Blashki, G. A., Burke, S. & Wiseman, J. (2008). Hope, despair and transformation: Climate change and the promotion of mental health and wellbeing. *International Journal of Mental Health Systems, 2*(13). Retrieved April 30, 2009, from http://ijmhs.com/content/2/1/13

Fuller, R., Irvine, K., Devine-Wright, P., Warren, P. & Gaston, K. (2007). Psychological benefits of greenspace increase with biodiversity. *Biology Letters, 3*(1), 390-394.

Fullilove, M. (1996). Psychiatric implications of displacement: Contributions from the psychology of place. *American Journal of Psychiatry, 153,* 1516-1523.

Fujii, S., & Gärling, T. (2003). Development of script-based travel mode choice after forced change. *Transportation Research Part F: Traffic Psychology and Behavior, 6*, 117-124.

Gardner, G. T., & Stern, P. C. (2002). *Environmental Problems and Human Behavior* (2nd ed.). Boston: Pearson Custom Publishing.

Gardner, G. T., & Stern, P. C. (2008). The short list: Most effective actions U.S. households can take to limit climate change. *Environment, 50*(5), 13-24.

Gatersleben, B., Steg, L., & Vlek, C. (2002). Measurement and determinants of environmentally significant consumer behavior. *Environment and Behavior, 34*(3), 335-362.

Geller, E. S., Winett, R. A., & Everett, P. B. (1982). *Preserving the environment: New strategies for behavior change.* Elmsford, NY: Pergamon Press.

Gergen, K. J. (1985). The social constructionist movement in modern psychology. *American Psychologist, 40*, 266-275.

Gheytanchi, A., Joseph, L., Gierlach, E., Kimpara, S., Houseley, J., Franco, Z. E., & Beutler, L. E. (2007). The dirty dozen: Twelve failures of the Hurricane Katrina response and how psychology can help. *American Psychologist, 62*, 118-130.

Gifford, R. (1976). Environmental numbness in the classroom. *Journal of Experimental Education, 44*(3), 4-7.

Gifford, R. (2007). Environmental psychology and sustainable development: Expansion, maturation, and challenges. *Journal of Social Issues, 63*(1), 199-212.

Gifford, R. (2007). *Environmental psychology: Principles and practice*. Coleville, WA: Optimal Books.

Gifford, R. (2008). Environmental psychology. In J. B. Callicott & R. Frodeman (Eds.), *Encyclopedia of environmental ethics and philosophy*. MacMillan Reference.

Gifford, R. (2008). Psychology's essential role in alleviating the impacts of climate change. *Canadian Psychology/Psychologie Canadienne, 49*(4), 273-280.

Gifford, R., Scannell, L., Kormos, C., Smolova, L., Biel, A., Boncu, S., et al. (2009). Temporal pessimism and spatial optimism in environmental assessments: An 18-nation study. *Journal of Environmental Psychology, 29*, 1-12.

Gilman, N., Randall, D., & Schwartz P. (2007). *Impacts of climate change: A system vulnerability approach to consider the potential impacts to 2050 of a mid-upper greenhouse gas emissions scenario.* Retrieved April 27, 2009, from http://media.washingtonpost.com/wp-srv/opinions/documents/gbn_impacts_of_climate_change.pdf

Glanz, K., Rimer, B. K., & Lewis, F. M. (2002). *Health behavior and health education: Theory, research and practice.* San Francisco: Wiley & Sons.

Goldenberg, J. L., Pyszczynski, T., Greenberg, J., & Solomon, S. (2000). Fleeing the body: A terror management perspective on the problem of human corporeality. *Personality and Social Psychology Review, 4*, 200-218.

Goldstein, N. J., Griskevicius, V., & Cialdini, R. B. (2007). Invoking social norms: A social psychology perspective on improving hotels' linen-reuse programs. *Cornell Hotel and Restaurant Administration Quarterly, 48*(2), 145-150.

Goldstein, W. M., & Weber, E. U. (1995). Content and discontent: Indications and implications of domain specificity in preferential decision making. In J. R. Busemeyer, R. Hastie, & D. L. Medin (Eds.), *Decision making from a cognitive perspective: The Psychology of Learning and Motivation* (Vol. 32, pp. 83-136). San Diego: Academic Press.

Gow, K., & Paton, D. (Eds.). (2008). *The phoenix of natural disasters: Community resilience*. New York: Nova Science Publishers.

Groopman, J. (2004). *The anatomy of hope*. New York: Random House.

Guagnano, G., Stern, P. C., & Dietz, T. (1995). Influences on attitude-behavior relationships: A natural experiment with curbside recycling. *Environment and Behavior, 27*, 699-718.

Haggerty, R.J., Sherrod, R., Garmezy, N., & Rutter, M. (1994). *Stress, risk, and resilience in children and adolescents: Processes, mechanisms, and interventions*. New York: Cambridge University Press.

Halberstadt, J. (2006). The generality and ultimate origins of the attractiveness of prototypes. *Personality and Social Psychology Review, 10*(2), 166-183.

Hall, M. J., Ng, A., Ursano, R. J., Holloway, H., Fullerton, C., & Casper, J. (2004). Psychological impact of the animal-human bond in disaster preparedness and response. *Journal of Psychiatric Practice, 10*(6), 368-374.

Hamilton, C. (2003). *Downshifting in Britain: A sea-change in the pursuit of happiness*. Retrieved April 26, 2009, from https://www.tai.org.au/file.php?file=DP58.pdf

Hanley, E. (2008, May). Economic growth and climate change: Exploring the relationship between GDP and CO2 emissions. In J. Nagel, T. Dietz, & J. Broadbent (Eds.), Presented at *Workshop on Sociological Perspectives on Global Climate Change*.

Hansla, A., Gamble, A., Juliusson, A., & Garling, T. (2008). The relationships between awareness of consequences, environmental concern, and value orientations. *Journal of Environmental Psychology, 28*, 1-9.

Hardin, G. (1968). The tragedy of the commons, *Science, 162,* 1243-1248.

Hardisty, D. H., Johnson, E. J., & Weber, E. U. (2009). A dirty word or a dirty world? Attribute framing, political affiliation, and Query Theory. Manuscript under review.

Harland, P., Staats, H., & Wilke, H. A. M. (2007). Situational and personality factors as direct or personal norm mediated predictors of pro-environmental behavior: Questions derived from norm-activation theory. *Basic and Applied Social Psychology, 29*(4), 323-334.

Harmann, B., & Barajas-Roman, E. (2009, January). *Reproductive justice, not population control: Breaking the wrong links and making the right ones.* Paper presented at the WE ACT for Environmental Justice conference on Advancing Climate Justice: Transforming the Economy, Public Health and Our Environment, New York.

Haskett, M. E., Scott, S. S., Nears, K. & Grimmett, M. A. (2008). Lessons from Katrina: Disaster mental health service in the Gulf Coast region. *Professional Psychology: Research and Practice, 39*, 93-99.

Hass, J. W., Bagley, G. S., & Rogers, R. W. (1975). Coping with the energy crisis: Effects of fear appeals upon attitudes toward energy consumption. *Journal of Applied Psychology, 60*(6), 754-756.

Heath, Y., & Gifford, R. (2002). Extending the theory of planned behavior: Predicting the use of public transportation. *Journal of Applied Social Psychology, 32*, 2154-2185.

Heath, Y., & Gifford, R. (2006). Free-market ideology and environmental degradation: The case of belief in global climate change. *Environment and Behavior*, *38*(1), 48-71.

Heberlein, T. A., & Baumgartner, R. (1978). Factors affecting response rates to mailed questionnaires: A quantitative analysis of the published literature. *American Sociological Review, 43*(4), 447-462.

Hertwig, R., Barron, G., Weber, E. U., & Erev, I. (2004). Decisions from experience and the effect of rare events. *Psychological Science, 15*, 534-539.

Hine, D. W., & Gifford, R. (1996). Individual restraint and group efficiency in commons dilemmas: The effects of two types of environmental uncertainty. *Journal of Applied Social Psychology, 26*, 993-1009.

Hirst, E. (1987). Individual and institutional behavior related to energy efficiency in buildings. *Journal of Environmental Systems, 16*(1), 57-74.

Hobson, K. (2003). Thinking habits into action: The role of knowledge and process in questioning household consumption practices. *Local Environment, 8*(1), 95-112.

Hogg, M. (2003). Social identity. In M. Leary & J. Tangney (Eds.), *Handbook of self and identity* (pp. 462-479). New York: Guilford.

Holdren, J. P., & Ehrlich, P. R. (1974). Human population and the global environment. *American Scientist, 62*, 282-292.

Holahan, C. J. (1982). *Environmental Psychology*. New York: Random House.

Holahan, C. J. & Wandersman, A. (1991). The community psychology perspective in environmental psychology. In D. Stokols & I. Altman (Eds.), *Handbook of environmental stress* (Vol 1, pp. 827-861). Malabar, FL: Krieger.

Holtgrave, D., & Weber, E. U. (1993). Dimensions of risk perception for financial and health risks. *Risk Analysis, 13*, 553-558.

Hulin, C. L. (1991). Adaptation, persistence, and commitment in organizations. *Handbook of industrial and organizational psychology, 2*, 445–505.

Hunecke, M., Haustein, S., Grischkat, S., & Böhler, S. (2007). Psychological, sociodemographic, and infrastructural factors as determinants of ecological impact caused by mobility behavior. *Journal of Environmental Psychology, 27*(4), 277-292.

Intergovernmental Panel on Climate Change [IPCC]. (2001). *Climate Change 2001: Synthesis Report*. Watson, R.T., & the Core Writing Team (Eds.). IPCC: Geneva, Switzerland. Retrieved June 15, 2009, from http://www.ipcc.ch/ipccreports/assessments-reports.htm

Intergovernmental Panel on Climate Change [IPCC]. (2007a). *Climate Change 2007: Synthesis Report*. Pachauri, R.K. & Reisinger, A. (Eds.). IPCC: Geneva, Switzerland. Retrieved June 15, 2009, from http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf

Intergovernmental Panel on Climate Change [IPCC]. (2007b). Glossary of Terms used in the IPCC Fourth Assessment Report: Working Group II (WG2). Retrieved June 15, 2009, from http://www.ipcc.ch/glossary/

Intergovernmental Panel on Climate Change [IPCC]. (2007c). Summary for Policymakers. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.* Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (Eds.). Cambridge University Press: Cambridge, UK and New York, NY. Retrieved December 8, 2008, from http://www.ipcc-wg2.org/

International Energy Agency. (2007). World Energy Outlook 2007: China and India insights. Retrieved June, 11, 2009, from http://www.iea.org/textbase/nppdf/free/2007/weo_2007.pdf.

International Energy Agency. (2008). World Energy Outlook 2008: Executive summary.

Retrieved June 11, 2009, from

http://www.worldenergyoutlook.org/docs/weo2008/WEO2008_es_english.pdf.

Jagtenberg, T., & McKie, D. (1997). *Eco-impacts and the greening of modernity: New maps for communication studies, cultural studies, and sociology*. London: Sage.

Jakobsson, C., Fujii, S. & Garling, T. (2000). Determinants of private car users' acceptance of road pricing. *Transport Policy*, **7**(2), 153-158.

James, W. (1890). *Principles of psychology*. New York: Henry Holt.

Janz, N. K., & Becker, M. H. (1984). The health belief model: A decade later. *Health Education Quarterly, 11*(1), 1-47.

Jayson, S. (2009, March 20). Psychologists determine what it means to think green. *USA Today*. Retrieved June 15, 2009, from http://www.usatoday.com/news/nation/environment/2008-08-13-green-psychology_N.htm.

Jevons, W. S. (1865). On the variation of prices and the value of the currency since 1782. *Journal of the Statistical Society of London, 28*(2), 294-320.

Johndon-Cartee, K. S. (2005). *News narratives and news framing: Constructing political reality*. Lanhan, MD: Rowan & Littlefield.

Johnson, B. B. & Covello, V. T. (Eds.). (1987). *The social and cultural construction of risk*. New York: D. Reidel.

Johnson, E. J., & Goldstein, D. (2003). Do defaults save lives? *Science, 302*(5649), 1338-1339.

Johnson, E. J., Haeuble, G., & Keinan, A. (2007). Aspects of endowment: A query theory of loss aversion. *Journal of Experimental Psychology-Learning Memory and Cognition, 33* (3), 461-474.

Johnson, E., Hershey, J., Meszaros, J., & Kunreuther, H. (1993). Framing, probability distortions and insurance decisions. *Journal of Risk and Uncertainty, 7*, 35-51.

Johnson, L. R., Johnson-Pynn, J. S. & Pynn, T. (2007). Youth civic engagement in China: Results from a program promoting environmental activism. *Journal of Adolescent Research, 22*, 355-386.

Jones*, J. M.* (2003). *TRIOS: A psychological theory of the African legacy in American culture*. Journal of Social Issues, *59*, 217-242.

Kahn, P. H. (1999). *The human relationship with nature.* Cambridge, MA: MIT Press.

Kahneman, D., Krueger, A. B., Schkade, D., Schwarz, N., & Stone, A. A. (2006). Would you be happier if you were richer? A focusing illusion. *Science, 312*(5782), 1908-1910.

Kaiser, F. G. (1998). A general measure of ecological behavior. *Journal of Applied Social Psychology*, *28*, 395-422.

Kaiser, F. G., & Gutscher, H. (2003). The proposition of a general version of the theory of planned behavior: Predicting ecological behavior. *Journal of Applied Social Psychology, 33*, 586-603.

Kasperson, R. E. & Dow, K. (1991). Developmental and geographical equity in global environmental change. *Evaluation Review, 15,* 149 -171.

Kasperson, J. X., Kasperson, R. E., Pidgeon, N., & Slovic, P. (2003). The social amplification of risk: Assessing fifteen years of research and theory. In N. Pidgeon, R. E. Kasperson, & P. Slovic (Eds.), *The social amplification of risk* (pp. 13-46). Cambridge, UK: Cambridge University Press.

Kasperson, R. E., Renn, O., Slovic, P., Brown, S., Emel, J., & Goble, R. et al. (1988). The social amplification of risk: A conceptual framework, *Risk Analysis*, 8, 177-187.

Kasser, T. (2005). Frugality, generosity, and materialism in children and adolescents. In K. A. Moore & L. H. Lippman (Eds.), *What do children need to flourish? Conceptualizing and measuring indicators of positive development* (pp. 357-373). New York: Springer Science.

Kasser, T. (in press). Cultural values and the well-being of future generations: A cross-national study. *Journal of Cross-Cultural Psychology*.

Kasser, T., & Brown, K. W. (2003). On time, happiness, and ecological footprints. In J. deGraaf (Ed.), *Take back your time: Fighting overwork and time poverty in America* (pp. 107-112). San Francisco: Berrett-Koehler.

Kasser, T., & Ryan, R. M. (1993). A dark side of the American dream: Correlates of financial success as a central life aspiration. *Journal of Personality and Social Psychology, 65*(2), 410-422.

Kasser, T., Ryan, R. M., Couchman, C. E., & Sheldon, K. M. (2004). Materialistic values: Their causes and consequences. In T. Kasser, & A. D. Kanner (Eds.), *Psychology and consumer culture: The struggle for a good life in a materialistic world* (pp. 11-28). Washington, DC: American Psychological Association.

Kasser, T., & Sheldon, K. M. (2009). Time affluence as a path toward personal happiness and ethical business practice: Empirical evidence from four studies. *Journal of Business Ethics, 84*(2), 243-255.

Kates, R. W. (2007). Forward. In S. C. Moser & L. Dilling (Eds.), *Creating a climate for change*. New York: Cambridge University Press.

Kauffmann-Hayoz, R., & Gutscher, H. (Eds.). (2001). *Changing thing s –Moving people: Strategies for promoting sustainable development at the local level.* Basel, Switzerland: Birkhäuser Verlag.

Keim, M. E. (2008). Building human resilience: The role of public health preparedness and response as an adaptation to climate change. *American Journal of Preventive Medicine*, *35*, 508-516.

Kempton, W. (1991). Public understanding of global warming. *Society and Natural Resources, 4,* 331-345.

Kempton, W., Darley, J. M., & Stern, P. C. (1992). Psychological research for the new energy problems: Strategies and opportunities. *American Psychologist, 47*(10), 1213-1223.

Kempton, W., Harris, C. K., Keith, J. G., & Weihl, J.S. (1985). Do consumers know "what works" in energy conservation? *Marriage and Family Review, 9*, 115-133.

Khazzoom, D. J. (1980). Economic implications of mandated efficiency standards for household appliances. *The Energy Journal, 1*, 21-40.

Kidner, D. W. (1994). Why psychology is mute about the environmental crisis. *Environmental Ethics, 16,* 359-376.

Kidner, D. (2007). Depression and the natural world: Towards a critical ecology of psychological distress. *The International Journal of Critical Psychology, 19,* 123-146.

Klöckner, C. A., Matthies, E., & Hunecke, M. (2003). Problems of operationalizing habits and integrating habits in normative decision-making models. *Journal of Applied Social Psychology, 33*, 396-417.

Kluger, J. et al. (2006a, April). Be worried. Be very worried. Earth at the tipping point. *Time,* 24-54.

Kluger, J. (2006b, April 3). Global warming. *Time*, 28-42.

Knott, D., Muers, S., & Aldridge, S. (2008). Achieving culture change: A policy framework. London: UK Cabinet Office.

Kolbert, E. (2006). *Field notes from a catastrophe: Man, nature and climate change*. New York: Bloombury.

Kollmuss, A., & Agyeman, J. (2002). Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research, 8*(3), 239-260.

Krantz, D. H., & Kunreuther, H. C. (2007). Goals and plans in decision making. *Judgment and Decision Making, 2*(3), 137-168.

Krenichyn, K. (2004). Women and physical activity in an urban park. *Journal of Environmental Psychology, 24*, 117-130.

Krosnik, J. A., Holbrook, A. L., Lowe, L., & Visser, P. S. (2006). The origins and consequences of democratic citizens' policy agendas: A study of popular concern about global warming. *Climatic Change, 77*, 7-43.

Kuo, F. & Faber Taylor, A. (2004). A potential natural treatment for Attention-Deficit/Hyperactivity Disorder: Evidence from a national study. *American Journal of Public Health 94*(9), 1580-1586.

Kuo, F., & Sullivan, W. (2001). Aggression and violence in the inner city: Effects of environment via mental fatigue. *Environment and Behavior, 33*, 543-571.

Kuo, F., Sullivan, W., Coley, R., & Brunson, L. (1998). Fertile ground for community: Inner-city neighborhood common spaces. *American Journal of Community Psychology, 26*, 823-251.

Laibson, D. (1997). Golden eggs and hyperbolic discounting. *Quarterly Journal of Economics, 112*, 443-477.

Lang, J. T., & Hallman, W. K. (2005). Who does the public trust? The case of genetically modified food in the United States. *Risk Analysis, 25*(5), 1241-1252.

Langford, I. H. (2002). An existential approach to risk perception. *Risk Analysis, 22,* 101-120.

Lavine, J. (2006). *Not buying it: My year without shopping*. London: Simon & Schuster.

Lazarus, R. S. (1966). *Psychological stress and the coping process*. New York: McGraw-Hill.

Lazarus, R. S., & Cohen, J. B. (1977). Environmental stress. In I. Altman & J. F. Wohlwill (Eds), *Human behaviour and environment: Advances in theory and research* (pp. 90-127). New York: Plenum.

Lazarus, R. S., & Folkman, S. (1984). (Eds.). *Stress, appraisal and coping*. New York: Springer.

Lehman, P. K., & Geller, E. S. (2004). Behavior analysis and environmental protection: Accomplishments and potential for more. *Behavior and Social Issues, 13*(1), 13-32.

Lehman, D., & Taylor, S. E. (1987). Date with an earthquake: Coping with a probable, unpredictable disaster. *Personality and Social Psychology Bulletin*, *13*, 546-555.

Leiserowitz, A. (2004). Surveying the Impact of "The Day After Tomorrow". *Environment, 46,* 23-44.

Leiserowitz, A. (2005). American risk perceptions: Is climate change dangerous? *Risk Analysis*, *25*, 1433-1442.

Leiserowitz, A. (2006). Climate change risk perception and policy preferences: The role of affect, imagery, and values. *Climatic Change, 77*, 45-72.

Leiserowitz, A. (2007). Communicating the risks of global warming: American risk perceptions, affective images, and interpretive communities. In S. C. Moser & L. Dilling (Eds.), *Creating a climate for change* (p. 44-63). New York: Cambridge University Press.

Leiserowitz, A. & Broad, K. (2008). Florida: Public opinion on climate change. A Yale University/University of Miami/Columbia University Poll. New Haven, CT: Yale Project on Climate Change. Retrieved June 15, 2009, from http://environment.yale.edu/uploads/FloridaGlobalWarmingOpinion.pdf

Leiserowitz, A. A., Kates, R. W., & Parris, T. M. (2005). Do global attitudes and behaviors support sustainable development? *Environment, 47*(9), 22-38.

Lepore, S. J. & Evans, G. W. (1996). Coping with multiple stressors in the environment. In M. Zeidner, & N.S. Endler (Eds.), *Handbook of coping: Theory, research and applications* (pp. 350-377). New York: Wiley.

Lertzman, R. (2008, September). The myth of apathy. *The Ecologist.* Retrieved December 1, 2008, from http://www.theecologist.org/pages/archive_detail.asp?open=y&content_id=1877#37060

Lesthaeghe, R. & Surkyn, J. (1988). Cultural dynamics and economic theories of fertility change. *Population and Development Review*, *24*(1), 1-45.

Levine, R. (1997). *A geography of time: The temporal misadventures of a social psychologist, or how every culture keeps time just a little bit differently*. New York, NY: Basic Books.

Lickel, B., Schmader, T., Curtis, M., Scarnier, M., & Ames, D. R. (2005). Vicarious guilt and shame. *Group Process and Intergroup Relations, 8*, 145-157.

Lindenberg, S., & Steg, L. (2007). Normative, gain and hedonic goal frames guiding environmental behavior. *Journal of Social Issues, 63*(1), 117-137.

Liu, J., Daily, G. C., Ehrlich, P. R., & Luck, G. W. (2003). Effects of household dynamics on resource consumption and biodiversity. *Nature, 421*, 530-533.

Livi-Bacci, M. (2007). *A concise history of world population* (4th ed.). Maldon, MA: Blackwell.

Loewenstein, G., & Elster, J. (Eds.). (1992). *Choice Over Time*. New York: Russell Sage.

Loewenstein, G. F., Weber, E. U., Hsee, C. K., & Welch, E. (2001). Risk as feelings. *Psychological Bulletin, 127*, 267-286.

Loukopoulos, P., Jakobsson, C., Gärling, T., Meland, S., & Fujii, S. (2006). Understanding the process of adaptation to car-use reduction goals. *Transportation Research Part F: Traffic Psychology and Behaviour, 9*(2), 115-127.

Lovins, A. B., Lovins, L. L., & Hawken, P. (1999, May-June). A road map for natural capitalism. *Harvard Business Review, 77*, 145-158.

Lowe, T., Brown, K., Dessai, S., DeFrancea, D. M., Haynes, K. & Vincent, K. (2006). Does tomorrow ever come? Disaster narrative and public perception of climate change. *Public Understanding of Science, 15,* 435-457.

Lule, E., Singh, S., & Chowdhury, S. A. (2007). Fertility regulation behaviors and their costs: Contraception and unintended pregnancies in Africa and Eastern Europe, and Central Asia. *Health Nutrition and Population (HNP) Discussion paper* (pp.165). Washington, DC: World Bank.

Lupton, D. (1999). *Risk*. London: Routledge.

Luthar, S. A. (2003). *Resilience and vulnerability: Adaptation in the context of childhood adversities*. New York: Cambridge University Press.

Lutzenhiser, L. (2009). Behavioral Assumptions Underlying California Residential Sector
Energy Efficiency Programs. Prepared for the California Institute for Energy and
Environment Behavior and Energy Program.

Maas, J., Verheij, R., Groenewegen, P., de Vries, S. & Spreeuwenberg, P., (2006). Green space,
urbanity and health: How strong is the relationship? *Journal of Epidemiology and
Community Health, 60*, 587-592.

MacGregor, D., Slovic, P., Mason, R. G., & Detweiler, J. (1994). Perceived risks of radioactive
waste transport through Oregon: Results of a statewide survey. *Risk Analysis, 14*, 5-14.

Macnaghten, P., & Urry, J. (1998). *Contested natures.* London: Sage.

Macy, J., & Brown, M. Y. (1998). *Coming back to life: Practices to reconnect our lives, our
world.* Gabriola Island, British Columbia: New Society Publishers.

Maio, G. R., Verplanken, B., Manstead, A. S. R., Stroebe, W., Abraham, C. S., Sheeran, P., &
Conner, M. (2007). Social Psychological Factors in Lifestyle Change and Their
Relevance to Social Policy. *Social Issues and Policy Review, 1,* 99-138.

Maiteny, P. T. (2002). Mind in the gap: Summary of research exploring "inner" influences on
pro-sustainability learning and behavior. *Environmental Education Research, 8,* 299-306.

Maller, C., Townsend, M., Pryor, A., Brown, P., & St. Leger, L. (2006). Healthy nature healthy
people: Contact with nature as an upstream health promotion intervention for
populations. *Health Promotion International, 21*, 45-54.

Mallett, R. K. (2009). Breaking the Pollution Habit: Validation of Three Eco-Emotion Scales.
Manuscript under review.

Mallett, R. K., Huntsinger, J. R., Sinclair, S., & Swim, J. K. (2008). Seeing Through Their Eyes: When Majority Group Members Take Collective Action on Behalf of an Outgroup. *Group Process and Intergroup Relations. 11*(4), 451-470.

Mallet, R. K., & Swim, J. K. (2004). Collective guilt in the United States. In N.R. Branscombe & B. Doosje. *Collective guilt: International perspectives* (pp. 56-74). Cambridge, MA: Cambridge University Press.

Marshall, R. D., Bryant, R. A., Amsel, L. Suh, E. J., Cook, J. M. & Neria, Y. (2007). The psychology of ongoing threat: Relative risk appraisal, the September 11 attacks, and terrorism-related fears. *American Psychologist*, *62,* 304-316.

Marx, S. M., Weber, E. U., Orlove, B. S., Leiserowitz, A., Krantz, D. H., & Roncoli, C. (2007). Communication and mental processes: Experiential and analytic processing of uncertain climate information. *Global Environmental Change, 17,* 47-58.

Masten, A. S. (2001). Ordinary magic: Resilience processes in development. *American Psychologist*, *56*(3), 227-238.

Matthews, F. (2009, February 10). *Sydney Morning Herald.*

Matthies, E., Klöckner, C. A., & Preißner, C. L. (2006). Applying a modified moral decision making model to change habitual car use: How can commitment be effective? *Applied Psychology: An International Review, 55*(1), 91-106.

McCracken, G. (1986). Culture and consumption: A theoretical account of the structure and movement of the cultural meaning of consumer goods. *Journal of Consumer Research, 13,* 71-84.

McCright, A. M. (2007). Dealing with climate contrarians. In S. C. Moser & L. Dilling (Eds.), *Creating a climate for change: Communicating climate change and facilitating social*

change (pp. 200- 212). New York: Cambridge University Press.

McKenzie-Mohr, D., & Smith, W. (1999). *Fostering sustainable behavior: An introduction to community-based social marketing.* Gabriola Island, B.C., Canada: New Society Publishers.

McKibben, B. (2007). *Deep Economy*. New York: Holt.

McKinsey, M. (2007). Externalism and privileged access are inconsistent. In B. P. McLaughlin, & J. Cohen (Eds.), *Contemporary debates in philosophy of mind.* (pp. 53-65) Blackwell Publishing: Malden.

McMichael, A. J. (2003). Global climate change and health: An old story writ large. In A. J. McMichael, D. H. Campbell-Lendrum, C. F. Corvalan, K. L. Ebi, A. Githelo, J. D. Scheraga, & A. Woodward (Eds.), *Climate change and human health: Risks and responses*. Geneva, Switzerland: World Health Organization.

Mertens, D. M. (2009). *Transforming research and evaluation*. New York: Guilford Press.

Merzel, C., D'Afflitti, J. (2003). Re-considering community-based health promotion: Promise, performance, and potential. **American Journal of Public Health,** *93*, 557-574.

Messick, D. M., & Rutte, C. G. (1992). The provision of public goods by experts: The Groningen study. In W. B. G. Liebrand, D. M. Messick & H. A. M. Wilke (Eds.), *Social dilemmas: Theoretical issues and research findings.* (pp. 101-107) Pergamon Press: Elmsford.

Milfont, T. L., Duckitt, J., & Cameron, L. D. (2006). A cross-cultural study of environmental motive concerns and their implications for pro-environmental behavior. *Environment and Behavior, 38*(6), 745-767.

Milfont, T. L., & Gouveia, V. V. (2006). Time perspective and values: An exploratory study of their relations to environmental attitudes. *Journal of Environmental Psychology, 26*(10), 72-82.

Millennium Ecosystems Assessment (2005). *Ecosystems and human well-being: Current state and trends: Findings of the Condition and Trends Working Group of the Millennium Ecosystem Assessment* (Vol. 2). Washington DC: Island Press.

Miller, G. A. (1969). Psychology as a means of promoting human welfare. *American Psychologist, 24*, 1063-1075.

Milne, S, Sheeran, P. & Orbell, S. (2000). Prediction and intervention in health-related behavior: A meta-analytic review of protection motivation theory. *Journal of Applied Social Psychology, 30*, 106-143.

Mischel, W., Grusec, J., & Masters, J. C. (1969). Effects of expected delay time on the subjective value of rewards and punishments. *Journal of Personality and Social Psychology, 11*, 363-373.

Mortreux, C., & Barnett, J. (2009). Climate change, migration, and adaptation in Funafuti, Tuvalu. *Global Environmental Change, 19*, 105-112.

Moscovici, S. (2000). *Social representations: Explorations in social psychology*. Cambridge: Polity Press.

Moser, S. C. (2007). More bad news: The risk of neglecting emotional responses to climate change information. In S. C. Moser & L. Dilling (Eds.), *Creating a climate for change*. New York: Cambridge University Press.

Moser, S. C., & Dilling, L (2004). Making climate hot: Communicating the urgency and challenge of global climate change. *Environment, 46,* 32-46.

Moser, S. C. & Dilling, L (2007a). *Creating a climate for change :Communicating climate change and facilitating social change*. New York: Cambridge University Press.

Moser, S. C., & Dilling, L. (2007b). Toward the social tipping point: Creating a climate for change. In S. C. Moser & L. Dilling. (Eds.), *Creating a climate for change: Communicating climate change and facilitating social change* (pp. 491-516). New York: Cambridge University Press.

Morrissey, S. A., & Reser, J. P. (2003). Evaluating the effectiveness of psychological preparedness advice in community cyclone preparedness materials. *Australian Journal of Emergency Management*, *18*, 44-59.

Morrissey, S. A., & Reser, J. P. (2007). Natural disasters, climate change and mental health considerations in rural Australia. *Australian Journal of Rural Health*, *15*, 120-125.

Mortreux, C., & Barnett, J. (2009). Climate change, migration, and adaptation in Funafuti, Tuvalu. *Global Environmental Change, 19*, 105-112.

Moyers, B. (2006). *Welcome to Doomsday*. New York: New York Review Books.

Musson, C. (1974). Local attitudes to population growth in South Buckinghamshire. In H. B. Perry (Ed.), *Population and its problems: A plain man's guide* (pp. 392-3). Oxford: Clarendon Press.

Myers, N., & Kent, J. (2003). New Consumers: The influence of affluence on the environment. *Proceedings of the National Academy of Sciences*, *100*(8), 4963-4968.

National Research Council. (1989). *Improving risk communication*. Committee on Risk Perception and Communication (Ed.). Washington, DC: National Academies Press.

National Research Council. (1992). *Global environmental change: Understanding the human dimensions*. Stern, P. C., Young, O. R., & Druckman, D. (Eds.). Washington, DC: National Academies Press.

National Research Council. (1996). *Understanding risk: Informing decisions in a democratic society*. Stern, P. C., & Fineberg, H. V. (Eds.). Washington, DC: National Academies Press.

National Research Council. (1999). *Making climate forecasts matter*, Stern, P. C., & Easterling, W. E. (Eds.). Washington, DC: National Academies Press.

National Research Council. (2008). *Public participation in environmental assessment and decision making*. Dietz, T., & Stern, P.C. (Eds.). Washington, DC: National Academies Press.

National Research Council. (2009). *Understanding and responding to climate change*. Washington, DC: National Research Council/The National Academies.

Nelson, C., Lurie, N., & Wasserman, J. (2007). Assessing public health emergency preparedness: Concepts, tools, and challenges. *Annual Review of Public Health, 28*, 1-18.

Neutra, R. Lipscomb, J., Satin, K. & Shusterman, D. (1991). Hypotheses to explain the higher symptom rates observed around hazardous waste sites. *Environmental Health Perspectives, 94,* 31-38.

Newman, R. (2005). APA's resilience initiative. *Professional Psychology: Research and Practice*, *36*, 227-229.

Nicholsen, S. W. (2002). *The love of nature and the end of the world.* Cambridge: MIT Press.

Nilsson, A., von Borgstede, C., & Biel, A. (2004). Willingness to accept climate change strategies: The effect of values and norms. *Journal of Environmental Psychology, 24*(3), 267-277.

Nisbett, R. E., & Wilson, T. D. (1977). Telling more than we can know: Verbal reports on mental processes. *Psychological Review, 84*(3), 231-259.

Nobel, J. (2007, April 9). Eco-anxiety: Something else to worry about [Electronic version]. *The Philadelphia Enquirer*.

Nolan, J. M., Schultz, P. W., Cialdini, R. B., Goldstein, N. J., & Griskevicius, V. (2008). Normative social influence is underdetected. *Personality and Social Psychology Bulletin, 34*(7), 913-923.

Norris, F. J., Friedman, M. J., Watson, P. J., Byrne, C. M., Diaz, E. & Kaniasty, K. (2002). 60,000 disaster victims speak: Part 1. An empirical review of the empirical literature, 1981-2001. *Psychiatry, 65*, 207-239.

O'Connor, R. E., Bord, R. J., & Fisher, A. (1998). The curious impact of knowledge about climate change on risk perceptions and willingness to sacrifice. *Risk Decision and Policy, 3*(2), 145-155.

O'Connor, R. E., Bord, R. J., & Fisher, A. (1999). Risk perceptions, general environmental beliefs, and willingness to address climate change. *Risk Analysis, 19*, 461-471.

O'Connor, R., Bord, R., Yarnal, B., & Wiefek, N. (2002). Who Wants to Reduce Greenhouse Gas Emissions? *Social Science Quarterly, 83*, 1-17.

O'Donoghue, T., & Rabin, M. (1999). Doing It Now or Later. *American Economic Review, 89*, 103-124.

Olson, D. R. (1965). Note on Haslerud and Meyers' transfer-of-principles experiment. *Journal of Educational Psychology, 56*(2), 107-108.

Olson, R., & Rejeski, D. (2005). *Environmentalism and the technologies of tomorrow: Shaping the next industrial revolution.* Washington, DC: Island Press.

Opotow, S., & Brook, A. (2003). Identity and exclusion in rangeland conflict. In S. Clayton, & S. Opotow (Eds.), *Identity and the natural environment: The psychological significance of nature (*pp. 249-271). Cambridge, MA: MIT Press.

O'Riordan, T. (Ed.). (1995). *Perceiving environmental risks.* New York: Academic Press.

Ostrom, E., Dietz, T., Dolsak, N., Stern, P. C., Stonich, S., & Weber, E. U. (Eds.). (2002). *The drama of the commons.* Washington, DC: National Academies Press.

Padgett, J. P., Steinemann, A. C., Clarke, J. H., & Vandenbergh, M. P. (2008). A comparison of carbon calculators. *Environmental Impact Assessment Review, 28*,106–115.

Pallonen, U. E., Prochaska, J. O., Velicer, W. F., Prokhorov, A. V., & Smith, N. F. (1998). Stages of acquisition and cessation for adolescent smoking: An empirical integration. *Addictive Behaviors, 23*(3), 303-324.

Paterson, R. J., & Neufeld, R. W. J. (1987). Clear danger: Situational determinants of threat appraisal. *Psychological Review*, *101*, 494-416.

Peek, L. A. & Miletti, D. S. (2002). The history & future of disaster research. In R. B. Bechtel, R. B., & A. Churchman (Eds.), *Handbook of environmental psychology* (pp. 511-524). New York: Wiley.

Pettenger, M.E. (2007). *The social construction of climate change*. London: Ashgate.

Pew Research Center. (2006). *Luxury or necessity? Things we can't live without: The list has grown in the past decade*. Pew Research Center: A Social Trends Report.

Pidgeon, N. F., Kasperson, R. K. & Slovic, P. (2003). *The social amplification of risk.* Cambridge: Cambridge University Press.

Pidgeon, N., Lorenzoni, I., & Poortinga, W. (2008). Climate change or nuclear power – No thanks! A quantitative study of public perceptions and risk framing in Britain. *Global Environmental Change*, *18,* 69-85.

Prochaska, J. O., DiClemente, C. C., & Norcross, J. C. (1992). In search of how people change: Applications to addictive behaviors. *American Psychologist, 47*, 1102-1114.

Professional Psychology: Research and Practice, 39 (2008). [Entire Issue].

Quarantelli, E. L. (1998). *What is a disaster*? New York: Routledge.

Rabinowitz, P. M. & Poljak, A. (2003) Host–Environment medicine: A primary care model for the age of genomics. *General Internal Medicine, 18*, 222–227.

Reser, J. P. (2004). The experience of natural disasters: Psychological perspectives and understandings. In J. P. Stoltman, J. Lidstone & L. M. DeChano (Eds.), *International perspectives on natural disasters: Occurrence, mitigation, and consequences* (pp. 369-384). Dordrecht: Kluwer Academic.

Reser, J. P. (2009). 'Climate change' is far more than climate change. Manuscript under review.

Reser, J. P. & Morrissey, S. A. (2008). Situating and framing individual and community experience and response: A psychological perspective. In K. Gow & D. Paton (Eds.), *The phoenix of natural disasters: Community resilience* (pp. 47-72). New York: Nova Science Publishers.

Reser, J. P. & Smithson, M. J. (1988). When ignorance is adaptive: Not knowing about the nuclear threat. *Knowledge in Society, 1*(4), 7-27.

Reuveny, R. (2008). Ecomigration and violent conflict: Case studies and public policy implications. *Human Ecology, 36*, 1-13.

Reyes, G. & Jacobs, G.A. (Eds.). (2006). *Handbook of international disaster psychology* (Vol.1-4). Westport, CT: Praeger.

Richins, M. L., & Dawson, S. (1992). A consumer values orientation for materialism and its measurement: Scale development and validation. *Journal of Consumer Research, 19,* 303-316.

Robertson, G., Mash, M., Tickner, L., Bird, J., Curtis, B., & Putnam, T. (Eds). (1996). *Future natural: Nature, science, culture*. London: Routledge.

Rogers, E. M. (2003). *Diffusion of Innovations* (5th ed.). New York: Free Press.

Rogers, R. W. (1975). A protection motivation theory of fear appeals and attitude change. *Journal of Psychology: Interdisciplinary and Applied, 91*(1), 93-114.

Rogers, R. W., & Prentice-Dunn, S. (1997). Protection motivation theory. In D. S. Gochman (Ed.), *Handbook of health behavior research 1: Personal and social determinants* (pp. 113-132). New York: Plenum Press.

Ruderman, A. J. (1985). Restraint and irrational cognitions. *Behaviour Research and Therapy, 23*(5), 557-561.

Rudmin, F. W. (2003). Critical history of the acculturation psychology of assimilation, separation, integration, and marginalization. *Review of General Psychology, 7*(1), 3-37.

Rutter, M. (1987). Psychosocial resilience and protective mechanisms. *American Journal of Orthopsychiatry, 57*, 316-331.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68-78.

Sallis, J. F., Bauman, A., & Pratt, M. (1998). Environmental and policy interventions to promote physical activity. *American Journal of Preventive Medicine, 15*(4), 379-397.

Sam, D. L., & Berry, J. W. (2006). *The Cambridge Handbook of Acculturation Psychology.* New York: Cambridge University Press.

Schade, J., & Schlag, B. (2003). Acceptability of urban transport pricing strategies. *Transportation Research Part F: Traffic Psychology and Behaviour, 6*(1), 45-61.

Scheier, M. F., Weintraub, J. K., & Carver, C. S. (1986). Coping with stress: Divergent strategies of optimists and pessimists. *Journal of Personality and Social Psychology, 51*(6), 1257-1264.

Schoon, I. (2006). *Risk and resilience: Adaptations in changing times.* Cambridge: Cambridge University Press.

Schmuck, P., & Schultz, W. P. (Eds.). (2002). *Psychology of sustainable development*. Boston, MA: Kluwer Academic Publishers.

Schor, J. (1998). *The overspent Americans: Why we want what we don't need.* Oxford: Harper Perennial.

Schwartz, S. H. (1992). Universals in the content and structure of values: Theoretical advances and empirical tests in 20 countries. In M. P. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 25, pp. 1-65). New York: Academic Press.

Schwartz, S. H. (1994). Are there universal aspects in the structure and contents of human values*? Journal of Social Issues, 50*(4), 19–45.

Schiffman, L. G., Kanuk, L. L., & Das, M. (2006). *Consumer behaviour.* Toronto: Pearson Education.

Schultz, P. W., Nolan, J. M., Cialdini, R. B., Goldstein, N. J., & Griskevicius, V. (2007). The

constructive, destructive, and reconstructive power of social norms. *Psychological Science, 18*(5), 429-434.

Searles, H. F. (1972). Unconscious processes in relation to the environmental crisis. *Psychoanalytical Review, 59,* 361-374.

Sen, R. (2003). *We the billion: A social psychological perspective on India's population.* Thousand Oaks, CA: Sage Publications.

Shapiro, D. H., Schwartz, C. E., & Astin, I. A. (1996). Controlling ourselves, controlling our world. *American Psychologist, 51*, 1213-1230.

Shinew, K. J., Glover, T. D., & Parry, D. C. (2004). Leisure spaces as potential sites for interracial interaction: Community gardens in urban areas. *Journal of Leisure Research, 36*, 336-355.

Sia, A. P., Hungerford, H. R., & Tomera, A. N. (1985). Selected predictors of responsible environmental behavior: An analysis. *Journal of Environmental Education, 17*(2), 31-40.

Siero, F. W., Bakker, A. B., Dekker, G. B., & Van Den Burg, M. T. C. (1996). Changing organizational energy consumption behaviour through comparative feedback. *Journal of Environmental Psychology, 16*(3), 235-246.

Sinaceur, M., Heath, C., & Cole, S. (2005). Emotional and deliberative reactions to a public crisis: Mad Cow Disease in France. *Psychological Science, 16*(3), 247-254.

Sjoberg, L. (2006). As time goes by: The beginnings of social and behavioral science risk research. *Journal of Risk Research, 9*(6) 601-604.

Sloman, S. A. (1996). The empirical case for two systems of reasoning. *Psychological Bulletin, 119*(1), 3-22.

Slovic, P. (1987). Perception of risk. *Science, 236,* 280-285.

Slovic, P. (2000). *The perception of risk*. London: Earthscan.

Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2006). The affect heuristic. *European Journal of Operational Research, 177*, 1333-1352.

Slovic, P., Finucane, M. L., Peters, E., et al. (2004). Risk as analysis and risk as feelings: Some thoughts about affect, reason, risk and rationality. *Risk Analysis, 24,* 311-322

Slovic, P., Fischhoff, B., & Lichtenstein, S. (1986). The psychometric study of risk perception. In V. T. Covello, J. Menkes, & J. Mumpower (Eds.), *Risk Evaluation and Management* (pp. 3-24). New York: Plenum.

Slovic, P., Flynn, J., & Layman, M. (1991). Perceived risk, trust, and the politics of nuclear waste. *Science, 254*, 1603-1607.

Smillie, I., & Helmich, H. (1999). *Stakeholders: Government-NGO partnerships for international development.* London: Earthscan.

Snyder, C. R. (2002). Hope theory: Rainbows in the mind. *Psychological Inquiry, 13*, 249-275.

Sokolov, A. P., Stone, P. H., Forest, C. E., Prinn, R., Sarofim, M. C., Webseter, M., et al. (in press). Probabilistic forecast for 21st century climate based uncertainties in emissions (without policy) and climate parameters. *Journal of Climate*.

Solomon, S., Plattner, G. K., Knuttic, R., Friedlingstein, P. (2009). Irreversible climate change due to carbon dioxide emissions. *Proceedings of the National Academy of Sciences*, *106*, 1704-1709.

Spence, A., Pidgeon, N., & Uzzell, D. (2009). Climate Change: Sparking off Debate about the Hot Topic. **The Psychologist**, 22(2), 118-121.

Spence, A., Pidgeon, N., & Uzzell, D. (2008). Climate change – psychology's contribution. *The Psychologist*, *21*, 108-11.

Spratt, D., & Sutton, P. (2008). *Climate code red: The case for a sustainable emergency*. Fitzroy,

   Melbourne: Friends of the Earth. Retrieved June 15, 2009, from

   http://www.climatecodered.net/

Staats, H., Harland, P., & Wilke, H. A. M. (2004). Effecting durable change: A team approach to

   improve environmental behavior in the household. *Environment and Behavior, 36*(3),

   341-367.

Stanton, A. L., Revenson, T. A., & Tennen, H. (2007). Health psychology: Psychological

   adjustment to chronic disease. *Annual Review of Psychology, 58*, 565-592.

Steg, L., Dreijerink, L., & Abrahamse, W. (2005). Factors influencing the acceptability of energy

   policies: A test of VBN theory. *Journal of Environmental Psychology, 25*(4), 415-425.

Stein, B. D. & Meyers, D. (1999). Emotional sequelae of disasters: A primary care physician's

   guide. *Journal of the American Medical Women's Association 54,* 60-64.

Stephens, C. E. (2002). *On time: How America has learned to live life by the clock*. Boston:

   Little, Brown, & Company.

Stern, P. C. (1986). Blind spots in policy analysis: What economics doesn't say about energy use.

   Journal of Policy Analysis and Management, 5(2), 200-227.

Stern, P. C. (1997). Toward a working definition of consumption for environmental research and

   policy. In P. C. Stern, T. Dietz, V. R. Ruttan, R. H. Socolow, & J. L. Sweeney (Eds.),

   *Environmentally significant consumption: Research direction*s (pp. 12-35). Washington,

   DC: National Academies Press.

Stern, P. C. (2000). Toward a coherent theory of environmentally significant behavior. *Journal

   of Social Issues, 56*(3), 407-424.

Stern, P. C., Aronson, E., Darley, J. M., Hill, D. H., Hirst, E., & Kempton, W. et al. (1986). The
    effectiveness of incentives for residential energy conservation. *Evaluation Review, 10*(2),
    147-176.

Stern, P. C., Dietz, T., Abel, T., Guagnano, G. A., & Kalof, L. (1999). A value-belief-norm
    theory of support for social movements: The case of environmentalism. *Human Ecology
    Review, 6*, 81-97.

Stern, P. C., Dietz, T., Ruttan, V., Socolow, R. H., and Sweeney, J. (Eds.). (1997).
    Environmentally Significant Consumption: Research Directions. Washington, DC:
    National Academies Press.

Stern, P. C., & Gardner, G. T. (1981). Psychological research and energy policy. *American
    Psychologist, 36*, 329-342.

Stokols, D. (1978). Environmental psychology. *Annual Review of Psychology, 29*, 253-295.

Stokols, D., Clitheroe, H. C. & Zmuidzinas, M. (2000). Modeling and managing change in
    people-environment transactions. In W. B. Walsh, K. H. Craik & R. H. Price (Eds.),
    Person-environment psychology: New directions and perspectives (2nd ed., pp. 267-296).
    Mahwah, NJ: Lawrence Erlbaum.

Stokols, D., Misra, S., Runnerstrom, M. G. & Hipp, A. (2009). Psychology in an age of
    ecological crisis. *American Psychologist, 64*, 181-193.

Takano, T., Nakamura, K., & Watanabe, M. (2002). Urban residential environment and senior
    citizens' longevity in megacity areas. *Journal of Epidemiology and Community Health,
    56*, 913-918.

Tan, T. X., Marfo, K., & Dedrick, R. F. (2007). Special needs adoption from china: Exploring child-level indicators, adoptive family characteristics, and correlates of behavioral adjustment. *Children and Youth Services Review, 29*(10), 1269-1285.

Tangney, J. (2003). Self-relevant emotions. In M. Leary & J. Tangney (Eds.), *Handbook of self and identity* (pp. 384-400). New York: Guilford.

Taylor, K. M., & Shepperd, J. A. (1998). Bracing for the worst: Severity, testing, and feedback timing as moderators of the optimistic bias. *Personality and Social Psychology Bulletin*, *24*, 915-926.

Taylor, S. E. (1983). Adjustment to threatening events: A theory of cognitive adaptation. *American Psychologist*, *38*, 1161-1173.

Taylor, S. E. (2006). *Health psychology* (6th ed.). New York: McGraw-Hill.

Taylor, S. E., & Brown, J. D. (1988). Illusion and well-being: A social psychological perspective on mental health. *Psychological Bulletin, 103*(2), 193-210.

Taylor, S. E. & Stanton, A. L. (2007). Coping resources, coping processes, and mental health. *Annual Review of Clinical Psychology, 3*, 377-401.

Thompson, C. J., & Coskuner-Balli, G. (2007). Enchanting ethical consumerism: The case of community supported agriculture. *Journal of Consumer Culture, 7*(3), 275-303.

Thoolen, B., de Ridder, D., Bensing, J., Gorter, K., & Rutten, G. (2008). Beyond good intentions: The development and evaluation of a proactive self-management course for patients recently diagnosed with type 2 diabetes. *Health Education Research, 23*(1), 53-61.

Tomaka, J., Blascovich, J., Kelsey, R. M., & Leitten, C. L. (1993). Subjective, physiological, and behavioral effects of threat and challenge appraisal. *Journal of Personality and Social Psychology, 65*(2), 248-260.

Townsend, E., Clarke, D. D. & Travis, B. (2004). Effects of context and feelings on perceptions of geneti cally modified food. *Risk Analysis, 24*, 1369-1384.

Trope, Y., & Liberman, N. (2003). Temporal construal. *Psychological Review, 110*, 403-421.

United Nations (1998). *World Population Prospects: The 1996 Revision.* United Nations Secretariat, Department of Economic and Social Affairs, Population Division, New York.

U.S. Census Bureau (2009). World population growth rates. *The international data base*. Retrieved June 30, 2009, from http://www.census.gov/ipc/www/idb/worldgrgraph.php

U.S. Environmental Protection Agency (2009). Climate Change-Greenhouse Gas Emissions. Retrieved April 20, 2009, from http://epa.gov/climatechange/emissions/index.html#ggo

U.S. Home Size. (2007). *Ask the Editors*. Pearson Education, publishing as Infoplease. Retrieved Jun 23, 2009, from http://www.infoplease.com/askeds/us-home-size.html

Uzzell, D. L. (2000). The psycho-spatial dimensions of global environmental problems. *Journal of Environmental Psychology, 20*(4), 307-318.

Uzzell, D. (2004). From local to global: A case of environmental hyperopia. *IHDP Update*, 4, 6-7.

Uzzell, D., Pol, E., & Badenas, D. (2002). Place identification, social cohesion, and environmental sustainability. *Environment and Behavior, 34*, 26-53.

Vandenbergh, M. P. (2005). The private life of public law. *Columbia Law Review, 105*(7), 2029-2096.

Van Lange, Paul A. M., Rusbult, C. E., Semin-Goossens, A., Görts, C. A., & Stalpers, M. (1999). Being better than others but otherwise perfectly normal: Perceptions of uniqueness and similarity in close relationships. *Personal Relationships, 6*(3), 269-289.

Van Lange, P. A. M., & Joireman, J. (2008). How we can promote behavior that serves all of us in the future. *Social Issues and Policy Review, 2,* 127-157.

Vargas, P.T., & Yoon, S. (2006). On the psychology of materialism: Wanting things, having things, and being happy. *Advertising & Society Review, 7*, Article 5. Retrieved May 1, 2009, from http://muse.uq.edu.au/journals/asr/v007/7.1vargas.html

Vasi, I. B. (2009). New heroes, old theories? Toward a sociological perspective on social entrepreneurship. In Ziegler, R. (Ed.), *An introduction to social entrepreneurship* (pp. 155- 173). Cheltenham, UK: Edward Elgar.

Vaughan, E. (1993). Individual and cultural differences in adaptation to environmental risks. *American Psychologist*, *48,* 673-680.

Vess, M., & Arndt, J. (2008). The nature of death and the death of nature: The impact of mortality salience on environmental concern. *Journal of Research in Personality, 42*(5), 1376-1380.

Voorhees, W. R. (2008). New Yorkers respond to the world trade center attack: An anatomy of an emergent volunteer organization. *Journal of Contingencies and Crisis Management, 16*(1), 3-13.

Vyncke, P. (2002). Lifestyle segmentation: From attitudes, interests and opinions, to values, aesthetic styles, life visions and media preferences. *European Journal of Communication, 17*(4), 445-463.

Wall, R., Devine-Wright, P., & Mill, G. A. (2007). Comparing and combining theories to explain proenvironmental intentions: The case of commuting-mode choice. *Environment and Behavior, 39*(6), 731-753.

Wapner, S., & Demick, J. (2002). The increasing contexts of context in the study of environment behavior relations. In R. B. Bechtel, & A. Churchman (Eds.), *Handbook of environmental psychology* (pp. 3-14). Hoboken, NJ: John Wiley & Sons.

Warming to the topic (2009, May). *Natural Hazards Observer, 23*(5), 4.

Waugh, W. L. (2006). Shelter from the storm: Repairing the national emergency management system after Hurricane Katrina [Special Issue]. *The Annals of the American Academy of Political and Social Science, 604*, 288-332.

Weber, E. U. (1997). Perception and expectation of climate change: Precondition for economic and technological adaptation. In M. Bazerman, D. Messick, A. Tenbrunsel, & K. Wade-Benzoni (Eds.), *Psychological Perspectives to Environmental and Ethical Issues in Management* (pp. 314-341). San Francisco: Jossey-Bass.

Weber, E. U. (2006). Evidence-based and description-based perceptions of long-term risk: Why global warming does not scare us (yet). *Climatic Change, 77*, 103-120.

Weber, E. U., Blais, A.-R., & Betz, N. (2002). A domain-specific risk-attitude scale: Measuring risk perceptions and risk behaviors. *Journal of Behavioral Decision Making, 15,* 263-290.

Weber, E. U., Johnson, E. J., Milch, K., Chang, H., Brodscholl, J., & Goldstein, D. (2007). Asymmetric discounting in intertemporal choice: A query theory account. *Psychological Science, 18,* 516-523.

Weber, E. U., Shafir, S., & Blais, A.-R. (2004). Predicting risk-sensitivity in humans and lower animals: Risk as variance or coefficient of variation. *Psychological Review, 111,* 430-445.

Weber, E. U. & Sonka, S. (1994). Production and pricing decisions in cash-crop farming: Effects of decision traits and climate change expectations. In B. H. Jacobsen, D. F. Pedersen, J. Christensen, & S. Rasmussen (Eds.), *Farmers' Decision Making: A Descriptive Approach* (pp. 203-218). Copenhagen, Denmark: European Association of Agricultural Economists.

Weinstein, N. (1989). Effects of personal experience on self-protective behavior. *Psychological Bulletin*, *105*, 31-50.

Weinstein, N. D., Lyon, J. E., Rothman, A. J., & Cuite, C. L. (2000). Preoccupation and affect as predictors of protection action following natural disaster. *British Journal of Health Psychology, 5*, 351-363.

Weinstein, N. D. & Kline, W. (1996). Unrealistic optimism: Present and future. *Journal of Social and Clinical Psychology*, *15*, 1-8.

Weinstein, N. H. (Ed.). (1988). *Taking care: Understanding and encouraging self-protective behaviour.* Cambridge: Cambridge University Press.

Weitzman, M. L. (2007). A review of the stern review on the economics of climate change. *Journal of Economic Literature*, *45,* 686-702.

Wheaton, B. (1996). The domains and boundaries of stress concepts. In H. B. Kaplan (Ed.), *Psychosocial stress: Perspectives on structure, theory, life-course, and methods* (pp. 29-70). San Diego: Academic Press.

Wheaton, B. (1999). The nature of stressors. In A. V. Horwitz, & T. L. Scheid (Eds.), *A handbook for the study of mental health: Social contexts, theories, and systems* (pp. 176-197). New York: Cambridge University Press.

Whipps, H. (2006, September 21). Census: U.S. household size shrinking. *MSNBC*. Retrieved June 23, 2009, from http://www.msnbc.msn.com/id/14942047/

Whitfield, S. C., Rosa, E. A., Dan, A., & Dietz, T. (2008). The future of nuclear power: Value orientations and risk regulation. *Risk Analysis*, *29*, 425-437.

Williams, K. D., Harkins, S. G., & Karau, S. J. (2003). Social performance. In M. A. Hogg & J. Cooper (Eds.). *Handbook of social psychology* (pp. 328-346). London: Sage Publications.

Wilson, E. O. (2002). *The future of life*. New York: Vintage.

Wilson, C., & Dowlatabadi, H. (2007). Models of decision making & residential energy use. *Annual Review of Environment & Resources, 32,* 169-203.

Winett, R. A., Hatcher, J. W., Fort, T. R., Leckliter, I. N., Love, S. Q., Riley, A. W., et al. (1982). The effects of videotape modeling and daily feedback on residential electricity conservation, home temperature and humidity, perceived comfort, and clothing worn: Winter and summer. *Journal of Applied Behavior Analysis, 15*(3), 381-402.

Yamaji, K., Matsuhashi, R., Nagata, & Kaya, Y. (1991). An integrated system for CO2/Energy/GNP analysis: Case studies on economic measures for CO2 reduction in Japan. In *Workshop on CO2 reduction and removal: Measures for the next century.* Laxenburg, Austria: International Institute for Applied Systems Analysis.

Yates, J. F. (Ed.). (1992). *Risk-taking behaviour.* Chicester, UK: Wiley.

Yechiam, E., Barron, G., & Erev, I. (2005). The role of personal experience in contributing to different patterns of response to rare terrorist attacks. *Journal of Conflict Resolution, 49*, 430-439.

Yeoman, B. (2009). Tomorrow's wars. *On Earth, 31*(2), 18-19.

Zhao, X., & Belk, R. W. (2008). Politicizing consumer culture: Advertising's appropriation of political ideology in China's social transition. *Journal of Consumer Research, 3*5, 231-244.

List of Figures

List of Tables

Glossary

Acute (environmental) stress: An immediate state of arousal during which a person feels that he or she does not have the resources available to meet the demands placed upon him or her.

Adaptation (re climate change): Adjustment to climate change, by individuals, human systems (household, community, group, region, sector, country) and/or natural systems, that moderates harm or exploits beneficial opportunity.

Adaptive capacity (re climate change): Having the ability and resources (psychological, social, community, economic, etc.) to adjust to, adapt to, and cope with the impacts of climate change.

Adjustment: Changing one's situation or life circumstances to achieve a desired outcome in relation to one's perception of threats and changing circumstances, particularly through direct action and/or alteration of one's immediate environment. Often adjustment is contrasted with adaptation, with the former emphasizing external changes and the latter emphasizing internal responses.

Anthropogenic: Made by people or resulting from human activities. Usually used in the context of emissions that are produced as a result of human activities.

Attribution theories: Theoretical approaches concerning individuals' explanations for why an event occurred and/or who was responsible for causing it. These theories examine the kinds of information people use to determine causality, the kinds of causes they distinguish, and the rules and psychological processes that lead from information to inferred cause.

Biophilia: "Positive emotion toward, interest in, or a wish to affiliate with living things." The opposite of Biopobia (Clayton & Myers, 2009, p. 207).

Chronic (environmental) stress: A long lasting state of arousal during which a person feels that he or she doesn't have the resources available to meet the demands placed upon him or her.

Climate: The mean and variability of, for instance, temperature, precipitation, cloud cover, and wind or broadly the state of the atmosphere (gaseous envelope surrounding the earth), hydrosphere (water on the surface of the earth), cryosphere (snow, ice, and permafrost on and beneath the surface of the earth and ocean), land surface, and biosphere (ecosystems and organisms living in the atmosphere, land, and oceans).

Climate change: In IPCC usage refers to any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the Framework Convention on Climate Change, where *climate change* refers to a change of climate that is attributed directly or indirectly to human activity that is in addition to natural climate variability observed over comparable time periods.

Collective coping: Social-based coping strategies such as community responses to draughts.

Collective efficacy: A collective's or group's perception of its ability and capacity to meet environmental demands. (JR)

Commons dilemma (aka tragedy of the commons, resource dilemma): One type of social dilemma in which an individual or group overexploits a commonly shared resource.

Connectedness to nature: A sense of an emotional bond with the natural environment.

Conservation psychology: A field of psychology that attempts to apply psychological methods and theories to understand the human relationship to the natural environment and to promote environmentally sustainable behaviour.

Coping: The process of managing specific external (e.g., environmental) pressures and/or internal demands that are appraised as taxing or exceeding the resources of the person.

Coping appraisals: Appraising or evaluating coping responses one might make to the stressor in terms of, for example, self-efficacy, the ability to carry out the coping response, or response-efficacy, the likelihood that the response will have the desired outcome.

Coping responses: Behaviours, cognitions, and regulatory mechanisms that a person uses to respond to a stressor. Coping responses may be aimed at managing and resolving a stressor or at ameliorating its negative emotional or bodily effects, for example by re-appraising the significance or personal relevance of a threat or by confronting the perceived cause of the problem. (JR)

Coping resources: Properties of individuals (e.g., self-efficacy), their social environment (e.g., social support), and physical environmental resources (e.g., privacy affordances) that enable them to respond to stressors.

Deep ecology: "A philosophical position that encourages a sense of identity that transcends the individual and encompasses the ecosystem, striving for a sense of similarity or shared community with the rest of nature" Clayton & Myers, 2009, p. 208).

Descriptive norms: Descriptions of what most people do.

Discourse: Extended discussion of a topic via written or verbal communication.

Discounting: The tendency to reduce the importance of an outcome with greater 'distance' (temporally, socially, geographically, and probabilistically).

Economic consumption: Paying for goods and services.

Ecology: The reciprocal relationship among all organisms and their biological and physical environments. (JR)

Ecological Psychology: "Theory and research about how individual experience (particularly perception) is constituted by intimate and often biologically entrenched relations to constant environmental patterns" (Clayton & Myers, 2009, p. 210).

Ecopsychology: A family of holistic approaches to understanding human-nature relationships and ecological degradation, often applying therapeutic theories and metaphors and using experiential methods. Also, psychotherapy based on a link between mental and ecological well-being.

Environmental consumption: The use of goods and services that directly influence the environment.

Environmental generational amnesia: The gradual loss of knowledge about what should compose a healthy ecosystem, as each generation experiences a new level of environmental degradation as the baseline against which changes are assessed.

Environmental hazards: Extreme events or substances in the earth and its ecological system that may cause adverse effects to humans and things they value. Environmental hazards include geophysical and meteorological phenomena such as earthquakes, droughts, and hurricanes, often called 'natural hazards,' as well as pollution problems and other 'technological' hazards.

Environmental identity: A sense of emotional and conceptual interdependence with nature; a belief that the natural environment is important to one's self-concept.

Environmental risk: "The product of a hazard and the likelihood of its occurring, using a simple formula that defines a risk as the product of the probability an event and its severity measured in terms of the population exposed, and the nature of the consequences" (Liverman, 2001, p. 4656).

Environmental psychology: The study of the transactions between individuals and their physical settings. In these transactions, individuals collectively impact the built and natural environment, and the built and natural environment impacts them. Environmental psychology includes theory, research, and practice aimed at better understanding and improving our relationship with the natural environment.

Environmentally significant behaviour (ESB): Behaviours that change the availability of materials or energy from the environment or alters the structure and dynamics of ecosystems or the biosphere itself. Other behaviours are environmentally significant indirectly, by shaping the context in which choices are made that directly cause environmental change.

Environmental Stress: Adverse individual and community impacts as a result of both acute and chronic environmental stressors including multiple and interacting stressors in the extended environment (e.g., noise, crowding, traffic congestion, pollution, contamination, natural and technological disaster events, and environmental threat.) (JR)

Forcing: Any imposed mechanism that forces climate to change. Natural forcing of climate change results from volcanic eruptions and solar variability; human-made or anthropogenic forcing of climate change comes from behaviours that influence the emissions of greenhouse gases.

Global warming: Literally one of the more salient and consequential impacts and mediating processes of current global climate change, but used by many, particularly in North America, as a synonymous expression for global climate change.

Greenhouse effect: The warming of the planet via the absorption of infrared radiation by the earth's atmosphere. The effect is similar to how a plant warms when it is encased in a house of glass or how a blanket traps body heat. It provides that the average surface temperature of the earth warms to 15 degrees Centigrade (59F). Greenhouse gases absorb thermal radiation emitted from the earth's surface and then reradiate this energy back to the surface of the earth – allowing temperatures to be significantly warmer than they would be in the absence of an atmosphere.

Greenhouse gases: Gases in the atmosphere that cause the Earth to retain thermal energy by absorbing infrared light emitted by Earth's surface. The most important greenhouse gases are water vapour, carbon dioxide, methane, nitrous oxide, and various artificial chemicals such as chlorofluorocarbons. All but the latter are naturally occurring, but human activity over the last several centuries has significantly increased the amounts of carbon dioxide, methane, and nitrous oxide in Earth's atmosphere, causing global warming and global climate change.

Habituation: A decrease in response to repeated stimulation. Response decrements due to altered sensitivity of receptors are often termed receptor adaptation.

Intergovernmental Panel on Climate Change (IPCC): The main international body established in 1988 by the World Meteorological Organization and the United Nations Environment Program to assess climate change science and provide advice to the international community. The IPCC is an international group of scientists who summarize the current understanding of climate change and predict how climate may evolve. The purpose of the IPCC reports is to give policy makers and other interested parties an in-depth, authoritative view of the state of scientific knowledge about climate change, making possible more-informed climate-related decisions. The IPCC does not recommend specific policies, but is restricted to describing scientific knowledge and its limitations.

Mitigation: With regard to climate change, any human action that reduces the sources of or enhances the sinks of greenhouse gases. Emissions can be decreased by a variety of means such as lowering energy demands, making existing energy systems more efficient, increasing the contribution of renewable forms of energy production, and afforestation or stopping deforestation.

Place attachment: Emotional attachment to a place, which may include the extent to which one is dependent on that place to fulfil one's goals.

Place identity: The component of identity that is associated with a particular locale.

Prescriptive norms: A description of behaviours that one should engage in as formulated by one's reference group or the wider society or culture.

Proactive coping: Proactive coping is a form of anticipatory coping in which anticipation and planning play important roles.

Psychological Adaptation: Internal adjustment to environmental changes and disruptions, through the management of individual's cognitive and emotional responses to perceived threats and changing circumstances. In terms of climate change, psychological adaptation can include cognitive reappraisal, the use of protection motivation strategies, and efforts at emotion regulation.

Psychosocial impacts: The consequences of an introduced intervention or natural change in the environment. Psychosocial impacts occur at the level of individual or shared experience (e.g., households or community) and entail consequences such as distress or anxiety, heightened environmental concerns, and optimism or pessimism about the future.

Reactance: "Resistance to obvious attempts at behavioural control, usually by doing the reverse of the behaviour that is desired" (Clayton & Myers, 2009, p. 211).

Resilience (Psychological): Individual, collective, or group patterns of successful adaptation (in the context of significant risk or adversity.) Enduring the temporary upheaval of loss or potentially traumatic events remarkably well, with no apparent disruption in ability to function, and moving on to new challenges with apparent ease. Resilience typically arises from the operation of common human adaptation systems rather than from rare or extraordinary processes.

Resilience (Climate change, disaster context): The ability of a system to respond and recover from disasters. It includes inherent conditions that allow the system to absorb impacts, cope with an event, re-organize and change in response to a threat.

Restorative environments: Environments whose qualities reduce stress and restore cognitive abilities. Natural environments have been shown to be particularly effective at this.

Risk: A situation or event in which something of human value (including humans themselves) has been put at stake and where the outcome is uncertain.

Risk appraisal: Individual or public subjective evaluations of the magnitude, probability, or personal vulnerability to a perceived risk.

Risk assessment: A more formal and objective assessment of risk by experts, against established criteria, to an environment, environmental attribute, or community or group of people (e.g., Gifford, 2007; O'Riordan, 1995). (JR)

Risk perception: Subjective belief (whether rational or irrational) held by an individual, group, or society about the chance of occurrence of a risk or about the extent, timing, or consequences of its effect(s).

Social adaptation: Continually adjusting group or community level responses to concerns and perceptions of threats and changing circumstances. Examples include group level sense-making, adjusting explanations, responsibility attributions, meta-narratives, shared accounts and social constructions of climate change as a risk domain.

Social amplification of risk: The intensification of perceptions of risk and its management via communication processes including the way that risk signals (images, signs, symbols) are disseminated via psychological, social, institutional, or cultural processes. The theoretical starting point is that the assumption that 'risk events' which might include actual or hypothesised accidents and incidents (or even news reports on existing risks), will be largely irrelevant or localised in their impact unless human beings observe and communicate them to others.

Social dilemma: A situation in which the pursuit of individual's goals conflict with collective goals.

Social representation: "Systems of values, ideas and practices" that "enable individuals to orientate themselves in their material and social world and to master it" and "enable communication to take place amongst members of a community by providing them with a code for social exchange and a code for naming and classifying unambiguously the various aspects of their world and their individual and group history." Social representations are built on shared knowledge and understanding of common reality. In the context of climate change, social representations include media coverage, articles, books, magazines, documentary and popular culture films, research findings, collective knowledge, and public discourse about climate change and its nature, causes and consequences.

Stressor: "Conditions of threat, demands, or structural constraints that, by the very fact of their occurrence of existence, call into question the operating integrity of the organism" (Wheaton, 1996, p. 32).

Sustainable development: Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Symbolic coping: The process of appropriating the novel and unfamiliar in order to make it intelligible and communicable. This includes sense-making such as naming the novel and attributing characteristics which allow the phenomenon to be talked about. In this understanding symbolic coping is the collective activity of a group struggling to maintain the integrity of its worldview which is also crucial for social identity.

Threat appraisal: Evaluating the extent to which an upcoming situation exceeds the perceptions of abilities or resources needed to cope. Threat appraisals differ from challenge appraisals where one anticipates that one has sufficient abilities and resources needed to cope and differs from harm/loss appraisals that occur after an event occurs.

United Nations Framework Convention on Climate Change: An international environmental treaty set out to reduce emissions of greenhouse gases in order to combat global climate change. It was agreed upon at the Earth Summit, staged in Rio de Janeiro, Brazil, in June 1992.

Vulnerability (Climate change): The extent to which systems and individuals are susceptible to, and unable to cope with, adverse effects of climate change. Vulnerability is a function of the characteristics of climate change impacts (e.g., its magnitude and rate of change) and variation in systems and individuals (e.g., degree of exposure to climate change impacts, individual and community adaptive capacity, and connectedness to communities).

Worldview: "An integrated set of beliefs about what is real, what is knowable, what is valuable, and what it means to be human, typically learned as part of a cultural socialization" (Clayton & Myers, 2009, p. 212).

References Used to Construct Definitions

Baird, A. (2010). *Think psychology*. Upper Saddle River, NJ: Prentice Hall.

Baum, A., & Fleming, I. (1993). Implications of psychological research on stress and

     technological accidents. *American Psychologist*, *48*, 665-672.

Benight, C. C. (2004). Collective efficacy following a series of natural disasters. *Anxiety, Stress,*

     and Coping, *17*, 401-420.

Bonanno, G. A. (2004). Loss, trauma, and human resilience: Have we underestimated the human

     capacity to thrive after extremely aversive events? *American Psychologist*, *59*, 20-28.

Brook, A., Clayton, S., Myers, G., Reser, J. et al., (2007, September 11). The power of voluntary

     actions. *Gristmill*.

Burdge, R. J., & Vanclay, F. (1995). Social impact assessment. In F. Vanclay & R. J. Burdge

     (Eds), *Environmental and social impact assessment* (pp. 31–65). Brisbane: John Wiley.

Chapman, M. (2008) Mitigation strategies. In B. Lerner & K. Lerner (Eds.), *Climate change in*

     context (pp. 657-659). Detroit, MI: Gale.

Cohen, S., Evans, G. W., Stokols, D. & Krantz, D. S. (1986). *Behavior, health and*

     environmental stress. New York: Plenum.

Cohen, S. (1980). Aftereffects of stress on human performance and social behavior: A review of research and theory. *Psychological Bulletin*, *88*, 82-108.

Cutter, S. L., Barnes, L., Berry, M., Burton, C., Evans, E., Tate, E., & Webb, J. (2008). A place-based model for understanding community resilience to natural disasters. *Global Environmental Change*, *18*, 598-606.

Cutter, S. L., & Mitchell, J. T. (2001). Environmental adaptation and adjustment. In N.J. Smelser & P.B. Baltes (Eds.), *International encyclopedia of the social and behavioural sciences* (pp. 4576-4580). Oxford: Elsevier.

Dunlap, R. E., & Rosa, E. A. (2001). Environmental sociology. In E. F. Borgatta & R .J. V. Montgomery (Eds.), *Encyclopedia of sociology* (Vol. 2, pp. 800-813). New York: Macmillan.

Gardner, G. Y., & Stern, P. C. (2008). The short list: The most effective actions U.S. Households can take to curb climate change. *Environment, 50*, 13-24.

Gifford, R. (2007). *Environmental psychology: Principles and practice* (4th ed.). Coleville, WA: Optimal Books.

Gilmore, L. (2008). IPCC Climate Change 2007 Report: Impacts, adaptation and vulnerability. In B. Lerner & K. Lerner (Eds.), *Climate change in context* (pp. 574-579). Detroit, MI: Gale.

Gilmore, L. (2008). Adaptation. In B. Lerner & K. Lerner (Eds.), *Climate change in context* (pp. 9-15). Detroit, MI: Gale.

Hallman, W. K. & Wandersman, A. (1992). Attribution of responsibility and individual and collective coping with environmental threats. *Journal of Social Issues*, *48*, 101-118.

Hewstone, M. (1989). Causal attribution: From cognitive processes to collective beliefs. Oxford, UK: Basil Blackwell.

Intergovernmental Panel on Climate Change [IPCC] (2007). Glossary of Terms used in the IPCC Fourth Assessment Report: Working Group II (WG2). Retrieved June 15, 2009, from http://www.ipcc.ch/glossary/

Kasperson, J. X, Kasperson, R. E., Pidgeon, N., & Slovic, P. (2003). The social amplification of risk: Assessing fifteen years of research and theory. In N. Pidgeon, R. E. Kasperson, & P. Slovic (Eds.), *The social amplification of risk* (pp. 13-46). Cambridge, UK: Cambridge University Press.

LePore, S. J., & Evans, G. W. (1996). Coping with multiple stressors in the environment. In M. Zeidner & N. S. Endler (Eds.), *Handbook of coping: Theory, research, applications*. (pp. 350-377). New York: Wiley.

Liverman, D. (2001). Environmental risk and hazards. In N. J. Smelser & P. B. Baltes (Eds.), *International encyclopedia of the social and behavioural sciences* (pp. 4655-4659). Oxford: Elsevier.

Moscovici, S. (1973). Foreword. In C. Herzlich (Ed.), *Health and illness: A social psychological analysis* (pp. ix–xiv). London/New York: Academic Press.

Parry, M., Canziani, O., Palutikof, J., van der Linden, P. & Hanson, C. (Eds.). (2007). *Climate change 2007: Impacts, adaptation and vulnerability*. Cambridge, UK: Cambridge University Press.

Philogene, G. & Deaux, K. (2001). Introduction. In K. Deaux & G. Philogene (Eds.), *Representations of the social* (pp. 3-7). Oxford, UK: Blackwell.

Reilly, W. M. (2008). United Nations framework convention on climate change (UNFCCC). In B. Lerner & K. Lerner (Eds.), *Climate change in context* (pp. 870-873). Detroit, MI: Gale.

Reser, J. P., & Bentrupperbäumer, J. M. (2005). The psychosocial impacts of visitation and use in World Heritage Areas: Researching and monitoring sustainable environments and encounters. In W. L. Filho (Ed.), *Handbook of sustainability research* (pp. 235-263). New York: Peter Lang Scientific Publishers.

Reser, J. P., & Bentrupperbäumer, J. M. (2001). Reframing the nature and scope of social impact assessment: A modest proposal relating to psychological and social (psychosocial) impacts. In A. Dale, N. Taylor, & M. Lane (Eds.), *Social assessment in natural resource management institutions* (pp. 106-122). Collingwood, Victoria: CSIRO Publications.

Skinner, E. A. (2001). Coping across the lifespan. In N.J. Smelser & P.B. Baltes (Eds.), *International encyclopedia of the social and behavioural sciences* (pp. 2761-2766). Oxford: Elsevier.

Stern, P. C. (2000). Toward a coherent theory of environmentally significant behaviour. *Journal of Social Issues*, *56*, 407-424.

Tomaka, J., Blascovich, J., Kelsey, R. M., & Leitten, C. L. (1993). Subjective, physiological, and behavioral effects of threat and challenge appraisal. *Journal of Personality and Social Psychology, 65*(2), 248-260.

Wagner, W., & Hayes, N. (2005). E*veryday discourse and common sense: The theory of social representations*. Houndsmills, UK: Palgrave Macmillan.

Werner, W., & Kronberger, N. (2001). Killer tomatoes! Collective symbolic coping with

biotechnology. In K. Deaux & G. Philogene (Eds.), *Representations of the social* (pp.

147-164). Oxford, UK: Blackwell.

Wheaton, B. (1996). The domains and boundaries of stress concepts. In H. B. Kaplan (Ed.),

Psychosocial stress: Perspectives on structure, theory, life-course, and methods (pp. 29-

70). San Diego: Academic Press.

World Commission on Environment and Development. (1987). *Our common future* [Known as

'The Brundtland Report']. Oxford: Oxford University Press.

[end of glossary]