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Who remembers a hot summer or a cold winter? The asymmetric effect of beliefs about global warming on perceptions of local climate conditions in the U.S.

Peter D. Howe [a,b,*], Anthony Leiserowitz [b]

[a] Department of Environment and Society, Quinney College of Natural Resources, Utah State University, 5215 Old Main Hill, Logan, UT 84322, USA
[b] School of Forestry and Environmental Studies, Yale University, 195 Prospect Street, New Haven, CT 06405, USA

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ABSTRACT

This paper explores the phenomenon of local climate perception and the extent to which public perceptions match climate conditions as recorded in instrumental climate data. We further examine whether perceptions of changes in local climates are influenced by prior beliefs about global warming, through the process of motivated reasoning. Using national survey data collected in the United States in 2011, we find that subjective experiences of seasonal average temperature and precipitation during the previous winter and summer were related to recorded conditions during each season. Beliefs about global warming also had significant effects on subjective experiences with above-normal temperatures, particularly among those who believed that global warming is not happening. When asked about the summer of 2010, those who believed that global warming is not happening were significantly less likely to report that they had experienced a warmer-than-normal summer, even when controlling for demographics and local climate conditions. These results suggest that the subjective experience of local climate change is dependent not only on external climate conditions, but also on individual beliefs, with perceptions apparently biased by prior beliefs about global warming.

1. Introduction

Thus far, global warming has manifested gradually over many decades and at spatial scales well beyond the direct perceptual capabilities of any individual human being (e.g. the global or continental scale). Local weather conditions, on the other hand, are a readily available source of information that, when aggregated over time, may enable people to detect long-term climate trends at the local scale (Howe et al., 2013; Orlove et al., 2010). The translation of personal experience of changes in local weather conditions to perceptions of climate variability and change is an important component of individual and community adaptation (Adger et al., 2007). Research on local climate knowledge has found that people are able to detect and respond to changes in climate (Strauss and Orlove, 2003), but the characteristics of local manifestations of climate change that are perceived have been hypothesized to be dependent on a variety of individual and contextual factors. These factors include the importance of specific climatic conditions to individual livelihoods (Meze-Hausken, 2004; Osbahr et al., 2011; Roncoli et al., 2002), the spatial scale of changes (Howe et al., 2013; Ruddell et al., 2012), and the reference periods over which individuals establish representations of a normal climate (Hulme et al., 2009; Sánchez-Cortés and Chavero, 2011). Perceptions of change in local climate, as with other individual judgments, may be subject to systematic cognitive biases that favor experiential over descriptive learning (Marx et al., 2007). However, there has been little attention to the possibility of biased perceptions of climate change at the local scale due to pre-existing beliefs about climate change at the global scale. The existence of strongly held beliefs about the direction of change in the global climate may bias judgments about local climate in the direction predicted by one's prior beliefs about the global climate. Such biases in local climate perceptions, if present, may act as a barrier to accurate detection of local climate change and an impediment to effective climate change adaptation.

Recent research has shown that perceived personal experience with global warming leads to heightened global warming risk perceptions and greater certainty in the belief that global warming is happening (Akerlof et al., 2013; Myers et al., 2012; Spence et al., 2011). More specifically, perceived experience appears to lead to greater certainty that global warming is happening only among those who have weakly held beliefs about global warming, while motivated reasoning affects perceived personal experience among

* Corresponding author at: Department of Environment and Society, Quinney College of Natural Resources, Utah State University, 5215 Old Main Hill, Logan, UT 84322, USA. Tel.: +1 4357979457.
E-mail addresses: peter.howe@usu.edu (P.D. Howe), anthony.leiserowitz@yale.edu (A. Leiserowitz).

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those who have strongly held beliefs about global warming (Myers et al., 2012). Motivated reasoning is the tendency to interpret information to fit pre-existing beliefs (Kunda, 1990). In this paper, we extend previous findings by exploring the effect of motivated reasoning on perceptions of local seasonal climate while controlling for actual local climate conditions. Drawing from a nationally representative survey of the U.S. population, we first characterize the relationship between instrumental climate data and perceptions of local seasonal climate. We subsequently examine the relationship between sets of beliefs about global warming and perceptions of local climate conditions.

The relationship between personal experience and beliefs about global warming is of considerable interest as changes in local weather and climate conditions continue to be consistent with scientific projections of global warming. For example, between January 2000 and September 2009 maximum temperature records were broken more than twice as frequently as minimum temperature records in the contiguous U.S. (Meehl et al., 2009), and extreme events such as the 2011 Texas heat wave and drought have become much more likely (Peterson et al., 2012). While direct attribution of any single weather event to long-term processes like global warming is not possible, the accumulation of weather events that fall outside the range of previous experience does provide evidence that the climate is changing, since local extreme events become more likely as the world warms (Hansen et al., 2012; Meehl and Tebaldi, 2004; Rahmstorf and Coumou, 2011). But can individuals, drawing upon their personal experience, accurately detect the extent to which recent conditions have changed relative to the past? It is therefore important to understand how people subjectively experience their local climate, and what factors influence their judgments about whether local climates are changing. Previous broad-scale survey research suggests that changes in local climate conditions can influence public perceptions of local warming trends (Howe et al., 2013). While there is some evidence that recent experience with short-term ambient temperatures may influence global warming beliefs (Akerlof et al., 2013; Borick and Rabe, 2010; Egan and Mullin, 2012; Goebbert et al., 2012; Hamilton and Stampone, 2013; Joireman et al., 2010; Li et al., 2011; Risen and Critcher, 2011), there has been little attention to the possibility that subjective experiences of local climate may also be influenced by pre-existing beliefs and attitudes about global warming, which could affect the ability to recognize local climate change.

2. Background

Research in communities around the world has documented many cases of people using personal experience to detect changes in their local climate; such changes include altered plant and animal phenology, new distributions of species, shorter or longer growing seasons, and the changing frequency of extreme weather events (Deressa et al., 2011; Orlove et al., 2000; Roncoli et al., 2002; Smit et al., 1997; Thomas et al., 2007; Tschakert et al., 2010; Weatherhead et al., 2010; West et al., 2008). Such research has almost exclusively been carried out at the local scale using case studies of one or a small number of communities. The communities in these studies tend to be rural, with most residents engaged in livelihoods based on agriculture, ranching, or fishing. Because their livelihoods are dependent on the weather, residents have a strong incentive to pay attention to the variability of local weather and climate, and indeed they tend to notice changes. The changes that people notice tend to be closely related to the aspects of the weather that have the most direct effect on the livelihoods in which they engage, to such an extent that residents of the same community may identify different changes depending on their occupation (Hartter et al., 2012; Meze-Hausken, 2004; Osbahr et al., 2011).

Less clear is how individuals whose lives are not as directly dependent on the weather might perceive local climate changes, and if other individual factors might influence their perception of climate. Relatively few people in the U.S. are employed in a profession that is as dependent on the vagaries of day-to-day weather as, for example, a farmer who relies on rain-fed agriculture (Meyer, 2000). Furthermore, the populations of industrialized countries like the U.S. have adopted indoor climate control technologies that insulate them in a thermal environment disconnected from their local climate for much of the day (Hitchings, 2011). These characteristics of the U.S. population may be barriers to the public perceiving long-term changes in their local climate. Despite findings from national surveys in the U.S. that majorities of the population believe that global warming is affecting local weather and making extreme weather events worse, it is not clear if the experience of such events is a causal factor in belief change (Leiserowitz et al., 2013, 2012). Existing research is mixed about the effect of short-term extreme events on beliefs and behaviors related to climate change. For instance, there is contradictory evidence that direct experience of flooding among U.K. residents relates to concern about climate change (Spence et al., 2011; Whitmarsh, 2008).

This analysis examines one facet of local climate perceptions: judgments about whether seasonal temperature or precipitation has differed from normal. Identifying abnormalities in seasonal climate involves comparing current experience to memories of past experience (Weber, 2010). If memories of past experience are uninformative or inaccurate, it is possible that current conditions may be falsely judged to be normal or abnormal, depending on the direction in which memories of past experience have been distorted (Rebetez, 1996). For example, an individual may assume a July heat wave to be normal for that time of year if she remembers previous years with hot summers, whether or not those memories are accurate representations of her experience. Thus, for personal experience with short-term climate conditions to be an effective source of information about long-term local climate change, individuals must be able to perform two processes: perceive current weather conditions, and compare their perceptions to their expectations of what is "normal." Expectations may be based on memories of personal experience or descriptive information from external sources. If perceptions of current conditions in relation to expectations are accurate, then personal experience may be able to serve as a useful source of information to motivate and guide adaptation to the specific climatic changes happening in local places.

There are, however, multiple ways by which climate perceptions and expectations can be distorted. When asked to make a rapid assessment of a complex phenomenon like the climate, people may rely on intuitive processes, which may create systematic biases in how people perceive seasonal climate. Cognitive biases such as the tendency to overweight recent experience in memory (known as the recency effect) and the tendency to disregard the prior probabilities of events (known as base rate neglect) may lead people to believe that the recent weather that they have experienced is more representative of a longer-term period than it really is. Base-rate neglect explains why people may fail to account for prior probabilities when evaluating conditional probabilities (Koehler, 1996), and may lead people to assign an inordinate weight to unusual recent weather events when evaluating the probability of long-term climate change. Indeed, some existing evidence suggests that recency effects are indeed present in farmer decision-making with respect to climate information (Hansen et al., 2004).

Another potential source of error in judgments about seasonal climate may result from motivated reasoning. Motivated reasoning is the unconscious tendency to fit information to conclusions that