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Politics eclipses climate extremes for climate change perceptions

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ABSTRACT

Whether or not actual shifts in climate influence public perceptions of climate change remains an open question, one with important implications for societal response to climate change. We use the most comprehensive public opinion survey data on climate change available for the US to examine effects of annual and seasonal climate variation. Our results show that political orientation has the most important effect in shaping public perceptions about the timing and seriousness of climate change. Objective climatic conditions do not influence Americans' perceptions of the timing of climate change and only have a negligible effect on perceptions about the seriousness of climate change. These results suggest that further changes in climatic conditions are unlikely to produce noticeable shifts in Americans' climate change perceptions.

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1. Introduction

Climate change remains a politically contentious issue in the United States (McCright and Dunlap, 2010; Oreskes and Conway, 2010). Ample research shows the strong influence of political orientation (i.e., political ideology and party identification) on perceptions about the reality, causes, and seriousness of climate change (Dietz et al., 2007; Hamilton, 2011; Marquart-Pyatt et al., 2011; McCright and Dunlap, 2011a,b; O'Connor et al., 2002). At the same time, recent years have witnessed a number of weather and climate events and extremes including flooding, hurricanes, tornadoes, record-breaking snowfalls, record-setting drought, and above normal temperatures in places across the contiguous U.S. Regional patterns reveal annual fluctuations in the temporal frequency and spatial distribution of these events and extremes (Rahmstorf and Coumou, 2011; Trenberth and Fasullo, 2012).

If public perceptions are driven entirely by political and related social dynamics, then mobilizing the political will necessary for taking policy action to reduce greenhouse gas emissions seems unlikely in the near future. But if public perceptions are also influenced by actual changes in the climate such as extreme weather or climate events, then changing climatic conditions attributed to climate change may overcome ideological and partisan blinders. That is, personal experience with the impacts of climate change may help override political and social barriers to action and facilitate an effective response to this serious global problem.

Recent work has shifted from speculating about a link between climatic conditions and weather events and public perceptions of climate change (The Earth Institute at Columbia University, 2011; The Economist, 2010; Shwartz, 2010) to empirical investigations of this potentially multi-faceted link. The relevant empirical research is inconclusive, however. Some results suggest that near-term weather or longer-term climate patterns influence climate change perceptions (Deryugina, 2013; Egan and Mullin, 2012; Hamilton and Keim, 2009; Hamilton and Stampone, 2013; Howe et al., 2013; Scruggs and Benegal, 2012; Shao et al., 2014; Zahran et al., 2006), while others do not (Brody et al., 2008; Brulle et al., 2012; Goebbert et al., 2012; Shum, 2012). Most of these studies only use temperature data and are thus unable to determine if broader climatic patterns influence climate change perceptions. Also, there is little agreement across these studies on how to construct a temperature trend indicator, and many of the indicators used are not informed by best practices in climatology. In addition, only a few of these studies use multilevel modeling. Properly combining individual-level geo-coded data with spatial data to precisely

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specify regional variation and examine effects across levels (i.e., individual-level effects and regional-level effects) is essential for accurately assessing the effects of climate on individual perceptions. Finally, a few of these studies fail to control for the most powerful individual-level predictors of climate change perception among Americans: political ideology and party identification. Indeed, consistent with the patterns found in the United States, political ideology and party identification are often significant predictors of climate change perceptions elsewhere: including in Australia (Tranter, 2011), Canada (Borick et al., 2011), the United Kingdom (Poortinga et al., 2011; Whitmarsh, 2011), and a wide range of other countries (Kvaløy et al., 2012, Tjernström and Tietenberg, 2008).

We offer the most thorough and rigorous test to date of the hypothesis that changing climatic conditions influence climate change perceptions, controlling for other factors known to shape such perceptions. Short-term weather fluctuations and extreme weather events may garner a flurry of media attention and may open windows of opportunity for policy action, but an effective policy response in the face of intense opposition from vested interests will require large-scale shifts in public opinion to align with scientific understanding of climate change (Dunlap and McCright, 2011; McCright et al., 2013). To assess the likelihood that this will occur as a result of climatic change itself requires answering two additional, unresolved questions.

First, what climate signals, if any, influence the public's perceptions of climate change? People may be attentive to annual patterns or to seasonal patterns like hot summers or warm winters. Previous research examining the influence of longer-term climatic trends (rather than short-term weather) has used indicators based on several different time frames (Goebbert et al., 2012; Hamilton and Keim, 2009; Howe et al., 2013; Shao et al., 2014). Here we systematically examine three ways of identifying climatic variability: annual averages; folk seasons defined by winter, spring, summer, and fall; and climate seasons defined by climatologists for North America as cold season, hot season, and hurricane season (see details in Section 3). *Second, how does the influence of changing climatic conditions vary with political orientation, controlling for other individual characteristics?* Prior research shows political orientation to be the dominant factor in climate change perceptions in the United States (Hamilton, 2011; McCright and Dunlap, 2011b; McCright et al., 2013). In particular there is some evidence that the effects of weather/climatic conditions on climate change perceptions differ across political orientations (Deryugina, 2013; Egan and Mullin, 2012; Hamilton and Stampone, 2013). If this effect is not incorporated into models of public perceptions, then strong effects for some groups may be masked by weak or opposite effects for others.

Our work addresses these questions by merging the best available social science time series data on climate change public opinion with the best climatic data for the same time frame. The annual U.S. Gallup Environment Polls for 2001–2011 are based on representative samples of the U.S. population and have a combined sample size of more than 10,000 (excluding cases with missing data). We merge this survey data with the Climate Extremes Index (CEI) of the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (Gleason et al., 2008), the most comprehensive measure of climate variability for the U.S. The CEI uses regionally based, objective measures of climate extremes developed by NOAA to account for comprehensive changes in climatic conditions within each of NOAA's nine climate regions.

2. Relevant studies

The existing literature exploring the relation between weather conditions and climate patterns and climate change perceptions can be characterized as largely pre-theoretical, conceptually and methodologically disparate, and thus inconsistent in findings. While several theories have been employed when examining the socio-demographic and political predictors of climate change views, no studies provide a compelling theoretical argument for why we would expect an impact of actual (or perceived) weather/climatic conditions on climate change perceptions (for a possible exception, see Li et al., 2011). As discussed shortly, studies in this literature vary widely in their overall approach, analytical techniques employed, geographical units observed, indicators of weather/climate phenomena utilized, and climate change perceptions examined. As this is an emerging literature, we have constructed our review to be as comprehensive as possible—including the full range of studies that claim to be contributing to our understanding of weather/climate effects on climate change perceptions. Our hope is that such an inclusive review, which identifies the different ways that the influence of weather/climate on climate change perceptions has been examined, may encourage future research to be more integrative and cumulative than has been the case in the past.

We have organized this literature into four groups of empirical studies based on their overall approach to examining the relationship between weather/climate phenomena and climate change perceptions. While there are notable differences among the studies within each group, the within-group differences are smaller and less meaningful than are differences across groups. Consequently, we treat the results emerging from these four groups of studies as distinct and separate. In each subsequent section, we first characterize the group of studies and briefly summarize the major findings before discussing the results of individual studies in turn. Given that the number of similarly designed empirical studies is quite small, we caution readers against assuming a robustness of findings that has not yet emerged.

2.1. Perceptions and self-reported experiences

The first group of studies uses survey items on *perceptions* of short-term temperature changes (Capstick and Pidgeon, 2014; Krosnick et al., 2006; Semenza et al., 2008), *self-reported experiences* with climate-related phenomena like air pollution and flooding (Spence et al., 2011; Whitmarsh, 2008), or self-reported personal experience with global warming (Akerlof et al., 2013) and links those to beliefs about climate change. Overall, these studies demonstrate that perceived indicators of short-term weather/climate phenomena are only modestly related to climate change perceptions. However, several of these studies have limited generalizability, with samples only of specific cities (Semenza et al., 2008) or counties (Akerlof et al., 2013; Whitmarsh, 2008). While this group of studies does attend to perceptions and self-reported experiences (both of which are mainstays of social science research), the studies nevertheless leave open the question of how *actual* short-term and/or long-term changes in weather and climate patterns influence individuals' climate change perceptions.

People who perceive an increase in local temperatures in recent years are more likely to believe that global warming exists (Krosnick et al., 2006), but those self-reporting having experienced global warming do not perceive a greater local risk from global warming (Akerlof et al., 2013). In a study that examined data from two cities, those who perceive greater heat on the previous day express greater concern about climate change in the Southern city but not in one in the Pacific Northwest (Semenza et al., 2008). In a survey of a nationally representative sample in the United Kingdom, three times as many people report that the pattern of recent cold winters is evidence for rather than against the existence of climate change (Capstick and Pidgeon, 2014).

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