Cold Winters Warming? Perceptions of Climate Change in the North Country

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ABSTRACT

Public acceptance of the reality of human-caused climate change has risen gradually in the United States, reflecting cumulative impacts from scientific research and communication, and perhaps also from experienced manifestations such as extreme weather or change to familiar seasons. In the rural North Country of northern New England, a key manifestation of climate change has been warming winters. A 2017 survey asked North Country residents whether they thought that recent winters have been warmer compared with earlier decades. Winter warming, which in this historically snowy region has broad impacts ranging from the economy to everyday life, was recognized by a majority of residents young and old, male and female, with little or much education—but not by the most conservative. Although our winter question does not mention climate change, responses followed patterns similar to a subsequent question about human-caused climate change. Moreover, the partisan gradient in response to both winter and climate questions is steepest among people reporting that most of their friends belong to the same political party. Partisan constraints on perception of a mundane physical reality could limit the scope for weather or climate experiences to alter beliefs among those whose political/social identity favors climate-change rejection.

1. Introduction

Physical manifestations of anthropogenic climate change are abundantly clear to scientists across many disciplines, informing their near-unanimous agreement on its reality (Cook et al. 2016; USGCRP 2017). Agreement among the U.S. public, on the other hand, is generally lower and tied to political identity. Public acceptance of anthropogenic climate change has, nevertheless, risen gradually from percentages in the low 50s in 2010 to the mid-60s by 2016 (Hamilton 2016). Scientific reports and communication undoubtedly contribute to this rise. Experiencing physical manifestations of climate change might contribute
to public acceptance as well. Evidence for lasting impacts of physical events on public beliefs about climate change has been mixed, however, and complicated by political effects.

Climate-change opinions show at least transient impacts from environmental factors such as weather trends (Hamilton and Keim 2009; Kaufmann et al. 2017; Shao et al. 2014, 2016), daily weather or ambient conditions (Broomell et al. 2017; Hamilton and Lemcke-Stampone 2014; Joireman et al. 2010; Ripberger et al. 2017; Risen and Critcher 2011; Zaval et al. 2014), and extreme events (Cutler 2015, 2016; Shao 2016) around the respondent’s location. Weather may particularly impress individuals who hold less committed political or climate-change beliefs (Egan and Mullin 2012; Hamilton and Lemcke-Stampon 2013; Myers et al. 2013). Researchers have explored a variety of different weather, climate, or environmental indicators as possible predictors of views on local or global change. With some indicators and datasets, they detect no significant climate or environmental effects, or find them to be weak.

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compared with political effects (Brulle et al. 2012; Carlton et al. 2016; Carmichael et al. 2017; McCright et al. 2014; Marlon et al. 2018; Marquart-Pyatt et al. 2014).

Much of this work employs objective indicators of weather or climate, derived from sources such as weather records, news accounts, or disaster expenditures. Subjective recollections regarding weather or climate correlate with climate-change beliefs as well (Akerlof et al. 2013; Borick and Rabe 2010; Capstick and Pidgeon 2014; Krosnick et al. 2006; Lee et al. 2015; Li et al. 2011; Weber 2010). This is consistent with weather perceptions affecting beliefs but also with the reverse: through motivated reasoning or following cues from media and political leaders, general climate-change beliefs can shape people’s perceptions of actual weather (Borick and Rabe 2017; Howe and Leiserowitz 2013; Myers et al. 2013; Shao 2016). The clearest evidence for beliefs constraining weather/climate perceptions comes from studies where political identity or climate beliefs predict individuals’ accuracy in characterizing known local trends in temperature or disasters (Hamilton et al. 2016a,b), and even their recollections of record-breaking weather that occurred a few weeks earlier (Hamilton and Lemcke-Stampone 2016). This pattern is ideologically asymmetric: conservatives and individuals who reject the reality of anthropogenic climate change are more inclined to report past weather that seems consistent with their position, whether accurately or not (Borick and Rabe 2017; Hamilton and Lemcke-Stampone 2016; Hamilton et al. 2016a,b; Howe and Leiserowitz 2013).

Gradual shifts in average temperature marking climate change, a few degrees over decades, are much smaller in magnitude than daily or seasonal variations. Many people might not personally notice the warming, if temperatures were the only change. Warming can bring along more obvious local changes, however, such as shortened seasons in a ski town, or earlier ice-out on a frozen lake. The timing of impactful transitions between water and snow or ice, in particular, provides mundane signals of change that should be noticeable regardless of political orientation.

This paper tests political identity along with other individual characteristics as predictors of weather/climate perceptions in a historically snowy rural region. In summer 2017, Carsey School researchers conducted a random-sample telephone survey of 1650 residents in the rural North Country of northern New England. Mainly covering nonclimate topics, the survey also carried a question asking respondents whether they thought that recent winters there had been warm compared with earlier decades. Objectively, winter warming over this period had been substantial, with broad consequences (Wake et al. 2014). Analysis of the North Country survey adds a new case study that extends previous work on how political identity affects individuals’ accuracy in characterizing a known local trend.

2. The North Country of northern New England

New England’s rural North Country (northern New Hampshire, northeast Vermont, and northwest Maine) differs from the more populous and economically diverse parts of New England. Geographic remoteness, rugged topography, and historically harsh winters have limited the appeal of this region as a place to live for many, but the vast forests and powerful rivers offered low-skill manufacturing job opportunities in forest products industries, particularly pulp and paper. Hit hard over the past several decades by the national decline in natural-resource and manufacturing jobs, North Country communities of northern New Hampshire and bordering areas of Maine and Vermont faced challenges in restructuring their economies (Baily and Bosworth 2014; Glasmeier and Salant 2006).

Figure 1 maps the four adjacent North Country counties surveyed in summer 2017: Coös and Grafton in New Hampshire, Oxford in Maine, and Essex in Vermont. A 2008 study classified Coös and Oxford counties as “amenity/decline” areas, a common pattern in rural America where historically resource-dependent places experience decline in their traditional industries, even while natural amenities present new opportunities for growth related to tourism or amenity-based in-migration (Hamilton et al. 2008). Complicating the transition for many places, there often is outmigration by young adults seeking jobs and financial stability elsewhere, as new businesses in rural areas tend toward seasonal employment or require different kinds of skills. Essex County, not part of the 2008 study, fits this amenity/decline description as well. Grafton County shares their mountainous landscapes and northern climate, but its more diverse economy includes substantial tourism, education, high-tech, and health-sector employment, placing it farther along the transition.

a. North Country winters

With the decline in traditional natural-resource dependent industries, cold-season snow and ice cover have become an economic resource. The winter recreation economy of northern New England generates more than $1 billion annually and supports thousands of local jobs (Burakowski and Magnusson 2012; Dawson and Scott 2013; Scott et al. 2008; Southwick Associates 2017). Because winter tourism for skiing, snowmobiling, and ice fishing depends on snow and ice cover, the industry and communities that rely on it are vulnerable to changes in
regional cold-season climate (Dawson et al. 2013; Scott et al. 2008; Wobus et al. 2017). Economic and recreational impacts from such changes are being felt already (Bever 2017; Hamilton et al. 2003, 2007; Perry et al. 2018).

Over the past century, northern New England winters have become warmer and wetter with fewer cold extremes (Kunkel et al. 2013; Thibeault and Seth 2014; U.S. EPA 2016). The number of days with minimum temperatures below freezing has decreased by two weeks, and the coldest winter nights are warming. The number of snow-covered days has decreased, while the length of the growing season became several weeks longer. More than a century of observations shows spring ice-out dates on major lakes (Umbagog and First Connecticut) occurring 7 to 10 days earlier than in the past (Wake et al. 2014).

Figure 2a graphs December through March average temperatures calculated from NOAA (2018) data for climate divisions 1 in Vermont, New Hampshire, and Maine, with a horizontal line marking the 1901–2000 mean. The lowess smoothed curve traces gradual change, exhibiting the early twentieth-century warming, midcentury pause, and 1970s takeoff pattern characteristic of global warming (IPCC 2013). North Country winters have warmed at more than twice the global rate since 1970, making this one of the fastest warming regions in the country (Thibeault and Seth 2014; U.S. EPA 2016; Vose et al. 2014). As average temperatures rose, the extremes shifted as well, so that the warmest winters recently are warmer, and coldest winters warmer as well, compared with earlier in the twentieth century.

Since the mid-twentieth century, warming North Country winters’ most visible consequences include decreases in snowfall, snow depth, snow extent, and seasonal lake ice cover, as well as earlier melting (Dudley et al. 2017; Hodgkins 2013; Knowles 2015; Kunkel et al. 2009, 2013, 2016; U.S. EPA 2016; Wake et al. 2014). These observed trends are projected to continue through the end of the century as northern interior winters become milder and shorter with fewer frost days and days with snow on the ground (Maloney et al. 2014; Thibeault and Seth 2014).
In recent years, anecdotal reports brought up two contrasting attitudes among North Country residents. Some were optimistic about prospects for the region’s communities, whereas others saw economic or social problems getting worse, and felt that the overall situation was deteriorating. To understand the balance and social bases of these views, Carsey School researchers conducted a telephone survey that interviewed 1650 North Country residents in June and July 2017. Respondents answered questions about their perceptions, hopes, and concerns for home communities and region. Some of the same questions had been asked with earlier surveys in 2007 and 2010, providing a longitudinal perspective on what has changed or stayed much the same (Colocousis and Young 2011; Hamilton et al. 2017). Trained interviewers at the Survey Center of the University of New Hampshire called randomly selected cell and landline telephone numbers of the four target counties [response rate 19% by definition 4 in AAPOR (2016)]. Probability weights, used for all analyses here, make minor adjustments toward representativeness in terms of number of adults and telephone numbers within households, county population, and respondent age, sex, and education.

One question on the 2017 survey, placed before any mention of climate change or politics, asked whether respondents thought that winters in this region over the past 20 years had been warmer, cooler, or about average compared with 30 or 40 years ago. Sixty-one percent accurately said “warmer” (Fig. 2b). This was followed by a standard climate-change question, where sixty-five percent agreed that climate change is happening now, caused mainly by human activities (Fig. 2c). Later items asked respondents their political orientation, and whether most of their friends prefer the same political party they do. We included this friends question to test a proposition from reports that Americans increasingly choose to associate socially with people of their own political persuasion, which accentuates polarization (Iyengar and Westwood 2015; Pew Research Center 2016, 2017).
Table 1 gives the wording of these and other questions analyzed here, along with response summaries and codes used in later analysis. Table 1 also describes background characteristics (age, sex, education) that previous research found relevant to climate-change views, including a four-party political indicator that distinguishes Tea Party supporters. The Tea Party, a more conservative wing of the U.S. Republican Party, emerged in 2009 following the election of Barack Obama. Although the Tea Party organization is decentralized and somewhat informal, self-identified supporters express distinctive views on a wide range of issues, including rejection of human-caused climate change (Hamilton and Saito 2015; Leiserowitz et al. 2011; Shao 2017). Hamilton et al. (2017) provide background on the North Country survey, and draw comparisons with earlier surveys in this region. Fogg et al. (2017) chart responses to all of the 2017 survey questions, which mainly focus on nonclimate topics.

The warming winters question allows testing for impacts of political identity on perceptions of local weather. In this paper, we evaluate three hypotheses arising from previous research.

H1: Political identity influences perceptions of local weather, such that conservatives less often recognize the trend toward warmer winters.

H2: Although the winters question does not mention climate change, political identity influences both winter and climate-change responses in similar ways.

H3: Political-identity effects on winter or climate responses are stronger among respondents whose friends prefer mostly the same party.

Adjusting for political effects, we test basic propositions related to length of experiential perspective.

H4: Older and long-term residents are more aware of decadal warming in this region.
3. Survey results

Sixty-one percent of our 2017 North Country respondents accurately reported that winters over the past 20 years have been warmer, on average, than winters 30 or 40 years ago. Given the many ways that winters in this region affect livelihoods, recreation, and daily life, it is not surprising that most people recognize the warming trend. But for those who did not, is this simply a matter of information, with some younger people, newcomers, or others (reasonably enough) lacking the perspective to compare seasons across decades? As a first analytical step, we break down responses by demographic subgroups.

a. Demographics of perceived winter warming

Figure 3a averages North Country winter temperature anomalies by decade (winter of 1897/98–1906/07 to 2007/08–2016/17), to match the wording of our survey question. By a substantial margin, winters over the past 20 years had been the warmest in this 120-yr record. Figure 3b charts the percentage of survey respondents aware of this warming, across demographic subgroups. Warming is recognized by majorities of every age group; by men and women; at each level of education; and by Democrats, Independents, and non–Tea Party Republicans. Tea Party supporters form the only major subgroup of North Country respondents in which most people do not recognize winter warming. A 31-point partisan gradient separates Democrats (70% recognize winter warming) from Tea Party supporters (just 39% do so). Partisan identity, alone among characteristics charted in Fig. 3b, correlates significantly with recognition of winter warming. The party/winter association fits with hypothesis H1.

Our winter question does not mention climate change, but the subsequently-asked climate question does. Overall, 65% of North Country respondents agree with the scientific consensus that humans are changing Earth’s climate; this proportion falls close to results from recent nationwide surveys that asked the same question (Hamilton 2017). The partisan gradient in North Country climate responses (not shown) is even steeper than that for winter, ranging...
from 85% agreement with the scientific consensus among Democrats to 37% among Tea Party supporters. Partisan gradients in the same direction for both winter and climate are consistent with hypothesis H2.

b. Regression analysis

Table 2 presents results from probability-weighted logit regression models formally testing political party alongside other respondent characteristics as possible predictors of winter and climate responses. Age and years lived in the North Country exhibit no detectable effects on awareness of winter warming, in contradiction to hypothesis H4. Political identity, on the other hand, shows strong effects. Even controlling for other background factors, Republicans and especially Tea Party supporters are less inclined to acknowledge that recent winters have been warmer, or that human-caused climate change is real. These results offer further support for H1 and H2.

Respondent education and having friends mostly of the same party affect winter warming responses through their interactions with party, described in the next section. The main effects of education are not significant for either winter or climate. Given the way our variables are centered, these main effects for education describe the impact of education among political Independents—that is, when party equals zero. Similarly the main effects of friends describe the impact of having mostly same-party friends, among Independents. Having a politically homogeneous peer group does not significantly affect the winter responses of Independents, although it does make them more likely to agree with the scientific consensus on climate change.

c. Interaction effects

Education \times party (and similar) interactions have been widely confirmed with regard to climate change views in general. Typically, acceptance of anthropogenic climate change rises with education among Democrats and Independents (or liberals and moderates), but does not rise and may even decline with education among conservatives (Bolin and Hamilton 2018; Drummond and Fischoff 2017; Hamilton 2008, 2011; Hamilton et al. 2015; Kahan et al. 2012; McCright 2011; McCright and Dunlap 2011; Shao et al. 2014). The education \times party interaction effect on climate in Table 2 conforms to this pattern. The weaker but also significant education \times party effect on winter extends this phenomenon to perceptions about local weather. Awareness of winter warming in the North Country rises with education among Democrats, is unrelated to education among Independents, and declines with education among Republicans and Tea Party supporters. In this key detail, political effects on winter perceptions resemble political effects on climate-change opinions, which is consistent with hypothesis H2.

One novel result in Table 2 is that having friends mostly in the same party steepens the effect of political identity on both winter perceptions and climate views, even after controlling for the well-known education \times party effect. This supports hypothesis H3, derived from previous reports of American trends toward same-party friends exacerbating polarization. Figure 4 visualizes the friends \times party interactions through margins plots that adjust for other predictors in Table 2. Recognition of winter warming is higher among Democrats and Independents with most friends of the same persuasion than it is among their counterparts with mixed friends. Among Republicans and especially Tea Party supporters, the opposite is true: having friends mostly of the same party decreases recognition of factual warming, compared with their counterparts who have mixed friends (Fig. 4a). Similar observations can be made

<table>
<thead>
<tr>
<th>Coef (SE)</th>
<th>Odds</th>
<th>Coef (SE)</th>
<th>Odds</th>
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<td>Climate changing</td>
<td></td>
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<tr>
<td>Age</td>
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<td>1.002</td>
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<td>Sex (female)</td>
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<td>1.040</td>
<td>0.144 (0.175)</td>
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<tr>
<td>Education</td>
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<td>1.032</td>
<td>0.149 (0.085)</td>
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<tr>
<td>Party</td>
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<td>0.795*</td>
<td>−0.673 (0.100)***</td>
</tr>
<tr>
<td>Friends</td>
<td>0.198 (0.186)</td>
<td>1.220</td>
<td>0.453 (0.209)*</td>
</tr>
<tr>
<td>Education \times party</td>
<td>−0.211 (0.069)**</td>
<td>0.810**</td>
<td>−0.247 (0.080)**</td>
</tr>
<tr>
<td>Friends \times party</td>
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<td>0.643**</td>
<td>−0.455 (0.187)*</td>
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<td>Constant</td>
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<td>1.166</td>
<td>1.470 (0.321)</td>
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<td>Test vs constant only</td>
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<td>20.15***</td>
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</table>
regarding the impacts of peer-group homogeneity on climate views, although in that case it makes somewhat less difference; acceptance or rejection of anthropogenic climate change is strongly linked to partisan identity regardless of friends’ leanings (Fig. 4b).

We also tested an alternative specification of the winter model in Table 2 by including climate as an additional predictor (not shown). The strong relationship between party identification and climate-change beliefs makes their separate effects hard to interpret, and coefficient estimates less precise. Education × party and friends × party interactions remain significant, however, and have the same general meaning under either specification.

4. Discussion

Warming North Country winters, which have broad impacts across the economy, recreation, and everyday life, were noticed by a majority of residents young and old, male and female, with little or much education—but not by the most conservative. As visualized in Figs. 3 and 4, the nonperception of warming among this subgroup is strikingly distinct. Responses to our winter warming question, which does not mention climate change, are predicted not just by political party, but by the interaction of party with education. Similar interactions have been widely observed on questions explicitly about anthropogenic climate change, including one asked later on this same survey. Our results fit with previous studies that found conservatives reporting past weather consistent with their beliefs about climate change, while extending that finding to rural northern winters. Also noteworthy is the lack of support for the hypothesis that older or long-term residents in this region would be more aware of winter warming.

Most respondents to our survey reported accurately that recent winters have warmed, and most also agreed with scientists that human activities are changing Earth’s climate. The overlap between these groups somewhat limits the scope for experienced weather or climate to shape climate beliefs; many people who already think
climate is changing notice change-consistent phenomena, whereas many of those who reject climate change do not. That dynamic helps to explain why climate-linked events such as hurricanes seem to have little immediate impact on public beliefs (Hamilton 2017). Physical events could nevertheless motivate action by those who recognize climate change already, and shift perceptions among people with less firm views, even while leaving many who firmly reject climate change unmoved.

One new result from the North Country survey is that area residents who primarily associate with people in their own political party tend to have more identity-consistent perceptions of weather. The causal interpretation of this result is ambiguous. Do people hold more partisan-shaded views about local weather because their friends reinforce that perspective? Or do people with overall more partisan outlooks, affecting even their perceptions about weather, also tend to select like-minded friends? Studies by the Pew Research Center (2016, 2017) report a parallel and similarly ambiguous finding that people whose friends are from the same political party tend to have stronger negative feelings about the other party and its people. Causality may operate in both directions, with choice of friends reflecting and amplifying partisan tendencies—another instance of the feedbacks exacerbating U.S. political divisions, but here occurring in rural communities on the mundane topic of local weather. The friends × party interaction invites wider replication to identify other situations where it operates, or does not.

Impacts already observed in the North Country make area residents stakeholders in global change, and hint at future impacts to come. The region’s tourism industry, especially winter recreation, offers hope for development of postresource economies but depends upon weather and climate (Dawson and Scott 2013). Cold season recreation visits to the northeastern United States are projected to decline through the end of the century as shorter, low, or marginal snow seasons become more frequent under both lower- and higher-emission scenarios (Wobus et al. 2017). In the short term, North Country visitations might benefit or at least remain level as areas farther south in New England and the Mid-Atlantic become less suitable for snow sports. Such activities at higher elevations of northern interior New England could remain operational for longer, particularly in cases such as downhill skiing (but not snowmobiling) that can be supported by snowmaking (Dawson and Scott 2013; Scott et al. 2008; Wobus et al. 2017). Other observed or projected consequences of winter warming include greater warm-season prevalence of insects harmful to forests, wildlife, and humans (DeSantis et al. 2013; Ogden et al. 2014; Paradis et al. 2008), which may affect prospects for summer tourism and amenity development as well. North Country residents have many practical reasons to be concerned about climate change, and to support broad efforts toward mitigation such as renewable energy development (Hamilton et al. 2018). Notwithstanding some politically based resistance, our survey found high overall awareness that humans are changing Earth’s climate, with local conditions shifting as well.

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REFERENCES


