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Extreme weather exposure and support for climate change adaptation☆

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ABSTRACT

Policy efforts to address climate change are increasingly focused on adaptation, understood as adjustments in human systems to moderate the harm, or exploit beneficial opportunities, related to actual or expected climate impacts. We examine individual-level determinants of support for climate adaptation policies, focusing on whether individuals' exposure to extreme weather events is associated with their support for climate adaptation policies. Using novel public opinion data on support for a range of adaptation policies, coupled with high resolution geographic data on extreme weather events, we find that individuals experiencing recent extreme weather activity are more likely to support climate change adaptation policy in general, but that the relationship is modest, inconsistent across specific adaptation policies, and diminishes with time. The data thus suggest that experiencing more severe weather may not appreciably increase support for climate adaptation policies.

1. Introduction

The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere" (UNFCCC, 1992). An important goal of governments is to limit the magnitude of future climatic change by reducing greenhouse gas (GHG) emissions. As the impact of climate change becomes clear, however, adaptation is emerging as a focus of public policy (Moss et al., 2013; Adger et al., 2009; Schlager and Heikkila, 2011). Governments in developed and developing countries are already implementing policies designed to adapt to the effects of climate change (Lesnikowski et al., 2013; Intergovernmental Panel on Climate Change, 2014; Georgeson et al., 2016).

Adapting to climate change presents challenges that differ from mitigation. A key difference lies in the certainty and immediacy of the risks to be managed. The worst effects of climate change are projected to occur in the future, and governments and citizens often cannot localize the benefits of climate mitigation actions, meaning actions that mitigate the scale of future climate change are likely to be underprovided. In contrast, adaptation measures address issues perceived as already emerging. The benefits are also commonly localized geographically. As a result, we can expect the political processes shaping the design and implementation of adaptation policies to differ from climate change mitigation (Berkhout, 2005).

In this study we focus on public opinion, which is identified as an important factor influencing the demand for, and the design and implementation of, adaptation policies (Haden et al., 2012; Hagen et al., 2016). We are particularly interested in whether there is an association between individuals' exposure to extreme weather events and levels of support for implementing adaptation measures in general, as well as whether this support differs across different policy instruments.

Our findings suggest that experiences of recent extreme weather activity are associated with an increase in support for climate adaptation policies. Specifically, the data presented here suggest that individuals' experience of extreme weather events is positively associated with support for coastal development restrictions, but less routinely with residential water use restrictions and stormwater control measures. The data show the size of the effect is small relative to other determinants of adaptation policy preferences, however, and our findings also suggest that only recent exposure to extreme weather is related to attitudes towards adaptation measures.

In the next section we review the existing literature on public opinion and climate change adaptation, and develop expectations

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regarding the relationship between individuals' exposure to extreme weather events and their support for climate adaptation policies. We then introduce the data and conduct our empirical analysis. We conclude with a discussion of the findings.

2. Climate change, public opinion, and adaptation policy

Climate adaptation has been defined as an "adjustment in ecological, social or economic systems in response to observed or expected changes in climatic stimuli and their effects and impacts in order to alleviate adverse impacts of change or take advantage of new opportunities" (Adger et al., 2005). While some evidence suggests that adaptation measures are rarely implemented, even in countries that have a high adaptive capacity, recent data shows that adaptation policies are being implemented by governments across different jurisdictions (Ford et al., 2011; Hagen et al., 2016; Mullan et al., 2015; Ray and Grannis, 2015).

Institutional differences are one important factor affecting adaptation planning (Mees et al., 2012; Eakin et al., 2014). In the United States, for example, institutional constraints, in addition to a lack of funding and uncertainty about future needs, limit the implementation and evaluation of adaptation measures (Bierbaum et al., 2013). Institutions promoting public participation are also found to be a factor in adaptation planning, although scholars note it is important to take into account relative levels of political power between individuals and social groups when designing institutions, to enable public participation in decisionmaking (Few et al., 2007).

In general terms, experimental evidence suggests people want to minimize the damage likely to occur because of sea-level rise and storms related to climate change (MacInnis et al., 2015). Data also shows sub-populations likely to be affected by climate change are sensitive to its effects, and are willing to adopt adaptation measures. Forest owners who believe in climate change, for example, are more likely to adapt forest management practices, while farmers who perceive climate change to be occurring are also more likely to plan for adaptation (Blennow and Persson, 2009; Wheeler et al., 2013). Farmers in California who experienced changes in water availability have been found to be more likely to adopt adaptation measures, with "adaptation…driven by psychologically proximate concerns for local impacts" (Haden et al., 2012). Experience of flooding has also been found to be associated with a greater willingness to engage in energy saving, although other data suggests that experience of drought does not have a statistically significant effect on climate change beliefs, or on attitudes toward adaptation (Spence et al., 2011; Carlton et al., 2016). Separately, social networks may also reduce the risks perceived by the elderly towards heat waves, and by extension the likelihood they will autonomously adapt to changes in climate (Wolf et al., 2010).

We contribute to research examining what determines support for climate adaptation policies. We are particularly interested in the role of extreme weather events on opinion formation. The question of how extreme weather events affects individuals' opinions has been examined with regard to climate-related beliefs, and support for climate mitigation policies. Flood victims in England, for example, appeared to differ little from non-victims in their level of concern about climate change, and climate change risk is also an insignificant predictor of participation in climate change mitigation policies in cities (Whitmarsh, 2008; Zahran et al., 2008). In contrast, perceived and actual experience of warmer weather appears is associated with higher levels of belief in, and concern about, climate change (Li et al., 2011; Egan and Mullin, 2012). Experience of a broader range of extreme weather events may also be related to individual concern about climate change, although the effect appears to be transient, and small relative to socio-economic and political factors (Konisky et al., 2016). Summarizing the state of knowledge, Marquart-Pyatt et al. (2014) suggest that perceptions of the seriousness of climate change are more heavily affected by political views than experience of changes in climactic conditions.

The effect that exposure to extreme weather has on opinion towards climate adaptation, plausibly differs from its effect on climate change beliefs, as well as on support for mitigation policies. Cross-national surveys suggest individuals tend to see climate change as an issue that is removed from them in both time and space (Hagen et al., 2016). There is evidence, however, that personal experience – and in particular experience of perceived extreme weather events – can reduce "psychological distancing" (Spence et al., 2012; Taylor et al., 2014). Adaptation policies commonly target geographically defined areas, with the benefits localized and immediate, in contrast to many mitigation actions (Berkhout, 2005). Thus, adaptation actions may be less susceptible to collective action problems (Adger et al., 2005; Glicksman, 2010).

We build on existing studies by using geospatially identified data on extreme weather, coupled with nationally representative survey data on climate adaptation, to study the correlates of individual attitudes towards adaptation policies. Although imperfect, the level of geospatial aggregation of the data used in the study improves considerably on existing measures. We also examine whether there are differences in public opinion across specific adaptation policies, as well as whether this support is greater in locations that are likely to benefit from the adaptation policies in question. Our approach recognizes that a range of different adaptation policies exist, and that the effect of these policies tends to be localized. Finally, we control for political and socio-economic factors, such as political ideology, party affiliation, education and gender, that also plausibly affect climate-related opinion (Zia and Todd, 2010; Dunlap and McCright, 2008; McCright, 2010; McCright and Dunlap, 2011a,b; Semenza et al., 2008; Hamilton, 2011).

From the discussion above, we hypothesize individuals experiencing extreme weather events willbe more likely to support policies that reduce vulnerability to climate impacts, after controlling statistically for socio-economic factors identified as affecting general opinion towards climate change-related measures. This expectation is reasonable given that adaptation measures are designed to directly deal with problems perceived to be emerging because of climate change.

H1. *Individuals experiencing higher frequencies of extreme weather events express greater support for policies that would help adapt to the effects of climate change.*

In addition to this general expectation, we posit that support for particular policies is positively correlated with the extreme weather event types that the policy is designed to address. Hence we can hypothesize that individuals that more frequently experience extreme weather will be more likely to support policies designed to dampen its specific impacts.

H2. *Individuals' experiencing higher frequency of policy-related extreme weather episodes will be positively correlated with support for those policies.*

A corollary is that the relationship between support for particular adaptation policies and individuals' experience of those events the policy is designed to adapt to should also be expressed geographically. Some past work, for example, has found that people living in drought-afflicted areas are more likely to be concerned about water supply issues and also are more supportive of government regulation to address the problem (Bishop, 2013). Thus, we can expect that individuals experiencing a higher frequency and severity of policy-related extreme weather episodes should express greater support for adaptation policies that are implemented in the regions in which they reside.

H2a. *Individuals' experiencing higher frequency of policy-related extreme weather episodes will express greater support for adaptation policies that are implemented in the regions in which they reside.*

3. Data and methods

In order to test these hypotheses we require data on extreme weather that can be joined to public opinion data, as well as data on