

Baptism by Wildfire? Wildfire Experiences and Public Support for Wildfire Adaptation Policies

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Abstract

In recent years, wildfires have ravaged the landscape in many Western American states, especially California. But will these horrific wildfire experiences increase public support for wildfire adaptation measures? We conducted an individual-level survey in California in 2019. Combining survey data with geocoded information about a respondent's proximity to wildfire events and exposure to wildfire smoke, we assess whether respondents' experiences increased support for several wildfire adaptation policies. We also control for party affiliation. We find that Californians generally oppose restrictive resilience policies and view the decision to take adaptive steps as a matter of personal choice. Republicans are generally more opposed than Democrats to spending public funds to incentivize resilience measures, but proximity to wildfires lessens their opposition to using public funds to encourage homeowners to upgrade their properties for increased protection from wildfires and encourage relocation to safer places. Although exposure to wildfire smoke is extensive and harmful to health, we found that its main impact on policy preferences was statistically insignificant.

Keywords

wildfire, wildfire smoke, personal experience, climatic event, partisan bias, environmental attitudes

Introduction

In recent years, wildfires have ravaged the landscape in many Western American states, especially California. According to CALFire statistics, in 2018 alone, there were 7,948 California wildfire incidents that burned about 1,975,086 acres of land, destroyed 24,226 structures, and claimed the lives of at least 100 people. In 2020, the number of incidents increased to 9,639, with 4,177,856 acres of land burned and over 30 fatalities. If global warming accelerates as predicted (IPCC Fifth Assessment Report, 2014; Karl & Trenberth, 2003), wildfires will become more frequent and intense (Differbaugh et al., 2017; Easterling et al., 2000; Planton et al., 2008). At the same time, increasing numbers of people continue to move into California's fire-prone wildland-urban interface areas, increasing the risks of human-caused ignitions, property loss, and deaths (Fried et al., 2004; Goss et al., 2020; Hurteau et al., 2014; Westerling & Bryant, 2008; Westerling et al., 2011). Making matters worse, the massive emissions from these fires have undermined California's ambitious efforts at decarbonization.

But will these horrific wildfire experiences increase public support for climate change resilience measures? Many studies have explored whether and how personal weather experiences affect the public's attitudes about climate

change, with very mixed results to date (see Howe et al., 2019). Some of them utilized subjective reports of personal experiences and weather perceptions (Egan & Mullin, 2012; Hamilton & Stampone, 2013; Howe et al., 2013; Li et al., 2011), while others employed objective contextual measures of extreme weather (Hamilton et al., 2016; Howe et al., 2014; Konisky et al., 2016). However, neither approach consistently finds a relationship between extreme weather experiences and climate change beliefs.

To date, there have been fewer studies exploring the connection between personal experience with extreme weather and climate adaptation policies (Demski et al., 2017). If the scientific projections are correct, communities in California and other Western states will need to take more proactive steps to protect themselves from heightened wildfire threats. Will they be able to do so given the strong partisan divide over climate change issues? One recent paper using precinct-level

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electoral data concludes that living within 5 kilometers of a recent wildfire increased public support for a “costly, climate-related ballot measure by 5 to 6 points,” but mainly in Democratic, not Republican areas (Hazlett & Mildenerger, 2020). In other words, personal experiences are filtered by partisanship.

In this paper, we use individual-level survey data combined with geocoded information about a respondent’s proximity to wildfire events and exposure to wildfire smoke to assess whether respondents’ experiences increased support for several wildfire adaptation policies. Danger from the flames is an easily comprehended hazard, but it mainly affects those in close proximity to the fire. Wildfire smoke has more extensive reach, but its adverse health effects are less well known and appreciated by the public. We find in our data that Californians generally oppose restrictive resilience policies and view the decision to take adaptive steps as a matter of personal choice. Moreover, party affiliation matters: Republicans are more opposed than Democrats to spending public funds to incentivize resilience measures. We test whether proximity to a wildfire and inhaling wildfire smoke might alter the willingness to use public funds to take subsidize protective steps. We find that proximity to wildfires does lessen Republican opposition to using public funds to encourage homeowners to upgrade their properties or relocate to safer places in order to protect themselves from wildfires. However, exposure to wildfire smoke either has no effect or slightly increases the partisan divide between Democrats and Republicans on using public money to encourage homeowners to take resilience measures. This is consistent with the fact that while the danger from flames is indisputable, the hazard of smoke is perceived differently across party lines: Republicans are much less inclined to believe that exposure to wildfire smoke is harmful to an individual’s health.

Personal Experience of Climatic Events

What are the impacts of personal experience with weather or climatic events on one’s support for related public policies? This is not only a big question in the academic literature, but also a big puzzle in the policy world. Especially in the U.S., where climate politics has become more polarized along party lines over time, bipartisan support for climate-related policies is hard to achieve (Dunlap et al., 2016; Ehret et al., 2018; Van Boven et al., 2018). Both academic researchers and politicians want to know whether an unexpected or extreme event would open a so-called “policy window,” when legislation that normally might not pass in ordinary circumstances could be enacted (Farley et al., 2007; Solecki & Michaels, 1994; Zanicco et al., 2018).

The first aspect of the challenge is a measurement problem: the prevalent use of the variable “personal experience.” Its definition can vary widely (Doherty & Clayton, 2011). The strictest meaning of the term, in this context, would be a

person who actually was present at and endures the experience of an extreme weather event such as a wildfire. A broader definition might include individuals who “experienced” the event vicariously or empathetically through someone they know, such as a family member, friend, or colleague. The broadest use of the term would include those who “experienced” an event tangentially through social media or newspapers. Unfortunately, it is often hard to discern between these definitions in surveys. Akerlof et al. (2013) find that personal experience of global warming is often “a combination of direct experience, vicarious experience (e.g., news media stories) and social construction.” Because of this, studies that utilize self-reported “personal experience” often have weaker predictive power of whether experience is linked to a policy preference (Howe et al., 2019).

In addition, studies have pointed out the discrepancy between “actual experience” and “perceived experience” (Howe et al., 2019). The latter tends to have larger measurement errors, for various reasons. One example of this is “partisan motivated reasoning,” when political party attachments influence how respondents assess factual evidence and make evaluations (Bayes & Druckman, 2021; Borick & Rabe, 2010; Druckman & McGrath, 2019; Hart & Nisbet, 2012). Another is the “consistency bias” that occurs when people are more inclined to believe facts that are consistent with their prior beliefs and knowledge about climate change and overlook inconsistent ones (Howe & Leiserowitz, 2013; Tversky & Kahneman, 1974). These cognitive biases taint, distort, and can ultimately shape policy preferences as well. We examine the discrepancy in actual versus recalled experience by partisanship in Supplemental Appendix 3. As expected, we find partisan bias in respondents’ recall of actual events.

In terms of impact, we expect actual and directly personal experience usually to have stronger and more lasting impact on respondents than vicarious or indirect experiences. Traumatic events, such as hurricane or wildfire, can leave physical harms through destroying homes and displacing people (Lujala et al., 2015). They can also exert tremendous psychological stresses that persist well after the event (La Greca et al., 1996; Mills et al., 2007).

What are the mechanisms by which personal experience can change policy preferences? One is through changing risk perception. There are three core elements of risk: (1) the hazard or danger to persons or property entailed in a natural disaster: (2) the exposure of individuals to that hazard: and (3) the vulnerability of those exposed individuals in terms of their capacity to take protective actions or recover from natural disasters. The hazards of wildfires include both the danger of the flames to life and property for those who live in or near wildland area and the health problems that arise from inhaling wildfire smoke. Wildfires in the Pacific West can move very rapidly with high winds and can spread large plumes of hazardous smoke over vast areas of land. Wildfire

smoke, when inhaled, is associated with increased rates of hospitalizations and deaths from asthma, heart attacks, and strokes (Delfino, 2009; Morgan, 2010).

Determining the threshold at which a particular hazard will motivate individuals to take protective actions or to be willing to pay more taxes so as to help protect others is an open empirical question. Those who fear for their lives or property or have to evacuate quickly in order to protect themselves should, on average, experience greater trauma than people who view a wildfire from afar or through the media. But wildfire smoke may have less attitudinal impact if those who inhale the smoke from afar do not appreciate the health risks they are exposed to.

A second aspect of risk is exposure to a hazard. Those who are directly and immediately threatened by wildfires are more likely to be sympathetic to government support and actions than those who are far removed from the flames. But the numbers of homes that are directly threatened by wildfires is typically a small minority of a state's population. Even in California, a state that has experienced several extremely large wildfires since 2017, only 11% in a 2020 survey stated that they had a great deal of fear about losing their home to wildfire and only 6.7% claimed to have evacuated their homes recently in order to protect themselves. By comparison, the reach of wildfire smoke is much greater: 52% of Californians claimed to have been exposed to wildfire smoke in 2019, and 73% in 2020. The question, however, is whether the danger from wildfire smoke is perceived to be great enough to impact the policy attitudes of this larger group of exposed people.

The last aspect of risk is vulnerability. While homes can be protected by better vegetation management, home hardening, and defensible space, there are no guarantees of adequate life and property protection in the most severe wildfire cases due to the tremendous heat and horizontal stream of sparks generated by western wildfires. By comparison, it is possible, through air filters, better insulation for the home, and the purchase of medical grade masks, to greatly diminish the medical risks involved with inhaling wildfire smoke. In sum, the risk from flames in wildfires is clearly high, but somewhat limited in scope to those who live in or near wildland urban interface (WUI) areas. By comparison, wildfire smoke travels further and has adverse health consequences for a wider swath of voters, but it might not be viewed as sufficiently hazardous to affect public policy attitudes.

It is possible that personal experiences with wildfires also affects what people believe about global climatic change (Hamilton & Stampone, 2013; Joireman et al., 2010; Myers et al., 2013; Zaval et al., 2014), which in turn might influence support for wildfire adaptation measures. However, we do not try to distinguish between the specific causal paths of personal experience, but rather only focus on whether the personal experience of being close to or inhaling the smoke from wildfires increases respondents' level of support for putting public resources into wildfire resilience policies.

Personal wildfire experiences may not matter if partisanship is too strong: that is, if Republicans simply do not believe that wildfires are more likely and more hazardous due to climate change or if Democrats are already so convinced about climate change that personal experiences add no additional information. Hence, we control for party affiliation.

Data

We conducted an online survey through a commercial vendor, YouGov. YouGov recruits and maintains its own panel of survey respondents in the U.S. Respondents were randomly selected from the panel to participate in our surveys. YouGov has consistently out-performed other polling companies on a variety of performance metrics (Pew Foundation, 2016).¹ The wildfire questions were part of a bigger regional poll conducted in the American West. The regional poll contained questions about different facets of living in the state, including length of residence and what respondents like or dislike about their state. The survey was in the field between August 15 and September 6, 2019. Within the regional sample, we had a sample of 1,042 respondents in California.² The questions in the wildfire module are presented in the Supplemental Appendix 1.

Methods

To obtain measures of partisanship, survey respondents were asked to self-identify as "Democrats," "Republicans," "Independents," or "others." We combined the last two categories as "Independent/others." In addition to asking about personal experience with wildfire and smoke, we also included several batteries of questions about respondents' support for various wildfire adaptive policies.

We included two batteries of questions on wildfire adaptation policies. The first battery (the question texts can be found in the Supplemental Appendix 1) asked respondents to choose between allowing versus requiring six different policy measures:

- 1) "prescribed burn": require prescribed burns versus allow homeowners to decide;
- 2) "private property landuse": restrict versus allow residential development in wildfire areas;
- 3) "commercial landuse": restrict versus allow commercial development in wildfire areas;
- 4) "insurance": mandate versus self-volunteer to buy wildfire insurance;
- 5) "retreat": mandate versus self-volunteer to relocate properties to safer places;
- 6) "rebuild": forbid versus allow rebuilding in areas that were affected by wildfire.

For this battery of dependent variables, we coded "1" if respondents picked the less restrictive position, otherwise

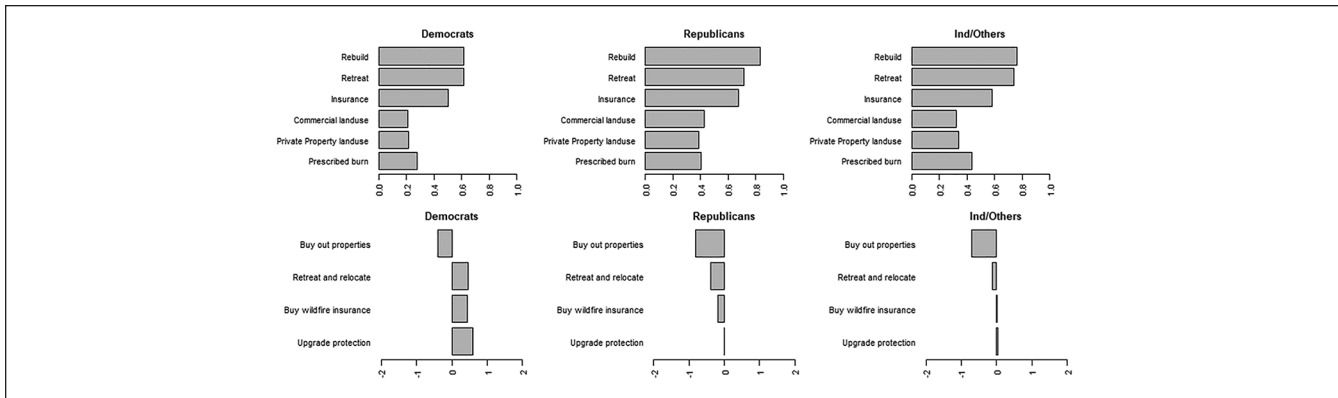


Figure 1. Proportion of respondents in support of various adaptive policies.

Note. The dependent variables in the top panel are binary in nature (1 = less restrictive; 0 otherwise). The dependent variables in the bottom panel are ordinal in nature (-2 = strongly disagree; 2 = strongly agree).

“0.” We ran logistic regression with these binary dependent variables.

The second battery asked respondents about their opinion toward using public funds to subsidize four adaptive strategies for private homeowners:

- 1) “upgrade protection” of their properties;
- 2) “buy wildfire insurance”;
- 3) “retreat and relocate” to safe areas;
- 4) “buyout all properties” in potentially hazardous zones.³

Democrats, historically, are more likely to support the use of public funds for social programs, whereas Republicans are more likely to prefer smaller government spending on transfers. For this battery, the dependent variables range from strongly disagree (-2) to strongly agree (2). We tried both ordinary least square (OLS) and ordinal logistic regression for all our models. As the two methods yielded the same conclusion, we present the results from OLS in this paper.

Given some evidence that beliefs about climate change can affect respondents’ recollections of self-reported weather experience and hence result in bigger measurement errors (Howe & Leiserowitz, 2013), we obtained and used data about respondents’ actual encounters with wildfire. The actual proximity to wildfire data was taken from the CALFire website in shapefiles with records of wildfires of at least 0.001 acres or 44 square feet from 1878 to 2019. We extracted the wildfire records between August 2018 and September 2019, since our questions explicitly asked about their experiences in the past 12 months. Because of the anonymity requirement, we could only obtain the zip codes of our respondents instead of their actual addresses.⁴ Using GIS, we measured the number of wildfires a respondent experienced within 3, 5, and 10-mile buffers from their zip code’s centroid.

Our measure of smoke density is constructed from satellite-based estimates of smoke plumes from NOAA’s Hazard

Mapping System (HMS) Fire and Smoke Product. Polygons showing the extent of smoke plumes are generated by trained analysts, who analyze imagery using true color imagery from geostationary satellites and manually delineate plume boundaries at locations where fires are detected. From these, we computed the density of the plumes and separated them into three categories: “thin,” “medium,” and “thick.” We then overlaid them with the Census zip code file to count how many days each zip code region experienced these three types of plumes.

For all our policy questions, we ran the following equations:

$$Y = \beta_0 + \beta_1 \text{PartyID} + \beta_2 \text{Actual Experience} + \epsilon \quad (\text{I})$$

$$Y = \beta_0 + \beta_1 \text{PartyID} + \beta_2 \text{Actual Experience} + \beta_3 (\text{PartyID} \& \text{Actual Experience}) + \epsilon \quad (\text{II})$$

When the interaction terms are not statistically significant, we will report results from equation (I). Since wildfires happened rather randomly in nature, the actual experience is orthogonal to socio-economic and demographic characteristics. We show in our Figure A4 in Supplemental Appendix 1 that our results remain nearly identical even after controlling for socio-economic demographic characteristics.

Results

We first present the proportion of support on our adaptation policies. Figure 1 shows the survey-weighted means of support for different policies by party identification. In the first battery of policies (i.e., the top row of Figure 1), voters across all partisan groups favor less restrictive policies with regards to rebuilding or retreating in areas after a wildfire. In contrast, all partisan groups lean towards restricting residential or commercial development in wildfire-prone areas and

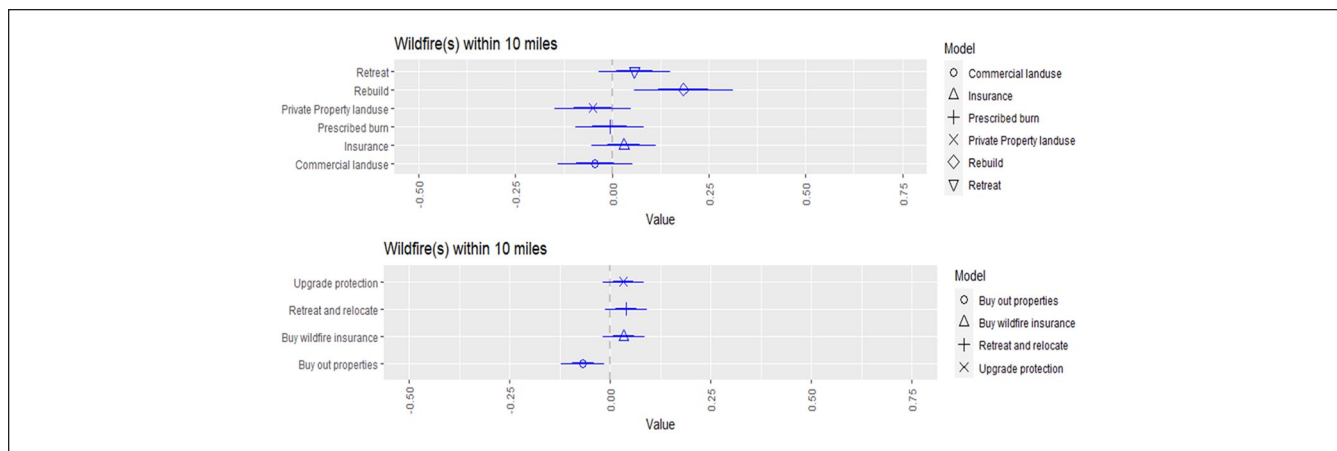


Figure 2. Magnitude of regression coefficients (β_2) for various adaptive policies (wildfire).

Note. The dependent variables in the top panel are binary in nature (1 = less restrictive; 0 otherwise). The dependent variables in the bottom panel are ordinal in nature (−2 = strongly disagree; 2 = strongly agree). Logistic regressions and OLS are applied to the top and bottom panel dependent variables respectively. Survey weight applied.

are more evenly split as to whether or not additional wildfire insurance should be required.

In the second battery (the second row), the partisan divide over how to spend public money with regards to various wildfire resilience measures looks sharper. All three partisan groups oppose using public funds to buy out private properties in hazardous areas. However, Democrats, as expected, are more likely than Republicans or Independents to support using public funds to subsidize wildfire insurance, retreat and relocate, and upgrade private properties.

Turning to our regression models, as discussed, we included both partisanship and actual fire experience. Actual experience is measured by the number of wildfires experienced within 3, 5, and 10 miles from one's zip code centroid. We also tested whether we should interact the party identification and actual experience. We found that *none* of the interaction terms were statistically significant in the first battery of our models. Hence, we stayed with the models without interaction terms.

We plot the magnitude of the coefficient β_2 in Figure 2 (number of fires wildfires within 10 miles). The results for the 3 and 5 miles are presented in the Supplemental Appendix 1. Overall, the patterns are highly comparable. The confidence intervals for 3 and 5 miles are wider than that of 10 miles because fewer respondents had such experiences. Figure 2 reveals that wildfire experiences had a significant effect on two major policies: whether to allow people to rebuild in wildfire-burned areas and whether to use public funds to buy out properties in high wildfire hazard areas. Respondents who experienced at least one wildfire were more likely to support rebuilding in affected areas and to oppose using public money for buyouts in wildfire-prone areas. These findings remain robust even after we applied the Bonferroni Correction for multiple testing (see Table A2 in Supplemental Appendix 1).

Nonetheless, when we examined the second battery of policy options regarding use of public funds in model (II) with interaction terms, we found statistically significant interactions between being Republican and actual experience with wildfire for two policy options, namely whether to allowing public funds to subsidize upgrade protection as well as retreat and relocation. Figure 3 shows the predicted responses – as actual experience increases, the partisan gaps shrink. In short, the frequency of fires in a given area has little effect on Democratic views but increases support among Republicans for using public money for some adaptive measures.

We repeated the same analyses for wildfire smoke. We measured three types of smoke days, thick-, medium-, and thin-density days. We present the results for high-density smoke days in Figure 4, and the others in the Supplemental Appendix 1. None of the coefficients in the Figure are statistically significant at 0.05 level. However, when we examined the second battery of policy options regarding use of public funds in model (II) with interaction terms, we found statistically significant interactions between being Republican and actual experience with wildfire smoke for the first two policy options, namely using public funds to subsidize upgrade protection, as well as retreat and relocate. Figure 5 shows the predicted responses – paradoxically, as actual experience increases, the partisan gaps increase.

We return to the earlier discussion about the perceptions of hazard. While no rational person would deny the danger of wildfire flames, the health hazards of wildfire smoke are not as well-known and hence more open to the motivated reasoning effects discussed earlier. In a 2020 re-survey, we followed up by asking about how much multiple days of wildfire smoke can be harmful to health. Republicans were significantly less likely to think that such exposure could be very harmful (Democrat 50% versus Republican 37%, or a

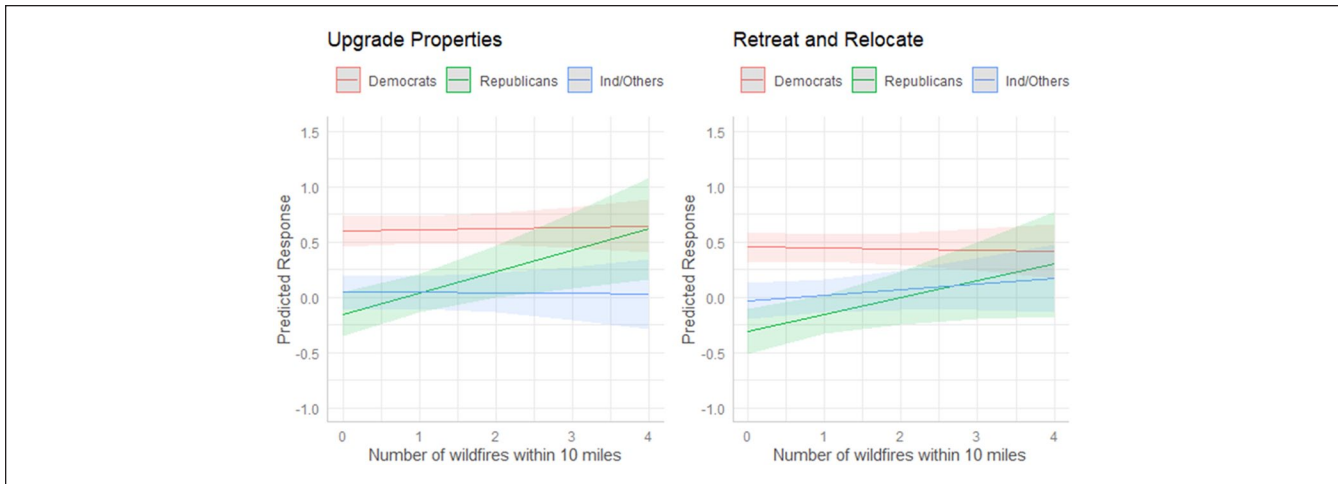


Figure 3. Predicted response from equations (II) with interaction terms (wildfire). Note. The dependent variables are ordinal in nature (-2 = strongly disagree; 2 = strongly agree). OLS with survey weights are applied. As the number of wildfires increased, partisan gaps on attitudes toward using public fund to upgrade properties or buy wildfire insurance decreased.

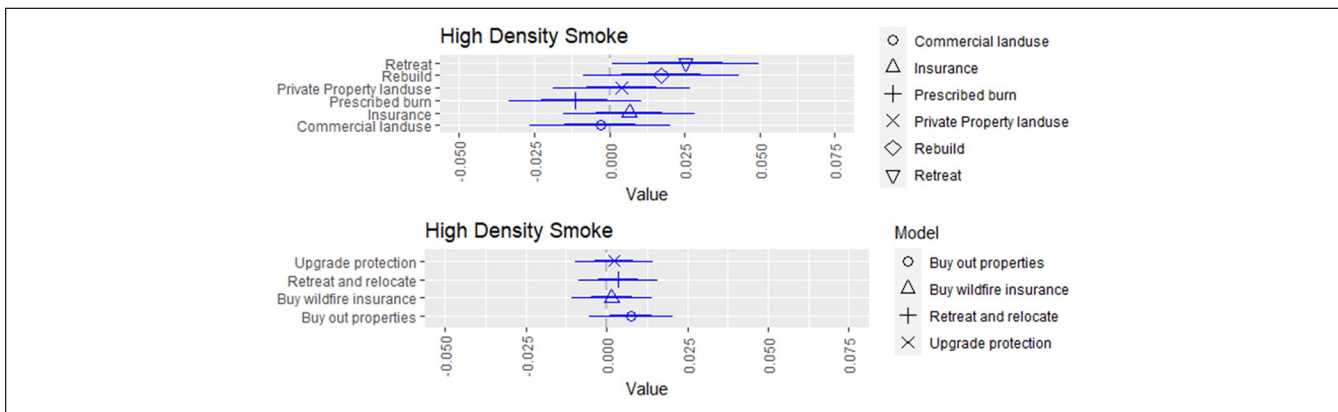


Figure 4. Magnitude of regression coefficients (β_2) for various adaptive policies (wildfire smoke). Note. The dependent variables in the top panel are binary in nature (1 = less restrictive; 0 otherwise). The dependent variables in the bottom panel are ordinal in nature (-2 = strongly disagree; 2 = strongly agree). Logistic regressions and OLS are applied to the top and bottom panel dependent variables respectively. Survey weight applied. Wildfire smoke does not affect attitudes on various policy options at all.

13-point gap) and much less likely than Democrats to take steps such as purchase an N95 mask (25-point gap) or buy a portable high efficiency air filter (12-point gap). We can conclude that the personal experience of wildfire smoke was not perceived to be harmful enough to change respondents' predisposition towards limiting public spending.

Discussion and Conclusion

There are several important conclusions from this analysis. First, there is widespread support in California for allowing people to make their resilience decisions themselves and widespread opposition to government restrictions such as permits and regulations. Californians also prefer making people safe in place rather than moving them to safer places. This helps explain why so many communities that are

heavily damaged by wildfires choose to allow people to rebuild in the same places. Experiencing nearby wildfire inclines some Republicans to be more supportive of using public funds to upgrade their properties to be resilient in place (e.g., home hardening, defensible space, etc.) and to enable people who want to leave and rebuild elsewhere to do so. The same cannot be said of exposure to wildfire smoke, which travels across a wide swath of area far away from the immediate dangers of the flames. Republicans are less likely to agree that the smoke is harmful or that people need to invest money to protect themselves from the smoke. Hence, experience with wildfire smoke has at best no effect and in some cases even diminishes support for public funding of certain resilience measures.

What, then, will it take for personal wildfire experiences to produce greater partisan agreement on wildfire adaptation

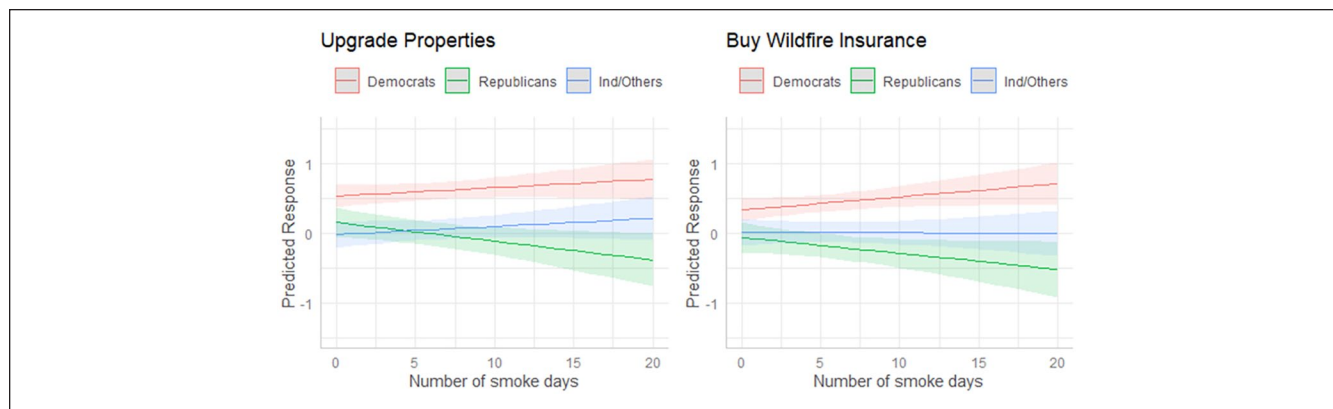


Figure 5. Predicted response from equations (II) with interaction terms (smoke).

Note. The dependent variables are ordinal in nature (-2 = strongly disagree; 2 = strongly agree). OLS with survey weights are applied. As the number of high-density smoke days increased, partisan gaps on attitudes toward using public fund to upgrade properties or buy wildfire insurance increased instead.

policies? Clearly, the continued expansion into Wildland-Urban Interface areas and the effects of a warming climate will increase the number of evacuations and personal experiences with wildfires, but even so, the impact will be localized to communities that border or inhabit forests and scrublands, not the vast majority of voters who live in urban and inner suburban areas. Returning to the elements of risk, the exposure to wildfires may not be sufficiently great to affect policy attitudes at a statewide level unless it is bundled with the needs of those who suffer from more extreme heat, drought or flooding. Wildfire smoke has the reach but not the perceived hazard level, particularly with Republicans. This might be lessened with better information outreach, but the problem of motivated reasoning will likely undercut such efforts. In the end, the expense of dealing with the health costs of wildfire smoke and the liability costs of wildfire incidents may be the best hope for increasing support for wildfire adaptation measures in the future.

Our study has several limitations. First, due to Internal Review Board anonymity requirements, we can have only the zip codes, not the actual addresses of our respondents. Undoubtedly, our distance to actual wildfire measure could be more precise if addresses, or cross-streets, were available. Second, since only a small fraction of our respondents experienced wildfire within 3 miles, we cannot further assess whether the magnitude of fire or damages have differential impacts on experiences. Similarly, we also cannot evaluate whether wildfire has a bigger impact on homeowners versus renters, haves versus have-nots. Follow up studies can pull together multiple years of observations so as to reveal any potential disproportionate impact on different subpopulations.

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Supplemental Material

Supplemental material for this article is available online.

Notes

1. <https://www.pewresearch.org/methods/2016/05/02/evaluating-online-nonprobability-surveys/>
2. The YouGov respondents were matched to a sampling frame on gender, age, race, and education. The frame was constructed by stratified sampling from the western states of the 2016 American Community Survey (ACS) 1-year sample with selection within strata by weighted sampling with replacements (using the person weights on the public use file). The matched cases were weighted to the sampling frame using propensity scores. The matched cases and the frame were combined and a logistic regression was estimated for inclusion in the frame. The propensity score function included age, gender, race/ethnicity, years of education, and region. The propensity scores were grouped into deciles of the estimated propensity score in the frame and post-stratified according to these deciles. The weights were then post-stratified on 2016 Presidential vote choice, and a four-way stratification of gender, age (four-categories), race (four-categories), and education (four-categories), to produce the final weight.
3. We also have the same battery of questions asking people about using public funds to subsidize commercial properties and low-income families. The results are similar to the ones reported in the paper.
4. Most of the zipcodes in our dataset contain only one respondent. The average zipcode radius is about 5 miles. See Supplemental Appendix 2 for graphs and detail.

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