



You vs. us: framing adaptation behavior in terms of private or social benefits

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Abstract

Private actions to mitigate and adapt to climate change may have benefits to both the individual and society. In some cases, an individual may be motivated by appeals that highlight benefits to others, rather than to oneself. We test whether such prosocial framing influences information-seeking behavior to address wildfire risk among homeowners. In a field experiment across ten communities in western Colorado, property owners ($n=2977$) received a postcard from their local fire department highlighting the impact of risk mitigation to either “your property” (*private benefits*) or “our community” (*social benefits*). The postcard directed recipients to visit a personalized webpage on wildfire risk. Overall, 10.5% of property owners visited their personalized risk webpage. There was little difference in webpage visitation between those who received the social (11.3%) rather than the private (9.7%) benefits message ($\chi^2=1.74$, $p=0.19$). However, response may depend on a property owner’s relationship to the community. Those who reside within the community (as opposed to out-of-town owners) or who were in an evacuation zone during a recent wildfire were more likely to visit their webpages after receiving the social benefits message. How homeowners view their contributions to shared risk and whether simple changes in messaging influence prosocial behavior can inform efforts to address climate-exacerbated hazards.

Keywords Wildfire · Field experiment · Risk · Communication · Prosocial behavior · Climate change

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1 Introduction

Individual actions to mitigate and adapt to climate change have both private and social benefits. Composting of food or yard waste, for example, can provide soil nutrients for a home garden and reduce greenhouse gas emissions. Mitigating disaster risk can protect a homeowner's valuables and reduce environmental, emergency, and recovery costs borne by society. Empirical work on climate adaptation has largely focused on individual behaviors with large private benefits, yet it is cooperative, or "prosocial," behaviors that lead to transformative change needed to address global environmental challenges (Wilson et al. 2020).

Whether an action is framed as prosocial or privately beneficial could influence how people respond. Framing is a way of communicating text in which some aspects of reality are made more salient, or noticeable, to shape how the recipient defines a problem, diagnoses causes, makes moral judgements, or seeks remedies (Entman 1993). Making the social benefits of an action more salient has increased prosocial behavior across a range of public goods. Intentions to engage in public health behaviors, such as vaccination and COVID-19 protective actions, increased when appealing to prosocial motives (Kelly and Hornik 2016; Betsch et al. 2017; Jordan et al. 2020; James et al. 2021). Messaging that highlights societal benefits has increased pro-environmental intentions and behaviors (Bain et al. 2012; Bolderdijk et al. 2013; Byerly et al. 2018). As with global public health and environmental conservation, adapting to climate change requires collective action, making people sensitive to the roles of others in determining outcomes (Nyborg et al. 2016; Geiger et al. 2021). Prosocial messaging can convey a sense of "working together" to address a collective action problem, rather than potentially pressuring conformity by communicating others' expectations (*injunctive* norms) or behavior (*descriptive* norms) (Howe et al. 2021).

Framing and social preferences have become central to the discussion on how to communicate about climate change and its impacts (Nisbet 2009; Weber and Stern 2011; van der Linden et al. 2015). A recent review identified 281 studies on framing effects related to climate change (Badullovich et al. 2020). The majority of these studies were observational, with only 22% using experimental methods to identify the causal effects of message framing. Many of these studies used small samples, nonrepresentative subject pools, or explicit research environments, such as online surveys, rather than real-world communication contexts (e.g., Spence and Pidgeon 2010; Morton et al. 2011; Wiest et al. 2015; McCright et al. 2016; Nabi et al. 2018; Wenger et al. 2021). Moreover, most of the experimental evidence on framing to address climate change or other environmental issues comes from studies employing attitudinal or stated preference outcome measures, rather than observed behaviors (Byerly et al. 2018; Badullovich et al. 2020; Ropret Homar and Knežević Cvelbar 2021).

In this study, framing treatments were embedded into real-world communications with nearly 3000 homeowners to observe effects on information-seeking behavior about wildfire risk. Climate change is contributing to more frequent and intense wildfires in areas where communities reside (Abatzoglou and Williams 2016; Schoennagel et al. 2017). Risk mitigation by homeowners is the most cost-effective strategy to reduce losses to private property from wildfire (Calkin et al. 2014). A homeowner's actions to create defensible space or adopt fire-resistant construction materials have clear private benefits: they can improve the chances that their home and possessions will survive a wildfire (Cohen 2008; Quarles et al. 2010). These actions also have social benefits. One homeowner's actions can reduce the likelihood of fire transmitting to nearby structures, thus reducing the wildfire risk of neighbors (Butry and Donovan 2008). Well-mitigated properties can be less likely to require

costly protection from emergency personnel or disaster recovery funds from government agencies. Thus, wildfire risk mitigation on private property requires collective action and actors may be sensitive to whether it is framed as privately or socially beneficial.

Highlighting the social benefits of wildfire risk mitigation could induce action among property owners by connecting to their social identity. Social identity, or sense of self stemming from membership in a social group, can play a large role in how people behave (Akerlof and Kranton 2000; Fielding and Hornsey 2016). Framing mitigation actions as beneficial to the community may establish a social norm of mitigation and appeal to that property owner's social identity as a community member (Cialdini 2003; Chang et al. 2019). Indeed, studies have found social norms, sense of community, and emotional connection to a place (or "place attachment") to be associated with behavioral adaptation to climate change (van Valkengoed and Steg 2019; Howe et al. 2021) and wildfire risk mitigation and resilience (Prior and Eriksen 2013; McCaffrey 2015; Howe et al. 2018). Wildfire mitigation activities also often occur in a social context, where friends and neighbors are reported to influence behavior (Brenkert-Smith et al. 2012, 2013; Dickinson et al. 2015, 2020) and mitigation is more likely on properties with mitigated neighbors (Shafran 2008; Schulte and Miller 2010; Warziniack et al. 2019). Despite this evidence linking social norms and sense of community with wildfire mitigation, we are not aware of any studies that identify the causal effect of highlighting social benefits on observed homeowner behavior.

Framing wildfire risk mitigation as socially beneficial may also appeal to certain property owners within a community over others. Compared to those who own a property as a second home or investment from afar, those who reside in the community are likely to be more connected to their neighbors, enabling communication and trust essential to cooperation and collective action (Ostrom 2000). In-town owners may also have stronger place attachment to the community, which is positively correlated to climate change adaptation behavior (Moser 2014; van Valkengoed and Steg 2019), and greater community participation and sensitivity to local social norms that may increase wildfire mitigation (Bright and Burtz 2006; Matarrita-Cascante et al. 2006; Armstrong and Stedman 2013). Emphasizing community benefits of mitigation could appeal to these values and induce greater engagement among in-town property owners.

Homeowners who have been evacuated by a wildfire may also think differently about the benefits of mitigation. Wildfires and other natural disasters have been associated with increases in altruism, cooperation, and solidarity (Carroll and Paveglio 2019; Kaniasty 2020). Close encounters with natural hazards can also lead to underestimation of future hazard risks, such that appealing to the private benefits of future risk mitigation may not resonate (Dillon et al. 2011; Tinsley et al. 2012). Of course, other factors, such as financial cost, physical difficulty, time requirements, perceived efficacy, and one-on-one information, can play a role in whether homeowners are willing and able to conduct wildfire mitigation (Brenkert-Smith et al. 2012; Meldrum et al. 2014). Many organizations face resource constraints that limit their capacity to address these barriers; simple changes in messaging and framing may cost-effectively induce behavior-change (Levin et al. 1998; Benartzi et al. 2017).

We tested whether framing wildfire risk mitigation as socially or privately beneficial affected property owner actions to learn more about their wildfire risk. In a pre-registered field experiment, wildfire organizations mailed outreach postcards about wildfire risk to property owners in ten communities in Colorado, USA. Property owners were randomly assigned to receive one of two versions of the postcard, which varied by how the benefits of wildfire adaptation were framed: either prosocial messaging about the community benefits of wildfire risk-reduction (*social benefits*) or messaging emphasizing benefits to

private property (*private benefits*). The postcards directed property owners to visit a property-specific webpage to learn more about wildfire risk factors and resources for wildfire risk-reduction. We examined differences in webpage visitation between the two groups.

We also explored whether response to the social benefits messaging differed according to property owners' relationship with their community. Specifically, whether highlighting the community benefits of mitigation had a different effect on property owners who resided within the community (vs. out-of-town owners) or on property owners who had recently faced evacuation orders due to a nearby wildfire.

While many climate adaptation actions on private property are costly to homeowners and may require financial incentives, completion of these actions is also associated with nonpecuniary factors, such as social interactions, norms, and feelings of efficacy (Brenkert-Smith et al. 2006, 2012; van Valkengoed and Steg 2019). Observing the effect of prosocial framing on homeowners' information-seeking behavior can provide a first step towards achieving more influential risk-mitigation actions.

2 Methods

2.1 Study area

The experiment was conducted across ten communities in western Colorado, USA. Colorado is among the country's most fire-prone states, with more than 625,000 acres burned and three of the state's largest wildfires in 2020 (NIFC 2020). The communities in the sample spanned from rural southwestern Colorado to a resort town along Interstate-70 (Fig. 1). All communities are at risk from wildfire, with variation in the proportion of low- or extreme-risk properties within each community (Figure S1). These communities were selected because local organizations were invested in encouraging wildfire mitigation on private properties in these areas.

2.2 Study design

Three wildfire organizations mailed postcards to engage property owners in the communities they serve. These organizations had conducted rapid wildfire risk assessments of the properties in their communities. The assessment involved a quick look at twelve wildfire risk-related attributes and was conducted from the public road or sidewalk for all homes within a community. Properties were scored for their wildfire risk, and these organizations sought to share this information with property owners. To do so, they developed personalized webpages describing each property's wildfire risk factors (Figure S2). Each organization sought to drive property owners to visit these webpages to learn about their wildfire risk and find resources to address that risk. For more on this design, see Byerly et al. (2020).

Properties that had received a rapid wildfire risk assessment were matched with owner information using county assessor's lists from each community. Duplicated names or addresses were flagged and used to identify households that owned more than one property in the community. Mailing addresses were used to identify whether the property owner resided in the community (i.e., was considered an "in-town" owner if the mailing address was in the community of the assessed parcel or an "out-of-town" owner, otherwise). For all communities except Vail, the sampling frame was a census of all property owners within the community. A subset of contiguous properties comprised the sample in Vail because

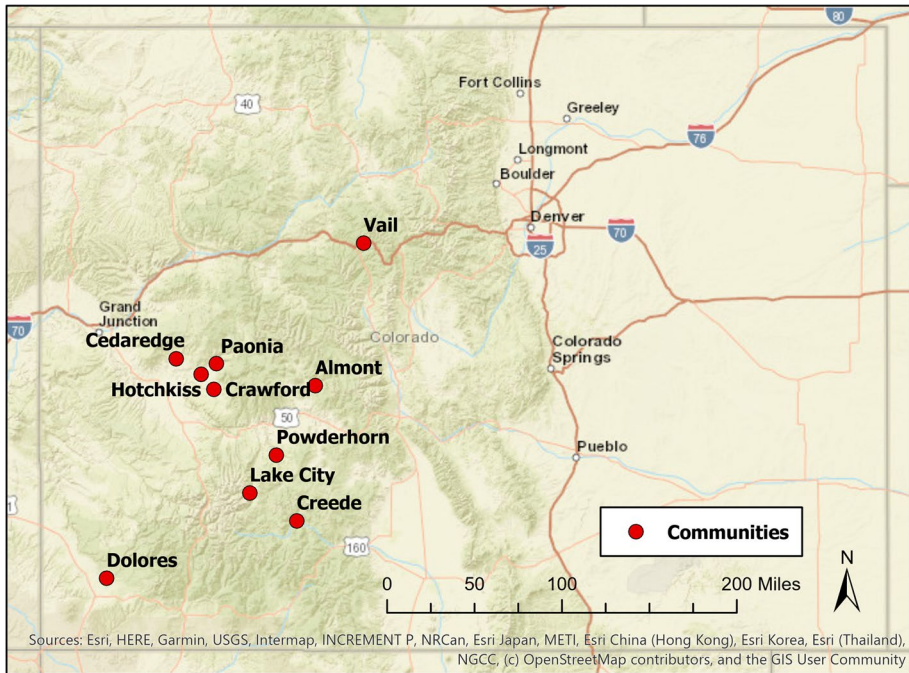


Fig. 1 The ten communities included in the field experiment within the state of Colorado. Basemap image is the intellectual property of Esri and is used herein under license. Copyright © 2020 Esri and its licensors. All rights reserved. Sources: Esri, DeLorme, HERE, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, Tomtom. Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the US Government

they had recently been assessed by the local wildfire organization, which was conducting risk assessments by geographic section over the course of 5 years.

The wildfire organizations mailed postcards between late August and early November 2020. The postcards encouraged property owners to visit their personalized wildfire risk webpages and provided a unique access code to each recipient to protect privacy and enable webpage visitation tracking.

2.2.1 Experimental conditions

Within each community, property owners were randomly assigned to one of two experimental conditions that determined which version of the postcard they received. First, a list of unique property owners within a community was generated to ensure the treatment remained consistent for owners of multiple properties who would receive multiple postcards. About 11% of the sample owned more than one property in a community. Then, randomization was blocked on multiple property ownership and wildfire risk rating to ensure balance across these characteristics, which were expected to influence webpage visitation.

Property owners were assigned to either a *private benefits* condition, which emphasized the impacts of wildfire risk mitigation on “your property,” or a *social benefits* condition, which emphasized the impacts of mitigation on “our community” (Fig. 2). Within each community, the conditions varied only by those two words on the postcard and otherwise had the same

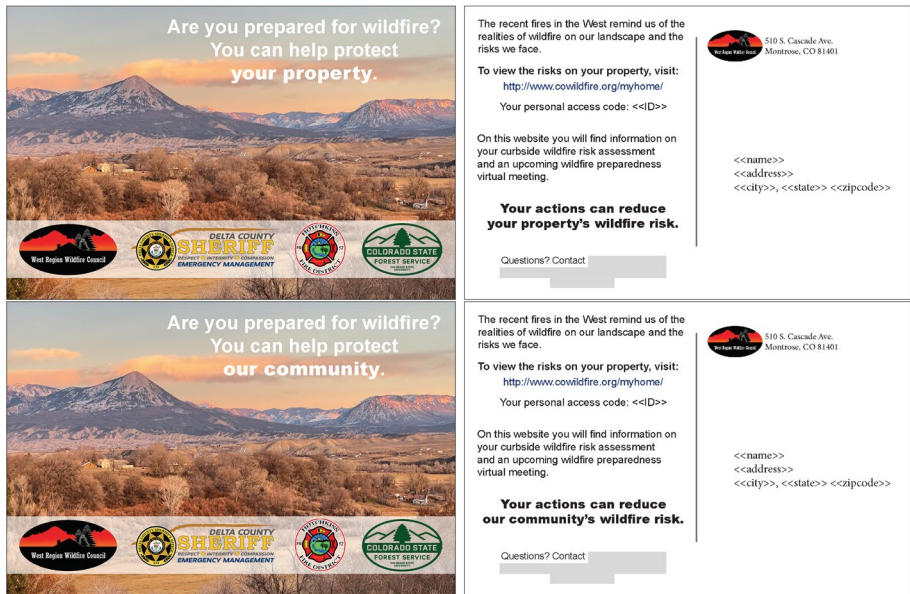


Fig. 2 Two versions of the postcard that were mailed to a community, which (like the postcards mailed to all communities) varied in emphasizing “your property” or “our community.” Postcards to other communities differed in the photo, logos, and (sometimes) sender and text at the top of the back of the postcard (right)

photo and content. The call to action on all postcards directed property owners to visit a personalized webpage to learn more about their wildfire risk. Across communities, the photo, logos, return address, and copy differed according to the local context. See Figure S3 for a selection of postcards that were sent to different communities.

We conducted a power analysis to determine the sample size needed to detect the main effect of the social benefits message and the interaction effect of in-town ownership. A previous study with a similar design and in the same region observed an overall response rate of 12.5% to a mailing directing property owners to visit a personalized risk webpage (Byerly et al. 2020; Meldrum et al. 2021). Given the minimal difference in messaging in our treatments, analysis on intent-to-treat, and a meta-analysis on social influence that found an overall effect of 0.35 (Abrahamse and Steg 2013), we sought to detect a small effect size but one that was still practically meaningful. If the difference in webpage visitation was five percentage points around the previous response (i.e., 10% visitation in one group and 15% in the other), we would observe an effect size of Cohen’s $h=0.15$. A power analysis estimated a minimum sample size of 341 at $\alpha = 0.05$ and $\beta = 0.80$ to detect such an effect. If the interaction effect size is half of the main effect, we needed a sample of 1361 property owners. The final sample size in our study ($n=2977$) was determined by organizational goals, giving us a minimum detectable effect of $h=0.05$.

2.3 Analyses

The behavioral outcome was whether or not the property owner visited their personalized wildfire risk webpage. This was measured by tracking unique webpage visits using an access code linked to the property owner, which appeared on the mailed postcard.

To examine whether prosocial messaging affected homeowners' risk information-seeking behavior, we tested whether the proportion of households that visited their webpages in the social benefit treatment differed from the proportion of households that visited their webpages in the private benefit treatment. Using the full sample (all ten communities pooled together), we used a linear probability regression model to estimate

$$y_i = \beta_0 + \beta_1 T_i + \gamma X_i + \epsilon_i$$

where y_i is an indicator for whether a household visited their personalized wildfire risk webpage, T_i indicates whether the household received the prosocial message, and X_i is a vector of individual characteristics, including community of residence and whether the owner had multiple properties in the community or had an in-town mailing address. We clustered standard errors by community to account for unobserved correlation in response within community and to generalize to the larger population of homeowners in the American West (Abadie et al. 2017).

We also tested whether the response to the prosocial messaging was moderated by in-town ownership. In-town ownership is a binary variable equal to one if the property owner's mailing address city matched the city of the study area (community), and zero if it did not match.

Lastly, we explored the effect of the outreach and its different versions on property owners who had recently faced wildfire evacuation orders. One of the communities in the study, Cedaredge, experienced a nearby wildfire 2 months prior to the mailing. During the fire, a fifth of Cedaredge properties were within an evacuation zone. This community had also received a similar outreach mailing from their local wildfire organization in 2016 that directed property owners to visit a personalized webpage and tracked visitation at the property-owner level (Byerly et al. 2020; Meldrum et al. 2021). Using these data, we examined whether property owners within the wildfire evacuation zone were more likely to respond differently to messaging about the benefits of mitigation. Because this community is relatively small (less than 1000 parcels), we did not have sufficient power to formally test for this moderation effect. Nor did we have strong priors about its direction. The results and interpretation are presented as exploratory.

We pre-registered the analysis plan on Open Science Framework (https://osf.io/abnk7/?view_only=deae1ee8ba0d4e199aa05be67d305d5d) prior to collecting data. At the time of registration, we had intended to test for a moderation effect of property size; however, these data were not consistently available for all study locations. We had also specified a model with interaction terms between the treatment and each community, but simply including community as a covariate and clustering standard errors at the community level better accounted for the within-community variation that we sought to control.

3 Results

A total of 2977 property owners received a postcard from their local wildfire organization. Of these, about 60% were in-town owners. Overall, 10.5% of postcard recipients visited their personalized wildfire risk webpage. The number of postcards sent and proportions of in-town owners and webpage visits varied by community (Table 1).

Response to the social benefits message (11.3%) was slightly higher than that to the private benefits message (9.7%), but this difference is not statistically significant ($\chi^2 = 1.74$, $p = 0.19$; Fig. 3). Modeling to adjust for covariates provides a similar result (difference = 1.4 percentage points, 95% confidence interval (CI) $[-0.6, 3.5]$, $p = 0.15$; Table 2). In-town owners were more likely than out-of-town owners to visit their personalized webpage ($\hat{\beta} = 6$ percentage points, 95% CI $[2.4, 9.6]$, $p < 0.01$). There is suggestive evidence that, among in-town owners, the social benefits message increased webpage visitation compared to the private benefits message ($\hat{\beta} = 3.4$ percentage points, 95% CI $[-0.4, 7.1]$, $p = 0.07$; Fig. 4).

Within Cedaredge—the community that had recently experienced a nearby wildfire—the social benefits message was associated with greater webpage visitation than the private benefits message among property owners within an evacuation zone ($\hat{\beta} = 11.6$ percentage points, 95% CI $[-0.1, 23.3]$, $p = 0.05$). Similar to the overall results, in-town owners were more likely to respond to the mailing, and those who had visited their personalized webpage in response to a previous mailing were also more likely to do so again (Table 2).

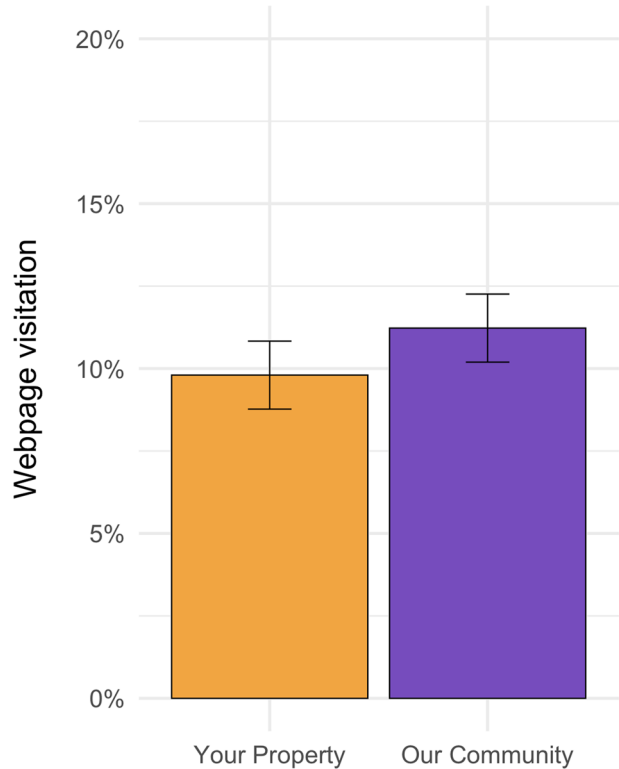
4 Discussion

Message framing that highlights the social rather than the private benefits of wildfire mitigation does not meaningfully affect engagement with risk information and wildfire programs. Across nearly 3000 property owners in Colorado, there was a slight increase in visits to personalized wildfire risk webpages among those who received the social benefits message, but it was not statistically distinguishable from chance. Even if the observed effect is real, its magnitude—including at the upper bound of the confidence interval—is

Table 1 Communities included in the study and summary statistics for evaluating whether prosocial framing influences information-seeking behavior to address wildfire risk among homeowners

County	Community	Postcards mailed	In-town owners	Visited risk webpage
Delta	Cedaredge	939	69% (649)	15% (138)
	Crawford	167	77% (128)	3% (5)
	Hotchkiss	331	81% (269)	8% (26)
	Paonia	308	81% (250)	9% (28)
Gunnison	Almont	52	0% (0)	17% (9)
	Powderhorn	73	21% (15)	7% (5)
Hinsdale	Creede	42	2% (1)	10% (4)
	Lake City	49	27% (13)	12% (6)
Montezuma	Dolores	415	67% (276)	10% (42)
Eagle	Vail	601	29% (175)	8% (50)
Full sample		2977	60% (1776)	11% (313)

Fig. 3 Overall response by homeowners to the social benefits messaging (“Our Community”) compared to the private benefits messaging (“Your Property”). Values are regression-adjusted means; error bars represent 95% confidence intervals



quite small. For the average size of a community in our study (~300 residents), highlighting the social benefits of mitigation could cause an additional four residents to visit their personalized wildfire risk webpages.

When considering whether to learn more about the wildfire risks on their property, the average homeowner may be indifferent about possible beneficiaries. Perhaps benefits are valued equally, such that homeowners are as motivated by protecting their property as by protecting their community. While a prosocial framing of risk mitigation could engage Colorado property owners, so might highlighting the private benefits. The American West is individualistic, which has hindered cooperation and increased vulnerability to wildfire (Petrzelka et al. 2013; Carroll and Paveglio 2019). Rural and wildland areas where wildfire threatens homes are also areas where homeowners select to live in privacy and with autonomy over their property (Butler et al. 2016; Sisante et al. 2019).

Conversely, benefits could have been ignored equally. Information-seeking about one's wildfire risk could be driven more by curiosity than by an expectation of meaningful impact on protecting property or neighbors. It is also possible that attempts to make the private and social benefits of mitigation salient were less effective than intended. Salience requires an interaction between the text and the receiver, so the mere presence of frames in text does not ensure successful influence on the receiver's thinking (Entman 1993). If property owners failed to attend to the text on the postcard in the process of sorting through mail, they may have not been treated by the message frame. A study with a similar design, which used small changes in wording in a mailing to farmers, found a null effect

Table 2 Estimated treatment effect of social benefits messaging on homeowner behavior to seek information about wildfire risk. Estimates are from ordinary least-squares (OLS) models. The dependent variable is whether a homeowner visited a personalized wildfire risk webpage. All models include adjustments for owning multiple properties. Models 1 and 2 include an adjustment for community and clustered-robust standard errors by community. Model 3 is estimated for the community of Cedaredge, in which 20% of property owners were within an evacuation zone (“Evacuation order”), and includes robust standard errors. 95% confidence interval (CI) shown in brackets; *p*-values in parentheses

	Model 1: average treatment effect (ATE)	Model 2: conditional ATE on in-town ownership	Model 3: conditional ATE on evacuation order (Cedaredge only)
Social benefits	0.014 [− 0.006, 0.035] (0.152)	− 0.006 [− 0.024, 0.013] (0.498)	0.012 [− 0.038, 0.062] (0.629)
In-town owner	0.060 [0.024, 0.096] (0.004)	0.043 [0.013, 0.074] (0.011)	0.060 [0.015, 0.106] (0.010)
Social benefits X In-town		0.034 [− 0.004, 0.071] (0.074)	
Evacuation order			− 0.050 [− 0.120, 0.019] (0.156)
Social benefits X Evacuation order			0.116 [− 0.001, 0.233] (0.052)
Previous webpage visit			0.153 [0.079, 0.228] (0.000)
Constant	0.101	0.110	0.076
<i>N</i>	2977	2977	939

of highlighting economic or environmental benefits of agricultural practices (Reddy et al. 2020). Such simple changes in wording allow for clear identification of the differences between treatments but may not achieve sufficient salience to influence the reader.

Prosocial framing of wildfire risk may be more effective among in-town owners than out-of-town owners. This result is supported by other research into risk management on private property. Perceptions of invasive species threats to public goods, including public safety, motivated residents to take action more so than threats to their private property (Niemiec et al. 2016). More data on the out-of-town owners’ relationship with the community could uncover the mechanisms behind this response. For example, sentimental attachment to a community was positively correlated with the length and amount of time spent there by seasonal residents (Jennings and Krannich 2013). Reason for ownership (e.g., investment vs. enjoyment) may also influence how a property owner views the risks to their assets. Future research on prosocial orientations might include data on whether out-of-town owners used their property for rental income or as a second home. Regardless of treatment, we found that in-town owners were more likely than out-of-town owners to visit their personalized wildfire risk webpages. This association could indicate that in-town

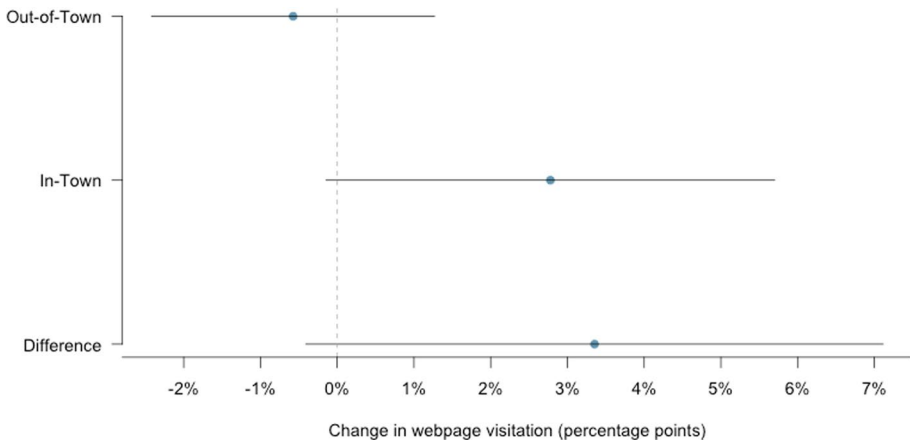


Fig. 4 Treatment effects of social benefits messaging on webpage visitation by property owner residence within (In-Town) or outside (Out-of-Town) the community. Dots represent coefficients from the ordinary least-squares (OLS) model. Error bars represent 95% confidence intervals

owners are more engaged with their properties' wildfire risk or that such mailings are less effective at reaching out-of-town property owners.

Exploratory evidence shows that property owners who were recently within a wildfire evacuation zone were more likely to seek risk information when framed as socially beneficial than privately beneficial. Interestingly, being in an evacuation zone was not associated with greater information-seeking overall. Rather, these property owners appear to have been sensitive to how the prospect of risk mitigation was framed. Previous research has found conflicting relationships between direct experience with wildfire and risk perceptions and mitigation efforts (e.g., Martin et al. 2009; Gan et al. 2015; Larsen et al. 2021). Given that the number of property owners who experienced this nearby wildfire in our study was quite small, we present these results with caution. Further work with larger samples would shed light on the direction and magnitude of this “near-miss” effect.

This study has several important limitations. Most notably, we cannot say how property owners interpreted the terms “your property” or “our community,” and whether those terms in fact made private and social benefits salient. We do not know the extent to which these terms caused homeowners to consider private or social benefits more broadly, or whether the benefits themselves—when made salient—differentially affect homeowners' information-seeking behavior. Still, because protecting “your property” is a private benefit of mitigation and protecting “our community” is a social benefit, the design of our field experiment—which was embedded in real-world communications with homeowners—provides externally valid results on homeowners' indifference between *message framing* about these benefits of wildfire mitigation. Thus, we provide evidence on the behavioral effects of how wildfire risk mitigation is presented to rather than perceived by homeowners. We encourage future experiments that include manipulation checks to identify the influence of highlighting different benefits on homeowners' perceptions of those benefits, and then subsequent behavioral change. Such studies might also consider adding a true “no benefits” control condition against which to compare messages.

We were also limited in our ability to explore how different mechanisms mediate the response to individual or social benefit messaging. It would be interesting to pair this type

of experimental research with survey data or qualitative interviews that provide insights into the motivations and identities of property owners. Lastly, we acknowledge that our outcome measure—information-seeking behavior—is only a small step in addressing wildfire risk on private property. We do not know whether webpage visits translated into risk-reduction actions. While webpage visitation is easy to observe and happens over a shorter time scale, we encourage future researchers to think creatively about how to measure changes in behaviors that directly affect wildfire risk.

Future research might also use more noticeable socially situated interventions. Informal social interactions are associated with wildfire beliefs and mitigation, and households that report talking with neighbors about wildfire also have higher levels of mitigation (Brenkert-Smith et al. 2006, 2012; Dickinson et al. 2015). Homeowners that mitigate are more likely to have risk-mitigating neighbors, and non-mitigating parcels are more likely to be neighbors (Warziniack et al. 2019). These trends suggest the importance of social norms, influence, and cooperation in wildfire mitigation decisions. Future studies might test messaging that describes in more detail the collective action problem of addressing wildfire risk and how individuals can work together to improve resilience (Niemic et al. 2020; Howe et al. 2021). Leveraging reputational concerns may be effective through interventions that make people's actions observable, or highlighting norms that many others are contributing to the public good of wildfire mitigation (Rand et al. 2014). Another avenue might examine the roles of homeowner associations (HOAs) or other neighborhood or community leaders to identify the effects of their influence on mitigation action (Abrahamse and Steg 2013; Steffey et al. 2020).

Communities also vary in their local social context, including demographic characteristics, access to resources, and social ties (Paveglio et al. 2015). These factors can influence adaptive capacity and may play a role in whether social benefits messaging resonates with property owners. While the communities in our study are too small to precisely estimate the effects of the social benefits message within each community, it could be worthwhile to test a similar design across multiple larger and distinct communities to explore how those factors interact. It is possible that the relatively small size of the communities in our study played a role in treatment response. It is unclear whether residents of larger or more urban communities would be similarly indifferent to the messages in this study. The communities in our study are also focal areas for active local wildfire organizations. While this attribute enabled the research described herein, the social context in these communities overall—especially access to resources—may differ from the average community in the American West.

It is important to note that changes in messaging are only part of the toolkit for encouraging property owners to reduce their wildfire risk. Fire-adapted planning that includes rules and regulations, such as building codes and HOA requirements, is key to increasing resilience for residents in the wildland-urban interface (Schoennagel et al. 2017; McWethy et al. 2019). Yet regulatory approaches may not have support among private property owners (Paveglio et al. 2021). Outreach strategies informed by behavioral science may offer low-cost ways to encourage voluntary actions that have social benefits (Benartzi et al. 2017; Byerly et al. 2018).

In densely developed areas in the wildland-urban interface, property-level wildfire risk is interdependent: the actions of one property owner can influence the risks faced by her neighbors, creating a collective action problem (Niemic et al. 2020). This *adaptation interdependence* is a characteristic of other climate-exacerbated hazards, such as flooding and sea-level rise, and requires careful attention to structural and behavioral challenges (Lubell et al. 2021). Although we did not detect a behavioral effect from

changing the wording on a postcard, future efforts that effectively make the idea of collective action salient, by highlighting how community members can work together to build resilience, may still be an effective way to encourage prosocial behavior (Prior and Eriksen 2013; Howe et al. 2021). Better evidence on how social factors can encourage collective action is needed to achieve large-scale, long-term transformative adaptation to climate-exacerbated hazards (Wilson et al. 2020).

The lack of overall framing effect and subgroup differences in response point to the importance of conducting framing experiments in the field (Byerly et al. 2020). By embedding treatments in programmatic outreach, we found that the change in messaging did not influence the average property owner. Yet, if response depends on certain property owner characteristics, it is important to include representative subject pools with those characteristics. Additionally, results have practical relevance to practitioners who must decide how to word their outreach to property owners.

Adaptation to wildfire and other climate-exacerbated hazards requires engaging individual property owners to reduce risk. Despite theoretical and empirical support for highlighting the social benefits of risk-reducing actions, doing so—particularly with subtle wording changes—does not meaningfully affect whether property owners engage. Yet characteristics of property owners and their communities are likely to influence the effectiveness of different outreach. We hope future efforts can build on this research to improve our understanding of how to encourage risk-reducing actions and for whom.

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Data availability The datasets analyzed in the current study are available from the corresponding author upon reasonable request and with permission of the wildfire organizations that collected them.

Declarations

Ethics approval The study design was determined to be Not Human Subject Research by the University of Colorado Institutional Review Board #18–0001.

Consent to participate Not applicable.

Consent for publication Not applicable.

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