Research article

# Homeowner firewise behaviors in fire-prone central Oregon: An exploration of the attitudinal, situational, and cultural worldviews impacting pre-fire mitigation actions

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| ARTICLE INFO | ABSTRACT |
|---|---|
| | As a result of climate change and past management practices, wildfires are becoming larger and occurring more frequently than ever before in the Western U.S. In order to mitigate the effects of this growing threat, fire management agencies such as the U.S. Forest Service have encouraged residents in at-risk communities to protect their homes, property, and communities by adopting Firewise recommendations. Using a survey of wildland-urban interface (WUI) homeowners in fire-prone Deschutes County, Oregon, this study examines homeowners' participation in Firewise activities. While the majority of survey respondents were concerned about the risk of a fire and damage to their property, engagement in pre-fire mitigation actions varied based on the level of concern, previous experience with wildfire, the presence of land use rules and policies, and close proximity to forests or rangelands. In addition, the application of cultural theory (cultural traits) to understand participation in Firewise activities revealed that respondents who have egalitarian cultural traits participate in more Firewise behaviors than those respondents who have hierarchical, individualistic and fatalist cultural traits. Fatalists participate in significantly fewer Firewise activities when compared to the other cultural traits. Results suggest that encouraging more engagement in Firewise activities requires a multi-faceted strategy employing both voluntary and compulsory actions. |

## 1. Introduction

Wildfires directly impact natural resources such as air and water quality, destroy homes and property, displace species by making areas uninhabitable, and cost a significant amount of money for fighting wildfires and mitigating the impacts of fire damage. As the prevalence of larger wildfires impact the American West, homes and structures that are in or around the wildland-urban interface (WUI) face a particular threat. The WUI is notable for homes that are built adjacent or within undeveloped, natural areas. These areas are often forested and dense with vegetation, or areas buttressing wildland prairies or other open spaces, making them desirable places to live, and simultaneously more susceptible to potential wildfires. They are also becoming more prevalent in the U.S. with about one-third of the housing in the lower 48 states now in the WUI (Radeloff et al., 2018). Increased housing structures in the WUI, combined with increasingly large, destructive fires in the American West, pose a unique challenge to fire management in these areas where not only structures need protection, but more importantly human lives.

Several large-scale fires have occurred in the WUI over the last few years, including the 2021 Marshall Fire in Boulder County, Colorado. Marked as one of the most destructive fires in Colorado, the grass fire, nudged on by winds exceeding 100 miles per hour, destroyed roughly 1100 residences and cost approximately $1 billion in damages (Summers and Kruegel, 2022). In 2018, the California Camp Fire eviscerated the town of Paradise, killing 85 people, destroying 18,800 structures and resulting in $8.4 billion of insured losses (Boghani, 2019), marking it as one of the costliest disasters in the world in 2018 (National Institute of Standards and Technology, 2021).

In order to mitigate the effects of this growing threat, educational programs, like Firewise, were created. Firewise was developed jointly by the National Fire Protection Association and the U.S. Forest Service to provide information to the public on how they can plan for wildfire, join community groups concerned about wildfire and engage in activities to protect their property and homes (National Fire Protection Association, 2022). Firewise activities (and other pre fire mitigation programs) involve the practical preventative tactics such as creating defensible space around homes, removing debris and flammable materials within

100 feet of the home, and planting fire-resistant plants. It also promotes broader actions like creating an evacuation plan and maintaining an awareness of fire threats in resident communities.

In Deschutes County, Oregon, the study area of this research, wildfires impact the county every year, often forcing evacuations and resulting in home and property damage and loss (Project Wildfire, 2022). In 1996, the Skeleton Fire burned about 18,000 acres, destroying 19 homes (30 structures total) leading the region to begin implementing more proactive wildfire mitigation efforts (Project Wildfire, 2022). In 2014, the Two Bulls Fire resulted in over 6900 burned acres and 250 homes evacuated (Project Wildfire, 2022). While fires continue to persist in the county, wildfire mitigation efforts, like landscape-level hazardous fuel reduction, has helped to prevent the spread and destruction of the fires, illustrating the benefits of pre-fire mitigation.

At present, there are roughly 50 communities within Deschutes County, OR that are participating in the Firewise program (Project Wildfire, 2022), and the county is considering other measures, such as changes to building codes and land use regulations, that could further protect communities from wildfires (Deschutes County, n.d.). Those efforts may be impacted by the passage of Senate Bill 762 – Wildfire Adapted Communities, passed by the Oregon legislature in 2021. The main goals of SB 762 are to minimize the impacts of large-scale wildfires on people, property and structures as well as creating safer and more protected wildland areas. As such, SB 762 tasks the Oregon Department of Land Conservation and Development (DLCD) to make recommendations on land use planning and zoning codes, which may include rules concerning defensible space and other wildfire mitigation actions (Oregon Department of Land Conservation & Development, 2022).

In order to encourage more homeowners to engage in wildfire mitigation actions, it is important to ascertain potential avenues to generate participation. Using a random sample of wildland-urban interface (WUI) homeowners in Deschutes County, Oregon, this study investigates homeowner engagement in pre-fire mitigation activities. This research builds on prior research exploring the motivations and barriers to homeowners engaging in pre-fire mitigation actions recommended by programs like Firewise. Additionally, this research contributes to the limited research investigating how cultural traits and, more broadly, how cultural theory adds insights into participation in pre-fire mitigation behaviors. Thus, this study provides a nascent application of cultural theory into social science wildfire research and offers insight into how policy development and educational outreach can be better informed by understanding these traits, along with other variables, that offer potential strategies to engage homeowners.

## 2. Literature review

### 2.1. Attitudinal and situational mitigation factors

An individual's risk perception, concern and subsequent mitigation of wildfire risk can be the result of a multitude of situational conditions such as prior wildfire experience, proximity to wildland areas, experiencing an evacuation, or the presence of rules and policies pertaining to land use, zoning codes, and defensible space. While risk perception and concern can be temporal in nature, research finds that as homeowners risk perceptions goes up, they are more likely to mitigate wildfire risk (Champ et al., 2013; Martin et al., 2009). Prior research finds that individuals who experience a wildfire (Ghasemi et al., 2020; McGee, 2011) and those who live in close proximity to wildland areas behaviors (Wolters et al., 2017; Ryan, 2010; Brenkert-Smith et al., 2006) are more motivated and likely to engage in mitigation efforts to avert future risk. These findings suggest that residents closer to the WUI recognize overall higher wildfire risk and seek to mitigate those risks (Brenkert-Smith

**Table 1**
Cultural theory views on nature and risk (taken from Saengawut et al., 2015, 15).

| Cultural Theory | Views of Nature | Perception of Risk |
|---|---|---|
| Egalitarian (nature ephemeral) | Seek to protect and preserve the environment | Risk averse, more likely to mitigate |
| Hierarchists (nature perverse/tolerant) | Defer to experts on natural hazards | Risk averse, more likely to mitigate |
| Individualist (nature benign) | Reliance on technology to solve environmental issues, feel nature is always in balance | Accepting of risk, less likely to mitigate |
| Fatalists (nature capricious) | Feel risk is unpredictable, and resources limited | Risk neutral, less likely to mitigate |

et al., 2013; McCaffrey et al., 2011).

Interestingly, experiencing an evacuation due to wildfire yields inconsistent results regarding mitigation actions. Brenkert-Smith et al. (2012) found that those who had been evacuated due to a wildfire were more likely to engage in mitigation techniques while other research (Wolters et al., 2017) did not find any significant difference in mitigation efforts as a result of prior evacuation experience. This suggests a lower sense of risk post-wildfire (McCaffrey et al., 2011; Martin et al., 2009), and may be the result of individuals' feeling that the wildfire that necessitated the evacuation had reduced fuels and therefore wildfire risk (McCaffrey et al., 2011).

Lastly, the presence of rules or policies as an effective motivator for wildfire mitigation has met with some mixed results. In one study, rules and policies (via homeowner's associations (HOA), building codes, etc.) were identified as the least effective mode of encouraging homeowners to perform wildfire mitigation actions among some homeowners (Paveglio et al., 2019). Conversely, in other studies, the presence of an HOA was a significant factor in homeowner wildfire mitigation (Steffey et al., 2020; Paveglio et al., 2016). Notably, some research found that the presence of an HOA helped to inform homeowners of risk as well as mitigation strategies, therefore encouraging engagement (McCaffrey et al., 2011).

### 2.2. Cultural theory

In many ways, risk can be temporal in nature when it is conditionally or situationally assessed. In 1982, researchers Douglas and Wildavsky proposed a new way to examine risk analysis as a more constant predictor of risk assessment. Their work expanded on research into risk through grid/group cultural theory (CT) asserting that there are two fundamental elements of social (grid) and political relations (group) that when combined creates four cultural traits: individualist, hierarchical, egalitarian, and fatalist (Johnson et al., 2019; Swedlow, 2011). Central to this theory is the assertion that perception of risk is directly tied to culture, or more specifically, to the 'cultural biases' that reflect people's worldviews (Johnson et al., 2019). Within this construct, the four worldviews capture core beliefs and can emerge as potential indicators of risk assessment, people with high grid worldviews (hierarchical and fatalist) feel less in control of social roles, conversely people with low grid worldviews (individualist and egalitarian) feel more in control of social roles through individual actions (Weare et al., 2014). Further, high group individuals (hierarchal and egalitarian) are more likely to act collectively, with low group individuals (individualist and fatalist) more likely to act independently.

Cultural theory relates to environmental risk perception with the four worldviews encapsulating beliefs on nature that are either nature ephemeral (egalitarian), nature perverse/tolerant (hierarchist), nature benign (individualist) and nature capricious (fatalists) (Schwarz and

Thompson, 1990). Saengawut et al. (2015) further defines the link between cultural theory and risk based on how the four worldviews perceive nature (see Table 1). Specifically, they find that people who are egalitarians and hierarchists are more risk averse, while individualists are more likely to accept risk due to their perceptions that the ecosystem is resilient, and that risk is part of a natural cycle. Finally, they find fatalists to be "risk-neutral" as they see the world as unpredictable, thus mitigation of wildfires is less of a concern (if a concern at all) (Saengawut et al., 2015). Therefore, it is more likely that egalitarians and hierarchists would seek to mitigate risk, while individualists and fatalists would not.

The connection between cultural theory and wildfire mitigation is explicit in that it "links risk perception to perceived solutions to reduce these risks" (Steg and Sievers, 2000). Thus, those holding more environmental views (egalitarians) would be more likely to want to avoid risk through wildfire mitigation behaviors in order to protect the environment, while individualists who are less risk averse, would exhibit fewer mitigation behaviors. In a study by Steg and Sievers (2000), researchers' findings aligned with the cultural theories, with the most robust connection between egalitarians and pro-environmental behaviors to mitigate negative environmental outcomes. Through this lens, risk is to a degree a social construction rather than an assessment of a real or perceived threat (Johnson and Swedlow, 2021) with values shaping risk assessment and response.

**Table 2**
Homeowner cultural theory responses, deschutes county, Oregon.

| *Question:* "Please indicate your level of agreement or disagreement for the following statements concerning the role of individuals in society" [1 = Strongly Disagree to 7 = Strongly Agree]. | | Mean/s. d. |
|---|---|---|
| ***Individualist Statements:*** | | |
| **a.** | Even if some people are at a disadvantage, it is best for society to let people succeed or fall on their own. | 4.00/ 1.76 |
| **b.** | Even the disadvantaged should have to make their own way in the world. | 4.08/ 1.66 |
| **c.** | We are all better off when we compete as individuals. | 3.76/ 1.70 |
| | Combined Individualist Index (n = 450) | 11.84/ 4.73 |
| | Cronbach's alpha | .915 |
| ***Hierarchical Statements:*** | | |
| **d.** | The best way to get ahead in life is to do what you are told to do. | 2.99/ 1.60 |
| **e.** | Our society is in trouble because we don't obey those in authority. | 3.01/ 1.49 |
| **f.** | Society would be much better if we imposed strict and swift punishment on those who break the rules. | 3.51/ 1.63 |
| | Combined Hierarchical Index (n = 450) | 9.51/ 3.97 |
| | Cronbach's alpha | .790 |
| ***Egalitarian Statements:*** | | |
| **g.** | What our society needs is a fairness revolution to make the distribution of goods more equal. | 3.45/ 1.67 |
| **h.** | Society works best if power is shared equally. | 3.44/ 1.65 |
| **i.** | It is our responsibility to reduce the differences in income between the rich and poor. | 3.52/ 1.79 |
| | Combined Egalitarian Index (n = 450) | 10.40/ 4.75 |
| | Cronbach's alpha | .920 |
| ***Fatalist Statements:*** | | |
| **j.** | Most of the important things that take place in life happen by random chance. | 3.67/ 1.66 |
| **k.** | No matter how hard we try, the course of our lives is largely determined by forces outside our control. | 3.10/ 1.54 |
| **l.** | It would be pointless to make serious plans in such an uncertain world. | 3.17/ 1.76 |
| | Combined Fatalist Index (n = 442) | 10.00/ 3.89 |
| | Cronbach's alpha | .684 |

### 2.3. Demographics

Indicators of risk perception among sociodemographic groups often includes age, gender, and education. Much like risk assessment itself, the use of demographics to ascertain risk and/or mitigation behaviors are somewhat inconsistent (Paveglio et al., 2016). Researchers have found older residents are more likely to perform more mitigation actions (Brenkert-Smith et al., 2012), while others have found younger people are more likely to mitigate (Wolters et al., 2017). Gender is a more consistent predictor with females more likely to report mitigation actions (Brenkert-Smith et al., 2012, 2013), which aligns with risk literature finding that females are more likely to assess higher risk in natural hazards. Education has also been found to be associated with higher levels of wildfire mitigation activities with the more highly educated significantly more likely to engage in such behaviors when compared to those with lower levels of formal educational attainment (Wolters et al., 2017).

## 3. Methods

### 3.1. Research objectives

A robust body of prior research examines the factors contributing to homeowners engaging in wildfire risk mitigation actions. This research builds on that foundation, while also addressing a more nascent understanding of how cultural traits impact pre-fire mitigation activities of homeowners in the WUI. Exploration of these factors guide three main objectives of this study including:

- Assess homeowner's perceptions about risk and concern in relationship to their pre-fire mitigation activities.
- Explore whether situational variables such as prior experience with a wildfire (including evacuation), proximity (living closer to wildland areas), or the presence of rules and policies pertaining to landscaping or building material nudge homeowners to conduct pre-fire mitigation actions.
- Examine whether cultural traits relate to engagement in pre-fire mitigation activities.

Further, additional sociodemographic variables (age, gender, and education) will be included in the analysis.

### 3.2. Study area

This research is based on a case study in Deschutes County, Oregon. Deschutes County is located in the heart of Central Oregon, between the towering Cascade Mountain Range to the west and the high desert plateau to the east (Deschutes County, 2021). The county encompasses an area of 3055 square miles and has a population of 181,307 in 2020 (US Census estimate). The county is well known for its scenic beauty and at the time of this study was experiencing the most rapid population growth of any county in Oregon.

### 3.3. Survey development and implementation

During Spring and Summer 2021, the Oregon Policy Analysis Laboratory (OPAL) at Oregon State University, conducted a random sample survey of WUI homeowners in Deschutes County, Oregon. Utilizing the Wildfire Risk Map created by the Oregon Department of Forestry (ODF, n.d.) to first identify areas within Deschutes County considered the WUI and at risk of wildfire, a random sample was then generated from county tax lot data to identify individual households for survey distribution. Following the survey design of Dillman's Tailored Design Method (2007), the survey was distributed using a mixed-methods (mail and online) approach, with respondents choosing their preferred response method. Two waves of mail surveys (initial contact and reminder) were

**Table 3**
Percent participating in pre-fire mitigation activities by category.

| Category | Activities | Percent Participating |
|---|---|---|
| General planning | Prepare an evacuation plan in case of wildfire | 37.9 |
| | Consider weather reports (e.g., moisture conditions) when planning recreational activities that involve fire (e.g., campfires, fireworks) | 61.1 |
| Community activities | Attend community-based meetings related to wildfire | 16.2 |
| | Obtain information from a land management organization, community group or firefighting agency on how to prepare for wildfire | 37.1 |
| Property protection activities | Plant fire-resistant plants | 27.5 |
| | Plant trees and shrubs at least 15 feet apart | 30.3 |
| | Prune the branches of all trees within 85 feet of your home | 52.4 |
| | Reduce the density of trees within 100 feet of your home | 44.1 |
| Home protection activities | Clean roof surfaces/gutters and surrounding vegetation to avoid accumulation of needles, leaves and dead plants | 69.7 |
| | Stack firewood/lumber at least 30 feet from house | 45.7 |
| | Use nonflammable building materials such as tile, slate, stone, etc. | 46.8 |

sent to 1500 households, including a URL with a link to a Qualtrics survey. Participation in the household survey was voluntary. Respondents consented by either following a link to complete the survey online or completing the mail survey and returning it in a postage pre-paid envelope. In total, 458 surveys were returned for a 30.5% response rate.

### 3.4. Operationalization and descriptive statistics

*Dependent variables:* The survey consists of 11 dependent pre-fire mitigation activities (initially developed by Kyle et al., 2010 for survey research), to document household activities. The activities fell into four sets of activities: general planning, community activities, property protection activities, and home protection activities. For each set of activities an additive index was created with 1 = participated in the activity in the last 5 years, and 0 = no participation. The range of possible responses range from 0 to 2 for general planning and community activities, to 0 to 4 for property protection activities, and 0 to 3 for home protection activities.

*Independent variables:* The independent variables in the analysis are presented below in Table 4. In order to measure the cultural traits of landowners, the survey included a set of 12 statements that reflect individualist, hierarchist, egalitarian, and fatalist cultural traits. The statements were previously used by Zanocco and Jones (2018) to examine peoples' political process preferences. For each of the 12 statements, respondents were asked their level of disagreement or agreement on a seven-point ordinal scale with 1 = strongly disagree to 7 = strongly agree.

Sociodemographic variables were measured with different techniques. Age was an open-ended question asking, "What is your current age in years?", providing a range from 25 to 85. The average age of respondents was 58 years old. Gender was measured using a dummy variable with 1 = Female, 0 = Male. Slightly more men (53%) responded to the survey, with gender measured using a dummy variable with 0 =

**Table 4**
Independent and control variables.

| Variables: | Variable Description: | Mean/s.d. |
|---|---|---|
| ***Sociodemographic:*** | | |
| Age | Age in years (range: 25–85 years) | 58.01/13.67 n = 455 |
| Gender | Gender dummy variable (1 = female, 0 = male) | .47 n = 450 |
| Education | Formal education attainment (1 = junior high or less to 6 = graduate degree) | 4.55/.99 n = 449 |
| ***Wildfire Risk:*** | | |
| Concern | Level of concern of wildfire damage to private property (1 = not a concern to 4 = great concern) | 2.71/1.11 n = 458 |
| Probability | Probability of wildfire near home in next 5 years (0 percent to 100 percent) | 58.05/32.08 n = 456 |
| ***Wildfire Experience:*** | | |
| Experience | Experience with wildfire within several miles of home last 5 years (1 = yes, 0 = no) | .56 n = 447 |
| ***Rules and Policy:*** | | |
| Rules | Homeowner's association, subdivision or insurance rules about landscaping or building materials to help protect against fires? (1 = yes, 0 = no/don't know) | .35 n = 458 |
| ***Home Situation:*** | | |
| Developed | Neighboring property developed with a structure or undeveloped? (1 = developed, 0 = undeveloped) | .84 n = 458 |
| Wildland | Home near a wildland area (either forest or rangeland)? (1 = live within a wildland area to 6 = more than 3 miles) | 4.13/1.72 n = 428 |
| ***Culture:*** | | |
| Individualist | Individualist Index (range 3–21) | 11.84/4.73 n = 450 |
| Hierarchist | Hierarchist Index (range 3–21) | 9.51/3.97 n = 450 |
| Egalitarian | Egalitarian Index (range 3–21) | 10.40/4.75 n = 450 |
| Fatalist | Fatalist Index (range 3–21) | 10.00/3.89 n = 442 |

Male, 1 = Female. Education was measured using a multi-categorical response choice, asking respondents to provide their highest level of formal education (on a scale of 1 = Junior high or less to 6 = Master's, doctoral, or professional degree). The average was 4.55, indicating some college education. Other variables such as wildfire risk, wildfire experience, rules and policy, and home situation were assessed utilizing ordinal responses.

## 4. Analysis and findings

Table 2 provides homeowner cultural theory responses and displays the statements and mean scores for each individual statement, and for combined indexes for each cultural trait. The highest mean index score was for the individualist statements ($\bar{x}$ = 11.84), the lowest mean index score was for the hierarchical statements index ($\bar{x}$ = 9.51). Cronbach's alpha is also provided to assess the internal consistency of each index. Very high alphas were found for the individualist (α = 0.915) and egalitarian (α = 0.920) indexes, followed by the hierarchical index (α = 0.790) and the fatalist index (α = 0.684). While the alpha for the fatalist index is not as large, it does fall within the 0.65 to 0.80 range that is most commonly used as a reliable indicator.

Table 3 displays the list of home and community pre-fire protection activities (initially developed by Kyle et al., 2010) and percent of survey respondents participating in each activity. Assessment of participation was 1 = participated in the activity in the last 5 years, and 0 = no participation. A majority of survey respondents reported participating in
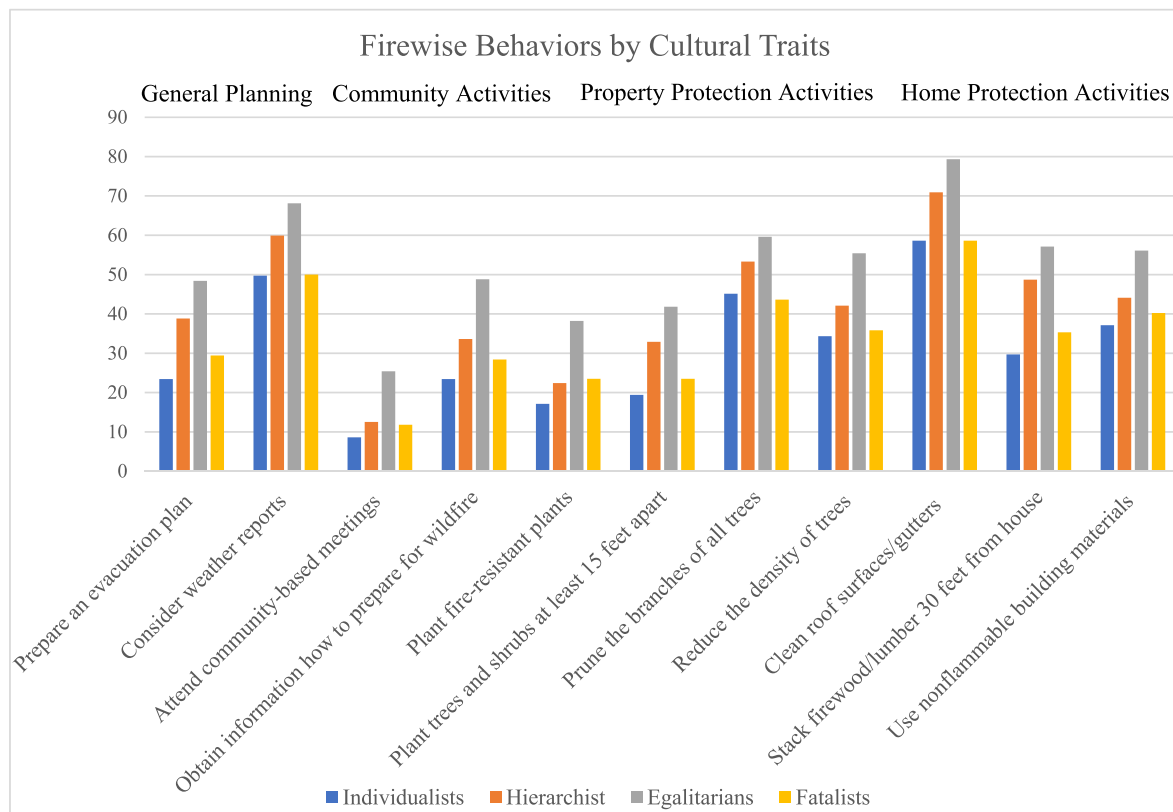
**Fig. 1.** Pre-fire mitigation behaviors by cultural traits.

three activities: cleaning roof surfaces/gutters (69.7%), considering weather reports (61.6%), and pruning the branches of trees within 85 feet of their home (52.4%) (see Fig. 1).

Fig. 1 displays the frequency of pre-fire mitigation activities based on cultural traits. Those respondents who had scores higher than the mean index score presented in Table 2 were classified as that trait for this table. For example, if a respondent had an above mean score for the individualist statements they were coded as a 1, with those at or below the mean being coded as a 0. The percentages presented in Fig. 1 are for those respondents who scored above the mean for the specific cultural rate and engaged in the activity within the last 5 years.

The average number of activities engaged in for the entire sample is 4.69. Those respondents with above average scores on the egalitarian index participated in 5.78 activities on average, followed by hierarchists at 4.60, fatalists at 3.81, and last individualists at 3.47. The activities index will next be used as a dependent variable in a multivariate analysis controlling for sociodemographic variables, some wildfire risk indicators, previous experience with wildfire, and the 4 cultural traits.

Table 4 presents mean scores for the various independent and control variables to be included in the multivariate analysis. The sociodemographic variables include age in years,[1] gender,[2] and formal educational attainment.[3] There are two indicators used to assess risk perceptions concerning wildfire. The first asked respondents their level of concern for wildfire damage to their own property.[4] The mean score of 2.71 is between "slight" and "moderate" concern. The second indicator asked respondents if there were a wildfire in the forests around their homes, what would be the chance of damage to their property?[5] The mean score for the entire sample is 58.1 percent, which means the average respondent thinks there is a 58.1 percent chance of damage to their property.

The next variable in the model asked respondents if they have any

experience with wildfire near their home within the last 5 years.[6] Fifty-six percent of the total sample indicated that they have experienced a wildfire within several miles of their home in the last 5 years. Another variable included in the multivariate analysis concerns local rules and policies that mandate certain types of landscaping and/or building materials to help protect against fire.[7] Thirty-five percent of respondents indicated that they do have such rules and policies in place that require landscaping and/or building materials to help protect against fires.

The next set of questions concern the location of the property within the WUI. The first question asked respondents if the neighboring property is developed with a structure or if it is undeveloped.[8] As California and Oregon wildfires in the Summer of 2020 remind us, once a structure catches fire, fire intensity increases and endangers homes nearby (Caton et al., 2017). Eighty-four percent of respondents indicated that their property is next to developed structures such as a neighborhood in the county. The second question asked respondents how close their homes are to a forest or range wildland area.[9] The mean is 4.13, which is closest to the response category of "more than 300 yards but less than a mile."

The final set of multivariate analyses conducted involve ordinal regression estimates for the four types of pre-fire mitigation activities presented in Table 3—general planning, community activities, property protection activities, and home protection activities (see Table 5). For the demographic variables included in each model, age was only significant in one model while gender was significant for two models. Younger homeowners were more likely to engage in home protection activities when compared to older homeowners (in other words, as people age, they are less likely to perform home protection activities). Gender was significant in two categories, general planning and home protection activities, with women more likely to engage in these activities. Education did not have a statistically significant coefficient in any of the four models.

**Table 5**
Ordinal regression estimates for types of pre-fire mitigation behaviors.

| Variable: | General Planning | Community Activities | Property Protection Activities | Home Protection Activities |
|---|---|---|---|---|
| | Coefficient (S.E.) | Coefficient (S. E.) | Coefficient (S. E.) | Coefficient (S. E.) |
| Age | −.013 (.008) | .008 (.010) | .011 (.008) | .016* (.008) |
| Gender | .549* (.219) | −.310 (.246) | .363 (.201) | .439* (.205) |
| Education | −.084 (.117) | .227 (.136) | .024 (.108) | .090 (.109) |
| Concern | .288** (.107) | .512*** (.127) | .295** (.100) | .369*** (.101) |
| Probability | .019*** (.004) | .021*** (.005) | .012*** (.003) | .014*** (.003) |
| Experience | .881*** (.226) | .858** (.272) | .438* (.212) | .610** (.212) |
| Rules | .939*** (.235) | 1.298*** (.262) | .975*** (.215) | .195 (.217) |
| Developed | .487 (.286) | .185 (.319) | .129 (.263) | .304 (.265) |
| Wildland | −.168* (.070) | −.284*** (.076) | −.161* (.064) | −118 (.066) |
| Individualist | −.009 (.030) | −.009 (.034) | .047 (.028) | .006 (.028) |
| Hierarchist | .024 (.030) | −.012 (.034) | .018 (.027) | .044 (.028) |
| Egalitarian | .075** (.028) | .048 (.030) | .144*** (.026) | .117*** (.026) |
| Fatalist | −.099** (.032) | −.075* (.038) | −.082** (.030) | −.078** (.030) |
| Chi-square = | 178.155*** | 206.244*** | 162.776*** | 152.515*** |
| Cox and Snell $R^2$ = | .365 | .409 | .341 | .323 |
| Nagelkerke $R^2$ = | .411 | .485 | .358 | .346 |
| N = | 392 | 392 | 391 | 391 |

*$p \leq .05$; **$p \leq .01$; ***$p \leq .001$.

For the two indicators of wildfire concern and risk, both had statistically significant coefficients for all four models. Those respondents that have greater concern about the possible effects of wildfire damage to their private property are more likely to engage in more pre-fire mitigation activities in all four areas compared to those homeowners with lower levels of concern. In addition, homeowners who perceive a higher level of probability that wildfire will occur in the wildlands around their homes in the next 5 years are significantly more likely than those who perceive lower levels of probability to engage in all four areas of mitigation activities.

In terms of previous experience with wildfire near their homes in the last 5 years, those homeowners who have experienced fire are significantly more likely to engage in all four types of mitigation activities when compared to those that have not experienced a wildfire event. In addition, those homeowners who live in neighborhoods or subdivisions with rules about landscaping and building materials to protect against fires were significantly more likely than those homeowners without rules to engage in general planning, community activities, and property protection activities. The status of the neighboring property—either developed or undeveloped—has no significant impact on any of the four activity areas. However, the proximity of homes near wildland areas—either rangelands or forests—did have a significant impact on pre-fire mitigation activities for general planning, community activities, and property protection activities.

Finally, for the cultural traits included in each model, the individualist and hierarchist indicators had no statistically significant effect for any of the four activity areas. However, the egalitarian and fatalist indicators did produce statistically significant results in three and four models respectively. Those homeowners with higher egalitarian scores were significantly more likely than those with lower scores to engage in

general planning, property protection, and home protection activities. Surprisingly, the coefficient for community activities was not significant, as we would expect egalitarians to be more engaged in those types of activities. The fatalist indicator was significant and negative in all four models with those homeowners with higher fatalist index scores significantly less likely to engage in the four pre-fire mitigation activity areas when compared to homeowners with lower index scores. As was discussed previously, we expected those homeowners with higher egalitarian cultural traits to participate more fully in mitigation behaviors while controlling for demographic, home characteristics and location, and we expected those homeowners with higher fatalist cultural traits to be less likely to engage in such activities.

## 5. Discussion

People living in the WUI have a unique role to play in both protecting their homes and the areas around them to reduce community impacts from wildfires. Wildfire mitigation in the WUI though pre-fire mitigation actions can have significant impacts on the effects of a wildfire in a community. Less fuel build-up, defensible space, and other behaviors could reduce the potential for small fires and embers around homes and other structures during a wildfire that are the primary cause of home and property destruction (National Fire Protection Association, 2022). Significant resources (via Firewise and other local government and community programs) are available for people in the WUI to understand what behaviors and actions they can take on their properties to mitigate wildfire damage, but whether this is adequately communicated to communities, or whether individuals prioritize these mitigation behaviors is debatable. However, not everyone acts uniformly to mitigate wildfires, although the impacts of wildfires can be minimized both by collective and individual actions.

This study sought to understand who engages more in wildfire mitigation strategies based on concern, experience with wildfires, proximity to wildland areas, rules and policies, demographic variables, and cultural traits. In terms of who performs the most pre-fire mitigation activities, people who are concerned about wildfire, have prior experience with wildfire, those who live closer to wildlands, and those homeowners with HOA or other rules in place were more likely to engage in mitigation behaviors. Prior research has found similar results related to concern of wildfire (Ghasemi et al., 2020; Wolters et al., 2017; Dickinson et al., 2015; Brenkert-Smith et al., 2012; McGee, 2011), prior experience with a wildfire (evacuation) (Ghasemi et al., 2020; Wolters et al., 2017; Brenkert-Smith et al., 2012), those who live closer to wildlands (Wolters et al., 2017; Brenkert-Smith et al., 2006), and rules (Olsen et al., 2017). Turning to engagement in activity areas, younger homeowners were more likely to engage in home protection activities and women were overall more likely to perform mitigation activities. Prior research has revealed mixed results pertaining to demographics, with many studies finding no association between demographics and wildfire mitigation activities (McCaffrey and Olsen, 2012). Findings in this study that younger people are more likely to engage in pre-fire mitigation activities may relate to younger people's physical ability to conduct the activities necessary for mitigation (Olsen et al., 2017; Martin et al., 2009). Regarding gender, research has found that women are more likely to perceive a greater risk from wildfire (Asfaw et al., 2022) thus incentivizing women to take more proactive steps to reduce risk. Further, finding no significant relationship with higher levels of formal education perhaps measures the wrong type of education, as educating homeowners of their personal risk through individualized property risk assessment could potentially provide the knowledge to mitigate risk (Champ et al., 2013).

In addition, cultural theory provided some significant, and interesting findings. Even though more people identified as individualists, which is not surprising for a central Oregon county that has many rural residents, it is the egalitarians that demonstrably fit within expectations based on cultural theory. Specifically, egalitarians were significantly

more likely to engage in pre-fire mitigation behaviors overall, and in three of the activity areas including general planning, property protection activities, and home protection activities. This is not surprising considering that egalitarians are more likely to want to protect the environment, act collectively, and recognize how their behaviors could benefit self and community. Egalitarians particularly focus on the good of the community and feel they have more control and can contribute to community good through individual action. Further, we would expect to see egalitarians given the in-migration of people with more progressive values that has made Deschutes county—the fastest growing county in the state—"purple" and increasingly "blue" (Steel et al., 2020; Buylova et al., 2018). However, there was no statistical significance regarding egalitarians and community activities. This is somewhat perplexing considering that egalitarians are planners and want to do what is good for the community which would include preparing for wildfire events.

Alternatively, fatalists reported doing the least mitigation behaviors. These findings are not surprising considering research into cultural theory that finds "fatalists do not initiate engagement with risk" (Cambardella et al., 2020, 653) as they have life outlooks that are not necessarily consistent with short- or long-term planning as "stuff happens" and there isn't much one can do about it. Thus, the higher people identify with egalitarian cultural traits, the more behaviors they engage in. Conversely, the higher people identify with the fatalist cultural traits, the fewer behaviors they engage in. Motivating fatalists to engage in more mitigation behaviors then may prove futile, as their worldview does not seek mitigation of outcomes, rather acceptance, leading some researchers to focus only on policy engagement among egalitarians, hierarchists and individualists (West et al., 2010). However, we found that fatalists do engage in some pre-fire mitigation activities, more so than individualists in some actions, suggesting that while people may demonstrate dominant traits of one group, the groups themselves are not stagnant, with different group identity activated based on behavior, experience, belief, etc.

Notably, the presence of rules about landscaping or building materials was also significant regarding engagement in pre-fire mitigation activities. This suggests that community requirements to protect against wildfires can be effective in motivating individuals to take steps to mitigate wildfire potential for their homes and property. It also suggests that a top-down approach to wildfire mitigation in the WUI can be effective in achieving desired wildfire protection. Further, there is evidence that building codes are highly effective in preventing structural loss in wildfires. A 2008 building code in California requiring fire resistant building materials prevented about half of the homes built after 2008 from destruction in the Camp Fire, compared to only 18% of homes saved that were built prior to 2008 (Kasler and Reese, 2021). The enactment of more stringent fire-prevention building codes and land use regulations are currently being explored not only in California, but other places in the U.S. West, like Oregon (specifically Deschutes County) (Legislative Analyst's Office, 2021; Deschutes County, n.d.). Land use requirements that are subject to inspections could result in a host of outcomes, most helpful perhaps, mitigating the financial cost of Firewise actions by establishing financial assistance programs for homeowners who face financial restrictions (Legislative Analyst's Office, 2021).

Three broad categorical variables were tested, demographics (including age, gender, and education), situational (including concern, probability, experience, rules, developed land, proximity to the WUI), and cultural (individualist, hierarchist, egalitarian, and fatalist). Reviewing the coefficient results, the situational variables (particularly concern, probability, experience, rules and proximity to the WUI), were overall more significantly correlated to most all pre-fire mitigation activities. However, of the cultural variables, both egalitarians and fatalists' orientations were most predictive of engagement in wildfire mitigation actions (with egalitarians performing more activities, fatalists performing less). This again suggests that efforts to increase participation in mitigation activities should focus on elevating and highlighting situational variables, particularly rules, which as

aforementioned, may be part of the implementation strategies of SB 762 in Oregon. The presence of rules demonstrably impacts positive engagement with general planning, community activities, and property protection activities. Tailored rules toward home protection activities could result in further engagement in this category as well.

Although focused on a fire-prone region in Oregon, the study offers a novel application of cultural theory and as such, provides new insights into who and who does not engage in pre-fire mitigation actions. While the findings in this study align with prior research on cultural theory and risk, showing that egalitarians and hierarchical individuals are more likely to take actions to avert risk, it is the view of nature and the construct of risk that may make individuals and fatalists less likely to engage in wildfire risk mitigation. Regarding fatalists, due to their high grid worldviews (less in control of social situations) and perceptions of nature (capricious) they "are typically not involved in policy or resource management process" (McNeeley and Lazrus, 2014, 508) and thus, more difficult to tailor messaging, engage with community, etc. to encourage pre-fire mitigation actions. Individualists, who are more likely to protect their autonomy and reject rules, were also less likely to engage in wildfire mitigation actions. Alternatively, egalitarians or hierarchical individuals are potentially more likely to be receptive to educational campaigns, conducting wildfire mitigation actions on their property, and having an evacuation plan in the event of a wildfire. For these groups, additional nudging and community appeals would potentially be beneficial in increasing pre-fire mitigation actions because it already fits within their cultural traits and worldviews. Egalitarians and hierarchical people may also be more receptive to efforts creating engagement through financial incentives, land use regulations, and building standards.

In terms of engaging more individuals in pre-fire mitigation actions, understanding the role of cultural worldviews can help in developing policies that appeal to specific worldviews. For example, for individualists, market-based incentives could make individualists more receptive to mitigation efforts, whereas for egalitarians more emphasis on community engagement would be beneficial. However, it is helpful to note that cultural traits and worldviews are not monolithic, they do not solely comprise the way an individual responds to risk. It was interesting that identifying as an individualist did not significantly correlate with behaviors. This suggests that other factors are at play and that identity alone is not always predictive of behavior. While an understanding of cultural traits can help inform and shape policies and educational efforts, the scope of the problem (wildfire mitigation) is such that all avenues for engagement need to be explored.

One limitation of this study was the focus exclusively on a fire-prone region in Oregon. However, a meta-analysis conducted by McCaffrey (2015) that examined global research on wildfire preparedness illustrates how some of our findings align with global studies. Specifically, similar to McCaffrey's (2015) findings, respondents in our study who engaged with a land management organization, community group or firefighting agency on how to prepare for a wildfire were more likely to engage in pre-fire mitigation, as were those who expressed higher levels of concern or risk of a wildfire. Further, research in Canada (Asfaw et al., 2022) on participation of pre-fire actions, aligns with our findings that more people engage in typical property maintenance tasks (e.g., vegetation management) than other activities. Another limitation to the study was the lack of questions pertaining to what would motivate an individual to engage in pre-fire mitigation activities, for example, community participation, low-cost actions, and ease of performing the action (or having a community program that could perform the more physically challenging actions) (Asfaw et al., 2022). Further research into understanding ways of mitigating barriers is an important on-going step to help design and implement policies and educational campaigns that would inspire residents to participate in home and community wildfire protection activities.
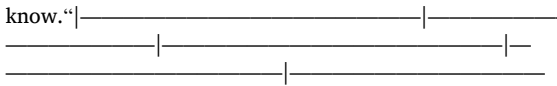
## 6. Conclusion

This research adds an emerging dimension to understanding engagement in pre-fire mitigation activities by examining the role of cultural traits. Findings that egalitarians are more likely to engage in these behaviors suggest that education, outreach, and community efforts will continue to encourage home and community wildfire protection efforts to this group. Conversely, findings suggest that promoting engagement for those least likely to perform wildfire mitigation activities perhaps necessitates either incentivizing actions, creating rules about defensible space and zoning, or both. This potentially holds true for people regardless of cultural identity, as we see that the presence of rules significantly and positively relates to mitigation actions. Thus, rules in place (or other forms of incentivized or disincentivizing policies), offers a foundation in which people, regardless of other factors, will engage in pre-fire mitigation actions.

In addition, it is key for efforts to focus on the most impactful mitigation activities. For example, research suggests that protection of the home itself and a zone within about 5 feet of the home is most effective at preventing wildfire spread and structural loss (Cal Fire, 2019). In this study, activities with the highest percent participating were property protection (pruning branches of trees) and home protection (clean roof surfaces/gutters). This is unsurprising since these activities are generally part of home maintenance, but can be leveraged by offering incentives, assistance programs, and debris collection or drop off options to make it both easier to perform, or financially more feasible.

Motivating more people in the WUI to engage in pre-fire mitigation behaviors is complex and multifaceted. People act due to experience, sense of place attachment, cultural worldview beliefs, risk assessment, etc. Further, risk assessment does not remain constant and generally people feel a greater sense of risk when risk is more immanent or possible, is discussed more, or have personal experience with the risk. Public engagement in wildfire mitigation activities in the WUI may rely, in part, on local communities (firefighting agencies, etc.) maintaining strong public campaigns about wildfire risk, the community or state developing landscaping and building rules, and developing financial assistance programs, as well as continually providing multiple avenues to accentuate participation in home and community wildfire protection activities.

## Notes

1 "What is your age in years?" An open-ended response formation was used.
2 "What is your gender?" Response categories included male, female, other, and prefer not to say. All respondents in the study replied either male or female with females being coded a 1 and males being coded a 0.
3 "What is the highest level of education you have completed?" Response categories provided were: 1 = junior high or less, 2 = some high school, 3 = high school or GED, 4 = Associate's degree, technical school, or some college, 5 = bachelor's degree, and 6 = master's, doctoral, or professional degree.
4 "Please indicate how concerned you are about the following possible effects of wildfire in Central Oregon: Damage to your private property." The response categories were 1 = not a concern, 2 = slight concern, 3 = moderate concern, and 4 = great concern.
5 "Considering the forests immediately around your home, what is the chance of wildfire of any severity in the next 5 years? Place a mark (X) between 0% and 100% or mark don't know."|—————————————|————————— —————————|——————————————|—|— ————————————————————————|———————————— ——————| 0% 20% 40% 60% 80% 100%

6 "Were you ever evacuated (voluntary or mandatory) due to wildfire in the past 5 years?" Response categories used were 1 = yes and 0 = no.
7 "Does your homeowners' association or subdivision have rules about landscaping or building materials in your area to help protect against fires?" Response categories were 1 = yes, 2 = no, 3 = don't know, and 4 = I don't live in a homeowner's association or subdivision.
8 "Is the neighboring property developed with a structure or undeveloped?"
9 "How close is your home in Central Oregon to a wildland area (either forest or rangeland)?" Response categories were 1 = live within a wildland area, 2 = adjacent to a wildland area, 3 = between 100 and 300 yards, 4 = more than 300 yards by less than 1 mile, 5 = between 1 and 3 miles, 6 = more than 3 miles.
10 "Who do you receive information from, talk with, or seek advice from about actions on your property for reducing fire risk, or making changes to your home to improve fire safety?" The 12 response categories included family member, neighbor, neighborhood association, local fire department, local fire awareness group (e.g., Project Wildfire, etc.), local collaborative group (e.g., Deschutes Collaborative Forest Project, etc.), city or county government, university extension agent, Oregon Department of Forestry, Bureau of Land Management, The Nature Conservancy, and the U.S. Forest Service. Response categories used were 1 = yes, 0 = no.

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