Environmental Management (2024) 73:579–594
https://doi.org/10.1007/s00267-023-01909-7

Cultural Theory, Wildfire Information Source, and Agency Public Trust: A Central Oregon Case Study

Brent S. Steel[1] · Nicholas P. Lovrich[2] · John C. Pierce[3]

Received: 1 May 2023 / Accepted: 28 October 2023 / Published online: 20 November 2023

Abstract

With the increasing occurrence and severity of wildfires in the U.S., and especially in the forests and rangelands of the western U.S., it is important to know which wildfire information sources are trusted by households and the amount of trust placed on natural resources agencies to manage for wildfire. The Theory of Motivated Reasoning suggests that people will trust and use those information sources that conform to their own value and ideological orientations. Similarly, trust in natural resource agencies' ability to manage wildfire may also be the result of cultural traits. This study uses Cultural Theory as a theoretical perspective to determine those value systems, and how cultural traits motivate people to use and trust various wildfire information sources and the agencies tasked with managing wildfire. Using random sample surveys of Wildland-Urban-Interface (WUI) households in fire-prone Deschutes County in central Oregon, the study finds that *egalitarians* are significantly more likely than those with other cultural traits to use and trust natural resource agency information sources, while *individualists* are more likely to use and trust family members and neighbors for their information. Similarly, egalitarians are trusting of natural resource managers to use prescribed fire, manage naturally ignited fires, and to thin forests to reduce fuels. Individualists are less trusting of government agencies to use the same approaches to reduce fuels. The study concludes with some suggestions for how wildfire policy makers and managers can use these findings to communicate more effectively important wildfire information to audiences with differing cultural traits and differing levels of natural resource agency trust.

Keywords Cultural Theory · Motivated Reasoning · Wildfire · Agency Trust · Wildfire Management

Introduction

Climate change is contributing to an increase in the frequency and severity of wildfires in the United States (Abatzoglou and Williams 2016; Schoennagel et al. 2017). As global annual mean temperature rises, droughts become more frequent and vegetation dries out, and the conditions for wildfires become more favorable. In addition, climate change is simultaneously altering precipitation patterns, leading to longer dry periods that increase the risk of wildfires in larger areas of the country (USDA Forest Service 2022). Wildfires have already caused significant damage in many parts of the United States, including California, Oregon and Washington states on the west coast. In recent years, these states have experienced some of the worst wildfires in recorded history, with millions of acres burned and thousands of homes destroyed (National Interagency Fire Center 2021, 2020, 2019). The 2020 wildfire season in the western United States was particularly devastating, with record-breaking wildfires burning over 10 million acres of land. Oregon in general has been experiencing an increase in the number and severity of wildfires in recent years with the 2020 wildfire season being one of the most destructive ever recorded. In 2020 there were 983 wildfires in the state destroying 1,221,324 acres (494,252 ha), 300+ structures, and causing 11 deaths. In 2021 there were 1134 wildfires burning 653,000 acres

These authors contributed equally: Nicholas P. Lovrich, John C. Pierce

✉ Brent S. Steel
bsteel@oregonstate.edu

[1] School of Public Policy, Oregon State University, Corvallis, OR 97331, USA

[2] School of Politics, Philosophy and Public Affairs, Washington State University, Pullman, WA 99164, USA

[3] School of Public Affairs and Administration, University of Kansas, Lawrence, KS 66045, USA

(264,000 ha) and causing 1 death (Oregon Department of Forestry 2022).

Climate change is also exacerbating the impact of wildfires. Smoke from wildfires can worsen air quality and have negative health effects on people who experience prolonged exposure (Environmental Protection Agency 2022). In addition, wildfires can release large amounts of carbon dioxide and other greenhouse gases into the atmosphere, contributing to further climate change (Liu, Mickley and Sulprizio 2016). There is little doubt that climate change and drought are contributing to an increase in the frequency and severity of Wildfires in the U.S., especially western states (Burke, Driscoll, Heft-Neal, and Wara 2021; Abatzoglou and Williams 2016). The public is also increasingly concerned about the increase in wildfires and smoke. A recent survey of voters conducted by The Nature Conservancy and the Aspen Institute found that 39 percent of respondents knows someone who has been personally impacted by wildfire and smoke (2023: 9). The survey also found that voter concern about wildfires has increased by 18 percent since a previous poll in 2018, and that there is strong bipartisan support for increased federal investment to reduce the risk of wildfire (77% Republicans, 92% Democrats, 74% Independents).

To address the problems associated with wildfires, it is necessary to both mitigate climate change and take steps to prevent and manage wildfires through evidence-based management practices and increasing resources available for both firefighting and prevention efforts (Hanan et al. 2021). It is also important to ensure that local communities are prepared for the impacts of wildfires, including through better land-use planning, evacuation planning, and public education efforts. This is especially true for landowners and households in the Wildland-Urban Interface (WUI), people who are at the highest risk from wildfire and the damage it can cause to life and property. Therefore, it is important to understand what sources people make use of and trust for information about wildfire and the factors that are associated with information source preferences. There is much concern by forest and rangeland managers and scientists that there has been much misinformation disseminated concerning wildfire in recent years. As a large group of prominent forest scientists have argued, "like misinformation about climate, misinformation about wildfire has flourished in the media and in political discourse" (Jones et al. 2022: 392). There also has been many wild conspiracy theories circulated about the causes of wildfires from Representative Marjorie Taylor Greene's "Jewish Space Lasers" starting fires in northern California (Dutton 2021) to antifacist ("Antifa") activists starting fires in Oregon and Washington (Caldera 2020). Using the Theory of Motivated Reasoning as a basis of inquiry, this study will examine how cultural biases, based on Cultural Theory, may lead people to use and trust particular sources for wildfire information, as well as the level of trust for government agencies tasked to manage wildlands. This article will briefly review the wildfire information source literature first, and then review the Theory of Motivated Reasoning and Cultural Theory next, followed by a description of the case study site of Deschutes County, Oregon. The article will then discuss the WUI home and landowners samples and surveys, followed by analyses of the survey data.

Wildfire Information Sources

The literature on wildfire information source use and trust examines a variety of factors that influence effective communication. The factors include the credibility of the source (Toman et al. 2006), transparency of communications (Toman et al. 2006), past experience with wildfire events (Kroepsch et al. 2017; McCaffrey et al. 2011), wildfire agency local and community engagement (Dickinson et al. 2015; McCaffrey et al. 2011), social networks and word of mouth (Crow et al. 2015; Koebele et al. 2015; Brenkert-Smith et al. 2013; Brenkert-Smith 2010), and effective risk communication (Brenkert-Smith et al. 2013). Research by Brenkert-Smith et al. found that both "vertical" (expert information sources such as the US Forest Service) and "horizontal" (nonexpert information sources such as neighbors and friends) are important sources of wildfire information and are "…associated with perceived risk of experiencing a wildfire" (2013: 800). The work by Toman et al. (2006) finds that the most effective method of communicating wildfire information is through interactive approaches where wildfire agencies directly engage with the public through guided field trips, interpretive centers, and public meetings. However, as with Brenkert-Smith et al. (2013), Toman et al. (2006) and Taylor et al. (2007) also found that "unidirectional" methods such as TV public service messages and brochures can also contribute to public wildfire knowledge.

The work by McCaffrey et al. suggests that "…key information sources and motivating factors vary by location and that it is not necessary to have relationships between community members to create defensible space" (2011: 475). These findings are consistent with recent field research from Alaska's interior where four wildfire information "audiences" were identified that have differing information needs and differing levels of trust for different information sources (Garbis et al. 2023). The Alaska audiences included active information seekers, people too busy to seek information, people that live off-grid, and Indigenous communities. In a survey of households in areas where five large fires had taken place, Steelman et al. (2015) also found that while people use a variety of sources for wildfire

information, they also found that "…significant gaps between the sources that were used by most respondents and those that they rated as useful or trustworthy" (2014: 615). Typically, most studies find that while people use a variety of sources for information, public agencies such as local fire departments are the most trusted sources of wildfire information (Steelman et al. 2015; Taylor et al 2007). In general, the literature identifies both the importance of formal and informal information sources to inform the public about wildfire risk and mitigation, and that context and and information source trust matters. This research will examine if CT can provide a more robust understanding of which wildfire information sources are used and trusted by individuals with differing cultural traits. The next section will provide a literature review of motivated reasoning and CT to provide a background for the study.

Motivated Reasoning and Cultural Theory

Motivated reasoning (MR) is a psychological theory that suggests that people's beliefs and attitudes are influenced not only by experience and evidence, but also by emotional and motivational factors. In MR, people *selectively* process information to support their pre-existing beliefs and values, while largely disregarding information that conflicts with their predispositions (Gerber and Green 1999; Kunda 1990). MR can be seen as a natural human tendency that helps people maintain their self-esteem and sense of identity by protecting their beliefs and values (Weston et al. 2006). This means that people are more likely to accept new information that confirms their beliefs and values, and are inclined to dismiss new information that challenges them. In other words, people are motivated to reason in a way that supports their beliefs and values rather than in a way that is purely objective or "rational" vis-à-vis an open-minded search for insight (Rudolph 2006; Lodge and Taber 2005; Kunda 1990).

MR can also be influenced by factors such as emotions, social identity, and group affiliation. People are more likely to accept information that bolsters their social identity or group affiliation, even if that information is not entirely accurate (Peralta et al. 2021; Nir 2011). In addition, continued exposure to biased information has been found to be one of the main reasons people's attitudes and positions on many issues become progressively extreme (Garret and Stroud 2014). Overall, MR suggests that people are not purely rational beings but are instead heavily influenced by their belief systems and values. However, while much research over the years have shown that U.S. voters can be correctly characterized as motivated reasoners (Taber and Lodge 2006; Kunda 1990), research by Redlawsk, Civettini and Emmerson suggests that there may be a "tipping point" when voters are overcome with extensive "…information incongruent with expectations" and therefore change their minds (2010: 563). Other research also has shown that when people are exposed to "balanced content" on political issues when compared to "one-sided" content, they are less likely to process information from a MR framework (Peralta et al. 2021). Given the results of the Redlawsk et al. (2010) and Peralta et al. studies (2021), some hope exists that it is possible to overcome MR and misinformation in wildfire outreach and education efforts with careful attention to messaging content and who is disseminating the information.

Turing now to Cultural Theory (CT), this study will be using CT in conjunction with MR to examine empirically wildfire information source use and trust, and trust in natural resource agencies' ability to manage wildfire in the fire-prone Deschutes County in central Oregon. In 1982, researchers Mary Douglas and Aaron Wildavsky proposed a then-novel way to explore risk analysis (Douglas and Wildavsky 1982). Their research expanded on research into risk through the application of *grid/group cultural theory*, asserting that there are two fundamental elements of social (grid) and political relations (group) that taken in combination creates four cultural biases: individualist, hierarchical, egalitarian, and fatalist (Johnson et al. 2020). Central to this theory is the assertation that perception of risk is directly tied to culture, or more specifically, to the 'cultural biases' that reflect people's worldviews (Johnson et al. 2020). CT suggests that culture is not merely a set of static beliefs and values but is rather a dynamic and constantly evolving system that adapts and changes over a lifetime. It also emphasizes the importance of power relations and social hierarchies in shaping cultural values and practices, and how these can contribute to inequality and social conflict (Swedlow 2014). CT has been applied to the study of social life in a wide range of fields, including anthropology, sociology, political science, public policy studies, and social psychology. It has been used to explore topics such as the role of culture in shaping individual perceptions of environmental risk (Steg and Sievers 2000), public perceptions of policy expert credibility (Lachapelle et al. 2014), and political process preferences (Zanocco and Jones 2018).

CT scholars argue that there are four distinctive worldviews, or what they call "cultural biases" -- namely, individualism, hierarchism, egalitarianism, and fatalism. These cultural biases or traits "…serve as broad social orientations upon which individuals relay to formulate more specific opinions" (Ripberger et al. 2012: 715). The hierarchical worldview is associated with a belief in clear social hierarchies and a preference for strong leaders who can

maintain order and stability. The individualistic worldview, on the other hand, emphasizes personal autonomy and individual freedom. The egalitarian worldview values equality and social justice, while the fatalistic worldview sees the world as chaotic and unpredictable (Mamadouh 1999; Swedlow 2014). In their research investigating the relationships between CT, political ideology and political knowledge-holding, Ripberger et al. conclude that CT "…is related to but different than political ideology, offers a robust system of worldviews that both high- and low-knowledge individuals might draw upon to formulate opinions and make decisions" (Ripberger et al. 2012: 713).

Using CT in conjunction with MR, this study examines the extent to which cultural biases lead individuals to use and trust certain wildfire information sources and avoid other sources that are not consistent with their cultural bias. CT has been used to examine individual perceptions of wildfire risk (Saengawut et al. 2015), but has never been used to examine wildfire information source use and trust. In addition, with the sole exception of Lachapelle et al.'s (2014) study on public perceptions of policy expert credibility, there is little to no previous research on CT's application to information source use and trust. Fortunately, Lachapelle et al.'s research and the research of some other researchers do provide a basis for how CT may inform information source use and trust.

In their study of CT and environmental activism in the Pacific Northwest, Ellis and Thompson found that egalitarians are aligned with environmental concerns such as climate change and deforestation "…because they desire to transform how human beings live with one another in an egalitarian direction" (1997: 674). Individualists, in contrast, believe that nature is more forgiving and resilient which "…makes it easier for them to justify laissez-faire and to resist those who would enhance centralized, governmental control" (1997: 674). Lachapell et al. echo these findings as they argue that egalitarians tend to emphasize the "social whole" of society and eschew individualist perspectives while individualists "…place greater emphasis on individual, rather than collective" (2014: 678).

Based on these prior findings, the expectation would be that individualists would prefer nongovernmental wildfire information sources while egalitarians would be more open to a variety of information sources including governmental agencies. For hierarchs, it is expected that they would prefer "expert" wildfire information sources such as government agencies, which are tasked with managing wildfires, including the U.S. Forest Service, the Bureau of Land Management, and the Oregon Department of Forestry. Hierarchs would be more willing to defer to experience and authority and prefer government rather than the unregulated market making policy decisions (Ripberger et al. 2014: 513). They believe that experts rather than the public should be responsible for making decisions concerning complex issues such as wildfire. As for Fatalists, they believe that "…the system is incapable of fixing anything because the things that happen in life are essentially random (at the very least) beyond human control" (Ripberger et al. 2014: 514). Therefore, it is expected that Fatalists are most likely not to use many wildfire information sources as additional information won't solve any potential problems.

Methods

Study Area

This research is based on a case study in Deschutes County, Oregon, which is located in central Oregon, between the 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 an estimated population of 207,921 in 2022 and is projected to grow to 308,894 by 2050 (Chen et al. 2022). The county seat is Bend, which has an estimated population of 102,059 in 2021. Much of the western part of the county lies in the Deschutes National Forest, which is managed by the U.S. Forest Service. The forest takes up about 51 percent of the entire county, and much of the population growth experienced there has been on private forest lands in the WUI. In addition, the Bureau of Land Management also has smaller tracks of land which they manage, areas that are mostly rangelands. The U.S. Forest Service has characterized the population growth situation in the county as follows:

> Central Oregon is experiencing the most extensive community growth in the State with some communities increasing almost 30 percent in the past 10 years. Hundreds of thousands of acres of Federal land are immediately adjacent to communities and subdivisions, which puts those communities and subdivisions at risk of fire.

As mentioned above, Oregon has been experiencing an increase in number and intensity of wildfires in recent years. In 2021 the state experienced 20 of the largest wildfires since 2002 (Price and Rein 2021). Deschutes County has seen an increase of fires as well over recent years (Deschutes National Forest 2022). In fact, central Oregon and Deschutes County have been classified as having an "immediate threat" from wildfire affecting communities by the U.S. Forest Service, leading to it being selected to receive $131 million to begin mitigation efforts under a *Wildfire Crisis Strategy*, a provision of the 2022 Bipartisan Infrastructure Law passed by Congress and signed by President Biden (Deschutes National Forest 2022).

Surveys

Two household surveys conducted in the Spring and Summer of 2021 and the Winter of 2023 are used in the forthcoming analyses to examine the potential impact of cultural traits on respondent use and trust of wildfire information sources, and the impact of cultural traits on natural resource agency trust to manage wildfire effectively. The 2021 survey focused on wildfire information source use and trust while the 2023 survey focused on agency trust to manage wildfire. Both surveys included the same measures of cultural traits and demographic variables. Random samples of households located in the wildland-urban-interface (WUI) were identified using county tax lot lists and an Oregon Department of Forestry revised WUI map (Oregon Department of Forestry, n.d.) based on the U.S. Forest Service's archival report *1990–2010 Wildland-urban Interface of the Conterminous United States-Geospatial Data* (Radeloff et al. 2017). The WUI is defined by the U.S. Fire Administration as (n.d.):

> The WUI is the zone of transition between unoccupied land and human development. It is the line, area or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.

In other words, the WUI is the area most at risk from wildfire and therefore where human occupants should be at least somewhat familiar with wildfire dangers and potential mitigation efforts (Schoennagel et al. 2017).

The survey design and development process followed Dillman's Tailored Design Method, with dissemination involving three waves of mailings along with an online (Qualtrics) option provided (Dillman et al. 2014). First, a hand signed postcard was sent to each household announcing the survey which also included an individual survey identification number and the URL if they preferred to complete the online (Qualtrics) survey. One week after the postcard was sent, households that had not completed the online survey were sent a mail survey with a hand-signed cover letter and a postage prepaid return envelope. After another week households that had not completed the online survey or returned the mail survey were sent a reminder letter, another copy of the mail survey, and postage prepaid return envelope. Both surveys were designed to be completed in 15 or fewer minutes using pretests, and the average respondent took about 12 min to complete the online versions of the survey for both years. As discussed above, Deschutes County is in a wildfire-prone area and has experienced many wildfires in recent years, which makes the topic of the survey salient to WUI households and therefore potentially impacting survey response rates. For the 2021 survey, questionnaires were sent to 1500 randomly selected WUI households with 458 surveys completed for a response rate of 30.5 percent. For the 2023 survey, questionnaires were also sent to 1500 randomly selected households with 421 completed for a 28.1 percent response rate. Data were analyzed using IBM's SPSS Statistics, Version 29. While the survey data collected contributed to a Natural Science Foundation research project ("Developing Adaptive Capacity in Wildfire-prone Regions"), it was entirely financed and implemented through the Oregon Policy Analysis Laboratory in the School of Public Policy at Oregon State *University*.

During the implementation of both the 2021 and 2023 surveys, there were no significant wildfire events in the county, and there were no significant statistical differences between the 2021 and 2023 respondents for common sociodemographic and cultural trait variables. In addition, those household randomly sampled and surveyed in 2021 were excluded from the 2023 sample.

Analytical Approaches

In the forthcoming multivate analyses, both OLS regression and Ordinal regression are used to examine the impact of cultural traits on information source use and trust and trust in agency wildfire management while controlling for sociodemographic characteristics, risk perceptions, previous wildfire exposure, and proximity of property to wildlands. OLS regression will be used for factor scores associated with information source use and trust as they are interval level data, while ordinal regression is used for the three agency trust questions which are ordinal variables.

Measuring Cultural Traits

To measure CT orientations, the study employed a set of twelve statements that cover all four cultural biases, a question set which was used by Zanocco and Jones (2018) in their examination of cultural worldviews and political process preferences. The same twelve statements were included in both the 2021 and 2023 WUI household surveys. For each of the statements, respondents were asked to "indicate your level of agreement or disagreement for the following statements concerning the role of individuals in society," with a scale ranging from 1 = strongly disagree to 7 = strongly agree. Mean scores for separate statements are included in Table 1 along with additive index means for each of the four worldviews. The responses for each cultural trait were summed for each individual to construct the four indices with a range of 3

Table 1 Cultural Traits for 2021 and 2023 Deschutes County WUI Household Surveys

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]		
Individualist Statements:	**2021**	**2023**
	Mean / s.d.	Mean / s.d.
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	4.03 / 1.76
b. Even the disadvantaged should have to make their own way in the world.	4.08 / 1.66	4.08 / 1.67
c. We are all better off when we compete as individuals.	3.76 / 1.70	3.78 / 1.69
Combined Individualist Index =	11.84 / 4.73	11.90 / 4.76
N =	450	415
Cronbach's alpha =	0.915	0.921
Hierarchical Statements:		
d. The best way to get ahead in life is to do what you are told to do.	2.99 / 1.60	3.05 / 1.61
e. Our society is in trouble because we don't obey those in authority.	3.01 / 1.49	3.09 / 1.54
f. Society would be much better if we imposed strict and swift punishment on those who break the rules.	3.51 / 1.63	3.58 / 1.62
Combined Hierarchical Index =	9.51 / 3.97	9.72 / 4.08
N =	450	415
Cronbach's alpha =	0.790	0.814
Egalitarian Statements:		
g. What our society needs is a fairness revolution to make the distribution of goods more equal.	3.45 / 1.67	3.35 / 1.56
h. Society works best if power is shared equally.	3.44 / 1.65	3.32 / 1.58
i. It is our responsibility to reduce the differences in income between the rich and poor.	3.52 / 1.79	3.38 / 1.75
Combined Egalitarian Index =	10.40 / 4.75	10.06 / 4.68
N =	450	416
Cronbach's alpha =	9.20	0.951
Fatalist Statements:		
j. Most of the important things that take place in life happen by random chance.	3.67 / 1.66	3.66 / 1.64
k. No matter how hard we try, the course of our lives is largely determined by forces outside our control.	3.10 / 1.54	3.12 / 1.49
l. It would be pointless to make serious plans in such an uncertain world.	3.17 / 1.76	3.33 / 1.73
Combined Fatalist Index =	10.00 / 3.89	10.11 / 4.11
N =	450	417
Cronbach's alpha =	0.684	0.795

(lowest level of agreement for each trait) to 21 (highest level of agreement for each trait).

When examining the combined cultural indexes, the highest mean scores are for the individualists in both the 2021 and 2023 surveys. Mean scores for the first two individualist statements are equivalent to 'neutral' responses, while mean scores for the third statement "we are better off when we compete as individuals" is trending toward disagreement. Given the conservative political history in central Oregon and Deschutes County, it is not surprising that individualism would garner the highest mean scores (Buylova et al. 2018; Weber et al. 2018). The second highest mean score for the combined indexes is for egalitarianism in the 2021 survey, which may well reflect the in-migration of new and younger residents (Chen et al. 2022) that have been turning the country from a formerly politically conservative county into a more politically moderate to liberal jurisdiction (Weber et al. 2018). However, for the 2023 survey, the egalitarian index mean ($\bar{X} = 10.06$) is very similar to the mean for fatalism ($\bar{X} = 10.11$). The combined indexes with the lowest mean scores are for the hierarchism index for both survey years ($2021 = 9.51$, $2023 = 9.72$). All four of these cultural indices will be used in multivariate analyses, along with other control variables, to examine wildfire information source use and trust.

Table 2 Sociodemographic and context control variables for 2021 and 2023 surveys

Variable	Variable description	2021 Mean / s.d.	2023 Mean / s.d.
Age	What is your age in years? [range = 25 to 85]	58.01 / 13.67 $N = 455$	55.86 / 13.77
Gender	Gender [1 = female, 0 = male]	0.47 $N = 450$	0.48 $N = 414$
Educ	Level of formal education [1 = junior high or less to 6 = graduate or professional degree]	4.55 / 0.99 $N = 449$	4.52 / 0.981 $N = 414$
Income	Annual household income before taxes [1 = less than $15,000 to 6 = $100,000 or more]	4.11 / 1.44 $N = 405$	4.16 / 1.72 $N = 393$
Concern	Level of concern of wildfire damage to central Oregon [1 = not a concern to 4 = great concern]	2.71 / 1.11 $N = 458$	2.65 / 1.11 $N = 421$
Risk21	Risk of wildfire around home in next 5 years [0% to 100%]	58.05 / 32.08 $N = 456$	NA
Risk23	Risk of wildfire to residence or property [1=no risk to 4 = high risk]	NA	2.83 / 1.19 $N = 416$
Exposure	Previous experience with wildfire near neighborhood [1 = yes, 0 = no]	0.31 $N = 438$	NA
Wildland	Proximity of home to wildland area [1 = live within a wildland area to 6 = more than 3 miles]	4.13 / 1.72 $N = 428$	NA

The control variables to be included in the following multivariate analyses are provided in Table 2. They include sociodemographic variables such as age,[1] gender,[2] formal educational attainment,[3] and annual household income.[4] These variables were included in both survey years. Other variables include general level of concern of wildfire in central Oregon (both 2021 and 2023),[5] perceived risk of wildfire asked in different formats each survey year,[6] previous exposure to wildfire in 2021,[7] and proximity of the respondents' home to a wildland area in 2021.[8] As the previous discussion of the wildfire information source literature suggests, these contextual variables have been found to be associated with how WUI homeowners in Arizona, California, and New Mexico perceive and respond to wildfire issues (e.g., Saengawut et al. 2015). For the control variables that were common in both the 2021 and 2023 surveys, there were no statiscally significant difference between the two sets of survey respondents. The average age of WUI respondents is 58.01 years for the 2021 survey and 55.86 years for the 2023 survey. Forty-seven percent of respondents in 2021 were females and 48 percent of 2023 respondents were female. In terms of education, the average respondent for both survey years has a bachelor's degree and the average annual household income is between $50,000 to $74,999. US Census population projections for Deschutes County in 2022 state that the county is 50.1 percent female, with 38.7 percent of the population having a bachelor's degree or higher, a median household income of $74,082, and 21.5 percent of the population 65+ years old (US Census 2022). Given that respondents had to be 18 years of age (IRB requirement) and that only WUI households were surveyed, it is difficult to determine how representative the samples are. However, given that surveys were sent to random samples and that the sociodemgraphic variables are similar for both surveys there is some degree of confidence that the results are fairly robust.

For the level of concern that wildfire will damage their private property, the average respondent for both survey

[1] "What is your age in years?" with an open-ended response option.
[2] "Are you…" with the response options: female, male, other, prefer not to say.
[3] "What is the highest level of education you have completed?" with the response options: 1 = junior high or less, 2 = some high school, 3 = high school or GED, 4 = associates degree, technical school, or some college, 5 = bachelor's degree, 6 = master's, doctoral, or professional degree.
[4] "What is your annual household income before taxes?" with the response options: 1 = less than $15,000, 2 = $15,000 to $24,999, 3 = $25,000 to $49,999, 4 = $50,000 to $74,999, 5 = $75,000 to $99,999, 6 = $100,000 or more.
[5] "Wildfire may create concerns for some people. Please indicate how concerned you are about the possible effects of wildfire in central Oregon? Damage to your private property" with the response options: 1 = not a concern, 2 = slight concern, 3 = moderate concern, 4 = great concern.
[6] *Survey 2021:* "Considering the forests immediately around your home, what is the chance of wildfire of any severity in the next 5 years" with the response option scale of 0 percent to 100 percent; *Survey 2023:* "We are interested in your perceptions about the future risk of wildfires and the possible need of taking greater action to reduce future wildfires. Please circle the number that indicates the level of risk you perceive for future fires in Central Oregon—Wildfire threat to your residence or property" with the response options: 1 = no risk, 2 = low risk, 3 = moderate risk, 4 = high risk.
[7] *Survey 2021:* "Within the last five years, have any of the following occurred on your property or nearby public or private lands?" with the response options of "in my neighborhood, 1 = yes, 0 = no."
[8] *Survey 2021:* How close is your home in Central Oregon to a wildland area (either forest or rangeland)? With the response options: 1 = live within a wildland area, 2 = adjacent to a wildland area, 3 = between 100 and 300 yards, 4 = more than 300 yards but less than a mile, 5 = between 1 and 3 miles, 6 = more than 3 miles.

Table 3 Wildfire information source use and trust (2021)

Question: 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? How much do you trust the information you get from this person/group?

		Level of Trust			
	Use Source	None	Limited	Moderate	Full
Information source:	Percent	Percent	Percent	Percent	Percent
Local Fire Department ($n = 457$)	50.1	1.3	2.2	12.9	83.5
Family Member ($n = 458$)	42.8	3.3	6.0	32.4	58.2
Neighborhood Association ($n = 458$)	35.8	10.3	13.3	43.6	32.7
Neighbors ($n = 458$)	34.9	2.1	15.8	55.5	26.7
U.S. Forest Service ($n = 456$)	32.0	4.6	2.6	30.3	62.5
Local Fire Awareness Group (e.g., Project Wildfire) ($n = 456$)	31.6	4.1	4.8	19.0	72.1
Oregon Department of Forestry ($n = 456$)	28.5	5.8	7.9	30.9	55.4
City and County Government ($n = 455$)	23.1	8.2	11.8	38.2	41.8
Local Collaborative Group (e.g., Deschutes Collaborative Forest Project) ($n = 454$)	13.0	15.4	7.7	25.6	51.3
Local Nature Conservancy ($n = 456$)	12.9	21.0	8.6	24.7	45.7
Bureau of Land Management ($n = 456$)	9.6	22.2	12.7	42.9	22.2
University Extension Agent ($n = 455$)	8.1	15.7	11.8	21.6	51.0

years responded that they had slight to moderate concerns (mean scoures of 2.71 and 2.65). Respondent risk assessment of probability that wildfire will threaten their homes used different questions for the 2021 and 2023 surveys. In 2021 respondents were asked the percentage chance that wildfire will threaten their homes in the next 5 years with the average respondent saying approximately 58 percent, which given the location of their homes in the WUI is probably an accurate perception. In 2023 respondents were asked about "future" wildfire risk to their property, with the average respondent answering "low" to "moderate" risk, but the mean score ($\bar{x} = 2.83$) is trending toward moderate risk. The final two control variables were only asked in the 2021 survey and include a question that asked if they have had "previous experience with wildfire near their neighborhood" and the proximity of their home to a wildland area. Thirty-one percent of respondents indicated that they have had previous wildfire near their neighborhood and the average respondent answered that their homes are "more than 300 yards but less than a mile" from a wildland area. Based on the previous literature review, it is expected that those WUI homeowners in Deschutes County that are concerned about wildfire in central Oregon, perceive risk to their homes or neighborhoods, who have been exposed to wildfire, and who live closer to wildland areas, to seek out more information about wildfire by accessing available information from diverse sources. However, it is also expected that cultural biases will mitigate which of those sources are actually being accessed and being trusted. Because wildfire information source use and trust was only asked in the 2021 survey, only those control variables asked in 2021 will be used in the forthcoming multivariate analyses for information source use and trust.

Dependent Variables

To ascertain information source use and trust, the 2021 survey asked respondents "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? Respondents were provided a list of 15 possible sources for wildfire information ranging from family members and neighbors to the Bureau of Land Management and the U.S. Forest Service (see Table 3). They were first asked, "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?" If they indicated that they used the source, then they were asked "how much do you trust the information you get from this person/group?" with response categories of "1 = none," "2 = limited," "3 = moderate," and "4 = full." Trust can take several distinct forms such as "particular trust" (based on knowledge gained from close contact), "social trust" (trust of others like yourself), and "political trust" (trust in political institutions) (Newton and Zmerli 2011). For this particular study, we do not distinguish between these three types of trust. The possible information sources listed do cover the trust gamut in our estimation.

Fig. 1 Wildfire management definitions

These next questions ask about specific practices resource managers use to reduce flammable fuels and the risk of wildfire in public forests and rangelands. The terms used are:

- **Prescribed fire:** also called controlled burning, this practice involves intentionally setting ground fires to reduce forest fuels like grass, brush, and small trees.
- **Monitoring and managing wildfire:** formerly called "let it burn," this practice involves managing some wildfires by monitoring them and allowing them to burn in a way that achieves ecological objectives without undue risk of loss to property and life. This is in contrast to a wildfire that is automatically suppressed.
- **Thinning:** using chainsaws or other machinery to reduce the number of small trees where they are so dense they increase the risk of wildfires.

Table 4 Trust in public natural resource managers (2023)

Question: For reducing the threat of wildfire, how much trust do you have in public natural resource managers (e.g., U.S. Forest Service, Bureau of Land Management) in your area…

	None Percent	Limited Percent	Moderate Percent	Full Percent
…to responsibly and effectively use prescribed fire? ($N = 408$)	20.6	21.6	39.7	18.1
…to safely allow some naturally ignited fires to burn? ($N = 405$)	24.0	20.2	35.3	20.5
…to responsibly use thinning to reduce forest fuels? ($N = 414$)	12.8	17.1	51.9	18.1

In terms of information source use, as the literature suggests, the local fire department was the most used source at 50.1%, followed by family members (42.8%), neighborhood associations (35.8%), neighbors (34.9%), the U.S. Forest Service (32%), and local fire awareness groups such as Project Wildfire (31.6%), which is a very active Deschutes County-based wildfire boundary educations group. The source least used was university extension agents (8.1%), the Bureau of Land Management (9.6%), and a local wildfire collaborative group (13.0%) that deals mostly with management issues rather than civic outreach. Low use of the BLM is most likely related to the nature and location of the lands it manages in the county, which are located in the sparsely populated rangelands in the arid eastern side of the county.

Turning now to how much trust each information enjoys, 83.5 percent have full trust in their local fire department, 72.1 percent have full trust in the local fire awareness group (72.1%), and 62.5 percent have full trust in the U.S. Forest Service. Few sources used by respondents garnered none or limited trust in the sources they used, which makes sense because why would someone get information from a group it didn't trust. However, 22.2 percent of those who said they use the BLM for information responded "none" to their level of trust and 21.0 percent answered similarly concerning the local Nature Conservancy. As a management agency, the BLM manages federal rangelands in the county and therefore interacts with ranchers who are not typically in favor of federal rules and policies that likely engender lower levels of trust. However, the Nature Conservancy results are more perplexing to explain. As a membership organization with with fewer potentential recipients of their information, perhaps there is a lower level of overall familiarity with the organization than other sources listed that may lead to lower levels of trust.

In order to investigate wildfire agency trust to manage wildfire, the 2023 Deschutes County WUI household survey included questions about trust in natural resource agencies to effectively use established management strategies. The three specific management approaches natural resource agencies use to mitigate the risk of wildfire include prescribed fire, monitoring and managing wildfire ("let it burn"), and the thinning of forests. All three techniques have been used by natural resource agencies in Deschutes County's public forests and on rangelands (Deschutes National Forest 2022). To make sure that survey respondents were familiar with the. Management techniques in question, respondents were provided definitions before asking a variety of questions concerning the topic, including agency trust (see Fig. 1).

The questions used to ascertain respondent trust in public natural resource managers' ability to apply these wildfire mitigation efforts are provided in Table 4. Both prescribed fire and monitoring and managing wildfire have been considered controversial by some members of the public due to situations where such fires got out of control and unintentionally burned areas outside of what had been planned (Fifer and Orr 2013; Manfredo et al. 1990; Ryan et al. 2013; Toledo et al. 2012). During the Summer of 2022, a prescribed fire conducted by the U.S.F.S. in Oregon's Malheur National Forest jumped the containment line and burned through a near-by ranch, which led to a confrontation with the ranch owners. The county sheriff appeared on the scene and promptly arrested the U.S.F.S. "burn boss," leading to much continuing controversy and hostility toward federal land managers (Baker 2022). Even though there

is some opposition to prescribed fire and "let it burn" management approaches to reduce fuels and therefore lessen the need to endure severe fires in the future, land managers and scientists view both management techniques as highly effective (Evans et al. 2015). And, as the previous survey data from The Nature Conservancy and Aspen Institute found, there is widespread support among the public for wildfire agencies to use a variety of approaches to reduce wildfire risk (2023). However, as Lachapelle and McCool remind researchers studying wildfire planning, "…building trust will help planning participants build a sense of ownership that is critical to successful community wildfire plans" (2012: 333).

Table 4 displays frequencies for three questions concerning the ability of public natural resource managers to implement the three wildfire management techniques responsibly. The lead-in question asked "For reducing the threat of wildfire, how much **trust** do you have in public resource managers (e.g., U.S. Forest Service, Bureau of Land Management) in your area…" Respondents were then provided with four response categories: 1 = none, 2 = limited, 3 = moderate, and 4 = full. For the first question, "…to responsibly and effectively use prescribed fire," 20.6 percent responded none, and 21.6 percent indicated limited trust. Over 39 percent responded that they had moderate trust, and only 18.1 percent said they had full trust. Certainly, these results reflect the on-going debate over using prescribed fire as a primary wildfire management technique.

The results for allowing naturally ignited fires to burn are similar in character to the prescribed burn responses, with 24 percent responding none and 20.2 percent answering limited trust. Over 35 percent indicated they had moderate trust, and 20.5 percent express full trust. Once again, these results mirror the current debate over managing naturally caused fires (e.g., lightening) versus fire suppression. This debate has been prevalent since the 1988 Yellowstone fires that burned 30 percent of the park's forest (Yellowstone Park 2022) and continues with the 2022 Yosemite National Park fires (National Park Service 2022). Thinning appears to be a more trustworthy management technique to reduce fuels, with only 12.8 percent responding none and 17.1 percent having limited trust. A slight majority of respondents (51.9%) have moderate trust, but only 18.1 percent answered full trust. Our next analyses investigate the degree to which cultural biases, as operationalized by CT, help to explain levels of trust in natural resources managers to implement these wildfire management strategies responsibly.

Findings for Wildfire Information Source Use and Trust

Table 5 reports the results of a principal components factor analysis of the fifteen sources of wildfire information.

Table 5 Principal components factor matrix of wildfire information source trust (2021 survey)

Information source	Local	Agency	Informal
Local Fire Department	0.532	0.093	0.451
Family Member	0.004	0.157	0.747
Neighborhood Association	0.507	–0.038	0.442
Neighbors	0.032	0.220	0.695
U.S. Forest Service	0.034	0.704	0.208
Local Fire Awareness Group (e.g., Project Wildfire)	0.743	0.107	0.027
Oregon Department of Forestry	0.252	0.661	0.091
City and County Government	0.583	0.221	0.190
Local Collaborative Group (e.g., Deschutes Collaborative Forest Project)	0.745	0.258	–0.118
Local Nature Conservancy	0.567	0.448	–0.044
Bureau of Land Management	0.118	0.751	0.147
Oregon State University Extension Agent	0.270	0.408	0.077
Eigenvalue =	3.707	1.317	1.083
Percent of Variance =	30.889	10.976	9.028

Information source use and trust were coded as follows for the analysis: 0 = do not use, 1 = use and no trust, 2 = use and limited trust, 3 = use and moderate trust, and 4 = use and full trust. Three quite distinct dimensions emerged with the first dimension including *local* sources such as local fire awareness groups, local collaborative groups, and the local Nature Conservancy. The second dimension included the major natural resource *agencies* -- to wit, the Oregon Department of Forestry, the BLM, and the U.S. Forest Service. The third dimension included what could be considered *informal* sources of information including family members and neighbors. For each of the three dimensions a factor variable was created for use in some forthcoming regression models wherein we investigate the degree to which CT predicts which wildfire information sources are used and trusted by citizens harboring differing cultural biases.

Table 6 provides OLS regression results for the three factors identified in the previous principal components analyses from which variables were generated for the factors *local*, *agency* and *informal* sources of wildfire information. F-test scores are statistically significant for all three models, indicating that each model is a good fit for the interpretation of the data in the statistical sense. Adjusted R^2 values range from 0.290 for the local model, 0.133 for the agency model, and 0.090 for the informal model. The first model examines the impact of the control variables and cultural traits on use and trust of local sources of wildfire information. The only significant control variables are education and concern and both variables are positive.

Table 6 Regression estimates for information source trust factor scores (2021)

	Local Coefficient (Std. Error)	Agency Coefficient (Std. Error)	Informal Coefficient (Std. Error)
Age	0.003 (0.004)	–0.004 (0.004)	–0.004 (0.004)
Gender	–0.178 (0.096)	0.114 (0.104)	0.069 (0.104)
Educ	0.267*** (0.054)	0.064 (0.059)	0.173** (0.059)
Income	0.008 (0.035)	–0.049 (0.038)	–0.038 (0.038)
Concern	0.155*** (0.048)	0.011 (0.052)	0.108* (0.052)
Risk	0.000 (0.002)	0.002 (0.002)	–0.001 (0.002)
Exposure	0.031 (0.066)	0.085 (0.072)	−0.034 (0.071)
Wildland	−0.017 (0.032)	0.030 (0.034)	−0.003 (0.034)
Indiv	−0.020 (0.013)	0.016 (0.014)	0.050*** (0.014)
Hierarch	−0.028* (0.013)	0.091*** (0.014)	−0.003 (0.014)
Egal	0.057*** (0.012)	0.038** (0.013)	−0.023 (0.013)
Fatal	0.025 (0.014)	–0.026 (0.015)	−0.010 (0.015)
F-test =	12.754***	5.393***	3.836***
Adj. R^2 =	0.290	0.133	0.090
N =	345	345	345

*$p \le 0.05$; **$p \le 0.01$; ***$p \le 0.001$

Those respondents with higher levels of formal education attainment and higher levels of concern of wildfire damage to their property are significantly more likely to use and trust local information sources than those with lower levels of education and wildfire concern. Turning now to the main focus of this research, the impact of cultural values on wildfire information source use and trust, two of the cultural traits provided statistically significant results including hierarchical and egalitarian indices. Those respondents with lower hierarchical index scores are significantly more likely to use and trust local information sources when compared to those with higher scores who are less likely to trust and use local sources. As previously discussed, those with a hierarchical worldview place a high value on formal lines of authority and defined, expertise-based roles in a society and local information sources may not be viewed as trustworthy as state and federal level wildfire agencies. For the egalitarian index, those respondents with higher index scores are more likely to use and trust local sources of information when compared to those with lower index scores. This is consistent with the previous discussion that egalitarians would use and trust many sources of information including local sources.

The second model in Table 6 examines control and cultural trait variables on use and trust of agency sources of information. Surprisingly, none of the control variables had a statistically significant impact of use and trust of these sources. However, the same two cultural trait variables that were significant in the local source model are also significant in the agency model. As expected, those respondents with higher hierarchical index scores were significantly more likely than those with lower scores to use and trust wildfire agencies for information such as the U.S. Forest Service, Oregon Department of Forestry, and Bureau of Land Management. Similarly to the local source model, those with higher egalitarian index scores were significantly more likely to use and trust agencies for information when compared to those with lower index scores. Both of these findings are consistent with research expectations with hierarchists valuing the formal and leading wildfire management agencies for information and egalitarians valuing multiple sources for information.

The third OLS model in Table 6 examines use and trust of informal sources of wildfire information. Similar to the local source model, both education and concern were positive and significant in the model. Those with higher levels of formal education were significantly more likely to use and trust informal sources such as family members and neighbors than those with lower levels. This is a somewhat surprising finding as the literature would suggest that the inverse would be more likely with less educated people relying on more informal sources and the more highly educated group relying on more expert information sources. However, the brief overview of the literature on wildfire information sources does suggest that informal sources can be an important component of wildfire information dissemination. The other significant control variable is concern, with respondents most concerned about property damage to their property more likely to use and trust informal information sources compared to those less concerned. Turning now to the cultural traits, only one of the variables had a significant impact on informal information source use and trust. As expected, those respondents with higher individualist index scores were significantly more likely to use and trust family members and neighbors than those with lower individualist index scores. While this cultural trait did not elicit significant results for the local and agency models, it does fit with CT whereas individualists would prefer the "market place" of informal information sources rather than formal expert sources.

The fatalist index did not produce a significant result in any of the three models, and the construct doesn't appear to be a useful cultural trait to predict what wildfire information sources are used and trusted by respondents in the Deschutes County WUI. Following the work of Zanocco and Jones (2018), different combinations of CT traits were investigated reflecting the Wildavsky and Douglas cultural map, but found no significant relationships for wildfire information use and trust. Overall, CT was found useful in identifying which information sources are used and trusted by certain cultural types, and if motivated reasoning is indeed present CT can help wildfire managers and policy makers identify the types of individuals and organizations that are best situated to conduct outreach and communicate new information to the public concerning wildfire issues.

Table 7 Ordinal regression estimates for trust in natural resource agencies (2023)

	Prescribed fire Coefficient (Std. Error)	Naturally ignited Coefficient (Std. Error)	Thinning Coefficient (Std. Error)
Age	0.004 (0.008)	−0.012 (0.008)	0.006 (0.008)
Gender	0.112 (0.201)	0.289 (0.206)	−0.613** (0.209)
Educ	0.019 (0.106)	0.057 (0.109)	−0.012 (0.109)
Income	0.054 (0.064)	−0.079 (0.065)	0.022 (0.065)
Concern	0.029 (0.100)	−0.074 (0.102)	−0.001 (0.103)
Risk	0.288*** (0.087)	0.287*** (0.088)	0.046 (0.088)
Indiv	−0.069* (0.028)	−0.103*** (0.029)	0.021 (0.029)
Hierarch	0.084** (0.027)	0.034 (0.028)	0.155*** (0.029)
Egal	0.075** (0.026)	0.108*** (.027)	0.186*** (0.029)
Fatal	−0.110*** (0.029)	−0.140*** (.029)	−0.069* (0.029)
Chi-square =	84.157***	150.201***	74.943***
Cox and Snell R^2 =	0.205	0.339	0.183
Nagelkerke R^2 =	0.221	0.363	0.200
N =	363	363	371

*$p \le 0.05$; **$p \le 0.01$; ***$p \le 0.001$

For hierarchists, it would be best to communicate through the major natural resource agencies such as the USFS. For Egalitarians, both local sources such as local government or a local fire awareness group (e.g., Project Wildfire in Deschutes County) and the natural resource agencies would be the best resources for effective dissemination of wildfire information. For individualists there would need to be some targeting of specific neighborhoods where wildfire information could be shared, perhaps through targeted mailings, television public service announcements, newspaper stories and/or op eds, or via social media. For fatalists, none of the listed individuals or groups were found to be more or less useful and either trusted or mistrusted Perhaps fatalists, feeling excluded from membership in other groups and bounded by forces out of their control, obtaining information on wildfire is not on their personal agendas.

Findings for Wildfire Agency Trust

Now that the previous analyses illustrated how CT can be used to identify wildfire information source use and trust, this study now examines how CT may predict peoples' trust in the ability of the major natural resource agencies to mitigate wildfire risk using the three most commonly employed techniques in the western U.S. Because the trust in natural resource management dependent variables are ordinal in nature, ordinal logistic regression is used to assess the impact of the control and CT variables for all three management techniques. All three multivariate models are displayed in Table 7, and all three models produce statistically significant Chi-square results, indicating that each model provides a good statistical fit to the survey data. Psuedo R^2 coefficients are also provided, including both Cox and Snell R^2 and Nagelkerke R^2 statistics for further evidence of adequate fit. For the prescribed fire model, the pseudo R^2 coefficients were 0.205 and 0.221, for the naturally ignited model they were .339 and .363, and for the thinning model they were .183 and .220. According to McFadden (1979), pseudo R^2s between .2 and .4 are considered strong coefficients, so each of our models attained at either one or both of the coefficients within this desired range.

The first model in Table 7 examines the level of trust respondents have in public natural resource managers "to responsibly and effectively use prescribed fire." Only perceived wildfire risk to respondent property was statistically significant with the remaining control variables having no impact on agency trust. As would be expected, those respondents who perceive higher levels of risk to their residences and property have more trust in agencies to responsibly and effectively use prescribed fire when compared to respondents who perceive low risk. For the cultural traits variables, all four have statistically significant relationships in the direction that CT would predict. As expected, those respondents with high individualism scores do not have trust in public agencies to manage the use of prescribed fire when compared to those with low index scores. On the other hand, those respondents with high hierarchical index scores were significantly more likely to trust public agency use of prescribed fire than those with lower index scores. The egalitarian index also conforms with what CT would hypothesize with higher egalitarian index scores associated with public agency trust and lower index scores having lower levels of trust. Finally, fatalism was also significant with respondents with higher index

scores having less public agency trust to manage prescribed fire than those with lower scores.

The second model in the table examines the level of trust for public agencies to manage naturally ignited fires. The results for this model are almost identical to the prescribed fire model with only risk having a statistically significant effect for the control variables. Those respondents who perceive higher levels of wildfire risk to their personal property and residences are significantly more trusting of agencies managing naturally ignited fires (aka "let it burn") than those with lower levels of perceived risk. For the cultural trait variables, three of the four variables are statistically significant in the same direction of the relationships in the previous model. Once again, those respondents with higher individualism index scores have lower levels of trust for government natural resource agencies to manage natural ignited fires when compared to those with lower index scores. The hierarchical variable is positive but not significant for this model, but both the egalitarian and fatalist variables are significant. However, as expected high egalitarian index scores are associated with agency trust to manage naturally ignited fires and lower index scores are less trusting of agencies to manage naturally ignited fires. Finally, those respondents with higher fatalist scores do not have agency trust to manage naturally ignited fires when compared to those with lower fatalist index scores.

The third and final model in Table 7 concerns respondent trust in agencies to use thinning to reduce forest fuels. This management option is less controversial given the results in Table 4 where a large majority of respondents either had moderate or full trust in natural resource agencies "…to responsibly use thinning to reduce forest fuels." Only one control variable was statistically significant in the model. The coefficient for gender is significant and negative, which means women when compared to men were less trusting of the agencies to responsibly use thinning. While this isn't the major focus of this research, it is a little surprising and hard to explain given that women are more likely to perceive higher levels of wildfire risk when compare to men (e.g., Brenkert-Smith 2013). For the cultural trait variables there are three out of the four generating statistically significant results. The individual index is positive but not significant, however the hierarchical index is significant and positive as CT would expect. Those with higher hierarchical index scores are significantly more likely than those with lower scores to trust natural resource agencies to responsibly use thinning to reduce fuels. The egalitarian and fatalist indexes also produce significant results in the direction that CT would expect. Higher egalitarian index scores are associated with higher trust levels for agencies using thinning responsibly and higher fatalist index scores are associated with lower levels of agency trust.

The results in Table 7 indicate that two cultural traits had a significant effect in two of the models, and two others have significant effects in all three models. The Individualist index had a negative and significant impact in both the prescribed fire and naturally ignited models, which would be consistent with individualists not trusting government. For the hierarchical index there are positive and significant results in both the prescribed fire and the thinning models. Survey respondents with strong hierarchical scores are significantly more likely than those with lower scores to trust managers to responsibly use prescribed fire and to thin forests effectively to reduce forest fuels. This is consistent with their support of government to help solve problems.

The egalitarian index coefficients are all positive and statistically significant in all three models, which is consistent with our previous findings noted above with egalitarians using and trusting natural resource agencies for wildfire information. Those citizens with higher egalitarian index scores are significantly more likely to trust natural resource managers to responsibly and safely use prescribed fire, to manage naturally ignited fires, and to conduct efficacious thinning to manage forest fuels. Finally, the fatalist index coefficients are negative and significant in all three models, which is consistent with a fatalist view of the world where major events are not predictable and maybe not effectively managed by people. Fatalists have lower levels of trust that natural resource managers can responsibly and safely use prescribed fire, manage naturally ignited fires, and thin effectively to reduce forest fuels.

Conclusion and Discussion

In general CT provides a useful approach to explaining peoples' trust — or lack thereof — in the ability of natural resource managers to use the three core practices of prescribed fire, managing natural fires, and thinning to reduce flammable fuels and the risk of wildfire in public forests and rangelands. While some examples of disastrous prescribed burns and managing naturally ignited fires were noted in this study, the use of these techniques to reduce wildland fuels have been overwhelmingly successful (Francos and Úbeda 2021; Kalies and Kent 2016; Ryan et al., 2013). Some fire science experts have even argued that these management techniques are not being used as often as they should be (Kolden 2019; Schultz et al. 2019). Given the increasing number and severity of wildland fires in the western U.S. and the devastating effects of climate change on western forests and rangelands (Schoennagel et al. 2017), public agency managers, local governments and community-based groups will need to work together effectively to both make plans and to take timely action

when needed, actions which will require building trust ahead of times of crisis (Lachapelle and McCool 2012).

Knowing what sources people use to acquire information, which motivated reasoning suggests tend to be relatively unwavering and based on values, norms, beliefs and ideological orientations, will be important knowledge indeed when attempting to engage in trust-building between natural resource agencies and local communities. CT can help in identifying those information sources used and trusted by various key actors, and illuminate the cultural traits that lead to mistrust of natural resource agencies and managers. And, as discussed above, MR researchers have been investigating ways to get people to look at other information sources and fact-check their beliefs (Sidik 2023; Redlawsk et al. 2010). Mattes and Redlawsk have found "…that topics salient to voters are most often fact-checked" (2020: 913). With increasing numbers and severity of wildfires in the western U.S., it is possible that salience will become more prevalent and people will become more interested in becoming more informed about the issue using a variety of sound evidence based information sources. And as the wildfire information source literature suggests, wildfire managers such as those in Deschutes County, interactions with WUI households and community groups should entail both both vertical (formal) and horizontal (informal) approaches to information dissemination to make sure all cultural types receive relevant and timely information in a format they use and trust. There is an additional reason that both vertical and horizontal approaches should be used, it is highly unlikely that wildfire agencies and managers will have access to data that specifies what types of cultural traits stakeholders have. Therefore, outreach should embrace both approaches to reach as many cultural traits as possible.

While a good deal of practical insight and theoretical refinement with respect to MR and CT can be derived from this study, some limitations of the research do require explicit notation. First off, this is but a single site case study, and as such the need for replication elsewhere in other wildfire-susceptible localities remains unfulfilled. Missing here are important data on preferred communication modalities (e.g., internet, radio, etc.) and data on the social media dynamics of message dissemination. Future research on this topic should focus on the modalities people use in addition to trusted sources of information. Likewise, the potential for the co-production of fire safety among the residents of Deschutes County is a relevant topic not examined here. Additionally, the potential for substantial bias in self-selection *in* and *out* of survey participation exists. The Oregon State University campus in Bend may have attracted some participation but may also have caused disinclination to participate by others. Similarly, citizens who are more generally alienated from the public policy process and civic engagement generally may have taken a pass on participation. Acknowledging these shortcomings of the study is important, but so too is the recognition that some sound evidence of the utility of both MR and CT theoretical constructs is presented to help guide future research and simulate evidence-based outreach efforts to build trust among the parties which might need to come together in collective service to public safety in their fast-growing county.

Acknowledgements The study "Public attitudes toward wildfire: A survey of homeowners in central Oregon" was approved by the Oregon State University's Institutional Review Board on March 30, 2021 (study number: IRB-2021-1031). Data are available with compliance with Oregon State University Institutional Review Board policy.

Author Contributions BSS planned and designed the study, conducted the analyses, and helped draft the manuscript. NPL and JCP helped draft the manuscript.

Funding Funding for this study was provided by the School of Public Policy, Oregon State University, Corvallis, Oregon, USA. The survey was implemented by the Oregon Policy Analysis Laboratory, Oregon State University. The study supports the National Science Foundation (Dynamics of Coupled Natural and Human Systems Program) study "Developing adaptive capacity in wildfire-prone regions, "Grant #1922866.

Compliance with ethical standards

Conflict of interest The authors declare no competing interests.

References

Abatzoglou JT, Williams AP (2016) Impact of anthropogenic climate change on wildfire across western U.S. forests, *Proceedings of the National Academy of Sciences*, 113(42). https://doi.org/10.1073/pnas.1607171113. Accessed 15 February 2023

Baker M (2022) Prescribed burns are encouraged. Why was federal employee arrested for one? The New York Times, October 28. https://www.nytimes.com/2022/10/28/us/oregon-prescribed-burn-boss-arrested.html. Accessed 15 February 2023

Brenkert-Smith H, Dickinson KL, Champ PA (2013) Social amplification of wildfire risk: the role of social interactions and information sources. Risk Anal 33(5):800–817

Brenkert-Smith H (2010) Building bridges to fight fire: the role of informal social interactions in six Colorado wildland-urban interface communities. Int J Wildland Fire 19:689–697

Burke M, Driscoll A, Heft-Neal S, Wara M (2021) The changing risk and burden of wildfire in the United States. *Proceedings of the National Academy of Sciences*, 118(2). https://doi.org/10.1073/pnas.2011048118. Accessed 15 March 2023

Buylova A, Warner RL, Steel BS (2018) The Oregon context. In: Weber E, Southwell P, Clucas R, and Henkels M (eds) *Oregon state and local politics: Innovation and change*. Corvallis, OR: Oregon State University Press, pp 19-38

Caldera C (2020) Fact check: Oregon, Washington fires not set by anti-fascist activists. USA Today, September 11. https://www.usatoday.com/story/news/factcheck/2020/09/11/fact-check-oregon-fires-were-not-set-antifa-any-other-activists/3460386001/ Accessed 21 March 2023

Chen C, Sharygin E, Whyte M, Loftus D, Rynerson C, Alkitkat H (2022) Coordinated population forecast for Deschutes County, its

urban growth boundaries (UGB), and area outside UGBs 2022-2072. Population Research Center, Portland State University
Crow DA, Lawhon LA, Koebele E, Kroepsch A, Schild R, Huda J (2015) Information, resources, and management priorities: agency outreach and mitigation of wildfire risk in the western United States. Risk, Hazards and Crisis in. Public Policy 6(1):69–90
Deschutes County (2021) Deschutes County keeps growing: what does that mean for the region? Oregon Public Broadcasting, September 22. https://www.opb.org/article/2021/09/22/deschutes-county-keeps-growing-what-does-that-mean-for-the-region/. Accessed 15 March 2023
Deschutes National Forest (2022) Wildfire crisis strategy: Central Oregon landscape. Bend, OR: U.S. Forest Service. https://www.fs.usda.gov/deschutes Accessed 21 March 2023
Dickinson K, Brenkert-Smith H, Champ P, Flores N (2015) Catching fire? Social interactions, beliefs, and wildfire mitigation behaviors. Soc Nat Resour 28(8):807–824
Dillman DA, Smyth JD, Christian LM (2014) *Internet, phone, mail and mixed-mode surveys: the tailored design method*, 4th edition. Hoboken, NJ: John Wiley
Douglas M, Wildavsky A (1982) Risk and culture: an essay on the selection of technical and environmental dangers. Berkeley, CA: University of California Press
Dutton J (2021) Marjorie Taylor Greene's jewish space lasers' conspiracy theory met with derision, jokes. Newsweek, January 29. https://www.newsweek.com/marjorie-taylor-greene-jewish-space-laser-mockery-1565325 Accessed 21 March 2023
Environmental Protection Agency (2022) Wildland fire research: health effects research. Washington DC: EPA. https://www.epa.gov/air-research/wildland-fire-research-health-effects-research. Accessed 10 March 2023
Evans A, Auerbach S, Wood Miller L, Wood R, Nystrom K, Loevner J, Aragon A, Piccarello M, Krasilovsky E (2015) Evaluating the effectiveness of wildfire mitigation activities in the wildland-urban interface. Madison, WI: Forest Stewards Guild
Fifer N, Orr SK (2013) The influence of problem definitions on environmental policy change: a comparative study of the Yellowstone wildfires. Policy Stud J 41(4):636–653
Francos M, Úbeda X (2021) Prescribed fire management. current opinion in environmental science and health 21:100250. https://doi.org/10.1016/j.coesh.2021.100250. Accessed 11 March 2023
Garbis Z, Cox A, Orttung RW (2023) Taming the wildfire infosphere in interior Alaska: tailoring risk and crisis communications to specific audiences. *International Journal of Disaster Risk Reduction* 91(1). https://doi.org/10.1016/j.ijdrr.2023.103682
Garret RK, Stroud NJ (2014) Partisan paths to exposure diversity: differences in pro and counter attitudinal news consumption. J Commun 64:680–701
Gerber A, Green D (1999) Misperceptions about perpetual bias. Annu Rev Political Sci 18(11):189–210
Hanan EJ, Ren J, Tague CL, Kolden CA, Abatzoglou JT, Bart RR, Kennedy MC, Liu M, Adam JC (2021) How climate change and fire exclusion drive wildfire regimes at actionable scales. Environ Res Lett 16:024051
Johnson BB, Swedlow B, Mayorga MW (2020) Cultural theory and cultural cognition theory survey measures: confirmatory factoring and predictive validity of factor scores for judged risk. J Risk Res 23(11):1467–1490
Jones MJ, Vraga EK, Hessburg PF, Hurteau MD, Allen CD, Keane RE, Spies TA, North MP, Collins BM, Finney MA, Lydersen JM, Westterling AL (2022) Counteracting wildfire misinformation. Front Ecol Environ 20(7):392–393
Kalies EL, Kent LL (2016) Tamm review: are fuel treatments effective at achieving ecological and social objectives? a systematic review. For Ecol Manag 375:84–95
Koebele E, Crow DA, Lawhon LA, Kroepsch A, Schild R, Clifford K (2015) Wildfire outreach and citizen entrepreneurs in the wildland-urban interface: a cross-case analysis in Colorado. Soc Nat Resour 28(8):918–992
Kolden CA (2019) We're not doing enough prescribed fire in the western United States to mitigate wildfire risk. Fire 2 (2):30. https://doi.org/10.3390/fire2020030. Accessed 10 March 2023
Kroepsch A, Koebele EA, Crow DA, Berggren J, Huda J, Lawhon LA (2017) Remembering the past, anticipating the future: community learning and adaptation discourse in media commemorations of catastrophic wildfires in Colorado. Environ Commun 12(1):132–147
Kunda Z (1990) The case for motivated reasoning. Psychological Bull 108(3):480–498
Lachapelle PR, McCool SF (2012) The role of trust in community wildland fire protection planning. Soc Nat Resour 25(4):321–335
Lachapelle PR, Montpetit E, Gauvin JP (2014) Public perceptions of expert credibility on policy issues: the role of expert framing and political worldviews. Policy Stud J 42(4):674–697
Liu JC, Mickley LJ, Sulprizio MP (2016) Particulate air pollution from wildfires in the Western U.S. under climate change. Climatic Change 138:655–666. https://doi.org/10.1007/s10584-016-1762-6. Accessed 7 March 2023
Lodge M, Taber C (2005) Automaticity of affect for political candidates, parties and issues: An experimental test of the hot cognitive hypothesis. Political Psychol 26:455–482
Mamadouh V (1999) Grid-group cultural theory: an introduction. GeoJournal 47:395–409
Manfredo MJ, Fishbein M, Haas GE, Watson AE (1990) Attitudes toward prescribed fire policies. J Forestry 88(7):19–23
Mattes K, Redlawsk DP (2020) Voluntary exposure to political fact checks. Journalism Mass Commun Q 97(4):913–935
McCaffrey SM, Stidham M, Toman E, Shindler B (2011) Outreach programs, peer pressure, and common sense: what motivates homeowners to mitigate wildfire risk? Environ Manag 48:475–488
McFadden D (1979) Quantitative methods for analysing travel behaviour of individuals: some recent developments. In: *Behavioural travel modelling*, Hensher DA and Stopher PR (eds) London, UK: Croom Helm, pp 279-318
National Interagency Fire Center (2021) Wildland fire summary and statistics report 2021. Boise, ID. https://www.nifc.gov/. Accessed 7 March 2023
National Interagency Fire Center (2020) Wildland fire summary and statistics report 2020. Boise, ID. https://www.nifc.gov/. Accessed 7 March 2023
National Interagency Fire Center (2019) Wildland fire summary and statistics report 2019. Boise, ID. https://www.nifc.gov/. Accessed 7 March 2023
National Park Service. 2022. Yosemite fire update. https://www.nps.gov/yose/learn/news/yosemite-fire-update-for-september-7-2022.htm. Accessed 7 March 2023
Newton K, Zmerli S (2011) Three forms of trust and their association. Eur Political Sci Rev 3(2):169–200
Nir L (2011) Motivated reasoning and public opinion. Public Opin Q 75(3):504–532
Oregon Department of Forestry (2022) Maps and data. https://www.oregon.gov/odf/aboutodf/pages/mapsdata.aspx. Accessed 7 March 2023
Oregon Department of Forestry (n.d.) Current wildfire information. https://www.oregon.gov/ODF/Fire/Pages/FireStats.aspx. Accessed 15 March 2023
Peralta CB, Wojcieszak M, Lelkes Y (2021) Can I stick to my guns? Motivated reasoning and biased processing of balanced political information. Commun Soc 34(2):49–66

Price Z, Rein H (2021) Oregon wildfires: 20 of the state's biggest since 2002. *Salem Statesman Journal*, August 17. https://www.statesmanjournal.com/. Accessed 7 March 2023

Radeloff VC, Helmers DP, David P, Kramer H, Mockrin MH, Alexandre PM, Bar Massada A, Butsic V, Hawbaker TJ, Martinuzzi S, Syphard AD, Stewart SI (2017) The 1990–2010 wildland-urban interface of the conterminous United States-geospatial data, 2nd ed. Fort Collins, Colorado: Forest Service Research Data Archive. URL: https://doi.org/10.2737/RDS-2015-0012-2. Accessed 8 March 2023

Redlawsk DP, Civettini A, Emmerson KM (2010) The affective tipping point: Do motivated reasoners ever "get it"? Political Psychol 31(4):563–593

Ripberger JT, Gupta K, Silva CL, Jenkins-Smith HC (2014) Cultural theory and the measurement of deep core beliefs within the advocacy coalition framework. Policy Stud J 42(4):509

Ripberger JT, Song G, Nowlin MC, Jones MD, Jenkins-Smith HC (2012) Reconsidering the relationship between cultural theory, political ideology, and political knowledge. Soc Sci Q 93(3):713–731

Rudolph T (2006) Triangulating political responsibility: the motivated formation of responsibility judgements. Political Psychol 27:99–122

Ryan KC, Knapp EE, Varner JM (2013) Front Ecol Environ 11(1):e15–e24

Saengawut, VC, Brunson MW, Howe PD (2015) Localized risk perception of wildland fire hazard. *Proceedings of the 13th international wildland fire safety summit and 4th human dimensions of wildland conference*, April 20-24, Boise, ID

Schoennagel T, Balch JK, Brenkert-Smith H, Whitlock C (2017) Adapt to more wildfire in western North American forests as climate changes. Proc Natl Acad Sci 114(18):582–590

Schultz CA, McCaffrey SM, Huber-Stearns HR (2019) Policy barriers and opportunities for prescribed fire application in the western United States. Int J Wildland Fire 28:874–884

Sidik SM (2023) How researchers aim to calm political hatred. Nature 615:26–28

Steelman TA, McCaffrey SM, Knox Velez AL, Briefel JA (2015) What information do people use, trust, and find useful during a disaster? Evidence from five large wildfires. Nat Hazards 76:615–634

Steg L, Sievers I (2000) Cultural theory and individual perceptions of environmental risks. Environ Behav 32(2):250–269

Swedlow B (2014) Advancing policy theory with cultural theory: An introduction to the special issue. Policy Stud J 42(4):465–483

Taber CS, Lodge M (2006) Motivated skepticism in the evaluation of political beliefs. Am J Political Sci 50(3):755–769

Taylor JG, Gillette SC, Hidgson RW, Downing JL, Burns MR, Chavez DJ, Hogan JT (2007) Informing the network: improving communication with interface communities during wildland fire. Hum Ecol Rev 14(2):198–205

Toledo D, Kreuter UP, Sorice MG, Taylor CA (2012) To burn or not to burn: ecological restoration, liability concerns, and the role of prescribed burning associations. Rangelands 34(2):18–23

Toman E, Shindler B, Brunson M (2006) Fire and fuel management communication strategies: citizen evaluations of agency outreach activities. Soc Nat Resour 19(4):321–336

US Census (2022) QuickFacts: Deschutes County, Oregon URL: https://www.census.gov/quickfacts/deschutescountyoregon Accessed 29 June 202

USDA Forest Service (2022) *Confronting the Wildfire Crisis*. Washington, DC: USDA

Weber E, Southwell P, Clucas R, Henkels M eds. (2018) *Oregon state and local politics: innovation and change*. Corvallis, OR: Oregon State University Press

Weston D, Blagov PS, Harenski K, Kilts C, Hamann S (2006) Neural bases of motivated reasoning: an fMRI study of emotional constraints on partisan political judgement in the 2004 U.S. Presidential election. J Cogn Neurosci 18(11):1947–1958

Yellowstone Park (2022) The summer Yellowstone burned: what went wrong in 1988? https://www.yellowstonepark.com/park/history/1988-fires-yellowstone/. Accessed 7 March 2023

Zanocco CM, Jones MD (2018) Cultural worldviews and political process preferences. Soc Sci Q 99(4):1377–1389