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Should I Stay or Should I Go Now? Or Should I Wait and See? Influences on Wildfire Evacuation Decisions

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As climate change has contributed to longer fire seasons and populations living in fire-prone ecosystems increase, wildfires have begun to affect a growing number of people. As a result, interest in understanding the wildfire evacuation decision process has increased. Of particular interest is understanding why some people leave early, some choose to stay and defend their homes, and others wait to assess conditions before making a final decision. Individuals who tend to wait and see are of particular concern given the dangers of late evacuation. To understand what factors might influence different decisions, we surveyed homeowners in three areas in the United States that recently experienced a wildfire. The Protective Action Decision Model was used to identify a suite of factors previously identified as potentially relevant to evacuation decisions. Our results indicate that different beliefs about the efficacy of a particular response or action (evacuating or staying to defend), differences in risk attitudes, and emphasis on different cues to act (e.g., official warnings, environmental cues) are key factors underlying different responses. Further, latent class analysis indicates there are two general classes of individuals: those inclined to evacuate and those inclined to stay, and that a substantial portion of each class falls into the wait and see category.

KEY WORDS: Decision making; evacuation; risk attitudes; wildfires

1. INTRODUCTION

As climate change has contributed to longer fire seasons and populations living in fire-prone ecosystems increase,[1] wildfires have begun to directly affect a growing number of people. As a result, interest in understanding the different choices individuals make when threatened by a wildfire has grown. In the United States, there is interest in understanding why some do not follow mandatory wildfire evacuation orders and whether alternatives to mass evacuation could be a viable option and under what conditions.[2–4] In other countries, particularly Australia, where households have the overt choice to stay and defend their property or to evacuate, a key interest is in understanding those who wait to assess the actual conditions before making a decision. In both countries, these individuals who "wait and see" are of particular concern as the biggest risk to public safety occurs during last-minute evacuations. Specifically, waiting too long to evacuate increases the possibility of being overrun by the flame front or having the evacuation process impeded in other ways (e.g., decreased visibility from smoke, limited evacuation routes, etc.).[3] Evidence from both the United States and Australia indicates a continuum of response, with a portion evacuating early or as soon as given official notice, a portion waiting to see if the conditions justify a particular response, and a portion who have made a committed decision to stay and defend their property.[5,6]

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As a result of this variability in behavior, there is a clear need to better understand the dynamics behind different wildfire evacuation decisions so that policy or outreach can be more strategically targeted. While many studies have examined factors that influence evacuation decisions, the vast majority of this work examines hurricane evacuations. However, wildfires differ in a number of critical ways that may shape the evacuation decision process. For instance, hurricanes tend to have a fairly long warning time, officials can reasonably predict the areas most likely to be affected, and evacuation is clearly the best protective action. In contrast, the direction of movement and speed of a wildfire is highly dependent on weather changes and topography, making it difficult to accurately predict who needs to evacuate and when they should evacuate. Further, evacuation may not always be the best option, particularly when there has been little warning time and the fire is already upon the individual.[3,4] Finally, unlike hurricanes, where there is little that can be done to protect property during the actual event, there is evidence that with the right preparation and in nonextreme conditions, staying and actively protecting one's property can decrease the odds of losing one's home.[7,8] These differences introduce added complexity into wildfire evacuation decisions, in terms of whether and when to evacuate and by creating potential tradeoffs between the desire to protect one's life and family and the desire to protect one's home. These differences suggest the need to examine the degree to which variables found to influence evacuation for other hazards apply for wildfire.

In this article, we first assess what lessons can be learned from the hazard evacuation literature, recognizing that the bulk of the knowledge is focused on hurricanes. We then examine what is known about evacuation decisions specifically in relation to wildfire to assess how variables may differ for the wildfire context. Although there are a number of Australian studies examining wildfire evacuation decision making, only a few U.S. studies provide insight into the topic. This study seeks to fill this gap by assessing the quantitative impact of a range of likely factors on wildfire evacuation decisions in three areas of the United States through a representative survey of local households. The results inform our theoretical understanding of protective action decision making with specific insights for the wildfire context, which is understudied relative to other hazards in the evacuation literature.

2. LITERATURE REVIEW

2.1. Hazard Evacuation Literature

The Protective Action Decision Model (PADM) integrates findings from hazards studies and relevant motivational theories (e.g., the theory of planned behavior (TPB),[9] protection motivation theory[10]) to understand why individuals do or do not undertake protective actions (such as evacuation) in response to a natural hazard.[11] Often applied in the context of hurricane evacuations, the model suggests that when a hazard event disrupts normal behavior, individuals seek out information about the threat to try to make sense of the uncertain situation and then determine the most appropriate response.[12,13] This information typically comes in the form of official (e.g., warnings or evacuation orders from public safety officers), environmental (e.g., seeing or hearing the hazard), or social cues (e.g., observing the behavior of others).

Research has shown that these initial decision cues contribute both directly and indirectly to a particular response.[12] For example, Huang *et al.*[14] and Lindell *et al.*[15] found that official warnings (e.g., evacuation recommendations), physical cues (e.g., observing actual storm conditions), and social cues (e.g., seeing others evacuate and businesses close) all directly predicted the decision to evacuate during Hurricanes Ike and Lilli, respectively. Huang *et al.*[14] also found that the same cues led to increased assessments of personal impacts, which in turn directly increased the likelihood of evacuation.

Risk perception or expected personal impacts related to the hazard is another key variable in the PADM that has been found to increase the likelihood of evacuation.[11] For example, along with official and social cues, Burnside *et al.*[16] found that higher perceived risk of hurricanes was positively associated with the decision to evacuate. However, there is a need for a more nuanced understanding of the role of risk as most studies focus on the perceived likelihood of negative consequences, or general concern about an event.[17] In particular, almost no work has examined the influence of risk attitudes on evacuation decisions. A risk attitude is one's tendency to be relatively "risk tolerant" or "risk averse" when engaging in behavior perceived as risky. This research gap in the evacuation literature is surprising given that one might expect individuals with particularly high tolerance for personal safety risks to be more likely to delay evacuation or stay home during a potentially threatening hazard.

In addition to decision cues and risk perception, the PADM also suggests that attributes associated with the suggested protective action or behavior are important. Specifically, in order to act, individuals who are concerned about a hazard must feel that they have the ability to take the protective action (high self-efficacy) and that the action will actually minimize the risks posed by the hazard (high response efficacy).[4] While believing in the effectiveness of a protective action is positively related to adoption, lacking the knowledge or ability to act tends to decrease the likelihood of taking action.[11] For example, Riad *et al.*[13] found that for two different hurricanes low self-efficacy was a common reason people did not evacuate (inability to evacuate due to being too sick or needing to care for a pet).

Several other factors have also been found to influence evacuation decisions. Specifically, a sense of territoriality or personal protection responsibility tends to decrease the likelihood of evacuation.[11,13] Experience with unnecessary evacuation has also been found to reduce the likelihood of future evacuation.[14] However, other studies have found no correlation between personal experience (previous hurricane exposure, unnecessary evacuations) and evacuation decisions.[15] A number of studies have in fact found stability in the evacuation decision, with little change in behavior over time: those who evacuate early continue to do so and those who do not evacuate continue to stay.[12,13,16,18] Finally, demographic variables are generally not dependable predictors of the evacuation decision.[11,14] The most consistent demographic finding is that those who do not evacuate are much more likely to be male than female.[13,15,19]

2.2. Wildfire Evacuation

Evacuation research specific to wildfires is limited, with the bulk of that work conducted in Australia. Most North American research has tended to focus either on modeling the evacuation process[20,21] or on understanding the feasibility of alternatives to evacuation in the United States.[2,3,22,23] However, two quantitative studies[24,25] examining the wildfire evacuation decision process in Montana and New Mexico, and several qualitative studies focusing on broader questions of public wildfire response, suggest a number of reasons why individuals in North America may choose to stay and defend their property. Many of these reasons relate to attributes of the suggested protective action as defined by PADM, including:

- Self-efficacy: concerns about late or limited evacuation options[2,4,26,27] and evacuating animals, particularly livestock.[24–26]
- Response efficacy: a belief the property was relatively safe due to either the nature of the property (irrigated fields) or prior mitigation actions that had been undertaken.[23,26]
- Individual traits or characteristics: personal beliefs related to a desire to protect the property or a sense of personal responsibility for one's property[2,24,26,28,29] and a culture of self-reliance and desire to make one's own decisions.[2,27–29]

The relatively large number of Australian studies examining wildfire evacuation decisions is due in part to the death of 173 individuals in Victoria, Australia, in the 2009 Black Saturday fires. This led to strong interest in understanding what contributes to the decision to leave early versus stay and defend one's property, as well as why so many tend to wait and see how the event unfolds. This body of work provides a more nuanced understanding of wildfire evacuation behavior and highlights the dynamic and contextual nature of the decision. In one study, over one-third of those who intended to stay during Black Saturday left at some point, and over half of those who planned to leave early felt they had left too late.[30] Although the decision is clearly dynamic at a particular point in time, there are also indications that individual plans are fairly stable across time, paralleling findings in the general hazard literature. Whittaker *et al.*[31] found that despite reporting challenges with visibility, traffic, fallen trees, and smoke, almost three-quarters of individuals surveyed who indicated they left late also indicated they would take the same action in a future fire because they ultimately arrived at their destination unharmed.

Specific to why people choose to leave early, there is evidence that a larger portion of those who left on Black Saturday were female and expected to receive official warnings. Consistent with the hurricane evacuation literature, evacuees were more likely to report a trigger event in the decision to leave, such as an official warning or a physical or

[4] Although the terms self- and response efficacy are more common in the risk and hazard literature, in particular in health promotion theories, the PADM tends to refer to these ideas as resource- and hazard-related attributes, respectively. For purposes of clarity, we have chosen to use the more broadly used language of self- and response efficacy throughout the article.

social cue (e.g., seeing flames or others evacuating).[8,30] In terms of risk perception, one study found that those who intended to leave had higher levels of concern about the bushfire danger and saw their homes as more vulnerable than those who intended to stay and defend. This study also provides some indication that risk attitudes may play a role as those who chose to stay did not see themselves as risk takers.[32]

Those who stayed on Black Saturday were more likely to mention a prior commitment to stay and a belief that they were prepared, or the belief that it was no longer safe to leave.[30] Those who stayed were also more likely than those who left to mention emotional attachment to their home and surrounding environment, strong ties to neighbors, and a greater sense of self- and response efficacy as reasons for their decision.[8] However, a survey of intended actions of individuals in areas not affected by Black Saturday found no meaningful differences between those who planned to leave early and those who planned to stay and defend in relation to self-efficacy, but did find that those who planned to leave early were more likely to think their preferred option was a safe option (higher response efficacy). The same study found that those who planned to stay were more likely to engage in vegetation management, prepare for active defense, and have a preexisting plan about what they will do if threatened by a fire.[32]

Assessments of the wait and see group are more limited, in part because the unpredictability of fires means determining what it means to leave early is not always clear. One study found that uncertainty about where the fire was located and how severe the risks might be led many to take a wait and see approach during the Black Saturday fires, only evacuating when some external event signaled that decisive action was needed,[30] which was often an official or physical cue.[33] Subsequent survey work found that respondents who saw staying and leaving as equally attractive options were less likely to indicate a clear plan to either stay and defend or leave early.[34]

Overall, the existing research highlights the complexity of the wildfire evacuation decision process and suggests that, given the greater unpredictability of wildfires and the potential tradeoffs between protecting life versus protecting property, the decision may be much more dynamic and contingent than for hurricanes. However, the literature also indicates that variables highlighted in PADM may still be useful in explaining different wildfire evacuation decisions. For example, a range of decision cues related to the physical risk, the behavior of others, and information from public safety officials may influence the decision to leave, while a sense of responsibility for protecting one's property may ultimately influence the decision to stay. While both the hurricane and wildfire literatures support the relevance of self-efficacy (i.e., the perceived ability to pursue a particular protective action) and of response efficacy (i.e., the perceived effectiveness of that action at protecting values at risk), the wildfire literature suggests that differential efficacy assessments about the actions available, as well as varying risk attitudes, may be important variables to consider in understanding different decisions.

Given the limited research specifically examining wildfire evacuation decisions in the United States, this study was conducted to model the wildfire evacuation decision process for fire-prone communities in the United States. To some degree, we are merging the literature on hurricane evacuation with the emerging literature specific to wildfire and assessing to what extent the PADM can explain variability in wildfire behaviors perceived as protective. Further, a critical gap in this literature is the role of risk attitudes, which to date have been little studied in relation to evacuation decisions. Our quantitative analysis of the decision process was intended to lend insight into two main research questions: (1) What factors tend to be most associated with past evacuation behavior in U.S. communities at risk? and (2) What is uniquely motivating to individuals who evacuate early versus wait and see versus stay and defend? By providing insights to these two questions, this study hopes to inform our understanding of the evacuation decision process as well as identify potential ways to intervene in that process to promote public safety.

3. METHODS

3.1. Population and Sampling Frame

Three study sites were selected in fire-prone areas across the United States: Horry County, South Carolina; Chelan County, Washington; and Montgomery County, Texas. To ensure results did not overly reflect a specific local ecological or social (e.g., land ownership) dynamic, the three areas were selected to represent different regions of the country with different fire contexts (vegetation, likely fire behavior, etc.). Further, to add to general wildfire

Table I. Sample across Sites

County	# Respondents	Response Rate	Respondents Threatened by a Fire	% Respondents Threatened by a Fire
Chelan	694	46%	413	60%
Horry	534	36%	311	58%
Montgomery	330	22%	233	71%
Total	1,558		940	

knowledge we chose areas where little social fire research had been conducted. Local fire experts were consulted at each site to determine residential areas with high wildfire risk that had experienced a fire that required evacuations within the past three years. Our sample was drawn from the evacuated areas and nearby areas that were also at high risk. Data about the individual land parcels within those areas were collected from the county tax assessor, including the names and mailing addresses of the owners of each residential parcel. A total of 1,500 parcels were randomly selected from each site (for a total of 4,500 parcels) to receive a self-administered mail survey including a cover letter explaining the purpose of the study, their rights as a participant, and any relevant risks of participation. Mailing was implemented between April and June 2013 using standard Salant and Dilliman[35] three-wave technique (letter and survey, reminder postcard, letter and survey). The distribution of response across the counties and the response rates can be found in Table I.

All respondents were asked if a fire had ever threatened them and, if so, how they had responded to the threat: 940 indicated they had been threatened. These individuals became the initial sample for our analysis to (1) ensure that a fire had threatened all respondents in the sample, and (2) control for past experience with the hazard of interest. Of this initial sample of threatened individuals, 152 respondents marked "Other" when asked how they had responded to the threat (comments suggest this was generally because they were not in the area at the time of the fire). These individuals were then eliminated from the initial sample, along with an additional 29 due to list-wise deletion for a final sample size of 759.

3.2. Construction and Measurement of Variables

The survey included a range of questions to assess past evacuation decisions and preparedness activities, as well as beliefs about the efficacy of different responses (e.g., staying vs. leaving), potential reasons for preparing or for evacuating, the importance of various evacuation decision cues, and risk perception and risk attitude. Given differences between hurricanes and wildfires, and the limited quantitative wildfire evacuation literature published at the time of the study, the majority of the survey items were created by the authors based on the literature. The main exceptions were the measures of risk attitude, which were based on the DoSpeRT scale,[36] and of risk perception, which were based on the perceived likelihood of negative impacts, a heavily used deliberative dimension of risk.[37] A number of measures contained multiple items to explore different dimensions of the expected construct. Given the lack of existing valid and reliable measures, these banks of items were assessed using principal components analysis (PCA) to identify any distinct constructs within each set of items. Any subset of items with an eigenvalue greater than one was combined to create a new variable. The following section describes the variables used in the analysis, including those identified by the PCA as distinct constructs.

3.2.1. Evacuation Decision

Respondents could choose from the following options to indicate how they responded to the most recent fire event:[5] (i) left before there was a mandatory evacuation order for my area, (ii) left as soon as I heard there was a mandatory evacuation order, (iii) planned to evacuate but waited until I was personally told to leave by an authority, (iv) waited to see what happened and stayed because the risk was not great, (v) waited to see what happened but left when the danger felt too great, (vi) stayed throughout the fire and tried to protect my property, and (vii) other. A categorical dependent variable, *Evacuation Decision*, was constructed using three categories: Leave Early

[5]Focusing respondents on the most recent fire event was important as some respondents indicated they had been threatened multiple times.

Table II. Evacuation Decision by County ($n = 759$)

	Chelan County (%)	Horry County (%)	Montgomery County (%)	Total (%)
Evacuation Decision				
Leave Early	27.4	9.1	34.8	23.5
Wait and See	54.0	85.4	58.6	65.2
Stay and Defend	18.6	5.5	6.7	11.3

((i) or (ii)); Wait and See ((iii), (iv), or (v)); and Stay and Defend (vi) (Table II).

3.2.2. Evacuation Order

Respondents were asked to indicate their level of exposure during the most recent wildfire experience: (i) the wildfire was in the general area, but there was no evacuation order issued for their property, (ii) a prealert or voluntary evacuation notice was in place for their home, and (iii) a mandatory evacuation order was in place for their home. A categorical variable, *Evacuation Order*, was created to represent the presence and seriousness of an evacuation warning. Although a large portion of Horry County respondents had experience with fire (40.9%), the nature of fires in that area (smaller one-day events) meant that less than 10% of this group had actually been under a mandatory evacuation order. Given that lack of a mandatory evacuation order might affect the evacuation rate of residents, we included a dummy variable for Horry County in our analysis to control for the potential disproportionate effect on the dependent variable (*Evacuation Decision*).

3.2.3. Disaster Plan

Respondents were asked to select one of the following options: (i) household does not have a disaster plan, (ii) household has a plan, but it is not written, (iii) household has a written plan, but is not very detailed for wildfire (specifically), and (iv) household has a detailed plan that is specific for a wildfire event. A categorical variable, *Disaster Plan*, was created to represent the degree of effort and specificity put into developing a household-level wildfire disaster plan.

3.2.4. Preparedness

Two items assessed the degree the respondent had prepared his or her home or property to mitigate fire risk. Respondents were asked to rate the extent to which they had managed vegetation around their home and made their house fire resistant. Answers for these two questions were combined into a continuous measure of *Preparedness Level* (see Table III for specific wording of questions).

3.2.5. Preparedness Beliefs

Respondents were asked a series of eight self-efficacy-related questions about how important different variables (e.g., cost, time) were in their decision to prepare their property. Only one interpretable factor was identified that composed of two questions about knowing how to: (i) manage the vegetation around my home to decrease risks from wildfire, and (ii) make structural changes to my home to decrease risks from wildfire. These two items were averaged to create a continuous variable called *Preparedness Knowledge*.

3.2.6. Response Efficacy

The survey included six items to elicit respondents' beliefs about the degree that they thought various protective actions (evacuating, staying and defending, increasing home fire resistance, etc.) increased or decreased the odds of losing one's home or of being personally harmed during a wildfire (see Table III). PCA identified two factors, with one clearly containing the items related to evacuation efficacy. The second factor contained the remaining four items but the factor loadings were highly variable. As a result, the items were combined to create three originally intended continuous variables each assessing the effectiveness of the action at protecting one's life and property, *Evacuation Efficacy*, *Defense Efficacy*, and *Preparedness Efficacy*.

3.2.7. Evacuation Beliefs

The survey included 16 items aimed at capturing a combination of personal beliefs and external conditions that the literature review suggested might influence an individual's decision to evacuate early (e.g., I am concerned about limited evacuation routes) versus stay and defend (e.g., Staying home during a wildfire can be done relatively safely). PCA identified two factors, with one containing five items related to personal responsibility or territorial notions. These five items were averaged to create a continuous variable called *Property Responsibility* (Table III). No other

Table III. Variables Developed from Multiple Items

Variable Name	Items[a]	Response Scale	Mean	*SD*
Preparedness Level	• To what extent have you *managed vegetation* to prepare your home or property for a potentially threatening wildfire. • To what extent have you *made my house more fire resistant* to prepare your home or property for a potentially threatening wildfire.	1 (not at all) 2 (only a little) 3 (somewhat) 4 (a great deal)	2.82	0.85
Evacuation Efficacy	• Evacuating during a wildfire event will decrease/increase the odds that I *lose my home* during a wildfire. • Evacuating during a wildfire event will decrease/increase the odds that I *will be harmed* during a wildfire.	−2 (greatly decrease) to 2 (greatly increase), where 0 = has no effect on the odds	−0.49	0.84
Stay and Defend Efficacy	• Staying to defend my home or property will decrease/increase the odds *that I will be harmed* during a wildfire. • Staying to defend my home or property will decrease/increase the odds that I will *lose my home* to a wildfire.	−2 (greatly decrease) to 2 (greatly increase), where 0 = has no effect on the odds	0.33	0.83
Preparedness Efficacy	• Managing the vegetation around my home will decrease/increase the odds that *I will lose my home* to wildfire. • Structural changes to my home will decrease/increase the odds that I *will lose my home* to a wildfire.	−2 (greatly decrease) to 2 (greatly increase), where 0 = has no effect on the odds	−0.90	0.81
Preparedness Knowledge	• I know how to manage the vegetation around my home to decrease risks from wildfire. • I know how to make structural changes to my home to decrease risks from wildfire.	−2 (strongly disagree) to 2 (strongly agree), where 0 = neither agree nor disagree	0.68	0.93
Property Responsibility	• We choose to live here and it's our responsibility to protect our property. • Staying on my property during a wildfire can be done relatively safely. • I have a home/property that is well prepared for a wildfire. • It's our house, and we want to do what we can to make sure nothing happens to it. • I have a right to protect my home or property.	−2 (strongly disagree) to 2 (strongly agree) where 0 = neither agree nor disagree	0.29	0.72

(*Continued*)

Table III (Continued)

Variable Name	Items[a]	Response Scale	Mean	*SD*
Official Cues	*To what extent will you consider the following when deciding when and whether to evacuate…* • I receive notice that I should be prepared to evacuate • I learn that a mandatory evacuation order has been issued for my area • A law enforcement or fire official personally tells me to leave	1 (not at all) to 5 (very great extent)	4.37	0.86
Physical Cues	*To what extent will you consider the following when deciding when and whether to evacuate…* • I can see flames heading my way • The fire is within a mile of my home • I can see embers near or on my property • The smoke is too dense to see • The wind is blowing the fire in my direction	1 (not at all) to 5 (very great extent)	4.40	0.77
Social Cues	*To what extent will you consider the following when deciding when and whether to evacuate…* • Family members or friends tell me I should leave • I see others in my neighborhood leaving	1 (not at all) to 5 (very great extent)	3.50	1.16
Safety Risk Attitude	*Please indicate the likelihood that you would engage in the described activity or behavior if you found yourself in that situation…* • Going camping in the wilderness • Going down a ski run that is beyond your ability • Going whitewater rafting at high water in the spring • Taking a skydiving class • Bungee jumping off a tall bridge • Piloting a small plane • Walking home alone at night in a safe area of town	−2 (very unlikely) to 2 (very likely), where 0 = neither likely nor unlikely	−0.88	0.96
Financial Risk Attitude	*Please indicate the likelihood that you would engage in the described activity or behavior if you found yourself in that situation…* • Betting a day's income at the horse races • Betting a day's income at a high-stake poker game • Betting a day's income on the outcome of a sporting event • Investing 10% of your annual income in a moderate growth mutual fund • Investing 5% of your annual income in a very speculative stock • Investing 10% of your annual income in a new business venture	−2 (very unlikely) to 2 (very likely), where 0 = neither likely nor unlikely	−1.11	0.67

[a] All multiitem measures were averaged to create the final variable for analysis.

interpretable variable was found for the remaining factor, so two items of note from prior wildfire research were analyzed individually in the model: *Limited Evacuation Routes* (i.e., I am concerned about limited evacuation routes) and *Limited Notice* (i.e., There is a good chance I will not have much notice before a fire is threatening my home). Both of these potential constraints are consistent with prior literature highlighting critical self-efficacy issues (e.g., If I don't think I will have a way to get out, or enough time to do so safely, then my confidence in my ability to respond appropriately will be low).

3.2.8. Decision Cues

Respondents were asked to indicate to what extent 10 potential decision cues would influence the decision of when and whether to evacuate. PCA identified three factors that were used to create the following continuous variables: *Official Cues* (three items), *Physical Cues* (five items), and *Social Cues* (two items) (Table III).

3.2.9. Risk Attitude

Respondents were asked to rate whether they are generally someone who is fully prepared to take risks or someone who tries to avoid taking risks (on a scale from 0 "don't like to take risks" to 7 "fully prepared to take risks") (*General Risk Attitude*). Respondents were also asked a series of more specific questions aimed at eliciting risk attitude across different domains. Specifically, they indicated the likelihood that they would engage in the described activity or behavior if they were to find themselves in that situation. The behaviors ranged from those considered health/safety risks (e.g., driving a car without wearing a seat belt), recreational risks (e.g., taking a skydiving class), and financial risks (e.g., betting a day's income at the horse races).[38] PCA identified two factors measuring risk attitude in different domains. One contained seven items related to safety and recreation, which were combined to create the variable *Safety Risk Attitude*. The second was composed of six items related to gambling and investment, which were used to construct the variable *Financial Risk Attitude* (Table III).

3.2.10. Risk Perception

Respondents were asked to assess their personal wildfire risk across two items: the likelihood that in the next five years a wildfire would threaten (i) their family's health and safety, and (ii) their home (on a five-point scale from extremely unlikely to extremely likely). We assessed these two items individually to attempt to capture the respondents' wildfire risk perception across the two main domains of interest, personal health and safety (i.e., *Family Risk Perception*) and property (i.e., *Property Risk Perception*).

Although existing studies have not found consistent findings related to sociodemographic variables and evacuation behavior, gender and household income were included as control variables.

3.3. Analysis

We employed a multinomial logistic model to explain individual evacuation decisions. Because an assumption in the logistic model is that all respondents are identical in their underlying preferences over the independent variables, we also carried out a latent class analysis where the assumption is that there are unique groups or classes of people with different preference parameters. In other words, within each class individuals will have similar beliefs and preferences for how to respond to wildfire but these beliefs and preferences will vary across classes (e.g., one class may have a preference for evacuation and low perceived efficacy for defense, while the other may have a preference for staying and defending and high perceived efficacy for defense). Class membership is modeled using two sets of variables: (1) covariates (e.g., perceived efficacy, risk attitude and perception, etc.), which affect the underlying latent preferences of individuals and hence determine membership in different classes but do not directly affect the outcome variable, and (2) predictors (e.g., level of threat, specific beliefs or concerns, decision cues, etc.), which determine the evacuation choice. The result tells us the number of classes existing in the sample (if there are multiple classes) and the probability of an individual belonging to a particular class with a given set of characteristics. The model is estimated via maximum likelihood estimation in Latent Gold 4.5. Results discussed below for both models were significant at $p < 0.05$.

4. RESULTS

Our respondents were largely full-time, year-round homeowners (73%), who had owned their current property for an average of 13 years (ranging from 0 to 68 years). A slight minority was retired

Table IV. Coefficients of the MNL Model on Evacuation ($n = 759$)

	Coefficients of MNL Model		Odds Ratio	
	Wait and See	Stay and Defend	Wait and See	Stay and Defend
Evacuation Efficacy	−0.193	−0.731***	0.82	0.48***
Preparedness Efficacy	0.21*	0.136	1.23*	1.15
Defense Efficacy	0.041	0.518***	1.04	1.68***
Preparedness Level	0.047	0.049	1.05	1.05
Preparedness Knowledge	0.112	0.704***	1.12	2.02***
Evacuation Order (Voluntary)	−0.909***	−1.043**	0.40***	0.35**
Evacuation Order (Mandatory)	−3.239***	−2.433***	0.04***	0.09***
Disaster Plan (Unwritten)	−0.213	−0.792**	0.81	0.45**
Disaster Plan (Written)	−1.237*	−1.9	0.29*	0.15
Disaster Plan (Wildfire Specific)	−0.542	−0.244	0.58	0.78
Property Responsibility	−0.122	−0.051	0.89	0.95
Limited Evacuation Routes	−0.135	−0.12*	0.87	0.89*
Limited Notice	0.229**	0.115	1.26**	1.12
Official Cues	−0.762**	−1.285***	0.47**	0.28***
Physical Cues	0.946***	0.752*	2.58***	2.12*
Social Cues	−0.372*	0.091	0.69*	1.10
General Risk Attitude	0.084	0.304***	1.09	1.36***
Safety Risk Attitude	−0.004	0.019	1.00	1.02
Financial Risk Attitude	−0.157	−0.377**	0.85	0.69**
Family Risk Perception	0.228**	0.367**	1.26**	1.44**
Property Risk Perception	−0.18	−0.335*	0.84	0.72*
Horry	0.505	0.902	1.66	2.46
Male	0.109	−0.177	1.12	0.84
Household Income	0.056**	0.044	1.06**	1.04
Constant	1.901***	−1.213	6.69***	0.30

***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

(45%), while the slight majority was male (58%). The ages ranged from 18 to 90, with an average age of 59. A slight minority had a college or postgraduate degree (48%), while only 17% had a high school diploma or less. The majority reported household income levels over $60,000 (~65%), with 35% specifically reporting household income levels over $100,000. The majority of individuals (70–80%) did not have decision-making constraints related to children, disabilities or physical ailments, or livestock.

In terms of preparing one's home, the vast majority (88%) of people reported having done some to a great deal of vegetation management for wildfire, while 55% indicated they had undertaken some to a great deal of work to make the structure more fire resistant. Similarly, more people reported knowing how to manage vegetation around their home to decrease risk (79%) than reported knowing how to make structural changes (50%). A slight majority (53%) of households had a nonwritten disaster plan and 41% did not have any disaster plan. Only 2% had a written plan and 4% had a wildfire-specific plan. The majority did worry about limited evacuation routes (59%), but fewer were worried about having proper notice of an impending fire (40%). Only 35% felt that their home or property was well prepared for a wildfire, while another 36% did not really know. Approximately 75% agreed that they have a right to protect their home or property, and that they want to do what they can to make sure nothing happens to it.

4.1. Multinomial Logistic Model

The multinomial logistic model compares those who wait and see, and stay and defend, to the base category of leave early. The final model was statistically significant (LR χ^2 (44, $N = 759$) = 338.76 and p-value = 0.00), indicating that the model was able to distinguish between categories of behavior. The model as a whole explained between 36% (Cox and Snell) and 43.8% (Nagelkerke) of the variance in behavior. The first two columns of Table IV report the coefficients of the multinomial logit model, while the last two columns report the odds ratio (or the relative risk ratio). Findings discussed below all indicate

Table V. Latent Class Regression—Two-Class Model ($n = 759$)

% Sample in Class	Evacuate Class 69%	Defend Class 31%
Evacuation Decision		
Leave Early	27.6%	16.2%
Wait and See	72.4%	48.0%
Stay and Defend	0.0003%	35.8%
Mean	1.725	2.19

the increased or decreased likelihood that an individual will engage in the referenced action as compared to leaving early. The results indicate that an increase in *Evacuation Order* level from no order to voluntary decreases the odds that an individual will wait and see by 60% (e.g., 1–0.40 = 0.60), and stay and defend by 65%. An increase in *Evacuation Order* level from no order to a mandatory order decreases the odds an individual will wait and see by 96%, and stay and defend by 91%. Having an unwritten *Disaster Plan* (vs. no plan) decreases the odds an individual will stay and defend by 55%. A one-unit increase in the importance of *Official Cues* decreases the odds an individual will wait and see by 53% and stay and defend by 72%. However, a one-unit increase in the importance of *Physical Cues* increases the likelihood an individual will wait and see rather than leave early by 158%. For every one-unit increase in *Evacuation Efficacy*, there is a 52% decrease in the likelihood an individual will stay and defend, while a unit increase in *Defense Efficacy* increases the odds an individual will stay and defend by 68%. This provides clear indication that perception of the efficacy of a particular response is a determinant of evacuation decisions. Interestingly, for every one-unit increase in concern about having *Limited Notice* there is a 26% increase in the odds an individual will wait and see. In terms of risk attitude, a unit increase in *General Risk Attitude* (i.e., toward greater risk tolerance) increases the likelihood an individual will stay and defend by 36%, while a one-unit increase in *Financial Risk Attitude* decreases the odds of staying and defending by 31%. Finally, a one-unit increase in *Family Risk Perception* increases the likelihood an individual will wait and see by 26% and stay and defend by 44%.

4.2. Latent Class Model

The results for the latent class analysis indicate the presence of two classes (see Table V). The majority of individuals are in Class 1 (69%): essentially no one in this class will stay and defend (<1%), 28% will leave early, and 72% will wait and see. In Class 2, only 16% leave early, while 48% wait and see and 36% stay and defend. Hence, Class 1 is more likely to leave early (*Evacuation Class*), and Class 2 is more likely to stay and defend (*Defend Class*), with the largest portion of individuals in both classes tending to wait and see before making a final decision.

Table VI. Means of Attributes across Estimated Classes ($n = 759$)

	Evacuate Class	Defend Class
Preparedness Level	−0.008	0.125
Evacuation Efficacy***	0.186	−0.493
Defense Efficacy	−0.141	0.304
Preparedness Efficacy	0.051	−0.144
Preparedness Knowledge***	−0.123	0.360
No Disaster Plan	0.334	0.337
Unwritten Disaster Plan	0.603	0.596
Written Disaster Plan	0.027	0.011
Wildfire-Specific Disaster Plan	0.034	0.055
General Risk Attitude***	3.043	4.280
Safety Risk Attitude	−0.080	0.129
Financial Risk Attitude	0.116	−0.195
Family Risk Perception	0.122	0.061
Property Risk Perception	0.482	−0.264

***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

Looking at the mean attributes of the covariates in the two classes, we see that only *Evacuation Efficacy*, *Preparedness Knowledge*, and *General Risk Attitude* are statistically significant in determining the membership of an individual in a particular class (see Table VI). The *Evacuation Class* has a greater belief in the efficacy of evacuation compared to the *Defend Class* (0.186 as opposed to −0.493), while the *Defend Class* is more tolerant of risk compared to the *Evacuation Class* (4.280 as opposed to 3.043) and has higher levels of knowledge about how to prepare their property (0.360 as opposed to −0.123).

Looking at the predictors, we see that the two classes have several common motivations for their decisions (Table VII). *Evacuation Order* determines individuals' decision in both classes, where all individuals are more likely to leave early as an evacuation order becomes more serious, particularly when there is a mandatory evacuation order (despite differences in assessments of response efficacy and risk attitude). However, the relative effect of an evacuation notice is not as strong for the *Defend Class*. *Official Cues* has a similar effect for both classes as well, where the likelihood of evacuation increases as the

Table VII. Ordinal Model of Evacuation Decisions, Two Latent Classes

	Evacuate Class	Defend Class	*p*-Value
Evacuation Order (none)***	1.857	0.468	0.00
Evacuation Order (voluntary)	0.607	−0.066	
Evacuation Order (mandatory)	−2.464	−0.402	
Property Responsibility	−0.338	0.095	0.21
Limited Evacuation Routes	−0.119	−0.022	0.59
Limited Notice**	0.365	−0.111	0.04
Official Cues***	−0.601	−1.623	0.00
Physical Cues**	1.006	−0.792	0.02
Social Cues	−0.452	0.021	0.37
Income**	0.092	0.018	0.02
Horry County	0.193	0.638	0.14
Male***	0.457	−0.439	0.00
Observations	759		

***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

importance placed on official cues increases. *Physical Cues* and *Limited Notice* affect the evacuation decisions of individuals in both classes; however, in opposite directions. Specifically, as the importance placed on physical cues or concern about limited notice increases, the *Evacuation Class* is less likely to evacuate, while the *Defend Class* is less likely to stay and defend. This indicates that more emphasis on physical cues and concern about limited notice shifts individuals away from the extremes and into the wait and see group. Finally, being male decreases the likelihood of leaving early for the *Evacuation Class* and also decreases the likelihood of staying for the *Defend Class*, while greater income increases the likelihood of staying for both classes.

5. DISCUSSION

The dynamic nature of wildfires creates unique evacuation challenges. The most appropriate response during a wildfire may be contingent upon the specific fire conditions and personal trade-off preferences between safety and property protection. These differences highlight the need to assess whether and how factors found to influence evacuation decisions for other hazards are relevant for wildfire evacuation decisions. Our results suggest that many of the key factors identified in the PADM literature do influence wildfire decisions, but often in ways that are distinct for different groups of people.

Consistent with the PADM, and motivational theories in general,[10,39,40] our results provide clear evidence that the perceived response efficacy associated with a particular response matters. A belief that evacuation is an effective way to minimize risk results in a greater tendency to evacuate, while believing that staying to defend one's property is an effective way to minimize risk results in a greater tendency to stay. These results are not dissimilar to McNeill *et al.*'s[34] finding that the distinctiveness of the benefits of evacuating versus defending predict different choices.

Results also confirm the importance of official cues: those who plan to leave early primarily pay attention to official cues, while increasing reliance on official cues by individuals in both the wait and see and stay and defend groups increases their tendency to evacuate. This supports findings about the role of official cues in hurricane evacuation studies[14,16] as well as the large body of literature on warnings that show that individuals are more likely to respond to official warnings.[41]

The role of physical cues is interesting and potentially problematic as they are relied on most by those who take a wait and see approach. This supports Australian findings that many households waited for a physical cue to leave due, in large part, to the uncertainty of where the fires were and whether they were severe enough to merit evacuation.[30,31] The role of physical cues provides insight into why the "wait and see" group is so problematic for authorities that want to encourage more decisive planning and action. Not only are those who wait and see the largest group of individuals, but the latent class analysis indicates that greater reliance on physical cues appears to lead individuals with different preexisting preferences to become less likely to do what they originally intended to do. A portion of those who wait and see may be relying on physical cues to determine when their preferred decision (evacuation) is necessary, while another portion appear to be allowing physical cues to override their initial commitment to defend their home due to a general tolerance for risk and belief that they are prepared to stay. Belief that one will have limited notice, effectively that official warnings cannot be relied on, also encourages more contingent and dynamic decision making whereby individuals in both classes become less likely to follow through with their initial intentions.

The varying risk associated with different decisions (e.g., staying is a higher risk to life but potentially lower risk to property) also highlights the need to assess whether risk attitude informs the decision process. Our results suggest risk attitudes do

play a role: a general tolerance for risk is associated with staying to defend one's property, while tolerance for financial risk increases the likelihood that a person will leave early. Both reflect different trade-off thresholds between taking on some personal risk to avoid potential costs of losing one's home versus protecting one's safety at all costs. In terms of risk perception, the perceived threat to the safety of one's family has a rather intriguing effect with those with higher risk perception in this regard less likely to leave early. Although somewhat counterintuitive, this result may reflect recognition that family members likely will be dispersed and that ensuring one's family is safe may not always allow for an early evacuation. This would parallel other hazards work that has shown that evacuation is unlikely to occur when family members are separated.[11]

There are a number of limitations in this analysis that should be recognized. First, as our primary interest in this article was initial identification of whether certain variables were more or less influential in different response decisions we chose to look at the data set as a whole. We only controlled for Horry County due to its much lower level of experience with mandatory evacuation (although roughly the same percentage of respondents indicated they had been threatened by a fire as the other counties). As such, it is possible that the patterns we found are differentially influenced by responses from either Chelan or Montgomery County. Future analyses could explore whether and how responses differed by county. Second, as we were not able to test for nonresponse bias, caution should be used in applying the results. However, as our results included a full range of responses (from leaving right away to staying and defending) that are parallel to findings from other studies,[6] we do not think the results likely represent any systematic bias toward one protective response over another. Finally, a challenge with asking any individual to recall past behavior is the accuracy of that recall. While this is a possibility that should be considered, the recall was for a specific action undertaken during a period of strong emotion, and such episodic memories have been shown to be less prone to revision.[30] Further, studies from other natural hazards have shown little shift in survivors' disaster memories over time.[42]

Finally, our study suggests a number of areas for future study. Of note is that two important variables from previous studies were not significant in our study. Specifically, desire to protect one's property has been suggested as a reason individuals do not evacuate for wildfires[2,26,28,29] as well as for other hazards;[11,13] however, it was not a distinguishing factor in our study. Similarly, although other wildfire studies suggest that those who planned to stay had done more to prepare their property,[26,27,30,32] we did not find such a distinction. However, we did find that higher preparedness knowledge distinguished the defend class from the evacuation class. This suggests that the key aspect of preparedness may not be the actual amount of mitigation that has been undertaken but the belief that you prepared correctly (i.e., higher self-efficacy). This would support Paveglio *et al.*'s[24] hypothesis that the specific knowledge of individuals employed in the wood products industry might explain why their study found this group was more likely to plan to stay and defend. Another potential explanation for these anomalies is that many of the prior studies were qualitative and reasons individuals gave in interviews may not in fact be as critical to the decision as described. Alternatively, it may be a result of different interpretations or means of measurement in the various studies. The lack of clear explanation invites further research to clarify the importance of these two variables.

It is also worth drawing attention to items that were marginally significant ($p < 0.10$). We did not discuss these in the results, but they may point to areas for future research as a number reflect dynamics that have been found to be significant in other studies. For example, marginally significant findings indicate that individuals who wait and see rely less on social cues compared to those who leave early, which would support other studies that found social cues are associated with evacuation.[8,14,15,30] Also of interest, given that prior work suggests that access issues are a reason to consider staying,[2,27] is the indication that greater concern about limited evacuation routes increases the tendency to leave early. Further, given our findings of the influence of perceived efficacy, it is worth examining our marginally significant finding that respondents who believed in the efficacy of preparing one's property were more likely to wait and see than leave early. This could be problematic as, while vegetation management around a home and increasing its ignition resistance are desirable activities, an unintended consequence of encouraging such mitigation efforts may be that they make individuals feel they have more leeway in their decision process (i.e., a potential false sense of security to delay evacuation).

6. CONCLUSION

Overall, this study identifies reasons why different people might respond differently to the same wildfire threat and characteristics of individuals who are more likely to choose one course of action over another. Our results provide clear evidence that variables found to influence hurricane evacuations in the PADM are important considerations in wildfire evacuation decisions, but that emphasizing different components of that model can lead to different decisions for wildfire evacuation. In particular, our work suggests that having high perceived efficacy for alternative protective actions leads to different choices and that, although official cues are an influence for all individuals, physical cues are also important for those who do not leave early. Our work further suggests that, for wildfire, risk attitudes may be as important as risk perception in understanding different choices.

We found two general classes of individuals: those who are more inclined to evacuate and those who are more inclined to stay. Those inclined to evacuate are defined largely by their belief in the effectiveness of evacuation as a risk mitigation strategy, and those inclined to stay and defend are defined by their tolerance for risk and a belief that they know how to prepare their property for a wildfire. Of note is that a substantial portion of each group is not committed to that course of action but is waiting to see whether to stick to their initial inclination. Although it would be a challenge to tailor information and interventions to each group, given the lack of overt identifying characteristics, it is nevertheless useful for managers to understand why there is no uniform response when individuals are told to evacuate. However, the greater reliance of the wait and see group on physical cues does suggest that one useful focus for targeted communication could be to increase understanding of how to appropriately assess physical cues (such as how fast a fire can travel), the challenges with making an accurate assessment, and under what (if any) conditions such cues might reasonably inform a choice.

The importance of efficacy-related beliefs further highlights the challenges with providing the public with clear information about the best course of action when threatened by a wildfire. If the primary goal is to encourage everyone to evacuate, this would seem to argue for only presenting information about the benefits of evacuation as a protective action. However, failing to provide information about how to stay and defend safely has not stopped individuals in the United States from choosing to remain with their property. Further, as some emergency responders have pointed out, not providing this information may place individuals who do stay and defend at greater risk than necessary due to a lack of knowledge of how to do so as safely as possible.[2] Finally, although vegetation management around a home and increasing its ignition resistance are seen as desirable activities, the fact that this behavior may be associated with waiting is problematic. This highlights the challenge of any effort focused on encouraging homeowners to prepare their property as a means of property protection yet leave early as a means of protecting personal safety.

Our findings thus provide a clear demonstration of the heterogeneous nature of those who live in fire-prone areas and how different risk attitudes and different beliefs about what is efficacious can lead to different preferences for evacuation behavior. The work also highlights the dynamic nature of protective actions within the context of wildfires and the associated complexity of any outreach effort. Clearly, further research to validate these findings as well as to clarify the role of a number of variables, such as social cues, preparedness knowledge, property responsibility, and limited evacuation routes, is needed.

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