Society and Natural Resources, 18:337–354
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ISSN: 0894-1920 print/1521-0723 online
DOI: 10.1080/08941920590915242

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Predicting Homeowners' Approval of Fuel Management at the Wildland–Urban Interface Using the Theory of Reasoned Action

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Social science models are increasingly needed as a framework for explaining and predicting how members of the public respond to the natural environment and their communities. The theory of reasoned action is widely used in human dimensions research on natural resource problems and work is ongoing to increase the predictive power of models based on this theory. This study examined beliefs, attitudes, and intention to support the implementation of three fuel management approaches (FMA)—prescribed burning, mechanical fuel reduction, and defensible space ordinances—in three wildland–urban interface (WUI) areas in the United States. Besides factors prescribed by the theory, the influence of three additional explanatory variables was assessed: past experience, personal importance, and trust. Personal importance of a FMA was a consistently significant predictor of attitude toward that approach, and trust in an agency's implementation of that approach was also a predictor of intention to approve the use of that approach.

Keywords fuel management approaches, fuel treatments, public acceptance, public opinion, resource management, theory of reasoned action, wildland fires

Resource managers and human dimensions researchers are finding social science theory increasingly useful for improving our understanding of how the public views resource management issues and support for their resolution (Cortner and Field 2004). One especially topical issue in U.S. forests is wildland fire, especially when

Received 2 July 2003; accepted 21 October 2004.
The authors gratefully acknowledge funding for this research from the USDA/USDI Joint Fire Science Program and the USFS North Central Research Station.
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nearby homes, lives, and property are at risk. Past federal policies and budgets have emphasized suppression over fuel management, and the end result has been increasing fuel loads and fire hazard for residents living in and adjacent to wildlands (General Accounting Office 1999; Machlis et al. 2002). Extensive fires in the late 1990s and early 2000s have produced funded initiatives to increase fuel management activities such as prescribed burning and mechanical fuel reduction, as well as expand programs to motivate homeowners to create defensible space around their homes (U.S. Department of Agriculture 2000; Jakes 2003).

This research examines homeowners' attitudes toward and intentions of approving the use of fuel management approaches (FMA) in the wildland–urban interface (WUI): specifically, prescribed burning, mechanical fuel reduction, and defensible space ordinances. We sought to test the strength of beliefs and attitudes in predicting support for implementing each FMA in the WUI, the area where homes and other buildings meet or intermingle with undeveloped wildlands creating a fuel environment in which fire can move readily between buildings and vegetation fuels. We applied selected elements of the theory of reasoned action (or TRA) (Ajzen and Fishbein 1980) to examine relationships between beliefs held about each FMA, attitude toward these approaches, and behavioral intention to approve of the implementation of each approach.

Conceptual Framework

Ajzen and Fishbein's (1980) theory of reasoned action (TRA) has been applied extensively to resource management (e.g., Manfredo et al. 1990; Harris, Miller, and Reese 1992; Bright and Manfredo 1996; Rossi and Armstrong 1999; Pouta and Rekola 2001), recreation and leisure behavior (e.g., Ajzen and Driver 1991; Manfredo, Yuan, and McGuire 1992), and consumer behavior (e.g., Sheppard, Hartwick, and Warshaw 1988; Bagozzi 1992; Smith and Vogt 1995). The essence of the theory is that a volitional behavior can be predicted by cognitive factors such as beliefs, subjective norms, attitudes, and intentions. Prior to an actual acting out of a behavior, an individual cognitively considers his or her willingness (or intentions) to support an act being implemented. Intentions are assumed to accurately capture the motives that predict actual behavior. In a meta-analysis of over 80 studies, Sheppard, Hartwick and Warshaw (1988) estimated an average correlation for the intention-behavior relationship was .53, suggesting intentions predict some, but not all, behaviors. Researchers continue to study additional variables, which add greater predictive modeling power and ultimately understanding of human behaviors.

Additional Factors to Expand the TRA

Past Experiences

Whether or not individuals have been exposed to or have participated in resource management in the past may influence their current views of fire management approaches. For example, whether a homeowner practices defensible space or works with a neighborhood group to maintain a fuel break around his or her neighborhood may influence that individual's attitude toward and intention to approve of the use of that FMA in the future (Fried, Winter, and Gilless 1999).

Personal Importance

Personal effort or commitment can affect how individuals form beliefs (Petty and Cacioppo 1984; Eagly and Chaiken 1993). The TRA model does not specifically include personal involvement or explain how beliefs are formed; however, other theories such as the elaboration likelihood model (Petty and Cacioppo 1984) suggest that involvement can lead to deeper, more thorough cognitions. Other behavioral research has found a slightly different type of personal effort to be compelling in predicting behavior. Bright and Manfredo (1995; 1997) found in their study of an attitude–behavior relationship regarding natural resource issues that personal importance of the natural resource issue accounted for almost the same amount of variance in behavior choices as did attitudes.

Trust

During focus-group interviews with WUI homeowners in California, Florida, and Michigan, trust in forest management agencies emerged as an important factor in the decision to support or oppose FMAs (Winter, Vogt, and McCaffrey 2004). These observations conformed primarily to the "competence" dimension of social trust wherein "trust is gained only when the individual or institution in a social relationship is judged to be reasonably competent in its actions over time" (Kasperson, Golding, and Tuler 1992).

Goal and Hypotheses

The goal of this study was to examine the influence of cognitive factors and past experiences on homeowners' intention to approve the implementing of FMAs (i.e., prescribed burning, mechanical fuel reduction, defensible space ordinances). Starting with cognitive factors included in the belief–attitude–intention pathway of the TRA model, a model including belief outcome and attitude toward each FMA was estimated. Next, an expanded model was estimated, adding variables such as past experience with wildland fire, direct personal experience with FMAs, personal importance of FMAs, trust in the government agency managing the wildland resource in the local area, and trust in the government agency to implement FMAs. Several locations with distinct fire management practices and fire histories were considered to assess model stability.

We hypothesized that:

1. Attitude toward a FMA will be more positive when (a) beliefs about the likely outcomes of that FMA are positive and strong, (b) the respondent has past experience with that FMA, (c) the respondent assigns a high degree of personal importance to that FMA, or (d) the respondent lacks negative past experiences with wildland fire.
2. Intention to approve implementation of a FMA is more likely when (a) there is a positive attitude toward that FMA, (b) the government is trusted to manage wildland resources, or (c) the government is trusted to implement that FMA.

We expected that the expansion of the TRA model to include 1b, 1c, 1d, 2b, and 2c would increase explanatory power, that experience and personal importance would directly influence attitude, and that trust would directly influence intention to approve implementation of a FMA.

Methods

The hypotheses were examined with data from mail surveys conducted in three areas in the United States that face WUI management challenges: Eldorado and Placer counties in the Sierra Nevada foothills of northern California; Clay County in northern Florida; and Crawford, Oscoda, and Ogemaw counties in Michigan's northern Lower Peninsula region. Data were collected in fall 2001 and early winter 2001/2002 in Florida and California, and in spring 2002 in Michigan.

Sample and Study Sites

The study population for each site consisted of homeowners living in areas abutting or near large tracts of public land with a high potential for wildland fire. Homeowner lists were obtained from local tax assessors. In California and Florida, homeowner lists were available in GIS (geographic information systems) databases and contained the necessary mailing information, physical location and address of the property, and an indication of whether or not the property contained improvements (buildings). For Michigan, meetings were held with federal and state foresters and fire managers to identify areas where homes were located near public lands with a high potential for wildland fire (e.g., in spatially continuous jack pine forests without fuel breaks) and cross-referenced to computerized mailing lists from the county assessor.

As mentioned earlier, the three study sites were selected to represent a spectrum of ecological and land management characteristics. The California site, including Placer and El Dorado counties, contains oak woodland, pine and mixed conifer forests. The forest is federally managed. There are frequent wildfires and rare prescribed burns. Defensible space ordinances are enforced by the California Department of Forestry. The Clay County, Florida, site is primarily pine forest and primarily privately owned, with forest products firms owning most of the forest land. There are frequent wildland fires and prescribed burns. The Michigan site, including Oscoda, Crawford, and Ogemaw counties, contains primarily jack pine forests that are managed by federal and state forests units. There are moderately frequent wildland fires and prescribed burns.

Survey Administration

A modified Dillman (2000) mail procedure was used whereby each household in the sample received an initial mailing comprised of a personalized cover letter, business reply envelope, and a numbered questionnaire. One week after the initial mailing, a reminder or thank-you postcard was sent to the entire sample. Three weeks into the process, respondents, bad addresses, and those who refused were excluded from the original database, and nonrespondents were mailed another personalized letter, business reply envelope, and a questionnaire.

Scale Measurement

Questionnaires were identical for each study area except for location specific references and a page of definitions for wildfire terms used was provided (i.e., prescribed burning, mechanical fuel reduction, and defensible space ordinance).

Measurement of Belief Outcome of FMAs. Belief was operationalized based on findings from focus groups conducted at two of the three study sites (Winter, Vogt, and Fried 2002). Seven salient beliefs pertaining to fuel management outcomes were identified and considered in this study; however, not all outcomes pertained to each FMA. Belief outcome was measured on a fully labeled 7-point response scale where "1" equaled zero likelihood (of occurring), "2" not at all likely, "3" slightly likely, "4" somewhat likely, "5" very likely, "6" extremely likely, and "7" certain. The seven belief items included (with the fuel management approach in parentheses, where prescribed burning was denoted as "pb," mechanical fuel reduction as "mfr," and defensible space ordinance as "dso"): impacts scenery (pb, mfr, dso), extracts usable wood products (mfr, dso), creates more smoke in the short-term but less smoke over time (pb), could allow fires to get out of control (pb), restores wildlands to a more natural condition (pb, mfr), saves money by reducing the cost of fighting a wildfire (pb, mfr, dso), and improves conditions for wildlife (pb, mfr, dso). Belief strength statements were tested individually and in a composite score. Single items were maintained in the final model estimation, as they were more descriptive of the specific beliefs homeowners hold about fuel management approaches than a composite belief score.

Measurement of Attitude Toward FMAs. Attitude was operationalized as an overall expression of positive or negative thoughts toward the implementation of a FMA. Respondents were asked to rate each FMA on a 7-point response scale on which "1" was labeled extremely negative (e.g., toward prescribed burning), "4" neutral, and "7" extremely positive.

Measurement of Intention to Approve the Use of FMAs. Following the TRA and recognizing that an actual behavior could not be measured in our study (e.g., actual voting in a local election for a defensible space ordinance, or evaluating the actual level of defensible space around a home), intentions were measured (Bright et al. 1993; Pouta and Rekola 2001; Rossi and Armstrong 1999). Intention was operationalized as the level of approval an individual held for the implementation of a FMA. A 7-point response scale was used with labels of "1" for strongly disapprove (of its implementation), "4" for neither approve nor disapprove, and "7" for strongly approve.

Measurement of Past Experiences with FMAs. In a series of multiple response questions, respondents were asked about experiences over their lifetime. These experiences were a priori categorized into one of four categories: wildland fire experience, prescribed burn experience, mechanical fuel reduction experience, and defensible space experience. Responses were coded "0" for no experience and "1" for experience. Summated scales were developed such that individuals' experiences could range from no experiences to experience with all events. Six items referred to wildland fire experiences, all of which suggest traumatic or negative experiences: been injured or suffered property damage from a wildland fire; felt fear or anxiety as a result of a wildland fire; experienced a road closure due to wildland fire; friends, family, or neighbors suffered property damage due to wildland fire; experienced discomfort from smoke caused by wildland fires; and evacuated my home or office due to wildland fire. A single item referred to a prescribed burning experience, "a prescribed burn has occurred near my home," and another referred to experience with mechanical fuel reduction, "a mechanical treatment to reduce fuels has

occurred near my home." Four items referred to defensible space experience: "been required to remove flammable vegetation on my property," "asked local fire department about how to reduce my risk of property damage," "read information on protecting homes from wildland fires," and "removed flammable vegetation on my property to protect my home from fire." The wildland fire experience scale was included in all models, and each FMA related experience was included in its respective model.

Measurement of Personal Importance of FMAs. Personal importance was measured at two levels—overall and for each FMA. The overall measure used a single item with a 7-point response scale and was worded, "How concerned are you that a wildfire could change your quality of life?" The endpoints of the scale were labeled "1" for not at all concerned to "7" for extremely concerned. The measure of personal importance for each FMA used a 7-point response scale that was endpoint labeled with "1" for not at all important to "7" for extremely important. The question stated, "Governments have programs or ways of improving communities and quality of life. Not all of these programs have the same importance to citizens. How important are these programs to you personally as they are practiced in [inserted geographic area where individual lives]?" The overall personal importance scale was included in all models, whereas each FMA-related personal importance scale was included in its respective model (see Bright and Manfredo 1995; 1997).

Measurement of Agency Trust for Managing Wildlands. The trust scale was adopted from Flynn, Burns, Mertz, and Slovic (1992). The question stated, "How would you rate the government agencies that manage wildlands in [insert geographic area]?" The scale was comprised of seven items. All trust items used a 7-point scale response labeled "1" for strongly disagree, "4" for neutral, and "7" for strongly agree.

Three items represented the management of public lands, forest issues, and protecting private property from wildland fires. These items read: "The government does a good job in managing public land," "the government does a good job communicating with the public about forest issues," and "the government does a good job of protecting private property from wildland fires." A Cronbach's test of internal consistency yielded an acceptable alpha of .78 (Nunnally 1978). Two items tested the management of prescribed burning. These included: "I trust the government to make proper decisions about the use of prescribed burning," and "the government does a good job of notifying the public about upcoming prescribed burns" (Cronbach's alpha = .72). A single item referenced trust in the agency's implementation of mechanical fuel reduction, "I trust the government to make the proper decisions about the use of mechanical fuel reduction," and another referenced trust concerning a defensible space ordinance, "I trust the government to make the best decision about enacting and enforcing defensible space ordinances."

Results

Response Rates

For the California and Florida samples, approximately 1200 questionnaires were sent in the initial mailing. The Michigan sample was double in size, with additional funding provided in a separate grant, with 2453 questionnaires initially mailed.

After adjustments for bad addresses, response rates ranging from a high of 53% in Michigan, followed closely by 49% in California, and a low of 31% in Florida. The lower than desired response rate for Florida was most likely a result of the unfortunate timing of the survey mailing to that study site—surveys were mailed during the week of September 11, 2001, when most people were preoccupied with matters quite unrelated to fuel treatments. Other wildfire research (Brunson and Shindler 2004) going on at the same time also reported comparable response rates and found nonrespondents tended to find the topic of less interest to them or too complex for them to comment about. Also, a comparison of parcel size and assessed values of homes for respondents and nonrespondents revealed no patterns. Still, the potential problem of nonresponse bias exists. For example, we cannot be sure that those who responded assign a similar level of personal importance and approval to fuels management policies than those homeowners who did not participate.

Descriptive Statistics of Independent Variables

Past experiences with fuel management approaches varied by study area and type of approach. Using defensible space practices (i.e., actually removing flammable vegetation) was most common, particularly for the households studied in California, where 91% reported having done this (Table 1). Other defensible space experiences, (i.e., "required vegetation removal," "asking local fire department about risk reduction," and "reading information on wildfire home protection," were also more common in California than in Florida or Michigan. "Prescribed burning occurring near homes" was next most common, and was most frequent in Florida (31%). Mechanical fuel reduction was a more common occurrence in California than in the other two areas. For general wildland fire experiences that would be considered negative, experiencing smoke discomfort was most common in California; experiencing a road closure due to wildland fire was most common in Florida; and friends, family, or neighbors suffering wildland fire damage, being injured or suffering property damage, and evacuating due to wildland fire was most common in Michigan.

Homeowners in the three study areas also had different levels of personal importance and trust for FMAs and wildland management, in general. Michigan respondents had the lowest trust in wildland management generally and in the three FMAs (Table 2). California respondents expressed the highest levels of personal importance for wildland management, mechanical treatment and defensible space. Florida respondents had the highest levels of personal importance for prescribed burning.

Finally, belief strengths varied by study area and FMA. California respondents were more certain that a FMA would achieve an outcome than Michigan respondents on almost all belief statements, except for FMAs impacting scenery (Table 3). Florida respondents also indicated high levels of certainty that FMAs would yield particular outcomes. Overall, respondents were fairly certain that these FMAs (tested individually) would reduce the cost of firefighting.

Descriptive Statistics of Dependent Variables

Attitude and intention to approve varied by study area and FMA. Florida respondents held the most positive attitude toward prescribed burning (Table 4). California respondents held a similar level of positive attitude toward mechanical treatment and

Table 1. Past experience with FMAs and wildland fire

Variable	California site, $n=544$ (%)	Florida site, $n=357$ (%)	Michigan site, $n=1244$ (%)
Prescribed burning			
Prescribed burning near home	25[a]	31[b,c]	21[a]
Mechanical fuel reduction			
Mechanical fuel reduction near home	21[a,b]	5[c]	9[c]
Defensible space			
Required to remove flammable vegetation	32[a,b]	2[c]	2[c]
Actually removed flammable vegetation	91[a,b]	44[c]	42[c]
Asked local fire department how to reduce my risk of property damage	22[a,b]	6[c]	5[c]
Read information on protecting home from wildland fire	72[a,b]	44[c]	42[c]
Negative wildland fire experiences			
Smoke discomfort from wildland fire	68[a,b]	61[b,c]	17[a,c]
Friends, family, neighbors suffered wildland fire damage	14[b]	14[b]	31[a,c]
Been injured or suffered property damage	4[b]	5[b]	9[a,c]
Evacuated home or office due to wildland fire	5[b]	7[b]	14[a,c]
Experienced a road closure due to wildland fire	37[a]	59[b,c]	33[a]
Felt fear or anxiety	41[b]	38	35[c]

[a] Statistically different than Florida (applying $p < .05$).
[b] Statistically different than Michigan.
[c] Statistically different than California.

defensible space. Florida and Michigan respondents were significantly less positive about defensible space than California respondents. Overall, intention ratings lagged behind attitude levels; however, average intention scores were above or close to the midpoint of the scale, suggesting at least some general support for all FMAs.

TRA Model

To test the modified TRA model (i.e., belief outcome, attitude, intention) for each FMA and location, attitude was regressed on belief outcome and intention was regressed on attitude. The TRA models of attitude explained from 19% of the variation for mechanical treatment in Michigan to 43% for prescribed burning in

Table 2. Independent variables testing with TRA variables

Fuel management approach	California site		Florida site		Michigan site	
	Mean	SD	Mean	SD	Mean	SD
Wildland management generally						
Experience with negative wildland fire outcomes[a]	1.69[g]	1.22	1.83[g]	1.28	1.38[f,h]	1.49
Agency trust—wildland management[b]	4.21[g]	1.21	4.21[g]	1.27	3.51[f,h]	1.35
Personal importance—wildfire concern[c]	5.91[f,g]	1.46	5.34[h]	1.69	5.41[h]	1.78
Prescribed burning						
Experience with prescribed burning	0.25	0.43	0.31[g]	0.46	0.21[f]	0.41
Agency trust—prescribed burning	4.04[g]	1.50	4.04[g]	1.50	3.31[f,h]	1.53
Personal importance—prescribed burning[d]	5.20[f,g]	1.73	5.83[g,h]	1.30	4.58[f,h]	1.91
Mechanical treatment						
Experience with mechanical treatment	0.21[f,g]	0.41	0.05[h]	0.23	0.09[h]	0.28
Agency trust mechanical treatment	4.23[g]	1.64	4.14[g]	1.63	3.50[f,h]	1.73
Personal importance mechanical treatment[d]	5.72[f,g]	1.41	5.38[g,h]	1.51	4.93[f,h]	1.67
Defensible space ordinance						
Experience with defensible space practices[e]	2.17[f,g]	0.96	0.96[h]	0.87	0.92[h]	0.91
Agency trust defensible space	3.85[g]	1.70	3.64[g]	1.83	2.98[f,h]	1.70
Personal importance defensible space[d]	5.78[f,g]	1.57	4.53[h]	1.99	4.44[h]	2.02

[a] Scores ranged from 1 to 6 based on the number of past experiences resulting from a wildland fire (six possible): been injured or suffered property damage; felt fear or anxiety; experienced a road closure; friends, family or neighbors suffered property damage; discomfort from smoke; evacuated home or office.

[b] Scale derived from mean of agreement scores (1–7, strongly disagree–agree) of the following items: "The government does a good job... (1) managing public land; (2) communicating with public about forest issues; and (3) protecting private property from wildland fires." Cronbach's alpha = 0.78.

[c] Measurement derived from responses to: "How concerned are you that a wildfire could change your quality of life?" Scores ranged from 1 to 7 (not at all concerned–extremely concerned).

[d] Measurement derived from responses to "Governments have programs or ways of improving communities and quality of life. Not all of these programs have the same importance to citizens. How important are these programs (prescribed burning, mechanical treatment, defensible space ordinance) to you personally as they are practiced in your local area?"

[e] Scores ranged from 1 to 4 based on the number of past experiences (four possible): been required to remove flammable vegetation on my property, asked local fire department about how to reduce my risk of property damage, read information on protecting homes from wildland fires, and removed flammable vegetation on my property to protect my home from fire.

[f] Statistically different than Florida (applying $p < .05$).

[g] Statistically different than Michigan.

[h] Statistically different than California.

Table 3. Belief outcome of FMA

Fuel management approach	California site		Florida site		Michigan site	
	Mean[d]	SD	Mean	SD	Mean	SD
Prescribed burning						
Impacts scenery	4.61[b]	1.32	4.47[b]	1.46	5.10[a,c]	1.55
Creates more smoke now, less long-term	5.04[b]	1.28	5.09[b]	1.26	4.48[a,c]	1.45
Reduces cost of firefighting	5.31[b]	1.44	5.47[b]	1.33	4.38[a,c]	1.61
Restores wildlands to more natural condition	4.77[a,b]	1.58	5.09[b,c]	1.46	4.26[a,c]	1.77
Improves wildlife conditions	4.80[b]	1.60	5.05[b]	1.62	4.52[a,c]	1.73
Could allow uncontrollable fires	4.47[a,b]	1.52	3.90[b,c]	1.55	4.86[a,c]	1.58
Mechanical treatment						
Impacts scenery	4.33[b]	1.40	4.40[b]	1.48	4.68[a,c]	1.52
Extracts wood products	5.27[a,b]	1.36	4.74[b,c]	1.49	5.00[a,c]	1.52
Reduces cost of firefighting	5.33[a,b]	1.37	5.10[b]	1.41	4.60[a,c]	1.51
Restores wildlands to more natural condition	4.45[b]	1.59	4.34[b]	1.65	3.91[a,c]	1.66
Improves wildlife conditions	4.60[b]	1.59	4.49[b]	1.70	4.19[a,c]	1.70
Defensible space ordinance						
Impacts scenery	4.03[a,b]	1.70	4.52[c]	1.85	4.58[c]	1.81
Extracts wood products	3.72	1.70	3.64	1.67	3.53	1.74
Reduces cost of firefighting	5.19[a,b]	1.55	4.31[c]	1.73	4.03[c]	1.70
Improves wildlife conditions	3.69[a,b]	1.81	3.35[b,c]	1.87	3.00[a,c]	1.74

[a] Statistically different than Florida.
[b] Statistically different than Michigan.
[c] Statistically different than California.
[d] Scores ranged from 1 (zero likelihood) to 7 (certain) in response to this question: "How likely do you think it is that [fuel treatment] will achieve the following outcomes?"

California. The TRA models of intention explained from 37% of the variation for mechanical treatment in Michigan to 60% for prescribed burning and defensible space in California and prescribed burning in Michigan. Attitude coefficients were all significant ($p < .001$); however, only some of the belief outcomes were significant. For all three FMAs and sites, a positive coefficient ($p < .001$) was estimated for the belief that a FMA will reduce the cost of firefighting. For mechanical treatment and defensible space in all three sites, a negative coefficient ($p < .05$) was estimated for the belief that these FMAs will impact scenery. For prescribed burning in all three sites, a negative coefficient ($p < .001$) was estimated for the belief that prescribed burning could allow uncontrollable fires.

Expanded TRA Model

Initial estimates showed that past experience (both negative wildland fire experiences and experiences with each of the three FMAs), trust in the management

Table 4. Dependent variables for attitude and intention to approve FMA models

	California site		Florida site		Michigan site	
Dependent variable	Mean	SD	Mean	SD	Mean	SD
Attitude toward FMA[d]						
Prescribed burning	5.11[a,b]	1.71	5.72[b,c]	1.37	4.02[a,c]	1.88
Mechanical treatment	5.75[a,b]	1.34	5.33[b,c]	1.48	4.90[a,c]	1.62
Defensible space ordinance	5.78[a,b]	1.61	4.26[c]	1.91	4.15[c]	1.98
Intention to approve FMA[e]						
Prescribed burning	4.70[a,b]	1.77	5.57[b,c]	1.34	3.65[a,c]	1.83
Mechanical treatment	5.43[a,b]	1.43	5.13[b,c]	1.50	4.56[a,c]	1.63
Defensible space ordinance	5.57[a,b]	1.59	3.97[c]	1.91	3.82[c]	1.97

[a] Statistically different than Florida.
[b] Statistically different than Michigan.
[c] Statistically different than California.
[d] Scores ranged from 1 (extremely negative) to 7 (extremely positive) in response to this question: "How would you rate your general attitude toward each of the three FMAs?"
[e] Scores ranged from 1 (strongly disapprove) to 7 (strongly approve) in response to this question: "How would you rate your level of approval toward the following FMAs?"

of public lands, and personal importance of wildfire leading to changes in quality of life were not significant in explaining variations in the dependent variables. The models were reestimated without these variables. Final regression models for each FMA, by study area, were estimated, including personal importance of the FMA to predict attitudes, and trust in resource agencies carrying out the FMA to predict intentions. For the attitude models, the inclusion of personal importance improved the explained variance by a minimum of 5% for the Michigan prescribed burning model and a maximum of 41% for the California defensible space model (Table 5). Personal importance of a FMA was significant ($p < .001$) in all nine attitude models. For all three FMAs and sites, a positive coefficient ($p < .001$) was estimated for the belief that a FMA will reduce the cost of firefighting. For prescribed burning in all three sites, a negative coefficient ($p < .001$) was estimated for the belief that prescribed burning could allow uncontrollable fires. Beliefs about FMAs impacting scenery mostly remained significant. Beliefs about prescribed burning improving wildlife conditions were related to attitudes toward prescribed burning by California ($p < .05$) and Michigan ($p < .001$) homeowners, but not Florida homeowners. Michigan homeowners' attitudes toward mechanical treatment were related ($p < .05$) to their beliefs that wildland conditions could be restored to a more natural condition through the use of that management approach.

Intention models were estimated, with attitude and trust factors treated as independent variables. Attitude coefficients remained significant in predicting intentions ($p < .001$) with the inclusion of trust. Trust in an agency implementing a FMA was significant ($p < .01$) in all nine intention models. The inclusion of trust in an agency that is implementing a FMA improved the explained variance from a range of no improvement for the Florida prescribed burning model to a maximum of 9 percent for the Michigan mechanical treatment model (Table 5).

Table 5. Expanded TRA to predict attitudes toward and intention to approve FMA

	California site (β)		Florida site (β)		Michigan site (β)	
FMAs	Attitude	Intention	Attitude	Intention	Attitude	Intention
Prescribed burning						
Attitude toward prescribed burning		0.67***		0.70***		0.63***
Agency trust: prescribed burning		0.23***		0.11**		0.28***
Personal importance: prescribed burning	0.34***		0.41***		0.27***	
Belief outcome						
Impacts scenery	−0.08*		0.02		−0.02	
More smoke now, less later	0.07		0.01		0.02	
Reduces cost of firefighting	0.17***		0.20***		0.25***	
Restores wildlands	0.05		0.09		0.09*	
Improves wildlife conditions	0.14*		0.00		0.13***	
Could allow uncontrollable fires	−0.21***		−0.17***		−0.26***	
N	495	497	331	338	1,124	1,137
R^2	0.51	0.64	0.37	0.53	0.47	0.65
F (df)	73.18***	442.21***	29.31***	194.60***	145.00***	1064.81***
Mechanical treatment						
Attitude toward mechanical treatment		0.58***		0.57***		0.51***
Agency trust: mechanical treatment		0.17***		0.28***		0.32***
Personal importance: mechanical treatment	0.49***		0.48***		0.42***	

Belief outcome						
Impacts scenery	−0.12***		−0.09		−0.11***	
Extracts wood products	0.03		0.01		0.01	
Reduces cost of firefighting	0.16***		0.23***		0.21***	
Restores wildlands	0.03		0.00		0.09*	
Improves wildlife conditions	0.02		0.00		0.00	
N	493	493	334	335	1,133	1,128
R^2	0.41	0.42	0.37	0.48	0.33	0.46
F (df)	57.05***	178.67***	33.82***	155.31***	95.35***	474.26***
Defensible space ordinance						
Attitude toward defensible space		0.75***		0.58***		0.68***
Agency trust: defensible space		0.09**		0.27***		0.21***
Personal importance: defensible space	0.73***		0.52***		0.51***	
Belief outcome						
Impacts scenery	−0.05		−0.15***		−0.13***	
Extracts wood products	−0.01		0.01		0.01	
Reduces cost of firefighting	0.10**		0.27***		0.21***	
Improves wildlife conditions	0.03		0.00		0.04	
N	495	505	327	332	1,112	1,126
R^2	0.62	0.61	0.50	0.54	0.44	0.62
F (df)	162.91***	398.54***	67.22***	192.92***	175.60***	928.15***

Note. Significance: $^{***}p \leq .001$, $^{**}p \leq .01$, $^{*}p \leq .05$.

Discussion

A goal of this study was to explain homeowners' intentions to approve of the use of FMAs in WUI areas where they live. To achieve this we applied a selected pathway of the TRA model, excluding subjective norms and belief evaluation, to help demonstrate that attitudes toward a FMA are related to the intention of approving the use of that FMA. Among those we studied in three different geographic areas, we consistently found that homeowners who were more certain that a FMA could reduce the cost of wildland firefighting tended to have a more positive attitude toward that FMA. We also found that homeowners who were more certain that prescribed burns could be controlled have a more positive attitude toward prescribed burning. In selected areas and with certain FMAs, homeowners' attitudes toward a FMA and whether the scenery is impacted are negatively related. That is, homeowners who are less certain the FMA will impact scenery (either negatively or positively) are more likely to have positive attitudes toward fuel management. These findings are consistent with our initial expectations regarding the influence of belief strength (as defined by TRA) on attitudes toward fuel management (as stated in hypothesis 1).

While the modified TRA model guided the predicting of intentions of approving FMAs, the inclusion of additional factors enriches what we know about the relationship between beliefs, attitudes, and intentions. Some factors that we expected to help explain attitude toward a FMA, such as past experiences with wildland fires or a FMA, were not significant once we controlled for beliefs and personal importance. Similarly, trust in the government to manage wildland resources (in general, not specific FMAs) was not significant in predicting intentions; however, trust in agencies to carry out specific FMAs was a significant predictor of intentions to approve each FMA at each location. These findings are partially consistent with our initial expectations that attitude would be positively influenced by belief outcomes, personal importance, and past experience, and that intentions would be positively influenced by attitudes and trust factors (as stated in hypothesis 2).

Several FMAs and multiple study sites were employed to assess model stability. Very consistent results were reported across FMAs and study sites, suggesting that these predictions of how attitude and trust are related to intentions to approve and how beliefs and personal importance are related to attitude, from a statistical perspective, are fairly robust. Figure 1 shows only those factors that were found to be significant predictors of attitude and intention across FMAs and study sites.

Management Implications

Given the positive attitude that results when homeowners believe that a specific FMA, such as mechanical fuel reduction, will accomplish a desired management outcome, such as reduced firefighting costs, natural resource managers have an opportunity to enhance acceptance of fuel treatments if they integrate evidence of such linkages into their communications with homeowners. We found that positive attitude was closely related to intention to approve of a FMA. To further enhance positive attitude, incentives could be provided to homeowners who support or practice FMAs, for example, reduced rates for provision of other public services or, if insurance companies can be brought on board, reduced rates for property insurance.

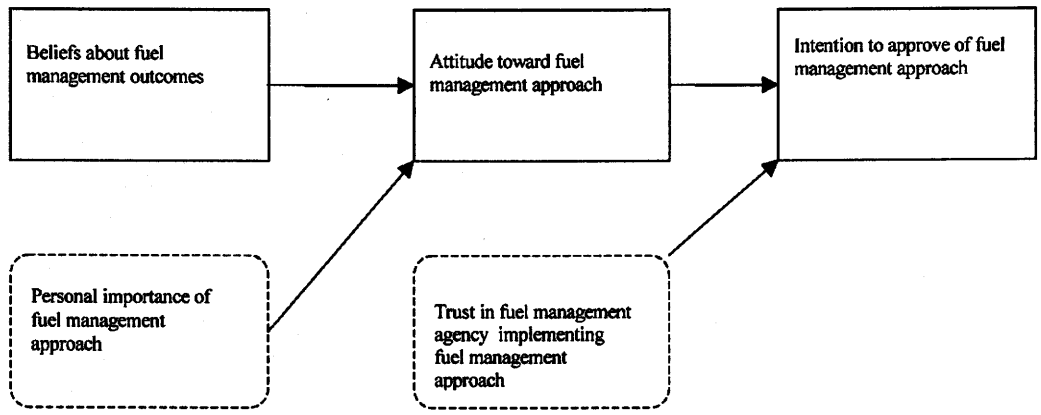

Figure 1. Expanded theory of reasoned action (solid boxes refer to traditional TRA factors and dotted boxes to newly tested factors).

Two cognitive factors, personal importance and trust in the agency implementing the FMA, are closely aligned with both attitude and the intention to approve of a FMA, and these too can be exploited to promote acceptance. Helping homeowners to personalize and identify with an effective FMA in ways that make the FMA central to their living in the WUI will promote positive attitudes and, ultimately, acceptance. The findings for defensible space, an approach that requires active homeowner participation, provide a compelling depiction of the strong positive relationship between personal relevance and positive attitudes. Focus groups held earlier with homeowners made clear that trust in FMA implementation centers on homeowners' thinking that the government makes good decisions when selecting FMAs (Winter, Vogt, and Fried 2002). In Michigan, prescribed burning has sometimes generated escaped fires that result in the loss of homes and lives. One such escape over 20 years ago remains widely remembered; as evidenced by a very low mean approval score, many residents intensely reject prescribed burning, even today. Michigan results also show that high levels of trust predict approval of the use of prescribed burning. Similar patterns are apparent with defensible space ordinances in Florida. Though each FMA is viewed differently and the ranking of FMAs varies regionally, WUI homeowners are generally supportive of the FMAs we considered. Multivariate analysis showed that even though the FMAs may not be equally regarded, the variables and their relationships, which comprise cognitive structure, are fairly consistent.

Theoretical Implications

The formation of intentions from personal factors, such as belief outcome strength and attitudes, was studied and provides useful management strategies. This belief, attitude, and intention relationship was replicated across prescribed burning, mechanical fuel reduction, and defensible space ordinances for three study sites. No research thus far has shown the strength of this relationship across multiple FMAs and locations.

While we tested just the personal factor of intentions, the social factor may be ripe for study. We may have been wrong in our thinking about the influence of others' beliefs on an individual's personal cognitions. For instance, recent research

by Kumagai and colleagues (2004) reported that individuals living in WUI areas were more likely to attribute wildfire to others' actions or to nature than to their own actions. The framing of our research problem focused on a prefire context to understand acceptance of fuel approaches to reduce wildfires, whereas Kumagai and colleagues (2004) focused on how residents view the causes of wildfire after it occurs. Another recent study on wildfire management practices (Kneeshaw et al. 2004) found that the acceptance of normative methods of handling wildfire (i.e., put the fire out, contain the fire, let the fire burn) was influenced by fire-specific situational factors (i.e., origin of fire, air quality, risk of private property loss, time of forest recovery, availability of outdoor recreation).

Similar to Bright and Manfredo's (1995; 1997) studies of old-growth-forest management, unroaded areas, and livestock grazing as examples of natural resource management issues, personal importance of a resource issue (i.e., FMAs) was positively related to attitudes toward that issue. Similar to findings reported by Winter (2003) of California residents' opinions on wildfire management, trust in an agency implementing a FMA was significantly positively related to approval of prescribed (controlled) burns and mechanical treatments. Surprisingly, past experience with a FMA or negative wildfire experiences were not predictors in our expanded model. This suggests that individuals, regardless of whether they have experienced a prescribed burn, mechanical fuel reduction, or one of several defensible space practices, hold similar attitude levels. Possibly, personal importance substituted for past experiences in the model.

Future research should continue to test and expand our findings, particularly on understanding how personal importance is formed and trust is gained. More importantly, general forms of importance—namely, concern that wildfire could change a person's quality of life and trust in wildlands and wildfire management—were found not to be significant in explaining attitudes toward or intentions of approving implementation of FMAs. Instead, a tightly focused application of importance and trust for each FMA was quite relevant and influential on WUI homeowners. Continued study on these divergent findings makes for interesting future research.

References

Ajzen, I. and B. L. Driver. 1991. Prediction of leisure participation from behavioral, normative, and control beliefs: An application of the theory of planned behavior. *Leisure Sci.* 13:185–204.

Ajzen, I. and M. Fishbein. 1980. *Understanding attitudes and predicting social behavior.* Englewood Cliffs, NJ: PrenticeHall.

Bagozzi, R. P. 1992. The self-regulation of attitudes, intentions, and behavior. *Social Psychol. Q.* 55(2):178–204.

Bright, A. D. and M. J. Manfredo. 1995. The quality of attitudinal information regarding natural resource issues: The role of attitude-strength, importance, and information. *Society Nat. Resources* 8:399–414.

Bright, A. D. and M. J. Manfredo. 1996. A conceptual model of attitudes toward natural resource issues: a case study of wolf reintroduction. *Hum. Dimens. Wildl.* 1(1):1–21.

Bright, A. D. and M. J. Manfredo. 1997. The influence of balanced information on attitudes toward natural resources issues. *Society Nat. Resources* 10:469–483.

Bright, A. D., M. J. Manfredo, M. Fishbein, and A. Bath. 1993. Application of the theory of reasoned action to the National Park Service's controlled burn policy. *J. Leisure Res.* (25)3:263.

Brunson, M. W. and B. A. Schindler. 2004. Geographic variation on social acceptability of wildland fuels management in the western United States. *Society Nat. Resources* 17:661–678.

Cortner, H. J. and D. R. Field. 2004. Introduction to the special issue: Humans, fire and Forests: The reemergence of research on human dimensions. *Society Nat. Resources* 17:473–475.

Dillman, D.A. 2000. *Mail and Internet surveys: The tailored design method*, 2nd ed. New York: John Wiley and Sons.

Eagly, A. H. and S. Chaiken. 1993. *The psychology of attitudes*. Forth Worth, TX: Harcourt Brace Jovanovich.

Flynn, J., W. Burns, C. K. Mertz, and P. Slovic. 1992. Trust as a determinant of opposition to a high-level radioactive waste repository: Analysis of a structural model. *Risk Anal.* 12(3):417–429.

Fried, J. S., G. Winter, and J. K. Gilless. 1999. Assessing the benefits of reducing fire risk in the wildland-urban interface: A contingent valuation approach. *Int. J. Wildland Fire* 9(1):9–20.

General Accounting Office. 1999. *Western national forests—A cohesive strategy is needed to address catastrophic wildfire threats.* GAO/RCED-99-65. Washington, DC: GAO.

Harris, C. C., T. Miller, and K. Reese. 1992. Possible influences on donation behavior: The case of Idaho's nongame wildlife and endangered species tax checkoff fund. *Society Nat. Resources* 5:53–66.

Jakes, P. J. 2003. *Homeowners, communities and wildfire: Science findings from the national fire plan. Proceedings of the 9th International Symposium on Society and Resource Management.* USDA Forest Service General Technical Report NC-231. St. Paul, MN: USDA Forest Service North Central Research Station.

Kasperson, R. E., D. Golding, and S. Tuler. 1992. Social distrust as a factor in siting hazardous waste facilities and communicating risks. *J. Social Issues* 48(4):161–187.

Kneeshaw, K., J. J. Vaske, A. D. Bright, and J. D. Absher. 2004. Situational influences of acceptable wildland fire management actions. *Society Nat. Resources* 17:477–489.

Kumagai, Y., J. C. Bliss, S. E. Daniels, and M. S. Carroll. 2004. Research on causal attribution of wildfire: An exploratory multi-methods approach. *Society Nat. Resources* 17:113–127.

Machlis, G. E., A. B. Kaplan, S. P. Tuler, K. A. Bagby, and J. E. McKendry. 2002. *Burning questions: A social science research plan for federal wildland fire management.* Moscow, ID: University of Idaho, College of Natural Resources, Idaho Forest, Wildlife and Range Experiment Station.

Manfredo, M. J., M. Fishbein, G. E. Haas, and A. E. Watson. 1990. Attitudes toward prescribed fire policies. *J. For.* 87(7):19–23.

Manfredo, M. J., S. Yuan, and F. McGuire. 1992. The influence of attitude accessibility on attitude–behavior relationships: Implications for recreation research. *J. Leisure Res.* 24(2):157–170.

Nunnally, J. 1978. *Psychometric theory*. New York: McGraw-Hill.

Petty, R. E. and J. T. Cacioppo. 1984. The effects of involvement on responses to argument quantity and quality: Central and peripheral routes to persuasion. *J. Personality Social Psychol.* 46:69–81.

Pouta, E. and M. Rekola. 2001. The theory of planned behavior in predicting willingness to pay for abatement of forest regeneration. *Society Nat. Resources* 14:93–106.

Rossi, A. N. and J. B. Armstrong. 1999. Theory of reasoned action vs. theory of planned behavior: Testing the suitability and sufficiency of a popular behavior model using hunting intentions. *Hum. Dimens. Wildl.* 4(3):40–56.

Sheppard, B. H., J. Hartwick, and P. R. Warshaw. 1988. The theory of reasoned action: A meta-analysis of past research with recommendations for modifications and future research. *J. Consumer Res.* 15(Dec.):325–343.

Smith, R. E. and C. A. Vogt. 1995. The effects of integrating advertising and negative word-of-mouth communications on message processing and response. *J. Consumer Psychol.* 4(2):133–151.

U.S. Department of Agriculture. 2000. *Managing the impact of wildfires on communities and the environment: A report to the President in response to the wildfires of 2000.* September 8. Washington, DC: USDA.

Winter, G., C. A. Vogt, and J. S. Fried. 2002. Fuel treatments at the wildland-urban interface: Common concerns in diverse regions. *J. For.* 100(1):15–21.

Winter, G., C. A. Vogt, and S. McCaffrey. 2004. Examining social trust in fuels management strategies. *J. For.* 102(6):8–15.

Winter, P. 2003. Californians' opinions on wildland and wilderness fire management. In *Homeowners, communities and wildfire: Science findings from the national fire plan. Proceedings of the 9th International Symposium on Society and Resource Management*, ed. P. Jakes, 84–92. USDA Forest Service General Technical Report NC-231. St. Paul, MN: USDA Forest Service North Central Research Station.