The Integrative Complexity of Wildfire Management Scale: Are We There Yet?

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Abstract

Integrative complexity is a measure of how complexly people think about an issue. A newly developed integrative complexity scale was applied in a study of perceptions of wildfire management. We explored the relationship between value-laden basic beliefs and attitudes, and integrative complexity's role as a moderator between them. The study data came from residents along the front range of Colorado, the Chicago metropolitan area, and Southern Illinois. While integrative complexity toward prescribed burning was not directly related to value-laden basic beliefs about prescribed burning, it was related to the direction and extremity with which people held attitudes toward prescribed burning. Also, the level of integrative complexity toward wildfire management moderated the relationship between value-laden basic beliefs and attitudes. Understanding the complexity with which people think about natural resource management issues such as prescribed burning can contribute to greater understanding of public perceptions regarding natural resource management strategies and policies. Additional information is also provided to guide further use and development of the instrument.

Keywords: *integrative complexity, cognitive hierarchy, wildfire management*

Introduction

Wildland fire provides essential ecosystem functions such as fuel reduction, regeneration of vegetation, forest reproduction, elimination of disease and insect threats, and improvements to wildlife habitat. Along with these benefits, wildland fire can threaten private property in the wildland-uban interface, natural resource harvests, air quality, and scenic beauty. The trade-off between wildland fire benefits and impacts complicates its management and leads to differences in public beliefs toward fire management techniques.

Due to extensive fire suppression on public lands in the past, high fuel loads and severe wildfire conditions exist in many forested areas throughout the U.S. Major fire events within the past decade have been particularly costly and threatening to human lives (Pyne 2001). Land management agencies realize that fuel reduction is necessary, and suggest several management techniques to help lower the risk of wildfire and attain a more sustainable fire regime (USDA Forest Service fire policy report 2008).

One approach to managing forests is *prescribed burning* (more recently referred to as *management ignited fire*). Our description of prescribed burning guided individuals' responses in this study and was defined as fire applied to a specific land area under selected weather conditions to accomplish predetermined, well-defined management objectives (USDA Forest Service fire policy report 2008). These objectives focus primarily on reintroducing the historical benefits of a natural fire regime to forests and other natural areas. However, the public has concerns with the potential negative outcomes of prescribed burning. The dangers associated with prescribed burns going awry has troubled some communities and groups dependent upon and in proximity of forested areas. As a result, public perceptions of fire management have become an important consideration for agencies charged with managing areas susceptible to wildland fires (Clute 2001).

Understanding the public's perceptions of wildland fire management can (a) help agencies recognize when policies might be supported by the public, (b) alert agencies when policies may run into public opposition, and (c) help agencies develop information campaigns designed to garner public support for potentially controversial strategies. With public

support, agencies could manage more efficiently, spending time and money on resources, as opposed to legal battles and policy adjustments.

Past Research about Public Perceptions of Wildfire Management

Research conducted since the 1970s has suggested that public perceptions of wildfire management are complex. Stankey (1976) showed that people with greater knowledge about fire and its role in forest ecology were more likely to support less fire suppression activity. This was a notable, though slight, change in public perceptions from the support for putting fires out resulting from years of fire suppression messaging by the Forest Service (Stankey 1976).

Folkman (1979) found that 75% of respondents agreed that naturally ignited fires should *not* be allowed to burn even if they did not endanger human life or property. Ironically, over half the respondents also agreed that occasional fires were an important part of ecosystem renewal. Rauw (1980) revealed that 70% of the visitors to Olympic National Park could define the practice of prescribed burning and also understood the beneficial effects of fire, yet almost 65% of these same respondents wanted fires controlled at all costs. These studies suggest that while most of the public recognized the role of fire in ecosystems, the negative potential outcomes of fire overrode these benefits.

Later studies revealed increasing public support toward prescribed burning. Zwolinski et al (1982) found that 84% of respondents had heard of prescribed burning of which 80% supported its use. Patton and Oliver (1985) found that not a single visitor to the Frank Church River of No Return Wilderness preferred suppression-only wildland fire policy, and McCool and Stankey (1986) determined 70% of respondents supported the let burn policy in wilderness areas.

Research in the 1980s also focused on influencing public perceptions of wildland fire management. Taylor and Daniel (1984) suggested that education about aesthetic impacts can increase public acceptance of particular fire management strategies. Shelby and Speaker (1990) found that among other factors, it was the success of prescribed burning campaigns that contributed to the public's acceptance of prescribed burning.

Manfredo et al. (1990) expanded the research on perceptions of wildland fire management by not only exploring the public's attitudes toward the National Park Service's controlled burn policy, but also beliefs about the outcome of the policy. Shortly after the Yellowstone fires of 1988, they found that more people supported controlled burning than opposed it (55% versus 41% in the West; 48% versus 45% nationally). Suggesting that an individual's attitudes toward a controlled burn policy were likely influenced by their beliefs about the outcomes of the policy, they found that supporters were most likely to believe that following such a policy improves wildlife conditions and allows natural events to occur. On the other hand, opponents believed that following a controlled burn policy destroys natural settings and scenery, and allows fires to get out of control. The researchers concluded that influencing beliefs and knowledge about burn policies will likely alter attitudes toward and acceptance of such policies.

Loomis et al. (2001) suggested that information would increase an individual's knowledge and also their tolerance of the use of prescribed fire as a wildfire management tool. In a panel research study, Shindler and Toman (2003) found that over the four-year period between 1996 and 2000, support for prescribed burning activities in the Blue Mountains remained constant. Monroe et al. (2006) note that there are unique differences in the beliefs toward fire management among interface residents, and that they will act and react differently to the same information. Toman and Shindler (2006) offer principles for effective communication to stakeholders on wildland fire management. They note that individuals progress through various stages in decision-making of whether to accept or reject a fire management plan. Knotek (2006) found that public decisions about fire are directly influenced by their cognitive disposition, which reflects human values (enduring beliefs), value orientations, attitudes, norms and behavioral intentions. Carroll et al. (2007) present a conceptual model for fire treatment dilemmas, which is quite complex. This conceptual model has 16 issues presented, all to try and capture the "complexities and dilemmas associated with each" fire management strategy (prescribed fire, mechanical thinning, and no-treatment). It is clear that the public's beliefs about wildland fire management are a key element to understanding and perhaps influencing their acceptance of fire management strategies.

Limitations of Current Attitude and Belief Research Regarding Prescribed Burns

A limitation of much of the research on perceptions of wildland fire is the lack of a theoretical framework (Manfredo et al. 1990; Bright et al. 2007). Most research has described attitudes and beliefs toward fire management without exploring the theoretical relationships among beliefs, attitudes, and values. Winter et al. (2002) utilized the Theory of Reasoned Action (Ajzen and Fishbein 1980) to identify factors that related to acceptability of fuel management approaches among communities in the wildland urban interface, but did not specifically test the relationships between attitudes and values. A second limitation is the narrowness with

which exploration of beliefs has occurred. Merely uncovering what attitudes and beliefs people hold about wildfire and its management falls short of understanding *how* people think about issues surrounding wildfire management. Carroll et al. (2007) have uncovered 16 dilemmas associated with fire treatment in the northwest, and conclude that the most productive approach to fire management would be one that takes into account both human values and scientific knowledge. One way of understanding how people think about an issue such as wildland fire management is through the concept of integrative complexity (Tetlock 1989). Integrative complexity can attune managers to how complexly various stakeholders are thinking about issues such as fire management and then guide information dissemination accordingly.

Defining Integrative Complexity

Integrative complexity (Suedfeld et al. 1996; Tetlock 1989) is a protocol for measuring how complexly people think about an issue. It focuses on the *structure* of thoughts, or beliefs, a person has about an issue rather than the *content* of those beliefs (Bright and Barro 2000) and consists of two components: differentiation and integration. Differentiation is a person's recognition of two or more sides or dimensions to an issue (Bright and Barro 2000; Tetlock 1989). Someone who sees one side of an issue exhibits low differentiation, while one who sees two sides (i.e., accepts two alternate sides to a topic) shows higher differentiation, and someone who sees three or more dimensions exhibits even higher differentiation (Bright and Barro 2000; Tetlock 1989).

Integration measures the recognition of complex connections among different dimensions of an issue (Bright and Barro 2000; Tetlock 1989). Consider an individual who supports closing logging roads in a National Forest. The reason for this person's support for closing logging roads may be to protect an endangered wildlife species. However, this person may also believe, on the other hand, that species protection will negatively impact the local economy unless the region can enhance tourism opportunities. This person may hold these two different beliefs with similar certainty. This reflects relatively high integration of diverse beliefs and makes intuitive sense since as a person learns more about an attitude object, they are more likely to encounter conflicts between their values (Brunson and Steel 1996). This study explored the relationship of integrative complexity about prescribed burning with traditional measures of public perceptions of the issue. In addition, the study explored the extent to which a person's broad values regarding an issue influence his or her attitudes toward specific management techniques, such as prescribed burning, and whether the strength of the value-attitude relationship depends on whether the person has high or low integrative complexity regarding the management issue. The conceptual framework driving this study is the value—attitude (or cognitive) hierarchy (Homer and Kahle 1986).

Conceptual Framework

The conceptual framework for this study is based on the cognitive hierarchy (Homer and Kahle 1986). This model predicts that basic value-laden beliefs toward wildfire management will influence a person's attitude toward prescribed burning. In addition, we explored the extent to which the strength of the value (as measured by basic beliefs)-attitude relationship will be moderated by, or depend on, the level of integrative complexity an individual exhibits about prescribed burning as a management tool.

Cognitive Hierarchy

The cognitive hierarchy has been used in many social science and natural resource contexts, such as determining and measuring wildlife values (Fulton et al. 1996) and predicting wildland preservation voting intentions (Vaske and Donnelly 1999). It suggests that values are a precursor of (and therefore influence) attitudes (Fulton et al. 1996; Vaske and Donnelly 1999). A *value* can be defined as an enduring belief that a specific mode of conduct is personally or socially preferable to an opposite or converse mode of conduct or end state of existence (Rokeach 1973). Fundamental values guide perceptions of what we believe to be true about the world, and are the basis of attitudes and behaviors. However, fundamental values are ineffective predictors of behavior because a) they are too general in nature to apply consistently across a population to specific objects and issues, b) there are relatively few of them, and c) they tend to remain consistent within a culture (Fulton et al. 1996).

Closely related to fundamental values are *basic beliefs*; value-laden beliefs that people hold about a particular issue or object. Basic beliefs can be viewed as the beginning of the application of fundamental values to more specific issues and are more predictive of attitudes toward specific behaviors and objects than are fundamental values (Fulton et al. 1996). An *attitude* is a cognitive tendency to respond either favorably or unfavorably toward a specific object or behavior (Eagly and Chaiken 1993).

Integrative complexity has been found to be related separately to both values and attitudes. High levels of integrative complexity are related to greater inclusion of fundamental values in guiding one's thought about an issue (Tetlock 1989). Regarding attitudes, more moderate attitudes are linked to higher levels of integrative complexity. For example, de Vries and Walker (1987) found that moderate attitudes toward capital punishment were accompanied by higher inte-

grative complexity of thought about the issue than were extreme attitudes. Bright and Barro (2000) found that moderate attitudes toward the Endangered Species Act were characterized by high levels of integrative complexity regarding the protection of endangered species. Both sets of researchers noted that it is not the attitude direction, but the extremity (i.e., the intensity with which one holds an attitude) that has a measurable and predictable relationship with integrative complexity. Considering the relationships among values and attitudes expressed by the cognitive hierarchy and the apparent relationship of integrative complexity with both values and attitudes, it follows that a person's level of integrative complexity may influence, or moderate, the value-attitude relationship.

Goals and Objectives

This study examined the impact of complex thinking on value-laden basic beliefs, attitudes toward one wildland fire management technique, specifically prescribed burning, and the relationship between them. To achieve this goal, specific objectives were identified.

Objective 1: To determine if the integrative complexity about prescribed burning is related to basic value-laden beliefs about wildfire and its management.

Objective 2: To determine if positive attitudes toward prescribed burning are characterized by different levels of integrative complexity than negative attitudes.

Objective 3: To determine if extreme attitudes toward prescribed burning are characterized by different levels of integrative complexity than moderate attitudes.

Objective 4: To determine if the relationship between value-laden basic beliefs about wildland fire management and attitudes toward prescribed burning are moderated by the level of integrative complexity.

Methods

Sampling and Administration

In consultation with USDA Forest Service personnel, three strata were chosen based on proximity to, and experience with, wildfire. The study population consisted of residents who live close to forested areas that had experienced frequent wildfire (front range, CO), residents who live close to forested areas but have experienced relatively little wildfire (southern Illinois), and residents of an urban area who do not live near a wildland/urban interface (Chicago, IL). For each strata, 1,000 names and addresses were obtained from Survey Sampling, International, yielding a random sample of 3,000 households. Introductory postcards alerted potential respondents that there would be a questionnaire arriving shortly. Seven days later, the questionnaires were mailed to each household including an introductory letter and a postage paid return envelope. Ten days later, a postcard reminder was sent to thank those who returned a questionnaire and remind non-respondents to please do so. Two weeks later, a questionnaire, cover letter, and postage paid return envelope were mailed to households who had not responded. To test for nonresponse bias, a 2-page version of the questionnaire was sent to a random sample of 500 non-respondent households. The nonresponse questionnaire contained measures of attitude toward prescribed burning and demographics.

Measurement of Factors

Items measuring basic beliefs about wildland fire management reflected value-laden perceptions related to *Freedom* to build in the wildland urban interface, *Responsibility* of agencies/homeowners, *Trust* in the government agency, and tenability of *Artificial Manipulation* in forests. These items were adapted from a previous study that investigated the public's basic beliefs about wildfire and management techniques (Bright et al. 2004), and have been applied in a number of other studies on wildland fire management (Bright and Burtz 2006; Bright et al. 2007; Kneeshaw et al. 2004). *Basic beliefs* were measured using a 7-point scale ranging from "strongly disagree" to "strongly agree". Indices for the basic belief dimensions were created from the items pending adequate reliability.

Integrative complexity about prescribed fire was measured with a newly-developed scale designed to measure both aspects of integrative complexity, differentiation and integration (Carroll and Bright in press). First, in an open-ended format, respondents were asked to list any arguments they believed are supportive of prescribed burning ("pro" arguments) and those they believed were against prescribed burning ("con" arguments). Next, respondents indicated the strength of each argument on a 7-point fixed scale from "extremely weak" to "extremely strong" (see Figure 1 for the format of this question on the survey). To measure *differentiation*, the number of "pro" arguments and "con" arguments were counted. The lower of the two was divided by the higher of the two to arrive at a differentiation score between 0 and 1. For example, if a respondent listed 5 "pro" arguments and 2 "con" arguments, differentiation was measured as $2 \div 5 = .40$. A score of 0 reflected no differentiation, while a score of 1 reflected the highest differentiation.

To calculate integration, the mean strength of both "pro" and "con" arguments regarding prescribed burning were calculated. As with differentiation, the lower mean was divided

Section IB. Beliefs about Prescribed Burning. In this section we are going to ask you to list arguments both FOR and AGAINST prescribed burning.

Prescribed burning is a fire policy alternative that involves the intentional lighting of fire by forest managers. It is used in specific locations in the forest and under selected weather conditions. The purpose of prescribed burning is to decrease the likelihood of large, potentially uncontrollable wildfire by systematically burning off excess vegetation in a forest.

- In **column A** please list any arguments **for** (Part 1) or **against** (Part 2) prescribed burning. *Please list as many as you can.*

***For example**: If you were responding to an issue such as wolf reintroduction to Colorado, for arguments for you might respond, "wolves improve tourism" and "wolves would balance deer and elk populations". For arguments against you might respond, "wolves attack livestock" and "wolves put pets and children in danger".*

- In **column B**, Indicate how **WEAK** or **STRONG** you think *each* argument you listed is. *Circle the number that represents your response.*

COLUMN A	***COLUMN B***						
***Part 1*: Arguments FOR prescribed burning (LIST AS MANY AS YOU CAN)**	Extremely Weak	Moderately Weak	Slightly Weak	Neutral or No Opinion	Slightly Strong	Moderately Strong	Extremely Strong
1._____	1	2	3	4	5	6	7
2._____	1	2	3	4	5	6	7
3._____	1	2	3	4	5	6	7
4._____	1	2	3	4	5	6	7
5._____	1	2	3	4	5	6	7
6._____	1	2	3	4	5	6	7
7._____	1	2	3	4	5	6	7
8._____	1	2	3	4	5	6	7
***Part 2*: Arguments AGAINST prescribed burning (LIST AS MANY AS YOU CAN)**							
1._____	1	2	3	4	5	6	7
2._____	1	2	3	4	5	6	7
3._____	1	2	3	4	5	6	7
4._____	1	2	3	4	5	6	7

Figure 1. Integrative Complexity Scale Measurement Instrument[2]

by the higher mean to arrive at an integration score between 0 and 1. For example, if the mean strength for the 5 "pro" arguments was 2.5 (out of 7) and the mean strength of the 2 "con" arguments was 3.8, integration was measured as 2.5 ÷ 3.8 = .65. The lowest integration, approaching 0, occurs where there is a large difference in the perceived strength of arguments for and against. The highest integration score, 1, reflects the situation where there is no difference in the strengths of pro and con arguments.

The overall integrative complexity score was calculated as the product of the differentiation and the integration scores. This calculation would again yield a value between 0 and 1. Carrying the previous example forward, an individual with a differentiation score of .40 and an integration score of .65 would have an overall integrative complexity score of .26. This scale went through a series of developments, tests, and revisions, and the final results showed a Pearson correlation of .81, $p < .01$, between traditional measurement methods and the scale. For a complete description of the development and validation of this scale, see Carroll and Bright (in press).

Attitude toward prescribed burning was measured using three survey items. Respondents were asked if they thought prescribed burning and mechanical thinning were extremely/moderately/slightly foolish or wise, ineffective or effective, and harmful or beneficial. Each of these three items were measured using a 7-point Likert-type scale. Attitude toward prescribed burning was the mean of the three items, pending adequate reliability.

Analysis

Objective 1 examined if integrative complexity about prescribed burning is related to basic beliefs about wildfire management. Using Pearson's correlations, the relationships between integrative complexity scores and each basic belief index of *freedom, trust in government, responsibility*, and *artificial manipulation* were examined.

Objective 2 explored if people with positive attitudes toward prescribed burning had different integrative complexity than those with negative attitudes. Based on the attitude index created from three attitude items, subjects were split into two groups; a positive attitude group (mean > 4 on a 7-point scale) and a negative attitude group (mean < 4 on a 7-

point scale). Independent samples t-tests compared the level of integrative complexity between these attitudinal groups.

Objective 3 explored whether people with extreme attitudes toward prescribed burning have different levels of integrative complexity than those with moderate attitudes. Extremity of attitudes in this study were based on the placement of an individual along the attitude scale, not relative to the attitudes of other respondents. Therefore, respondents with an attitude score ≥ 6 or ≤ 2 (on a 7-point scale) were placed in the extreme attitude groups. Those with scores between 2 and 6 (on a 7-point scale) were placed in the moderate group. Independent samples t-tests compared the level of integrative complexity between respondents with extreme versus moderate attitudes toward prescribed burning.

Objective 4 explored the moderating effects of integrative complexity on the relationship between value-laden basic beliefs about wildland fire management and attitude toward prescribed burning. Moderation analysis (Baron and Kenny 1986) was conducted separately for each basic belief dimension and requires two regressions for each analysis. First, attitude toward prescribed burning was regressed on a dimension of basic beliefs and the integrative complexity score. Second, attitude was regressed on a dimension of basic beliefs, integrative complexity, and a multiplicative interaction of these two independent variables. If, in the second regression, the betas for the main effects of the independent variable change, and the interaction term is significant, moderation has occurred. In practical terms, significant moderation means that the strength of the relationship between basic beliefs about wildland fire management and attitude toward prescribed burning is different for respondents with high integrative complexity than it is for those with low integrative complexity. Table 1 summarizes this analysis framework.

For those analyses that showed moderation, additional regressions were run in order to determine the nature of the moderation. First, a high integrative complexity group (integrative complexity > .5) and a low integrative complexity group (integrative complexity <= .5) were created. Second, attitude toward prescribed burning was regressed on the relevant basic belief dimensions for each integrative complexity group. The R2 and beta coefficients were compared across the integrative complexity groups to provide the descriptive information about the nature of the moderation.

Table 1. Moderation analysis framework of integrative complexity (IC) on basic belief dimension-attitude relationship

	Regression 1[1] Independent Variables	Regression 2[2] Independent Variables
Analysis 1:	• Freedom • IC	• Freedom • IC • Freedom * IC
Analysis 2:	• Responsibility • IC	• Responsibility • IC • Responsibility * IC
Analysis 3:	• Trust • IC	• Trust • IC * Trust * IC
Analysis 4:	• Artificial manipulation • IC	• Artificial manipulation • IC • Artificial manipulation * IC

[1] Regression 1 focuses on the main effects of each basic belief dimension and integrative complexity on attitude toward prescribed burning.

[2] Regression 2 adds a multiplicative interaction term based on the basic belief dimension and integrative complexity. Attitude toward prescribed burning is regressed on the three independent variables.

See Baron and Kenny (1986) for a detailed discussion of moderation analysis.

Results

Of the 3,000 questionnaires sent to the three different study strata, 2,500 were deliverable, and 468 were returned, for a response rate of 19%. To test for nonresponse, a shortened 1-page survey was mailed to a random sample of 500 non-respondents, of which 207 (41%) were returned. This survey included the three attitude toward prescribed burning items and socio-demographic variables of age, gender, and residence in relation to distance from a forest. There was a statistically significant but non-substantive difference between respondents and non-respondents in their attitude toward prescribed burning (m = 5.39 vs. 5.15, t = 2.04, p = .042). There were no differences between respondents and non-respondents in age (t = .718, p = .473), gender (Phi = .041, p = .290), and distance of residence from a forest (Cramer's V = .098, p = .290).

Reliability of Study Indices

The basic belief indices were constructed using the items developed and validated in previous research (Bright et al. 2004; Bright and Burtz 2006; Bright et al. 2007; Kneeshaw et al. 2002), and have been applied in a number of other studies on wildland fire management. All indices had adequate Cronbach's alphas; Freedom (? = .84), trust in Government (? = .87), Responsibility (? = .76), and Artificial Manipulation (? = .72). Attitude toward prescribed burning was also reliable (? = .89).

Relationship between Basic Beliefs and Integrative Complexity

Objective 1 was to determine if the level of a respondent's integrative complexity about prescribed burning was related to their basic beliefs. No significant relationships were found between basic belief dimensions and integrative complexity (Table 2).

Table 2. Relationship between integrative complexity and basic belief dimensions: Pearson's correlations

Basic Belief Dimension	Integrative Complexity	p-value
Freedom	.056	.409
Trust in government	-.003	.969
Responsibility	-.095	.165
Artificial manipulation	.02	.767

Integrative Complexity and Attitude Direction

Objective 2 was to determine if respondents with positive attitudes toward prescribed burning had different levels of integrative complexity than respondents with negative attitudes. Previously, attitude *direction* was independent of integrative complexity (e.g., Bright and Barro 2000; de Vries and Walker 1987). In this study, individuals with positive attitudes toward prescribed burning showed significantly higher integrative complexity than those with negative attitudes (Table 3).

Table 3. Comparison of integrative complexity (IC) between positive and negative attitude groups: Independent samples T-tests

	n	Mean IC	Standard Deviation	t-value	p-value
Attitude Direction					
Positive Attitude	166	.46	.40	3.22	p < .01
Negative Attitude	34	.25	.34		
Attitude Extremity					
Moderate Attitude	116	.49	.37	1.95	.05
Extreme Attitude	100	.38	.42		

Integrative Complexity and Attitude Extremity

Objective 3 was to determine if respondents with extreme attitudes toward prescribed burning had different levels of integrative complexity than respondents with moderate attitudes. Past research has shown high integrative complexity to be related to moderate attitudes, while lower levels of integrative complexity were related to more extreme attitudes (Bright and Barro 2000; de Vries and Walker 1987). Respondents with moderate attitudes toward prescribed burning showed significantly higher levels of integrative complexity than those with extreme attitudes (Table 3).

Moderating Effects of Integrative Complexity on Basic Belief-Attitude Relationship

Objective 4 was to determine the moderating effects of complex thinking on the relationships between basic beliefs and attitudes toward prescribed burning. Of the four moderation analyses, moderation occurred in three of the four cases (Table 4). The basic belief indices of "freedom", "trust in government", and "artificial manipulation" had betas for the two predictors which increased, and betas for the interaction which were significant at $p < .05$, though the variance explained by the model was low. The criteria for moderation according to Baron and Kenny (1986) was met, and indicates that integrative complexity may function as a moderator for the value-laden basic belief-attitude relationship for these dimensions. The relationship between "responsibility" and attitude toward prescribed burning was not moderated by integrative complexity.

Table 4. Regression analyses for the moderating effects of integrative complexity on the basic belief-attitude relationship: Study objective 4

	Dependent Variables in Regression	
Independent Variables	Attitude: Prescribed Burning	
	Regression 1	Regression 2
Freedom	.08	-.17
Integrative Complexity (IC)	.08	-.46*
Freedom*IC		.65*
R^2	.013	.052
Trust in government	.38*	.56*
Integrative Complexity (IC)	.09	.92*
Trust in government*IC		-.88*
R^2	.143	.195
Responsibility	-.029	-.08
Integrative Complexity (IC)	.08	-.17
Responsibility*IC		.025
R^2	.008	.024
Artificial manipulation	.36*	.47*
Integrative Complexity (IC)	.08	.59*
Artificial manipulation*IC		-.54*
R^2	.135	.152

*indicates significance at p<.05

Note: None of the independent variables showed a Pearson's correlation > .095, therefore multi-colinearity issues were of no concern for these analyses.

Table 5 presents analysis to examine the nature of the moderating effects of integrative complexity. The high and low integrative complexity groups were compared on the relationship between basic belief and attitude. *Artificial ma-*

Table 5. Comparison of high and low integrative complexity on basic belief-attitude relationship: Study objective 4

	Integrative Complexity Group			
	Low		High	
Basic Belief Dimension	R^2	B	R^2	B
Freedom	3%	-.06	11.8%	.34*
Trust in government	23%	.48*	1.4%	.12
Artificial manipulation	17.2%	.42*	4.5%	.21*

*indicates significance at p<.05

nipulation and *trust in government* both explained more of the variance in attitude toward prescribed burning for the low integrative complexity group (23.0 % and 17.2% respectively) than for the high integrative complexity group (1.4% and 4.5% respectively). The reverse was the case for the effect of *freedom* on attitude toward prescribed burning.

Discussion

Integrative complexity is a construct focused on how people think about issues such as prescribed burning in addition to the content of the beliefs they hold. This study examined how integrative complexity toward prescribed burning related to the values one holds and characteristics of one's summary attitude toward the issue as well as how the complexity with which one considers an issue such as prescribed burning influences the connection between one's values and attitudes.

The Relationship of Integrative Complexity with Values and Attitudes

Results were consistent with past research that failed to find a relationship between the values one holds and how complexly he or she thinks about an issue (Bright and Barro 2000). Values, and the beliefs that give meaning to these values, begin forming early in an individual's life (Fulton et al. 1996) while cognitive style such as complexity of thinking is most likely developed later in life (Hashway 1998) and may be situational. While a person with high integrative complexity toward an issue would likely access his or her broad values in thinking about the issue, the direction of those values in relation to the issue (that is, if they support or oppose the general premise of the issue) would not be a correlate of how complexly they think about an issue. That is, someone who strongly believes in protecting natural areas from human development and keeping them as natural as possible would not necessarily think more or less complexly about prescribed burning than someone who believes that natural areas should be developed for the betterment of human kind. Given the specific, and situational nature of prescribed burning in people's lives, it is likely that factors such as previous experience with fire may impact their thinking as much or more than values.

Previous research has not found a relationship between attitude direction and integrative complexity, however in this study, people with positive attitudes towards prescribed burning thought about the issue significantly more complexly than those with negative attitudes. Though not tested, this could be attributable to safety concerns that often accompany prescribed burning campaigns. Since negative attitudes towards prescribed burning may be associated with a fear of burns gone awry, concerns about safety may dominate, or supersede, non-safety factors that potentially influence attitudes toward prescribed burning, limiting the complexity with which people with negative attitudes view the issue.

The significant relationship between attitude extremity and integrative complexity in this study was consistent with previous research (e.g., de Vries and Walker 1987; Linville 1982; Tetlock 1989; Bright and Manfredo 1992). Individuals that recognize the tenability of competing sides to an issue are more likely to have more moderate attitudes about the topic than those who view the same issue in strict black and white terms. A person's attitude toward prescribed burning may be based to a large degree on concerns for the safety of humans and property; however that person's attitude may be tempered somewhat by the belief that while prescribed burning can result in problems to humans, it also benefits natural processes.

Integrative Complexity as a Moderator of the Value-Attitude Relationship

This study supported integrative complexity as a moderator for the relationship between values (operationalized as basic beliefs about wildland fire and management) and attitude toward specific strategies such as prescribed burning. However, results suggest that the nature of this moderation depends on the value considered. Integrative complexity was found to moderate the relationship between attitude toward prescribed burning and the value-laden basic beliefs of *freedom, trust in government*, and *artificial manipulation*. Value-laden beliefs regarding *trust in government* and *artificial manipulation* explain more of the variance in attitude toward prescribed burning for the *low* integrative complexity group, than for the *high* integrative complexity group. On the surface, this makes intuitive sense. When one's attitude toward an issue is based on very few or only one dimension(s), as in the case of low integrative complexity, the nature of that attitude is likely to be more easily ascertained than for issues where one's attitude is driven by a larger number of potentially diverse dimensions. On the other hand, *freedom* explained more of the variance in attitude toward prescribed burning for people with *high* integrative complexity than with *low* integrative complexity. Freedom is a particularly salient issue in this country. While integratively complex individuals may see the issue as being about many things such as freedom, safety, resource health, etc., the freedom to build and live where one wants may overshadow other considerations, or dimensions.

Limitations of This Study

There are a number of limitations that should be addressed in order to inform future efforts to enhance the de-

velopment and application of a scale to measure integrative complexity toward issues such as wildland fire management. For one, the response rate in this study was very low. This may limit the ability to generalize to a broader population, which was a goal of this study. Though the non-response check pointed out only one significant difference between respondents and non-respondents, it is indeed still a difference and therefore a limitation.

The language around the topic of wildfire management can also be confusing. What one person calls *prescribed fire*, another may refer to as *prescribed burning*, while yet another may know it as *management ignited fire*. It does not help that there has been a lack of consistency by several land management agencies in the past. However, respondents were given a clear definition of how prescribed fire was defined in this study, so the terminology was less important than what was described prior to their responses. Regardless, a broader examination of the issue of wildland fire management would require additional qualitative and quantitative research in the future to fully overcome these semantic challenges.

Although the requirements for moderation were met in several cases in this study, the R^2 statistics were quite low. This indicates that although there were some cases of moderation, the amount of variance explained by the independent variable was still minimal, and there are other factors that may more significantly impact people's attitudes toward wildfire management. This is an important area for future research.

Finally, this measure of integrative complexity is quite new (Carroll and Bright in press) and improvements could likely be made. For one, the scoring is sometimes misunderstood by readers or seems complicated. The scoring of differentiation (total number of comments on each side of the argument) is consistent with the original approach to measuring integrative complexity using the paragraph completion method, and the integration score is then used to weight the responses and bring the method to completion. It is not intended that one calculation be used in isolation as that would be inherently flawed, but when both differentiation and integration scores are calculated and then multiplied together, a sound integrative complexity score seems to result. That is not to say that there is no room for improvement or future research.

Future Research

Future research should continue to use this method on this and other topics to see how the instrument behaves in different scenarios. As mentioned above, this study only uncovered a small portion of what influences people's attitudes toward wildfire management, and though it is apparent this is an important topic to understand, more work can be done. Past experience with fire, proximity to burn sites, and knowledge, all play a role in how we perceive something such as wildfire management and offer avenues of future research.

Future research should also explore the initial question used in the integrative complexity scale to generate the positive and negative responses. It has not been determined which type of leading question would more succinctly insure that the different dimensions are (or are not) being identified. It would also be beneficial to explore different scales in the integration side of the instrument to see if there is a better way to capture the complex nature of people's stance on an issue. This study asked respondents how "strong" or "weak" they believed the argument to be, but perhaps a different scale would do a better job (e.g., important/not important; true/untrue; likely/unlikely). If the initial leading question was altered then perhaps some other combination of the integration scale would make more sense. One approach could be to ask respondents to first list reasons for and against a wildfire management technique and then to ask them to evaluate those items they listed on how "sound" or "unsound" they believe those practices to be. This may provide a more direct evaluation of wildfire management practices that would be beneficial information to those charged with managing these lands. Perhaps then the amount of variance explained by integrative complexity would be greater when combined with attitudes and basic beliefs. Finally, future research could examine the integrative complexity of the managers themselves to understand how they think about the issues for which they are managing, and if this complexity is consistent with their agency's goals and mission.

Conclusion

Considering the complexity with which people think about natural resource management, issues such as prescribed burning can contribute to greater understanding of public perceptions regarding natural resource management strategies and policies. Much related human dimensions research has focused on *what* people think about an issue; their values, beliefs, and attitudes. Information about *how* people think about these same issues; that is, the complexity of those values, beliefs, and attitudes complements the more traditional social psychological approach and provides additional information that manager's can apply to working with the public. Understanding the complexity with which certain groups think about resource issues will act as an indicator of their response to controversial management practices. People who think complexly about an issue should be more willing to consider the benefits to management approaches that are different than those of which they generally approve. The complexity with which people think about an issue may influence the potential effectiveness of information programs

designed to educate the public about resource management issues. People who think with greater levels of complexity about an issue may elaborate more or differently on agency information than people who think about issues with little complexity. Understanding whether members of a particular stakeholder group approach a resource management issue with a common level of complexity can inform the development of information campaigns. Managers could target their messages with varying levels of complexity, emotionality, and educational elements in ways that enhance the effectiveness of the messages. This relates to the findings of Eagley and Chaiken (1993) who point out that individuals will better listen and respond to information that is at or near the level of complexity at which the individual functions.

Endnote

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2. Original survey instrument had eight blank spaces for arguments both "for" and "against" prescribed burning but has been trimmed down for publication formatting.

References

Ajzen, I. and M. Fishbein. 1980. *Understanding Attitudes and Predicting Social Behavior*. Englewood Cliffs, NJ: Prentice Hall.

Baron, R. and D. Kenny. 1986. The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology* 51, 6, 1173-1182.

Bright, A.D. and R.T. Burtz. 2006. Creating defensible space in the wildland-urban interface: The influence of values on perceptions and behavior. *Environmental Management* 37, 2, 170-185.

Bright, A.D. and S.C. Barro. 2000. Integrative complexity and attitudes: A case study of plant and wildlife species protection. *Human Dimensions of Wildlife* 5, 30-47.

Bright, A.D. and M. J. Manfredo. 1992. The effects of cognitive complexity on the extremity of attitudes toward recreation and natural resource management issues. Abstract in Proceedings of the *Fourth North American Symposium on Society and Resource Management*. Madison, WI.

Bright, A.D., P. Newman and J. Carroll. 2007. Context, beliefs, and attitudes toward wild and fire management: An examination of residents of the wildland-urban interface. *Human Ecology Review* 14, 2, 212-222.

Bright, A.D., J.J. Vaske, K. Kneeshaw, and J. Absher. 2004. Scale development of wildfire management basic beliefs. In proceedings of *2003 International Symposium on Society and Resource Management*. Bloomington IN.

Brunson, M. and B. Steel. 1996. Sources of variation in attitudes and beliefs about federal rangeland management. *Journal of Rangeland Management* 49, 69-75.

Carroll, J. and A. Bright. In press. The integrative complexity of public beliefs toward wildfire management: Development of a scale. *Journal of Applied Social Psychology*. Proceedings from the *2006 Northeast Recreation Research Symposium (NERR)*. Bolton Landing, NY.

Carroll, M.S., K.A. Blatner, P.J. Cohn, and T. Morgan. 2007. Managing fire danger in the forests of the U.S. inland northwest: A classic "wicked problem" in public land policy. *Journal of Forestry* 105, 5, 239-244.

Clute, K. 2001. A perspective from wildland communicators. *Communicators Guide* 59-66.

deVries, B. and L. Walker. 1987. Conceptual/integrative complexity and attitudes toward capital punishment. *Personality and Social Psychology Bulletin* 13, 448-457.

Eagly, A.H. and S. Chaiken. 1993. *The Psychology of Attitudes*. New York: Harcourt, Brace, Jovanovich.

Folkman, W.S. 1979. Urban users of wildland areas as forest fire risks. *USDA Forest Service Research Paper*. Berkley, CA.

Fulton, D., M.J. Manfredo and J. Lipscomb. 1996. Wildlife value orientations: A conceptual and measurement approach. *Human Dimensions of Wildlife* 1, 24-47.

Hashway, R.M. 1998. *Developmental Cognitive Styles: A Primer to the Literature Including an Introduction to the Theory of Developmentalism*. Bethesda, MD: Austin and Winfield.

Homer, P.M. and L.R. Kahle. 1986. A social adaptation explanation of the effects of surrealism in advertising. *Journal of Advertising* 15, 50-54.

Kneeshaw, K., J.J. Vaske, A.D. Bright and J.D. Absher. 2004. Acceptability norms toward wildland fire management. Paper presented at the *10th International Symposium on Society and Resource Management*. Keystone, CO.

Knotek, K. 2006. Understanding social influences on wilderness fire stewardship decisions. *International Journal of Wilderness* 12, 1, 22-25.

Linville, P.W. 1982. The complexity-extremity effect and age-based stereotyping. *Journal of Personality and Social Psychology* 42, 193-211.

Loomis, J.B., L.S. Blair and A. Gonzalez-Caban. 2001. Prescribed fire and public support: Knowledge gained, attitudes changed in Florida. *Journal of Forestry* 99, 11, 18-22.

Manfredo, M.J., M. Fishbein, G.E. Haas and A.E. Watson. 1990. Attitudes towards prescribed fire policies. *Journal of Forestry* 99, 7, 19-23.

McCool, S.F. and G.H. Stankey. 1986. Visitor attitudes toward wilderness fire management policy, 1971-84. *USDA Forest Service Research Paper* INT-357. Ogden, UT.

Monroe, M., K. Payton and M. Nelson. 2006. Communicating with homeowners in the interface about defensible space. *The Public and Wildland Fire: Information for Managers*. Newtown Square, PA: USDA Forest Service, General Technical Report. Northern Research Station.

Patton, T. and M. Oliver. 1985. *Frank Church River of No Return Wilderness Fire Management Plan*, final draft. Washington, DC: USDA Forest Service.

Pyne, S.J. 2001. *Year of the Fires, The Story of the Great Fires of 1910*. New York, NY: Viking.

Rauw, D.M. 1980. Interpreting the natural role of fire: Implications for fire management policy. In *Proceedings of the 6th Conference on Fire and Forest Meteorology*, 228-233. Washington, DC: Society of American Foresters.

Rokeach, M. 1973. *The Nature of Human Values.* New York: Free Press.

Shelby, B. and R.W. Speaker. 1990. Public attitudes and perceptions of prescribed burning. In J.D. Walsted, S.R. Radosevich and D.V. Sandberg (eds.), *Natural and Prescribed Fire in Pacific W Forests*, 253-260.

Shindler, B. and E. Toman. 2003. Fuel reduction strategies in forest communities: A longitudinal analysis of public support. *Journal of Forestry*, 9-15.

Stankey, G.H. 1976. Wilderness fire policy: An investigation of visitor knowledge and beliefs. Ogden, UT: *USDA Forest Service research paper* INT-180.

Suedfeld, P., B. de Vries, S. Bluck, A.B. Wallbaum and P.W. Schmidt. 1996. Intuitive perceptions of decision-making strategy: Naive assessors' concepts of integrative complexity. *International Journal of Psychology* 31, 177-190.

Taylor , J.G. and T.C. Daniel. 1984. Prescribed fire: Public education and perception. *Journal of Forestry* 82, 6, 361-365.

Tetlock, P. 1989. Structure and function in political belief systems. In A.R. Pratkanis, S.J. Breckler and A.G. Greenwald (eds.), *Attitude Structure and Function*, 129-151. Hillsdale, NJ: Erlbaum.

Toman, E. and B. Shindler. 2006. Wildland fire and fuel management: Principles for effective communication. In *The Public and Wildland Fire: Information for Managers. USDA Forest Service, General Technical Report*. Northern Research Station, Newtown Square, PA.

USDA Forest Service Fire Policy Report. 2008. http://www.fs.fed.us/fire/management/index.html. Accessed on February 4, 2008.

Vaske, J. J. and M. P. Donnelly. 1999. A value-attitude-behavior model predicting wildland reservation voting intentions. *Society and Natural Resources* 12, 523-537.

Winter, G.J., C. Vogt and J.S. Fried. 2002. Fuel treatments at the wildland-urban interface: Common concerns in diverse regions. *Journal of Forestry* 100, 1, 15-21.

Zwolinski, M.J., H.J. Cortner, E.H. Carpenter and J.G. Taylor. 1982. Public support for fire management policies in recreational land management. *Final Report to the Eisenhower Consortium.* USDA Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. Tucson, AZ: School of Renewable Resources report, University of Arizona.