

**Can Interpretive
Messages Change Park
Visitors' Views on
Wildland Fire?**

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Abstract

This study evaluated the effect of differently formulated interpretive messages embedded in a 90-minute guided tour on Mesa Verde National Park visitors' knowledge and attitudes about wildland fire. Using a Solomon four-group experimental design, 31 different groups of visitors ($N=496$) received affective arguments, cognitive arguments, a combination of arguments, or no persuasive argument. All persuasive programs led to significant increases (one to two points) on a five-question knowledge scale and two attitude scales, although the three treatments did not differ in their effects. Attitudes became slightly more positive about the ecological role of fire and less negative about the destructive nature of fire. A slight priming effect of the pre-test was found for one measure but there were no effects on other measures, supporting the external validity of study findings. Attitude and knowledge changes related to fire were greater for those who had weaker prior attitudes or lower prior levels of knowledge. Counter to hypotheses, the personal relevance of fire and need for cognition did not exhibit a significant relationship to knowledge gain or attitude change.

Keywords

affect, persuasion, interpretation, evaluation, need for cognition, guided walks, wildland fire, attitudes

Introduction

Influencing Public Views on Wildland Fire

In the literature that addresses public attitudes toward wildland fire, a common theme is the need for public education. Many Americans know little about the natural processes of fire (Manfredo, Fishbein, Haas, and Watson, 1989), and many were brought up to believe that all fires should be suppressed (Loomis, Bair, and Gonzalez-Caban, 2001). In a recent study of visitors to national forests in three states, the most favored option for responding to various hypothetical fire scenarios was suppression, regardless of the nature and outcomes of the fires (Kneeshaw, Vaske, Bright, and Absher, 2004). Yet

wildland fire is an important and inevitable process in many ecosystems, and across the country public land managers are striving to return fire to a more natural role. To accomplish this, it will be necessary to have public support (Machlis, Kaplan, Tuler, Bagby, and McKendry, 2002).

Interpretive activities in parks and forests reach a wider and larger cross-section of people than most types of agency communication campaigns. Many programs deal with wildland fire, but few studies have evaluated the effects of such efforts. However, at least three studies have documented a significant impact on knowledge. One discovered that attending fire-themed slide programs or interpretive walks increased knowledge about and support for the National Park Service's fire policy (Nielsen and Buchanan, 1986). Baas, Haas, Ross, and Loomis (1983) also documented a moderate influence of interpretation on visitors' knowledge of prescribed burning and their support for prescribed fire. Finally, Taylor and Daniel (1984) demonstrated that interpretive media could change public perceptions and increase public knowledge of prescribed fire among a sample of Tucson, Arizona, residents.

While many interpretive programs strive to increase factual knowledge about resource issues, knowledge change is often insufficient to promote stewardship or garner public support. Instead, one must focus on influencing attitudes. Attitudes are defined as general evaluations of an object or issue (Eagly and Chaiken, 1993), and it is well accepted that public behavior and support for policies is determined more by attitudes than by factual knowledge (Bright, Fishbein, Manfreda, and Bath, 1993; Fishbein and Yzer, 2003). People can believe things to be true or false, but unless they evaluate the outcomes as good or bad, we cannot know how they will respond to policy proposals. Thus, research is needed that goes beyond assessing the impact of interpretation on knowledge alone (Orams, 1997; Tubb, 2003).

Recently there has been a call in literature to balance emphasis on the cognitive (belief) components of attitude with attention to affective (emotional) components when developing environmental education programs (Bright and Tarrant, 2002). Programs should target both domains because affect and cognition have a synergistic relationship; affect is a significant predictor—in combination and by itself—of attitudes toward environmental issues (Pooley and O'Connor, 2000). Few studies have evaluated the use of emotion to change knowledge or attitudes about natural resource issues or compared emotional to more rationally cognitive appeals. In response to this call for an increased emphasis on the use of affective persuasion, we conducted a study to compare messages with an affective versus cognitive tone. Our evaluation was guided by the Elaboration Likelihood Model of Persuasion (ELM).

Factors Affecting Attitude Change

The ELM suggests that whether attitudes will change in response to persuasive arguments depends on a variety of individual characteristics, situational factors, and message properties (Eagly and Chaiken, 1993; Petty, McMichael, and Brannon, 1992). Most interpreters strive to influence attitudes through the "central" route, which involves message recipients carefully scrutinizing the arguments presented, generating cognitive responses, and creating links between new information and pre-existing cognitive structures. Central route processing is typically desired because the impacts tend to be more enduring and predictive of later attitudinal expressions or behavior (Anderson, Lucas, and Ginns, 2003).

Among individual factors that affect whether central route processing will occur, the

personal relevance of the topic and need for cognition are two of the most important (Eagly and Chaiken, 1993). Personal relevance refers to the level of psychological involvement one feels toward an attitude object (Bright and Manfredi, 1997; Petty and Cacioppo, 1979). People for whom a message is personally relevant are more likely to process a message deeply, and therefore to learn more, especially if prior knowledge is low (Falk and Adelman, 2003).

Need for cognition is defined as a psychological tendency (i.e., a disposition or trait) to engage in and enjoy thinking (Cacioppo and Petty, 1982). People high in need for cognition are more likely to attend to and process persuasive messages. Therefore, they should gain more knowledge than people who are not highly motivated to consider the arguments presented by an interpreter in a leisure context. In this study we sought to determine whether personal relevance or need for cognition was positively related to knowledge gain or attitude change.

Another individual characteristic that relates to attitude change is one's prior attitude. It is axiomatic among communication scholars that "strong" attitudes are difficult to change (Eagly and Chaiken, 1993; Orams, 1997). Attitudes may be strong due to vested interest in outcomes, connection of an issue to one's identity, or various other factors (Thomsen, Borgida, and Lavine, 1995). People with strong attitudes may counterargue the messages presented, which can ultimately reinforce the prior attitude (Bright and Manfredi, 1997). Empirical evidence from interpretive research shows greater changes in knowledge and attitudes among those with lower prior knowledge or weaker attitudes (Falk and Adelman, 2003).

Situational factors can affect attitude change by influencing participants' motivation or ability to process messages deeply (Orams, 1997). Interpretive contexts, especially guided tours, have the potential for many distractions, including the behavior of other participants and captivating elements of the environment. In low motivation settings, the source of the message can be more important to persuasion than the message arguments themselves (Andrews and Shimp, 1990). The number of times a message is repeated can also affect cognitive processing. Repetition increases the chances that a message will capture attention in the first place, and it affects the nature and type of cognitive elaboration.

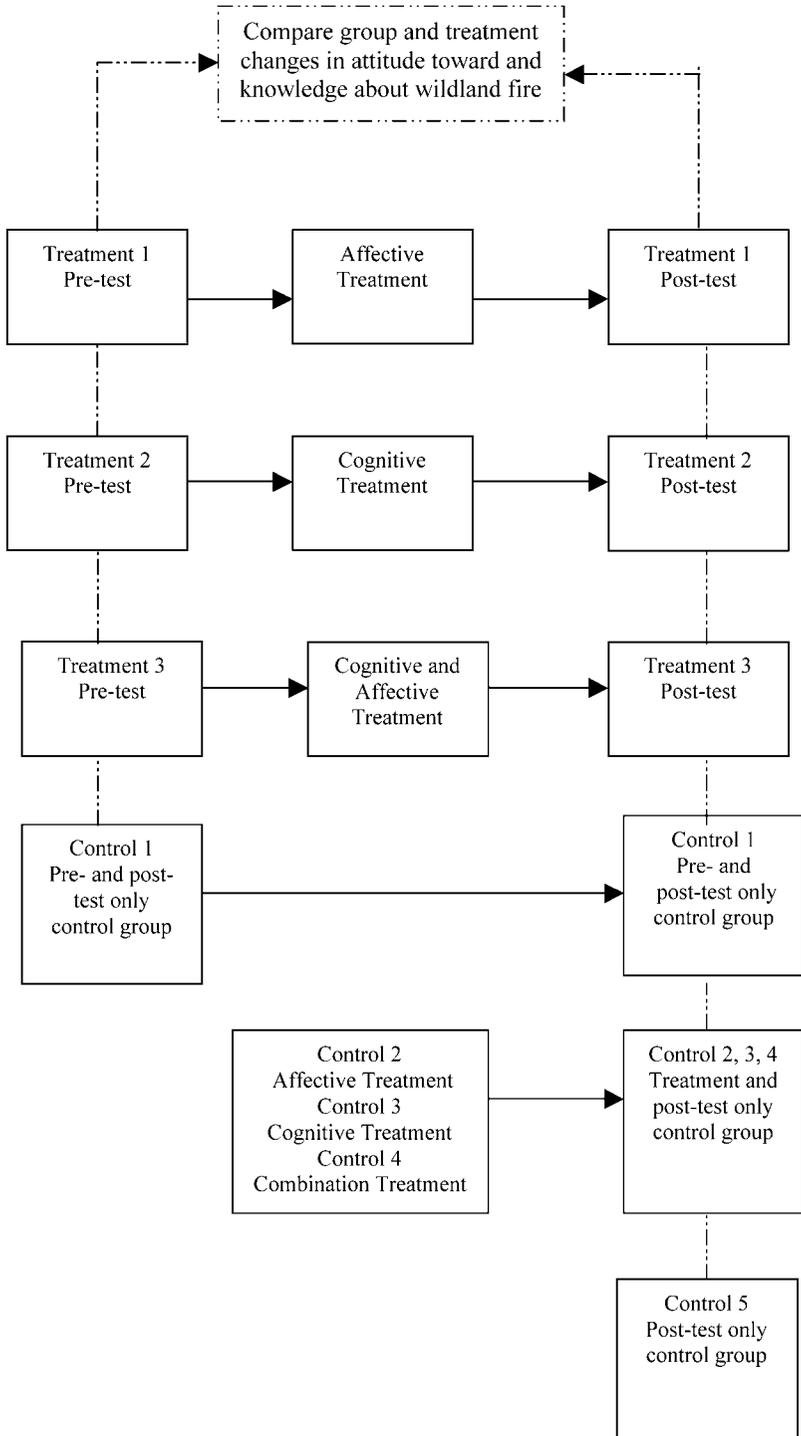
The purpose of the study was to assess the effect of differently formulated interpretive messages (affective and cognitive) on knowledge and attitudes. Additionally, we investigated the influence of two individual characteristics—personal relevance of the topic and need for cognition—on changes in knowledge about and attitudes toward wildland fire. We attempted to control for many situational factors that could influence attitudes, because we wanted to isolate the effect of the type of arguments presented. We accomplished this by replicating each treatment and control with several different randomly selected tours, having the programs all delivered by the same interpreter (a uniformed National Park Service employee), and having a consistent number of message repetitions in each program.

Methods

Study Area

Mesa Verde National Park, one of the largest archeological preserves in the United States, was the center of the Ancestral Puebloan culture between the sixth and 13th centuries (Wenger, 1991). Wildland fire is an important topic at Mesa Verde for two reasons. First, the

Figure 1. Modified Solomon's four group design



Ancestral Puebloans used fire in their daily lives, and it is important to share this aspect of their lives with the visitors to provide a more comprehensive picture of this culture. Second, wildland fire plays an intricate role in the forest and shrub ecosystems found throughout the park. Wildland fires have recently reshaped the park's landscape, which provides visitors the opportunity to view the various stages of forest regrowth after a wildland fire.

Research Design

The study used a pre-test/post-test Solomon's four group experimental design (Figure 1), in which some groups (both treatment and control) completed pre-test and post-test instruments and others received only a post-test (Graziano and Raulin, 2002). A concern in many experimental studies is that the pre-test itself, or something that occurs with participants during the course of the study but is unrelated to the treatment, can cause changes that mistakenly are attributed to the treatment itself. Solomon's four-group design permits the researcher to isolate the effects of the treatment from those of priming due to the pre-test or exposure to the environment during the course of the tour. Each of three treatments—*affective arguments, cognitive arguments, and a combination of affective and cognitive arguments*—was replicated with seven different groups of visitors to help mitigate any unique findings that might occur on one specific tour or with one type of group. Control groups consisted of those who received both the pre- and post-test without a treatment message (replicated three times), treatment and post-test but no pre-test (replicated once for each of the three programs), and post-test only controls who did not receive either a pre-test or a treatment (replicated three times). Experimental conditions (treatment or control) were randomly assigned to randomly selected tour groups in the summer of 2003.

Participants in the control groups that did not receive treatment messages attended a program that focused on the daily lives of the Ancestral Puebloans without reference to wildland fire. All three experimental treatments had the same central core program, whose theme was "fire has an important role in our lives today, just as it did in the lives of the Ancestral Puebloans." The two main points were 1) when fire is under control it sustains human life (e.g., cooking, heating), but when fire is out of control it destroys life; and 2) fire is needed to maintain healthy fire-dependent ecosystems. The experimental cognitive and affective persuasive arguments were stand-alone segments of the programs that supported the overall theme. Affective arguments incorporated emotionally arousing elements, such as birth or death (Lang, 2000; Orams, 1997). They also attempted to personalize the message in ways that would cause people to reflect on their own lives. The cognitive arguments focused on factual information, largely related to fire's role in nutrient cycling (see Appendix for examples of the arguments used). Program conclusions touched on the general idea of the arguments, but did not repeat them verbatim.

Procedures

Long House cliff dwelling, the site of this study, attracts visitors interested in prehistoric archaeology. It was chosen as the study location because it offered the longest tour length of all the interpretive programs at Mesa Verde (90 minutes), thus providing more time to influence attitudes. It was also the only cliff dwelling with ranger-guided tours that would logistically facilitate the administration of both pre- and post-test questionnaires. Before the tour, visitors were seated on a Long House tram for five minutes before being transported to the site, and this time was used to administer the pre-test. The post-test was administered while

Table 1. Pre-test Attitudes and Knowledge

Measure	N	Mean Score	SD
Pre-test Knowledge ^a	425	0.70	0.86
Pre-test Ecological Attitude ^b	423	11.56	5.68
Pre-test Destruction Attitude ^b	422	-3.39	6.71

^a 6-point scale: 0 to 5.

^b Scale: -21 to +21

Table 2. Paired t Tests Comparing Pre- and Post-test Scores on Attitudes and Knowledge

Treatment	Element	Mean Score		<i>t</i>	<i>df</i>
		Pre-test	Post-test		
Affective	Ecological Attitude ^a	10.67	14.38	-7.04*	123
	Destruction Attitude ^a	-3.79	-0.72	-4.87*	121
	Knowledge ^b	0.62	2.11	16.40*	126
Cognitive	Ecological Attitude	12.20	14.72	-4.43*	115
	Destruction Attitude	-2.63	-1.93	-1.07	115
	Knowledge	0.84	2.12	11.08*	116
Combination	Ecological Attitude	12.07	15.87	-8.21*	117
	Destruction Attitude	-3.57	-1.23	-3.61*	116
	Knowledge	0.60	2.02	14.14*	122
Control	Ecological Attitude	11.50	11.40	0.14	56
	Destruction Attitude	-3.31	-2.13	-1.39	56
	Knowledge	0.81	0.89	0.76	56

^a Scale: -21 to +21

^b 6-point scale: 0 to 5

* $p < .0005$

the visitors were waiting for the return tram back to the parking area. An additional advantage was that Long House visitors were unlikely to expect a tour focused on fire, so we felt that self-selection bias based on topic interest would be reduced.

Self-completed questionnaires were distributed by the uniformed National Park Service interpreter who delivered all programs. All English-speaking adults (age 18 and older) were invited to participate. To assess change in knowledge and attitudes, we needed to match individuals' pre-test and post-test questionnaires. The pre-test had a number written on the upper corner and on a small tag stapled over the written number. The visitor kept the numbered tag when he or she turned in the pre-test. Upon completing the post-test, the numbered tag was stapled to the post-test instrument. This process allowed study participants complete anonymity.

Measures

Dependent measures of knowledge and attitudes appeared on both the pre-test and post-test. The post-test also included questions to measure need for cognition and personal relevance, as well as socio-demographic characteristics. The expectancy-value theory of attitudes was used to develop attitudinal measures (Fishbein and Ajzen, 1975). This approach requires measuring both belief strength (how strongly a respondent believes something to be true) and the evaluation of each belief (favorableness of that condition). For example, a belief statement was "many animals die in a wildland fire." The response scale for belief strength was a seven-point unipolar scale (1 = strongly disagree; 7 = strongly agree), and the response scale for evaluation was a seven-point bipolar scale (-3 = really bad; +3 = really good). Following expectancy value theory, each belief item was multiplied by its corresponding evaluation, generating a possible range of values between +21 and -21 for each item. The belief items were developed by having a panel of judges rank 63 initial items related to fire in terms of their inherent favorableness toward wildland fire (Trochim, 2001). A subset of items that captured a range of positive and negative sentiments was pre-tested with a convenience sample of residents in the community of Moscow, Idaho. Thirteen items that represented a range of favorability and were highly correlated were selected as the final attitude measures. Exploratory factor analysis was used on the final data to identify underlying attitudes that were being measured by multiple items.

Knowledge about wildland fire was defined as the factual information presented in the interpretive programs. The scale consisted of five multiple-choice questions, each of which included a "don't know" option (which was scored as incorrect). The items were highly specific; for example, they included the number of acres burned in the park during a recent fire and the purpose of the Haines index. The total correct score (zero to five) was computed for each respondent.

Potential moderating variables were need for cognition and the personal relevance of wildland fire. Six five-point questions from the efficient assessment of need for cognition scale (Cacioppo, Petty, and Kao, 1984) were included in the post-test. The average of the five items became the individual's score. Personal relevance was measured with five yes/no items developed for this study related to interest in fire. An example is, "Do you enjoy learning about wildland fires?" Possible scores on the index of relevance ranged from zero to five.

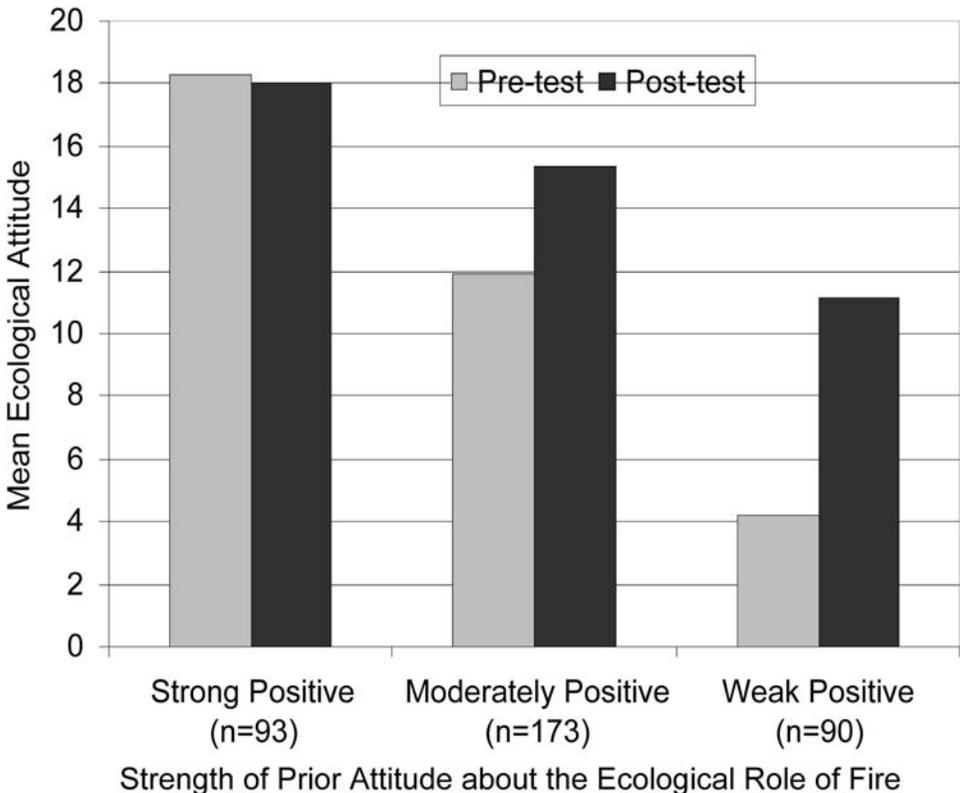
Table 3. Mean Change in Attitude and Knowledge Scores from Pre-test to Post-test, by Treatment

	Argument Type				<i>F</i>
	Affective	Cognitive	Combination	Control	
Ecological Attitude	3.71 _a	2.52 _a	3.80 _a	-0.11 _b	7.20**
Destruction Attitude	3.07 _a	0.70 _b	2.35 _{ab}	1.18 _{ab}	2.71*
Knowledge	1.49 _a	1.28 _a	1.42 _a	0.09 _b	24.17**

Note: Means with different subscripts differ significantly at $\alpha = .05$ in the Duncan test.

* $p < .05$

** $p < .0005$

Figure 2. Pre- and post-test mean ecological attitude scores as a function of prior attitude strength

Results

Visitor Characteristics

A total of 496 visitors participated in the study, in 31 different tour groups. The response rates ranged from approximately 80 to 85 percent. Study participants were for the most part well educated (32 percent having a post-college degree), middle-aged (with most between 25 and 64 years of age), and first-time visitors to the park (63 percent). Pre-test knowledge levels were very low, as might be expected given the specific, technical questions we asked (Table 1). None of the pre-test measures differed significantly (at $\alpha = .05$) among treatment or control groups.

Change in Attitudes and Knowledge

To reduce the attitude items to a smaller number of attitude measures, factor analysis was performed, and only items loading uniquely on a single factor with a loading of at least 0.40 were retained. This generated two independent attitudinal dimensions: an "ecological attitude" that included six items related to fire's role in ecosystems (Cronbach's $\alpha = 0.87$) and a "destruction attitude" ($\alpha = 0.56$) that included three items related to the destructive nature of fire (e.g., burning trees and killing wildlife). Attitude scores were computed as the mean for the items loading on each factor, with a potential range of -21 to +21. Respondents on average had positive attitudes toward the ecological role of wildland fire before the tour but had weakly negative attitudes about its destructive nature (Table 1).

We used paired *t* tests to determine the effect of the persuasive messages on participants' attitudes and knowledge for respondents who completed both the pre-test and post-test (Table 2). All three treatments led to a positive change in ecological attitudes and an increase in knowledge, while two led to a positive change in the attitude about the destructive nature of fire. Control groups who did not receive a fire program showed no change in any of the three measures, as expected.

For each participant, we computed change scores for knowledge and attitudes (post-test minus pre-test), and we used ANOVAs to determine whether the treatments differed from each other in the amount of change generated (Table 3). For the ecological attitude, all three treatments differed from the control, but not from each other. For the destruction attitude, the affective treatment had a significantly larger effect than the cognitive treatment, but neither differed significantly from either the combination program or the control group. There was a significant effect of the treatments on knowledge change. All treatments caused an increase relative to the control, but treatment effects did not differ.

Influence of Prior Attitudes and Knowledge on Cognitive Change

Additional analyses assessed the effect of prior attitudes and knowledge on degree of change. Because, for the most part, the three treatments did not differ, they were combined in this analysis. Respondents were classified into three categories for each of the two pre-test attitude measures. For the ecological attitude, inspection of frequencies indicated obvious break points, with scores below 7.67 considered "weak positive" and scores greater than 15.75 considered "strong positive." Scores between these points were considered "moderately positive." For attitude about the destructive nature of fire, break points occurred at 1.00 (scores above this were labeled "weak positive") and -7.33 (scores below this were labeled "moderately negative"). Intermediate scores were labeled "weak negative." Within each atti-

tude category, paired t tests were used to determine whether post-test scores differed from pre-test scores.

For the ecological attitude (Figure 2), the largest change was observed for people in the weak positive group, $t(90) = 11.16$, $p < .0005$, and the change for the moderately positive group was also statistically significant, $t(172) = 9.08$, $p < .0005$. However, within the strong positive group, there was no change, $t(93) = 0.62$, $p = .54$, probably due to a ceiling effect (i.e., initial attitudes were so positive that there was little room for change). For the attitude about the destructive nature of fire (Figure 3), changes in all groups were statistically significant (weak positive group, $t(79) = 3.01$, $p = .003$; weak negative group, $t(179) = -3.21$, $p = .002$), but the change for the moderately negative group was the largest, $t(94) = -8.88$, $p < .0005$. Interestingly, those who initially held weak positive attitudes became slightly more negative, while those who were initially most negative became substantially less negative.

In all three treatment groups, most participants ($n = 193$) scored zero correct on the pre-test knowledge questions. Among these people, the median number of correct answers on the post-test was two, and only 5 percent answered no questions correctly. The mean change for this group was 1.93 ($SD = 0.86$). For people scoring at least one correct answer on the pre-test ($n = 174$), the median post-test score was also two. Among these participants 15 percent scored lower on the post-test than on the pretest, and the mean change was 0.82 ($SD = 1.11$). Thus, more change occurred for the initially least knowledgeable group.

The Relationship of Individual Characteristics to Cognitive Change

Possible scores on the need for cognition scale could range from 6 to 30, and observed values fell between 9 and 21 ($M = 16.4$, $SD = 1.86$). Scores on the five-item personal relevance scale fell near the midpoint ($M = 3.12$; $SD = 1.24$), indicating a moderate level of interest. Correlational analyses showed no significant relationship between participants' need for cognition scores and either attitude or knowledge change. Neither was there a statistically significant relationship between the personal relevance of wildland fire and any of the dependent measures. Additional analyses showed personal relevance and need for cognition to be independent of all other of the pre-test or post-test dependent variables.

Assessment of Testing Effects

Administering the pre-test had the potential to influence what visitors learned during the tours because they may have been provoked to pay more attention than they otherwise would have done. To assess this possibility, we made two comparisons that are permitted by the Solomon four-group design. The first was among people who did not receive a treatment but some of whom completed both the pre- and post-tests and others of whom completed only the post-test. Among these control groups, there was no evident priming due to the pre-test for knowledge ($t(87) = 0.71$, $p = .43$), for ecological attitude ($t(85) = 1.59$, $p = .12$), or for destruction attitude ($t(85) = 1.75$, $p = .08$). As these control tours did not receive any information about fire, this outcome was expected. The pre-test apparently did not cause participants to inquire substantially more about the burned environment they saw and therefore learn more.

The second assessment compared treatment groups who completed both the pre- and post-tests to people who completed only the post-test (Table 4). There was no difference in post-test knowledge scores or attitudes toward the destructive nature of fire, indicating that the pre-test did not affect these variables. However, post-test attitude scores about the eco-

logical role of fire were significantly higher among the pre/post treatment groups than among the groups that did not receive the pre-test. Thus, it is possible that receiving the pre-test accounted for at least some of the observed changes in ecological attitudes. People who received the pre-test may have paid more attention to the tour message and therefore experienced a greater change in ecological attitude.

Discussion

Magnitude of Changes in Attitudes and Knowledge

Pre-test results indicated that, on average, study participants came to the program with a positive attitude toward the ecological consequences of fire and a slightly negative attitude regarding fire's destructive potential. These results are consistent with other surveys of public attitudes toward wildland fire (Manfredo *et al.*, 1989). In general, the destructive element of fire is considered bad. However, Americans are beginning to support the use of fire as a land management tool because they are starting to understand its ecological role in fire-dependent ecosystems (Brunson and Shindler, 2004; Shindler and Toman, 2003; Taylor and Mutch, 1986).

On a five-question scale, the mean knowledge score for all treatments increased from 0.69 to 2.08. The interpretive programs also changed attitudes toward wildland fire, although the magnitude of these changes was smaller than those observed for knowledge. The ecological attitude change ranged from 2.8 points (cognitive treatment) to 3.5 points (combination treatment), while the change in destruction attitudes ranged from 1.6 points (combination treatment) to 2.3 points (affective treatment). All changes were in the direction advocated by the program. These results, together with other studies (e.g., Loomis *et al.*, 2001), provide the fire education community with empirical evidence that fire education/interpretation can have positive impacts on adult attitudes toward and knowledge about wildland fire.

The magnitude of effect is only really meaningful in the context of other studies of persuasive influence, because complete comprehension and recall of material encountered during leisure excursions is rare. Although there have been few studies of the effects of guided tours on knowledge or attitudes, such influences have been more fully investigated for other interpretive media such as visitor centers or self-guided tours. These studies have documented highly variable levels of change. Often the effects, though statistically significant, are small in a practical sense. For example, Brown and Koran (1998) documented an improvement of 1.5 points (on a 15-point scale) among visitors spending 1.5 to 3.5 hours at Mayan ruins. Similarly, Olson, Bowman, and Roth (1984) found mean improvement on seven-point knowledge scales to range from 0.47 to 1.13 for questions dealing with environmental issues among an audience of nature center visitors. Madin and Fenton (2004) reported that visitors who participated in six to 10 interpretive activities related to coral reefs only scored approximately 1.5 points higher on each of two five-point knowledge questions than those who participated in four or fewer activities, and two other questions showed no differences at all. In all these cases, effects were small.

However, in other cases, knowledge gains have been quite large (Lee and Balchin, 1995). For instance, in Falk's (1993) study of visitors to a marine ecosystem exhibit, more than 65 percent of exiting visitors could define the term "ecosystem," compared to only

Figure 3. Pre- and post-test mean destruction attitude scores as a function of prior attitude strength

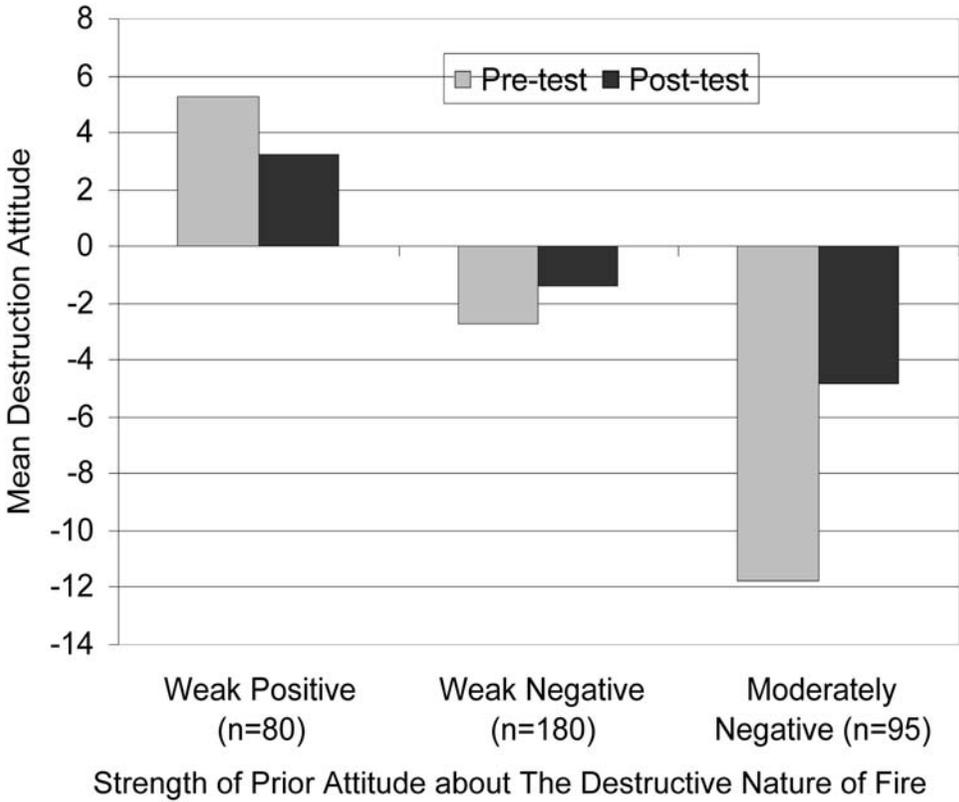


Table 4. Comparison of Post-Test Scores on Knowledge and Attitudes among Groups That Received Treatments to Assess Priming

Group	Mean Score		
	Ecological Attitude	Destruction Attitude	Knowledge
Pre-test/Post-test	14.97	-1.31	2.08
Post-test Only	11.33	-1.66	2.05
<i>t</i>	3.66*	0.30	0.22

* $p < .0005$

10 percent of those entering. One of the few studies of personally delivered interpretive messages found participants in one program scored between 50 and 71 percent correct on a post-visit knowledge test and participants in a different program scored 50 to 57 percent correct, where the questions dealt with material the visitors would not have known ahead of time (Ryan and Dewar, 1995). In a study most similar to ours, Morgan, Absher, Loudon, and Sutherland (1997) reported that forest visitors taking a guided walk about wildfire scored between 6.5 and 7.0 on a test of eight questions, compared to 3.9 for control hike participants. Our findings about the magnitude of knowledge gain are well within the range found in other assessments of personally delivered interpretive messages, particularly when compared to research in similar types of settings.

A common finding in studies of interpretive communication is that knowledge is more easily influenced than attitudes (Knapp and Barrie, 1998; Orams, 1997). Indeed, global attitudes often do not change at all (Doering, Bickford, Darns, and Kindlon, 1999). For example, Brown and Koran (1998) reported no change in interest levels (attitude) about Mayans, despite significant increases in factual learning, and Peart (1984) found that attitudes toward wildlife management were no different among people exposed to exhibits than people not exposed, despite scoring twice as high on knowledge tests. Similarly, Lee and Balchin (1995) reported variable but sometimes dramatic improvements in the percentage of people scoring correctly on knowledge tests about nuclear power, depending on the exhibit topic, but there were few positive changes in overall attitudes. In our study, both attitudes and knowledge changed, although the magnitude of change was greater for knowledge. Our attitude results are similar to those reported by Morgan et al. (1997); in their study attitudes toward wildland fire increased from 2.8 (on a five-point scale) among control participants to 3.5 among those who participated in a guided walk focused on fire. It remains an open, and potentially important, question whether the larger attitude changes in the two studies dealing with fire are due to personally delivered messages or some other factor.

While programs with affective arguments caused the greatest change, the differences between treatments were not statistically significant. One possible explanation for this lack of differentiation is that different visitors are affected by different types of messages, and just as many responded to the cognitive presentations as the affective presentations. However, the lack of difference might also be due to the way treatment arguments were embedded in longer programs. All three treatment programs had the same framework and base messages, and the impact of cognitive and affective arguments may have been diluted by the rest of the 90-minute program. Finally, we may not have achieved a substantial differentiation between the messages to begin with. Indeed, questions on the post-test designed to serve as manipulation checks showed that participants evaluated all programs as equally "emotional." Interpreters and others believe that emotion is a powerful persuasive tool, and more studies are needed—especially ones that differentiate levels of emotionality more clearly—to evaluate this assumption.

Individual Characteristics and Cognitive Change

Interestingly, individual characteristics that we expected to predict change, namely personal relevance and need for cognition, were unrelated to change in attitude or knowledge. Falk and Adelman (2003) showed that a high level of interest or concern was required for visitors to an aquarium to show significant increases in knowledge or changes in attitudes. This was

not the case in our study. Perhaps Mesa Verde visitors are highly interested in learning, and people attending a long, guided tour may anticipate and desire to learn. Alternatively, it is possible that messages delivered on a guided walk are more readily assimilated by all visitors, and do not require a particularly high level of motivation to process.

On the other hand, prior attitudes and knowledge had a substantial moderating effect on attitude change and knowledge gain. Those with the lowest levels of prior knowledge learned the most. This is consistent with findings reported by Falk and Adelman (2003), in which the most knowledgeable people showed no change after their aquarium visit, but those with little prior knowledge and high interest learned a significant amount.

Communication scholars agree that strong prior attitudes—particularly those that are important to people—are difficult to change (Bright and Manfredi, 1997; Eagly and Chaiken, 1993). However, weak attitudes, which may be based on little prior thought, can be altered substantially by strong arguments. This was observed for the ecological attitudes, with a large (seven-point) average change among those with the weakest prior attitudes. However, outcomes were not so clear for the attitudes about the destructive nature of fire. Bright et al. (1993) observed that negative attitudes about fire were almost impervious to messages targeted directly at changing them. In our study, few individuals came to the programs with strongly negative destruction attitudes, but those who changed the most were those with the most negative initial attitudes. Reasons for the differences between the two studies are unknown.

Although interpreters do not have control over the prior attitudes or knowledge of their audience members, these findings do indicate that interpretation can have the most impact with visitors who hold weak attitudes or know little about the subject matter presented. They also demonstrate the value of pre-tests in evaluation studies, because post-test only or cross-sectional designs cannot uncover such effects.

Future Research

Our study raises several questions. First, we documented a priming effect for one of the three dependent measures. Pre-test/post-test designs are the most powerful for understanding persuasive influence (Tubb, 2003), but priming is a potential drawback. We feel this should become a fundamental part of future research designs. Although we detected some priming, others (e.g., Falk and Adelman, 2003) have not, and due to the lack of study, the impact of such effects remains an open question.

Another direction for research is to develop and test other emotional messages. Our experience showed that what interpreters consider to be emotional (or non-emotional) may be evaluated differently by visitors. Understanding persuasive influence would also benefit from conducting similar studies in areas where visitor involvement differs. It is likely that visitors who paid to attend a lengthy, guided walk may have been more interested in learning than visitors to other places. Learning and attitude change might be different in other types of settings.

Conclusion

The more the public knows about wildland fire and its key roles in fire-dependent ecosystems, the more it may support land managers' use of fire as a land management tool (McCool and Stankey, 1986; Shindler and Toman, 2003). Wildland fire is a key component of the ecosystems in Mesa Verde National Park and throughout the country, and interpretive

programs present an important opportunity for resource managers to communicate with a large segment of the public. This study demonstrates that interpretive programs are effective in changing some adults' attitudes toward and increasing their knowledge about wildland fire. Only through program evaluation like this can we more clearly understand the links between our audiences and effective interpretive programs.

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Appendix

Example of Cognitive Argument Related to Wildland Fire

How many of you folks have heard that fires sterilize the soil? A fire can sterilize the soil if the fire becomes hot enough. The severity of a fire is measured by soil heating. Certain fires may heat the soil so high that the top layer of soil is melted. This layer prevents water from going into the soil—in essence sterilizing the soil. However, here at Mesa Verde, we have not seen this problem. Rather, we can see the renewal that fires bring to this landscape. Look at the small oaks growing in the burn area from three years ago. This re-growth illustrates how fires are a natural phenomenon akin to the changing of the seasons. Fires create renewal. Here at Mesa Verde grass can return as soon as two weeks after a fire. Our forests are living, dynamic systems. Without fire, the dynamic nature of the ecosystem is interrupted. Tall trees choke out smaller trees and the forest floor becomes littered with duff. Ash from forest fires, sometimes five inches deep, is rich with calcium, phosphorus, and other minerals. These nutrients support new plant growth. Fire recycles organic matter, provides new food sources for wildlife, and clears the way for a new generation of trees and other plants. Lightning strikes the earth more than eight million times a day. We have no more control over this natural phenomenon than we do an ice storm in Iceland. At our next stop we will talk a bit more about how lightning caused fires have changed the landscape here at Mesa Verde in recent times.

Example of Affective Argument Related to Wildland Fire

Fire sterilizes everything! Have you heard this said? But, what about the explosion of wildflowers the summer following a fire? What about the new trees that sprout after a fire? Fire brings change, diversity, and new life. We are all familiar with these things. Change—for example: a move, a marriage, a new house. Diversity—take a look around at the diversity of people in this group, in our communities, or the diversity of plants and animals in forests, deserts, and prairies. New life—the birth of a child. These are things we can all relate to on some level. The forest ecosystem is dynamic, just as human lives are. Fire does not sterilize everything. Fire is not a villain of our forest but rather an agent of change. Change at first can be a stark contrast with the old and new—like trying to adjust to a new home after a move or wildflowers against blackened trees. Fire is nature's recycler. In a sense, all living things borrow a supply of the earth's minerals for a while. Wildfire makes the pine needles, branches, and other once-living things of the forest give them back. They become available to other life, to renew life.