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# Factors Influencing Behavioral Intentions for Leave No Trace Behavior in National Parks

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Facts and views expressed in this paper are the responsibility of the authors and do not necessarily reflect the opinions of the Leave No Trace Center for Outdoor Ethics.

## Abstract

Resource degradation resulting from visitor behavior continues to be a significant concern for land managers, and effective educational messages such as those promoted through Leave No Trace, which target depreciative behaviors, are imperative. This study examined psychological and knowledge variables that were hypothesized to influence future Leave No Trace behavioral intent of visitors in Rocky Mountain National Park. Data were obtained from an on-site survey administered to individuals ( $n = 390$ , response rate 74%) in the Bear Lake corridor of the park. Results of a multiple regression analysis revealed that *perceived effectiveness* of Leave No Trace practices is a significant predictor of future behavioral intent ( $\beta > .21$ ,  $p < .001$ , in all cases). Frontcountry visitors like those at Bear Lake are more likely to practice Leave No Trace if they perceive the practices to be effective at reducing impacts.

## Keywords

Leave No Trace, environmental education, environmental attitudes, frontcountry, recreation impacts, depreciative behavior

## Introduction

Public land managers face a myriad of complex challenges. From invasive species to inadequate funding and staffing to increasing recreational use, land managers must strike a balance between resource protection and the provision of recreational opportunities in a manner consistent with the law and agency policies. In many protected areas, including those with a multiple use mandate, resource degradation due to inappropriate visitor behavior continues to be a significant concern for managers (Leung & Marion, 2000; Taff, Newman, Bright, & Vagias, 2011; Vagias & Powell, 2010). Given the fact that even nominal recreational use can cause considerable impacts, particularly since some impacts are cumulative over time, park and protected area managers must utilize a variety of strategies to minimize these impacts (Hammitt & Cole, 1998; Leung & Marion, 2000).

Land managers primarily address visitor use issues through one of two approaches: indirectly through visitor education or directly through enforcement or sanctions (Manning, 2003; Marion & Reid, 2007). Direct management approaches including enforcement of regulations and intensive site management such as fencing or hardening of recreation sites tend to be costly and can limit visitors' sense of freedom (Marion & Reid, 2007). Indirect management approaches such as visitor education have become a primary and effective method used to minimize depreciative behaviors of protected area visitors (Hammitt & Cole, 1998; Hendee & Dawson, 2002; Manning, 1999; 2003; Marion & Reid, 2001). This has led to the development of several educational initiatives aimed at minimizing recreation-related impacts including Codes of Conduct, Leave No Trace, and Guidelines for Tourists (Marion & Reid, 2007). Although there is some variation between the programs, their overarching intent is to raise awareness, reduce depreciative behaviors, increase knowledge, influence attitudes, and enhance the visitor's experience (Vagias, 2009). In many parks and protected areas, managers provide minimum-impact

visitor education in the form of the seven Leave No Trace principles for responsible use of lands. The Leave No Trace concepts and principles have become one of the most frequently used methods for encouraging responsible use of recreational resources (Harmon, 1997; Marion & Reid, 2001; Vagias & Powell, 2010).

In spite of recent advances towards understanding attitudes and behaviors related to Leave No Trace of backcountry recreationists, there is a dearth of information pertaining to the attitudes frontcountry visitors have towards Leave No Trace-related behaviors and recommended practices (Taff, 2012). Frontcountry, as defined by The Leave No Trace Center for Outdoor Ethics (The Center), includes areas that are easily accessed by car and mostly visited by day users as well as developed campsites used for overnight car camping (Leave No Trace Center for Outdoor Ethics, 2012a). In many parks and protected areas, park managers direct most visitors to frontcountry locations (Kuentzel, Laven, Manning, & Valliere, 2008). This study investigated day-use visitor knowledge, behavioral intent, and beliefs concerning recommended Leave No Trace practices in the Bear Lake corridor of Rocky Mountain National Park. The study findings offer insight for improving educational messages targeting depreciative behaviors that could be applied to the Bear Lake corridor and other similar frontcountry, day-use areas in other national parks.

### *Leave No Trace*

Leave No Trace is the most prevalent minimum-impact visitor education program in use in parks and protected areas in the U.S. (Vagias & Powell, 2010). The intent of the Leave No Trace program is to educate recreationists about the nature of their recreational impacts with the goal of resource protection (Leave No Trace Center for Outdoor Ethics, 2013). Leave No Trace is particularly appealing to land managers because it offers a more light-handed approach to visitor management as opposed to more heavy-handed management strategies (Vagias, 2009). The Leave No Trace concept dates back to the 1960s, when the USDA Forest Service began promoting the notion of “pack it in, pack it out” to outdoor enthusiasts (Marion & Reid, 2001). The program was further developed through the 1970s, and began to take shape as a minimum-impact camping message. As recreation increased through the 1980s, the effort gained additional attention as more focus was being placed on recreation impacts by the federal land management agencies. In the early 1990s the USDA Forest Service forged a partnership with the National Outdoor Leadership School (NOLS), to begin jointly promoting a science-based approach to minimum impact recreation. This resulted in the development of numerous publications detailing minimum-impact recreational practices (Hampton & Cole, 2003; Marion & Reid, 2001; McGivney, 2003; Swain, 1996).

In 1993, three of the other primary federal land management agencies (Bureau of Land Management, National Park Service, and the U.S. Fish and Wildlife Service) adopted Leave No Trace as their chief minimum-impact educational program (Marion & Reid, 2001). Soon thereafter, an outdoor recreation summit in Washington D.C. led to the creation of a national 501(c)(3) non-profit Leave No Trace, Inc. Now known as the Leave No Trace Center for Outdoor Ethics, the organization has continued to advance and grow the Leave No Trace program, which has been adopted by most parks and protected areas in the U.S., as well as numerous international land management agencies. The center has the following mission: “To teach people how to enjoy the outdoors responsibly” (Leave No Trace Center for Outdoor Ethics, 2012b). The seven

Leave No Trace principles (Figure 1), which are the foundation of the program, can be seen in many parks and protected areas. These principles are routinely used on signage, in educational and promotional materials, and included in interpretive information and programs.

The center has a variety of education, training, and outreach programs designed to educate the recreating public about enjoying the outdoors responsibly. The center and its partners offer formal Leave No Trace courses ranging from a one-day course to a five-day, intensive field-based course known as the Leave No Trace Master Educator Course (Leave No Trace Center for Outdoor Ethics, 2012d). The organization has a current focus on three key programmatic areas: youth, frontcountry, and local efforts (Leave No Trace Center for Outdoor Ethics, 2013).

#### *Previous Research*

Two primary scientific disciplines form the foundation of the Leave No Trace literature base: recreation ecology and human dimensions of natural resources. Recreation ecology research, “a field of study that examines, assesses, and monitors visitor impacts, typically to protected natural areas, and their relationships to influential factors” (Leung & Marion, 2000, pg. 23), has provided the foundation for Leave No Trace messaging because of its focus on recreational impacts (Cole, 2004; Hammitt & Cole, 1998; Hampton & Cole, 2003; Leung & Marion, 2000). Recreation ecology has dominated most minimum-impact research, and reviews suggest that there have been more than 1,000 recreation ecology articles published within recent decades (Monz, Cole, Leung, & Marion, 2010). Yet, the behavior of recreationists is perhaps the largest determinant of impact, and human dimensions research, which focuses on the sociological, psychological, cultural, and economic aspects of recreationists (Ewert, 1996), is limited but growing with regard to Leave No Trace-related studies (Taff, 2012).

The majority of human dimensions research related to Leave No Trace has evaluated educational efficacy through various communication strategies in an effort to increase knowledge and influence behavioral change (Marion & Reid, 2007). For example, studies have evaluated communication strategies to mitigate human and wildlife conflict (Hockett & Hall, 2007; Lackey & Ham, 2003), reduce litter (Cialdini, 1996), minimize removal of natural objects (Widner & Roggenbuck, 2000; Widner & Roggenbuck, 2003), or deter off-trail hiking (Winter, 2006). Few studies have addressed Leave No Trace specifically, instead focusing on minimum-impact behaviors, and even fewer studies have evaluated the most common user-group, frontcountry visitors (Taff, 2012). More recently, however, social scientists have explored concepts such as knowledge, attitudes, beliefs, values, and behaviors of outdoor enthusiasts in the context of Leave No Trace practices (Marion & Reid, 2007; Vagias, 2009; Vagias & Powell, 2010), and have begun examining the perceptions of frontcountry visitors (Jones, 1999; Jones & Bruyere, 2004;

#### **Leave No Trace Principles:**

1. Plan Ahead and Prepare
2. Travel and Camp on Durable Surfaces
3. Dispose of Waste Properly
4. Leave What You Find
5. Minimize Campfire Impacts
6. Respect Wildlife
7. Be Considerate of Other Visitors

Figure 1. Seven Principles of Leave No Trace (adapted from the Leave No Trace Center for Outdoor Ethics, 2012c)



Leung & Attarian, 2003; Mertz, 2002; Taff, 2012; Taff et al., 2011). This study adds to this body of social science research by evaluating frontcountry visitor attitudes toward Leave No Trace.

### *Theoretical Orientation*

The Theory of Reasoned Action (TRA) and its successor the Theory of Planned Behavior (TPB), which was used to orient this research, are general theories of social psychology that seek to explain human behavior through an understanding of the determinants of said human behavior (Ajzen, 1991; Fishbein & Ajzen, 1975). Both theories have been applied to investigations into the human dimension of natural resource management science generally (Fishbein & Manfredo, 1992; Manfredo, Teel, & Bright, 2004; Marion & Reid, 2007; Vagias & Powell, 2010) and to Leave No Trace investigations specifically (Taff, 2012; Vagias, 2009). The overarching assertion of these theories is that individuals are rational creatures and that their behavior is largely determined by their intention to engage in a particular behavior (Ajzen, 1991; Fishbein & Ajzen, 1975). Behavioral intentions are determined by attitudes, the influence of others (norms), perceived behavioral control (Ajzen, 1991), and potentially other factors such as values and emotions (Kollmuss & Agyeman, 2002).

Both theory and previous research suggest that while numerous factors can influence behavior, one's specific attitude towards a particular behavior is a determinant factor in governing his or her actions (Ajzen, 1991; Ajzen & Fishbein, 1980; Fishbein & Manfredo, 1992; Ham & Krumpal, 1996). Eagly and Chaiken (1993) described an attitude as an individual's evaluation of a particular object. Once an evaluation has taken place, and a specific attitude has been formed, it is stored in memory and can be drawn on to guide behavior (Ajzen, 1991). Thus, behavior in terms of Leave No Trace is theoretically determined in part by attitudes (positive or negative) towards specific Leave No Trace recommendations and guidelines. Therefore, if attitudes can accurately predict behavioral intention, then to the extent attitudes can be modified, park and protected area managers can alter visitors' behaviors by changing the salient attitude or belief (Vagias, 2009). Thus, in order to create effective visitor education and communication tactics that can minimize overall recreational impact by influencing visitor behavioral intent, understanding visitor attitudes related to Leave No Trace is paramount.

Based on the TPB and previous research, we hypothesized that future Leave No Trace behavioral intent would be influenced by:

- Attitudes towards Leave No Trace
- The perceived effectiveness of Leave No Trace practices
- The perceived difficulty of practicing Leave No Trace
- Self-reported knowledge of Leave No Trace practices

The Theory of Planned Behavior was used to orient this research, but this study did not test the theory directly, nor did it measure either the perceived behavioral control or the influence of norms components of the TPB. It should be noted that some theorists conceptualize perceived behavioral control as multidimensional, consisting of two discrete dimensions: perceived control and perceived difficulty (Traifmow, Sheeran, Conner, & Finlay, 2002). Ajzen (2002) defined perceived behavioral control as "the perceived ease or

difficulty of performing the behavior” (p. 665), which could be interpreted as two separate constructs. Despite the potential differentiation of perceived behavioral control, the variable in this study that measured perceived difficulty of Leave No Trace practices was not operationalized to measure the construct in terms of the TPB.

Therefore, based on previous investigations of Leave No Trace behavioral intentions (see Vagias & Powell, 2010), the primary component of the TBP under investigation in this research was attitude. According to Manfredo, Vaske, and Decker (1995), “It is important to measure attitudes because they are believed to cause human behavior” (p. 19).

## Methods

Data were collected between July 15 and August 15, 2009, in the Bear Lake corridor of Rocky Mountain National Park, a heavily visited and predominately day-use area of the park. Respondents were specifically targeted at the Glacier Gorge and Bear Lake trailheads, both of which offer numerous day-use recreational opportunities. These trailheads are two of the most heavily trafficked areas in the Bear Lake corridor due to the availability of parking for personal vehicles and the regular and convenient shuttle service to the area provided by the National Park Service (Park, Lawson, Kaliski, Newman, & Gibson, 2010; Taff, 2012).

The survey instrument explored social psychological and knowledge variables related to six of the seven Leave No Trace Principles. The survey did not address the fifth Leave No Trace Principle Minimize Campfire Impacts due to the park regulations that prohibit fire in the Bear Lake corridor. The researchers used a stratified random sampling procedure and asked visitors if they would be willing to participate in a “visitor opinion study.” Data were collected at both trailheads with sampling designed to take place over a 16-day period, segmented equally between weekday and weekend, A.M. and P.M. sampling times. All surveys were completed by a single individual regardless of group size, and were completed on site. Sampling locations at both trailheads were near park interpretive signage that displayed the Leave No Trace principles. For this reason, two methodological adjustments were made. First, the phrase “Leave No Trace” was not seen in the survey form until the last few questions. Second, researchers only approached those individuals or groups exiting trailheads to decrease the likelihood they recently viewed the signage.

A total of 390 completed surveys were collected providing a response rate of 74%. Because of the large sample size and high response rate, non-response bias was deemed to not be a concern. Based on sample size and visitation to these trailheads there is 95% confidence that these findings are accurate to +/- five percentage points (Vaske, 2008). There were no significant differences found between the Glacier Gorge and Bear Lake responses so results have been combined for analysis purposes.

### *Variable Measurement*

The dependent variable was behavioral intent to perform recommended Leave No Trace practices in the future (Table 5), operationalized as how likely or unlikely visitors were to engage in Leave No Trace behavior in the future for each of the following categories: planning ahead; staying on designated trails; packing out all waste; leaving natural objects in place; not feeding, following, or approaching wildlife; and taking breaks away from trails and other visitors.

The independent variables consisted of the following: attitudes towards Leave No Trace practices (how appropriate or inappropriate practices are perceived; Table 1),

Table 1.  
*Attitudes towards frontcountry Leave No Trace practices*

How APPROPRIATE or INAPPROPRIATE do you think the following activities are for a visitor to do in Rocky Mtn. National Park...	N	Mean	S.D.	Percentage <sup>a</sup>						
				Very Inappropriate		Neutral			Very Appropriate	
				1	2	3	4	5	6	7
Experience nature by not preparing for weather/hazards	388	2.51	1.9	46	19	11	7	6	4	8
Travel off trail to experience nature	388	2.62	1.9	43	18	9	11	8	5	6
Carry out all litter, leaving only food scraps	388	4.64	2.7	27	6	5	3	3	5	50
Keep a single item like a rock, plant, stick or feather as a souvenir	388	2.25	1.6	49	17	12	11	5	3	3
Drop food on the ground to provide wildlife a food source	388	1.43	1.2	82	10	2	2	1	1	3
Take a break along the edge of a trail	387	5.48	1.6	3	3	5	15	13	27	34

a. Percentages may not equal exactly 100% due to rounding.

Table 2.  
*Perceived level of effectiveness of Leave No Trace practices*

Participating in the following activities in Rocky Mtn. National Park would reduce impact...	N	Mean	S.D.	Percentage <sup>a</sup>						
				Never		Sometimes			Every time	
				1	2	3	4	5	6	7
Prepare for all types of weather, hazards and emergencies before getting on trail	387	6.02	1.16	1	0	1	13	14	23	48
Stay on designated or established trails	382	6.38	0.97	1	0	1	4	10	22	62
Carry out all litter, even crumbs, peels or cores	386	6.65	0.71	3	0	0	2	3	9	85
Never removing objects from the area, not even a small item like a rock, plant or stick	387	6.05	1.51	3	1	2	10	7	17	60
Never approach, feed or follow wildlife	388	6.19	1.54	5	2	1	6	5	16	66
Take breaks away from the trail and other visitors	387	4.57	1.88	10	8	9	21	15	20	18

a. Percentages may not equal exactly 100% due to rounding.

Table 3.  
*Perceived difficulty of practicing Leave No Trace*

Please indicate how DIFFICULT you think each of the following would be for a visitor to do in Rocky Mtn. National Park...	N	Mean	S.D.	Percentage <sup>a</sup>						
				Not at all Difficult		Moderately Difficult			Extremely Difficult	
				1	2	3	4	5	6	7
Prepare for all types of weather, hazards and emergencies before getting on trail	387	2.65	1.56	33	21	13	22	7	3	2
Stay on designated or established trails	383	1.62	1.14	66	20	8	3	1	2	1
Carry out all littler, even crumbs, peels or cores	386	1.14	0.96	78	12	5	3	1	1	1
Never removing objects from the area, not even a small item like a rock, plant or stick	386	1.52	1.10	74	14	4	5	2	1	1
Never approach, feed or follow wildlife	387	1.61	1.22	71	14	7	4	1	2	1
Take breaks away from the trail and other visitors	386	2.12	1.39	49	19	12	14	4	1	1

a. Percentages may not equal exactly 100% due to rounding.

Table 4.  
*Level of self-described Leave No Trace knowledge*

N	Mean	S.D.	Percentage						
			No Knowledge	Very Limited	Limited	Average	Above Average	Extensive	Expert
			0	1	2	3	4	5	6
383	3.45	1.74	11	7	7	16	27	25	7

Table 5.  
*Behavioral intentions to practice Leave No Trace in the future*

Please indicate how LIKELY you are to do the following activity in the future...	N	Mean	S.D.	Percentage <sup>a</sup>						
				Not at all Likely		Moderately Likely			Extremely Likely	
				1	2	3	4	5	6	7
Prepare for all types of weather, hazards and emergencies before getting on trail	384	5.95	1.34	1	1	2	15	11	19	51
Stay on designated or established trails	382	6.22	1.18	1	1	1	10	8	21	59
Carry out all littler, even crumbs, peels or cores	378	6.70	0.89	1	0	2	3	2	8	85
Never removing objects from the area, not even a small item like a rock, plant or stick	379	6.09	1.60	4	3	2	10	5	11	66
Never approach, feed or follow wildlife	380	6.00	1.74	7	2	2	6	6	14	63
Take breaks away from the trail and other visitors	380	4.87	1.79	8	5	5	23	18	16	24

a. Percentages may not equal exactly 100% due to rounding.

perceived effectiveness of Leave No Trace practices (Table 2), perceived difficulty of Leave No Trace practices (Table 3) and self-described Leave No Trace knowledge (Table 4). All variables were measured on a 7-point scale.

## Results

### *Descriptive Findings*

Attitudinal statements were used to analyze how park visitors felt about the appropriateness of specific Leave No Trace practices. The results (Table 1) indicate that many visitors are either unfamiliar with or simply misunderstand some Leave No Trace practices. In particular, the majority of respondents (55%) felt that it was *very appropriate* ( $M = 4.64$ ) to leave food scraps behind as a food source for animals. Similarly, the majority of respondents (61%) felt that taking breaks along the edge of the trail was *very appropriate* ( $M = 5.48$ ). These results indicate that visitor may not fully understand the Leave No Trace principles *Dispose of Waste Properly* and *Be Considerate of Other Visitors*, which recommend packing out all waste including food scraps and taking breaks away from trails on durable surfaces such as rock, bare ground, gravel, etc. when available to not impact the experience of others. Though limited in number, previous studies have found similar shortcomings in visitors understanding of these Leave No Trace concepts (see Taff et al., 2011; Vagias & Powell, 2010). For all other attitudes measured, mean scores were less than  $M = 2.62$  indicating that respondents understood and had attitudes consistent with land manager recommendations towards these practices.

Survey respondents were asked to rate whether certain Leave No Trace practices would reduce impact in the park. The concept of perceived effectiveness of Leave No Trace practices is important because it is possible that practices that are perceived as ineffective are likely to be practiced less than those with a higher perception of effectiveness. The majority of practices (Table 2) were perceived to reduce impact *every time* ( $M \geq 6.02$ ), indicating that respondents felt impact would be reduced by following these practices. One practice, *taking breaks away from the trail and other visitors*, had a lower mean score ( $M = 4.57$ ) indicating that respondents felt that this practice would only be effective at reducing impact sometimes.

Respondents were asked to rate the level of difficulty in performing the same practices asked about previously. None of the practices received a mean score higher than  $M = 2.65$  indicating that the practices were not viewed as being *extremely difficult* (Table 3). If specific practices are perceived as being too difficult, there is a greater likelihood that these recommended practices might not be followed.

Survey respondents were asked to rate their knowledge of Leave No Trace on a 7-point scale (0 = no knowledge to 6 = expert). The mean score was 3.45, with nearly 60% reporting above average to expert in terms of their Leave No Trace knowledge (Table 4).

Respondents were asked how likely they were to engage in future Leave No Trace behaviors and practices (Table 5). On all survey items but one, the majority of respondents indicated that they were *extremely likely* to practice Leave No Trace in the future. The one exception was *taking breaks away from the trail and other visitors* ( $M = 4.87$ ), indicating that visitors were only *moderately likely* to follow this recommendation. In all other categories, mean scores ( $M \geq 5.95$ ) indicated that respondents were *moderately to extremely likely* to practice Leave No Trace in the future.

Table 6.  
*Predicting future Leave No Trace behavior<sup>a</sup>*

Future Behavior	Appropriateness	Effectiveness	Difficulty	Knowledge	R <sup>2</sup>
Preparing for all types of weather, hazards and emergencies	-.11*	.36**	.17	.17	.29
Staying on designated or established trails	-.25**	.40**	-.07	.06	.34
Carrying out all litter, including food scraps	-.07	.33**	-.19*	.01	.18
Not removing natural objects from the area	-.19**	.21**	-.14*	.12*	.17
Not feeding, following or approaching wildlife	-.08	.26**	-.12*	.14*	.15
Taking breaks away from trails and other visitors	-.03	.25**	-.16**	.13*	.12

a. Cell entries are standardized regression coefficients — \*  $p < .05$ , \*\*  $p < .001$

### Regression Analysis

Six separate linear regression models were run. For each of the models, one item from Table 5 served as the dependent variable. Consistent with the hypotheses, the analysis revealed that future Leave No Trace behavioral intent was influenced at varying levels by attitudes, perceived effectiveness, perceived difficulty, and self-reported Leave No Trace knowledge (Table 6). The analysis explained the most variance ( $R^2 = .34$ ) in respondent's future likelihood of *staying on designated or established trails*. The next highest level of explained variance ( $R^2 = .29$ ) was respondent's future likelihood of *preparing for all types of weather, hazards, or emergencies*. The smallest amount of variance was explained ( $R^2 = .12$ ) for the variable *taking breaks away from trails and other visitors*. Perceived effectiveness of Leave No Trace practices was the strongest predictor ( $\beta > .21$ ,  $p < .001$ , in all cases) of future Leave No Trace behavioral intent. Despite the high level of self-reported knowledge of Leave No Trace, it was not shown to be a significant predictor ( $\beta < .17$ ,  $p \geq .05$ , in all cases) of future Leave No Trace behavioral intent. While attitudes towards Leave No Trace practices and perceived difficulty of Leave No Trace practices were statistically significant in some of the models ( $p < .05$ , in some cases), they were weaker predictors of future behavioral intent than perceived effectiveness. Taken together, these results indicate a need for park education and interpretation staff to focus messages on the effectiveness of recommended Leave No Trace practices in order to influence future behavioral intent in park visitors.

### Discussion

This study examined the influence of attitudes, perceived effectiveness, perceptions related to the difficulty of following practices, and self-reported knowledge on future Leave No Trace behavioral intent in Rocky Mountain National Park. Of particular interest was determining which of these variables has the most influence on future visitor behavioral intent. Across all respondents, the majority indicated that they were *moderately to extremely likely* to practice Leave No Trace in the future. However, behavioral intent does not necessarily equate to actual behavior. Therefore, this study



attempted to determine which variables most influence future Leave No Trace behavioral intent in national park visitors. If specific influences can be determined, park managers can effectively message to visitors in Rocky Mountain National Park, as well as in other park and protected areas, about how to minimize their recreation-related impacts. Data from this study indicate that perceived effectiveness of Leave No Trace practices is a significant predictor of future Leave No Trace behavioral intent.

Of particular interest is the level of self-reported Leave No Trace knowledge. Nearly 60% of respondents rated their knowledge as *above average to expert* (Table 4), indicating that park visitors feel they have extensive experience with Leave No Trace skills and ethics. This is consistent with results from previous Leave No Trace-related investigations but in the absence of actually testing knowledge, the accuracy of self-reported knowledge is inconclusive (see Taff et al., 2011; Vagias & Powell, 2010). However, the results of the attitudinal measures (Table 1) suggest that some park visitors are either unfamiliar with or do not clearly understand recommended Leave No Trace practices. It is also plausible that visitors do not agree with certain Leave No Trace practices and therefore have a negative evaluation (attitude) of those practices. Furthermore, visitors may perceive some level of inconsistency among the Leave No Trace practices. This may be particularly likely with respect to recommendations to refrain from traveling off-trail yet at the same time recommending that visitors do travel off-trail to take breaks away from other visitors to minimize social impacts. These seemingly conflicting messages likely warrant further investigation in future studies, and suggest that the center consider providing additional detail concerning the purpose of these recommendations.

In order to minimize depreciative behavior, protected area managers often rely on educational strategies both to inform visitors and attempt to change visitor behavior (Cialdini, 1996; Ham, 2007; Manning, 2003; Marion & Reid, 2007; Vagias, 2009). Heimlich and Ardoin (2008) noted that for some environmental education efforts, “the ultimate purpose...is to affect individuals’ behaviors” (p. 215). However, education efforts that focus solely on providing new knowledge do not always result in attitude or behavior change (Hwang, Kim, & Jeng, 2000; Kollmuss & Agyeman, 2002; Petty, McMichael, & Brannon, 1992). Data from this research supports the assertion that knowledge does not necessarily equate to behavioral intent, and suggests that focusing on the effectiveness of Leave No Trace practices at reducing impacts to the landscape may lead to increased Leave No Trace behavior in the future.

Despite robust educational efforts by Rocky Mountain National Park, recreation-related impact continues to be a concern for park managers (National Park Service, 2012). Many park visitors may be unaware of both the nature of their impacts and Leave No Trace practices to reduce those impacts or they simply disagree with the recommended practices. As shown by this study, perceived effectiveness of Leave No Trace practices is a meaningful predictor of future Leave No Trace behavioral intent. Therefore, park managers and the Leave No Trace Center for Outdoor Ethics should consider focusing educational efforts on how effectively Leave No Trace practices minimize impacts to the landscape. While this study found that that knowledge is not a significant predictor of future behavioral intent, park visitors do need to be made aware of the recommended Leave No Trace practices for Rocky Mountain National Park and other similar protected areas. However, and perhaps more importantly, park visitors need to better understand why certain Leave No Trace practices are recommended, and why those practices are effective at reducing impacts.

For the past decade, the Leave No Trace Center for Outdoor Ethics has encouraged its educators to emphasize the effectiveness of recommended Leave No Trace practices in order to bolster understanding and compliance. This recommendation has largely been based on anecdotal evidence and feedback from course and workshop participants (Dana Watts, personal communication, August 10, 2012). However, this research suggests that education efforts specifically focused on the perceived effectiveness of Leave No Trace practices may prove more effective at modifying visitor behavior in order to minimize recreation-related impact in parks.

### **Study Limitations and Future Research**

This study has several limitations that warrant further investigation in future studies. First, this study only examined one component of the TPB—attitudes. It is clear that other factors influence behavioral intent such as norms and perceived behavioral control (Vagias, 2009), neither of which were under investigation in this research. Second, reported behavioral intent was used as a proxy for actual behavioral intent, which has limitations in terms of making valid predictions about future behavioral intent. In the absence of testing of actual behavior through behavioral observation or other methods, it remains unclear in this context how well reported behavioral intent determines actual behavior. Third, anticipating and avoiding biasing effects from particular wording of survey questions is often challenging (Babbie, 2008; Vaske, 2008). Due to the structure of the Leave No Trace principles and how survey questions were crafted to address those principles, there is the possibility of inadvertent research-induced bias. Future studies of this kind should strive to minimize this potential bias to the extent possible. Lastly, this study did not examine other possible mediating variables of behavioral intent such as weather conditions. Despite the limitations of this study, the results confirmed the importance of visitor perceptions of the effectiveness of recommended practices in terms of behavioral intent to practice Leave No Trace in national parks.

Some past Leave No Trace-focused studies have utilized increased knowledge as a measure of efficacy (Daniels & Marion, 2005; Vagias, 2009). While there are issues with these kinds of knowledge evaluations, the primary concern is that an individual's behavior is largely determined more by factors such as attitudes, norms, perceived behavioral control, and perhaps other factors, than by knowledge (Ajzen, 1991). According to Kaiser, Wolfing, and Fuhrer (1999), attitudes are far more important than knowledge in environmental contexts. This study and previous research (Vagias, 2009) indicate a need to undertake studies that address attitudes, norms, perceived behavioral control, values, beliefs, and perceptions about the effectiveness of Leave No Trace behaviors in question rather than knowledge of specific Leave No Trace practices. Studies that focus specifically on Leave No Trace in frontcountry contexts may be most beneficial to both the Leave No Trace Center for Outdoor Ethics and land managers as trend data indicate that a continued increase in frontcountry recreation is likely to occur in the future (Cordell, 2012; Outdoor Industry Foundation, 2012).

### **Conclusion**

Resource impact due to uninformed visitor behavior continues to be a chief concern for land managers, and effective educational messages such as those promoted through Leave No Trace, which target these behaviors, are essential. This study examined how psychological and knowledge variables influence future Leave No Trace behavioral



intent of visitors in Rocky Mountain National Park. The results suggest that perceived effectiveness of Leave No Trace practices is a meaningful predictor of future behavioral intent. Education efforts are likely to be successful at influencing future behavioral intent if they focus on why certain Leave No Trace practices are recommended and why those practices are effective at reducing impacts.

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