

Final Report: Dog Guardians' Perceptions and Behaviors Related to the Disposal of Pet Waste in City of Boulder Open Space and Mountain Parks

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Executive Summary: The purpose of this study was to explore dog guardian behaviors and self-reported perceptions regarding the disposal of dog waste on Open Space and Mountain Parks (OSMP) lands in Boulder, Colorado, in an effort to increase compliance with proper disposal practices. This study utilized direct observations of dog guardians and their behaviors regarding pet waste, and separate self-reported surveys to examine dog guardians' perceptions of pet waste disposal on OSMP lands. The Theory of Planned Behavior served as a framework to explore how dog guardians' attitudes, norms, and perceived behavioral control might influence behavioral intentions, as well as self-reported current behavior, regarding the disposal of pet waste on OSMP lands. Finally, this study explored potential management techniques that may influence dog guardians to properly dispose of pet waste on OSMP lands in the future.

Data were collected across 10 sites on OSMP lands, for total of $n=541$ observations and $n=386$ surveys. Canine defecation and human behavioral response occurred $n=102$ times during the $n=541$ observations, and overall 73.5% of dog guardians properly (i.e., bag waste and immediately take all bags) disposed of waste. Guardians with dogs on-leash were significantly more likely to bag their pet's waste than guardians with dogs off-leash, and they were ~11% more likely to bag and immediately take pet waste for disposal (i.e., compliance) than guardians with dogs off-leash. With regard to the self-reported survey results, perceived behavioral control was the construct that most significantly correlated with behavioral intent regarding proper disposal of dog waste. Many respondents reported that additional trash or compost receptacles and bag dispensers along OSMP trails would make them more likely to follow recommended practices related to the disposal of pet waste in the future. These results suggest that management should consider the following direct actions: designating more on-leash-only sites because compliance is substantially higher when dogs are on-leash; establishing longer on-leash

segments at off-leash areas/trailheads; installing additional, more frequent trash and/or compost receptacles and bag dispensers, specifically at the end of existing on-leash segments and at off-leash areas/trailheads. Pairing these with indirect actions, such as education strategies, that inform pet guardians that it is not best practice to leave bagged pet waste for later disposal, while highlighting the ease of immediately bagging waste and carrying it to a trash or compost receptacle may further increase compliance.

Keywords: *open space, dogs, pet waste, leash, behaviors, Leave No Trace, Theory of Planned Behavior*

Introduction

Across the United States, dogs produce 10.6 million tons of waste annually (Stevens & Hussmann, 2017). Not surprisingly, dog waste has become an issue in the field of outdoor recreation in protected areas. Dog waste is non-native to park and protected area environments and has the potential to carry zoonotic bacteria and parasites, such as roundworms and hookworms, which can pose health hazards to humans, other dogs, and wildlife (Kachnic et al., 2013; Rahim, Barrios, McKee, McLaws, & Kosatsky, 2017; Wilson, 2014; Acosta-Jamett et al., 2011). Additionally, the excess nutrients, such as nitrogen and phosphorous, from dog waste create environmental conditions that can produce algal blooms in waterways (Stevens & Hussmann, 2017). When algal blooms persist over time, they can result in oxygen depletion and fish mortality (Hallegraeff, 1993; Svircev et al., 2016). Lastly, research suggests that park visitors (both those with and without dogs) are often bothered when dog guardians do not properly dispose of pet waste (Vaske & Donnelly, 2007) and as a result, conflict between visitors may arise (Jones & Lowry, 2004).

Leaving pet waste is an issue on many public lands, and managers often implement regulations in order to attempt to prevent issues related to health, the environment, and visitor experiences. Many dog guardians dislike behavioral restrictions related to their dogs while in parks (Slater et al., 2008), while non-dog guardians desire the implementation of more restrictions and regulations (Instone & Mee, 2011). Therefore, visitors' park experiences may be negatively affected by pet waste. For these reasons, it is important to understand the factors that affect dog guardian behavior related to the disposal of dog waste in parks.

The purpose of this study is to explore dog guardian behaviors regarding pet waste and self-reported perceptions and behaviors concerning the disposal of dog waste on Open Space and Mountain Parks (OSMP) lands in Boulder, Colorado, and specifically compare the behaviors between dog guardians who keep their dog(s) on-leash and those who have their dog(s) off leash. OSMP lands manage over 45,000 acres of wildlife habitat, unique geologic features, and greenways, with an estimated 5.3 million individual visits to OSMP lands each year (OSMP, 2014). Almost 90% of the 150 miles of public trails are open to dogs, and an estimated 30 tons of dog waste (75% of the allowable freight weight of one semi-truck) is left behind in OSMP lands each year (Jones & Lowry, 2004). As such, pet waste has become a major issue on these lands. Research suggests that dogs are the most common source of conflict among visitors on OSMP lands (Vaske & Donnelly, 2008; Giolitto, 2012). In particular, conflicts may arise due to the behaviors of off-leash dogs and their guardians and pet waste left on OSMP lands (VanderWoude, 2010). In order to reduce conflict, OSMP lands have designated certain trails as sites where dogs are required to be on a leash, and installed garbage and compost bins to help mitigate this issue (VanderWoude, 2010). However, a recent study on OSMP lands found that visitor compliance with leash regulations fell below a 90-100% range of acceptability (Lezberg,

2011; OSMP Visitor Master Plan, 2005). Compliance rates for properly disposing of dog waste, particularly considering site regulations and actual behaviors (i.e., whether or not dogs are on or off leash) also require further study.

In relation to dog-guardian behavior after a pet's defecation event, OSMP lands consider compliant behavior to include both immediately picking up all of the waste and immediately taking the bag(s) of waste away from the area for proper disposal in a trash or compost bin. Deserting bags with waste for later pick-up is not considered compliant. Leaving pet waste on public open space is largely an avoidable impact, and these types of impacts are frequently mitigated through direct (regulatory), or indirect (education/communication) management actions (Hendee & Dawson, 2002; Martin, Marsolais, & Rolloff, 2009). Within the United States, Leave No Trace messaging, administered through the Leave No Trace Center for Outdoor Ethics (The Center), has become the most prominent form of indirect management aimed at decreasing depreciative behaviors (Marion, 2014). Leave No Trace Principles have been foundational on OSMP lands as a communicational framework for examining, understanding, and promoting proper disposal of pet waste (Jones & Bruyere, 2004). A significant body of research regarding Leave No Trace has applied the Theory of Planned Behavior (Ajzen, 1991) to inform approaches to increase efficacy. This theory has been used in numerous studies to improve understanding of human behavior, particularly regarding depreciative behaviors within the natural resources context (Fishbein & Manfredo, 1992; Manfredo, Teel, & Bright, 2004).

According to the TPB (Ajzen, 1991), whether or not one performs a particular behavior is directly affected by one's intention to perform the behavior in question. The intention to perform or not perform a particular behavior is directly influenced by one's attitudes, subjective norms, and perceived behavioral control related to the behavior in question. Ajzen (1991) defines

attitude as a measure of the degree to which a person has a favorable or unfavorable assessment of a particular behavior, whereas norms are defined as the perceived social pressure to perform or not perform a behavior. Lastly, perceived behavioral control is defined as one's perception of the ease or difficulty of performing a particular behavior (Ajzen, 1991; Traifmow, Sheeran, Conner, & Finlay, 2002). Factors that influence this perception may be internal (related to the person performing or not performing the behavior in question) or external (related to the environment around the person performing or not performing the behavior in question).

Building upon the growing body of empirical research that has applied the TPB to examine Leave No Trace-based social science (e.g., Lawhon, Taff, Newman, Vagias, & Newton, 2017; Lawhon et al., 2013; Taff, Newman, Vagias, & Lawhon, 2014; Vagias, Powell, Moore, & Wright, 2014), this study also employs the TPB to explore attitudes, norms, perceived behavioral control, intentions and self-reported behaviors related to a Leave No Trace-related practice: properly disposing of dog waste in public parks. Specifically, this study has two overarching objectives: 1) to analyze dog guardians' behaviors related to the proper disposal of pet waste on OSMP lands through direct observation after a dog defecation event; and 2) to compare dog guardians' attitudes, norms, perceived behavioral control, behavioral intentions, and self-reported behaviors related to dog waste disposal. This exploration aims to improve understanding, and ultimately inform management strategies for influencing dog guardians' behaviors, thus decreasing the amount of pet waste on OSMP lands and improving the quality of visitor experiences. These study objectives will be explored through the following research questions:

1. *What are the observed differences regarding dog waste disposal between dog guardians with dogs on-leash, versus those off-leash?*

2. *What are the self-reported differences regarding perceptions of dog waste disposal between dog guardians with dogs on-leash, versus those off-leash?*
3. *What is the influence of dog guardians' perceptions (as oriented by TPB constructs) on self-reported behavioral intent and behavior?*
4. *What factors would persuade visitors to properly dispose of their dog's waste during future visits to OSMP lands?*

Literature Review

Park managers typically mitigate undesirable visitor behaviors through direct or indirect methods (Hammit, Cole, & Monz, 2015; Hendee & Dawson, 2002). Direct methods include site management and enforcement of regulations (Marion & Reid, 2007), while indirect methods focus more on influencing visitor behaviors through communication and education (Manning, 2003). Although indirect approaches are often preferred because of the freedom they allow visitors to make decisions for themselves (Marion & Reid, 2007), direct approaches may be necessary in some contexts (McAvoy & Dustin, 1983; Manning, 2003). While numerous studies have examined depreciative behaviors, few empirical studies have examined visitor perceptions and behaviors regarding pet waste specifically. Despite the lack of research regarding perceptions of pet waste — particularly examinations applying theory to understand pet guardian behaviors — several recent studies, which largely took place in European contexts, have helped inform this topic.

Management Actions and Pet Waste Disposal Behaviors

Specific to direct management actions, several researchers have debated the merit of increased enforcement rates for dog guardians that fail to properly dispose of pet waste (Webley & Siviter, 2000; Wells, 2006). Wells (2006) found that dog guardians who used a leash were

more likely to pick up dog waste than dog guardians who did not utilize a leash, and presented two possible reasons for this occurrence. First, she suggests that dog guardians who do not utilize a leash may fail to notice when their dogs leave waste. Secondly, she suggests that dog guardians who do not utilize a leash may be more irresponsible than dog guardians who utilize a leash. Contradicting some of the results Wells (2006) found, Webley and Siviter (2000) discovered that there was no relationship between the act of picking up dog waste in public places and leash utilization. Although, these discrepancies call for further research, leash utilization by pet guardian is especially important to pursue, as this is a variable that park managers may have more ability to control via direct and indirect management approaches.

While the studies mentioned above explored actual behaviors and various direct management approaches that may influence whether a dog guardian picks up dog waste or not, a few studies have investigated facility infrastructure, and spatial and temporal variables pertaining to pet waste disposal. Direct actions such as physical infrastructure, including dog waste bags and trash bins that are made available to the public, have been found to increase the number of occurrences when dog guardians pick up pet waste (Miller & Howell, 2008). Similarly, Lowe, Williams, Jenkinson, and Toogood (2014) examined spatial and infrastructure-related variables by conducting dog waste audits along popular dog-walking paths in Lancashire, England. The infrastructural variables that were found to influence behavior were the presence of garbage bins, garbage bin location, visibility to other visitors, and proximity to entrances and exits. Dog guardians were more likely to pick up dog waste in locations that offered easily accessible garbage bins, caused dog guardians to be highly visible to other visitors, and were in close proximity to pathway entrances and exits (Lowe et al., 2014). In other words, convenience and a

sense that other visitors may be watching may influence dog guardian behavior related to the disposal of dog waste.

Visitor Perception Variables to Inform Management

Although research that explores visitor perceptions and behaviors related to leash compliance has been prevalent in recent research (i.e., Bowes, Keller, Rollins, & Gifford, 2017; Kellner et al., 2017) research regarding visitor perceptions related to the disposal of dog waste in public parks and open spaces is limited. However, the findings from the scant research on the topic have been mixed. In one study, dog guardians identified pet waste as a deterrent to visiting outdoor public spaces (Cutt, Giles-Corti, Wood, Knuiman, & Burke, 2008). Webley and Siviter (2000) found that dog guardians who did not pick up dog waste were more tolerant of dog waste left in public spaces, and viewed dog waste as “natural waste” and “biodegradable.” Having such views may have allowed these dog guardians to self-justify their behavior. In the same study, noncompliant dog guardians were more likely to believe that rules requiring dog guardians to pick up dog waste were excessively restrictive (Webley & Siviter, 2000).

Despite the prevalence of TPB research in parks and natural resources research (Fishbein & Manfredo, 1992; Manfredo, Teel, & Bright, 2004) studies that have applied TPB constructs to explore perceptions of behaviors related to pet waste are limited. However, Webley and Siviter (2000) explored an important construct of TPB --- norms. They examined respondent’s subjective norms regarding what their friends would think or say if they failed to dispose of their dog’s waste appropriately. However, they found no relationship between perceived disapproval of friends, and their self-reported behavior related to the disposal of pet waste. Although Webley and Siviter (2000) explored normative perceptions, they did not include measures to evaluate attitudes, perceived behavioral control, and self-reported behavioral intentions, which are

theorized to influence actual behaviors. Therefore, research that measures the TPB constructs, which have been useful for examining depreciative behaviors and specifically, Leave No Trace-related behaviors (e.g., Lawhon, Taff, Newman, Vagias, & Newton, 2017; Lawhon et al., 2013; Taff, Newman, Vagias, & Lawhon, 2014; Vagias, Powell, Moore, & Wright, 2014; Bowes, Keller, Rollins, & Gifford, 2017) such as improper disposal of pet waste, would be useful for understanding pet waste disposal behaviors by dog guardians. For example, previous research has demonstrated that attitudes toward the effectiveness and appropriateness of Leave No Trace practices are important predictors of behavioral intent, the antecedent to actual behavior (Lawhon et al., 2013; Lawhon, Taff, Newman, Vagias, & Newton, 2017). Given the social and ecological issues associated with pet waste, exploration of the TPB variables in this context may yield improved understanding of both direct and indirect management strategies that can influence pet guardian compliance with recommended practices.

Methods

Study Setting and Timeframe

This study took place across 10 trailheads on OSMP lands, to represent diverse types of settings and visitors within the system. These trailheads were selected for this study by OSMP land managers with consideration of two components. First, the selected sites have medium to high rates of visitation. Secondly, for stratification reasons discussed below, five of the ten selected sites have rules that require all dogs to be on a leash during their entire visit. The other five sites allow dog guardians who have participated in a ‘Voice and Sight’ training (see <https://bouldercolorado.gov/osmp/voice-and-sight>) to have their dogs off-leash in specific areas. Data collection took place from June 4, 2017 to July 14, 2017.

Data Collection

Data was collected via two methods for this study. First, data related to behaviors was collected through direct, unobtrusive visitor observation. Secondly, applying the theoretical foundations of TBP, attitudes, norms, perceived behavioral control, intentions, and self-reported behaviors were collected through separate visitor surveys. Although these types of data are not directly paired at the individual level, because of the potential for biasing self-reported responses and actual behaviors, observational data was collected separately as a measure of compliance for following recommended practices on OSMP lands.

Stratification was based upon the following considerations: a) leash required or voice and sight locations, and b) morning (9:00 a.m. – 12:00 p.m.) or afternoon (2:00 p.m. – 5:00 p.m.) data collection. All dogs were required to be on-leash at five of the sampling locations (i.e., Dakota Ridge, Enchanted Mesa, Four Mile, Skunk Canyon, and Wonderland Lake). Dog guardians who had participated in a fee-based “Voice and Sight Dog Tag Program” were permitted to let their dogs off leash within the entire observation zones of the other five sampling locations (i.e., Bobolink, Boulder Valley Ranch, Cragmoor Connector, Marshall Mesa, and Sanitas Valley) (for detailed descriptions and maps, see <https://bouldercolorado.gov/osmp/trails-and-maps>). Compliance with on- and off-leash requirements was also documented in both the observation and survey logs. Site sampling was randomized, and researchers attempted to collect data at each site an equal number of times during morning hours and afternoon hours.

Observation Protocol

The observation protocol was developed through a collaborative, iterative review process between OSMP lands staff and the researchers. The observation protocol was pre-tested on OSMP lands with visitors prior to actual data collection. Ultimately, an observation zone was pre-determined for each of the 10 study locations. Dogs are most likely to defecate within the

first quarter mile of a trail (VanderWoude & Bitune, 2015; Leslie, 2017), therefore all 10 observation zones included the segment of trail that allowed for the most visibility of the first quarter of a mile from the trailhead when the observer was positioned at the midpoint of the observation zone. These observation zones were marked on maps of each site that were provided for the trained observers. Pre-study visits to each location and reference photos were also utilized to ensure the observation zones remained constant among the observers. In order to be able to reduce sight obstruction via vegetation or park visitors, observers were permitted to move within a 20-foot radius from the midpoint of the observation zone.

Morning observations took place from 7:00 a.m. – 9:00 a.m. Afternoon observations took place from 5:00 p.m. – 7:00 p.m. Only one researcher was present during each session, and they wore plain clothes (without any identifying logos) and attempted to be unobtrusive to visitors (e.g. carried a book/field guide or sketchbook). Researchers positioned themselves in pre-determined locations specific to each site. Once the observation period began, every individual or visitor party that entered (from the trailhead) the pre-determined observation area with at least one dog was considered for inclusion in the observation sample. In order to better ensure quality data, researchers utilized focal sampling, such that only one visitor party was under observation at a time. An observation was terminated if 1) the dog(s) and/or visitor party exited the observation zone and no event occurred, 2) a dog traveled more than 10 feet away from the trail and remained outside the buffer for at least one minute, 3) a dog, for any reason (e.g. vegetation), is out of sight for one minute or longer, or 4) any dog in the visitor party under observation had an event and the guardian(s) clearly completed their compliant or non-compliant actions regarding pick up and disposal of the pet waste (bagged, picked up, and/or left). Once an observation was terminated, the researcher observed the next individual or party with at least one

dog who entered the observation zone. Any individuals or parties with at least one dog who previously entered the observation zone during the same observation session were not included in the observation sampling.

Survey Protocol

The survey instrument was framed within the context of the TPB (Ajzen, 1991) and developed to incorporate 7-point Likert-type scale response anchors for each variable, which had been established and validated through previous Leave No Trace-based research (e.g., Lawhon, Taff, Newman, Vagias, & Newton, 2017; Lawhon et al., 2013; Taff, Newman, Vagias, & Lawhon, 2014; Vagias, Powell, Moore, & Wright, 2014). The battery of questions examining respondent attitudes contained behaviors that are not best practice if considering recommendations by Leave No Trace or OSMP lands, and these items were ranked on a 7-point scale ranging from 1 = “Very Inappropriate” to 7 = “Very Appropriate.” For example, respondents were asked to rate the appropriateness of “Leaving pet waste to decompose on-site.” Perceived behavioral control was measured through statements that aligned with Leave No Trace or OSMP lands recommendations for dog waste disposal. These items were ranked on a 7-point scale ranging from 1 = “Very Difficult” to 7 = “Very Easy.” For example, respondents were asked to rate how difficult it would be “Carrying an unused pet waste bag with me [them] every time” or “Always watching my [their] dog to see if, and where it poops.” Future behavioral intent was measured through the same statements as those measured through the behavioral control construct. These items were ranked on a 7-point scale ranging from 1 = “Extremely Unlikely” to 7 = “Extremely Likely.” Similarly, using the same statements, the survey evaluated self-reported current behavior through a 7-point scale ranging from 1 = “Never True of Me” to 7 = “Always True of Me.”

The instrument was field tested with visitors prior to the actual data collection to refine any potentially confusing variables. Morning survey sampling took place from 9:00 a.m. – 12:00 p.m., and afternoon sampling took place from 2:00 p.m. – 5:00 p.m. In order to attempt to capture a census of OSMP lands visitors with dogs, the researcher attempted to contact every adult visitor who exited the site (i.e., returning to the trailhead) and had at least one dog, and asked her/him to participate in the survey. If the researcher came in contact with a group of people, he or she asked which person(s) was/were in charge of the dog(s). Only the person or people in charge of a dog were asked to complete the survey. If a visitor was not able or willing or complete the survey, the researcher asked the visitor “How many days did you visit a City of Boulder Open Space and Mountain Park area with your dog(s) during the last month?”, to determine whether there was a non-response bias. The surveyor did not attempt to administer the survey to any person conducting official OSMP lands business, or any person who already completed a survey.

Analyses

The relationships among the variables in the data were analyzed using IBM SPSS Statistics 23. Rather than examine observed differences between leash required or voice and sight locations, the researchers focused on whether the observed dogs were actually on or off leash. Therefore, all parties that had at least one dog on-leash and one dog off-leash were excluded from all analyses. Research Question #1 was examined using chi square analyses and frequency analyses. To explore potential differences in self-reported perceptions and behaviors between dog guardians with dogs on-leash, versus those off-leash, (RQ #2) *t*-tests were used. To explore Research Question #3, multiple and linear regressions were used to examine the potential relationships between TPB constructs (i.e., dog guardians’ attitudes, perceived subjective norms,

perceived behavioral control, behavioral intentions) and self-reported behaviors. Finally, to examine potential factors that might persuade visitors to properly dispose of their dog's waste during future visits to OSMP lands, (RQ #4), the researchers examined responses to the open-ended question: *During your next visit, what would make you more likely to bag your pet's waste and dispose of it in a trash or compost receptacle in City of Boulder OSMP?* Following recommended qualitative coding approaches (see Saldaña, 2016) multiple researchers independently coded responses and subsequent examinations of the combined codes confirmed identical results.

Results

RQ #1: What are the observed differences regarding dog waste disposal between dog guardians with dogs on-leash, versus those off-leash?

A total of $n=541$ observations occurred, with 56.5% of dog-guardians keeping dog(s) on-leash, 40.4% of dog guardians allowing their dog(s) off-leash, and 3.0% of dog guardians keeping at least one dog on-leash and allowing at least one dog off-leash. Canine defecation and human behavioral response occurred $n=105$ times. Parties that had at least one dog on-leash and one dog off-leash were removed from the analyses, resulting in $n=102$. A chi square test ($\chi^2=9.397$; $p=.002$) revealed that dog guardians who keep their dog(s) on-leash were significantly more likely to immediately bag their pet's waste than dog guardians who allow their dog(s) to be off-leash. Guardians with dogs on-leash were ~11% more likely to bag and immediately take pet waste for disposal (i.e., compliant behavior) than guardians with dogs off-leash, but there was not a statistically significant difference between the groups. Overall, the majority (73.5%) of dog guardians immediately picked up their pet's waste after a defecation event occurred and immediately took all bags for proper disposal (Table 1). It was found that 13.7% of the dog

guardians did not take all of the bags with them, and 12.7% of the dog guardians did not pick up their pet's waste at all.

Table 1 About Here

RQ #2: What are the self-reported differences regarding perceptions of dog waste disposal between dog guardians with dogs on-leash, versus those off-leash?

A total of $n=386$ surveys were collected with a response rate of 56%, and no differences were discovered between willing respondents and those that refused to participate in the study in relation to number of days they visited OSMP lands with at least one dog within the previous month. Dog guardians who had at least one dog on-leash and at least one dog off-leash (i.e., leash utilization was not uniform across all dogs in the party) were excluded from this analysis. Only two variables, which measured normative perceptions, resulted in significant differences between dog guardians with dogs on-leash, compared with those off-leash. The variables "I believe others feel guilty when they leave their pet's waste behind" [guardians with dog(s) on-leash: scale mean (M) = 4.32, guardians with dog(s) off-leash: M = 5.88; p < .05, Eta (η) = .136] and "Most dog guardians are responsible individuals who immediately bag their pet's waste and take it with them to dispose of in a trash or compost receptacle" [guardians with dog(s) on-leash: M = 5.14, guardians with dog(s) off-leash: M = 5.54; p < .05, η = .125] resulted in significant differences. However, for both guardians who keep their dog(s) on-leash and guardians who allow their dog(s) off-leash, the mean differences for these items were negligible, or lacking substantive practical difference (Vaske, 2008) (Table 2). Beyond these two items, no other significant differences were found between guardians who keep their dog(s) on-leash and guardians who allow their dog(s) off-leash concerning attitudes, perceived behavioral control,

intentions, and behaviors (and no substantive differences were found between a.m. and p.m. respondents).

Table 2 About Here

Despite the lack of differences discovered through Research Questions #2 the mean findings provide insight regarding attitudes, norms, perceived behavioral control, future behavioral intent, and self-reported behaviors (Table 2). The low mean values for all of the behaviors that are not best practice suggest that attitudes toward the disposal of dog waste largely aligned with recommended behaviors prescribed by the Leave No Trace Center's Principles, and specific management directives from OSMP lands. High mean values for items that measured norms suggest that dog guardians consider appropriate behaviors related to dog waste disposal to be a part of their normal behavior. High mean values for items that measured perceived behavioral control suggest that dog guardians find appropriate behaviors related to dog waste disposal to be easy to accomplish and under their volitional control. Large mean values for items that measured intentions suggest that dog guardians intend to follow appropriate behaviors related to the disposal of dog waste in the future. High mean values for items that measured self-reported behaviors suggest that dog guardians currently follow appropriate behaviors related to the disposal of dog waste.

RQ #3: What is the influence of dog guardians' perceptions (as oriented by TPB constructs) on self-reported behavioral intent and behavior?

Reliability measures were considered high for attitudes ($\alpha = .732$) and perceived behavioral control ($\alpha = .866$), and adequate for norms ($\alpha = .674$) (Table 3). All three explanatory constructs significantly impacted behavioral intentions to properly dispose of dog waste. Of the

three explanatory variables in the TPB, perceived behavioral control ($R^2 = .500$; $\beta = .707$) demonstrated stronger influence on self-reported behavioral intentions than attitudes ($R^2 = .097$; $\beta = -.312$) or norms ($R^2 = .114$; $\beta = .337$) (Figure 1).

Table 3 About Here

Figure 1 About Here

Results indicate that attitudes had a negative relationship with self-reported intentions, because the items used to measure attitudes described improper behaviors, according to OSMP lands and Leave No Trace recommendations. Therefore, respondents who believed the described improper behavior was very unacceptable would select lower numbers (i.e., 1 or 2) on the scale for attitudes. The multiple regression ($R^2 = .525$) indicated that attitudes, norms, and perceived behavioral control predicted 52.5% of the variability in intentions to properly dispose of dog waste. The reliability scores were acceptable for both behavioral intentions and self-reported behavior (Table 4), and behavioral intentions significantly impacted self-reported behaviors ($R^2 = .885$; $\beta = .941$). The results from the linear regression indicate a strong correlation between intentions and self-reported behaviors, as behavioral intentions predicted approximately 89% of the variability in self-reported behaviors.

Table 4 About Here

RQ #4: What factors would persuade visitors to properly dispose of their dog's waste during future visits to OSMP lands?

Regarding what might influence dog guardians to dispose of their pet's waste during their next visit, 42.4% of participants ($n=156$), responded to this open-ended question: *During your next visit, what would make you more likely to bag your pet's waste and dispose of it in a trash*

or compost receptacle in City of Boulder OSMP? Themes found among the answers were: 1) more trash/compost bins along the trail (66.7% of respondents who answered), 2) more bag dispensers along the trail (17.9% of respondents who answered), and 3) more trash/compost bins and bag dispensers along the trail (10.9% of respondents who answered) would influence their behavior in the future (Table 5). Therefore, cumulatively, approximately 96% of the respondents who provided a response stated that additional trash/compost bins and/or bag dispensers would make them more likely to properly dispose of their dog's waste during their next visit.

Table 5 About Here

Discussion

This study explored actual behavior, as well as self-reported behavior related to properly disposing of dog waste on OSMP lands. Based on observational results, it was determined that the majority (73.5%) of dog guardians were compliant to OSMP lands regulations. However, if a 90-100% range of acceptability is used for compliance (OSMP Visitor Master Plan, 2005), as was used in leash compliance studies on OSMP lands (Lezberg, 2011), compliance related to immediately picking up dog waste falls below this range of acceptability. It should be noted that, of the survey respondents whose dog(s) defecated during their visit, 95.5% reported that they immediately picked up their pet's waste, while observations showed that 87.2% of dog guardians immediately bagged their pet's waste. This may indicate a bias among self-reported behaviors, even though surveys were anonymous. Observation results suggested ~11% less compliance in properly disposing of pet waste among guardians who allow their dogs off-leash.

This study also explored the influence of leash utilization on TPB constructs in relation to waste pick up. Only the means from two normative items were found to differ significantly

between visitors who utilized a leash and visitors who did not utilize a leash; however, low Eta values suggest that this difference is not significant enough to merit practical management implications. Attitudes related to the proper disposal of dog waste largely align with recommendations by the Leave No Trace Center and OSMP lands. However, there is less congruence among attitudes related to leaving bagged pet waste on the trail and picking it up at a later time. Measurements of personal norms suggest that dog guardians think they should follow recommendations from the Leave No Trace Center and OSMP lands related to the disposal of pet waste, yet normative results suggest that dog guardians believe that others do not feel as guilty, and are not as responsible as themselves. Measurements of perceived behavioral control suggest that most dog guardians believe it is relatively easy to carry an unused waste bag every time they visit OSMP lands, and to always watch their dog(s) to see if and when it defecates. However, dog guardians find it slightly more difficult to pick up pet waste when it is off-trail and to carry pet waste with them until they reach a trash or compost receptacle than other best practices. Measurements of behavioral intentions suggest that most dog guardians intend to follow the recommended practices in the future. Although, consistent with the other constructs, there is less intention to pick up pet waste when it is off-trail, and to carry pet waste until a trash or compost receptacle is found. Similarly, with regard to self-reported behaviors, dog guardians report that they are largely compliant with recommendations, but less so when the desired behavior involves picking up pet waste off-trail and carrying pet waste until a trash or compost receptacle is found.

This study also examined TPB constructs related to the proper disposal of dog waste in OSMP lands. Of particular interest was determining which variable(s) among attitudes, norms, and perceived behavioral control have the most influence on future dog guardians' intent to immediately pick up and properly dispose of their dog's waste. Results suggested that perceived

behavioral control had more influence on behavioral intentions than either attitudes or norms. It was also found that behavioral intent directly predicted self-reported behaviors. Thus, whether or not a pet guardian thought that behaviors were easy or difficult had a significant impact on their self-reported intent and behavior.

Lastly, this study explored what would make respondents more likely to properly dispose of their dog's waste in the future. Approximately 96% of the participants that responded to this inquiry, indicated that more trash/compost bins and/or bag dispensers along the trail would make them more likely to properly dispose of their dog's waste. Therefore, the researchers suggest that direct management approaches, such as installing additional trash/compost bins and bag dispensers along the trails, may increase perceived behavioral control (perceptions of ease), and therefore increase intentions to properly dispose of dog waste. If the cost of additional infrastructure is prohibitive, communication programs and other indirect strategies, located at trailheads with trash or compost receptacles and bag dispensers, that highlight the ease of bagging waste and carrying it to trash or compost receptacles could be implemented. It should be noted that, even though dog guardians reported that they are less likely to pick up pet waste when it is off-trail, OSMP land managers should take caution before implementing communication programs that encourage dog guardians to travel off-trail to locate and gather their pet's waste. An increase in the number of dog guardians traveling off-trail may damage vegetation or result in undesignated trails. Therefore, OSMP land managers should determine whether they would prefer dog guardians to pick up pet waste off-trail or stay on designated trails before communication programs are implemented. Given the practical difference in disposal behavior between on-leash and off-leash dogs, OSMP lands should strongly consider moving the

beginning of off-leash zones further down the trail, rather than at the trailhead, to increase appropriate disposal of waste.

Limitations and Future Research

This study has several limitations that merit consideration. First, there is no way to determine if a defecation and associated disposal behavior occurred either before or after the party left the observation zone. Future research should consider observation locations where the viewshed can be maximized for the observer. The survey response rate (56%) was slightly lower than some onsite social science research (Vaske, 2008). However, there were no differences discovered between willing respondents and those that refused to participate in the study, implying that a certain “type” of visitor was not excluded during data collection. The low response rate may be a factor of respondents trying to manage their dogs and not physically being capable of completing the survey while maintaining control of their pet. Future research may employ strategies where the surveyors can provide leash stations to maintain control of the pets while guardians complete the survey. Finally, observation data was not paired with the survey data, due to the contentious topic and possible bias that could be introduced with the paired methodological approach. Future research should attempt to pair behaviors while minimizing bias effects.

Specific to OSMP lands, future examinations should reevaluate actual behaviors, as well as self-reported perceptions, intent, and behaviors if additional direct and indirect management strategies, such as enhanced Leave No Trace messages, are implemented. For example, observations and paired surveys should be reassessed should the length of leash utilization segments be extended on OSMP lands. Future studies should also explore the relationship between the length of the on-leash zone at the beginning of a trail and pet waste disposal

compliance. This study should be implemented for longer periods of time and during seasons other than summer to explore temporal changes in behavior. Given the importance of this topic for social and ecological wellbeing in protected areas, other similar properties facing pet waste issues may consider employing these methods to determine if these findings translate to other places.

Conclusion

The purpose of this study was to explore dog guardian behaviors regarding pet waste and self-reported attitudes, norms, perceived behavioral control, intentions and behavior concerning the disposal of their dog's waste on OSMP lands. The TPB served as a useful framework to explore how dog guardians' attitudes, norms, and perceived behavioral control might influence behavioral intentions, as well as self-reported behavior, regarding the disposal of pet waste on OSMP lands. Results indicate that direct and indirect management actions could further mitigate dog waste impacts on OSMP lands. Results from observation sessions suggest that the majority of dog guardians properly disposed of waste. With regard to the separate, self-reported survey results, perceived behavioral control, which was operationalized as perceived difficulty or ease, was the most significant predictor of behavioral intent and self-reported behavior regarding proper disposal of dog waste. Respondents indicated that more pet waste-related infrastructure, such as bag stations, and receptacles would influence them to properly dispose of their dog's waste in the future. Lengthening the on-leash zones at voice and sight areas/trailheads and increasing the number and frequency of available bags and receptacles are direct strategies that may increase compliance. Pairing these direct approaches with indirect strategies aimed at influencing behaviors by highlighting the ease of properly disposing of dog waste are options that OSMP lands, and other similar protected areas facing comparable pet waste issues, should

consider. However, all of these recommendations must be considered with regard to overall objectives for high quality visitor experiences for all visitors on OSMP lands.

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Table 1. Excrement Removal Behaviors After Defecation Event

Observed Behaviors	<i>Guardians</i>		<i>All Guardians</i>
	<i>With Dog(s) On-leash</i>	<i>Guardians With Dog(s) Off-leash</i>	
Picked Up Dog Waste and Took All Bags (Compliant)	44 (78.6%)	31 (67.4%)	75 (73.5%)
Picked Up Dog Waste and Left Bag(s) (Non-compliant)	10 (17.9%)	4 (8.7%)	14 (13.7%)
Did Not Pick Up Dog Waste (Non-compliant)*	2 (3.6%)	11 (23.9%)	13 (12.7%)
Total	56 (100%)	46 (100%)	102 (100%)

*Significant $p < .05$ between guardians with dogs on- and off-leash

Note: n=102

Table 2. Comparative Means of TPB-based Dog Waste Variables between Pet Guardians with On- and Off-Leash Dogs

TPB-based Constructs & Variables related to Dog Waste	Scale Mean/Item Mean (On-Leash)	Scale Mean/Item Mean (Off-Leash)	<i>t</i>	<i>df</i>	<i>p</i>
Attitudes	Scale M = 2.11	Scale M = 2.03	--	--	--
Leaving pet waste, un-bagged, on the edge/side of a trail	1.55	1.37	-1.152	354	.250
Leaving pet waste, bagged, on the edge/side of a trail	2.35	2.58	1.092	352	.275
Moving or placing un-bagged pet waste away from the trail	2.36	2.04	-1.480	351	.140
Moving or placing bagged pet waste away from the trail	2.44	2.43	-.019	350	.985
Leaving pet waste to decompose on-site	1.73	1.64	-.539	354	.590
Norms	Scale M = 5.89	Scale M = 6.30	--	--	--
I believe I should immediately bag my pet's waste and take it with me to dispose of in a trash or compost receptacle	6.54	6.47	-.524	356	.601
I feel guilty when I leave my pet's waste behind	6.48	6.53	.358	347	.721
I believe others should immediately bag their pet's waste and take it with them to dispose of in a trash or compost receptacle	6.47	6.52	.374	353	.708
I believe others feel guilty when they leave their pet's waste behind	4.32	5.88	1.403	348	.011*
Most dog owners are responsible individuals who immediately bag their pet's waste and take it with them to dispose of in a trash or compost receptacle	5.14	5.54	2.410	352	.016*
It bothers me when dog owners/guardians do not pick up after their dogs	6.41	6.60	1.624	354	.188
Perceived Behavioral Control	Scale M = 6.01	Scale M = 5.95	--	--	--
Carrying an unused pet waste bag with me every time	6.53	6.54	.058	355	.954
Always watching my dog to see if, and where, it poops	6.39	6.15	-1.829	356	.068
Bagging pet waste when it is on or adjacent to the trail	6.63	6.65	.211	354	.833
Bagging pet waste when it is off-trail	5.55	5.52	-.157	354	.876
Immediately bagging pet waste and taking it with me to dispose of in a trash or compost receptacle	5.90	5.84	-.346	353	.729
Immediately bagging pet waste when it is off of the established trail and taking it with me to dispose of in a trash or compost receptacle	5.55	5.46	-.470	354	.639
Carrying bagged pet waste until I find a trash or compost receptacle	5.54	5.46	-.371	356	.711
Behavioral Intentions	Scale M = 6.46	Scale M = 6.38	--	--	--
Carrying an unused pet waste bag with me every time	6.74	6.79	.644	356	.520
Always watching my dog to see if, and where, it poops	6.64	6.56	-.785	355	.433
Bagging pet waste when it is on or adjacent to the trail	6.73	6.76	.710	356	.478
Bagging pet waste when it is off-trail	6.19	6.17	-.162	355	.871

Immediately bagging pet waste and taking it with me to dispose of in a trash or compost receptacle	6.41	6.19	-1.597	355	.111
Immediately bagging pet waste when it is off of the established trail and taking it with me to dispose of in a trash or compost receptacle	6.14	5.91	-1.307	355	.192
Carrying bagged pet waste until I find a trash or compost receptacle	6.34	6.24	-.660	355	.510
Self-reported Behaviors	Scale M = 6.38	Scale M = 6.34	--	--	--
Carrying an unused pet waste bag with me every time	6.67	6.73	.667	356	.505
Always watching my dog to see if, and where, it poops	6.60	6.51	-.958	355	.339
Bagging pet waste when it is on or adjacent to the trail	6.70	6.81	1.602	356	.227
Bagging pet waste when it is off-trail	6.09	6.05	-.207	355	.836
Immediately bagging pet waste and taking it with me to dispose of in a trash or compost receptacle	6.34	6.17	-1.213	355	.226
Immediately bagging pet waste when it is off of the established trail and taking it with me to dispose of in a trash or compost receptacle	6.03	5.86	-.988	355	.324
Carrying bagged pet waste until I find a trash or compost receptacle	6.26	6.23	-.183	354	.855

Note. *Significant $p < .05$ between on- and off-leash respondents. Item “I believe others feel guilty when they leave their pet’s waste behind” resulted in $\eta = .136$. Item “Most dog owners are responsible individuals who immediately bag their pet’s waste and take it with them to dispose of in a trash or compost receptacle” resulted in $\eta = .125$ (Item

Items measured using a 7-point scale (attitudes: very inappropriate to very appropriate; norms: strongly disagree to strongly agree; perceived behavioral control: very difficult to very easy; intentions: extremely unlikely to extremely likely; self-reported behaviors: never true of me to always true of me)

Table 3. Reliability Analysis and Linear Regression Between Three Predictors and Intentions

<i>TPB-based Constructs & Variables related to Dog Waste</i>	<i>α if item deleted</i>	<i>α</i>	<i>Bivariate Correlations (r)</i>	<i>b-values (β)</i>	<i>Partial Correlation</i>
Attitudes	--	.732	.312**	-.108*	-.146*
Leaving pet waste, un-bagged, on the edge/side of a trail	.692	--	--	--	--
Leaving pet waste, bagged, on the edge/side of a trail	.724	--	--	--	--
Moving or placing un-bagged pet waste away from the trail	.629	--	--	--	--
Moving or placing bagged pet waste away from the trail	.664	--	--	--	--
Leaving pet waste to decompose on-site	.704	--	--	--	--
Norms	--	.674	.337**	.103*	.137*
I believe I should immediately bag my pet's waste and take it with me to dispose of in a trash or compost receptacle	.601	--	--	--	--
I feel guilty when I leave my pet's waste behind	.610	--	--	--	--
I believe others should immediately bag their pet's waste and take it with them to dispose of in a trash or compost receptacle	.579	--	--	--	--
I believe others feel guilty when they leave their pet's waste behind	.734	--	--	--	--
Most dog owners are responsible individuals who immediately bag their pet's waste and take it with them to dispose of in a trash or compost receptacle	.658	--	--	--	--
It bothers me when dog owners/guardians do not pick up after their dogs	.612	--	--	--	--
Perceived Behavioral Control	--	.866	.707**	.646**	.657**
Carrying an unused pet waste bag with me every time	.867	--	--	--	--
Always watching my dog to see if, and where, it poops	.847	--	--	--	--
Bagging pet waste when it is on or adjacent to the trail	.865	--	--	--	--
Bagging pet waste when it is off-trail	.844	--	--	--	--
Immediately bagging pet waste and taking it with me to dispose of in a trash or compost receptacle	.831	--	--	--	--
Immediately bagging pet waste when it is off of the established trail and taking it with me to dispose of in a trash or compost receptacle	.826	--	--	--	--
Carrying bagged pet waste until I find a trash or compost receptacle	.839	--	--	--	--
Constant				2.881**	
Multiple R				.725**	
R ²				.525	
Adjusted R ²				.521	

*Significant $p < .01$ **Significant $p < .001$

Note. Items measured using a seven-point scale (attitudes: very inappropriate to very appropriate; norms: strongly disagree to strongly agree; perceived behavioral control: very difficult to very easy)

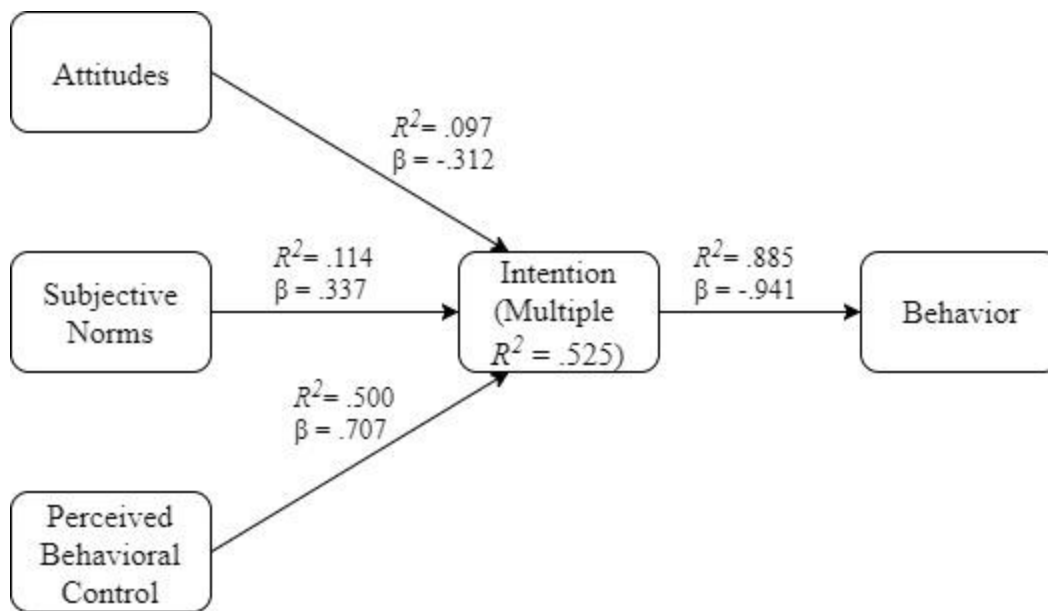


Figure 1. The Theory of Planned Behavior (adapted from Fishbein & Ajzen, 2010) as Applied to the Disposal of Dog Waste on OSMP lands

Table 4. Reliability Analysis and Linear Regression Between Intentions and Self-Reported Behaviors

TPB-based Constructs & Variables related to Dog Waste	<i>a if item deleted</i>	<i>α</i>	<i>Bivariate Correlations (r)</i>	<i>b-values (β)</i>	<i>Partial Correlation</i>
Behavioral Intentions	--	.897	.941*	.941*	.941*
Carrying an unused pet waste bag with me every time	.892	--	--	--	--
Always watching my dog to see if, and where, it poops	.890	--	--	--	--
Bagging pet waste when it is on or adjacent to the trail	.885	--	--	--	--
Bagging pet waste when it is off-trail	.879	--	--	--	--
Immediately bagging pet waste and taking it with me to dispose of in a trash or compost receptacle	.872	--	--	--	--
Immediately bagging pet waste when it is off of the established trail and taking it with me to dispose of in a trash or compost receptacle	.866	--	--	--	--
Carrying bagged pet waste until I find a trash or compost receptacle	.886	--	--	--	--
Self-reported Behaviors	--	.869	--	--	--
Carrying an unused pet waste bag with me every time	.877	--	--	--	--
Always watching my dog to see if, and where, it poops	.858	--	--	--	--
Bagging pet waste when it is on or adjacent to the trail	.858	--	--	--	--
Bagging pet waste when it is off-trail	.838	--	--	--	--
Immediately bagging pet waste and taking it with me to dispose of in a trash or compost receptacle	.836	--	--	--	--
Immediately bagging pet waste when it is off of the established trail and taking it with me to dispose of in a trash or compost receptacle	.820	--	--	--	--
Carrying bagged pet waste until I find a trash or compost receptacle	.849	--	--	--	--
Constant				.384*	
Multiple R				.941*	
R ²				.885	
Adjusted R ²				.884	

*Significant $p \leq .001$

Note. Items measured using a seven-point scale (intentions: extremely unlikely to extremely likely; self-reported behaviors: never true of me to always true of me)

Table 5. *Factors that could influence visitors to properly dispose of their dog's waste during future visits to OSMP*

Responses	<i>Frequency</i>	<i>%</i>
No Response	212	57.6
More trash bins along the trail	104	28.3
More bag dispensers along the trail	28	7.6
More trash bins and bag dispensers along the trail	17	4.6
More communication related to desired behaviors	3	.8
More signage related to desired behaviors	2	.5
Cut grass along/next to the trails	2	.5

Note: n=156/368 respondents that completed the survey provided a response to this open-ended question