Effective Communication and Campground Recycling: Lessons Learned from Yosemite, Grand Teton, and Denali National Parks

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Abstract: Outdoor recreation continues to be persistently high in national parks across the United States, particularly as the COVID-19 pandemic has led to increased use. In popular frontcountry destinations such as national park campgrounds managers are challenged with new issues more familiar to urban settings. One of these challenges is waste management. The largest source of visitor-generated waste in national parks is campgrounds. This research uses a mixed-methods approach to develop and test strategic communications designed to increase recycling and minimize trash to the landfill by altering campground visitor behaviors. Intercept surveys were used to create theory-based messages, and a quasi-experimental approach was used to evaluate message effectiveness. Our results show that messages emphasizing ease concepts were two times more effective at changing campground visitor waste disposal behaviors than control conditions. The results help inform the management of visitors as national parks strive to meet sustainability goals.

Keywords: national parks; communication; visitor behavior; recycling; waste management; campgrounds; camping; Leave No Trace; Zero Landfill Initiative

1. Introduction

Between 2012 and 2017, approximately 1.5 billion people visited the national parks of the United States [1]. This trend of high visitor use is continuing, with near record-breaking visitation to units of the National Park Service (NPS) in 2019 [2]. Even during the COVID-19 pandemic, visitation to NPS sites continues to exceed the previous year with places like Yellowstone National Park seeing approximately 1 million visitors in July of 2020 [3]. This volume of people creates myriad challenges for managers of national parks, including human–wildlife conflict [4–6], deteriorating visitor experiences [7–9], and impacts to the biophysical environment [10,11]. Despite their wild and remote reputations, many national parks are also struggling with issues more familiar to urban planners and managers of municipalities like parking and traffic congestion [12,13] and even domestic violence [14]. These issues represent an emerging challenge for managers as they adapt to persistently high visitor use levels.

Waste generation (i.e., trash and recyclables) from visitors is one issue more typical of urban areas, which many NPS units are struggling to address. One hundred million pounds of trash are produced annually in US national parks and much of it is generated from visitors [15]. Reducing this amount of waste was identified as an objective by the NPS through a public-private partnership referred to as the Zero Landfill Initiative (ZLI) [16]. Though general waste behavior research is fairly abundant, e.g., [17–19] specific research to inform management of waste behaviors in parks and protected areas is sparse [20], and the work that does exist focuses on littering behaviors [21–23].
Previous research shows that cognitive concepts like attitudes, norms, and values play an important role in guiding waste behaviors [17,21]. Furthermore, these cognitive concepts can be used to create communication strategies that influence visitor behaviors in parks and protected areas [17,20,24–26]. These “light-handed” communication strategies (as opposed to regulations and restrictions) are generally preferred by park managers and visitors because they can be highly effective [21,26,27] and are more reflective of park values relating to freedom and autonomy [28,29].

Study Purpose

This study examines the efficacy of data-driven messaging to influence visitor waste disposal and recycling behaviors in national parks using a mixed-method, two step approach. In the first step, we formulate a data-driven communication strategy using cognitive concepts previously associated with waste disposal behaviors, e.g., [17,20,21] such as attitudes, norms, and other cognitive concepts. In the second step, we test the data-driven communication strategies to determine if they influence visitor waste disposal and recycling behavior. The results from this study could help managers make better decisions about waste-disposal communications directed at visitors to increase the amount of waste diverted to recycling from the waste stream generated by visitors, thereby lowering the amount of waste that would otherwise go to a landfill.

In step one (e.g., develop a data-driven communication strategy using cognitive concepts previously associated with waste disposal behaviors), we followed a similar process to [20,30] by using intercept surveys in three national parks. The surveys measured cognitive concepts (e.g., attitudes, norms, etc.) and self-reported behaviors to identify drivers of waste-related behaviors through statistical modeling. Similar to previous studies [21,26], “leverage points” for strategic communication can be identified from this process. The results from step one inform step two of this study.

Step two of the study (e.g., test the data-driven communication strategies to determine if they influence visitor waste disposal and recycling behavior) is addressed using quasi-experimental design and visitor observation techniques [20,21,26,30,31]. Identified leverage points from the first step of this study are used to create two types of messages to implement across three national parks.

2. Materials and Methods

This study uses a mixed-methods, quasi-experimental approach. A quantitative intercept survey informs the development of the messaging strategy, and the messaging strategy is evaluated using observations of visitor behavior. Messaging is implemented in a field-based treatment and control approach, making it quasi-experimental.

Data for Step 1 and Step 2 are collected in select campgrounds of three national parks: Yosemite (YOSE; CA, USA), Grand Teton (GRTE; WY, USA), and Denali National Parks (DENA; AK, USA). These parks were selected because the NPS and other collaborators created a pilot program for the ZLI in these locations. Additionally, the three parks represent large, natural resource-focused units with relatively high levels of visitation and are geographically dispersed across the western United States (Figure 1). The work focuses on campgrounds, as they are the single largest source of visitor-caused waste in US national parks [15,30].

Step 1: Identifying Strategies for Communicating with Campground Visitors about Waste Reduction
Figure 1. Study Site Locations.

2.1. Procedures

Sampling is stratified across select campgrounds in the three parks over a three-month period in the summer of 2018. Approximately 20–24 days of sampling are allotted for data collection in each park and are stratified by campground site (i.e., 2 per park), time of day (AM/PM), and weekday or weekend. AM shifts take place from 7AM to 1PM and PM shifts take place from 1PM to 7PM. The sampling design was developed in consultation with park managers, including determinations for sampling locations in each park. Data were collected in YOSE from 3 June to 30 June, in GRTE from 9 July to 2 August, and in DENA from 9 August–10 September. Surveys were recorded via iPad using a Qualtrics offline survey application.

Trained researchers administered surveys in professional field shirts with nametags. Visitors were intercepted in one of two locations: either at their campsite location or at the site of the waste infrastructure. At campsites, sampling was stratified to allow for a random contact of visitors. In the larger campgrounds, a sampling schedule targeted odd numbered campsites one period, and even numbered campsites the next. This avoided contacting the same campsites numerous times. In smaller campgrounds researchers attempted a census of campground visitors on any given sampling day. At the site of the waste infrastructure visitors were intercepted using an nth sampling strategy to randomize the process of intercepting (i.e., every second visitor). In both campsite locations and waste infrastructure surveys, if a group was contacted, the person with the most recent birthday (not date of birth) was asked to complete the survey to avoid a self-selection bias.

2.2. Data Instrument

The survey instrument was developed through a collaborative, iterative review process among the researchers, NPS staff, and other key partners. It included items stemming from established Leave No Trace-focused questions [26,32–34]. Moral norms measures were also included, as they can be additive measures when the behavior in question is rooted in underlying morally or ethically grounded beliefs or attitudes [35]. Additionally, questions
about visitor use history, visitation patterns, waste generation, information sources, and basic demographic information were included for descriptive purposes.

In early development, the survey instrument was pretested to improve question wording and clarity. Prior to finalization and field deployment, the survey instrument was field-tested with visitors at YOSE before data collection. Pretesting allowed respondents to inform researchers about potentially confusing wording and layout issues and provided the opportunity to revise and improve the instrument for data collection. Items measured are presented in Tables 1–3.

**Table 1. Intentions of Campground Visitors.**

| Component Variables | Factor Loading | Mean (sd) |
|---------------------|----------------|-----------|
| Self-reported waste behavioral intentions | | |
| α = 0.85 | | |
| Reduce the amount of waste materials I bring with me | 0.882 | 5.55 (1.57) |
| Reduce the amount of waste materials I create while camping | 0.876 | 5.57 (1.52) |
| Only purchase items in the park that can be reused or recycled | 0.688 | 4.82 (1.68) |
| Bring a reusable water bottle rather than purchasing bottled water | 0.423 | 6.47 (1.18) |
| Sort all of my waste items for disposal in recycling and trash containers while in the campground | 0.472 | 6.40 (1.05) |

**Table 2. Perceived Difficulty of Waste Behaviors of Campground Visitors.**

| Component Variables | Factor Loading | Mean (sd) |
|---------------------|----------------|-----------|
| Perceived difficulty of waste behaviors | | |
| α = 0.67 | | |
| Reduce the amount of waste materials I brought to the campground | 0.835 | 5.06 (1.65) |
| Sort my items between recycling and trash in the campground | 0.521 | 6.01 (1.41) |
| Reduce the amount of waste I create while in the campground | 0.850 | 5.10 (1.61) |
| Avoid the purchase of items in the park that cannot be reused or recycled | 0.589 | 5.17 (1.62) |

**Table 3. Additional Cognitive Measures.**

| Component | Variables | Factor Loading | Mean (sd) |
|-----------|-----------|----------------|-----------|
| Self-efficacy | | |
| α = 0.77 | | |
| Recycling in this campground is inconvenient | 0.757 | 5.92 (1.57) |
| Trash disposal in this campground is inconvenient | 0.757 | 6.26 (1.29) |
| Trash disposal in this campground is confusing | 0.698 | 6.37 (1.19) |
| Recycling in this campground is confusing | 0.741 | 6.17 (1.38) |
| Recycling in this campground is difficult | 0.700 | 6.11 (1.41) |

| Conservation | | |
| α = 0.84 | | |
| By reducing the amount of trash I produce in this campground, I am helping to protect the health of the environment | 0.793 | 6.64 (0.75) |
| By recycling in this campground, I am helping to protect the health of the environment | 0.864 | 6.69 (0.72) |
| By recycling in this campground, I am helping to conserve natural resources | 0.815 | 6.71 (0.67) |

1 KMO = 0.652; Bartlett’s test of sphericity, p < 0.001. 2 Measured on a scale where 1 = very unlikely and 7 = very likely.

1 Measured on a scale where 1 = very difficult and 7 = very easy. 2 KMO = 0.626; Bartlett’s test of sphericity, p < 0.001.
### Table 3. Cont.

| Component Variables                                                                 | Factor Loading | Mean (sd) |
|-------------------------------------------------------------------------------------|----------------|-----------|
| Items removed for cross-loading or insufficient reliability                          |                |           |
| Recycling in national parks is useless *                                               | 6.81 (0.80)    |           |
| Recycling in national parks takes too much time *                                     | 6.50 (1.06)    |           |
| It is pointless for me to recycle while in national park campgrounds *                | 6.71 (0.93)    |           |
| I know what items can be recycled in this campground                                 | 5.71 (1.70)    |           |
| I know where to take my recycleable items in this campground                         | 5.96 (1.76)    |           |
| This campground provides plenty of opportunities to refill water bottles              | 5.42 (1.76)    |           |
| Recycling in national parks is a responsible behavior                                 | 6.81 (0.80)    |           |
| The amount of waste produced by visitors to national parks is a problem               | 5.37 (1.56)    |           |
| I can help to make a difference by bringing fewer disposable items with me during my visit to this park | 6.21 (1.27)    |           |
| It would be wrong for me to not recycle during my visit to this park                  | 6.37 (1.27)    |           |
| I would feel guilty if I did not recycle during my visit to this park                 | 6.21 (1.32)    |           |

1 Measured on a scale where 1 = strongly disagree and 7 = strongly agree. 2 KMO = 0.898; Bartlett’s test of sphericity, \( p < 0.001 \). * Items reverse coded.

### 2.3. Analysis

Principal components analysis (PCA) and a reliability assessment (Cronbach’s alpha) examined the underlying structure of the data. The PCA used varimax rotation to increase the interpretability of the constructs. To use PCA, the data needed to demonstrate a Kaiser-Meyer-Olkin (KMO) statistics >0.50 and a significant value (\( p < 0.05 \)) for Bartlett’s test of sphericity. Items with loadings > 0.40 were included in each construct. Cronbach’s alpha of 0.65, a value generally accepted in park and protected area research [36], was used as the cut off point for scale reliability. Any items that cross-loaded on more than one construct or did not demonstrate sufficient loading (e.g., >0.40) were treated as single-item measures in future analyses. Three different PCAs were conducted due to measurement on different scale types.

A multiple regression analysis examined the influence of measured components and single-item measures on behavioral intentions. A decision was made to include awareness of the Zero Landfill Initiative (ZLI) on behavioral intentions as well, as awareness predicts behavioral intentions in some studies [35]. All items from above were placed into a regression model explaining behavioral intentions. The strength of the relationships (i.e., effect size) in the multiple regression analysis identified leverage points for step two.

### 3. Results

#### 3.1. Step 1 Results

#### 3.1.1. Sample Characteristics

Researchers intercepted 1719 park visitors in all three parks throughout the sampling period. Only 51 visitors (3%) had a substantial language barrier and could not complete the survey. From the eligible visitors, 1292 agreed to participate in the research. The overall response rate across the entire sample was 89.3%. Type of camping (e.g., tent/car, tent/backpacking, RV, etc.) was examined to check for non-response bias between respondents and non-respondents. Only 5 respondents reported bicycle tent camping. Due to this low response, bicycle tent campers were removed from the analysis. From the remaining participants, there was no significant difference between respondents and non-respondents related to the type of camping \( (X^2 = 6.558, df = 5, p = 0.256) \).

#### 3.1.2. Principal Components Analysis to Identify Cognitive Concepts

PCAs showed sufficient KMO and Bartlett’s test of sphericity values (see Tables 1–3). The first PCA focused on analyzing behavioral intentions related to waste behaviors (Table 1). One component was identified and was called Behavioral intentions. The second PCA analyzed perceived difficulty of engaging in waste behaviors (Table 2).
component was identified and was called Perceived difficulty. The third PCA examined numerous cognitive concepts measured on the same scale, and two components were identified (Table 3). Based on the items that loaded on to each component, they were named Conservation and Self-efficacy. The rest of the items from this third PCA were treated as single-item measures in future analyses. The items in each component that demonstrated sufficient reliability were combined to create a summated index for each concept.

3.1.3. Multiple Regression Analysis for Identifying Leverage Points for Communication

A multiple regression analysis examined the influence of cognitive concepts on behavioral intentions. All indexes from the PCAs and single-items were placed into a multiple regression model explaining behavioral intentions. Researchers checked for collinearity and found no evidence that it existed (All VIF < 4.0 [range 1.05 to 1.77] and Tolerance > 0.10 [range 0.56 to 0.95]). Overall the model was statistically significant (F(14, 1264) = 51.05, p < 0.001, adj. R² = 0.36) and explained about 36% of the variance in behavioral intentions. Perceived difficulty and the single item measures “I can help make a difference by bringing fewer disposable items with me during my visit to this park” displayed the highest effect sizes [37] and were thus selected as leverage points for implementation of messaging in step two.

Step 2: Evaluation of data-driven messaging strategy

3.1.4. Procedures

Data collection involved direct unobtrusive visitor observation by researchers dressed in plain clothing (see Figure 2). Sampling was distributed across select campgrounds in GRTE, YOSE, and DENA over a three-month period in the summer of 2019. Approximately 21 days of sampling were allotted for data collection in each park and were stratified by campground site, time of day (AM/PM), weekday or weekend, and treatment (2 treatments, 1 control). AM shifts took place from 7AM to 1PM and PM shifts took place from 1PM to 7PM. The sampling design was developed in consultation with park managers, including determinations for sampling locations in each park. Each treatment was only in place for 6 h per sampling period for a total of 32 h per park. Data were collected in YOSE from 2 June to 1 July, in GRTE from 7 July to 4 August, and in DENA from 10 August to 8 September.

Figure 2. Unobtrusive observations of waste disposal behaviors in National Park campgrounds.
3.1.5. Quasi-Experimental Treatments

Informed by the results of Step 1 (see Table 4 above), two cognitive concepts were selected to develop messages for Step 2. These cognitive concepts related to perceived difficulties and moral norms. An iterative process among scientists, park managers, and other collaborators was used to develop messages that targeted these two cognitive concepts while applying best practices for developing messages in parks and protected areas [38]. Initial messages were pretested in a psychological laboratory at with \( n = 166 \) students, following elicitation strategies, e.g., [26,39]. Respondents were told the messages were intended to provide visitors in national parks with information to encourage them to properly dispose of trash and recyclable materials. The respondents were then asked to rate the ten messages based on (1) how persuasive (scaled, where 1 = Not at all Persuasive, to 7 = Very Persuasive), and (2) the likelihood that the message would make them more or less likely to dispose of their waste and recyclable materials (scaled, where \(-4 = \text{Less Likely}; 0 = \text{No Effect}; 4 = \text{More Likely}\)). Pretesting results showed that lack of difficulty (i.e., ease) and norms associated with properly disposing of waste/recyclable materials to benefit the wellbeing of the park were perceived as the most effective and influential messages.

Table 4. Multiple Regression Explaining Self-reported Waste Behavioral Intentions.

| Predictor                                                                 | Standardized Coefficient | Unique Variance Explained\(\%\) | \(p\)-Value | Effect Size \(^1\) |
|--------------------------------------------------------------------------|---------------------------|---------------------------------|-------------|------------------|
| Perceived difficulty of waste behaviors                                   | 0.26                      | 5.3%                            | <0.001      | Small-medium     |
| Self-efficacy                                                            | -0.02                     | <1.0%                           | 0.602       | No effect        |
| Conservation                                                             | 0.08                      | <1%                             | 0.006       | Small            |
| Recycling in national parks is useless \(*\)                             | 0.01                      | <1.0%                           | 0.801       | No effect        |
| Recycling in national parks takes too much time \(*\)                     | 0.03                      | <1.0%                           | 0.262       | No effect        |
| It is pointless for me to recycle while in national park campgrounds \(*\)| 0.03                      | <1.0%                           | 0.263       | No effect        |
| I know what items can be recycled in this campground                     | 0.04                      | <1.0%                           | 0.135       | No effect        |
| I know where to take my recyclable items in this campground              | 0.01                      | <1.0%                           | 0.855       | No effect        |
| This campground provides plenty of opportunities to refill water bottles   | 0.04                      | <1.0%                           | 0.064       | No effect        |
| Recycling in national parks is a responsible behavior                     | -0.01                     | <1.0%                           | 0.634       | No effect        |
| The amount of waste produced by visitors to national parks is a problem   | 0.12                      | 1.3%                            | <0.001      | Small            |
| I can help make a difference by bringing fewer disposable items with me during my visit to this park | 0.25                      | 6.5%                            | <0.001      | Small-medium     |
| It would be wrong for me to not recycle during my visit to this park      | 0.04                      | <1.0%                           | 0.208       | No effect        |
| I would feel guilty if I did not recycle during my visit to this park     | 0.18                      | 2%                              | <0.001      | Small            |
| ZLI awareness                                                            | 0.03                      | <1.0%                           | 0.173       | No effect        |

\(^1\) [37]. \(*\) Items reverse coded.

The first treatment message was called *Ease* and targeted perceived difficulty. The message stated, “Taking one minute to sort your recycling is an easy way to help this park.” The second treatment message targeted moral norms and was called *Moral norms*. This message stated, “You have the power to either help or harm the health of this park.” Both treatment messages were implemented on top of existing infrastructure and signage. Existing infrastructure and signage were considered the “control.” Examples of treatments, control, and infrastructure is found in Figure 3.
Recycling in national parks is a responsible behavior

3.1.6. Data Collection

Visitor observation is a previously employed social science research method in parks and protected areas [20,21,26,30,31]. The use of such methods is critical to this study. Other methods, such as solely conducting visitor surveys and interviews to assess self-reported behavior, cannot accurately produce some types of data on actual behavior.

Specific behaviors of interest were identified by the research team and collaborators, as well as the specifics of how observers/surveyors conducted their field work. This process led to the development of digital field observation data forms which were used by the field assistants. All of the methods described above were approved by the lead author’s University Institutional Review Board and by each park unit through the research permit process.

The observer captured proper disposal of waste behavior and visitor characteristic data for every individual or visitor party that used the campground waste/recycling infrastructure under study. Before data collection began, the observer/surveyor would refer to the sampling schedule to determine whether they would be using a treatment message or a control that day. The researcher would then place the signage in the appropriate location on the waste/recycling bins (see Figure 3). Observers dressed in plain clothes and positioned themselves near the waste/recycling infrastructure under study as inconspicuously as possible to avoid bias/influence on visitor behavior. Observation data was recorded on an iPad using Qualtrics software. Of fundamental interest to the efficacy of the messaging strategy was whether or not visitors disposed of their waste properly. Proper disposal of waste was recorded by observers as yes, no, or unclear. Protocols for this are found in Table 5 by park. Once data collection ended for that shift, the observer/surveyor would remove all signage from waste/recycling bins.

There was a specific instruction for bags of items that were deposited into recycling bins. All three parks consider disposal of a plastic bag of items into recycling improper disposal. As such, any campground visitor who was observed depositing a plastic bag of items into recycling bins was recorded as no for proper disposal of waste rather than unclear. Unclear observations refer to instances of visitors depositing bags of items for which the observer was unable to determine the contents, or the inability to accurately identify the items being disposed.
Table 5. Observation Protocols for Proper Disposal of Waste in Campgrounds by Park.

| Waste Items           | YOSE | GRTE | DENA                  |
|-----------------------|------|------|-----------------------|
| Hot coffee cups       | Bottom cup | All | Bottom of cup and paper sleeve Plastic water cup (Plastic #5) |
| Cold coffee cups      | —    | All  | —                     |
| Aluminum/steel        | —    | —    | —                     |
| Glass                 | —    | —    | —                     |
| Paper                 | —    | All  | —                     |

| Recyclable Items      | YOSE | GRTE | DENA                  |
|-----------------------|------|------|-----------------------|
| Hot coffee cups       | Plastic top and paper sleeve | — | Plastic top (Plastic #7) |
| Cold coffee cups      | Top and bottom of plastic cup | — | — |
| Aluminum/steel        | All  | All  | All                   |
| Glass                 | All  | All  | All                   |
| Paper                 | All  | —    | —                     |

3.1.7. Analysis

A binary logistic regression assessed the effectiveness of the treatment conditions on observed proper disposal of waste. If proper disposal of waste was unclear, the case was removed from the analysis. We controlled for park-level effects in the models because each park has different infrastructure, conditions, setting, and other unique features (see Figure 3 and Table 5). In this way, we are able to better identify the effects of the experimental signage as opposed to park-level factors. Park-level effects are not interpreted, as they are not seminal to our research questions.

3.2. Step 2 Results

Binary Logistic Regression for Proper Disposal of Waste Observations

The treatment signage had a significant effect on campground visitors properly disposing of waste when controlling for the effect of park ($X^2 = 7.85, df = 2; p = 0.02$). Only the Ease treatment significantly increased campground visitor proper disposal of waste (Table 6). When compared to control conditions, campground visitors exposed to the Ease treatment message were 2.08 times more likely to properly dispose waste, and those exposed to the Moral Norms treatment message were no more likely to properly dispose waste. About 9% more visitors were properly disposing waste under Ease treatment conditions when compared to control conditions (see Figure 4).

Table 6. Binary logistic regression model for proper disposal of waste with campground visitors.

| Variable 2      | B       | S.E.  | Wald  | Df   | p-Value | Exp (β) | 95% CI for Exp (β) |
|-----------------|---------|-------|-------|------|---------|---------|-------------------|
| Overall treatment | –       | –     | 7.85  | 2    | 0.020   | –       | –                 |
| Ease treatment  | 0.733   | 0.31  | 5.57  | 1    | 0.018   | 2.08    | 1.13 3.83        |
| Moral norms treatment | –0.10 | 0.27  | 0.15  | 1    | 0.701   | 0.90    | 0.53 1.53       |
| Overall park    | –       | –     | 9.39  | 2    | 0.009   | –       | –                 |
| Yosemite        | –0.86   | 0.30  | 8.36  | 1    | 0.004   | 0.42    | 0.24 0.76       |
| Grand Teton     | –0.82   | 0.32  | 6.58  | 1    | 0.01    | 0.44    | 0.24 0.82       |

1 Omnibus test: $X^2 = 17.86, df = 4; p = 0.001$; Nagelkerke $R^2 = 0.06$; Percent correctly classified = 80%. 2 The Control treatment and Denali do not appear as variables in the model due to the dummy coding process.
3.2. Step 2 Results

Binary Logistic Regression for Proper Disposal of Waste

![Bar chart showing proper disposal of waste by treatment condition]

**Figure 4.** Proper or improper disposal of waste by treatment condition.

4. Discussion

As managers of parks and protected areas face new challenges related to high levels of visitor use, science-informed, data-driven management will become increasingly important. This includes the development of strategic communication programs that help inform visitor use management. A criticism of previous work using cognitive concepts to develop strategic messaging is that they are rarely tested and instead rely on the concept of behavioral intentions to make inferences about behavior [35]. Behavioral intentions are not actual behavior, and the uncertainty about this left many skeptical. This study, in combination with several others, e.g., [20,21,26,30,31] demonstrated evidence that science-based, data-driven messaging can impact actual behaviors. These findings, and the application of these results is particularly important as outdoor recreation and the use of parks and protected areas continues to increase amidst the COVID-19 pandemic [40].

Although communication strategies can influence visitor behaviors in parks and protected areas, not all are effective. In our research, we showed that *Ease* messages were effective, but *Moral Norms* messages were not for the behavior of interest. The reason for this is not exactly clear but may be related to a mismatch between the *Moral Norms* measurement item and the observed behavior of proper disposal of waste. In the measurement item, it contained wording about bringing fewer disposable items to the park. Our observations in the park focused on proper disposal of waste. The result is that perhaps the *Moral Norms* measure (though a good measure of general waste disposal intentions), is not a good “leverage point” for the specific behavior of proper disposal of waste. Further evidence of this can be found from the *Perceived Difficulty* construct, which contained two items that specifically pertain to proper disposal of waste and was ultimately effective in changing that behavior. Future research on communication in parks and protected areas should move beyond if communication is effective in changing behavior. A more prudent approach would be where the questions explore under what conditions communication can be effective.

A few limitations of this research should be noted. First, we only sampled visitors at a selection of campgrounds in three national parks. Caution should be used when trying to generalize these results to other locations and populations. Additionally, although thorough training was provided for all research technicians, and they could select an “unclear” option for proper disposal of waste, there may be an unknown amount of human error in the observations. These limitations also create a variety of interesting potential for future work. For instance, how do messaging strategies differ among different visitor populations, such as people at visitor centers or day hikers? Additionally, implementing...
this and similar research at other types of parks may provide insights. This could include cultural and historic based national parks (i.e., the National Mall in Washington, DC, Jimmy Carter National Historic Site, etc.), but could also be extended to state and local parks as well. Exploring this work with a variety of populations and in different settings will allow researchers and managers to understand if strategies designed to influence proper disposal of waste and recyclables are generalizable, or if different strategies are needed for each new site and population. Lastly, waste stream analysis could be used to further determine the effectiveness of communication strategies by providing empirical data on exactly what items were unclear or items that were contained in trash bags.

5. Conclusions

Waste management is a major visitor use issue in national parks and other protected areas, which must be addressed to aid with the long-term sustainability of these valuable resources. This research applied a mixed-methods approach to develop and test strategic communications designed to increase recycling and minimize trash to the landfill by altering campground visitor behaviors in three iconic U.S. National Park Service units. Results demonstrate that theoretically developed and tested messages can positively change behavior on-site. Messaging focusing on ease was two times more effective at changing campground visitor waste disposal behaviors than control conditions. These results largely align with previous Leave No Trace-related messaging research [4,26,32], suggesting that these types of educational efforts can make a positive difference with visitor behaviors and resource conditions. These results can be applied in these parks and other types of protected areas through relatively inexpensive signage and other forms of messaging. These types of interventions can help mitigate visitor use impacts and sustain the health of these parks for future generations.

Author Contributions: Conceptualization, P.N., B.L., B.D.T. and Z.M.; Methodology, Z.M. and S.F.; Formal analyses, Z.M. and S.F.; Original draft preparation, Z.M. and B.D.T.; Writing, review, and editing, B.D.T., Z.M., B.L. and P.N. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Subaru of America and the Leave No Trace Center for Outdoor Ethics.

Acknowledgments: We acknowledge that the views expressed in this article are the responsibility of the authors and do not necessarily represent the opinions or policy of the U.S. National Park Service. We would also like to thank Subaru of America and Denise Coogan, and the staff at the Leave No Trace Center for Outdoor Ethics. We would also like to acknowledge Jennifer Newton, Karen Hockett, Jodi Bailey, and Margaret Wilson with the U.S. National Park Service for their support of this research. Finally, this research would not have been possible without the support of our amazing data collection team, facilitated through the Leave No Trace Center for Outdoor Ethics.

Conflicts of Interest: The authors declare no conflict of interest.

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