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Predicting physical distancing on recreational trails during COVID-19

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1. Introduction

The emergence of Coronavirus 19 (COVID-19) led to societal and behavioral changes, including intensified use of many public parks and trails for mental respite and leisure time physical activity. As visitors sought stress-relief in the great outdoors, they also encountered stressful situations as they navigated risk exposure. Recommendations to physically distance between parties was a key component to reduce risk, but compliance is unknown in the outdoor arena. This observational study of more than 10 000 trail user encounters documented distancing and enabled predictive analysis that revealed wider trails, smaller groups and signage led to greater distancing compliance. Managers and planners can integrate these findings immediately and in consideration of future trail designs to minimize risk exposure.

Management implications: Select site features increase odds of distancing compliance and can inform management decisions and designs immediately and in addressing future use surges: wider trails, unpaved surfaces, and COVID-19 signage.

As distancing compliance waned with time but signage increased compliance, innovative and dynamic signs may sustain compliance and multi-media communications should be considered.

Both activity size and group type influence distancing so considering group size recommendations and activity separation are in order.
create public parks and trails, increasingly recognized as ‘critical infrastructure’ (Lopez et al., 2020).

Toward data-driven decision making, researchers explored visitation patterns (ie. Derks et al., 2020), visitor intentions (Katz et al., 2020), and actual behaviors during COVID-19s emergence (Bias et al., 2021; Hoeben et al., 2020; Wynveen et al., 2021). Reflecting self-report data among the U.S. public (Freeman & Eykelbosh, 2020), behavioral observations of trail users across the United States revealed a majority were not distancing (Wynveen et al., 2021) and extant distancing waned over time (Hoeben et al., 2021). This lack of compliance is significant for a number of reasons, most prominently the risk exposure to COVID-19 (Schneider, Lindsey et al., 2021).

As visitors sought stress-relief in the great outdoors, they encountered stressful situations as they navigated risk exposure (Burtscher et al., 2020). Particularly as the COVID-19 pandemic became wide-spread and scientific understanding evolved, uncertainty and fear permeated public life and public spaces (Meyer et al., 2020). Such disruptions to daily life are stressful (Wagner, Conpas, & Howell, 1988), constrain recreation (Schneider & Wilhelm Stanis, 2007), and incite coping responses (Schneider & Hammit, 1995; Schuster et al., 2006).

Recreation research reveals trail visitors most frequently cope with stress by following established trail etiquette (Schneider & Hammit, 1995; Schneider, 2000; Schneider et al., 2013). Given that the rules were evolving at the COVID-19 pandemic onset, visitors’ ability to follow them was unclear. Subsequently, understanding manageable attributes and actionable opportunities were of keen interest as planners and policy managers considered options to simultaneously provide for and protect visitors. As such, building on descriptive (Wynveen et al., 2021) and comparative observational research (Schneider et al., 2021), this project leveraged trail user observations to assess the influence of site, visitor and time-related factors on physical distancing compliance.

2. Methods

Observation data were used to predict the odds of physical distancing on recreational trails. As described elsewhere (Schneider et al., 2021; Wynveen et al., 2021), systematic observation across 14 non-motorized public trails in six U.S. states resulted in detailed recordings of more than 10 900 unique trail user group encounters within an observation zone by trained observers, March to June 2020. Site information recorded included COVID-19 signage presence, trail width, and trail surface. Visitor group characteristics recorded included activity type (walking, biking, etc.) and group size for both the group followed through the zone and groups they encountered in the observation zone. Encounters with other trail groups were evaluated in terms of the number of encounters as well as estimated distance between those closest in the observed and encountered groups for each encounter (0–3, 3–6, > 6 feet apart).

The outcome variable was a binary indicator of the U.S. Centers for Disease Control physical distancing compliance for each encounter: maintaining a six-foot (1.8 m) distance between groups that met on the trail. Situational covariates included encounter number (first, second, etc.), group size, and activity type for both observed and encountered groups. Activity type was included as a three-level categorical variable (pedestrian only, bike, mixed). Trail characteristics included trail width, trail surface (paved or not), and presence of COVID-19 related signage (yes/no). Month of data collection (April–June) was also recorded.

Logistic mixed-effects regression models quantified associations between physical distancing compliance and covariates. Random intercepts were included to account for possible correlation between multiple encounters involving each group. All analyses were conducted using the lmte and lmerTest packages in the R statistical software.

3. Results

Situation, trail and time variables were all significantly associated with compliance to physical distancing recommendations during encounters (unless otherwise noted, p < 0.01 for all effects described; Table 1).

In terms of the trail characteristics, every additional foot of trail width was associated with a 5.1% (95% CI: 2.3%–7.9%) increase in the odds of compliance, and encounters on unpaved trails had 85% higher (95% CI: 63%–109%) odds of compliance than those on paved trails. COVID-19 signage presence was associated with a 50% (95% CI: 30%–74%) increase in the odds of compliance.

With regard to the encounters, group size, number of encounters and activity type significantly impacted odds of compliance. Specifically, every additional person in the observed group was associated with a 42% (95% CI: 38%–45%) decrease in compliance and similarly, every additional person in the encountered group was associated with a 39% (95% CI: 35%–42%) decrease. Similarly, every additional encounter for an observed group was associated with a 5.2% (95% CI: 2.7%–7.7%) increase in the odds of compliance. Biking-only groups’ odds of compliance were 38% (95% CI: 25%–48%) lower than pedestrians, while mixed groups’ odds of compliance were 29% higher (95% CI: 10%–51%).

As time progressed, compliance waned: odds of compliance were 28% (95% CI: 17%–37%) lower in May and 44% (95% CI: 35%–51%) lower in June compared to April.

4. Discussion

Prior to this study, limited literature on distancing in public green spaces during COVID-19 was largely descriptive or self-reported (Wynveen et al., 2021; Hoeben et al., 2020). This study advanced our understanding of distancing by collecting actual, in-situ behavioral data and evaluating manageable features that contribute to physical distancing compliance: wider trails, unpaved surfaces, small group sizes, and pedestrian or mixed-use groups. Findings mirror previous trail-behavior research where group size and available infrastructure influence behavior (Patten et al., 2006; Goh 2020). Subsequently, if faced with limited resources, managers can hone their attention on the places where distancing is less likely: narrower, paved trails with larger group sizes. While additional research can illuminate the causes for these findings, consideration to activity separation and trail surface seem prudent for initial future decisions. Certainly such decisions need to consider the evolving mitigation measures, such as masks, and their impact. When planning for the future, considerations to the “resilience and adaptive capacity of the built environment” will be key to creating safe public space opportunities (Derks et al., 2020).

Unlike some other research where signage did not lead to desired behaviors (Goh, 2020; Guo et al., 2015), this data revealed a positive association between sign presence and physical-distancing compliance. This finding supports past research where visitors adhere to clearly communicated rules, especially when reinforced by social norms (Schneider et al., 2021; Schneider & Hammit, 1995). While a reverse causality explanation cannot be ruled out (e.g., signage is placed in areas where compliance is anticipated to be poor), visitors’ attention to

| Table 1 |
| Mixed Full Model w/Group Observed, Group Encountered Sizes, Pedestrian vs Bike. |

| Trail Width (Feet) | 1.051*** |
| Trail Surface Unpaved (vs. Paved) | 1.849*** |
| COVID-19 Signage Present | 1.501*** |
| Observed in May (vs. April) | 0.724*** |
| Observed in June (vs. April) | 0.564*** |
| Observed Group Size ≥ 1 | 0.581*** |
| Encountered Group Size ≥ 1 | 0.612*** |
| Observed Group Bike (vs. Pedestrian only) | 0.624*** |
| Observed Group Mixed (vs. Pedestrian only) | 1.293*** |
| Every Additional Encounter | 1.052*** |

Note: ***p < 0.01.
signage and behavior norms deserve further research attention, as does the signage content. Moving forward, integrating a variety of messaging mediums and content may be necessary to maintain visitors’ attention and compliance, particularly given the waning compliance since the initial recommendation in April 2020 and other research with similar findings (Hoeben et al., 2020).

Due to the nature of the data collection, individual-level data were limited to what could be reliably observed from a distance. Potentially important demographic information and other social determinants were not available (Hao & Shao 2021; Rollston & Galea, 2020). Research reveals that older, better educated, and more liberal leaning individuals are more likely to adjust behaviors than others (Hao & Shao). More data are needed to understand how the interaction between individual and situational characteristics influences compliance with social distancing recommendations. For example, how does level of concern for the environment impact willingness to step off trail to comply? Follow up visitor interviews or focus groups can provide insight on these, and other, remaining important questions. Although data were collected at a variety of locations across multiple states, some trail characteristics (e.g., trail surface) were the same for all sites within a state, raising the possibility that the estimated effects of these characteristics might partially reflect the effect of unmeasured regional or state-level factors. Along the same vein, attention to case and vaccination rates likely influence behaviors and deserve attention in future research as does the impact of time on behavior.

Although physical distancing guidance for COVID-19 mitigation and future pandemics remains uncertain, safe public green spaces during future public health crises are imminently important. Acting on the design and activity factors that increase compliance helps move us toward satisfying outdoor experiences with less stress and uncertainty and, subsequently, a healthy visitworth.

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Ingrid E. Schneider: Conceptualization, Data curation, Writing – original draft, Supervision, Project administration, Methodology, Validation, Investigation, Writing – review & editing. Julian A. Wolfson: Conceptualization, Formal analysis, Data curation, Writing – original draft, Visualization, Methodology, Validation, Investigation, Writing – review & editing. Wyatt J. Tarter: Formal analysis, Methodology, Validation, Investigation, Writing – review & editing. Christopher J. Wynveen: Data curation, Project administration, Methodology, Validation, Investigation, Writing – review & editing. Mecha S. Budruk: Methodology, Validation, Investigation, Writing – review & editing. Heather J. Gibson: Methodology, Validation, Investigation, Writing – review & editing. Kimberly J. Shinew: Project administration, Methodology, Validation, Investigation, Writing – review & editing. Taylor V. Stein: Project administration, Methodology, Validation, Investigation, Writing – review & editing. Deonne VanderWoude: Methodology, Validation, Investigation, Writing – review & editing.

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