

Visualizing and Tagging Trail Experiences

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Abstract: Public spaces are changing in importance for people as they seek new opportunities to use protected areas for outdoor recreation. Within these spaces, constructed features including trails, encourage visitors to move throughout and use the landscape in particular ways. In designing these spaces, public land managers and landscape architects play a key role in shaping the kinds of activities and relationships to the environment are encouraged or discouraged. In this paper, we examine trail user and maintainer perceptions of the kinds of activities people engage in on trails. This pilot paper shares analysis tools and interactive modes for communicating survey results. We create a domain-specific sentiment tagging lexicon for classifying trail activities and experiences. Finally, we develop an interactive digital dashboard to explore possibilities for new forms of public and planner engagement with protected areas and trails through virtual data products.

Keywords: Text analysis, digital dashboards, nature-based experiences, public spaces

1 Introduction

Public interest in protected areas, including hiking and other recreational trails, is on the rise, particularly in the context of the COVID-19 pandemic (CHRISTIANA et al. 2022, POWER et al. 2021). Park visitation is at an all-time high, causing many iconic trails and sites to implement waiting lists and lotteries for entry (NEW YORK TIMES 2021, POHLE 2021). More broadly, trails of local or regional importance are also seeing increased visitation, including an increased number of visitors who are new to outdoor recreation. Dismayed and concerned visitors documented these increased pressures in numerous viral videos on social media that showed heavily trafficked trails and overcrowded campsites across National Parks and local wilderness areas. Thus, the pandemic has brought a public conversation around trail maintenance, usage, and behavior to the national forefront, and raises important questions about public engagement, access, and stewardship of shared wilderness sites.

Given the broad-reaching significance of trail spaces, in addition to their growing importance as shared common spaces in the public eye, the necessity of further examining how trail users engage with these spaces is clear. In the context of landscape architecture, tools for analyzing and communicating data related to public trail use, perceptions, and values may help improve the efficacy of user-centered and community-engaged design. In addition to providing spaces for outdoor recreation, trails also support mental and physical health (EMIL et al. 2016) and are visible design features on a landscape. Due to the impacts of trails on their surrounding natural environment (BALLANTYNE & PICKERING 2015), trail design is a particularly important topic in the realm of sustainable land management. Moreover, trails are critical components of urban greenways (LUYMES & TAMMINGA 1995), which, for decades, have been a core emphasis of green infrastructure studies and environmental management.

Drawing on survey data of trail users and maintainers, we approach two challenges for working with digital data related to trails, outdoor spaces and nature experiences: 1) improving domain-specific text analysis frameworks and 2) creating platforms for public engagement with datasets. In this paper, we develop an open-source trail activity lexicon that can be used by planners and scholars to tag terms related to outdoor recreation experiences and spaces. In addition, we designed an interactive digital dashboard that visualizes information about trail use across the United States. Accessibility is emphasized in the design of both outputs to ensure their contribution to broader themes of public space management. To this end, we also include further discussion on possible future applications of this framework, as well as analysis of its potential limitations, towards the end of the paper.

In landscape design and planning practice, communication plays a key role in supporting public engagement. Language-based communication is a common approach for engaging the public and stakeholders through workshops, online/in-person surveys, and public hearings. Increasingly in the age of big data, incorporating public perception on landscape issues necessitates a more efficient methodology. For example, in terms of landscape design and conservation planning, the Geodesign-based support approach demonstrates that public perception and diverse engagement are well communicated (LI & MINLBURN 2016, PERKL 2016, RODERICK 2018). Studies engaging with social media also demonstrate the advantages of synthesizing public perception into planning practice (WANG et al. 2018). However, constructing platforms integrating various forms of information into a single, publicly accessible format remains an emerging area (SCHÄPERMEIER et al. 2021). The popularity and ready availability of Python programming gives the opportunity to establish dashboards dealing with information, visualization, spatial configuration, and even social networks. There are many potential applications of user-specific research in the context of landscape architecture. For example, understanding the activities people perceive to be encouraged and discouraged can yield insights into the values and preferences of diverse user groups, which in turn may inform more thoughtful, user-centered landscape design.

The main purpose of this dashboard is to ensure wider accessibility of this research. Data visualizations are important tools in the field of landscape architecture. Various visual representations of landscape design, including maps and models, are used by landscape designers and planners to reach diverse stakeholders. Visual representations have become fundamental owing to their pivotal role in the wide range of social, political, and ecological issues faced by landscape architects. These visualizations can augment awareness which in turn enhances the efficacy of communication between various stakeholders, such as policymakers, community-based groups, non-governmental organizations, and the general public with varied levels of visual literacy contributing to a participatory landscape design process (RAAPHORST et al. 2019, RAAPHORST et al. 2020).

Data visualizations are recognized as efficient tools for generating education around civic topics as they help the public to understand the underlying process for formulating policies, and to arrive at informed decisions regarding civic issues (WILLIAMS 2016). Researchers found that visualizations can overcome language barriers, address diverse cultural aspects and disparate education levels, and promote inclusivity. In addition, they can effectively communicate complex data, helping bridge the information gap between diverse stakeholders (SLEIGH & VAYENA 2021). Public dashboards are a promising tool to see how existing users engage with and conceptualize public spaces like trails, which can significantly shape efforts to address unequal access, exclusive norms, and safety concerns of such public spaces, and

how these intersect with societal inequalities along various axes such as race, class, and gender. Thus, data visualizations can become collaborative public engagement tools and reduce the power differentials pertaining to the possession of knowledge (WILLIAMS 2016).

2 Visualizing and Tagging Trail Data

2.1 Survey of Trail Users and Maintainers

The framework put forth in this paper draws on data derived from an online survey about trail use and trailwork conducted over several months in 2021. The survey was posted online and sent to various trail clubs, outdoor recreation groups, online forums, and other organizations with interests in trailwork and trail-based recreation. The data used here were collected until December 2021 and include ~570 responses from across the US. In this paper, we focus primarily on responses to the freelist question: “What types of things do people do on trails? (List up to 10 things).” These open-ended text responses involve nuanced descriptions of trail activities, allowing for emergent coding of themes in trail activities, which further revealing underlying values, perceptions, and experiences of nature.

The 559 survey respondents for the trail activity question listed a total of 1252 unique responses, which after text cleaning and standardization are grouped into 739 activity types. We developed several distinct frameworks for classifying and interpreting trail activities, two which are represented in the dashboard figures and lexicon. For example, co-author KT manually coded activity responses according to whether they had active, passive, or negative impacts on the environment. In another case, co-author MB assigned tags to individual words drawn from activity responses to develop the lexicon described in the following section. Data wrangling, cleaning and analysis was done in R (R CORE TEAM 2022). Analyses of the significance of survey results and these methodological processes are ongoing. Here, we present two aspects of this project that are most relevant to the practice of digital landscape architecture: tagging lexicons for open science and digital dashboards for science communication. This paper represents a reflective timestamp documenting the first phase of developing digital outputs for the broader project focused on trail management and use.

2.2 Lexicon of Trail Activities

The first contribution of this paper is an open-source semantic tagging lexicon for outdoor recreation and nature experiences. The text analysis lexicon may be accessed here: (<https://trailusestudy.web.app/assets/traillexicon.html>). At present the online lexicon is based on annotations by co-author MB. Although these data are focused specifically on trail experiences, the lexicon is designed to also be applicable to experiences in other public spaces and natural environments. By releasing the tagging lexicon publicly, other scholars, communities, land managers, and planners interested in understanding behavior, perceptions, and experiences of public lands are able to use and extend this framework. In particular, land managers and landscape architects who work with social media or other digital big data sources may find this tagging library helpful as part of a reproducible text analysis workflow.

The primary objective of this lexicon is providing a broadly applicable method of understanding human-nature interaction, not only within but also beyond trail spaces. Research demonstrates that our relationship with the environment extends far beyond traditional forms

of ‘usage’ (such as gardening or farming) into realms including, but not limited to, recreation; physical and mental wellbeing; craftsmanship; social engagement; community building; and education. Studies also indicate that in order to fully grasp the breadth of human-nature relationships, peoples’ experiences in nature must be understood as not only cognitive (mind and thought-related) but also sensory (relating to bodily sensations) and affective (relating to moods and emotions) (PRAMOVA et al. 2022). For example, Temmes (2022) qualitatively coded social media posts in order to understand the multisensory aspects of visiting protected areas. Building on these existing studies, we tagged words found in survey responses based on themes that may be applicable to big data sets related to nature experiences. Here we draw inspiration from domain-specific lexicons developed in other fields (e. g. CODEN et al. 2005, OLTEANU et al. 2014) to develop tools for text analysis in conservation planning and nature-experience research. Developing and sharing tagged text datasets related to nature experiences and protected areas is an important step for linking text analysis, open science, and conservation planning.

Research surrounding peoples’ affective relationship with the environment is also being used to promote more frequent and sustainable human-nature interactions, such as through efforts to build a sense of ‘connectedness’ with nature via participatory approaches (RENOWDEN et al. 2022). People use trails not just for hiking, walking, or commuting, but also for exercise (e. g. running and biking); recreation (e. g. horse riding and rock climbing); promoting mental wellbeing (e. g. meditation and alone time); caring for the environment (e. g. picking up trash or improving the trail); and more. Thus, recognizing the wide-ranging benefits of understanding trail users’ experiences, especially with respect to designing landscapes and digital products extending beyond the scope of trails, we designed this lexicon to be applicable for a wide variety of contexts related to nature and outdoor experiences.

In addition to classification based on the types of recreational activities, we developed a tagging library or lexicon for identifying the less tangible and more affective attributes of trail experiences. This allows for individual terms within a text to be systemically tagged for themes. For example, if a survey response or social media post mentions “Going fishing with friends to relax,” it might be tagged with themes such as mental health, socialization, engaging with wildlife, and fishing. On the other hand, text reading: “Going fishing alone to enjoy the quiet” would result in a different set of tags including solitude and hearing. Tagging individual terms allows for greater nuance in interpreting how nature experiences are described when working with texts at a big data scale, since it becomes more difficult to manually tag entire phrases when working with larger datasets. The main lexicon presented here is developed along three nested scales. At the broadest level, there are 48 tags, which are grouped into 18 categories, which are in turn grouped into five themes. For example, tags are developed for each of the senses. Additionally, words associated with physical and mental health, socialization, contemplation, and community were compiled along with other tagging lists. Categories include conflict, health, senses, outdoor skills, social, and learning among others. Themes include: individual, social, trail, nature, and action. Groups are not mutually exclusive, meaning that a given term might be linked to several tags.

2.3 Digital Dashboard of Trail Activities

The second contribution of this paper is a web application that visualizes and explains key information on trail use, experiences, and perceptions, based on the online survey and presented through charts and diagrams organized into panels. The dashboard can be accessed

here: <https://trailusestudy.web.app/>. This online dashboard allows viewers to explore relationships in the data by customizing which and/or how variables are plotted. This may provide the general public and stakeholders with the ability to actively interact with the data in a manner difficult to achieve through reports or articles. The interactive digital dashboard presents four aspects of the survey data: the impact of COVID-19 on trail experiences; the geographic distribution of responses about trail activities; trail activities; and demographics and activities mentioned. Detailed descriptions of these components are as follows:

COVID-19 impact: this component of the dashboard is an interactive bar chart depicting the impact of COVID-19 on various aspects of trail experience (e. g. places visited, frequency of use, number of people on trails, frequency of volunteering, number of different activities; trash along trails, and social trails). The chart is based on responses to the survey question: “To what extent has COVID-19 changed your experience of trails compared to during pre-COVID times?” Data are presented here as they are of timely interest for understanding how COVID-19 has impacted trails. Figure 1 shows two static images drawn from this component.

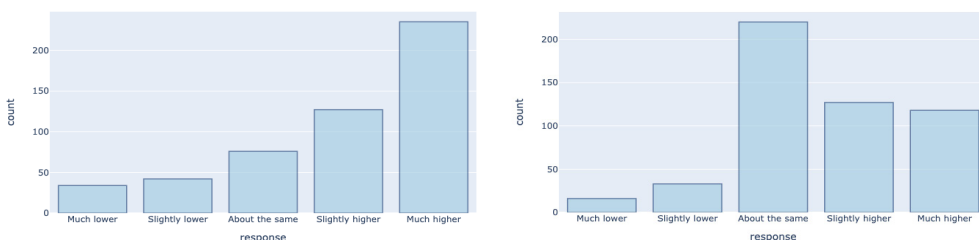


Fig. 1: Survey responses to questions about how COVID-19 has impacted various aspects of their experiences on trails. The left figure refers to changes in the number of people on trails. The right figure refers to the amount of trash along trails.

Activity distribution: this component is an interactive map depicting the frequency of survey response references to trail activities (including hiking, horseback riding, biking, running, and bird watching) across the U.S., by state. The interactive map displays the numeric frequency of trail activities for each U.S. state. The map uses graduated color symbology, where darker shades represent greater frequency of the activity type. Viewers can see the specific number of responses per activity type within each state by hovering over the state on the map. Each activity type has a separate map to ensure readability.

Trail activities: this component is a sunburst diagram that depicts the types of activities that survey respondents reported as occurring on trails, as well as the frequency of each type of activity (based on the number of responses for each type). This chart is based on responses to the question: “What types of things do people do on trails? (List up to 10 things).” The activities data are grouped into nested levels. For example, the first level of grouping combines activities into precise categories (such as hiking, bird watching, and equestrian), while the final level combined all activities into two overarching groups (human-centered and nature-centered). The sunburst diagram was thus used to display this data in a hierarchical structure: each subsequent ring of the diagram represents a broader level of grouping (with the center ring being the final, most comprehensive level). Users can click on categories across each level to reshuffle the view of the diagram. Hovering over the diagram also displays the

percentage as well as the number of responses for each category. Figure 2 presents two views of the sunburst figure at different levels of specificity. These categories are not meant to be universal but rather to open a conversation about how to group and differentiate between different kinds of things that people report doing on trails.

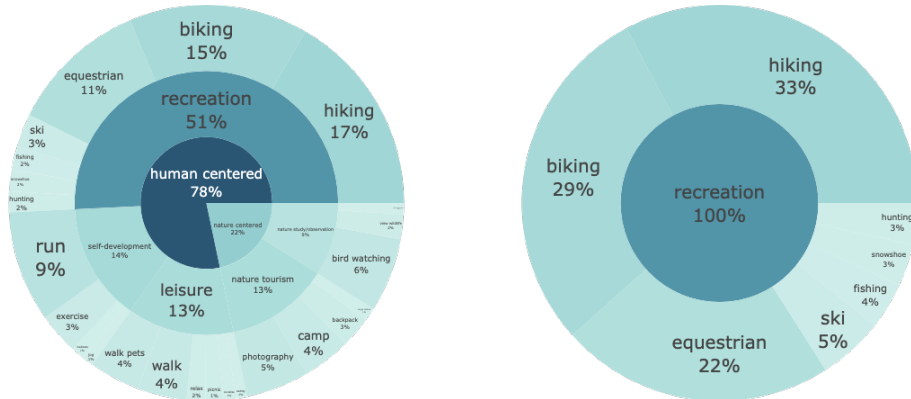


Fig. 2: Sunburst diagram of the distribution of survey responses to “things people do on trails.” The figure on the left displays the broadest level of the sunburst. The figure on the right shows a zoomed-in view of the sunburst.

Demographic factors: This component is an interactive chord diagram displaying two directions of relationships between trail activities and survey respondent demographics. This graphic simultaneously allows the user to explore both the demographics of all respondents who mentioned a particular activity, as well as all the types of activities named by individuals within a particular demographic group.

3 Discussion and Outlook

Trail spaces are an important lens for understanding human-environment interactions. Many trails are constructed in a way that renders them suitable for a wide variety of uses: whether travel, recreation, education, or an escape from society. While trail spaces attract visitors of all demographic groups, there is also considerable variation in how each of these groups engage with these spaces; this ensures that trail usage data is not only broadly applicable but also extremely useful for gaining deeper insights into the impact of demographic factors (i. e. race, class and age) on human-nature interaction. Thus, research on trails may involve analyzing data and drawing conclusions that will prove useful for future applications in digital landscape architecture extending beyond the scope of trail usage.

We recognize that this study has limitations, which provide a basis for informing future directions for this line of research. First, the lexicons and text analysis tools developed are not applicable across all texts referring to human-nature interactions. This is a pilot version of the lexicon, which will be expanded and improved through future validations and applications to new datasets. We plan to continue to update these tools as new development emerge.

The survey data used for creating the dashboard also has limitations, namely its exclusion of some demographic information. Other aspects of identity or demographic information could be of use to land managers and landscape architects who seek to expand trail and park accessibility. To better consider multiple demographic variables, studies into the perceptions of trail use will require an inclusive method to understand values associated with trails. An additional limitation for generalizability of the results is that the trails survey was sent primarily to outdoor groups and NGOs focused on trails and conservation. This means that individuals who are not part of these groups are less likely to have responded to the survey. As such, the results are not representative of individuals in the US as a whole, but rather should be interpreted as perceptions of people who are involved in trail use or maintenance, particularly through formal groups.

Finding new ways of analyzing and visualizing data is critical for the future of digital landscape architecture, conservation planning, and landscape design. This ability to capture and link demographic data to a variety of qualitative user experiences has important future implications in analyzing questions of inequality, access, exclusion, and safety as they relate to different user groups and identities such as race, class, sexuality, and gender. Furthermore, future directions for these research tools could further investigate different conceptions of stewardship, ownership, usage, access, and belonging in different kinds of public lands, as trails traverse a wide range of property regimes, from federal, state, county, municipal, private, and tribal lands. Here we explored the potential for creating open-source text analysis tools for trail and nature-based experiences and developed an interactive dashboard of survey results. Together, these digital tools offer platforms for engagement with text or other big data sets related to protected areas and trails.

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