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Public use of Outdoor Spaces as a Function of Landscape and Demographic Factors

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Abstract

Spending time outside is beneficial to individuals in many ways. Since landscapes may be manipulated through policy mechanisms, planners and other land stewards may desire to know how they can manipulate landscapes to encourage greater park use. Our study used a questionnaire to measure multiple dimensions of park usage by suburban and urban residents – including time spent outside and activities they engaged in while in parks. We then performed a factor analysis to see how these park related activities were related to landscape and demographic factors. Park visitation was demonstrated to be related to the density and length of roadways, how much vegetation cover an area had, and demographic variables including pet ownership. Knowing that these are related can guide planners and land stewards in management of parks based on their landscape and the features of the population they serve.

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Introduction

Spending time outside has been demonstrated to have a positive impact on individual mental, physical, psychological, and emotional well-being[1–5]. Furthermore, public parks have been shown to have a positive impact on community well-being as a whole, and the well-being of individuals within communities[4,6–9]. Evidence, however, also suggests that many public parks may be underutilized[10].

To understand public park use, several questions must be answered, such as; how often individuals visit the park, what types of parks they are visiting, and the activities they engage in while using the park. These questions can then be related to individual demographic characteristics that influence the amount, type, and location of use, as well as the landscape factors shaping these and individual park quality perception.

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Previous work has demonstrated that certain amenities may be more likely to draw people into parks[6,10–12]. Furthermore, park use may rely in part on park infrastructure and accessibility, which is related to the spatial distribution of parks[11,13–19]. Therefore, studying how people use parks, and the factors impacting this use is important to better manage parks. Additionally, the characteristics of the park uses are valuable for understanding who is making use of the space[7,10,13,16]. Previous work has established that dimensions of identity beyond environmentalism is an important factor of how individuals use outdoor public spaces[10,20–22]. The goal of this study was to determine what factors of landscape influence how individuals use parks, as well as the individual personal characteristics influencing park use.

Methods

Survey Instrument

As part of a larger research study, a survey instrument was developed and piloted over the spring and summer of 2016 and given to respondents in the fall of 2016. Qualtrics, a United States based research services company, was hired to collect responses – 290 responses were gathered. The selection criteria for inclusion were that respondents lived within the study area, and that they were at least 18 years of age.

There were approximately 65 items on the survey, though the exact number was not expected to be the same for all respondents, as responding "yes" to some items led to additional questions. The items used in the analysis described for this paper included demographic information, as well as questions about individuals' use of outdoor spaces. In particular, we focused on four questions about use of outdoor space. These four items were selected based on the fact that they were dimensions of behavior and attitudes that park managers may want to impact (i.e., frequency of park visitation, number of activities, where activities take place, and park quality rating). Additionally, preliminary correlation analysis of this dataset for the previously mentioned study [Two other papers by authors' currently in review 2018 and 2018] indicated that these items may be explicable based on the demographic variables in the dataset. These four primary variables of interest are listed in Table 1.

Table 1: Seven survey items for analysis

Item	Explanation
Activity Score	This variable indicates the number of activities, multiplied by the frequency a respondent reported to engaging in that activity. For each of the activities, respondents selected how many times they had done it in the previous year. Respondents selected in increments of 5 up 25, and then 26+. An answer of 1-5 was weighted as "1", 6-10 as "2", etc., with a maximum possible score of 144 (6 * 24 activities).
Park Quality	How would you rate the quality of parks in your area? Possible answers: 1. Excellent; 2. Good; 3. Average; 4. Poor; 5. Terrible
Park Visitation	In the last month, how often have you visited local parks for fun, pleasure, or recreation? Possible Answers: Never, then 5 step increments (1-5, 6-10, etc.) up to 25, and then "More than 25 times".
Number of outdoor places	Respondents were asked: When you go spend time outside, where do typically spend it?(check all that apply). They could select 0-7 of the following, and this represents the count of places that they selected. Possible answers: Outside my home; Outside someone else's home; On jogging, hiking or running trails; On/along sidewalks; On cycling trails; In public parks, fields, or other facilities; In/On waterways such as rivers, ponds, lakes, oceans; Other

Eleven demographic variables of interest were also used in this analysis: pet ownership (0/1 binary); number of pets; age; educational attainment; perceived socioeconomic status (affluent, comfortable, stable, or struggling); whether they like living in an urban, suburban or rural setting (1=urban,

2=suburban, 3=rural); Latinx (0/1 binary); gender (female/male/other); income; race; political beliefs.

All surveying was carried out in compliance with the Rutgers Institutional Review Board [#15-678], and all investigators underwent Collaborative Institutional Training Initiative (CITI) Human Subjects Training prior to the investigation.

Municipal-Level Data

The land cover and land use data in this analysis came from the New Jersey Department of Environmental Protection (NJ DEP)[23], and additional information on specific location data for parks were obtained from the Grant F. Walton Center for Remote Sensing and Spatial Analysis (CRSSA)[24]. The land cover data uses an adapted version of the Anderson Classification System[25]. This classification system or variants thereof are often used in public datasets such that they may be compared uniformly. The Anderson System is hierarchical in that there are several levels of classification from broad to narrow[23]. These were further collapsed into even broader categories for the purposes of analysis. This included collapsing all residential land cover into a category, all forest cover into one category, all water types into a single category, and a category of scrub and shrub land into a category. The reason for this was to categorize landscape into classes as it would be experienced by park users. Most members of the public may not think of an area as being "deciduous dominant mixed forest with greater than 50% crown closure[23]", for example, but would be more likely to classify this and other forested areas as simply forests. The variables included in this analysis were: percent residential areas; percent water; percent barren land; percent forest; percent other vegetation; number of parcels; total road length; and road density.

All spatial and remote sensing analyses were done using ArcMap version 10. Most of the land cover data used as variables for analysis are relatively straight forward, such as the percentage of different land use types within municipal boundaries. The land cover variables were chosen as the amount of residential areas, and the amount of forest and other vegetative cover were seen as potential motivating factors for park usage – as was access to water features. Barren land may serve as a potential barrier for park use, and studies often cite it as having little to no ecological value[26]. The road length and density measures were used as proxy measures of a form of accessibility. The road density used in this study was obtained by calculating the total road length within a municipality and then dividing it by the area of that municipality. The number of parcels was used as a way of gauging the approximate residential density of a given area. Two of the variables, municipal population and population density, came from the U.S. Census Bureau's 2010 census[27].

Analysis

All analysis was performed using SAS version 9.4. Factor analysis was chosen as it is a useful method to analyze the underlying patterns of variables that are not immediately observable in the dataset[28,29]. Exploratory factor analyses showed that demographic and landscape variables did not load exclusively on separate factors. We then performed a less restricted factor analysis that allowed for combinations across these variables such that an underlying factor could incorporate both individual demographic features and municipality-wide landscape characteristics.

We also did not assume that this underlying structure would be the same across all four of the outside use items of interest (found in Table 1). The number of activities a participant engages in, and park quality rating may have some similarity, but these items also have fundamental differences.

Our goal was to determine which of the four outside items could be adequately explained by what subset of explanatory variables, and how those explanatory variables interacted within the latent factor structure. To do this, we used the Factor procedure using these variables, and retained the ten highest-loading explanatory factors. For frequency of park visitation and number of places that respondents spent time outside, the tenth (and ninth on number of places) highest-loading variables were markedly lower in these models. Thus, we dropped them, and re-ran the factor analysis with nine explanatory variables (park visitation frequency) and eight variables (number of places respondents spend time outside).

Results

Park Visitation

Park visitation had the highest Kaiser's Measure of Sampling Adequacy (MSA) of any of the four outdoor items, 0.61, furthermore, the total explained variance for two factors is 101%. While this indicates that some of the variance explained in this is not unique variance, the fact that it is only slightly over 100% means that only a minute portion is not unique variance. This is the best fit for factor analysis of any of the four outside items analyzed in this study. These loadings are presented in Table 2.

Table 2: Park visitation factor loadings

	Factor1	Factor2
Road Density (meters/hectare)	0.88905	0.13709
Road Length (meters)	0.86026	0.16833
Pet Ownership	0.1239	-0.11457
Race (Coded as White "0", Non-White "1"; all municipalities white-majority)	-0.00327	0.07704
Urban, Suburban, or Rural Preferences	-0.13174	0.11141
Educational Attainment	-0.1535	0.47075
Perceived Socioeconomic Status	-0.17778	0.4916
Income	-0.18143	0.52537
Percentage Other Vegetation	-0.54382	-0.03202

The two most highly-loaded explanatory variables on factor one are road density and total road length. This indicates that as both of these (and pet ownership) increase, respondents were more likely to visit local parks more often. Conversely, percentage of other vegetation, income, perceived socioeconomic status, educational attainment, urban-rural preference, and race were all negative. This indicates that areas with more other vegetation; higher income; socio-economic status; educational attainment; more rural preference; and non-white population were likely to visit parks less often. Three of these nine explanatory variables are landscape variables, with the remaining six being individual-level variables. Given that this is the best fit, the factor loadings are represented graphically in Figure 1.

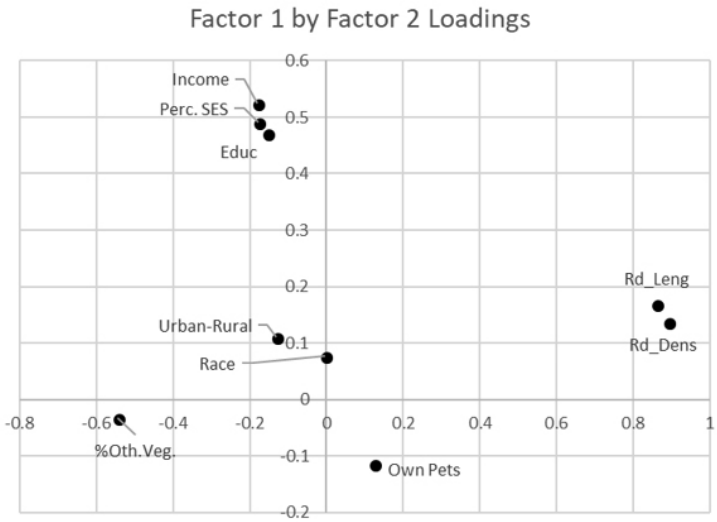

Fig. 1: Factor loadings for park visitation

Total road length and roadway density act similarly on factors one and two, indicating that as both of these increase, park visitation is likely to increase. There also appears to be a cluster around income, perceived socio-economic status, and educational attainment. The remaining four variables do not appear to cluster together for the most part. Urban-rural preference and race are somewhat close to each other indicating that these may have a similar impact on park visitation.

Other Outside Items

On the other three items of interest, Kaiser's MSA was low, and the amount of variance explained was well over 100%. This indicates that much of the variance explained was not unique, and that the amount and/or level of sampling was likely not adequate. Some of the explanatory variables did, in fact, appear multiple times. Table 3 summarizes the factor analyses of these three items.

Table 3: Other Outside item factor analyses summary

Outside Item	Kaiser's MSA	# Factors	Variance Explained
Activity Score	0.47	3	117%
Number of Places	0.48	2	116%
Park Quality	0.54	3	103

There was some overlap in the variables used in these three analyses. Table 4 summarizes which explanatory variables were used in each of the four analyses.

Table 4: Explanatory Variables used for all four outside items of interest

	Park Visitation	Activity Score	Park Quality	Number of Places
# Pets		X		X
Age		X		X
Educ	X	X		
Gender			X	
Income	X			X
Latinx		X		
Own Pets	X	X	X	X
Perc. SES	X	X	X	
Politic				X
Race	X			
Urban-Rural	X	X	X	
# Parcels			X	
% Barren			X	X
% Rec				X
% Res		X		
% Water			X	
%Forest			X	
%Oth. Veg.	X		X	
Pop_Dens		X	X	
Population		X		X
Rd_Dens	X			
Rd_Leng	X			

Discussion

Across the four sets of outdoor behavior, it does not appear that these demographic and landscape variables can be neatly sorted into two factors based on the extent to which that they may influence respondents' use of outside places. However, the individual explanatory variables were used across more of the models.

The only variable to show up in all four factor analyses is pet ownership. Based on this, pet ownership has a large influence on how people use outdoor recreation spaces. Pet owners go to parks more often, go to a greater number of different outdoor places, and engage in more activities, supporting findings of earlier studies[10,12]. Pet owners are also more likely to rate parks as being of worse quality. Therefore, this may represent a gap in terms of amenities available to pet owners in public parks. Dog owners, for example, may have a daily or more frequent need to visit local parks, and may be primarily using the closest park for this purpose. Conversely, other park users may be utilizing their parks for other reasons, and be more selective of which parks they visit, and thus avoid parks that may be nearby, that they perceive to be of lower quality. It may also be the case that pet owners may pay closer attention to aspects of the landscape that others have fewer reasons to notice grass: height in areas where dogs might walk for example, or availability of rubbish bins for pet waste.

Perceived socio-economic status and urban-rural preference are factors in three of these four analyses. In the one model where perceived SES and income co-occur, they load similarly - in that as people earn more money and perceive themselves to be wealthier, they visit local parks less often. Prior work in this field has indicated that in highly urbanized areas, parks may be more accessible to wealthier people, whereas increased wealth in suburban areas may mean owning property large enough to engage in some level recreation instead of going to a park[6–10,13,30–32]. Therefore, the effect of wealth on park visitation overall may not be uniform across the study area in terms of implications for lot size or proximity to parks, and hence, not uniform in its influence over park visitation. As respondents' preference for more rural areas increased, they were found to have lower activity scores, and go to parks less often, but also rate their parks to be of higher quality; this may indicate that on the rare occasions these individuals go to parks that they select parks that they perceive to be of high quality.

Other vegetation was the only land cover type to show up in the analysis for park visitation. The land cover classes for "other vegetation" were scrub and brushlands, and scrub and brush dominated wetlands. This designation was meant to indicate that these were areas a resident would recognize as being vegetated, but not think of as forested. The designation of land cover categories into "other vegetation" was made by the authors in consultation with other researchers, and included those classes of land cover which included vegetation, but were not designated as forests, agricultural land, plantations, or old fields. Areas with increased other vegetation had higher park quality ratings, but less frequent visitation. Some studies have observed that perception of color may impact individual feelings about an area[33–36]. Perhaps, these added green areas boost perception of quality in parks, even though they are not forested – especially if other types of non-forested land in some urban or suburban areas appears to be barren, or empty lots.

Respondents in areas with increased other vegetation were less likely to visit parks as often, which may indicate that they serve as some sort of barrier to park utilization. The fact that forested areas, residential areas, recreational areas, and water played a role in only one model each may indicate that these do not have as broad importance in public use of outdoor space as we had hypothesized. Percentage of recreational land led to an increase in the number of places people went outside, which may indicate that more recreational land generally is related to more varied recreational opportunities. Likewise, as percentage of forest land increased, park quality ratings improved. Trees and forests have been tied to greater property values[37], and so respondents likely view forests as a positive in their parks favorably. Since park quality ratings increased with both forest cover and other vegetation cover, it is possible that respondents are not perceiving a difference between these, or, that simply having any vegetation is related to increased park quality

ratings. The latter[34,35] would be in line with literature on how seeing green relates to mood and landscape perceptions.

Municipal population and population density loaded on two models each. Both were used in the factor analysis for activity score and indicated that persons in areas with higher populations had a higher activity score, but that activity score decreased as density increased. Perhaps this indicates that some threshold of other people may be required to partake in some activities team sports for example but that too densely populated areas do not provide sufficient outdoor green spaces. Population loaded positively on number of outdoor places, indicating that as population increased, respondents were more likely to utilize a greater range of outdoor recreation spaces. Population density loaded on park quality rating, indicating that as density increased, park quality was rated lower. Thus, perhaps outdoor amenities were being over-utilized in densely populated areas, or there was a link to densely populated areas having tighter budgets when it comes to green space maintenance. Future studies could test this by comparing municipal park budgets on a per capita basis, perhaps with adjustments for park size and amenities. Additional information would also be needed in regard to whether areas with higher population density have, in fact, higher rates of park visitation and utilization.

The most meaningful model among these four items is the factor analysis of park visitation. Public land managers may have a strong interest in increasing park visitation, and thus these results could be applied to this line of work. It would appear that areas with more and a greater density of roadways lead to increased park visitation. Therefore, managers may want to look closely at how residents can get to parks, by what method, and establish adequate entry points and signage leading to public parks. Perceived SES, education, and income all load negatively on the first factor, and positively on the second factor to a much greater magnitude. They cluster closely together on both factors, which indicates that they have a similar effect. It is likely not straightforward. These three demographic trends often co-vary within populations[27,38–40], so, while it is unsurprising that they have similar effects, it is notable that in this context it seemed to be a combination of both socio-economic status and education and not one or the other.

Understanding the dynamics of what precise income level of people may utilize a park, and what they use it for may be useful in increasing park usage. As mentioned above, wealthier individuals may mostly recreate around their own homes, and perhaps public parks do more to serve the needs of middle- and working-class persons living in apartments or on smaller plots of land. As other vegetation increased park visitation also dropped off. In terms of managing a landscape this may indicate an opportunity to use these areas more effectively for recreation, or to place informational signage and use them for educational opportunities. Additionally, conscientious management of these areas or restoration may increase effective use of these areas. Some types of vegetation might be threatening if it is not adequately maintained. Therefore, in these areas, key management practices may include keeping walkways clear and accessible such as the boardwalks sometimes found in wetland areas and providing sufficient signage.

In summation, this study suggests that people use outdoor spaces as a function of both their individual characteristics, and of certain landscape features. Pet ownership appears to be a very important piece of how people use parks, as do perceived SES, and individual landscape preference. Management of scrub and brush areas should be a priority, as well as work on making parks more accessible to visit or use, and amenities within parks more accessible. Moving forward, additional research at the park level to isolate specific functions of different parks may be useful, and broader surveys asking individuals to compare features of different parks that they find attractive would also prove to be informative and useful in management and policy formulation. Parks and public green spaces are important environmental resources in both human and natural systems health, and thus environmental management of parks that promotes human and environmental health can result in more sustainable and livable landscapes.

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