Article

Urban Analytics and City Science

Environment and Planning B: Urban Analytics and City Science
2018, Vol. 45(2) 275–294

DOI: 10.1177/0265813516672212
journals.sagepub.com/home/epb
SAGE

A QUality INdex of Parks for Youth (QUINPY): Evaluating urban parks through geographic information systems

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Abstract

Visiting urban parks regularly can provide significant physical and mental health benefits for children and teenagers, but these benefits are tempered by park quality, amenities, maintenance, and safety. Therefore, planning and public health scholars have developed instruments to measure park quality, but most of these tools require costly and time-consuming field surveys and only a handful focus specifically on youth. We rectify these issues by developing the QUality INdex of Parks for Youth (QUINPY) based on a robust literature review of studies on young people's park visitation habits and an extensive validation process by academic and professional experts. Importantly, the QUINPY relies on publicly available geospatial data to measure park quality. We then successfully pilot test the QUINPY in Denver and New York City. We believe that park agencies, planning consultants, researchers, and nonprofits aiming to assess park quality will find this tool useful. The QUINPY is particularly promising given the increasing amount of publicly available geospatial data and other recent advancements in geospatial science.

Keywords

Urban parks, evaluation tool, park quality, young people, geographic information systems

Introduction

Research in various contexts has shown that visiting urban parks on a regular basis provides numerous benefits for children's and teenagers' well-being, particularly in terms of physical health, mental health, and personal development (Blanck et al., 2012; Chawla, 2015; McCurdy et al., 2010). Regarding physical health, nearby parks can foster young people's

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physical activity and contribute to lower obesity rates among youth (Christian et al., 2015; Cohen et al., 2014; Wolch et al., 2011). City parks can also provide people living in dense urban environments with natural elements, such as trees, lawns, water bodies, and natural landscapes (Chiesura, 2004), and such contact with nature can be valuable for young people's mental health and overall well-being, including lower stress levels, improved concentration, and longer attention spans (Bratman et al., 2012; McCurdy et al., 2010; Wells, 2014). Free play in nature can be particularly beneficial for cognitive and physical development (Christian et al., 2015).

But not all parks are created equal, and park quality often varies directly and significantly with park use, especially when it comes to attracting young people (Loukaitou-Sideris and Sideris, 2009; McCormack et al., 2010). Factors related to a park's condition, security features, and amenities can significantly shape how a park is used and by whom (Baek et al., 2015; McCormack et al., 2010). Therefore, park quality matters for environmental justice-related efforts that aim to understand whether the demographic groups who need parks the most such as low-income people, persons of color, elderly populations, and youth, are appropriately served (Boone et al., 2009). And although many studies focus on the former groups, very few examine what it takes to make parks more inclusive of young people, a particularly difficult group to attract to parks on a sustained basis and a traditionally underserved group when it comes to planning decisions (Loukaitou-Sideris and Sideris, 2009).

In this paper, we address three interrelated aspects connected to park quality. First, park and recreation agencies are increasingly collecting data to inform decision-making for capital improvement investments in parks (National Recreation and Park Association, 2016). With documented socioeconomic and ethnic inequities in access to high-quality parks in the U.S. and elsewhere (Rigolon, 2016; Wolch et al., 2014), park agencies need practical instruments to guide investment addressing local park quality issues. Second, tools that can generate accessible, "democratized" data on park quality are not available. For example, nonprofits and park advocacy groups without adequate technical skills in geographic information systems (GIS) could not generate evidence of inequities in park quality with the available tools (e.g. ParkScore; The Trust for Public Land, 2016). Third, although instruments to measure park quality have been developed, our analysis shows that these suffer from important limitations related to scope, usability, age focus, and cultural focus.

We address these challenges in this paper by developing, validating, and pilot testing a simple and reliable QUality INdex of Parks for Youth (QUINPY) that relies on publicly available, secondary data and includes variables proven to attract sustained park use by young people. We use youth, or young people, as an encompassing term describing individuals aged 2–18, including toddlers, children, tweens, and adolescents. We focus on this broad range to create a widely applicable index that represents park quality as park inclusiveness, with the idea that great parks should be able to support multiple age groups (see below). Also, our index focuses on urban parks, which we define as publicly owned green spaces for active and passive use managed by park and recreation agencies.

Previous park quality instruments

Given this backdrop, public health and planning scholars have worked in earnest to develop useful instruments to evaluate urban park quality (Edwards et al., 2013; Gidlow et al., 2012; Kaczynski et al., 2012). In particular, our initial review found 11 instruments that measure urban park quality by assessing park amenities, condition, maintenance, safety, or other characteristics (see Table 1). All were developed in "Western" contexts such as the

Table 1. Summary of instruments measuring park or public open space quality.

Authors	Tool and focus	# Items	Categories	Usability	Age group
Broomhall et al. (2004)	POST—Assess public open space, namely the features that foster or limit physical activity	42	Activities, environmental quality, amenities, safety	Field raters—no estimated time per public open space	All ages
Cavnar et al. (2004)	RFET—Evaluate recreation facility quality	61	Condition, maintenance, and safety	Field raters—20 min per park	All ages
Byrne et al. (2005)	SAGE—Assess the features of green spaces in Los Angeles	96	Facilities and services, landscape features, condition, safety	Web-based information + Field raters with tech devices—no estimated time	All ages
Lee et al. (2005)	PARA—Describe the features of physical activity resources, including parks	49	Features, incivilities, size, cost, signage, amenities	Field raters—10 min for small park, 30 min for large park	All ages
Bedimo-Rung et al. (2006)	BRAT-DO—Assess the features of parks, focus on physical activity	181	Features, condition, access, esthetics, safety	Field raters—no estimated time	All ages—but includes some youth-specific features
Saelens et al. (2006)	EAPRS—Evaluate public recreation areas for their physical activity potential	646	Trails, water, access, esthetics, comfort, information, educational, safety, seating, play areas, sport facilities	Field raters—no estimated time	All ages—but includes a partial focus on play spaces (youth)

(continued)

Table 1. Continued.

Authors	Tool and focus	# Items	Categories	Usability	Age group
Green Flag Award Scheme (2008)	PGSSAG—Evaluate the quality of green spaces and parks	27	Welcoming, health/safety, maintenance, cleanliness, environmental sustainability, conservation, community, marketing, management	Field raters—no estimated time	All ages
Gidlow et al. (2012)	NGST—Assess the quality of neighborhood parks through an easy-to-use tool	36	Accessibility, recreational facilities, amenities, natural features, incivilities	Field raters—around 11 min per park (but parks are small)	All ages
Kaczynski et al. (2012)	CPAT—Assess parks for their physical activity potential	140	Park info, access and surrounding neighborhood, park activity areas, and park quality and safety	Field raters—32 min per park	Youth oriented, but not exclusively
Edwards et al. (2013)	POSDAT—Evaluate the features of public open space	44	Activities, environmental quality, dogs, amenities, and safety	Web data + remote sensing—reduced time by 22%	All ages
Bird et al. (2015)	PARK—Evaluate park features, with a focus on youth	92	Activities, environmental quality, services, safety, and general impression	Field raters—no estimated time	Youth oriented

U.S., U.K., and Australia, which potentially introduces concerns about the replicability of these—and our own index—in non-Western contexts, an issue we discuss below. Although some of these instruments have been successfully deployed in park audits, they also contain a number of aforementioned gaps, which we outline below.

Scope gap

Most of these instruments were developed by public health scholars, typically focusing on parks' potential to promote physical activity (e.g. Bedimo-Rung et al., 2006; Kaczynski et al., 2012). Although childhood obesity is a major concern, park quality assessments should capture park features related to both active and passive recreation. We address the scope gap by bringing together the physical activity literature on park use and the environmental psychology literature on young people's outdoor play and park experience (e.g. Gearin and Kahle, 2006; Kaczynski et al., 2011; Loukaitou-Sideris, 2003; Timperio et al., 2008).

Usability gap

All but one instrument depend on direct site observations of parks to assign quality scores. As most audit instruments necessitate on average 20–30 min per park, especially in medium and large cities with hundreds of parks, relying on field raters requires significant time and funding. The only tool not based on site audits relies on Google Earth aerial photos and other web data (Edwards et al., 2013). However, no instruments measure urban park quality through geospatial data describing park attributes, or through similar data that can be easily geo-referenced. In contrast, the QUINPY relies on data about parks that agencies such as park and recreation departments regularly collect and make public on the web. These include GIS shapefiles, geodatabases, and spreadsheets that can be joined to geospatial data through unique identifiers, addresses, or geographic coordinates. Thus, our instrument does not require data collection in the field. For cities in which some data are not available, additional information can be digitized through aerial photos (see Edwards et al., 2013; Taylor et al., 2011).

Age focus gap

Most existing instruments do not focus on specific age groups and only two explicitly center on young people, although neither was developed or assessed in partnership with young people themselves (Bird et al., 2015; Kaczynski et al., 2012). In response, the QUINPY focuses specifically on youth by including their views of parks through an in-depth literature review of studies that engaged young people in research activities and a validation process involving experts in planning parks for youth. Our tool can be used in cities that aim to increase young people's use of parks, perhaps because of significant obesity and mental health issues.

Cultural focus gap

Only one park quality instrument explicitly includes elements that describe cultural and ethnic differences in recreation (Kaczynski et al., 2012). Acknowledging cultural differences in park preferences is important, particularly since most park design in the United States tends to adhere to White European esthetic standards and visions of recreation (Byrne and Wolch, 2009). To address this gap, we oversampled literature that focuses specifically on ethnic minority and low-income young people's use of parks and park perceptions (e.g. Gearin and Kahle, 2006; Loukaitou-Sideris and Sideris, 2009). Also, our index was validated by a diverse group of experts in park planning, including several individuals from underrepresented backgrounds themselves.

In summary, the QUINPY can advance research and practice on park quality by expanding existing tools' scope, usability, age focus, and cultural focus. In addition, the QUINPY addresses an area of significant need for practitioners, academics, and nonprofits who aim to measure park quality, allowing them to quickly and accurately generate comprehensive quality information using secondary geospatial data. Our tool is particularly advantageous thanks to the increasing amount of open GIS data and other recent developments in geospatial science.

Development and validation of the QUINPY

To develop and validate the QUINPY, we first conducted an analytical literature review of studies on young people's park visitation and outdoor play, and created an initial index based on available GIS data in Denver, Colorado, USA. We chose a literature review of young people's park visitation to include elements that describe their perspectives, experiences, and behaviors in parks in several geographical contexts and to include diverse views of recreation based on ethnicity and social class. Second, we asked known experts in the field to assess the validity of our tool by ranking six Denver parks (see "Expert validation" section). This process confirmed the validity of the instrument and provided insights on the applicability of the QUINPY.

Review of features attracting youth to parks

To gather literature on young people's outdoor play and park visitation, we searched several full-text academic databases for social science disciplines (Web of Science, Science Direct, Jstor, and EBSCOhost) with the following expression: ("child" OR "teenager" OR "young people" OR "youth") AND ("outdoor play" OR "parks" OR "playground" OR "green space" OR "public open space" OR "schoolyard" OR "school ground" OR "play yard"). Using these keywords, we sought out literature that uncovered park features that attract children and teenagers to urban parks as well as green space features that young people prefer, both of which can lead to longer park visits and higher physical activity levels (McCormack et al., 2010).

The search yielded 62 scholarly entries (including journal articles, books, book chapters, reports, and doctoral dissertations); we found 18 additional entries matching our criteria in these articles' reference sections, bringing the final sample to 80 works published variously in the fields of public health, urban design, landscape architecture, planning, environmental psychology, and geography (see online Appendix A). To analyze these, we coded the geographic location of the study, the article's focus (park visitation, green space perceptions, and behaviors in green space), methods, emphasis on ethnic/class/gender differences, and findings. The majority focused on geographic locations in the U.S. (37 entries), followed by northern Europe (24 entries), the U.K. (nine entries), Canada (eight entries), and Australia (eight entries), with some studies covering more than one country. Although many centered on parks and playgrounds, we also reviewed studies on schoolyards (see online Appendix A), as these can include features such as natural areas, sport fields, and play equipment also found in urban parks. Also, research on use of schoolyards show they are often utilized just like urban parks after school hours (e.g. Colabianchi et al., 2011).

Our review showed that park features that tend to matter most for young people's park visitation can be categorized into five main themes: Structured play diversity (44%), nature (28%), park size (9%), park maintenance (10%), and park safety (9%). The reported percentages describe how many articles of the 80 explicitly considered this theme; this percentage justified our initial weighting of the five themes in the resulting index.

Structured play diversity describes the presence of playgrounds, sport facilities, and supporting amenities. Play diversity matters because preferences vary by age, gender, and ethnicity and because multiple play choices help keep a prolonged interest in a park (Czalczynska-Podolska, 2014; Loukaitou-Sideris and Sideris, 2009; McCormack et al., 2010; Moore and Cosco, 2007).

Nature describes the fact that many urban parks provide significant shade-producing tree canopy, water features, vegetation, sand, rocks, and other natural materials affording exploratory play and in which young people can "prospect and seek refuge" (Appleton, 1975). Much research on the subject shows that children appreciate natural elements as play features (e.g. Czalczynska-Podolska, 2014; Dyment et al., 2009; Fjørtoft, 2001; Loukaitou-Sideris, 2003; McCormack et al., 2010).

Park size matters: larger parks are, in general, more frequently used by young people than smaller parks, particularly in low-income, minority–majority, inner-city neighborhoods (Castonguay and Jutras, 2009; Loukaitou-Sideris and Sideris, 2009; Slater et al., 2013). Large parks can provide teenagers with opportunities to avoid any gangs present in parks, while in pocket parks encountering gangs is more likely (Slater et al., 2013).

Park maintenance and *park safety* significantly affect young people's park visitation, with gang violence, physical hazards, run-down facilities, and lack of cleanliness deterring use, particularly in low-income communities of color (Gearin and Kahle, 2006; Loukaitou-Sideris and Sideris, 2009; McCormack et al., 2010; Ries et al., 2008).

Based on the review, we developed a list of park features for each theme and used geospatial datasets made available by the City and County of Denver (2016) to operationalize a first version of the QUINPY.

The QUINPY

The resulting index includes 18 variables grouped into five key themes: *structured play diversity*, *nature*, *park size*, *maintenance*, and *safety* (see Table 2). The total possible score for the QUINPY is 32 points, including 14 points for *structured play diversity*, 9 points for *nature*, and 3 points each for *park size*, *maintenance*, and *safety*. The relative weights of the five categories derive from the literature review (see below). The variables presented in Table 2 were operationalized based on geospatial and web data available for Denver and New York City. Similar data are available for many other large and medium-sized cities in the U.S. (see "Pilot testing the QUINPY" section below).

Some characteristics of the QUINPY deserve further discussion. First, the five categories included in the QUINPY, and their relative weights, derive from our analytical literature review. We counted how often park features positively and negatively related to park use appeared in our 80-paper sample. We then regrouped park features in the five emerging categories and summed up the number of counts for features within each category. The importance of *structured play diversity* (44% of the QUINPY score) reflects the literature's emphasis on park inclusiveness, representing park characteristic that can support frequent park visitation for young people of different gender, age, ethnicity, and physical ability (Moore and Cosco, 2007). Park inclusiveness also highlights high-quality park features

Table 2. A QUality INdex of Parks for Youth (QUINPY).

Categories	Variables	Score
Structured play diversity	Playground number	0: no playground 1: 1 playground 2: 2 or more playgrounds
	Playground surface	0: below median playground surface for parks in city 1: above median playground surface for parks in city
	Sport fields (soccer, baseball, football, rugby, and lacrosse)	0: no sport field 1: sport field of one type 2: sport field of two or more types
	Sport courts (basketball, tennis, skateboard, and handball)	0: no sport court 1: sport court of one type 2: sport courts of two or more types
	Walking/bike paths and hiking/horseback trail	0: no paths or hiking trails 1: paths or hiking trails are included
	Public swimming pool	0: no swimming pool 1: a swimming pool is included
	Supporting facilities (picnic areas, benches, barbeque areas, and bathrooms/water fountain)	0: no picnic area/BBQ/benches or bathroom/water fountain 1: picnic area/BBQ/benches or bathroom/water fountain 2: picnic area/BBQ/benches and bathroom/water fountain
	Organized sport activities (after school programs or rec centers)	0: no organized sport activities 1: organized sport activities
Nature	Water as a visual amenity (lakes, streams, fountains, or beach)	
	Access to water for recreation (possibility to access water to swim, canoe, or kayak)	
	Tree canopy: Tree coverage in relation to park acreage	0: no water as a visual amenity 1: water as a visual amenity is included
	Vegetation/shading around behavior settings: tree cover enclose settings for more than 50% of perimeter	0: no access to water for recreation 1: access to water for recreation is included (large lake, beach, etc.)
	Natural areas, nature preserves, or nature centers	0: no natural areas/preserves/centers 1: natural areas/preserve centers are included

(continued)

Table 2. Continued.

Categories	Variables	Score
	Community gardens	0: no gardens
		1: gardens
	Distant views (from waterfront or hills)	0: no distant views
		1: distant views
Park size	Park acreage	0: park acreage in the lower quartile in the city
		1: park acreage in the middle-lower quartile in the city
		2: park acreage in the middle-upper quartile in the city
		3: park acreage in the upper quartile in the city
Maintenance	Park maintenance standards	0: Lowest maintenance level (e.g. natural areas)
		1: Mid-low maintenance level
		2: Mid-high maintenance level
		3: Highest maintenance level (e.g. metropolitan park with public-private partnerships)
Safety	Violent crime density (total number of violent crimes in park and in 100-yard buffer around a park divided by the combined surfaces of the park and of its 100-yard buffer)	0: violent crime density in the higher quartile for parks in the city
		1: violent crime density in the mid-higher quartile for parks in the city
		2: violent crime density in the mid-lower quartile for parks in the city
		3: violent crime density in the lower quartile for parks in the city

regardless of the needs of individuals from different neighborhoods or with different demographic or socioeconomic status.[1]

Second, on the surface the index favors large parks given their known ability to attract youth (see above). Yet although park size matters, the QUINPY does not overly bias large parks. For example, the park acreage variable accounts for 9% of the total index, which aligns with the results of our literature review. Thus, the smallest park in a city would only receive a maximum of three fewer points for the size variable than the largest park in that city. Other variables in the QUINPY do not excessively favor large parks, as different types of sport fields or courts are valued over their total number (which would likely be higher in larger parks), and parameters such as the tree canopy variable are calculated as a ratio between tree coverage and park acreage (see Table 2).

Third, as the primary goal of the QUINPY is to assess park quality variations *within* a public agency's park system (city or county), the index produces rankings representing *relative* quality. Since most index variables are thus calculated based on quartiles or terciles of absolute values (see Table 2), overall ''scores'' do not represent absolute quality values. Instead, QUINPY rankings can be useful to guide investment for park reprogramming or park patrolling, or to understand which demographic groups within a city or county have access to higher quality parks. Researchers and practitioners aiming to compare parks in two or more cities could create a pool with all parks from the selected cities; then, they could calculate variables related to tree coverage, park size, and park safety for the whole pool, based on terciles and quartiles.

Fourth, we operationalize the park maintenance variable through maintenance standards developed by individual park agencies. Public park agencies in the United States and elsewhere have different guidelines for park maintenance, which reflect different levels of spending. For example, Denver's standards range from low-maintenance levels like natural areas to high-maintenance levels that apply to heavily used regional parks (City and County of Denver, 2016). To apply the QUINPY in other contexts, researchers, practitioners and nonprofits can use locally available park maintenance data to develop four levels of park maintenance through quartiles. This approach is in line with the QUINPY's focus on parks' relative rankings within a park agency.

Expert validation

To validate the QUINPY, we reached out to 33 diverse scholars and practitioners with expertise in planning, urban design, and landscape architecture, many with a particular emphasis in park planning for youth. Twenty accepted our offer to participate to the validation process; this sample includes significant variations in terms of country of origin (U.S., Australia, Denmark, Sweden, and Ethiopia), gender, age, and ethnic background, thus providing diverse perspectives on park quality. We chose to engage experts instead of young people because we highly valued the diverse insights provided by scholars and professionals living in different countries, while reaching out to youth from various geographical contexts would have been logistically complex and could have introduced self-selection bias.

We asked these experts to rank six Denver parks (see Table 3) based on how well they believed the parks *should* promote repeated and prolonged park visitation among children and teenagers of different age, gender, ethnic/racial background, and physical ability, regardless of any explicit recognition of the parks' surrounding context and population. We selected the six parks using a stratified random sampling approach based on their QUINPY scores. We provided each expert with a PDF file including the parks' names,

Table 3. Results of the expert validation process.

Park name	QUINPY score	QUINPY rankings	Experts' median rankings	Experts' mean rankings
City Park	26	1	1	1.4
Ruby Hill Park	21	2	2	2.45
Crestmoor Park	16	3	3	2.8
Montclair Park	11	4	4	3.75
George Morrison Sr. Park	6	5	5	4.95
Community Plaza Park	4	6	6	5.25

addresses, maps, amenities, and links to detailed plans and Google Street Views. We encouraged experts to use the information we provided and any other additional source, including web searches.

The 20 experts returned rankings, conducted without using the QUINPY, which they were not provided, of the six parks ordered based on their relative quality. We then aggregated the rankings of the 20 experts and compared these to our own ranking calculated using the QUINPY. Table 3 shows the results of the expert validation process, with the experts' median rankings exactly reflecting the median rankings using the QUINPY. Table 3 also includes the experts' mean rankings for illustrative purposes; although we recognize the inappropriateness of considering the means of ordinal data, these mean values show how closely the QUINPY-derived rankings matched the experts.

Pilot testing the QUINPY

After operationalizing the QUINPY based on Denver's geospatial data, we checked whether other important U.S. cities had similar available datasets. We searched public GIS databases of the five largest U.S. cities (New York City, Los Angeles, Chicago, Houston, and Philadelphia) and five medium-sized cities relatively comparable in size to Denver (Portland, Seattle, San Francisco, Boston, and Washington DC). The search showed that, among these 10 cities, three have all the necessary data for the QUINPY (New York City, Chicago, and Washington DC); four have data that, through geocoding and other data processing, would allow the use of the QUINPY (Los Angeles, Philadelphia, Portland, and Seattle); and three do not have sufficient open data to employ the QUINPY (Houston, San Francisco, and Boston). Although the last three cities do not have public data on some park features (e.g. playgrounds, sport facilities, vegetation, etc.), they are likely to own these data and keep them for city use only; indeed, more and more park and recreation agencies in the U.S. are regularly collecting data on their facilities. To develop a national database on public parks, the National Recreation and Park Association (NRPA, 2016) created a tool called PRORAGIS, through which park agencies can upload data about their park systems. With more cities and counties uploading their data to PRORAGIS, it is likely that the QUINPY will be applicable to an increasing number of locations in the U.S.

We then pilot tested the QUINPY in two U.S. cities: Denver and New York City, collecting geospatial and web data from their open access datasets (City and County of Denver, 2016; City of New York, n.d.). Pilot testing took approximately two weeks, including collecting data, data processing, and GIS work to operationalize the 18 variables included in Table 2 for the two cities. For example, the variable describing the vegetation around behavior settings was calculated through GIS data describing tree

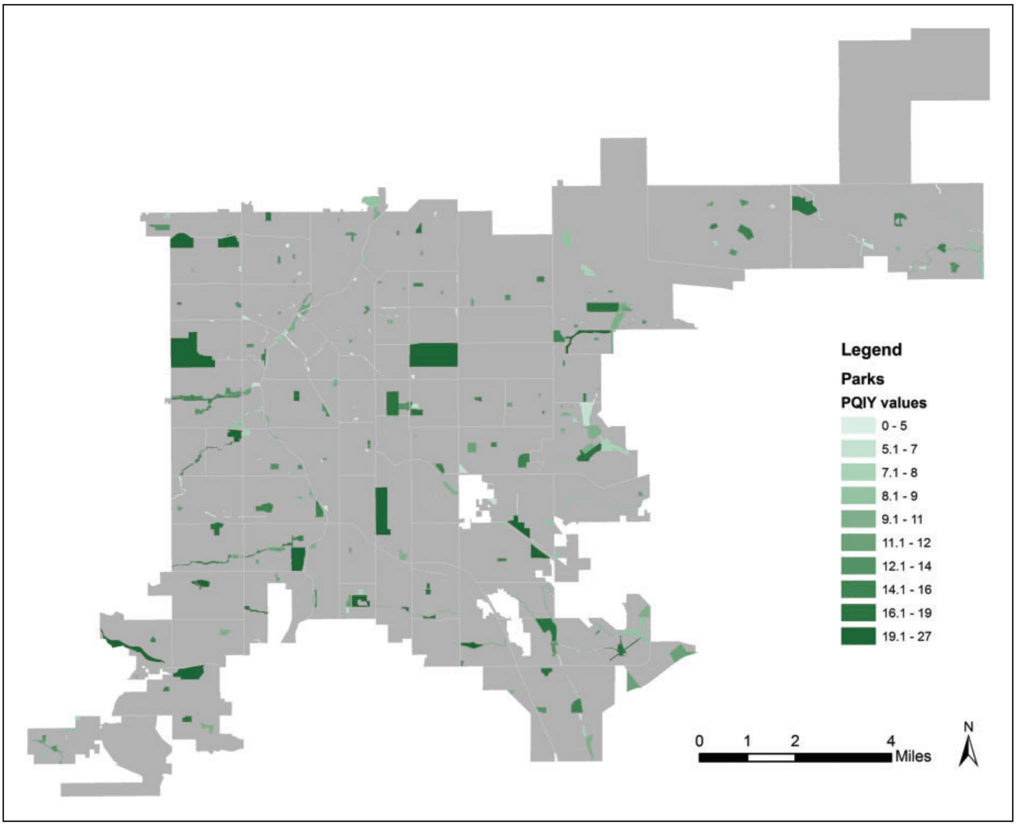

Figure 1. Map of the city of Denver, with parks ranked based on the QUINPY.

canopy. Operationalizing park maintenance required slightly different approaches for the two cities. For Denver, we used the city's maintenance standard levels, which are already categorized. For New York City, we used audit scores on park conditions based on the city's maintenance benchmarks, which we categorized into quartiles. Online Appendix B includes a complete description of the datasets we used for Denver and New York City and of the data processing we conducted. The GIS operations require what we would consider to be an intermediate knowledge of ArcGIS, including basic geoprocessing, spatial and table joins, and geocoding.

For illustrative purposes, Figures 1 and 2 show maps of Denver and New York City, with parks ranked using the QUINPY. Denver's QUINPY values range from a minimum of 0 (pocket parks without amenities) to a maximum of 27 (Washington Park). The mean value is 10.47 (standard deviation of 4.75) and the median is 10. New York City's QUINPY values span from 0 (pocket parks without amenities) to a maximum of 28 (Central Park). The mean value is 10.56 (standard deviation of 4.91) and the median is 10. While these statistics are fairly similar between the two cities, there are very significant variations with each city's park system. These differences can provide valuable information for park planners aiming to distribute funding as well as for environmental justice researchers and advocates. The parks included in the top quantile include large metropolitan parks but also medium-sized parks with a variety of play amenities, natural elements, and high levels of maintenance and safety.

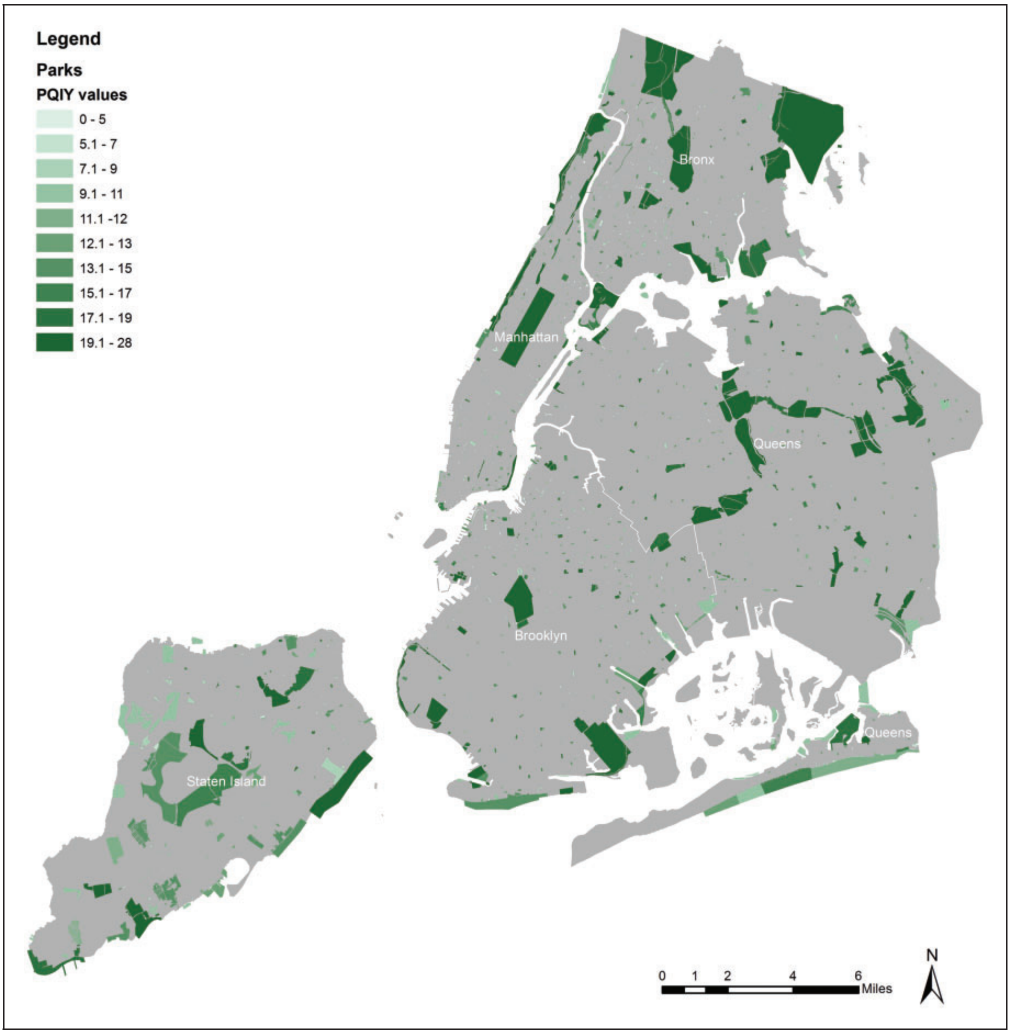

Figure 2. Map of the city of New York, with parks ranked based on the QUINPY.

Table 4 summarizes QUINPY descriptive statistics for New York City's five boroughs. The QUINPY values show that park quality is relatively well balanced across the five boroughs, as medians only vary between 9 (Bronx and Manhattan) and 11 (Brooklyn, Queens, and Staten Island). Staten Island's highest mean value (11.61) and lowest standard deviation (4.07) suggest that the borough has several parks with an average quality without many low and high values (see Table 4). Among the other boroughs, Manhattan includes Central Park, which has the highest quality score (28), but also several triangles and pocket parks without significant amenities for young people, which contribute to relatively low median and mean QUINPY values for the borough (see Table 4). Figure 3 shows New York City parks with significant variations in QUINPY scores.

The pilot testing demonstrates the reliability of the instrument. We examined the Google Earth's aerial photos and Google Street View images of 5% of Denver's and New York

Table 4. QUINPY values for New York City by borough.

Borough	N	Median	Mean	Standard deviation	Minimum	Maximum
Bronx	279	9	9.65	5.02	0	26
Brooklyn	398	11	10.83	4.7	1	24
Manhattan	257	9	9.65	4.86	1	28
Queens	411	11	11.14	5.09	2	27
Staten Island	136	11	11.61	4.07	3	23

QUINPY: QUality INdex of Parks for Youth.

City's parks and compared them to the GIS data for the same parks. The reliability analysis yielded a Cronbach's alpha of 0.967, which can be considered satisfactory. The QUINPY is also reliable because it is based on well-defined GIS datasets and procedures (see online Appendix B), thus others can use the instrument and would obtain ostensibly the same scores.

Finally, the pilot testing also showed small-to-medium associations between some of the QUINPY variables in Denver and New York City, although most variables are not statistically significantly associated. For example, cross-tabulations highlighted that the distant views and park size variables are positively associated in both cities, with a medium effect size (Denver, $p < .00$, Cramer's $V = .314$; and New York City, $p < .00$, Cramer's $V = .398$). This means that large parks are more likely to include distant views than small parks. These associations reinforce that some park attributes are particularly important (e.g. size and presence of trees), as highlighted in our preceding literature review.

Discussion

Contributions

This paper makes two important contributions. First, it provides a useful tool for data-driven park planning, specifically for environmental justice-oriented planning, research, and advocacy efforts. Second, the paper presents a tool that can be used to democratize data on the quality of parks and of other public amenities. The QUINPY has a substantial advantage over existing tools as it relies on increasingly publicly available geospatial data and can thus easily sync with park quality mapping tools that make data on park amenities and conditions accessible to the general public (see more below).

Applications

The QUINPY has at least three types of potential users: practitioners, academics, and nonprofits. Practitioners such as park agency staff and planning consultants can use the QUINPY to prioritize investment for capital improvement projects and maintenance, especially in underserved areas of cities. The QUINPY allows park agencies to assess the quality of their park systems in relation to young people's needs. In addition, as the QUINPY includes five categories, it can be used to prioritize investments focusing on play diversity, nature, park size, maintenance, and safety. For example, our pilot testing showed that, in New York City, Staten Island has parks with the lowest mean scores for

Figure 3. Photos and QUINPY scores of several New York City parks. (a) Prospect Park. QUINPY = 24. Total acres = 478.65 Photo credit: Brad Clinesmith on Flickr (Creative Commons). (b) Brooklyn Bridge Park. QUINPY = 15. Total acres = 20.56 Photo credit: dumbonyc on Flickr (Creative Commons). (c) Minetta Playground. QUINPY = 7. Total acres = 0.22 Photo credit: Kosboot on Wikipedia (Creative Commons). (d) Minetta Green. QUINPY = 5. Total acres = 0.05 Photo credit: Kosboot on Wikipedia (Creative Commons). QUINPY: QUality INdex of Parks for Youth.

structured play diversity (2.08 out of 14), whereas the Bronx has the lowest values for *nature* (2.11 out of 9). As such, park master plans could prioritize capital improvement investments focusing on playgrounds and sport facilities in Staten Island, and investments in natural elements like trees and water features in the Bronx.

The QUINPY has several applications for academics who study park equity and physical activity in parks. First, it can be used in environmental justice investigations focusing on how park quality varies across socioeconomic and ethnic groups. These studies would illuminate who benefits most from public spending for parks, which is particularly important when public funds are limited. The instrument capitalizes on a growing interest in park equity in the U.S., with related initiatives recently introduced by the National Recreation and Park Association (2016) and other agencies. Second, the QUINPY can be employed in public health studies testing, for example, connections between park quality and young people's physical activity levels.

For park nonprofits, the QUINPY can serve as a tool to democratize data on park quality. In the United States, nonprofits have assumed a central role in park funding and advocacy (Joassart-Marcelli, 2010). For example, The Trust for Public Land's (2016) ParkScore is a website that ranks the park systems of the U.S. largest 100 cities, based on parameters of park acreage, amenities, and investment and access. The QUINPY could be used to add data on park quality to ParkScore or other online platforms, making park quality data easier to access. Smaller nonprofits without the capacity of national organizations could either use publicly available online park quality mapping tool (e.g. expanded ParkScore) or partner with local universities, which could provide GIS support, to apply the QUINPY to their city. And regardless of their capacity, park nonprofits can use QUINPY-generated data to prioritize investments and advocacy efforts to underserved areas, including park-deprived low-income communities of color. All of these analyses can be conducted cross-sectionally or longitudinally (e.g. before and after a particular investment or improvement).

Replicability

As with other existing park quality tools, the QUINPY was developed with a focus on Western contexts, and particularly on the United States. The literature we used to build our index and the experts who validated it almost exclusively come from Western contexts such as the U.S., Europe, and Australia. This might limit the applicability of the QUINPY beyond Western countries. Indeed, countries with predominantly nonwhite cultures might see parks or gardens as having different purposes than escape from the city and recreation, which are the main values that Western culture has attributed to parks (Byrne and Wolch, 2009). Therefore, we suggest that researchers and practitioners aiming to use the QUINPY in non-Western countries should edit the tool based on local ideas of recreation for young people.

Also, data availability can vary significantly from country to country and city to city. The University of Pennsylvania Library's (n.d.) catalog provides a good summary of open GIS databases in various continents. For example, more and more European countries (e.g. England, France, and Italy) are providing open data services, whereas most developing countries do not seem to have the same data availability. This might further hinder the replicability of the QUINPY beyond Western contexts. Also, large and medium-sized cities are more likely to have the necessary capacity to produce geospatial data to support the use of the QUINPY than small cities.

Limitations

The main limitations of the QUINPY include potential data availability issues, trade-offs between using secondary data and collecting rich field data, and cultural appropriateness within Western countries. First, instruments such as ours that rely on secondary data are inevitably susceptible to data availability variations. In case some data are not available, researchers and practitioners could digitize park features in GIS using aerial photos. Second, the QUINPY exposes the trade-offs between park quality instruments relying on secondary data and on primary data collected through field audits, as outlined in Table 5.

Table 5. Trade-offs between park quality tools based on secondary data and field audits.

	Secondary data based	Field audit based
Time and resources to rank parks	Less time and fewer resources if all data are available	More time and resources, especially with large park systems
Technical knowledge	Upfront investment for GIS software and training. Intermediate GIS skills required	Field auditors do not need high technical skills and can be trained
Data on park maintenance and conditions	Secondary data on maintenance might be flawed and not updated	Richer and more timely data on park maintenance and conditions
Reliability	No major reliability issues as several researchers would use the same secondary GIS data	Potential intercoder reliability issues when multiple observers rate parks

Nonetheless, the biggest advantage of secondary data-based tools is that they require less time and funds compared to field audits instruments. This is particularly true for large park systems. However, relying on GIS data requires some upfront cost in terms of software and technical GIS training. Most park agencies in medium and large U.S. cities have access to GIS services, but small nonprofits with limited means might not. Also, instruments based on field audits can capture data about actual park conditions at a specific point in time. Park conditions, which can strongly limit park visitation when poor, cannot be measured through secondary data such as aerial photos (Gidlow et al., 2012). Although some park agencies collect and share detailed data on park conditions (e.g. New York City), using these data and other GIS data might introduce cross-sectional errors, as secondary data can be produced at different points in time. We also acknowledge that maintenance levels, as expressed by city standards, might not reflect actual park conditions, which could vary due to frequency of park use or malfunctioning maintenance systems.

The third limitation of our instrument deals with cultural appropriateness within Western countries which include significant diversity. A recent study by Smiley et al. (2016) in Houston, Texas shows that the city's ethnic groups have very different priorities for parks and recreation. Particularly, people of color in Houston were more concerned with park conditions and safety, probably due to subpar parks in their neighborhoods. Because the QUINPY is a one-size-fits-all instrument with the ability to be adapted to certain contexts, it suffers from this same limitation. Still, it is based on an extensive review of the literature including the recreational preferences of ethnic minority children and teenagers, and on a validation process that engaged experts from different cultural backgrounds. As a result, the QUINPY favors inclusive parks, those that can support park visitation for young people of different gender, age, ethnicity, and physical ability.

Conclusion

In this paper, we presented the development, validation, and pilot testing of a tool that measures park quality for youth in the United States and beyond. The QUINPY advances previous park quality instruments for its scope (active and passive recreation), usability (GIS data), age focus (young people), and cultural focus (cultural inclusiveness). Particularly, the usability advantages of the QUINPY set it apart from other tools and make it suitable for practitioners, academics, and nonprofits. Our approach is relevant beyond parks, as secondary data can be used to assess the quality of other public amenities such as sidewalks, biking facilities, and transit. This would generate powerful data on how public agencies distribute resources across geographic areas and demographic groups.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Note

1. We recognize that interpretations of "park quality" are never universal and can differ from group to group, and even individual to individual. We discuss this issue in the "Discussion/limitations" section.

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