

Article

What Park Visitors Survey Tells Us: Comparing Three Elevated Parks—The High Line, 606, and High Bridge

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Received: 3 November 2019; Accepted: 10 December 2019; Published: 22 December 2019



Abstract: Many cities have replaced abandoned transportation infrastructure with an elevated park to gain increased economic benefits by developing old fabric. By following this trend, most studies to this point have only focused on the economic rewards from the replacement rather than its uses in the real world. This study aims to understand how park visitors use elevated parks through a park visitors' survey. The authors selected three representative elevated parks—the High Line in New York City, the 606 in Chicago, and the High Bridge in Farmville—for the study and asked visitors about their activities, perceived benefits, and satisfaction. Results indicate that the 606, a mixed-use elevated park, allows visitors to engage in high-intensity activity, the High Line as an elevated urban park provides visitors public arts and gardens, and the High Bridge as an elevated green park provided visitors with a connection to unique natural scenery. This study, as the first to compare three different elevated parks, contributes to an understanding of who uses elevated parks and how they use elevated parks.

Keywords: elevated park; park visitor survey; High Line; 606; Bloomingdale Trail; High Bridge

1. Introduction

Due to the changes in modes of transportation [1,2] and the phenomena of shrinking cities [3,4], transportation infrastructure in many places have become obsolete and are becoming brownfields [5]. Recently, several cities, such as New York City, Chicago, and Seoul, have replaced abandoned transportation infrastructure with a park to serve the recreation needs of the citizens. After the High Line, built on an abandoned railroad, was seen to have achieved significant economic returns [6–9], dozens of cities completed or proposed to replace abandoned transportation infrastructure with parks in the US [10] and around the globe. While replacing old infrastructure with a park has become a trend, there is still a need for research on how this should be done.

Most studies about parks built over or on transportation infrastructure have only focused on the economic impacts to adjacent areas [11–15]. Cities use these conversions from transportation infrastructure to a park as a tool for urban regeneration. Studies on recent projects such as the Big-dig in Boston [16,17], the High Line in New York [7,18], and the Cheonggyecheon restoration project in Seoul, Korea [12,19], have attempted to determine the economic benefits of these new parks, mainly focused on tax revenues and property value. Based on these economic studies, many cities are now looking to develop elevated parks. However, these previous studies did not specify who visits elevated parks, how the parks are used, and user satisfaction with elevated parks.

This study investigates three different elevated parks and compares visitor activities, perceived benefits, and perceived satisfaction. The objective of this study is to (1) identify elevated park visitor characteristics, (2) illustrate differences between three different types of elevated parks, and (3) provide design implications for future elevated parks. To answer these questions, the authors selected three

elevated parks that represented three types of elevated parks and conducted an on-site survey to determine who are park visitors and their behavior. The authors have examined the relationship between activities, perceived benefits, and perceived satisfaction.

2. Emerging an Elevated Park

2.1. Elevated Park

There are several terms to describe an elevated park such as a skywalk, skyway, sky garden, and sky park. This study defines an elevated park based on its conceptual origin, physical attributes, and functions (Figure 1). Conceptually, an elevated park as a green corridor that links destinations. Greenways, large systems for connecting parks [20–22], are also sometimes referred to as thin parks or thick edge-spaces to connect dominantly urban contexts [23]. Connectivity is also an important characteristic of elevated parks. This comes from the fact that connectivity is a basic function of the transportation infrastructure being replaced. Connectivity is the degree to which an elevated park is connected to various domains in a city. Two important physical attributes of an elevated park are a linear form and an elevated level. In terms of linear spaces in urban areas, Kullmann (2011) explains elevated parks as a by-product of a plethora of cultural processes such as changing transportation modes from railways to freeways. In terms of function, an elevated park serves as a conduit for the physical activity of neighborhoods, such as with trails, which allow visitors to access local landscapes [24] and promote physical exercise [25]. Based on these conceptual origins, this study defines an elevated park as an open space that connects multiple areas of a city or neighborhood that was built above the ground level, which facilitates physical and social activities, and provides environmental services.

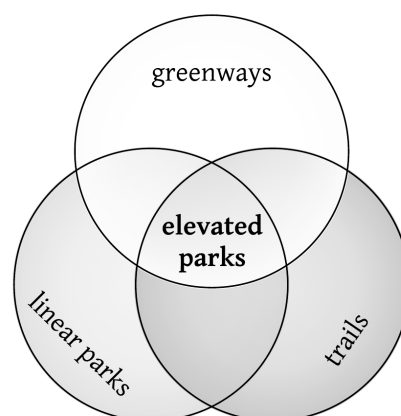


Figure 1. Conceptual diagram of an elevated park.

The construction of elevated parks on abandoned railways or freeways serves several purposes. First, developing a park on a vacant field such as an old railway can save maintenance costs abandoned infrastructure, as well as the costs to purchasing land parks in other locations. It is estimated that it would take over \$170 billion USD to restore the condition of the US transportation system [26]. This is hard to justify when the per capita vehicle miles traveled has declined over the last decade [27]. Renting unused transportation sites for the long term is one way to save costs. Also, the purchase of parcels for parks in city centers is very expensive. Finally, replacing the transportation infrastructure with an elevated park can trigger economic vitality in adjacent areas. Many studies have verified the economic benefits to urban areas that can be accrued by promoting tourism, increasing property values, and generating increased tax revenues. This has occurred with the Big-dig in Boston [16,17], the Highline in New York [7,18], and the Cheonggyecheon restoration project in Seoul [12,19]. Also, linear elevated parks appear to be more effective in generating economic benefits in adjoining areas because linear elevated parks provide more access points for adjacent communities than other park types.

Maddox (2016) explains how linear parks raise the opportunity of public access from adjacent areas. He asserts, “a hypothetical, square 2km x 2km park comprises a ‘people catchment area’ of about 2.5km within a 0.5km walking distance of its border; a 0.5km x 8 km linear park captures an area of 4.5km” [28]. Overall, elevated parks have emerged as a paradigm shift away from transportation while contributing to economic benefits and social equity.

As linear greenways and trails above ground, elevated parks can be organized into three types based on connectivity, design features, and location. Connectivity, an essential feature of an elevated park, refers to the concept of accessibility. Park connectivity enhances social interaction [28], biodiversity [29,30], and recreational opportunities [22,31]. Design features are also crucial factors in understanding the characteristics of elevated parks. Shafer et al. (2000) and Fabos (1995) also use design features to develop a classification system for a greenway. The Recreation Opportunity Spectrum (ROS) (1979), invented to assess greenway systems, has been widely used to classify linear green spaces [32,33]. The ROS offers a spectrum from the urban (modernity) to rural (primitive) to identify the roles and functions of green spaces by its location. By considering three features that affect a greenway—connectivity, design features, and location—we specify the following three types of an elevated park: urban, mixed-use, and green. The urban type is designed for high-density cities to provide green spaces, connect multiple points of interest, and functions as a linear park in a city. The mixed-use type of elevated park is located in a mid-density city, is designed for daily activities, and functions like a greenway. The green type protects nature and minimizes interventions, connects between communities, and functions as a trail [34]. Identifying the differences between types allow us to figure out implications for making a new elevated park and managing existing elevated parks to provide ecosystem services for visitors.

2.2. Benefits of Elevated Parks

Most past studies on the benefits of urban parks examine park functions and contributions to cities. Basically, the benefits of urban parks can be divided into several categories. Some studies divided the benefits into direct and indirect benefits [35–37]; other studies used on-site and off-site benefits depending on the nature of the benefits [38,39]. Stevens and Allen (1988) explain methods that can be used to evaluate urban park values and evaluate four parks using a hedonic pricing model. In terms of social benefits, evidence supports the idea that urban parks and urban green spaces improve the quality of life [39]. Also, environmental services such as purification of pollution, air filtration, and mitigating the urban heat island effect contribute to improved health. Urban parks also enhance social interactions and provide a sense of peacefulness [40–43]. Ulrich (1981), for example, compares psychophysiological reactions toward three environments—vegetation, water, and built. By using physiological and psychological measures, he found that landscapes containing vegetation and water had a beneficial effect on people’s positive state of mind. Coley, Sullivan, and Kuo (1997) found that urban parks encourage social interactions among residents and contribute to social integration. They found that natural elements increased opportunities for social interactions in outdoor gathering places. They seemed to promote communication within neighborhoods [44]. Peters, Elands, and Buijs (2009) assert that urban parks can generate social interactions by stimulating social cohesion. By using a survey and observation, they found that urban parks promote the mingling of different ethnic groups and interactions among visitors [45].

Most studies in elevated parks have focused only on economic benefits. Levere, an economist from UC San Diego, who assessed the High Line’s impact on house prices using home sales and property valuations, estimates that, in 2010 alone, the city gained \$100 million USD in property tax increases because of increased property value as a result of the High Line [18]. Kang and Cervero (2009) investigated changes in land values for properties resulting from the Cheonggyecheon restoration project in Korea, which replaced an old overhead highway with an urban park. They found that land values had increased as a result of the park construction. The increase in property value depended on the distance from the park [12].

3. Methods

3.1. Study Site

The authors of this study selected three cases that represented elevated parks in three different contexts to examine park visitor behaviors in and perceptions of elevated parks. The selected sites were the High Line in New York City as the urban type, the 606 in Chicago as the suburban type, and the High Bridge Park as the rural type (Table 1). All three elevated parks built on abandoned railways and opened to the public within a decade. All of these elevated park sites were on abandoned railroads. Also, they all opened between 2009 and 2015 to provide a green space for citizens. These three elevated parks are located in various contexts and have unique physical features. For example, one elevated park provides a recreation place, another offers a place for arts, and the last one allows users to contact nature. By reviewing three elevated parks and comparing those parks, the authors determined the similarities and differences between them.

Table 1. Study sites.

| Attributes | The 606 | High Line | High Bridge |
|-------------------------|-----------------------------------|--|---|
| Location | Chicago, IL | New York City, NY | Farmville, VA |
| Type | Suburban elevated park | Urban elevated park | Rural elevated park |
| Advocacy group | Friends of the Bloomingdale Trail | Friends of the High Line | Friends of High Bridge Trail State Park |
| Proposed year | 2002–2004 | 1999 | 2007 |
| Opened year | 2015 | 2009, section 1 | 2008, east part |
| | | 2011, section 2 | 2009, west part |
| | | 2014, section 3 | 2012, the High Bridge |
| | | 2019, finalized | itself |
| Average visitors a year | 1,000,000 | 7,000,000 | 200,000 |
| Social contexts | Across multiple neighborhoods | Connects five neighborhoods in lower Manhattan | Connects several communities |

The 606 was the Bloomingdale line is an elevated railroad that crosses the east-west side of Chicago. The railroad was constructed in 1873 and was elevated in the 1910s to reduce pedestrian fatalities. The line was used for passenger and commercial trains but stopped its operation in 2001. After that, from 2002 to 2004, the greenway concept was introduced to the public. The Friends of the Bloomingdale Trail was launched in 2003 to advocate for the park [46]. In 2015, the 606 opened as the longest elevated park in the US.

In 1847, the High Line was a set of street-level railroad tracks along 10th and 11th street on Manhattan's West Side. In 1929, when safety issues were raised, the city, the state, and New York Central agreed on the West Side Improvement Project led by Robert Moses [47], and the street-level tracks were turned into an elevated railway. The invention of standard container cargo fostered the growth of the interstate trucking system during the 1950s [48] and also led to a reduction in rail traffic throughout the United States. In 1980, the owner, Conrail, decided to disconnect the High Line elevated railway from the national rail system. The railway was reconnected in 1981, but this line remained unused. The tracks ceased operation at this point. The High Line opened as an elevated park in 2009 and has achieved enormous success. It has become a symbol of what an elevated park is. In 2015, seven years after its opening, 7.6 million people visited the park, which was nearly six times the number of visitors in the first year, 1.3 million [49]. It is also projected generate about \$1 billion USD in tax revenues to the city over the next 20 years [50]. The High Line succeeded more than expected and became an exemplary case for cities.

High Bridge is a part of the High Bridge Trail State Park in Virginia. High Bridge was originally built in 1854 for a train that connected Petersburg with Lynchburg by crossing the Appomattox River. The bridge length is 730 meters, and the height is 18 to 38 meters. In 2005, the railway stopped

operation, and the track was donated to the Virginia Department of Conservation (VDC). In 2012, the VDC opened the park to provide recreational services to Virginians [51].

3.2. Data Collection

A survey was conducted from 18 April to 12 May 2019. The authors included at least two weekdays and two weekend days at each of the elevated parks to reduce the differences between weekdays and weekends. At each elevated park, the researchers approached every fifth adult visitor and asked if they would answer the two-pages park survey. The survey asked questions about activity, perceived benefits, and perceived satisfaction. Activity in the park includes physical, social, viewing, and relaxing. Physical activity such as walking, jogging, and hiking have mainly been discussed in previous studies [52–54].

The survey response rate at all elevated parks was 54.19%, and it differed with each elevated park (Table 2). Many of the visitors to High Bridge are tourists. They come from different countries and often did not use English. Many of these foreign visitors refused the survey. The lowest response rate was 42.18% at the High Line due to the language issue. Most visitors of the High Bridge gladly participated in the survey. However, because of its rural setting, the total visitors to the park were less than 80 visitors on a weekday, which was remarkably lower than other elevated parks. A total of 750 respondents was collected for the study, excluding partial responses.

Table 2. Response rate and sample size.

| Responding | The 606 | High Line | High Bridge | Total |
|---------------------------------|---------------------|----------------|----------------|----------------|
| Fully responding ¹ | 63.12% (n = 320) | 42.18 (310) | 84.51 (120) | 54.19 (750) |
| Partial responding ² | 1.58 (8) | 1.63 (12) | 1.41 (2) | 1.59 (22) |
| Refusal | 35.31 (179) | 56.19 (413) | 14.08 (20) | 44.22 (612) |

¹ The total sample size for the study. ² Disqualifying responses.

3.3. Descriptive Statistics

The survey revealed demographic differences among three elevated parks (Table 3). The results indicate that more females (54.93%) visited elevated parks than males (45.07%), and this result was similar across each elevated park in the study. Age differences of park visitors differed by each park. In the case of the 606, 33.12 percent of visitors were 18–29 ages and 26.25 percent of visitors were 30–39 years old. In addition, more people over 50 years old visited the high bridge (36.50%) than people under 29 years (33.12%). In terms of race, Caucasian users visited elevated parks more than (68.13%) other races. In the case of the High Bridge in Farmville, white visitors were 80 percent of the total respondents (80%).

Table 3. Characteristics of visitors.

| Categories | The 606 | High Line | High Bridge | Total |
|--------------------|---------------------|----------------|---------------|----------------|
| Gender | | | | |
| Male | 45.31% (n = 141) | 43.55 (135) | 48.33 (58) | 45.07 (334) |
| Female | 54.69 (175) | 56.45 (175) | 51.67 (62) | 54.93 (412) |
| Age | | | | |
| 18–29 | 33.12 (106) | 24.52 (76) | 25.83 (31) | 28.40 (213) |
| 30–39 | 26.25 (84) | 30.65 (95) | 19.17 (23) | 26.93 (202) |
| 40–49 | 12.19 (39) | 18.06 (56) | 17.50 (21) | 15.47 (116) |
| 50–59 | 13.75 (44) | 12.90 (40) | 15.83 (19) | 13.73 (103) |
| 60–69 | 10.94 (35) | 8.71 (27) | 14.17 (17) | 10.53 (79) |
| Over 70 | 2.50 (8) | 5.16 (16) | 7.50 (9) | 4.40 (33) |
| Prefer not to say | 1.25 (4) | 0.00 (0) | 0.00 (0) | 0.53 (4) |
| Race | | | | |
| White | 72.50 (232) | 59.03 (183) | 80.00 (96) | 68.13 (511) |
| Black | 1.56 (5) | 2.26 (7) | 3.33 (4) | 2.13 (16) |
| Hispanic | 13.12 (42) | 15.48 (48) | 2.50 (3) | 12.40 (93) |
| Asian | 4.38 (14) | 11.61 (27) | 4.17 (5) | 7.33 (55) |
| Other ¹ | 4.28 (14) | 8.71 (27) | 7.50 (9) | 6.67 (50) |
| Prefer not to say | 4.06 (13) | 2.90 (9) | 2.50 (3) | 3.33 (25) |
| Income | | | | |
| 25,000 or less | 8.12 (26) | 10.00 (31) | 17.50 (21) | 11.33 (85) |
| 25,000–50,000 | 12.50 (40) | 17.74 (55) | 17.50 (21) | 15.47 (116) |
| 50,000–75,000 | 14.69 (47) | 17.10 (53) | 13.33 (16) | 15.47 (116) |
| 75,000–100,000 | 16.25 (52) | 11.29 (35) | 17.50 (21) | 14.40 (108) |
| 100,000–150,000 | 18.44 (59) | 20.65 (64) | 20.83 (25) | 19.73 (148) |
| Over 150,000 | 19.69 (63) | 9.35 (29) | 10.83 (13) | 14.00 (105) |
| Prefer not to say | 8.12 (26) | 13.87 (43) | 2.50 (3) | 9.60 (72) |
| Education | | | | |
| High school | 10.32 (33) | 10.32 (32) | 19.16 (23) | 13.21 (88) |
| University | 47.19 (151) | 57.54 (179) | 43.33 (52) | 50.93 (382) |
| Graduate school | 32.81 (105) | 23.23 (72) | 29.17 (35) | 28.27 (212) |
| Postgraduate | 5.94 (19) | 8.71 (27) | 8.33 (10) | 7.47 (56) |
| Prefer not to say | 3.75 (12) | 0.00 (0) | 0.00 (0) | 1.60 (12) |

4. Results

4.1. What Visitors Do in the Elevated Parks

We can categorize activities at three elevated parks into four categories based on the activity types as follows: (1) physical activity, (2) social activity, (3) relaxing and restoration, and (4) viewing (Table 4). The main activity in elevated parks differs from each type of elevated park, but overall, the highest volumes of visitors took part in physical activity (Figure 2). Overall, the highest portion of visitors participated in physical activity in the 606. Hiking and walking were the main physical activity in the 606 (80.94%), then biking (48.13%), and jogging and running (28.75%). The high bridge visitors also actively participated in physical activity such as biking (25.83%) and hiking and walking (25.83%). But, they rarely joined Jogging and Running (5.83%). In the High Line, most visitors walked on the park (76.77%) and rarely took a bike (4.19%). Since biking and walking a dog are banned in the High Line, this is an obvious result.

Table 4. Main activities in each elevated park.

| Activities | The 606 | High Line | High Bridge | Total |
|-----------------------------------|---------|-----------|-------------|--------|
| Physical activity | | | | |
| Biking | 48.13% | 4.19% | 25.83% | 26.40% |
| Hiking/walking | 80.94 | 76.77 | 65.83 | 76.80 |
| Jogging/running | 28.75 | 10.97 | 5.83 | 17.73 |
| Walking a dog | 17.81 | 7.74 | 7.50 | 12.00 |
| Social activity | | | | |
| Picnicking | 5.94 | 11.29 | 0.00 | 7.20 |
| Posting on social media | 9.38 | 20.65 | 7.50 | 13.73 |
| Relaxation and restoration | | | | |
| Relaxing/no main activity | 53.75 | 63.87 | 28.33 | 53.87 |
| Taking photos | 25.31 | 49.03 | 70.83 | 42.4 |
| Viewing | | | | |
| Viewing from overlooks | 21.56 | 70.83 | 62.26 | 46.27 |
| Viewing public arts | 27.19 | 40.97 | 0.00 | 28.53 |
| Viewing nature | 17.50 | 13.87 | 49.17 | 21.07 |

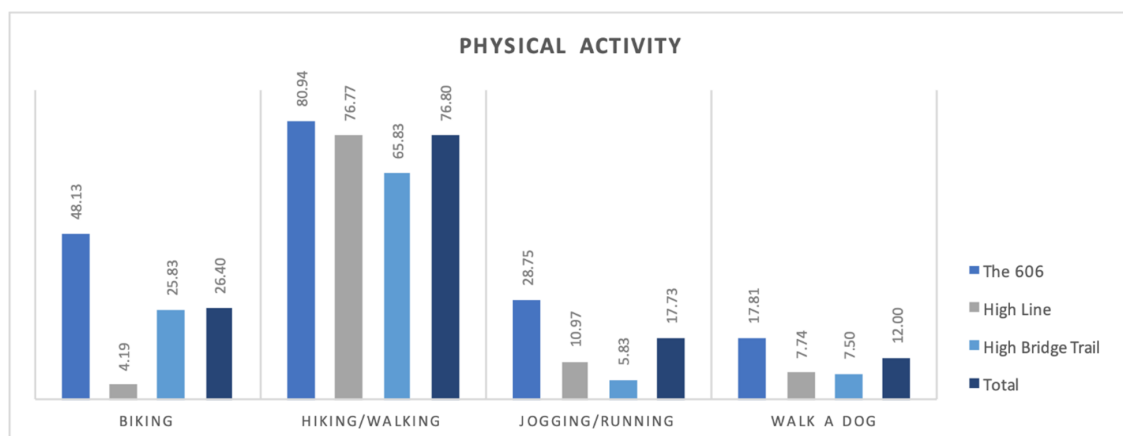


Figure 2. Physical activity.

Social activity shows the differences between elevated parks (Figure 3). For example, visitors of the High Line actively joined together to have picnics (11.29%) and posted their experiences on social media (20.65%). Visitors who visited the High Bridge had a picnic in the park (0.00%) and rarely posted on social media at the park or about the park. Relaxation and restoration or no main activity also showed differences among the three elevated parks (Figure 3). Visitors of the 606 and the High Line relaxed in the park in a high percentage (the 606: 53.75%, the High Line: 63.87%), but for visitors

at High Bridge, relaxation (28.33%) was lower than at other parks. Taking photos as a restoration activity also differed from elevated parks. Only 25.31% of visitors of the 606 took photos, and this was much lesser than other elevated parks. In addition, the majority of visitors of the High Bridge enjoyed taking photos (70.83%).

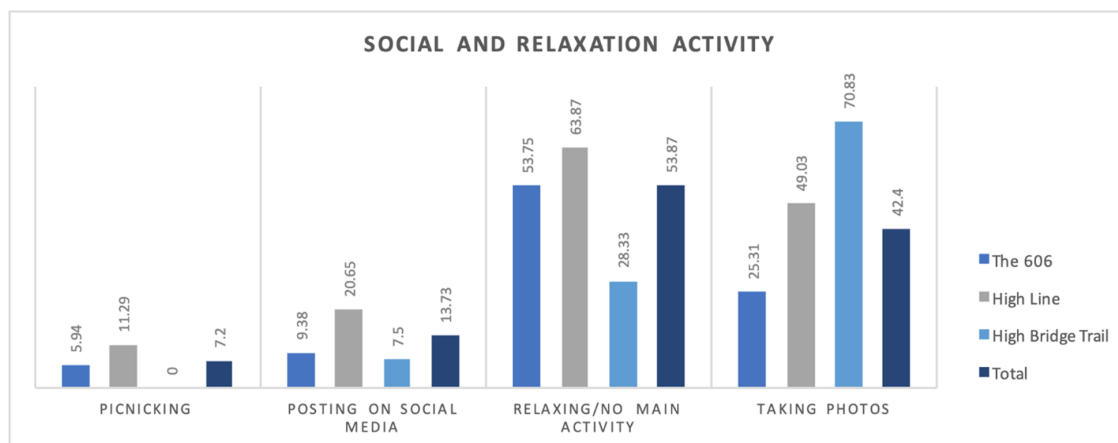


Figure 3. Social and relaxation activity.

The authors measured viewing activity through three themes (Figure 4)—overlooking on observatory points (viewing from overlooks), enjoying public arts (viewing public arts), and nature (viewing nature). Visitors of the High Line enjoyed overlooking from observatory points (70.83%) and public art (40.97%) more than at other elevated parks. In the case of the High Bridge, many visitors viewed from overlooks (62.26%) and nature scenery (49.17%), but no visitor stated an interested in public art. The 606 visitors moderately enjoyed overlooking (21.56%), viewing public art (27.19%), and nature (17.5%).

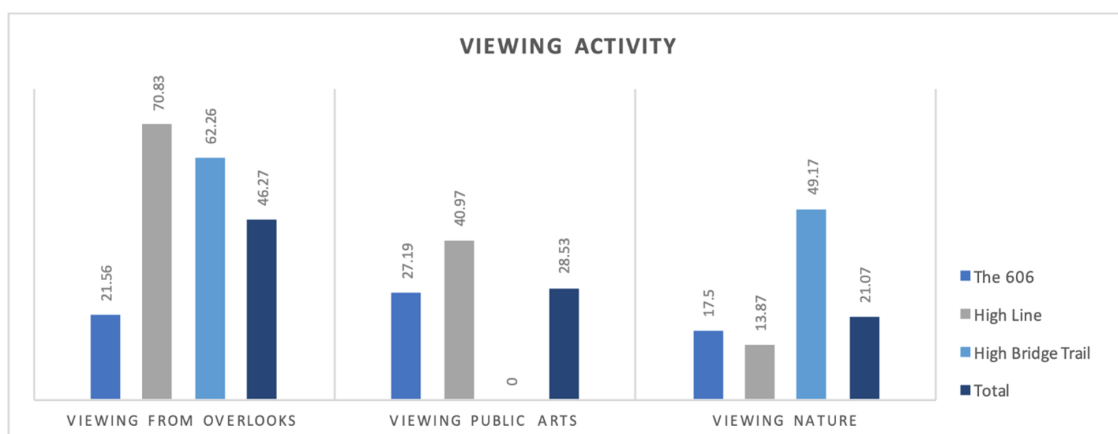


Figure 4. Viewing Activity.

In summary, 606 visitors participated in physical activities, especially biking and walking, and rarely joined the social activity. They liked to relax and to take photos in the park. The visitors also liked to see from overlooks at certain points, enjoyed public art, and liked to experience nature, but those activities are much lesser than other parks. Overall, visitors of the 606 were likely to undertake individual activities, such as biking, walking, relaxing, and viewing scenery, rather than social activities. In the case of the High Line, most visitors also joined physical activities like the 606, but the main activities in the park were hiking/walking and jogging/running. Visitors mainly visited the park to relax and see interesting things such as public art or urban scenery from observatory points. Also, visitors participated in social activities more than in other parks. Overall, visitors of the High Line

came to the park 1) to take a rest; 2) to walk, run, or jog; 3) to have a picnic; 4) to interact with other people through social media; and 5) to enjoy public art and urban scenery. In the High Bridge, like other parks, the major of visitor activity physical activity. Visitors rarely posted on social media about their experiences in the park and rarely had a picnic. Visitors also enjoyed the view from overlooks and nature but were not interested in public art. Overall, visitors were doing physical activity in the park and liked to take photos at lookout points and enjoy the scenery.

4.2. What Types of Benefits Are Perceived by Visitors?

Six questions were asked to understand the visitor's perceived benefits. Through Principle Components Analysis (PCA), the authors combined six variables into three factors (Table 5)—nature benefits, social benefits, and health benefits. The nature benefits helped visitors to better understand nature (Q10.1) and enjoy the attractive natural scenery (Q10.2). The social benefits helped visitors interact with each other (Q10.3) and build or strengthen their relationship with others (Q10.4). Finally, the health benefits included benefits that improving physical (Q10.5) and mental health (Q10.6).

Table 5. Results of the Principal Component Analysis (PCA) of perceived benefits.

| Question Number | Mean | Median | Commonality | Cronbach Alpha (0.78) | Loading | Factor |
|-----------------|------|--------|-------------|-----------------------|---------|---------------------|
| Q 10.1 | 3.23 | 3.00 | 0.76 | 0.74 | 0.81 | Benefit from nature |
| Q 10.2 | 4.23 | 4.00 | 0.81 | 0.75 | 0.86 | |
| Q 10.3 | 3.28 | 3.00 | 0.86 | 0.77 | 0.92 | Social benefit |
| Q 10.4 | 3.33 | 3.00 | 0.82 | 0.75 | 0.86 | |
| Q 10.5 | 4.07 | 4.00 | 0.84 | 0.75 | 0.88 | Health benefit |
| Q 10.6 | 4.23 | 4.00 | 0.82 | 0.75 | 0.84 | |

Based on three loading factors that explained the benefits from the park, descriptive statistics were calculated (Table 6 and Figure 5). Visitors perceived benefits from nature in the High Bridge (mean = 4.17), social benefit from the 606 (3.35), and health benefit also from the 606 (4.51). Visitors of the High Line perceived the three benefits to be less than in other parks. Visitors of the 606 perceived social benefits (3.53) and health benefits (4.51) to be higher than in other parks. The difference between each park and each factor was statistically significant (Table 7).

Table 6. Descriptive statistics of benefits.

| Categories | Count | M | Median | SD |
|-----------------------|-------|------|--------|------|
| Nature benefit | | | | |
| The 606 | 320 | 3.89 | 4.0 | 0.74 |
| High Line | 310 | 3.42 | 4.0 | 0.51 |
| High Bridge | 120 | 4.17 | 3.5 | 0.89 |
| Total | 750 | 3.73 | 4.0 | 0.83 |
| Social benefit | | | | |
| The 606 | 320 | 3.53 | 3.5 | 0.86 |
| High Line | 310 | 3.06 | 3.0 | 0.89 |
| High Bridge | 120 | 3.31 | 3.5 | 1.29 |
| Total | 750 | 3.30 | 3.00 | 0.98 |
| Health benefit | | | | |
| The 606 | 320 | 4.51 | 5.0 | 0.58 |
| High Line | 310 | 3.66 | 4.0 | 0.85 |
| High Bridge | 120 | 4.47 | 4.5 | 0.91 |
| Total | 750 | 4.15 | 4.0 | 0.83 |

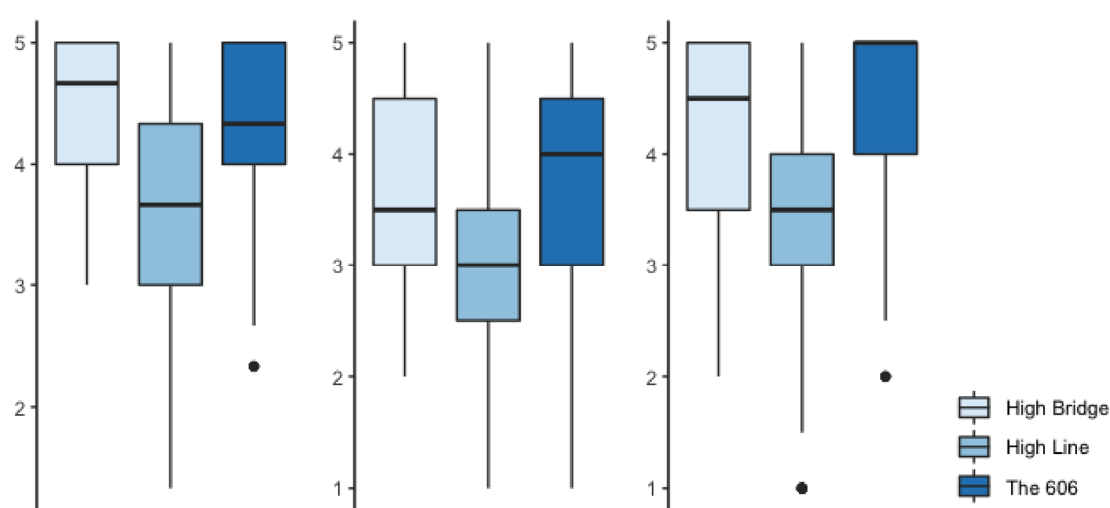


Figure 5. Box plots for the benefits. Left: Nature benefits; middle: social benefits; right: health benefits.

Table 7. Results of ANOVA.

| Categories | Df | Sum Sq | Mean Sq | F-Value | <i>p</i> (>F) |
|----------------|-----|--------|---------|---------|--------------------------|
| Nature benefit | 2 | 59.5 | 29.75 | 48.5 | $<2 \cdot 10^{-16}$ *** |
| Residuals | 747 | 458.2 | 0.613 | | |
| Social benefit | 2 | 35.4 | 17.696 | 19.39 | $6.17 \cdot 10^{-9}$ *** |
| Residuals | 744 | 678.9 | 0.912 | | |
| Health benefit | 2 | 127.5 | 63.77 | 122 | $<2 \cdot 10^{-16}$ *** |
| Residuals | 747 | 390.4 | 0.52 | | |

Note: *** 0; ** 0.001; * 0.01.

The High Line is considered to be the most successful project [6] since it opened and became a catalyst to promote the construction of elevated parks globally. However, visitors to the High Line perceived fewer benefits from nature, social, and health aspects than visitors to other elevated parks. Visitors to the 606 perceived health benefits (mean = 4.51) by visiting the 606. For nature and social benefits, the 606 visitors and the High Bridge visitors showed similar results.

4.3. How Satisfied Are Visitors?

Participants were asked to provide their perceived satisfaction with eight sub-questions about the physical attributes of the park (Table 8). Among the eight variables, the quality of vegetation (Q12.4) and overall satisfaction variables (Q12.8) were deleted because those variables were not related to other variables (communality value < 0.7). After deleting two variables, three factors about satisfaction were derived from the PCA test as follows: connectivity, uniqueness, and facility. Connectivity included how easy it was to access the park (Q12.1) and how easy it was to visit other destinations through the park (Q12.2). Uniqueness meant the satisfaction of visitors of observation points and scenery (Q12.3) and historical elements associated with the railroad. Facility factors included satisfaction about general facilities such as restrooms, trash cans, and drinking fountains (Q12.6) and places to sit and gather along the park (Q12.7).

Table 8. Results of the PCA about satisfaction.

| Question Number | Mean | Median | Commonality | Cronbach Alpha (0.71) | Loading | Factor |
|-----------------|------|--------|-------------|-----------------------|---------|--------------|
| Q 12.1 | 3.98 | 4.00 | 0.84 | 0.71 | 0.91 | Connectivity |
| Q 12.2 | 3.92 | 4.00 | 0.72 | 0.65 | 0.73 | |
| Q 12.3 | 4.43 | 5.00 | 0.75 | 0.64 | 0.83 | |
| Q 12.4 | 4.32 | 5.00 | deleted | - | - | Uniqueness |
| Q 12.5 | 3.68 | 4.00 | 0.71 | 0.65 | 0.79 | |
| Q 12.6 | 3.21 | 3.00 | 0.75 | 0.69 | 0.75 | Facility |
| Q 12.7 | 4.14 | 4.00 | 0.82 | 0.65 | 0.82 | |
| Q 12.8 | 4.16 | 5.00 | deleted | - | - | deleted |

The descriptive statistic table shows the differences between the elevated parks (Table 9). In terms of connectivity, the most satisfied visitors were 606 visitors (mean = 4.35). The High Line and the High Bridge visitors were less satisfied than the 606 visitors about the connectivity of the park. Regarding uniqueness, the 606 visitors rated the lowest level of satisfaction (3.82) among elevated parks. The High Line and the High Bridge visitors rated higher than average. For the facility, the 606 was the lowest rated (3.57), and the High Bridge was highly rated (4.25). The 606 visitors frequently mentioned a lack of restrooms and drinking fountains. Overall, the 606 visitors were satisfied with connectivity but not that satisfied with the uniqueness and facilities of the park. The High Line and the High Bridge visitors showed similar satisfaction levels for connectivity, uniqueness, and facilities. The differences between elevated parks were also supported by the results of ANOVA (Table 10 and Figure 6).

Table 9. Descriptive statistics of satisfaction.

| Categories | Count | Mean | Median | sd. |
|---------------------|-------|------|--------|------|
| Connectivity | | | | |
| The 606 | 320 | 4.35 | 4.50 | 0.76 |
| High Line | 310 | 3.65 | 3.50 | 0.87 |
| high bridge | 120 | 3.67 | 3.50 | 0.67 |
| Total | 750 | 3.95 | 4.00 | 0.87 |
| Uniqueness | | | | |
| The 606 | 320 | 3.82 | 3.75 | 0.85 |
| High Line | 310 | 4.21 | 4.50 | 0.83 |
| high bridge | 120 | 4.25 | 4.50 | 0.72 |
| Total | 750 | 4.05 | 4.00 | 0.86 |
| Facility | | | | |
| The 606 | 320 | 3.57 | 3.50 | 0.78 |
| High Line | 310 | 3.67 | 4.00 | 0.79 |
| high bridge | 120 | 3.94 | 4.00 | 0.78 |
| Total | 750 | 3.67 | 3.50 | 0.86 |

Table 10. Result of ANOVA.

| Categories | Df | Sum Sq | Mean Sq | F-Value | p (>F) |
|--------------|-----|--------|---------|---------|----------------------------|
| Connectivity | 2 | 99.9 | 49.95 | 80.76 | <2.10 ⁻¹⁶ *** |
| Residuals | 740 | 457.7 | 0.62 | | |
| Uniqueness | 2 | 36.4 | 18.186 | 26.91 | 5.27.10 ⁻¹² *** |
| Residuals | 733 | 495.3 | 0.676 | | |
| Facility | 2 | 11.6 | 5.799 | 108.1 | 0.000703 *** |
| Residuals | 740 | 585.3 | 0.791 | | |

Note: *** 0; ** 0.001; * 0.01.

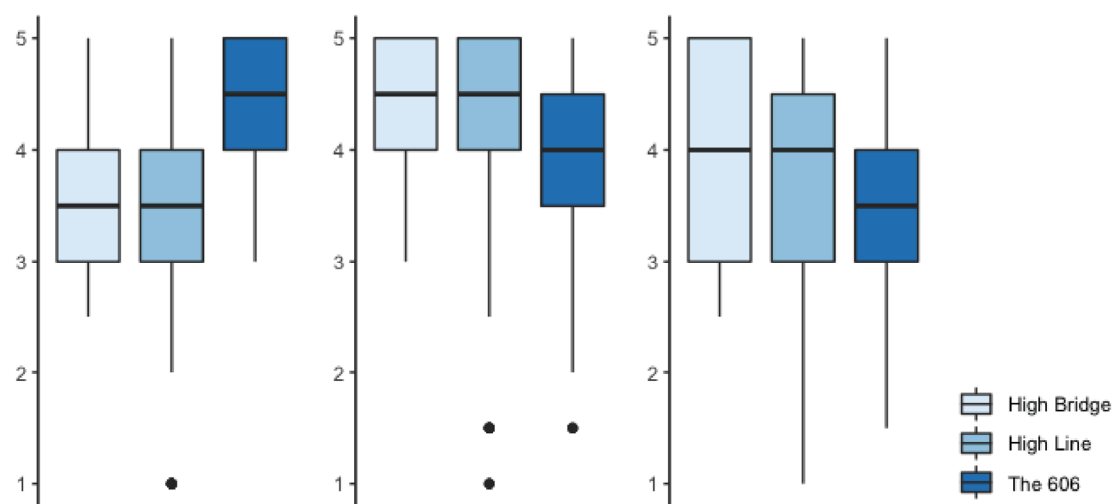


Figure 6. Box plots for satisfaction. Left: Connectivity; middle: uniqueness; left: facility.

5. Conclusions

While many studies have identified the economic benefits of elevated parks, most studies rarely examine the user benefits and satisfaction focusing instead on economic benefits. Three elevated parks, the High Line, the 606, and the High Bridge are built on abandoned elevated railways. Each elevated park in this study represents a type of elevated park, urban, suburban, and rural. This study compared the three elevated parks, mainly focused on park visitors' activity, perceived benefit, and satisfaction. This study used a survey of park visitor usage and satisfaction to determine how people use each park and how satisfied they are in this use.

The overall demographic characteristics of elevated parks indicate that female, Caucasian, and young generations from 18 to 39 mainly visited elevated parks. In terms of race and generation, these results support the previous studies that Caucasian is the majority race of park users [55]. Previous studies have shown that male is the main gender of park users [55,56], but this study showed that female is the main gender of those using elevated parks.

Physical activity was the most common activity discovered in all elevated parks. The 606 visitors were highly involved in physical activity, especially high-intensity activities such as running, jogging, and biking. The High Bridge elevated park visitors also participated in physical activities like walking and biking. Compared to the other two elevated parks, the High Line visitors participated less in physical activity and participated mostly in low-intensity activities like walking. Rather than physical activity, the High Line visitors engaged in more social activity than the users of the other two parks. When it came to viewing activity, the High Line visitors enjoyed seeing public art, while the High Bridge visitors liked to view nature. For the urban type park, people used the park for low-intensity physical activity, interacting with people, and enjoying public art. For the suburban type of elevated park, visitors actively participated in low- to high-intensity physical activities. Interacting with other people or nature was also important in the rural elevated park, but the main uses of the park were physical activities. The suburban elevated park is also used for physical activity, but it is mainly used to interact with nature. These findings contribute to our understanding of the park design and planning process by indicating the level of physical activity appropriate for each elevated park type. For example, when park planners and designers develop and plan an elevated park at the center of a city, they may plan for low-intensity activities such as light walking instead of biking or running.

For other activities in elevated parks such as social, relaxation, and overlooking activities, the High Line visitors had a high level of participation compared to the other two elevated parks. This result is one of the reasons for the success of the High Line. In the case of the High Bridge, visitors participated in those same activities, but the rate of participation was lower than at the other two elevated parks.

With regard to perceived benefits from each elevated park type, the suburban elevated park, the 606, showed the highest score in social and health benefits. On the High Bridge, a rural elevated park, visitors perceived the nature benefits as being important. However, the High Line visitors represented a lower score in all benefits. Even though the High Line is considered to be the most successful elevated park in the world, park visitors perceived less benefits from their visits and experiences in the park. This result demonstrates that economic success does not guarantee positive perceived visitor benefits.

In terms of satisfaction, there were three sub-factors, connectivity, uniqueness, and facilities considered. The 606 visitors were mostly satisfied in the park's connectivity but not satisfied in the facilities. Many visitors pointed out that restrooms and water fountains were needed in the park. The High Bridge visitors were satisfied with the uniqueness of the park and the facilities in the park. This may be related to the rarity of the High Bridges and the convenient location of parking lots. The High Line visitors were the least satisfied among the visitors to the three elevated parks. Based on this, the elevated suburban park is the friendliest among the three types. The Suburban elevated park that provides the opportunity for physical activity that visitors perceive to benefit their social and health wellbeing. Also, visitors are satisfied with the connectivity of the elevated suburban park. In the elevated urban park, visitors actively join low-intensity physical activity like walking and tend to enjoy public arts. For the elevated urban park, providing cultural resources such as public art needs to be considered. Finally, for elevated rural parks, visitors like to walk and bike, and they tend to want to interact with nature that cannot be seen in urban and suburban areas.

As the first step to understanding elevated parks, this study compared three types of elevated parks and found that 1) the elevated suburban parks designed for physical activity promotes high-intensity activity and fosters social and health benefits, 2) the elevated urban park offers a place for a low-intensity activity and public arts, and 3) the elevated rural park provides unique natural scenery that cannot be viewed in urban and suburban areas. These implications should be considered in designing the elevated park type before a city proceeds to build the park. The results of this study are likely to be used to design and plan parks. In particular, it provides a way to serve visitor needs by providing research and findings on elevated parks that have not been studied so far. It is also significant that it provides clues to creating a sustainable park by revealing that one of the reasons for the success of the High Line is that it provides a variety of activities.

Replacing abandoned railways with parks contributes to the sustainable growth of communities and cities. This kind of urban redevelopment can be regarded as having two aspects—1) the redevelopment of brownfields and 2) the creation of green space [57]. Brownfields (abandoned transportation infrastructure) are viewed as drawbacks in adjacent communities, where there is potential for negative exposure to health and safety risks [58]. Research on the impact of brownfield redevelopment indicates that there are economic returns related to taxes, property, and employment [57,59]. Reusing abandoned infrastructure as green space affords benefits to the surrounding neighborhoods by providing places for sustainable development [60].

This study compared the differences in the uses of three elevated park types through a survey. The authors selected three cases to capture a broad range of uses and perceived benefits. However, since the three cases are located in three differential locations, the results can be affected by the unique characteristics of the location. To minimize this limitation, future studies should consider location characteristics. Furthermore, the study only focused on the comparison of the parks but did not examine the relationship between factors. For future studies, the causal relationship between factors needs to be investigated.

Author Contributions: Study design, writing—original draft, J.S.; study design, writing—review and editing, P.M. and C.L.B. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the College of Architecture and Urban Studies at Virginia Tech.

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

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