Article

Different Views From The 606: Examining the Impacts of an Urban Greenway on Crime in Chicago

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Brandon Harris[1], Lincoln Larson[1], and Scott Ogletree[1]

Abstract

Parks and greenways provide many benefits to urban communities, but their relationship to crime is often debated. We examined the links between an elevated linear trail and crime within census block groups (CBGs) surrounding Chicago's Bloomingdale Trail, colloquially known as The 606, using two different approaches: (a) a matched case-control comparison of crime trends in 606-proximate CBGs and similar socioeconomic status (SES) neighborhoods in other parts of the city and (b) spatially oriented hierarchical regression models of crime in 606-proximate CBGs before and after trail construction. Using this dichotomous approach, we detected a positive influence of The 606 on all types of crime (violent, property, and disorderly) when examined at a coarse scale, particularly in low SES neighborhoods (Study 1), and an inverse relationship between trail proximity and property crime on a spatially proximate scale (Study 2). Future research should continue to explore complex relationships between urban greenways and crime in diverse cities.

Keywords

linear trails, crime, disadvantage, built environment, urban change

[1]Clemson University, SC, USA

Corresponding Author:
Brandon Harris, Department of Parks, Recreation & Tourism Management, Clemson University, 137 Lehotsky Hall, Clemson, SC 29634-0735, USA.
Email: bsharri@clemson.edu

Introduction

During the past decade, the United States has witnessed an unprecedented urban migration with millions of people choosing to live, work, and play in cities across the country (Gehl, 2013). Given the rapid population change and stress associated with urban lifestyles, cities are now focusing heavily on residents' health and well-being. One way cities have done this is through the integration of parks, linear trails, and green space into urban landscapes (Gobster & Westphal, 2004; Swanwick, Dunnett, & Woolley, 2003). Research suggests urban green spaces generate a variety of benefits that range from enhancing overall well-being (Godbey, 2009; Larson, Jennings, & Cloutier, 2016; Maas, Verheij, Groenewegen, de Vries, & Spreeuwenberg, 2006; Sandy, Tchernis, Wilson, Liu, & Zhou, 2013) to increasing community unity (Browning & Cagney, 2002; Cohen, Inagami, & Finch, 2008; Groenewegen, van den Berg, de Vries, & Verheij, 2006), to offsetting socioeconomic disparities (Jennings, Larson, & Yun, 2016). In addition, urban green space has been shown to be related to another aspect of city life directly affecting the health and well-being of residents: crime.

Urban crime typically stems from residential instability, sustained economic depravity, and group dynamics that reinforce concentrated disadvantage within communities (Hughey et al., 2016; Sampson, 2012). These interacting forces precipitate a lack of social control and eventual social disorganization (Bursik, 1988). In urban environments, crime has been linked to high poverty and low income levels (Carvalho & Lewis, 2003; Ludwig, Duncan, & Hirschfield, 2001), low levels of education (Lochner, 2008; Lochner & Moretti, 2001), racial segregation (Blau & Blau, 1982; Lee, 2000), and overall lack of resources (Kuo & Sullivan, 2001a; Markowitz, Bellair, Liska, & Liu, 2001; Zembroski, 2011). Whereas these factors highlight the inequities in socioeconomic status (SES) within urban hierarchies that are consistently linked to crime, other potential crime correlates have generated less conclusive results.

The relationship between the built environment and crime in urban settings has been studied for decades, revealing complex relationships (Schroeder & Anderson, 1984; Shaw & McKay, 1942). Specifically looking at parks and green space, studies have demonstrated that both can be effective in crime prevention and reduction (Bogar & Beyer, 2015; Branas et al., 2011; Donovan & Prestemon, 2012; Garvin, Cannuscio, & Branas, 2013; Kuo & Sullivan, 2001b). For instance, Kuo and Sullivan (2001a, 2001b) showed that vegetation and "greener" surroundings were associated with a reduction in crime and incivilities in a historically disadvantaged Chicago housing complex. In a similar study in Austin, Texas, Snelgrove, Michael, Waliczek, and

Zajicek (2004) found that crime was reduced when vacant lots were "greened." The researchers posited that this decline was due to increased feelings of safety, resulting in enhanced socialization and community interactions. In Philadelphia, Garvin et al. (2013) also studied the impact of greening vacant lots, finding that assault with and without a gun, theft, and disorderly conduct were all reduced with increases in green space. The authors concluded that "vacant lot greening changes the physical environment from one that may promote crime and fear to one that may reduce crime and improve perceptions of safety" (p. 201). Studies focusing on urban tree cover in Portland, Oregon (Donovan & Prestemon, 2012), and Baltimore, Maryland (Troy, Grove, & O'Neil-Dunne, 2012), have revealed similar inverse relationships between canopy coverage and violent, property, and disorderly crime rates (Donovan & Prestemon, 2012).

Despite the apparent benefits of urban green space from a crime prevention perspective, potential costs also exist. Parks may actually attract crime to certain areas of the city (Groff & McCord, 2012; Shafer, Lee, & Turner, 2000), thus fostering avoidance behavior (Shinew, Stodolska, Roman, & Yahner, 2013; Stodolska, Shinew, Acevedo, & Izenstark, 2011) and inadvertently propagating segregation (Solecki & Welch, 1995). For example, research has shown that when parks are allowed to decay or are designed in a manner that propagates segregation, they can create social and economic boundaries between existing communities (Solecki & Welch, 1995; Stodolska et al., 2011). Eventually these boundaries can lead to an increase in crime as cohesion among community residents decreases (Bernasco & Block, 2011; Jean, 2008). And, although the relationship between crime and parks is multidimensional, dependent on a variety of geographical, cultural, and managerial factors, it is strongly influenced by the physical and social factors associated with the built environment.

The built environment can be defined as the physical elements existing within a neighborhood or community that affect the emotional, psychological, and physical well-being of neighborhood residents (Northridge, Sclar, & Biswas, 2003; Schweitzer, Kim, & Mackin, 1999). A majority of the literature on the built environment and crime has focused on structural features that increase the likelihood of criminal activity such as poor lighting (Farrington & Welsh, 2002) or gang tagging (Lane & Meeker, 2003). These associations are founded in the theory of broken windows (Wilson & Kelling, 1982), which posits that deteriorating and unrepaired physical structures, which convey negative images of communities and their ability to control crime, are the catalyst for delinquency and disorder within a neighborhood (Ross, 2013). Minor forms of delinquency such as graffiti or vandalism lead to an escalation of offenses and an eventual breakdown of community (Jean,

2008; Wilson & Kelling, 1982). Although this theory has been criticized for its limited scope (Taylor, 2001), it has succeeded in drawing attention to the importance of the built environment on crime and disorder.

Given the inadequacies of the theory of broken windows, the crime prevention through environmental design (CPTED) approach has been adopted by many urban environment scholars (Marzbali, Abdullah, Razak, & Tilaki, 2012; Newman, 1972; Sohn, 2016). CPTED seeks to reduce crime through neighborhood design and structure modification that focus on the permeable versus defensible space (Marzbali et al., 2012; Sohn, 2016). Permeable space is defined as space that has a high density of individuals, allows for free-flowing human movement, and is easily accessible to strangers (Cozens & Love, 2009). In contrast, defensible space is characterized as residential space with low traffic density, restricted access to strangers, and the ability of residents to recognize potential threats in the community (i.e., self-policing; Sohn, 2016).

One of the first people to recognize the connection between the built environment, social familiarity, and the community's ability to recognize criminal activity and "self-police" a defensible space was Jane Jacobs (1961). In her book, *The Death and Life of Great American Cities*, Jacobs developed and defended the "eyes on the street" theory, advocating for the use of mixed residential and commercial communities to deter deviant activities and foster mutually supportive relationships through social interactions, economic transactions, and continuous surveillance (Sampson, Raudenbush, & Earls, 1997). A space that is highly trafficked, while being permeable, may also be defensible as criminals become unwilling to risk the increased chance of being seen or caught (Jacobs, 1961). Jacob's idea aligns with the CPTED concept of activity support, which is built on the premise that spaces possessing elements that attract people who do not wish to commit a crime naturally deter people who do (Cozens, Saville, & Hillier, 2005). This concept, however, stands in contrast to other CPTED tenets such as access control, which persist that when a space becomes more permeable and residents lose the ability to control through movement, they become more vulnerable to crime (Armitage, 2011). This contrast reflects the complex nature of occupied space in large cities, where the relationship between crime and the built environment can vary from neighborhood to neighborhood (Bernasco & Block, 2011).

The complex relationship between the built environment and crime is particularly evident along urban greenways. Greenways are defined as linear parks that connect places and are used for recreation or travel (Lindsey, 2003). Greenways contribute to communities by providing residents with increased opportunities to socialize, commute, engage in physical recreation, and enjoy the restorative benefits of a nature (Larson, Keith, et al., 2016;

Shafer et al., 2000). Given their unique attributes, some of which invite crime and others that diffuse it, the ambiguous relationship between urban greenways and crime remains a subject of heavy debate. Whereas some have argued that urban greenways help to reduce crime by providing residents with a place to meet, interact, and unify (Shafer et al., 2000; Sinha, 2014), others contend that by increasing the connectivity of a neighborhood, urban trails may unintentionally provide avenues for crime expansion and migration (Armitage, 2006, 2011). Recent literature on linear parks and crime has also shown that linear parks may incite fear among users (Crewe, 2001). Due to a lack of information or control over the environment, fear is increased as users *perceive* the threat of victimization to be higher (Bogar & Beyer, 2015; Sreetheran & van den Bosch, 2014). For example, in her study of Boston trails, Crewe (2001) found that areas along the trails that were narrow, well lit, close to shops, and offered refuge were perceived as safe throughout the day and early evening. At night, however, the trail was not perceived as safe regardless of physical characteristics, especially in areas where visibility was limited. Despite not actually observing crime or disorder in the park, user perceptions of the space led directly to fear and their subsequent avoidance of the trail (Crewe, 2001).

Collectively, theoretical approaches such as CPTED suggest ambiguous or uncertain connections between urban greenways and crime. To investigate this relationship and better understand the complex relationship between greenways and crime, our study sought to address the following questions: (a) is there a relationship between an elevated linear trail and crime in a diverse and densely populated urban environment and (b) if so, what effects does this built environmental space have on different types of crime in the surrounding area? Using two separate but related studies of Chicago's Bloomingdale Trail, an elevated linear trail affectionately known by local residents as The 606, we examined different aspects of the greenway–crime relationship that focused on trail presence/absence at course scales (Study 1) and trail proximity at finer spatial resolution (Study 2).

Study Site and Unit of Analysis

The 606 was selected as the study site for this investigation based on its urban location, the diversity of residents it serves, and the large number of crimes present in neighboring areas. Originally a railroad passage, the Bloomingdale Line was vacated in the early 2000s by Canadian Pacific Railway. The area was closed off for public use until its reopening in 2015. In the decade prior to trail construction, the abandoned corridor became "an unregulated getaway for the homeless, drug users, urban curiosity seekers, joggers and

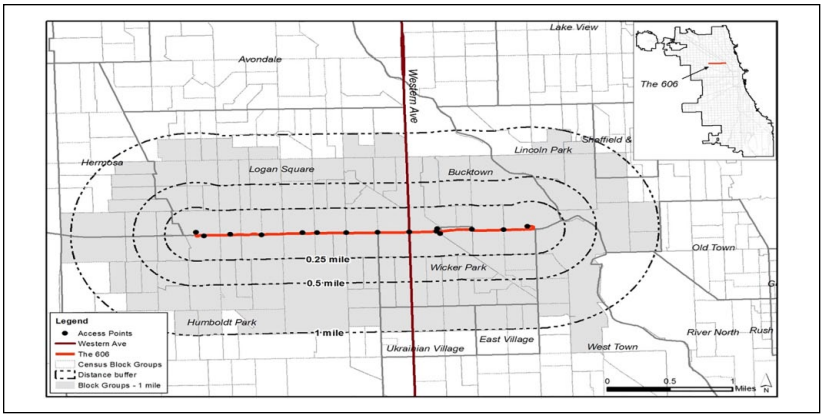

Figure 1. Map of Chicago's Bloomingdale Trail (The 606) showing primary neighborhoods and trail access points.

teenagers—some carrying backpacks full of beer, spray-paint, and fireworks" (Dudek, 2015). Whereas some individuals used the abandoned railroad for recreational purposes, others used the abandoned space for criminal activity such as drug distribution and gang activity (Dudek, 2015).

The 100 million dollar transformation of the railway to its current state began in 2013, when The Trust for Public Land, The City of Chicago, The Chicago Park District, and The Chicago Department of Transportation joined to break ground on Mayor Rahm Emanuel's signature project ("The Story," n.d.). Devised as a traffic congestion relief mechanism (Mortice, 2015), the 2.7-mile-long trail is one of Chicago's few east–west pedestrian corridors. The 606 features 12 access points between the western trailhead located in West Humboldt Park and its easternmost point in Walsh Park (Figure 1; Sinha, 2014). From its conception, The 606 has been marketed by the city as a sustainable amenity designed to relieve congestion and unify the vastly different neighborhoods it transverses (Figures 2 and 3). At the time our study was conducted (January 2016), The 606 had officially been open for 6 months (Trotter, 2015).

Although The 606 has become a recreation destination that attracts users from all over Chicago, the trail extends over several neighborhoods that are drastically different in terms of racial, ethnic, and socioeconomic composition: Humboldt Park, Logan Square, and West Town (Wicker Park and Bucktown; Sinha, 2014). On the west end, Humboldt Park is characterized by a large minority population (93.2%), high unemployment (17.3%), high poverty (33.9%), and a large number of residents without a high school diploma (35.4%). In comparison, the neighborhoods of Wicker Park and

Figure 2. View looking east from the Lawndale Avenue access point located on the west end of the Bloomingdale Trail.

Figure 3. View looking east from the Western Avenue access point located on the Bloomingdale Trail.

Bucktown on the east end are more affluent, with a larger White demographic (59%), low unemployment (6.6%), poverty (14.7%), and few residents

without a high school diploma (12.9%) (Esri, 2015; U.S. Census Bureau, 2015). The Logan Square neighborhood, located in the middle of the trail, remains largely Latino (50.7%) but is quickly gentrifying as developers seek to take advantage of increased consumer interest (Gomez-Feliciano et al., 2009). For analytical purposes, we divided each of these larger neighborhoods into census block groups (CBGs), which represents the next to smallest spatial unit recognized by the U.S. Census Bureau (U.S. Census Bureau, 2015). Previous studies have shown that CBGs are a reliable unit of analysis for examining park proximity and other neighborhood correlates such as crime (Hughey et al., 2016; Nicholls, 2001).

Dependent Variable: Crime

Crime was the dependent variable in our analysis. Specifically, we examined differences in violent, property, and disorderly crime rates for the years 2011 (pretrail) and 2015 (posttrail) in CBGs throughout Chicago (Study 1) and surrounding The 606 (for Study 1 and Study 2). According to the FBI, violent crime is composed of murder and involuntary manslaughter, forcible rape, robbery, and aggravated assault (Federal Bureau of Investigation, 2016a). We also included simple and domestic battery under the violent crime categorization. Property crime includes incidents of burglary, larceny-theft, motor vehicle theft, and arson (Federal Bureau of Investigation, 2016b). Although no FBI definition exists for disorderly crime, we grouped all other crimes into this category, including criminal damage, trespassing, narcotics, weapons, solicitation violations, interference with public officers, and other violations (stalking, harassment, parole violation, illegal possession). We obtained all crime data from the City of Chicago's crime data portal (City of Chicago, 2016). To maintain consistency across years, we only examined crime data from June to November, the warmer months where crime in the city typically peaks (City of Chicago, 2016).

Study 1: Matched Case-Control Analysis

Method

In the first phase of our study, we used a quasi-experimental matched case-control approach to compare per capita crime rates in 606-proximate neighborhoods (or CBGs) with those in socioeconomically similar neighborhoods in other parts Chicago. First, we placed every CBG in the city into one of two categories using the disadvantage index, a reliable measure of concentrated socioeconomic disadvantage in urban environments (Hughey et al., 2016;

Kirby & Kaneda, 2005; Turney & Harknett, 2009). The disadvantage index is composed of unemployment percentage, households below poverty, percentage of individuals with no high school education, and the percentage of renter-occupied housing. It is calculated by first standardizing the four indicators and then summing each of their totals (Hughey et al., 2016). Higher scores on the index indicate greater disadvantage, or lower SES. Because crime in neighborhoods characterized by low SES occurs at higher rates than in neighborhoods that are more affluent (Friedson & Sharkey, 2015; Sampson, 2012; Sampson & Sharkey, 2008), analyses of urban crime patterns should account for social disadvantage at the neighborhood level.

Using sociodemographic data from U.S. Census Bureau (2015) and Esri (2015), an index score was calculated for each CBG in the city. Low disadvantage neighborhoods reflected high SES, and high disadvantage neighborhoods reflected low SES. Next, we identified all CBGs within 0.5 miles of The 606 and determined their 2011 disadvantage index scores. This approach revealed a clear west (high disadvantage, Humboldt Park, etc., 43 CBGs) to east (low disadvantage, Wicker Park, Bucktown, 19 CBGs) divide along the trail, bisected by Western Avenue. We used the mean 2011 disadvantage index scores for 606-proximate west and east neighborhood clusters to identify comparable neighborhoods in Chicago that were not near the trail (i.e., matched case controls): low disadvantage Lincoln Square (22 CBGs on Chicago's North Side, about 5 miles from the trail) and high disadvantage Pilsen (44 CBGs on the Lower West Side, about 6 miles from the trail; Figure A1 in Online Appendices). Contiguous CBGs were selected within these neighborhoods until a distribution was reached that closely resembled that of the neighborhoods near The 606.

To confirm that 606 neighborhoods and matched controls were similar, we compared 2011 statistics and found no major differences with respect to other urban demographic indicators such as total population, median home values, or diversity index, which examines the probability that two randomly selected individuals will be from the same race category (Simpson, 1949). Initial differences were observed in per capita crime rates (crimes per 100 residents) within each CBG (higher 2011 crime rates near the current 606 location), so we attempted to normalize comparisons by examining the mean changes in absolute crime rates (property, disorderly, and violent) from 2011 and 2015. Because construction of The 606 began in 2013 and the trail was completed in 2015, we presumed that—when compared with other comparable Chicago neighborhoods experiencing similar citywide change—observed changes in crime rates for 606-proximate neighborhoods over that time period would be primarily due to the trail itself. In total, we compared 87 high disadvantage (low SES) CBGs and 41 low disadvantage (high SES) CBGs.

Data in Study 1 were analyzed using IBM SPSS (IBM SPSS Statistics Version 23, 2015). First, to understand the general distribution of crime and examine the linearity of the data, descriptive statistics were run for each crime category and covariate. We used standardized *z* scores, Cook's *D*, and Mahalanobis distance to detect outliers. In total, three CBGs with greater than 80 occurrences of property crime in 2011 were removed from the analysis, as each was found to exceed the critical value for Mahalanobis distance. For disorderly and violent crime, there were no outliers. We then conducted two series of independent sample *t* tests to compare the differences in per capita crime rates in 2011 and 2015 for neighborhoods adjacent to and farther from the trail, based on social disadvantage. The Bonferroni correction to family-wise error rate (adjusted $\alpha = .05/3$) was applied prior to interpretation of the multiple comparison tests. To further assess the interactions among 606 proximity, neighborhood status, and crime rates, we pooled all CBG data and conducted ANOVA to test for differential impacts on crime based on 606 proximity, neighborhood status (i.e., disadvantage index), and potential interactions between these two variables. Effects sizes were estimated using Cohen's *d* for *t* tests and partial eta-square for ANOVA.

Results

Results suggested that the presence of The 606 had a significant and large positive effect on violent crime in both high disadvantage (low SES) and low disadvantage (high SES) neighborhoods (Table 1). In other words, violent crime rates near The 606 decreased more substantially between 2011 and 2015 (post-606 construction) than they did in comparable neighborhoods away from the trail. Similar patterns were observed for property and disorderly crimes, though these differences were only statistically significant with moderate effects sizes in low SES neighborhoods (Table 1). Diversity index scores also increased at a significantly higher rate in low SES neighborhoods near the trail than in other comparable Chicago neighborhoods. Disadvantage and diversity index scores for high SES neighborhoods did not appear to be significantly affected by 606 construction.

We observed similar patterns in the ANOVA, evaluating relationships among 606-proximity, neighborhood status, and changing per capita crime rates for the pooled set of CBGs. In the violent crime model, both The 606 proximity, $F(1, 124) = 15.06$, $p < .001$, $\eta_p^2 = .11$, and disadvantage index variables, $F(1, 124) = 15.12$, $p < .001$, $\eta_p^2 = .11$, were significant. Examining violent crimes for 2011 and 2015 showed that it decreased faster in low SES CBGs and those closer to the trail. Results were similar for disorderly crimes, with significant effects for both The 606 proximity, $F(1, 124) = 4.79$,

Table 1. Comparison of Mean Changes From 2011 to 2015 in Crime Rates Per 100 Residents, Social Disadvantage, and Diversity for High and Low Disadvantage Chicago Neighborhoods (CBGs) Close to and Away From The 606 Trail.

	High disadvantage (low SES)			Low disadvantage (high SES)		
Variable (change from 2011 to 2015)	Near 606 (n = 43)	No 606 (n = 44)	Difference test	Near 606 (n = 19)	No 606 (n = 22)	Difference test
Violent crimes per 100 residents	−0.863	−0.311	$t(85) = 3.91$, $p < .001$, Cohen's $d = .83$	−0.310	−0.017	$t(39) = 2.93$, $p = .006$, Cohen's $d = .91$
Property crimes per 100 residents	−0.922	−0.570	$t(85) = 2.17$, $p = .033$, Cohen's $d = .46$	−0.938	−0.865	$t(39) = .27$, $p = .792$, Cohen's $d = .08$
Disorderly crimes per 100 residents	−1.019	−0.577	$t(85) = 2.31$, $p = .024$, Cohen's $d = .49$	−0.433	−0.194	$t(39) = 1.21$, $p = .232$, Cohen's $d = .37$
Disadvantage index	−1.084	−0.814	$t(85) = 1.20$, $p = .232$, Cohen's $d = .26$	−0.413	−0.271	$t(39) = 0.73$, $p = .470$, Cohen's $d = .23$
Diversity index	0.102	0.027	$t(85) = -3.92$, $p < .001$, Cohen's $d = .84$	0.026	0.046	$t(39) = 0.54$, $p = .591$, Cohen's $d = .18$

Note. CBG = census block group; SES = socioeconomic status.

$p = .030$, $\eta_p^2 = .04$, and disadvantage index variables, $F(1, 124) = 9.71$, $p = .002$, $\eta_p^2 = .07$. Property crime trends reflected the same general pattern, although neither variable had a statistically significant influence in that particular model. The 606 Proximity × Disadvantage Index interaction term was not significant for any of the ANOVA crime models.

Discussion

In the past decade, crime rates in major metropolitan areas have declined at a nearly unprecedented rate (Friedson & Sharkey, 2015; Sampson, 2012). With the exception of 2016, which has seen a spike in violent crime (City of Chicago, 2016), Chicago has followed this general pattern (Friedson & Sharkey, 2015). Our study highlighted substantial differences in crime between 2011 and 2015 for almost all the CBGs in the analysis. However, per capita crime rates appear to be falling more rapidly in some parts of the city than others. Our results suggest that construction of The 606 has led to significant decreases in per capita crime rates—particularly in low SES neighborhoods along the trail. This was particularly true among violent crime rates, which decreased more rapidly in both low and high SES 606-proximate neighborhoods than in similar Chicago neighborhoods farther from the trail. Several potential explanations for this result exist. First, when compared with high SES neighborhoods, the 2011 baseline for violent crime rates was much higher in low SES neighborhoods along the trail's western end, leading to greater room for improvement. But other factors likely contributed to this change as well.

Returning to Jacobs's (1961) "eyes on the street theory," criminals may choose to avoid The 606 area because increased overall traffic and density lead to an enhanced risk of being caught. Looking at the relationship between violent crime and traffic density, Christens and Speer (2005) found similar results. They postulated that as population in an area rises, violent crime falls because of the increased presence of individuals to intervene. Because The 606 traverses neighborhoods that are high in both commercial and residential densities, traffic in the area is naturally increased as commuters, exercise enthusiasts, and tourists frequent the trail (Vivanco, 2016b). The increase in traffic due to The 606 may be particularly beneficial to the low SES neighborhoods on the west end, which have historically been more prone to violent crime than those neighborhoods located farther east (Rúa, 2012). The increase in traffic as a mechanism for violent crime reduction is supported in the CPTED factor of activity support (Sohn, 2016), whereby heavy use leads to heightened overall natural surveillance of the area and decreases in deviant behavior. In other urban spaces, greenways have generally shown to promote positive outdoor recreation participation for a diverse array of urban residents

(Branas et al., 2011; Groenewegen et al., 2006; Larson et al., 2016; Wolfe & Mennis, 2012), including those living in low SES neighborhoods. The encouragement of positive recreational activities along The 606 may deter crime by providing increased opportunity for positive recreational engagement (Cohen et al., 2016; Garvin et al., 2013).

Another potential explanation for the more rapid decline in violent crime in 606-proximate neighborhoods may stem from enhanced social interactions made possible by the trail. Such interactions can lead to an increase in social capital, defined as the "cooperative social relationships that facilitate the realization of collective goals" (Rosenfeld, Baumer, & Messner, 2001, p. 284). Multiple studies have shown that social capital directly contributes to reduction in violent crime (Rosenfeld et al., 2001; Sampson, 2012; Sampson et al., 1997). For example, in a study on neighborhood social ties and the reproduction of social capital, Kaźmierczak (2013) found that neighborhood parks, when properly maintained and perceived as safe, serve to facilitate interactions and, as a result, increase the overall social capital in a community. Additional research on the relationship between green space and social capital in low SES neighborhoods has produced similar results, with increases in green space showing a positive relationship with social capital and an inverse relationship with violence (Garvin et al., 2013; Kuo & Sullivan, 2001b). However, as Collier (2002) explained, for social capital to be effective in crime reduction, both the "social" and "capital" components must be present. Integration of The 606 has potentially provided this positive structural component that the low SES areas located on Chicago's West Side were previously lacking (and components that continue to be absent in the comparable neighborhoods we studied). By revitalizing and removing a space that visually signified decay and disorder, The 606 is now a common space for neighborhood residents to engage with one another without fear. Social capital may, therefore, be a product of the interactions both between and within the neighborhoods now possible as a result of the trail's construction (Cozens, Hillier, & Prescott, 2001; Cozens, Saville, & Hillier, 2005; Jacobs, 1961).

In addition to significant impacts on violent crime, The 606 also seemed to have a significant and positive impact on property and disorderly crime in neighborhoods immediately surrounding the trail. In both these latter cases, the strength and trajectory of the relationship between the trail and crime appeared to be moderated—at least to some degree—by a neighborhood's SES. For individuals living in high disadvantage (low SES) neighborhoods close to The 606, disorderly and property crimes are decreasing faster than in comparable neighborhoods farther from the trail. This finding supports previous literature on the positive impact parks have in urban communities plagued by low SES (Garvin et al., 2013; Kuo & Sullivan, 2001a; Wolfe & Mennis, 2012). However, despite associations with lower levels of violent crime, the

presence of The 606 appears to have fewer effects on property or disorderly crimes in low disadvantage (high SES) neighborhoods. Although this finding may simply be indicative of the drastic changes occurring in the more western neighborhoods and the stability of the eastern communities, results also highlight greenways' potential to act as either a crime attractor or generator (Groff & McCord, 2012). Given that the east end of the trail is more commercialized, it may provide criminals with both the ability to remain anonymous and target an increased number of potential victims (Brantingham & Brantingham, 1995; Groff & McCord, 2012).

Study 2: Hierarchical Linear Modeling (HLM) Methods

Method

In the second phase of our study, we employed HLM to conduct a more spatially refined analysis of 606-proximate CBGs to examine the impact of trail proximity on violent, property, and disorderly crime. Again, we focused on CBGs within a 0.5-mile radius of The 606 ($n = 62$). Recent research from The Trust for Public Land supports the use of the half a mile standard, finding that residents in urban centers are willing to travel distances of up to half a mile to reach a park destination (Trust for Public Land, 2016). Given The 606's use as both a recreational amenity and transportation conduit, it is reasonable to assume that the trail's impact extends at least half a mile from its borders.

We wanted to assess the influence of time on crime, primarily because it served as the proxy to the trail's construction. We again focused on crime data at two points in time: 2011 (representing the "pretrail" condition 2 years prior to the trails groundbreaking) and 2015 (representing the "posttrail" condition 2 years after groundbreaking and after the trail opened). The second important independent variable in this study was spatial proximity to The 606 (measured in feet). If the trail were influencing crime, we assumed the effect would be more pronounced in CBGs closer to the trail. To calculate proximity, each of the 12 access points along The 606 was mapped using ArcGIS. Proximity was estimated as the distance from the center of each CBG to the nearest 606 access point. The neighborhood disadvantage index (calculated for both 2011 and 2015) was included as a control in our HLM analysis to isolate the effects of the trail (time) and trail spatial proximity while accounting neighborhood SES disparities.

Data in Study 2 were also analyzed using IBM SPSS Statistics software (IBM SPSS Statistics Version 23, 2015). After screening all data and removing three CBG outliers based on property crime data using the process described in Study 1, we developed a mixed model to examine the variance existing

both within (Level 1; e.g., time—in this case, pre- and posttrail and disadvantage) and between (Level 2; e.g., CBG and corresponding variables such as trail proximity) each of the CBGs in our study (Hofmann, 1997). In other words, years (2011, or pretrail, and 2015, or posttrail) were nested (Level 1) within CBGs (Level 2).

Given the hierarchical nature of the study, it was important to first determine a baseline (or null) model for each of the three dependent variables (i.e., types of crime). These analyses reveal how much variance resides within and between groups and also serve as a baseline for further analyses (Raudenbush & Bryk, 2002). Intraclass correlation coefficients (ICCs) derived from the null modes revealed a significant amount of nesting between groups (property crime = .401; violent crime = .458; disorderly crime = .373). These results provided support and justification for the use of our mixed model approach.

After determining the null model (Model 1), potential predictors were entered into the model hierarchically to determine the incremental predictive power of each variable. The time variable was entered first as a fixed effect to determine the linear trend of crime across 2011 and 2015 (pre- and posttrail). Time was also entered as a random effect to determine the random error term. After recording results for year, the disadvantage index was added to the model as both a fixed and random effect. Following Raudenbush and Bryk's (2002) strategy of mixed model construction, which professes to keep models as simple as possible, we chose to use only the disadvantage index as a control variable to minimize the risk of multicollinearity while still accounting for a key SES-based crime correlate (Raudenbush & Bryk, 2002). Once we had recorded the impact of disadvantage, our Level 2 predictor, proximity, was added to the model as a fixed effect. Both year and proximity were grand mean centered to remove between group variance and provides a "pure" estimate of the within-group slope (Tabachnik & Fidell, 2007). Following Raudenbush and Bryk's (2002) model explanation, the Level 1 equation was

$$Y_{ij}\left(\Delta \text{ violent, property, disorderly}\right) = \beta_{0j} + \beta_{1j} X_{1j}\left(\text{year}\right) + \beta_{2j} X_{2j}\left(\text{disadvantage index}\right) + \varepsilon,$$

- Y_{ij} is the change in violent, disorderly, and property crime;
- β_0 refers to intercept of crime at Level 2 proximity;
- β_{1j} regression coefficient for the explanatory Level 1 variable year;
- β_{2j} regression coefficient for the explanatory Level 1 variable disadvantage index;
- X_{1j} = Level 1 predictor variable year;
- X_{2j} = Level 1 predictor variable disadvantage index; and
- ε refers to the random errors at Level 1.

The Level 2 model used the proximity variable to predict the Level 1 intercept, and the Level 1 slopes were not allowed to vary. The Level 2 equation was

$$\beta_{0j} = y_{00} + y_{01} Z_j (\text{proximity}) + u_{0j}, \quad (1)$$

$$\beta_{1j} = y_{05} (\text{year}) + u_{1j}, \quad (2)$$

$$\beta_{2j} = y_{10} (\text{disadvantage index}) + u_{2j}. \quad (3)$$

Equation 1 predicts the average property crime (the intercept β_{0j}) using proximity (Z) at the CBG level (Level 2). In Equation 1, y_{00} is the overall intercept, whereas y_{01} is the coefficient between property crime and proximity. Both Equations 2 and 3 predict the Level 1 coefficients, or slope, between property crime and the Level 1 predictors (year and disadvantage index). The u terms in the equations represent (random) residual errors at Level 2.

In addition to testing each of the variables individually, we also tested the cross-level interaction between the year (Level 1) and proximity of the CBGs to the trail (Level 2). The inclusion of the interaction allowed us to test the effect of year (i.e., trail construction) on each type of crime, moderated by proximity (Aguinis, Gottfredson, & Culpepper, 2013). If moderation were occurring, we would expect to find differences in the slope across time (pre- and posttrail), or a nonparallel relationship between those areas with high, average, and low crime. This interaction was tested when controlling for the disadvantage index.

Results

The HLM analysis revealed multiple significant predictors of property crime (Table 2). When the Level 1 variable year was added (Model 2), property crime declined significantly across years, reducing the residual variance by 50.9% from the null model (Model 1). This finding is consistent with prior research in Chicago (Friedson & Sharkey, 2015), which has shown that city-wide crime has dropped substantially during the past decade. Disadvantage also proved to be a significant predictor (Model 3), accounting for 1.7% of the overall variance with results showing $\gamma = -1.43$, $SE = 0.478$, $p < .05$. This model reaffirms what was found in Study 1: The 606 seems to have a stronger positive influence on property crime rates in low SES neighborhoods (relative to comparable low SES neighborhoods in other parts of Chicago), than it does on property crime rates in more affluent areas. In Model 4, the Level 2 variable proximity was entered as a fixed effect. Results show that proximity to The 606 is a significant predictor of property crime $\gamma = .003$, $SE = 0.0014$, $p < .05$, reducing the overall intercept variance by 4.5%. For every additional

Table 2. Multilevel HLM Regression Models Examining Factors Associated With Property Crime Rates in Neighborhoods Near Chicago's 606 Trail (n = 62).

	Model 1 (null)	Model 2	Model 3	Model 4	Model 5
Effect	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)
Intercept	24.464 (1.42)	24.74 (1.52)	24.75 (1.49)	24.67 (1.37)	24.68 (1.41)
Level 1 year	—	−11.23* (1.32)	−11.21* (1.33)	−11.14* (1.36)	−11.15* (1.33)
Level 1 disadvantage index	—	—	−1.43* (0.478)	−1.590* (0.467)	−1.515* (0.473)
Level 2 Proximity	—	—	—	0.003* (0.0014)	0.0027* (0.0014)
Interaction Level 1 year and Level 2 proximity	—	—	—	—	−0.0031* (0.0013)
Change in Model R^{2a}	—	.5089	.017	.045	.027

Note. HLM = hierarchical linear modeling.
[a]R^2 is the HLM version of the percent reduction in variance.
*$p < .05$.

foot one moves out from the trail, property crime increases by .002. Or, simply stated, as proximity to The 606 increases, property crime rates decrease. Finally, in Model 5, we examined the cross-level interaction between proximity and year while controlling for disadvantage. The cross-level interaction tested the change in the slope of distance moving from the 2011 to 2015 or the change in the slope of year as distance increases 1 unit (Aguinis et al., 2013). Results showed that all predictor variables, including the interaction, were significant, with a 2.7% change in the R^2 and an overall reduction in slope variance of 23.6%. For every 1 unit increase in the moderator (proximity), the slope for property crime decreases by .03. The cross-level interaction indicated that although overall property crime is decreasing over the 4-year period, the rate of the decline is lower at greater distances from the trail (i.e., the effect is moderated by trail proximity).

Using the same multilevel modeling, we also examined the effect of The 606 on violent and disorderly crime. Consistent with violent crime trends outlined in previous literature (Friedson & Sharkey, 2015), violent crime decreased at a significant rate in 606-proximate neighborhoods from 2011 to 2015, $\gamma = -6.81$, $SE = 0.828$, $p < .05$, reducing the residual variance by 44.4%. In addition to time (year) being a significant predictor of violent crime, the disadvantage index was also found to be significant, $\gamma = 1.632$, $SE = 0.247$, $p < .05$, reducing the overall variance by 4.2%. This finding is also in line with previous research, which has shown violent crime is significantly higher in those areas with lower SES and higher amounts of concentrated disadvantage (Sampson, 2012). However, for CBGs within 0.5 miles of The 606, significant effects of trail proximity and cross-level interactions involving trail proximity were not evident with respect to violent crime.

Disorderly crime also decreased significantly across years before and after 606 construction, $\gamma = -9.17$, $SE = 1.18$, $p < .05$, reducing the residual variance by 41.3% from the null model. The disadvantage index was also a significant predictor of disorderly crime, $\gamma = 1.136$, $SE = 0.363$, $p < .05$, reducing the overall variance in the model by 3.1%. However, similar to violent crime, significant effects of trail proximity and cross-level interactions involving trail proximity were not evident with respect to disorderly crime. Although the presence of The 606 (i.e., year) is associated with reductions in violent and disorderly crime when compared with similar neighborhoods in Chicago, particularly in low SES neighborhoods, specific trail proximity at a more localized scale does not seem to be significant.

Discussion

Although our first study showed that the presence of The 606 was positively correlated with decreases in all types of crime when compared with similarly

stratified neighborhoods without the trail's presence (particularly in low SES neighborhoods near the trail), our second analysis sought to examine more specific effects of trail proximity on crime in CBGs near the trail. Results revealed the most significant relationship with property crime, which was lowest at close proximity to The 606 and gradually rose as proximity increased (Figure A2 in Online Appendices). Although our analysis did not reveal mechanisms driving the observed crime distribution patterns, several potential explanations exist. One possible cause for this phenomenon is that areas immediately surrounding The 606 have commanded the attention of formal surveillance systems, especially in the high disadvantage, 606-proximate neighborhoods that were once plagued by crime (Velez, 2001). Because The 606 is being marketed by Chicago as a safe and friendly environment, increased emphasis has likely been placed on monitoring and removing delinquent activity from areas immediately surrounding the trail (Hinkle & Weisburd, 2008).

In addition to formal surveillance, the decrease in property crime may also be a result of the CPTED concept of territoriality (Sohn, 2016). Territoriality is centered on the premise that individuals within a community will protect their own space and be mindful of outsiders who travel through the area (Anderson, MacDonald, Bluthenthal, & Ashwood, 2012; Minnery & Lim, 2005). Levels of theft and other crimes in communities are reduced when local residents feel a sense of ownership and guardianship (Wortley & McFarlane, 2011). It is possible that reduction of property crime along The 606 is a reflection of individuals in the neighborhoods taking ownership of both the areas around the trail and the trail itself. For example, the volunteer organization Friends of the Bloomingdale Trail recently created a map that aggregates news stories occurring with a two block radius of the trail (Hauser, 2015). Through actions such as this, community residents are empowered with the ability to rapidly share communication about deviant activity along the trail and assist one another in informal surveillance. Vigilance may decrease at distances farther from the trail.

Natural surveillance, another hallmark of CPTED, may also play an important role in the prevention of property crime in areas adjacent to the trail (Sohn, 2016). Research has shown that natural surveillance and subsequent crime reduction is enhanced through increased lighting (Farrington & Welsh, 2002; Painter, 1996; Pease, 1999), street designs that are difficult to navigate (Cozens & Love, 2009), and designs with numerous escape points (Fisher & Nasar, 1992; Luymes & Tamminga, 1995). All these built environment factors inhibit criminal movement and refuge (Marzbali et al., 2012; Sohn, 2016). Because each of these design components is present on The 606, criminals may be discouraged to engage in deviant actions along the trail and

within its immediate surroundings. However, one area where this does not seem to hold true is Damen Avenue on the east end of the trail. Here, property crime spikes and extends outward to a distance of a half mile (see dark red coloring on Figure A2 in Online Appendices). The reason for the deviation in crime patterns at this location may stem from high levels of commercialization at the Damen–Milwaukee Ave. intersection in Wicker Park. As discussed in Study 1, highly commercialized areas can often serve as crime generators due to the vast number of targets available for potential criminals (Brantingham & Brantingham, 1993, 1995).

Although trail proximity appeared to affect property crime rates, effects on violent and disorderly crime were less pronounced. Both types of crime declined significantly in 606-proximate CBGs after trail construction, but neither was influenced by distance from the trail. Other correlates remained important, however. For example, social disadvantage proved to be a significant predictor for all three types of crime, a result found in prior literature on crime in urban environments (Carvalho & Lewis, 2003; Ludwig et al., 2001; Morenoff, Sampson, & Raudenbush, 2001). In Chicago, Sampson (2012) found that concentrated disadvantage is a perpetuating cycle that weakens infrastructure by undermining positive social processes needed to build strong community. The systematic breakdown in social process eventually leads to community disorganization and an increase in crime and disorder (Sampson, 2012). Although crime has shown significant decreases in almost all neighborhoods along The 606 over time, overall violent and disorderly crime rates remain higher in the more western neighborhoods characterized by higher disadvantage (City of Chicago, 2016).

Limitations and Future Research

Before considering broader implications of our results, it is prudent to take a closer look at the limitations of our studies. First, The 606's relationship with crime may have been moderated positively or negatively by exceptionally high traffic patterns during the 6 months we studied in 2015 (June-November), the opening months of the trail. To address this issue, future longitudinal studies could examine normalized trail patterns after the postconstruction hype has passed and the trail has become more a fixture in trail-proximate neighborhoods. A longitudinal approach could also help researchers fully understand the trail's impact on the culture of surrounding neighborhoods, especially related to gentrification. Before the opening of the trail, the neighborhoods on Chicago's West Side were fairly homogeneous and operated in isolation of one another. However, the infusion of The 606 has brought an inevitable blending of the neighborhoods, particularly in Humboldt Park

where White individuals are choosing to purchase homes in what once was a primarily Latino community (Gomez-Feliciano et al., 2009; Vivanco, 2016a). Future studies should explore how the blending of the communities resulting from The 606 is impacting the social and cultural identity of residents and how these residential fluctuations may influence social capital.

Future research on urban greenways should seek to extend on the CPTED aspect of connectivity and increased access (an attribute that distinguishes linear trails from parks and other types of green space). Given that our analyses were limited to CBGs within a half mile radius of the trail, future studies should look to extend the measurements to neighborhoods existing outside of this boundary. Specifically future studies should focus on the concept of neighborhood spatial interdependence (Sampson, 2012), where significant changes in one neighborhood create a "ripple effect" that extends outward to other neighboring communities (Sampson, 2012). Our results provide evidence that The 606 may be inadvertently creating such a "ripple effect," lowering crime in those areas immediately adjacent to it, but simultaneously making other communities more permeable and, thus, potentially more vulnerable to property crime (Marzbali et al., 2012; Sohn, 2016). Geographic criminology research supports this notion, having previously shown robbers to be attracted to areas that are both easily accessible and highly dense, granting them the ability to prospect and target without detection (Bernasco & Block, 2009). By facilitating pedestrian movement and access to a number of neighborhoods, The 606 may allow offenders to remain "hidden" as they choose new targets and permeate areas that were previously isolated. Finally, given the vast disparities in disadvantage and neighborhood composition along The 606, additional investigations could explore the effect of neighborhood stigma and perceptions of disorder on trail use and social interactions in surrounding areas.

Conclusion and Management Implications

Using multiple analytical approaches, our study showed that creation of Chicago's 606 was associated with decreases in violent, property, and disorderly crimes between 2011 and 2015. It appears the crime deterrent effects of 606 construction have been particularly effective in low SES neighborhoods along the western half of the trail. Our findings also give rise to questions regarding spatial interdependence and mechanisms influencing deviant behavior when moving away from the trail, highlighting a significant inverse relationship between property crime and trail proximity. Although we have integrated theoretical frameworks such as CPTED to generate several explanations for associations between The 606 and crime, future studies are needed

to understand mechanisms driving these observed patterns and determining the influence of The 606 on the rapidly changing communities that surround it.

Although our results raise many future questions about mechanisms driving the relationship between The 606 and crime, they also highlight several management implications for areas considering adding a linear park. First, because The 606 is heralded as an innovation in the park and recreational field that provides a template for future elevated linear parks, officials planning similar projects should carefully consider the costs and benefits with respect to crime and disorder in both trail-proximate communities and those located several blocks from the amenity itself. This is particularity vital in low SES communities that often rely on community cohesion and social capital to combat crime. Next, to unify neighborhoods, facilitate resident interactions, and reduce crime, cities should continue to activate trails through programming and events. Thus far, the City of Chicago and Chicago Park District have offered a variety of diverse programs, appealing to individuals of various ages and interest ("Trail Mix Event Series," n.d.). Prior research has shown that structured park programs have the ability to increase park use and lower crime (Cohen et al., 2016). Maintaining and adding programming, such as The 606 Moves, a dance workshop facilitated by Chicago Park District in The 606's pocket parks, is, therefore, an essential part in helping to increase neighborhood interactions and combating potential deviance ("Trail Mix Event Series," n.d.).

Finally, although general decline in crime in neighborhoods along The 606 is encouraging, it may be driven in part by gentrification and neighborhood trajectory (Hwang & Sampson, 2014). Gentrification has been shown to significantly reduce violent crime (Papachristos, Smith, Scherer, & Fugiero, 2011). The reason for this reduction is that new resources, such as businesses and new residential buildings, often take the place of previously decaying or abandoned infrastructure that perpetuate disorganization and disorder (Kreager, Lyons, & Hays, 2011). Beginning with the gentrification of Wicker Park in the 1980s and 1990s (Lloyd, 2002) and the more recent migration of White renters and homeowners into Logan Square (Gomez-Feliciano et al., 2009), the sociodemographic composition of neighborhoods around The 606 continues to change. As the increasing diversity and decreasing disadvantage scores in our study suggest, the trail seems to be attracting more affluent residents to the area, especially Logan Square and Humboldt Park (Biasco, 2015; Rúa, 2012). Regardless of future trajectory, however, Chicago must work to ensure that The 606 continues to be an inclusive, safe, and welcoming space for all 80,000 residents living within walking distance (Vivanco, 2016b). Finally, as urban trails continue to gain popularity and are integrated into the landscape of cities around the country, both researchers and professionals

working in the field must continue to study and monitor these trails to gain a better understanding of their long-term impacts on crime and community.

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Author Biographies

Brandon Harris is pursuing a doctoral degree in the Department of Parks, Recreation and Tourism Management at Clemson University. His research interests include the impact of park and recreational amenities on urban neighborhoods and residents, deviant behavior in parks and recreation, and stigma in park and recreational settings and its influence on social identity construction.

Lincoln Larson is an assistant professor in the Department of Parks, Recreation and Tourism Management at North Carolina State University. His research explores a variety of topics related to parks and conservation area management, including effects of urban green space on health and well-being across diverse populations.

Scott Ogletree is currently a PhD student in the Department of Parks, Recreation and Tourism Management at Clemson University. His research is focused on spatial relationships between protected areas and the human environment. He has a master's degree in landscape architecture and is interested in how geographic tools can be used to understand complex systems.