Urban Park Redevelopment: Neighborhood Benefits and Leisure-Time Physical Activity Engagement

by

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DEDICATION

This dissertation is dedicated to my mother for your endless support and love. Without you this work would be impossible.

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ABSTRACT

Population-level engagement in adequate leisure-time physical activity (LTPA) can improve mental and physical health and potentially save billions in health care costs. Despite these potentially positive outcomes, inadequate LTPA engagement is prevalent in the United States with urban residents' living in poverty when compared to residents not living in poverty. The joint effects of the built and social environments, as they relate to LTPA, is a growing area of research and advocacy. Related to this, multiple urban neighborhoods across the United States are redeveloping parks and anticipating various health promotive co-benefits for neighborhoods. However, assessment of post redevelopment impacts on characteristics such as crime, physical disorder, and property values are infrequent and a current research gap. This dissertation uses spatial and quantitative statistical methods to address the question of, "*Is park redevelopment associated with changes in leisure-time physical activity (LTPA), blight crime, and property values, in neighborhoods with at least one redeveloped park?"*

Specifically, this work studies Detroit, Michigan, United States of America which recently released a redevelopment plan to improve 163 of its 308 parks with 36 done in the first phase (2016 – 2017). Using the 500 Cities: Local Data for Better Health dataset, this dissertation will assess differences in LTPA prevalence in census tracts that had parks redeveloped 2006 – 2015 (n= 99) compared to tracts without redeveloped parks (n= 62) (Paper I). The following two papers compare census tracts (n= 31) with at least one park completed in Phase 1 to matched

census tracts without a redeveloped park, to assess changes to physical disorder (i.e., blight) and crime (Paper II), and property values (Paper III).

There were several key findings across these studies. The neighborhood percentage of LTPA was not associated with park redevelopment. While the crime rate per 1,000-population is increasing in the City of Detroit, neighborhoods with at least one redeveloped park had non-significant changes in rates of reported crime following park redevelopment compared to neighborhoods without redeveloped parks. This same research study found that neighborhoods with at least one redeveloped park had non-significant changes in violent crime rates per 1,000-population compared to neighborhoods without any redeveloped park. The final question of this study found that total blight fines per parcel were significantly higher in neighborhoods with at least one redeveloped park; however, the confounding of total park acres in the census tract made the association insignificant in the full repeated measures model. Finally, valid arm's length (VAL) sales price did not change following park redevelopment. However, the effect of park redevelopment on VAL differed based on additional greenspace (i.e., greenway) where there was a higher VAL sales price in neighborhoods with redeveloped parks and additional greenspace. In addition, neighborhoods with at least one redeveloped park and more than five acres of total park space reported a lower VAL sales price compared to neighborhoods with more than five acres of total park space and no redeveloped parks.

These findings more broadly provide urban neighborhoods nationwide with methods to measure health-related changes in their neighborhoods following park redevelopment and respond to questions from Detroit residents and decision-makers. Further, decision-makers should be cautious before making up-front assertions in publicly available published plans that changes will occur following park redevelopment without first testing the associations.

Chapter I

Introduction

Scholarly interest in the joint effects of built[1] and social[2] environments on physical activity (PA) has increased in recent years (Ding & Gebel, 2012; Ferdinand, Sen, Rahurkar, Engler, & Menachemi, 2012; Floyd, Taylor, & Whitt-Glover, 2009; Rao, Prasad, Adshead, & Tissera, 2007; Sallis, Floyd, Rodríguez, & Saelens, 2012; Wen & Kowaleski-Jones, 2012). The literature suggests that access to parks (Cohen et al., 2010, 2007; Cutts, Darby, Boone, & Brewis, 2009) and characteristics of neighborhood built and social environments (Kelly, Schootman, Baker, Barnidge, & Lemes, 2007) are inconsistently associated PA. These local environments may be particularly relevant for leisure-time physical activity (LTPA) levels (Ferdinand et al., 2012), influencing both opportunities for and the quality of recreational activities.

The benefits of engaging in sufficient PA include preventing and managing health conditions, such as obesity (Ferdinand et al., 2012; Sallis et al., 2012), cardiovascular disease (CVD) (Sallis et al., 2012), diabetes (Loprinzi, 2015), and depression/anxiety (Asmundson et al., 2013; Fetzner & Asmundson, 2015). In the United States, annual health care expenditures between the years 2006–2011 averaged $1.05 trillion. Of those expenditures, 11.1% were estimated to be due to insufficient LTPA (Carlson, Fulton, Pratt, Yang, & Adams, 2015).

[1] Built environments are man-made surroundings that influence human activity, which include land use (e.g., open space, green space, connectivity), transportation systems (both motorized and active), buildings, and infrastructure (e.g., water supply, energy networks) (Environmental Protection Agency, 2016).
[2] The social environment includes not only social interactions but factors related to the economy, community, home, school/daycare, demographics, safety, food security, access to healthcare, discrimination, or violence (Environmental Protection Agency, 2016).

Carlson and colleagues (2014) found that annual mean health expenditures increase compared to individuals with sufficient LTPA by $576 for those who obtain insufficient LTPA and $1,313 for those who obtain none at all. Given the research indicating links between environmental factors and LTPA, these statistics underscore the importance of improving environments in ways that encourage LTPA. This is particularly the case in urban neighborhoods where chronic diseases and their risk factors are more prevalent (Brawner, Churilla, & Keteyian, 2016; Fitzpatrick, Shi, Willis, & Niemeier, 2018).

The presence or absence of parks, particularly good quality parks where the features can be used by the general public safely, are part of the social determinants of health (SDOH). As defined, the SDOH are "conditions in the environments in which people are born, live, learn, work, play, worship, and age that affect a wide range of health, functioning, and quality-of-life outcomes and risks" (Office of Disease Prevention and Health Promotion, 2014). The continual bombardment of negative environmental conditions, such as crime, blighted properties, and vacancies in low-income neighborhoods have been linked to chronic stress and post-traumatic stress disorder (PTSD) (Garvin, Branas, Keddem, Sellman, & Cannuscio, 2013; Phelan & Link, 2015; Williams, Mohammed, Leavell, & Collins, 2010). Specifically, chronic stress and/or PTSD promote risky behaviors, such as by increasing substance use, and minimize healthy behaviors, such as by reducing LTPA (Garvin, Branas, et al., 2013).

Studies conducted over several decades have consistently found associations between a lower socioeconomic position (SEP) and reduced likelihood of meeting activity recommendations (Ford et al., 1991; Michigan Department of Health and Human Services, 2016; Yang, Diez-Roux, Auchincloss, Rodríguez, & Brown, 2012). Furthermore, beyond individual SEP, neighborhood SEP is associated with engagement (Ding & Gebel, 2012; Ferdinand et al.,

2012). For instance, as the location of this study, Detroit ranks among the lowest in the United States for median household income (United States Census Bureau, 2016). Compared to wealthier neighboring neighborhoods, Detroit has a statistically higher percentage of residents who indicate that they do not engage in any LTPA (Table I.1) (Michigan Department of Health and Human Services, 2016; Pickens, Pierannunzi, Garvin, & Town, 2018).

Table I.1. Household Median Income, Poverty, and LTPA Engagement

	Detroit City	Wayne County (Excluding Detroit)	Oakland County	Washtenaw County	State of Michigan	United States
Household Median Income	$25,764	$41,210*	$67,465	$61,003	$49,576	$55,775
Percent below 100% of the Federal Poverty Line (FPL)	39.8%	25.0%	10.1%	15.4%	16.7%	15.5%
No LTPA Engagement (95% Confidence interval)	35.5% (32.1-39.0)	24.3% (22.3-26.4)	21.3% (19.4-23.3)	16.4% (13.6-19.8)	25.5% (24.5-25.8)	25.5% (17.6%–47.1%)

Sources: United States American Community Survey 2011–2015 5-Year Estimates; Michigan Behavioral Risk Factor Surveillance Survey 2013–2015; Morbidity and Mortality Weekly Report, 2015

* Includes Detroit

In efforts to improve both the opportunities for and the quality of recreational environments, decision-makers in urban neighborhoods across the country are redeveloping their city's parks. Three current examples are Detroit, Houston, Texas, and Seattle, Washington. (City of Detroit, 2016; City of Houston, 2015; City of Seattle, 2017). Detroit has had decades of disinvestment in its recreational infrastructure because of economic decline. Houston has experienced population growth and is responding with more recreational investment. Seattle experienced a 16-year gap in facets of their recreational planning and determined that a new plan was necessary. All three urban neighborhoods expect positive outcomes from the park redevelopment, including reduction in health disparities, crime reduction, and economic development. Starting in 2016 and continuing over the next 10 years (Table I.2, further detail in Appendix A), Detroit will invest over $80 million in 163 of its 308 public parks (Appendix B)

and build three new parks. Of this, nearly $12 million has been committed in the first phase year 2016-2017. (City of Detroit, 2016). This work focuses on Phase 1, which has the most redeveloped parks with 36. The remaining 127 parks are to be redeveloped over the next 10 years (Figure I.1).

Table I.2. City of Detroit, Michigan Park Improvement Phases Construction Season

Parks	Dates
Phase 1 "Neighborhood 40" (n= 36)	
Phase 1A (n= 12)	2016
Phase 1B (n= 24)	2017
Phases 2 – 10 (n= 127)	2018 – 2026
All City of Detroit parks (n= 308)	

The City of Detroit acknowledges that parks and recreation centers "promote healthy lifestyles, crime reduction, community interaction, climate change management, and educational opportunities…[and] serve as catalysts for economic development" (City of Detroit, 2016). Further, the City of Detroit considers parks to be a "proactive measure against blight" (City of Detroit, 2016). As cities are investing millions in park redevelopment, understanding the linkage to health-related issues is of the utmost importance.

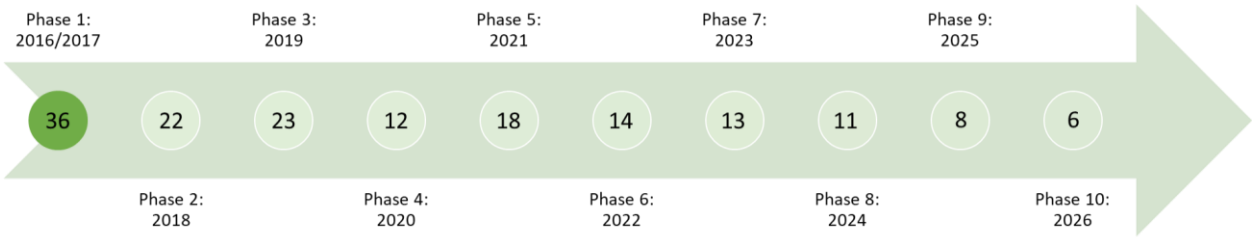

Figure I.1 City of Detroit Park Redevelopment Phases

Socioecological Approach for Understanding Correlates of Leisure-time Physical Activity

To understand how the built and social environments influence individual behavior, first, we start with the socioecological model (Bronfenbrenner, 1979). The socioecological model

posits that the environment, including policies, behavior settings (e.g. infrastructure), perceptions, and intrapersonal demographics, influences behaviors. Sallis and colleagues created an ecological model for active living, which indicates that the active living behaviors (e.g. LTPA) are an interaction between the individuals and their environment. Individuals and their environment interact across four ecological model domains: the policy environment (e.g. zoning codes, recreation investments, and park policies), the access and characteristics of the neighborhood (e.g. walkability, physical disorder, traffic safety, and recreation environment), the individual perceived environment (e.g. safety, comfort, and accessibility), and the intrapersonal characteristics of the individual (e.g. demographics, family situation, psychology) (Sallis et al., 2006).

Using Sallis and colleagues' ecological model domains, Figure I.2 demonstrates a conceptual model indicating the relationship of park redevelopment and attributes of the built and social environments for promoting urban adult LTPA. The model will form the basis for this dissertation. Specifically, this dissertation will include research on park redevelopment as an independent factor and test its relationship to the built and social environment attributes of crime, physical disorder (i.e., blight), and property values. In addition, this work will measure engagement in the active living behavior of LTPA as it relates to park redevelopment.

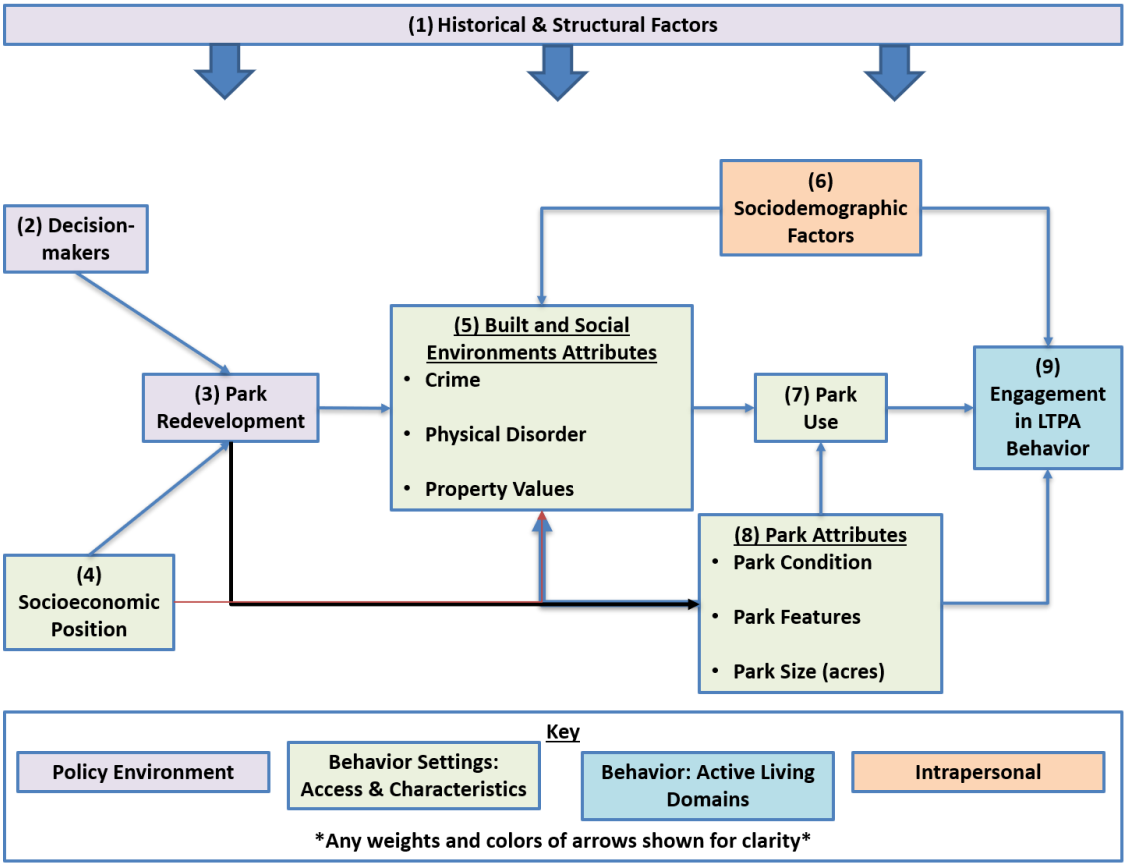

Figure I.2 Conceptual model of park redevelopment, environment attributes, and physical activity

Establishing & Maintaining Parks in U.S. Cities: Historical and Structural Factors

Racial/ethnic segregation and discrimination have resulted in minority neighborhoods that face institutional neglect, concentrated poverty, and disinvestment (e.g. absence of grocery stores, businesses, banks, and recreational facilities such as parks). It is more difficult as a result to achieve good health in these neighborhoods (Bailey et al., 2017; Sampson, Morenoff, & Gannon-Rowley, 2002; Sugrue, 1992; Williams et al., 2010). Notably, two specific factors that have influenced urban parks and LTPA engagement are the federal freeway system expansion and discriminatory recreation environments. These nationwide factors have directly impacted urban neighborhoods, including Detroit.

The construction of the federal freeway system in the 1950s and 1960s targeted urban neighborhoods of color and low-income neighborhoods in the U.S. (Brown, Morris, & Taylor, 2009; Rothstein, 2017). The federal freeway system often bulldozed through neighborhoods with high concentrations of minorities and low-income residents. On January 12, 1967, President Lyndon B. Johnson created the National Commission on Urban Problems to explore zoning, housing, building codes, taxation, and development standards. By the time the report was published, an estimated 1,054,000 housing units had been demolished as part of public housing development, urban renewal, and the federal freeway (highway) expansion. The Commission reported:

> It has been primarily the poor, the near poor, and lower middle class whose houses have been demolished. Public housing and most urban renewal sites naturally have been selected in areas with substandard housing, where by definition few if any of the upper income groups live and where, according to [Robert] Groberg, at least 57 percent of the families are poor. The remaining 43 percent are primarily members of the near poor and lower economic middle class with a sprinkling of those above this level, particularly among Negroes who find it difficult to find housing elsewhere. The various freeways into and throughout major cities more often than not avoid the areas where the well-to-do and affluent live and tend to cut through areas inhabited by families with comparatively low incomes. This is explained by three factors:
>
> 1. to the extent property values are lower in low-income areas, routes through these areas reduce expenditures for rights-of-way;
> 2. almost invariably, the more well-to-do families are both more articulate and more influential in opposing plans for highways through their residential areas; and

3. some planners actually use highway location as a kind of backdoor slum clearance device (National Commission on Urban Problems, 1969, p. 82).

The results of new freeway systems not only bulldozed homes, but destroyed other community assets in their way, including churches, businesses, and parks (Biles, Mohl, & Rose, 2014; Karas, 2015). The assets that remain were often inaccessible due to the sprawling freeway (Gioielli, 2011); thus, they fell into disrepair or their integration within a neighborhood changed (Wineman et al., 2014). Freeways also affected plans for future development of neighborhood assets such as parks.

Further, access was affected by discriminatory housing practices, the effects of which continue to this day despite repeated legal challenges. The Buchanan v. Warley court decision was the first to challenge discriminatory housing practices in the United States Supreme Court in 1917. The court decision abolished housing discrimination against racial and ethnic minorities (Supreme Court of the United States, 1917). Later, the Federal Fair Housing Act of 1968 and the 1988 amendment (United States of America, 1968, 1988) reduced discriminatory practices on the basis of race, color, religion, familial status, and disability. The resulting recreational inequities from the discriminatory housing practices are still present in urban cities. For instance, in Baltimore, the Maryland Home Owners Loan Corporation, a New Deal federal agency, worked together with the Parks and Recreation Board in the 1930s to create separate recreational spaces in African American and low-income neighborhoods. Their work created smaller, less resourced, and more congested parks in African American and low-income neighborhoods in Baltimore, which remain to this day (Anguelovski, 2016; Boone, Buckley, Grove, & Sister, 2009).

In 1972, the non-profit The Trust for Public Land was founded. It is the most prominent and well-known organization examining park systems across the United States. Their goal is to "ensure that every *child* has easy access [10-minute walk] to a safe place to play in nature" (The Trust for Public Land, 2017c). To accomplish their goal, they release an annual "ParkScore ®" that ranks the 100 largest cities in the United States according to their park system for the entire population regardless of age. Their ranking is based on the acreage, spending, and presence per capita of four types of facilities: basketball hoops, dog parks, playgrounds, and recreation/senior centers. It also includes access to the park within a 10-minute walk (approximately 0.5 miles) using street connectivity networks of the public right-of-way uninterrupted by built environment barriers such as freeways, train tracks, or water features. The 100 largest cities in the United States are compared based on where the cities rank given the nationwide median (The Trust for Public Land, 2017b). Consistently, the City of Detroit ranks near the bottom. In 2015, it ranked 60th (The Trust for Public Land, 2015), and by 2017 the ranking fell to 75th (The Trust for Public Land, 2017a). The table below (Table I.3) compares Detroit with top-ranked Minneapolis and the United States as a whole, and includes non-Hispanic Black (NHB) information for comparison (The Trust for Public Land, 2017c; United States Census Bureau, 2016). The need for recreational improvements in Detroit is evident.

Table I.3. Trust for Public Land Rankings

	Detroit, Michigan	Minneapolis, Minnesota	United States
TPL Rank, 2015	60	1	--
Non-Hispanic Black (%)	82.7%	18.6%	7.9%
Median Park Size (acres)	2.4	6.8	5.0
Spending per Resident, 2015	$19.00	$224.00	$83.00

Park Redevelopment

Following the series of "rebellions" (riots) across urban cities in the 1960s, municipalities were left to try to rebuild (The National Criminal Justice Reference Service, 1968). For decades these cities experienced the "further deterioration of already inadequate tax bases" (The National Criminal Justice Reference Service, 1968, p. 10) projected by the Federal Government. The erosion of the tax base started as early as the 1940s in Detroit when hundreds of thousands of auto industry jobs disappeared (Sugrue, 2014). Decades later, the City of Detroit – one of the post-riot urban cities – filed for bankruptcy and has since seen a gradual rebirth. Parks can serve as starting points to reduce the threats of crime and physical disorder (also referred to as aesthetics or blight) in post-industrial[3] urban neighborhoods. Researchers, private funders and municipalities assume that park redevelopment is a catalyst for changes in built and social environments, such as aesthetic improvements, crime reductions, and property sales price increases (City of Detroit, 2016; City of Houston, 2015; City of Seattle, 2017; Cohen et al., 2015; Sharkey, 2013). However, there is a dearth of research about the impact of park redevelopments on built and social environments (Branas, Rubin, & Guo, 2013; Garvin, Cannuscio, & Branas, 2013).

Municipalities, private donors, and public-private partnerships are spending millions of dollars on park redevelopment (City of Detroit, 2016; City of Houston, 2015; City of Seattle, 2017; Cohen et al., 2015). Park redevelopment includes replacing existing walkways and adding new walkways; replacing existing sports facilities and adding new sports facilities; and adding security phones, lighting, and other features. Urban governments responsible for distributing general fund dollars during budget decision-making must balance how to allocate funding for

[3] Cities where the manufacturing industry is no longer the main source of economic wealth.

issues such as public safety, which is considered to be essential, over investing in what some may perceive as non-essentials, such as public recreation (Joassart-Marcelli, 2010). However, these plans attest that park redevelopment is a method to improve public safety. Further, in some cases funding is already allocated to recreation. Advocates of park improvements in urban neighborhoods find that residents may not understand why funding is allocated toward park redevelopment when poor public safety or other problems are present in their neighborhood (T. Scott, personal communication, January 31, 2018). The outcomes for neighborhoods after park redevelopment have rarely been assessed due to the time constraints of city employees (M. Elliott, personal communication, January 30, 2017) and a need for instruction in replicable methods. Therefore, with the substantial amount of money from taxes, grants, and government funding spent on park redevelopment, it is important to assess whether improvements to the built and social environments are following. This is an area of research that would benefit residents and city decision-makers alike and help influence future planning efforts.

Park Redevelopment & Environment Attributes

Physical Disorder and Crime. Current research delivers mixed findings as to whether changes to crime and physical disorder in urban neighborhoods follow park redevelopment. Research in this area has mostly focused on qualitative studies of the effects of vacant properties on a neighborhood, not parks (Garvin, Branas, et al., 2013; Garvin, Cannuscio, et al., 2013; Ries et al., 2008). For example, in qualitative interviews of 29 African American adult residents in Philadelphia, Pennsylvania, the participants noted that vacant land made their community look "nasty" and attracted crime. Vacant land tends to take on the appearance of "nature" or a "prairie." While this visualization for some seems to be a return to the original natural state, it signifies the legacy of a lost neighborhood (Nassauer & Raskin, 2014). This natural state of the

vacant land, as the study participants contend, attracts more physical disorder and crime (Branas et al., 2013; Galster, 2001) and, with disinvestment and neglect, can also contribute to dropping property values (Whitaker & Fitzpatrick IV, 2013). Participants in the Garvin study recommended multiple solutions for the vacant land, including parks for the elderly and community gardens (Garvin, Branas, et al., 2013).

In the neighborhoods that Garvin and colleagues (2013) surveyed, the non-profit Pennsylvania Horticulture Society (PHS) performed a greening project which transformed a previously vacant or dilapidated property. PHS removed debris, added topsoil, planted grass and trees, and built wooden fences. Following the park-like greening, perceptions of physical disorder (aesthetics) and reported crime were assessed 3.5 months pre- and post-greening within a radial half-mile of the greening area and a control area that did not receive the greening treatment. Following the greening, an unadjusted difference-in-difference analysis within the radial buffer area found there were non-significant decreases in total reported crime to law enforcement. However, residents ($n = 21$) reported feeling safer ($p < 0.01$) following the greening in intervention neighborhoods (Garvin, Cannuscio, et al., 2013). The same Garvin study found that resident survey scores of physical disorder increased in both sites, indicating that residents perceived that the aesthetics in the neighborhood got worse. Given that the findings of this study were mixed, the sample size was low, and physical disorder used perceived measures, future research is warranted. Future studies could expand the length of time for the assessment, increase the number of intervention locations, and use objective measures of physical disorder to increase confidence in their conclusions.

Seemingly as a follow-up to the work with PHS, Branas and colleagues (2018) conducted a study of creating “park-like” settings and studying crime and fear. This study expanded the

observation time to a three year pre- and post-greening study period and used a citywide cluster randomized control trial featuring both qualitative and quantitative measures. Police reported gun assaults, burglary, and nuisances (e.g. loitering and loud music) in the three year post-greening period were significantly decreased; this effect was even more pronounced in neighborhoods below the poverty line. This empirical finding matched the perceptions of residents, who noted feeling safer in their neighborhood. In addition, more visitors were observed relaxing and socializing with others during the follow-up period (Branas et al., 2018).

Following the work in Philadelphia, Pennsylvania, similar greening work was done in Youngstown, Ohio. The City of Youngstown, in partnership with the Youngstown Neighborhood Development Corporation, greened lots using similar strategies as the PHS. Using a spatial Durbin regression model, they assessed crime within one-eighth and one-quarter radial miles of the greening sites at a minimum of six months and an average of 22 months. They found that reported felony assaults, burglaries, and robberies significantly decreased, by 85%, 25%, and 69%, respectively, while motor vehicle thefts and general thefts were not significantly decreased (M. Kondo, Hohl, Han, & Branas, 2016).

A national literature review of qualitative studies identifies mediators between land improvements and physical activity (McCormack, Rock, Toohey, & Hignell, 2010). Multiple studies included in the review indicated crime and physical disorder inhibit PA among urban and racially/ethnically diverse populations. Like Detroit, Philadelphia has thousands vacant lots and issues with crime and safety. In a study with a 3:1 match of not greened to greened vacant lots that used data from a previously collected household survey, Branas and colleagues found that residents from neighborhoods with greened lots reported less stress and more LTPA (Branas et al., 2011). While these findings indicate a change in self-reported LTPA, the survey measures

were designed to assess LTPA in any location, not only in the greened lots, which is a limitation by not attributing LTPA to the greened lots.

Similarly, Hoehner and colleagues (2005) examined the associations of built and social environments with LTPA of urban adults in St. Louis, Missouri and Savannah, Georgia at the census tract level. The cross-sectional study found that residents in neighborhoods free of garbage, litter, and broken glass had higher odds of reaching recommended LTPA targets. Using the same dataset, Boehmer and colleagues (2007) examined built and social environments contributing to inactivity associated with obesity. They found that objectively measured physical disorder indicators such as graffiti, broken windows, and abandoned cars were directly and positively associated with environments contributing to obesity.

Researchers in Austin, Texas surveyed newer residents to a New Urbanist-inspired community in Austin and found that negative perceptions and objective measures of violent and non-violent crime were associated with decreased recreational walking (Nehme, Oluyomi, Calise, & Kohl, 2016). The study found the strongest association between recreational walking and perceived crime. Additionally, a cross-sectional study of residents in Albuquerque, New Mexico, Chapel Hill/Durham, North Carolina, Columbus, Ohio, and Philadelphia, Pennsylvania assessed the perceived safety of parks within 0.5 radial miles of residences and the association between perceived safety and park use (Lapham et al., 2016). The study found that those who perceived the park as safe or very safe were more likely to visit the park for recreation and/or social gatherings compared to those who perceived the park to not be very safe or not safe at all.

Further, the reduction of crime also had some financial benefits. Estimates from Philadelphia indicate that remediation of vacant land returned approximately $26 [sic] to taxpayers in the first year of the investment from the prevention of violence (Branas et al., 2016).

Though the authors did not break down these tax savings, this return on investment to taxpayers may be attributed to fewer responses from emergency personnel responding to crimes.

Crime and blight can be measured using objective and/or perceived indicators. Though observational and perceived measures had a low agreement, both have been shown to be associated with LTPA (Orstad, McDonough, Stapleton, Altincekic, & Troped, 2017). An area for further research is to continue studying the associations between crime and blight and park redevelopment using objective measures, which are less often employed than perceived measures.

Property Values. Research indicates there may be additional benefits from parks for the surrounding neighborhood, such as increasing property values. Open green space increases property values (Brander & Koetse, 2011) and makes the neighborhood more desirable for other investment activities (Chrysochoou et al., 2012). Research has repeatedly found that living near a park is associated with higher property values in urban neighborhoods (Anderson & West, 2006; Brander & Koetse, 2011; Poudyal, Hodges, Tonn, & Cho, 2009). However, in neighborhoods where the home values are low, the money spent on recreation is lower compared to neighborhoods with higher home values (Joassart-Marcelli, 2010; Wolch, Byrne, & Newell, 2014). Thus, lower investment based on lower property values may introduce a "chicken and the egg dilemma," in which lower park investment and lower property values are cyclical. Lower property values are inevitable for some cities, such as Detroit. In the decades between the 1960s and the 2010s, property values fell by 77%. In 2007 at the start of the housing crisis, foreclosures ran rampant in Detroit in large part due to the disproportionate percentage of subprime loans (Deng, Seymour, Dewar, & Manning Thomas, 2018; Sugrue, 2014). In contrast, wealthier neighborhoods which were spared from rampant foreclosures viewed financially supporting

parks and recreation as a way to increase property values and promote development (Joassart-Marcelli, 2010).

That perception is corroborated by evidence from other Midwestern cities. Residents in both Milwaukee, Wisconsin and Minneapolis, Minnesota perceived that remediating brownfields into residential and park projects would have the greatest impact on property values. Upon completion, park creation in Milwaukee increased property values of homes within 4,000 radial feet (1,219.2 meters) by 11.7%. In Minneapolis, the increase was 4.4% for homes within 2,500 radial feet (762 meters). (De Sousa, Wu, & Westphal, 2009). In Milwaukee, the creation of residential and industrial development did not increase property values as much as the creation of parks, with the increases being 4.7% and 8.6%, respectively. Similarly, in Minneapolis, both residential (3.1%) and industrial (3.2%) development did not increase property values as much as parks (De Sousa et al., 2009). An earlier study of the Twin Cities, Minneapolis and St. Paul, Minnesota, specifically investigated the effect of open spaces on property values. They found an increase in home value with increasing proximity to a neighborhood park; however, beyond a certain park size in acres, there was a drop in the home value. The authors believed that while living near a park is important, that increased traffic or noise – which is common as the park size increases – may be a disamenity for residents (Anderson & West, 2006). In contrast, Poudyal and colleagues investigated the changes in property values for urban parks in Roanoke, Virginia (Poudyal, Hodges, Tonn, et al., 2009). They found that, when park size increased, houses were purchased at an average of $160 more than their actual worth.

Finally, although research shows that living near parks increases property values, little is known about the comparisons of living near newly renovated parks compared to living near a park that has not recently been redeveloped.

Detroit Foreclosures. By some estimates, three years after the housing market collapse in 2008, there were on average over 90 foreclosed properties per square mile in Detroit, which is more than 1/6 of all parcels in Detroit (Cell et al., 2017; Sugrue, 2014). Foreclosures behave like a contagion on property values. There is evidence indicating that foreclosures between 90–400 meters of a property decrease the sales price anywhere between 1% and 3% for up to five years after a foreclosure (Biswas, 2012; Harding, Rosenblatt, & Yao, 2009).

Research in Louisville, Kentucky indicates that neighborhood walkability, defined in part by street connectivity using Walkscore™, can reduce foreclosures. Neighborhoods with more walkability encourage consumers to purchase local goods and create economic resilience. At the height of the housing crisis (2007–2008), Gilderbloom and colleagues found a negative association between Walkscore™ and foreclosure rate (Gilderbloom, Riggs, & Meares, 2015). Some have suggested that saving homes in "stronger" neighborhoods, based on higher property values and amenities such as parks, can provide a greater return on investment (Whitaker & Fitzpatrick IV, 2013).

Detroit and Wayne County received funds from the federal Neighborhood Stabilization Program (NSP) to mitigate distress in neighborhoods by rehabilitating (i.e. saving homes) or demolishing properties. Research indicated that the properties in Wayne County were an "extreme example" of devastation and expanded the NSP to additional census tracts beyond the originally selected tracts. While other neighborhoods (including Philadelphia, Los Angeles, and Miami-Dade) included in the study opted to rehabilitate the homes, Wayne County and Detroit opted to use the funding to primarily conduct demolitions (Nassauer & Raskin, 2014; Schuetz, Spader, & Cortes, 2016). In an evaluation of the program (2009-2012), Wayne County saw an increase in vacant properties from 2009–2013, and during the same time period did not see a

decrease in the number of distressed properties or an increase in valid arm's length (VAL)[4] sales prices, indicating that the housing market did not recover and vacant homes continued to exist (Schuetz et al., 2016).

In another examination of the VAL sales prices following the 2007 housing crisis in Detroit, Deng and colleagues (2018) examined four strong neighborhoods[5]. Deng and colleagues found that external funding from the NSP, Habitat for Humanity, the Next Detroit Neighborhood Initiative, coupled with mobilization efforts by community organizations, resulted in increased property values in two neighborhoods from 2008–2014 with a third community seeing increases only in 2009 and 2013. In some cases the improved property values were more than doubled compared to before the housing crisis (Deng et al., 2018). This finding also held up in a spatial lag model accounting for the spatial correlation of the data. An expansion of this research for Detroit could be to include an assessment of more census tracts, including those that are not considered to be "strong." As well, the literature supports a positive association between park improvements and property values, but Detroit has not been studied in that context.

Park Redevelopment & Engagement in Leisure-time Physical Activity

Conventional wisdom leads researchers to believe that when park renovations were completed, LTPA of the residents would increase. McCormack and colleagues conducted a systematic review of English-language studies conducted in the United States, Canada, Australia, Holland (the Netherlands), and the United Kingdom. They found Geographic Information Systems (GIS) techniques are one of the most common method for examining changes in PA behavior with built environment changes (including redevelopment of parks and playgrounds)

[4] Sales where buyer and seller are both acting in their best interest to get the best deal possible (e.g., a buyer wanting to spend the least amount, while the seller desires to gain the most amount of money).
[5] Census tracts with a proportion of owner-occupied households, property values, and household incomes comparable or higher than the city of Detroit mean; and active local organizations.

(McCormack & Shiell, 2011). GIS measures of aesthetics, non-motorized infrastructure (e.g. greenways), and traffic related concerns are often used to assess PA behavior as it relates to the built environment. Researchers use multiple methods of defining neighborhoods including local areas, transportation zones, census districts (e.g. tract or block group), and radial/network buffers. Using GIS data and with these differences in neighborhood definition, the researchers noted that measures assessing changes in PA have been inconsistent across studies, with most studies finding a significant positive association but a few studies finding no association.

For example, in the year following the devastation of Hurricane Katrina (August 29, 2005), researchers compared low-income repopulated African American neighborhoods in New Orleans where parks were restored to a control group of neighborhoods where parks were not restored. PA in the neighborhoods was assessed before and after the improvements. The researchers observed that there was a significant increase in those observed engaging in PA from baseline to follow-up one year after walking paths were reconstructed (Gustat, Rice, Parker, Becker, & Farley, 2012). Although the changes were statistically significant, the findings may not be generalizable to other populations. The extreme devastation and redevelopment of the neighborhood parks may have created other factors that were not accounted for in this study (e.g. changes to the physical disorder of the neighborhood during the rebuilding process).

Another study in Los Angeles, California (Cohen et al., 2009) tested whether park improvements were followed by changes in LTPA. Researchers observed that park use declined in both the intervention and the control parks. The authors noted that there were other factors that they failed to account for, such as months-long periods of park closure, that could have affected the park use. Further, they stated that the decline in park use was "distressing." This is

an area where additional research is needed to aid funders and municipalities to improve neighborhoods and public health.

Cohen and colleagues (2015) in another study of parks in the Bay Area (California) and in Southern California measured park users' activity before and after park redevelopment. They evaluated pre- and post-redevelopment activity in the park using the validated System for Observing Play and Recreation in Communities (SOPARC) tool (McKenzie & Cohen, 2006) which measures any park use and translates PA into Metabolic Equivalent of Task (MET) [energy expended] (Ainsworth et al., 2000). Following the completion of the redevelopment, they found that park use increased by 233.1% and MET-hours in the park increased by 254.8%, indicating more PA in renovated parks (Cohen et al., 2015).

When municipalities redevelop parks, they have multiple expectations for changes to the neighborhood, including decreases in crime and blight, and increases to property values and LTPA. However, research offers mixed support for these suppositions. Multiple studies included in this review found objective decreases in crime following redevelopment, which create neighborhoods more welcoming to LTPA (Branas et al., 2016; Garvin, Cannuscio, et al., 2013; M. Kondo et al., 2016). These studies did not include behavioral outcomes of LTPA. Two studies in this review found that greening lots into parks and objective measures of safety were correlated with LTPA (Branas et al., 2011; Nehme et al., 2016). The studies in the review overwhelmingly used subjective measures of physical disorder. For example, one study found that following redevelopment residents perceived the neighborhood around the park to have more physical disorder (Garvin, Cannuscio, et al., 2013). In addition, studies included in this review of parks and property values found that parks are related to higher property values (Anderson & West, 2006; De Sousa et al., 2009; Poudyal, Hodges, & Merrett, 2009) and

property values are associated with neighborhoods more conducive to PA (W. C. Taylor, Franzini, Olvera, Carlos Poston, & Lin, 2012).

Study Purpose

The City of Detroit's park development allows for a natural experiment, in which changes in the environment can be observed as they are happening. Further, research to date has not used real time data on, physical disorder fines, crimes, and property values, which is newly available in Detroit.

Analysis of park redevelopment in the City of Detroit may be a unique case due to its economic devastation. However, Detroit holds similarities to other urban cities across the country, including Los Angeles, California, Newark, New Jersey, Atlanta, Georgia, and Cincinnati, Ohio. These cities each experienced similar "rebellions" during the same time period (The National Criminal Justice Reference Service, 1968), yet the resulting fallout has been particularly strong in the case of Detroit. In comparison to other major cities in the Midwest, including Cincinnati, Cleveland, and Youngstown , Detroit has lost more than 60% of the population since its peak in 1950 (Dewar & Manning Thomas, 2013) with implications for disinvestment, blight, and recent efforts towards land reuse.

At the 1950 Census, an estimated 1.8 million residents lived in Detroit. The population began to decline through the 1950s and 1960s (Eisinger, 2014; Gallagher, 2013; Sugrue, 2014; United States Census Bureau, n.d.). Prior to the 1967 race riots (Detroit Rebellion), during 1964–1966, an average of 22,000 White residents left Detroit annually. Following the Detroit Rebellion, the population decline accelerated with an average of 58,000 residents, mostly White, leaving the City annually between 1967 and 1969 (Safransky, 2014). The continued population decline has resulted in a smaller tax base, including uncollected taxes, and thus declines in the

built and social environment (Bentley et al., 2016; Eisinger, 2014; Gallagher, 2013; Sugrue, 2014). These economic challenges have had substantial implications for the social and built environmental conditions in which Detroit residents currently live. For example, during the 20 years between 1974 and 1994, Detroit closed 113 skating rinks and six swimming pools and reduced general services responsible for the upkeep of parks. Furthermore, 2,500 police and fire personnel were laid off, leaving the City vulnerable to crime and blight (Borney & Gallagher, 2013).

As a consequence of these long-term forces exacerbated by the 2008–2009 recession, on August 18, 2013, Detroit became the largest city in the United States to file for Chapter 9 Bankruptcy and fall under emergency management from the state of Michigan (Eisinger, 2014; Sugrue, 2014). During the months leading to the bankruptcy, the City attempted to save costs by proposing cuts to city parks (Eisinger, 2014), among other targets. The City of Detroit announced approximately six months before bankruptcy that they would close nearly half of the City-owned parks (Burns, 2013). Private organizations, non-profit organizations, companies, and residents were able to raise $14 million to keep all the parks open (Eisinger, 2014). In late 2014, Detroit emerged from bankruptcy and has since announced recreational investment to the sum of over $80 million over 10 years. However, today's residents still experience an excess of social and economic adversity compared to their suburban counterparts, which directly impacts health behaviors and outcomes.

Overarching Research Question

Using the data from the City of Detroit, this dissertation will answer this overarching question: "*Is park redevelopment associated with changes in leisure-time physical activity (LTPA), blight crime, and property values, in neighborhoods with at least one redeveloped*

park?" The results will inform urban neighborhoods across the country who have experienced economic/social declines and resurgences to better understand how park redevelopment influences the built and social environments as well as LTPA. Further, the findings of this work serve as an important step to changing planning practices on how environments change following decisions on park redevelopment.

Chapter II

Paper I

Associations of Neighborhood Park Redevelopment and Leisure-Time Physical Activity

Background and Hypothesis

Insufficient LTPA is a problematic issue across the United States, with more than one in four Americans reporting engaging in no LTPA (Pickens et al., 2018). Further, multiple studies show that those living in poverty engage in less LTPA compared to those not living in poverty (Stalsberg & Pedersen, 2018). There are multiple chronic diseases related to inadequate LTPA, including obesity, diabetes, hypertension, CVD, cancer, depression, and anxiety (Asmundson et al., 2013; Ferdinand et al., 2012; Fetzner & Asmundson, 2015; Loprinzi, 2015; Sallis et al., 2012). These health implications of LTPA underscore the need to understand its environmental contributors.

Previous research in St. Louis, Missouri and Savannah, Georgia found that residents reporting more physical disorder in their neighborhood were less likely to engage in LTPA (Hoehner, Brennan Ramirez, Elliott, Handy, & Brownson, 2005). In another study, Austin, Texas residents reported that crime in their neighborhood was related to recreational exercise (Nehme et al., 2016). Finally, Bracy and colleagues found that Baltimore, Maryland residents reporting more traffic safety (including reduced traffic, speed limits below 30 miles per hour (48 kilometers per hour), and less reckless driving) engaged in an average of 15.7 more LTPA minutes/week when having one or more recreational facility "nearby" (Bracy et al., 2014).

Understanding the association of LTPA with park redevelopment across neighborhoods is beneficial to the goal of decreasing chronic disease and thus reducing health care costs and improving quality of life. For the United States population, those who have inadequate amounts of LTPA have higher health care costs compared to those with adequate amounts of LTPA (Carlson et al., 2015). The difference is in the billions. Finding ways of increasing LTPA can decrease health care costs and reduce the burden of chronic diseases on individuals.

There are multiple characteristics that relate to sedentary behavior, including poor facilities. The connection between sedentary behavior and poor facilities suggests that redeveloped parks could combat some of the sedentary behaviors (Owen et al., 2011). However, some cities have not developed or redeveloped parks for long stretches of time (City of Detroit, 2016; City of Seattle, 2017), in some cases leaving them uninviting for LTPA. In the case of Detroit, a low tax base and bankruptcy have made park redevelopment challenging (Safransky, 2014). A potential consequence of aging parks, combined with low socioeconomic resources for residents, is a reduced likelihood of residents reporting any LTPA (Michigan Department of Health and Human Services, 2015).

Park redevelopment can bring new features, improved accessibility (e.g. the removal of gates and the addition of new walkways), and better aesthetics. Cities that are desperate to improve neighborhoods and health outcomes for residents lean on the common assumption that redeveloped parks are associated with more LTPA compared to parks that have not been redeveloped (Cohen, Marsh, Williamson, Golinelli, & McKenzie, 2012). Though this is a common belief, current research reports mixed associations between park redevelopment and LTPA. Work in New Orleans following Hurricane Katrina (August 2005) found that increased PA was observed in parks where walking paths were installed compared to control parks (Gustat

et al., 2012). However, this finding may not be generalizable to the general population, given the extreme devastation and redevelopment of the neighborhood. Further, the authors did not report on possible population changes that may have occurred with residents returning to the neighborhood. Another study in Los Angeles found that park redevelopment was not followed with observed and reported increases in LTPA (Cohen et al., 2009). Given these limited findings, further research is needed to test associations of LTPA with park redevelopment, especially in Detroit where a large amount of taxpayer and private funding has been spent redeveloping parks since emerging from the 2013 bankruptcy.

This paper investigates differences in LTPA between neighborhoods, spatially defined by census tracts, with and without redeveloped parks in Detroit. Using cross-sectional data, this paper will add to the research findings on whether redeveloped parks are associated with engaging in any LTPA. We hypothesize that census tract neighborhoods with redeveloped parks will have a higher mean of engaging in LTPA compared to neighborhoods without park redevelopment (Figure II.1).

Methods

Geography. Detroit, Michigan (USA) is the largest city in the state of Michigan by both size and population. The total land area of Detroit is 138.75 square miles (359.36 square kilometers) (United States Census Bureau, 2017a), which would encompass Boston, Manhattan, and San Francisco combined. The City is estimated to have 690,000 residents, of which 80% are non-Hispanic Black (NHB), and 39.8% of households living below the Federal Poverty Line (FPL) (United States Census Bureau, 2016). Detroit has 382,560 parcels (City of Detroit, 2018).

Census tract boundary data from the 2000 (n = 314) and 2010 Census for all tracts (n = 297) were obtained from the Census Topologically Integrated Geographic Encoding and

Referencing (TIGER) products (United States Census Bureau, 2017b). There are four unpopulated tracts due to industry. A shapefile with all roads, residential roads, state roads, freeways, service drives and other roads in the City of Detroit was obtained from Esri Logistic Services (Esri, 2018). All spatial data from the City of Detroit was analyzed using ArcGIS 10.4.1 for Desktop ("ArcGIS 10.4.1 for Desktop," 2015). The spatial data was projected to the NAD 1983 Michigan meters projection, with the North American 1983 Geographic Coordinate System.

Sample. This study analyzes LTPA levels in 161 census tracts across the City of Detroit with parks redeveloped from 2006–2015. 99 of those census tracts have at least one redeveloped park (parks, n = 115) and 62 census tracts have no redeveloped park (parks, n = 77) (See Appendices C and D). Some census tracts had multiple parks that were either redeveloped or not redeveloped, in which case all of the features and acres available to the public were summed.

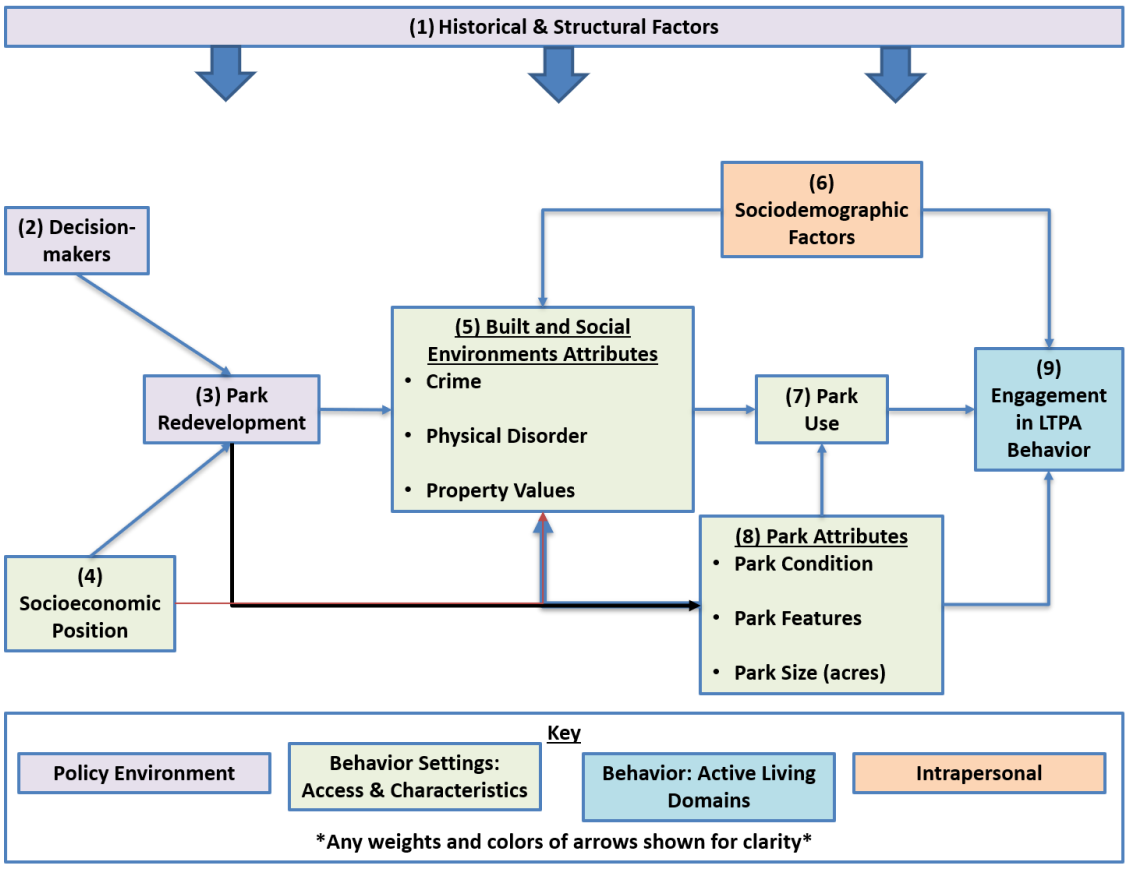

Figure II.1 Conceptual model of association of park redevelopment with environment attributes and physical activity

Measures and data sources. Table II.1 below details the outcome variable, independent variable, and covariates that were used for this research question.

Table II.1: Study variables

Variable Type	Variable Name/Coded	Description	Data Source(s)
Dependent Variable	Leisure-time physical activity (LTPA) percent of population in census tract reporting any LTPA engagement (continuous)	The 500 Cities Project provided tract-level averages from a multilevel logistic small area estimate model for the proportion of residents participating in any LTPA engagement using data modeled from the 2016 Behavioral Risk Factor Surveillance System (BRFSS).	Centers for Disease Control and Prevention (Centers for Disease Control and Prevention, 2017a)
Independent Variable	Park redevelopment (dichotomous)	The City of Detroit provided a database indicating park redevelopment "since 2006" [2006-2015].	City of Detroit (City of Detroit, 2016; J. Fulton, personal communication, March 15, 2017)
Covariate	Park redevelopment age (dichotomous)	Age of park redevelopment before or after 2012.	Google Maps (Google, n.d.)
Covariate	Total park acres (continuous)	Size of the park in acres in the census tract.	City of Detroit (City of Detroit, 2016; J. Fulton, personal communication, March 15, 2017)
Covariate	Total park features (continuous)	Count of the park features (e.g., play area, comfort station) in the park.	City of Detroit (City of Detroit, 2016; J. Fulton, personal communication, March 15, 2017)
Covariate	Crimes per 1,000-population (continuous)	A 1,000-population rate of crimes within the census tract of the redeveloped and not redeveloped neighborhoods from 2011.	City of Detroit Open Data Portal (City of Detroit, 2018)
Covariate	Average blight fines per parcel ($) (continuous)	An average of 2011 fines based on total fines divided by the number of parcels within the census tract of the redeveloped and not redeveloped neighborhoods.	City of Detroit Open Data Portal (City of Detroit, 2018)
Covariate	Traffic crashes per square mile (continuous)	A per square mile rate of traffic crashes within the census tract of the redeveloped and not redeveloped neighborhoods from 2011.	Southeast Michigan Council of Governments (Southeast Michigan Council of Governments (SEMCOG), 2018a)
Covariate	Proportion of vacant properties (continuous)	Proportion of vacant properties per census tract (B25002).	2000/2010 United States Census data (United States Census Bureau, 2000, 2010)
Covariate	Population density (continuous)	Total population divided by the tract size in square miles per census tract (B01003).	2000/2010 United States Census data and Census TIGER products (United States Census Bureau, 2000, 2010, 2017b)

Leisure-time Physical Activity. The Behavioral Risk Factor Surveillance System (BRFSS) is an annual survey on health behaviors, health outcomes, and prevention collected by the CDC (Centers for Disease Control and Prevention, 2018). In 2015, the Robert Wood Johnson Foundation and the CDC Foundation started the *500 Cities Project* to calculate model-based small area estimates (SAE) using the 2014 BRFSS data (Centers for Disease Control and Prevention, 2017a). For estimating census averages of LTPA, the 500 Cities Project used data from the BFRSS item asking, "During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?" To calculate the SAE, researchers used a multilevel regression and post-stratification (MRP) approach at the census block, block group, and tract level[6]. The statistical team used multilevel models, controlling for the BRFSS data of respondent age, sex, race, and educational attainment, as well as the American Community Survey measure of residents below 100% of the FPL to estimate findings in census geographic units (Wang et al., 2017a). This model-based approach for SAE was found to be valid and reliable in subsequent research studies (Wang, Holt, Xu, & Zhang, 2018; Zhang et al., 2014, 2015). By comparing the SAE results with results from local survey data from Boston, Massachusetts, Wang and colleagues found estimates to be reliable and valid, including those for LTPA (Wang et al., 2017b). Specifically, the correlations between the 500 Cities Project model-based SAE and direct local data in Boston were moderate-strong for LTPA, and the same moderate-strong correlation was found in binge drinking, obesity, sleeping less than seven hours, diabetes, high

[6] As the CDC explains, "We are not producing estimates for individuals, only census tracts and cities. There is one estimate per measure for the entire population of each census tract and of each city. The modeling process uses individual-level responses, and includes county-and state-level contextual effects (fixed and random) to estimate the probability of developing an outcome at the individual level, given their age, race/ethnicity, sex, education, and county-level poverty. We will apply these probabilities to the target population (e.g., city or census tract) to derive the estimated prevalence. So, the Project uses a combination of individual characteristics and responses, as well as county and state context." (Centers for Disease Control and Prevention, 2017b)

blood pressure, and frequent distress (Wang et al., 2017a). Another study validating the SAE from the 500 Cities Project, conducted in Missouri with direct estimates at the county level for chronic obstructive pulmonary disease, found the correlation to be significant and positive at 0.69 (Zhang et al., 2015).

Years Since Park Redevelopment. The City of Detroit was unable to provide the dates of the park renovation due to unavailability and staff constraints (J. Fulton, personal communication, December 13, 2018). However, in recent years, technological advances (e.g. Google Maps, Bing Maps) provide detailed street views. In this case, Google Maps street view was used to assist with dating park redevelopments through the month and year time stamp indicating when the image was taken (Google, n.d.). Google Maps gathers their photographs by driving through neighborhoods with a rooftop camera taking several photographs and then creating a continuous linear image (Google, n.d.). The use of Google images in measuring park quality is a relatively new and "timely" method (J. S. Wilson & Kelly, 2011). One research study examined a comparison of Google imagery with direct observation (B. T. Taylor et al., 2011). The researchers found that there was a strong correlation between the two methods, and Google imagery took considerably less time. However, Taylor and colleagues reported that Google imagery was limited and could not detect minute details, such as the presence of dog litter bags and evidence of well-watered grass. While it appears that researchers have yet to use Google Maps for retrospective dating of public space redevelopment, this is a relatively simple assessment and related research supports the method.

Assessing the dates of the park renovation used multiple steps. First, the City of Detroit provided addresses for all the parks. Following input of each address into Google Maps, the street view dates were reviewed. To determine the dates of the park renovation, paths, gates, and

equipment were compared with the dates noted. Given the years of neglect of Detroit parks, in some cases, the park renovation was easy to notice. However, to further ensure that the same park was pictured, in addition to the address, landmarks including trees, fire hydrants, and buildings were included into the determination of renovation (see Figures II.2-II.4). In Figure II.2, two street trees and a building in the background were used as landmarks, in addition to the address entered displayed in the lower left corner. In two cases, the Google Map date of redevelopment was corroborated through news articles (Kozlowski, 2015; WXYZ-TV Detroit, 2014). A dichotomous value was assigned signifying census tracts with newer park improvements (i.e. 2012–2015). This time range was determined based on research indicating when residents are enjoy features the most (Livy & Klaiber, 2013) and were supported by local parks and recreation leaders as an ideal time for park improvements (J. LaFever, C. Summers, & E. Sheffer personal communication, April 17, 2019).

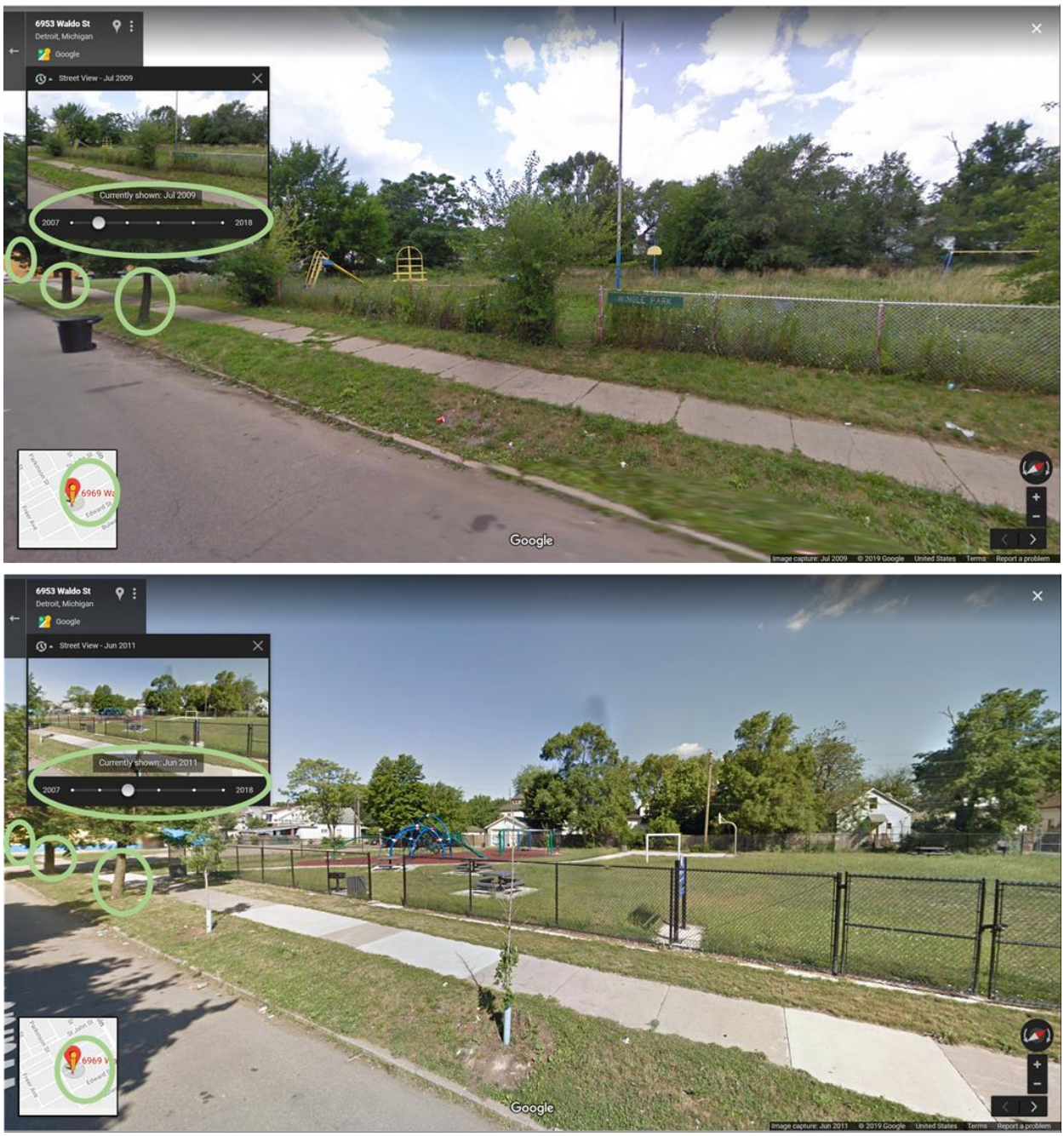

Figure II.2 Example of improvement to Wingle Park (2010)

Figure II.3 Example of improvement to Muliett Park (2010)

Figure II.4 Example of improvement to Littlefield Playfield (2012)

Covariates and Environment Attributes. Based on prior research, covariates included non-Hispanic Black (NHB) proportion, population density per square mile, the proportion of vacant units in the census tract, the total park acres and park features in the census tract, and, as a measure of SEP, the proportion of the census tract below 100% of the FPL (Humpel, Owen, & Leslie, 2002; Joseph & Maddock, 2016b). The SAE of LTPA used NHB proportion and proportion of the census tract below 100% of the FPL to create its estimates, and so will not be included in the models (Y. Wang, personal communication, August 21, 2019).

Environment attributes important in the study area (Baldas, 2017; Cell et al., 2017; Smart Growth America, 2017; Southeast Michigan Council of Governments (SEMCOG), 2018b) and available from the City of Detroit Data Portal for the analysis of the 2012-2015 park redevelopment analysis include crime, physical disorder (blight), and traffic crashes.

Data Analysis

Geographic Information Systems Analysis. Data from 2011 sourced from the City of Detroit Data Portal on blight fines (n = 6,587) with the assessed dollar amount, violent and non-violent crimes (n = 83,755), and traffic crashes (n = 9,363) were downloaded. Each of these incidents includes latitude and longitude to map to a corresponding location. Using ArcGIS 10.4.1 for Windows ("ArcGIS 10.4.1 for Desktop," 2015), these variables were geocoded. Using the *Spatial Join* feature, point locations of the previously mentioned variables was joined as a one-to-many to each census tract. The most common way, based on a previous literature review, is to use continuous measures of violent and non-violent crimes within the study area when using comparison groups (Bogar & Beyer, 2015). A continuous measure was used for crime and traffic crashes; for blight ticket fines, the fine dollar amount for each tract was divided by the number of assessed tickets during that time period (2011).

Quantitative Analysis.

Extreme observations. The dependent variable, LTPA, was found to be normally distributed. However, SAS ("SAS," 2011) reported extreme observations for the following variables, which were all evident in skewed histograms: 1) 2011 sum of blight tickets in two census tracts; 2) 2011 sum tickets dollar amount per ticket in two census tracts; 3) 2011 sum of crime in one census tract; 4) sum of park features in two census tracts; and 5) park size in acres in four census tracts. These extreme observations were removed to produce normally distributed data that were interpretable based on the original measure.

Bivariate Analysis. The bivariate analysis detailed the relationships between all major study variables as a correlation. For the continuous variables, a Pearson correlation was completed, and for the categorical variables, a polychoric correlation was completed.

Crosstabulations. The crosstabulations for park redevelopment and LTPA engagement were calculated. Additional crosstabulations of the park redevelopment and the census tract falling below 100% of the FPL were calculated.

Linear Regression. Interactions of the population density, proportion of vacancy, total available acres, and total available features variables were tested.

Associations in census tract level LTPA were measured by a posttest-only nonequivalent design using a regression model with the *proc reg* procedure in SAS 9.4 64-bit for Windows ("SAS," 2011). Given the outcome variable at the tract level, only the tract-level geography (adjusted) was analyzed. The subscript *c* indicated census tract. Two analyses were completed based on the timing of park improvement: 1) park redevelopment, 2006–2015; and 2) park redevelopment 2012–2015. Based on data available from the City of Detroit, additional neighborhood covariates were included in the analysis for parks redeveloped during 2012–2015.

Given the spatial nature of the data, a Moran's I in ArcGIS 10.4.1 for Windows will test the residuals for spatial autocorrelation. The formulas were:

$$LTPA_c = \beta_0 + \beta_1\ Park\ redevleopment\ community, 2006-2015_c + \beta_2\ Population\ Density_c + \beta_3\ Vacancy\ proportion_c + \beta_4\ Average\ of\ park\ features_c + \beta_5\ Average\ park\ acres_c + \epsilon_c$$

$$LTPA_c = \beta_0 + \beta_1\ Park\ redevleopment\ community, 2012-2015_c + \beta_2\ Population\ Density_c + \beta_3\ Vacancy\ proportion_c + \beta_4\ Blight\ fine\ dollar\ amount\ per\ ticket_c + \beta_5\ Sum\ of blight\ tickets\ amount_c + \beta_6\ Sum\ of\ Crime_c + \beta_7\ Sum\ of\ traffic\ crashes_c + \beta_8\ Average\ of\ park\ features_c + \beta_9\ Average\ park\ acres_c + \epsilon_c$$

Results

Table II.2 includes descriptive statistics for all study variables.

Table II.2. Summary Statistics

Variable	N	Percentage	Mean	Median	Standard Deviation	Minimum	Maximum
Census tract percent of population reporting any LTPA engagement	161		63.75	63.10	5.60	52.50	85.10
Tracts with park redevelopment, 2006-2015	161	61.49%					
Tracts with park redevelopment after 2012	148	20.27%					
Population density (per sq. mile) in census tract, 2000 Census	161		7199.00	2882.00	7407.00	266.20	17088.00
Proportion of vacant units in census tract, 2000 Census	161		0.10	0.06	0.09	0.01	0.30
Population density (per sq. mile) in census tract, 2010 Census	161		5403.10	5510.10	2335.22	650.10	14871.40
Proportion of vacant units in census tract, 2010 Census	161		0.25	0.23	0.11	0.05	0.68
Average fine dollar amount per parcel, 2011	161		$23.36	$139.64	$8.24	$0.31	$1,737.00
Crimes per 1,000-population, 2011	143		167.11	114.24	143.33	60.61	980.49

2011 Traffic crashes per square mile	161	118.17	57.43	117.04	8.95	281.74
Total features in census tract - removed outliers	159	8.20	6.00	8.64	1.00	46.00
Total acres of parks in census tract - Removed Outliers	157	8.01	3.24	13.15	0.11	84.99

Bivariate Analysis. Correlations of the study variables with LTPA found that park redevelopment from 2006–2015 and park redevelopment from 2012–2015 were both positively correlated with LTPA (see Tables II.3-II.4). The correlations were statistically significant ($p < 0.05$), but moderately correlated at 0.17 and 0.19, respectively. Additionally, in the 2010 census measure, vacancy was correlated with LTPA at -0.35 ($p < 0.001$). Finally, parks redeveloped from 2006–2015 were positively and significantly correlated with park size in acres, 0.24 ($p < 0.01$).

Table II.3. Bivariate Analysis of Park Redevelopment 2006-2015 and Leisure-Time Physical Activity

Variable	1	2	3	4	5	6
1. Census tract percent of population reporting any LTPA engagement	1					
2. Park redevelopment (Y/N), 2006-2015	0.17*	1.00				
3. Population density (per sq. mile) in census tract, 2000 Census	0.00	-0.01	1.00			
4. Proportion of vacant units in census tract, 2000 Census	-0.04	0.05	-0.21**	1.00		
5. Total features in census tract - Removed Outliers	-0.09	0.21	0.09	-0.04	1.00	
6. Total acres of parks in census tract - Removed Outliers	-0.06	0.24**	0.03	-0.01	0.45***	1.00

***p < 0.001, **p < 0.01, *p < 0.05

Table II.4. Bivariate Analysis of Park Redevelopment 2012-2015 and Leisure-Time Physical Activity

Variable	1	2	3	4	5	6	7	8	9
1. Census tract percent of population reporting any LTPA engagement	1.00								
2. Park redevelopment (Y/N), 2012-2015	0.19*	1.00							
3. Population density (per sq. mile) in census tract, 2010 Census	0.16*	0.14	1.00						
4. Proportion of vacant units in census tract, 2010 Census	-0.35***	-0.13	-0.21*	1.00					
5. Average fine dollar amount per parcel, 2011 - removed outliers	0.03	-0.05	0.20*	-0.04	1.00				
6. Crimes per 1,000-population, 2011 - removed outlier	0.11	0.09	0.23***	-0.11	-0.02	1.00			
7. Traffic Crashes per square mile, 2011	-0.05	-0.01	-0.33***	0.03	-0.21*	0.32***	1.00		
8. Total features in census tract - removed outliers	-0.09	-0.02	0.15	-0.13*	0.04	0.12	-0.05	1.00	
9. Total acres of parks in census tract - removed outliers	-0.06	0.13	-0.05	-0.13*	-0.02	0.08	-0.01	0.45***	1.00

***p < 0.001, **p < 0.01, *p < 0.05

Park redevelopment, 2006–2015. The association of LTPA in neighborhoods with and without park redevelopment from 2006–2015 was assessed in five linear regression models building on related variables from previous models, with three models presented below (Table II.5). The Moran's I was significant ($p < 0.05$), but the spatial models did not yield results changing the significance or β of the variables, indicating that the linear regression models (Table II.5) were sufficient for reporting. Interactions of the population density, proportion of vacancy, total available acres, and total available amenities variables were tested, and no interactions were found to be significant.

Model 1 presents the main independent variable model of park redevelopment 2006–2015. The census tract percentage of LTPA on average significantly ($p < 0.05$) increased ($\beta = 1.92$, CI = 1.15, 3.70, $R^2 = 0.03$) in redeveloped compared to non-redeveloped park neighborhoods. However, as shown in Model 2, when including the 2000 American Community Survey population density and proportion of vacant units variables, the main independent variable was no longer significant ($\beta = 0.85$, CI = -0.90, 2.61, $R^2 = 0.14$). Finally, in Model 3, with the inclusion of the variables from Model 2 and the total features and total park acreage in the census tract, the main independent variable remained insignificant ($\beta = 1.51$, CI = -0.27, 3.30, $R^2 = 0.17$). It is important to note that the study was underpowered with a power achieved of 0.60.

Finally, crosstabulations were done to examine the findings further. Neighborhoods with a lower proportion of residents living below 100% of the poverty line had 71.76% of their neighborhoods not receiving park redevelopment ($p = 0.005$).

Table II.5. Regression Models of Leisure-Time Physical Activity and Park Redeveloped, 2006-2015

	Model 1: Main Independent Variable, n= 161		Model 2: Neighborhood Model, n= 161		Model 3: Full Model, n= 155	
	β (SE)	95% CI	β (SE)	95% CI	β (SE)	95% CI
Intercept - Census tract percent of population reporting any LTPA engagement	62.57 (0.70)***	61.18, 63.96	69.77 (6.92)***	56.11, 83.43	67.21 (7.27)***	5.85, 81.57
Park redeveloped census tract (Y/N), 2006-2015	1.92 (0.90)*	1.15, 3.70	0.85 (0.89)	-0.90, 2.61	1.51 (0.90)	-0.27, 3.30
Covariates						
Log-transformed population density (per sq. mile) in census tract, 2000 Census			-0.87 (1.74)	-4.31, 2.56	-0.06 (1.84)	-3.69, 3.57
Proportion of vacant units in census tract, 2000 Census			-31.25 (7.13)***	-45.33, -17.18	-31.25 (7.13)***	-45.34, -17.16
Total features in census tract - removed outliers					-0.10 (0.06)	-0.21, 0.02
Total acres of parks in census tract - removed outliers					-0.02 (0.04)	-0.10, 0.05
R^2	0.03		0.14		0.17	
Adjusted R^2	0.02		0.12		0.14	
						Power Achieved: 0.60

***p < 0.001, **p < 0.01, *p < 0.05

Park redevelopment, 2012-2015. More recent park redevelopment was tested for the association of LTPA in neighborhoods with and without park redevelopment. This was done using eight linear regression models building on related variables from previous models, with four models presented below (Table II.6); unlike the previous examination of park redevelopment from 2006–2015, this study achieved a power of 0.72. The Moran's I of residuals was insignificant indicating that the linear regression models (Table II.6) were sufficient for reporting. Interactions of the population density, proportion of vacancy, total available acres, and total available features variables were tested, and no interactions were found to be significant.

Model 1 presents the main independent variable model of park redevelopment from 2012–2015. The census tract percentage of LTPA was positively and significantly ($p < 0.05$) associated with park redevelopment from 2012-2015 ($\beta = 2.53$, CI = -0.24, 3.90, $R^2 = 0.17$). However, in Model 2, the main independent variable was no longer significant ($\beta = 1.77$, CI = -0.26, 3.80, $R^2 = 0.30$) when including the 2010 American Community Survey log-transformed population density, proportion of vacant units, along with 2011 blight fine per parcel, and the 2011 crimes per 1,000-population variables. Similarly, in Model 3, when including the 2010 American Community Survey log-transformed population density, proportion of vacant units, along with 2011 blight fine per parcel, and the 2011 crimes per 1,000-population, and the 2011 traffic crashes per square mile, the independent variable was not significant ($\beta = 1.67$, CI = -0.36, 3.72, $R^2 = 0.31$). Finally, in Model 4 with all covariates (identical to Model 3 plus park variables of total features and size in acres) the main independent variable remained insignificant ($\beta = 1.91$, CI = -0.29, 3.61, $R^2 = 0.37$).

Finally, crosstabulations were done. Neighborhoods with a higher proportion of residents living below 100% of the poverty line had 86.84% of their neighborhoods not having park redevelopment in their communities ($p = 0.03$).

Table II.6. Regression Models of Leisure-Time Physical Activity and Park Redeveloped, 2012-2015

	Model 1: Main Independent Variable, n= 148		Model 2: Neighborhood, Blight, and Crime Covariates n= 147		Model 3: Traffic Crashes with Neighborhood, Blight, and Crime Covariates, n= 147		Model 4: Full Model, n= 144	
	β (SE)	95% CI			β (SE)	95% CI	β (SE)	95% CI
Intercept - Census tract percent of population reporting any LTPA engagement	63.12 (0.50)***	62.13, 64.11	52.27 (8.12)***	36.20, 68.34	52.87 (8.12)***	36.79, 68.95	51.43 (8.07)***	35.45, 67.41
Park redeveloped census tract (Y/N), 2012-2015	2.53 (1.11)*	0.34, 4.73	1.77 (1.03)	-0.26, 3.80	1.67 (1.03)	-0.36, 3.72	1.91 (1.02)	-0.29, 3.61
Covariates								
Log-transformed population density (per sq. mile) in census tract, 2010 Census			3.11 (2.07)	-0.98, 7.20	3.15 (2.07)	-0.93, 7.24	3.93 (2.06)	-0.16, 8.02
Proportion of vacant units in census tract, 2010 Census			-14.21 (4.16)**	-22.45, -5.97	-13.83 (4.17)**	-22.09, -5.57	-16.72 (4.10)***	-24.84, -8.60
Average fine dollar amount per parcel, 2011			-0.001 (0.003)	-0.01, 0.01	-0.001 (0.003)	-0.01, 0.01	-0.001 (0.003)	-0.01, 0.01
Crime rate per 1,000-population, 2011			0.02 (0.004)***	0.01, 0.03	0.02 (0.004)***	0.01, 0.03	0.003 (0.002)***	-0.001, 0.02
Traffic crashes per square mile, 2011					-0.01 (0.01)	-0.02, 0.01	-0.01 (0.01)	-0.02, 0.01
Total features in census tract - removed outliers							-0.11 (0.06)	-0.22, 0.001
Total acres of parks in census tract - removed outliers							-0.01 (0.04)	-0.08, 0.09
R^2	0.03		0.30		0.31		0.37	
Adjusted R^2	0.03		0.27		0.27		0.32	
								Power Achieved: 0.72

***p < 0.001, **p < 0.01, *p < 0.05

Discussion

The findings of this study show that park redevelopment was associated with LTPA in bivariate analysis, but once we included other covariates in the linear regression models, there was no significant association.

Park Redevelopment and LTPA. This research found that there is some evidence in the Pearson correlation and the linear regression model that park redevelopment is associated with model-based reporting of LTPA, with higher levels of LTPA being seen in neighborhoods that also have redeveloped parks. Further, this work indicated in the unadjusted model that park redevelopment was positively associated with census tract averages of reporting any LTPA in models that examined both park redevelopment from 2006–2015 and more recent park redevelopment from 2012–2015. However, since the correlation describes the relationship between two variables without the inclusion of the other aspects in the lived environment (e.g., vacancy) it has a limited and unrealistic interpretation.

The 500 Cities Project dataset is rather new and has been used in few studies (Browning & Rigolon, 2018; Fitzpatrick et al., 2018; Liu, Liu, & Li, 2018). However, one study using the 500 Cities Project to study greenspace and obesity found that cities with more greenspace also had less model-based measured obesity and better mental health (Browning & Rigolon, 2018). The researchers found no relationship between greenspace and obesity or mental health, which is similar to our null findings. (Browning & Rigolon, 2018).

The inconsistent relationship between LTPA and greenspace (e.g. parks) is seen in other research on interventions. In one study that used a validated park observation tool, System for Observing Play and Recreation in Communities (SOPARC), coupled with resident surveys, researchers found a decline in LTPA in intervention parks following park redevelopment.

However, the researchers also found a decline in areas with parks that did not receive any redevelopment (Cohen et al., 2009). In another study conducted in New Orleans following rebuilding from Hurricane Katrina, intervention parks with newly constructed paths had more use for vigorous exercise as evaluated by the System for Observing Play and Leisure Activity in Youth (SOPLAY) tool. The same increase was identified in self-reported household surveys (Gustat et al., 2012). Similar to our work, these studies in Los Angeles and New Orleans indicate that more research is needed to investigate the relationship of parks and LTPA. Future research could include qualitative information to more fully understand the inconsistent relationship, such as what types of redevelopment residents relate to their LTPA (e.g., walking paths, comfort stations, other features).

Poverty and Park Redevelopment. Findings indicated that the City of Detroit is redeveloping parks in neighborhoods that have less poverty. A recent news article reported that low-income Detroiters feel as if they are being pushed out of their neighborhoods by redevelopment that is both more frequently occurring in wealthier neighborhoods or occurring in neighborhoods that will result in low-income residents moving (Finley, 2014). There has not been systematic research to back up this anecdotal finding in Detroit; however previous work in Los Angeles found that funding for recreation redevelopment disproportionately went to wealthier neighborhoods (Wolch, Wilson, & Fehrenbach, 2005). More recent research in Denver found a similar finding as Wolch and colleagues (2005), that the city center where wealthier residents, and presumably healthier residents, live received more funding for park redevelopment (Rigolon & Németh, 2018). These inequitable redevelopment strategies could exacerbate health disparities due in part to a lack of development in the community that encourages healthy behaviors.

Limitations

This study is not without its limitations. Most notably, the LTPA variable used is a model-based measure at the tract level derived from a selection of Census and BRFSS variables. The LTPA data were not directly collected from residents living in census tracts included in our study; further, since the redevelopment did not change the Census or BRFSS sociodemographics, it could not detect changes in the neighborhood. In addition, the 500 Cities Project team made data widely available at the tract level; however, due to work constraints, the CDC was unable to provide data at the census block or block group levels (J. Holt, personal communication, December 12, 2018). In addition, it was recommended to use the dataset to detect associations and cannot assess associations related to an intervention of park redevelopment. Therefore, the null findings may be attributed to the flaws in the available dataset for this study – which to my knowledge is the only citywide dataset available – and thus demonstrates the need for adequate citywide datasets with direct measures.

Further, the LTPA variable only provides dichotomous information, precluding detecting whether a person is achieving any LTPA even if it is insufficient. Even those who engage in inadequate LTPA pay approximately $700 less per year than those engaging in no LTPA (Carlson et al., 2015). An improved LTPA measure for this study would be a two-pronged measure, including direct observation at the parks pre- and post-park redevelopment, along with the use of an accelerometer or another technology to measure LTPA in the population. While validation and reliability of the LTPA estimate used are promising, this self-reported data is not as strong as other LTPA measurements, including accelerometers (Lawman, Wilson, Van Horn, Resnicow, & Kitzman-Ulrich, 2011) and pedometers (Schulz et al., 2014). The timing of this dissertation prevented these observations and objective measures from being employed.

Given that this study cannot detect causal differences based on park redevelopment and uses a model-based measure, the findings must not be over-interpreted. However, the findings indicate that there is some evidence that LTPA and park redevelopment are positively correlated. More research is needed examining the relationship between park redevelopment and LTPA in urban neighborhoods.

Blight fines, crimes, and traffic crashes were sourced from the City of Detroit Data Portal, which introduces another possible limitation on this study. The Data Portal was opened for public access in April 2018 based on a commitment from the Detroit City Charter (City of Detroit, 2012, 2018). Given the date of the opening, it is probable that some data from 2011 have data entry errors from the backlog of entries and may not be as reliable as more recent data. Some data entry errors were noticed during the geocoding process for the data, as some of the latitude and longitude coordinates far outside of Detroit were incorrectly coded. However, the City of Detroit is one of a few but growing number of cities with open data portals. Thus, having access to this pinpoint data is a unique opportunity for enriching the data analysis.

Despite these limitations, this research adds to the literature by increasing the understanding of associations of LTPA in urban areas with and without redeveloped parks. Further, it uses geographic information systems and regression, an understudied coupling of methods. Finally, though this research does not support the hypothesis that there are associations of park redevelopment's effects on LTPA, it demonstrates the need for further research.

Chapter III

Paper II

Changes in Reported Crime and Blight Fines Following Park Redevelopment

Background and Hypothesis

Researchers, private funders and municipalities assume that park redevelopment is a catalyst for built and social environmental changes, particularly reductions in physical disorder (i.e. blight) and crimes (City of Detroit, 2016; City of Houston, 2015; City of Seattle, 2017; Cohen et al., 2015; Sharkey, 2013). When the City of Detroit released its 2016 plan to redevelop 163 of its 308 parks, the City claimed that parks and recreation "promote healthy lifestyles, crime reduction, community interaction, climate change management, and educational opportunities…[and] serve as catalysts for economic development" (City of Detroit, 2016). Furthermore, city planners consider parks to be a "proactive measure against blight" (City of Detroit, 2016). These arguments for park redevelopment are similar to those made by planners from other urban cities with similar redevelopment activities (City of Houston, 2015; City of Seattle, 2017).

Though the City government and developers have high hopes for park redevelopment, the literature does not consistently support that the redevelopment is a catalyst for reductions in crime and blight. The literature has focused more on vacant properties than parks, which have distinct differences. For example, remediated vacant properties can be transformed for multiple uses, including parks, whereas park redevelopment signifies transforming an existing park into a

higher quality park. A study in Philadelphia, Pennsylvania conducted qualitative interviews of 29 African American adult residents in that city. Participants shared their perception that vacant land made the neighborhood look "nasty" and attracted crime. These residents noted that they wanted the vacant land to be turned into other land uses, namely parks (Garvin, Branas, et al., 2013) as a way to decrease the "nasty" areas and crime. As a follow-up to this work, the non-profit Pennsylvania Horticulture Society (PHS) performed a greening project in neighborhoods. The PHS transformed previously vacant or dilapidated properties by removing debris, adding topsoil, planting grass and trees, and building a wooden fence (essentially creating pocket parks). Following the greening, objective reports of physical disorder (aesthetics) and subjectively perceptions of crime were assessed (3.5 months pre- and post-greening) within a radial half-mile of the greening area as well as in a control area that did not receive the greening treatment. Following the greening, residents did not perceive changes in physical disorder. There were non-significant decreases in total reported crime to law enforcement. However, residents ($n = 21$) reported feeling safer ($p < 0.01$) following the greening in intervention neighborhoods (Garvin, Cannuscio, et al., 2013).

Following this work, Branas and colleagues (2018) conducted a cluster randomized control trial, also in Philadelphia, to study if creating "park-like" settings reduces crime and fear in residents. The study used both qualitative and quantitative measures. Police reported gun assaults, burglary, and nuisances (e.g. loitering and loud music) significantly decreased in the three-year post-period. This effect was even more pronounced in neighborhoods with residents below the federal poverty line (FPL). This objective finding matched the perceptions of residents, who noted feeling safer in their community. In addition, more visitors were observed relaxing and socializing with others in the follow-up period (Branas et al., 2018).

In another urban city, Youngstown, Ohio, in partnership with the Youngstown Neighborhood Development Corporation, greened lots using efforts similar to those of the PHS. They examined within one-eighth and one-quarter radial miles of the greening sites at a minimum of six months and an average of 22 months. They found that felony assaults, burglaries, and robberies statistically significantly decreased, by 85%, 25%, and 69%, respectively, while motor vehicle thefts and general thefts were not significantly decreased (M. Kondo et al., 2016).

While researchers have studied whether the transformation of vacant properties to parks changes blight and crime, there is room to research whether redevelopment of existing parks reduces blight and crime. The parks are already known as recreational sites. The redevelopment of a communal gathering area differs slightly from adding a park space. Further, as noted, neighborhoods eager to transform parks have rarely studied the effects afterwards.

This paper will assess changes to physical disorder (i.e. blight violations) and crime in census tract neighborhoods following park redevelopment compared to neighborhoods without redeveloped parks. We hypothesize that, compared to neighborhoods without redeveloped parks, the neighborhoods with redeveloped parks will have decreases in blight fines decreases in both reported violent and reported non-violent crimes (Figure III.1). This work will add to the literature by demonstrating the uses for objective measures to evaluate crime and blight by way of spatial and statistical methods. Specifically, there is a dearth in the literature of work using natural experiments of large-scale park improvements in a major urban city.

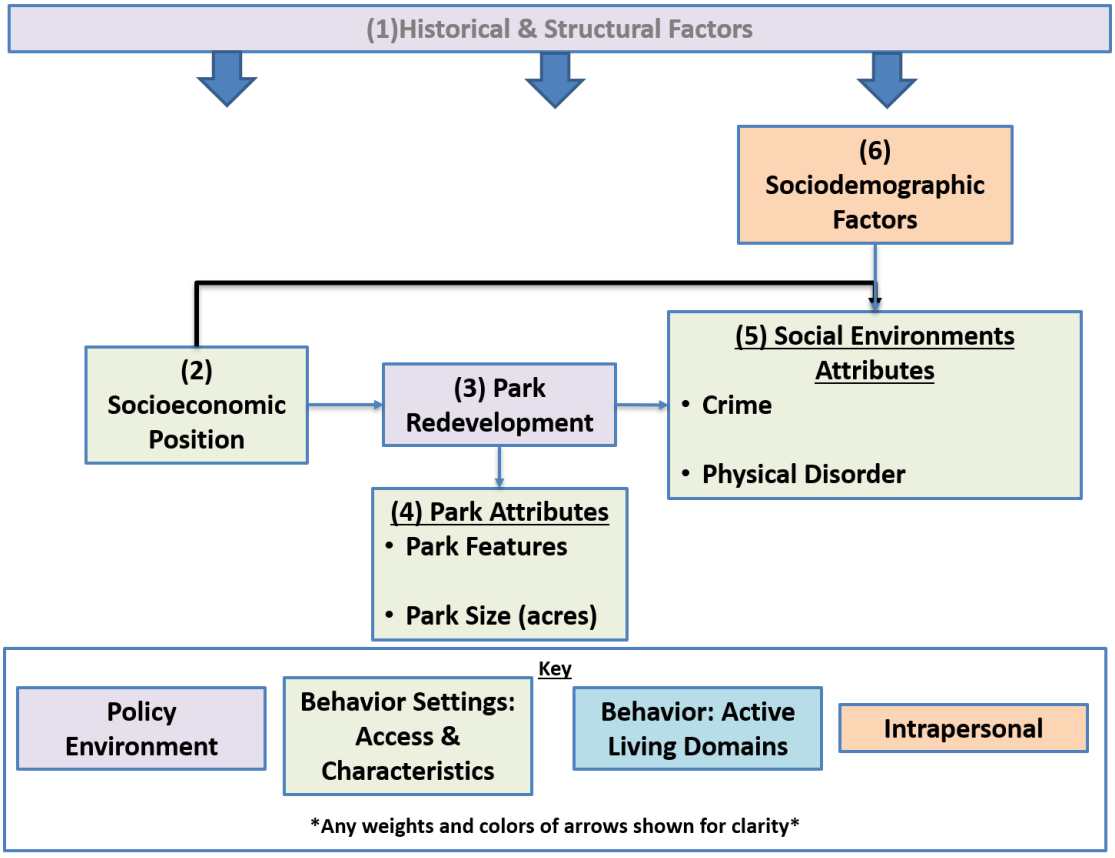

Figure III.1 Conceptual model of association of park redevelopment with crime and physical disorder

Methods

Geography. Detroit, Michigan (USA) is the largest city in the state of Michigan by both size and population. The total land area of Detroit is 138.75 square miles (359.36 square kilometers) (United States Census Bureau, 2017a), which would encompass Boston, Manhattan, and San Francisco combined. The City is estimated to have 690,000 residents (80% non-Hispanic Black (NHB)) and 39.8% of households living below the FPL (United States Census Bureau, 2016). Detroit has 382,560 parcels, of which 104 have no listed ownership as of October 3, 2018 (City of Detroit, 2018).

Census tract boundary data from the 2010 Census for all tracts (n = 297) were obtained from the Census Topologically Integrated Geographic Encoding and Referencing (TIGER)

products (United States Census Bureau, 2017b). There are four unpopulated tracts due to industry. A shapefile with all roads, residential roads, state roads, freeways, service drives and other roads in the City of Detroit was obtained from Esri Logistic Services (Esri, 2018). All spatial data from the City of Detroit was analyzed using ArcGIS 10.4.1 for Desktop ("ArcGIS 10.4.1 for Desktop," 2015). The spatial data was projected to the NAD 1983 Michigan meters projection, with the North American 1983 Geographic Coordinate System.

Matching comparison neighborhoods. Multiple steps were used to obtain the comparison group for the park redevelopment neighborhoods. There are multiple ways to define a neighborhood in spatial terms. As noted in the literature on crime and blight, one common way to spatially define a neighborhood is a radial buffer (McCormack & Shiell, 2011), but there is no universal standard in research to spatially define a neighborhood (Poudyal, Hodges, Tonn, et al., 2009). This research paper uses census tracts to spatially define neighborhood boundaries. A census tract is a reasonable approximation of a neighborhood due to the boundaries following "visible and identifiable features," such as a highway or river (United States Census Bureau (Commerce), 2018; United States Census Bureau, 2019). With this criterion set by the United States government, setting the neighborhood definition as the census tract is an appropriate approximation and has been used in similar research (Boggess & Maskaly, 2014; Soltero, Hernandez, O'Connor, & Lee, 2015).

The census tract location for each park in the City of Detroit was provided by the Division of Parks and Recreation (City of Detroit, 2016; J. Fulton, personal communication, March 15, 2017). Using the *Join Feature* in ArcGIS 10.4.1 for Desktop, parks (n = 308) were joined with median household income for the census tracts where they are located using the 2011–2015 five-year United States ACS estimates (United States Census Bureau, 2017c). The

2015 point source data from the City of Detroit Data Portal (City of Detroit, 2018) was joined as a one-to-many with each census tract using the *Spatial Join Feature* in ArcGIS 10.4.1 for Desktop. This data was then exported to a Microsoft SQL Server 12.0.5207.0 for ("SQL 12.0.5207.0," 2014) and averaged for each eligible census tract. The resulting table was exported to MedCalc 15.2 for Windows ("MedCalc," 2018). Census tracts with at least one Phase 1 park were matched with census tracts with at least one park, except tracts with any Phase 2 parks, using the *case-control* procedure in MedCalc. The matching was restricted to variables that were no more than one standard deviation away from the mean of the Phase 1 park census tracts (Stuart, 2010; Stuart & Rubin, 2008). The matching hierarchy was: 1) averages of the dependent variable from 2015, 2) available acres of parks of the tract, and 3) median household income (Cohen et al., 2009).

Sample. This study analyzes the average monthly blight fines per ticket in 31 census tracts having at least one redeveloped park (parks, n = 36) and 56 census tracts having no redeveloped park (parks, n = 89) (See Appendix E). This study also analyzes monthly number of crimes in 31 census tracts having at least one redeveloped park (parks, n = 36) and 51 census tracts having no redeveloped park (parks, n = 87) (See Appendix F). Some census tracts had multiple parks that were either redeveloped or not redeveloped, in which case the features and acres available to the public were summed.

Measures and data sources. The following table (Table III.1) details the dependent variables, independent variable, and covariates that will be used in this research question.

Table III.1. Study variables

Variable Type	Variable Name/Coded	Description	Data Source(s)
Dependent variable	Non-violent and violent crimes per 1,000-Population (continuous)	A 1,000-population rate of monthly violent and non-violent crimes within the study areas (census tract) for each redeveloped (n = 31) and matched (n = 51) neighborhoods during the 12-months before, the intervention period, and the 12-months following redevelopment will be the outcome variable of interest.	City of Detroit Open Data Portal (City of Detroit, 2018)
Dependent variable	Violent crimes per 1,000-Population (continuous)	A 1,000-population rate of monthly violent crimes (crimes per day) within the study areas (census tract) for each redeveloped (n = 31) and matched (n = 51) neighborhoods during the 12-months before, the intervention period, and the 12-months following redevelopment will be the outcome variable of interest.	City of Detroit Open Data Portal (City of Detroit, 2018)
Dependent variable	Blight fines per parcel ($) (continuous)	Total monthly fine dollar amounts (USD) will be averaged by the number of parcels within the study areas (census tract) for each redeveloped (n = 31) and matched (n = 56) neighborhoods during the 12-months before, the intervention period, and the 12-months following redevelopment will be the outcome variable of interest.	City of Detroit Open Data Portal (City of Detroit, 2018),
Independent variable	Park redevelopment neighborhood (dichotomous)	The City of Detroit provided a database indicating park redevelopment based on the phase. To create the neighborhood, the census tract where the park(s) is/are located will serve as a neighborhood.	City of Detroit (City of Detroit, 2016; J. Fulton, personal communication, March 15, 2017)
Independent variable	Time (discrete)	Time incident occurred based on the park redevelopment timeline.	City of Detroit Open Data Portal (City of Detroit, 2018)
Covariate	Total park acres (continuous)	Total size of the park acres available in the census tract.	City of Detroit (City of Detroit, 2016; J. Fulton, personal communication, March 15, 2017)
Covariate	Total park features (continuous)	Count of the park features (e.g., play area, comfort station) available in the census tract.	City of Detroit (City of Detroit, 2016; J. Fulton, personal communication, March 15, 2017)
Covariate	Proportion less than 18 years of age (continuous)	Proportion of children per census tract (B01001).	2011-2015 American Community Survey (ACS) estimates (United States Census Bureau, 2016)
Covariate	Proportion of female (continuous)	Proportion of self-reported sex of residents per census tract (B01001).	2011-2015 American Community Survey (ACS) estimates (United States Census Bureau, 2016)
Covariate	Proportion in poverty (continuous)	The proportion of residents falling below the FPL in the past 12 months based on the ratio of income to poverty level per census tract (C17002).	2011-2015 American Community Survey (ACS) estimates (United States Census Bureau, 2016)
Covariate	Proportion of renter-occupied households (continuous)	The proportion of renter-occupied housing tenure per census tract (B25003).	2011-2015 American Community Survey (ACS) estimates (United States Census Bureau, 2016)
Covariate	Proportion of single-parent household (continuous)	The proportion of single-headed households based on labor force participation per census tract (B23008).	2011-2015 American Community Survey (ACS) estimates (United States Census Bureau, 2016)
Covariate	Proportion of NHB residents (continuous)	Proportion of self-reported NHB residents per census tract (B02001).	2011-2015 American Community Survey (ACS) estimates (United States Census Bureau, 2016)

Covariate	Proportion of vacant properties (continuous)	Proportion of vacant property per census tract (B25002).	2011-2015 American Community Survey (ACS) estimates (United States Census Bureau, 2016)

Blight Fines. Outward-facing physical disorder (blight) violations in Detroit from June 29, 2010–October 2, 2018 were downloaded from the City of Detroit Data Portal (City of Detroit, 2018) (n = 122,500). The dataset included the latitude/longitude for ticketed violations, the day of the offense ticket, parcel number, violation description (See Appendix G), code (exterior and interior violations), and fine amount (showing severity of the violation and offense reoccurrence). For some codes, the Excel system transformed them into dates; for example, code 9-1-18 was transformed into September 1, 2018. This is automatic formatting in Microsoft Excel, and these cases were not excluded. Blight identification and ticketing is done by City of Detroit employees using a manual and extensive training. Of those, 305 were excluded – 1 with no address, parcel, or latitude and longitude, 5 with negative addresses, and the remaining with no street listed on the address. Once geocoded to the census tracts in the study and restricted to the study period, the number of total violations dropped (n = 21,820). Ticketed blight fines have different amounts, including $1.00 for excessive weeds/grass, $100.00 for excessive rodent infestation, $500.00 for failing to evacuate a dangerous building, and $1,000 and more for dumping. The dollar amount for repeat offenders increases from the initial fine. To standardize the measure for neighborhoods, the total blight violation was averaged by the number of parcels in the census tracts. A map of the 86 census tracts included in the study is available in Appendix E.

Reported Crime. Violent and non-violent crime data in Detroit from June 29, 2010–October 2, 2018 (n = 476,331) were downloaded from the City of Detroit Data Portal (City of Detroit, 2018). Of these 726 crimes were excluded due to lack of location information. The datasets included the latitude/longitude and day and time of the crime. In some specific examples, it appears that 262 were assigned the same latitude and longitude coordinates outside

of Detroit (32.02636, -127.91418) in error, and thus were excluded. There are multiple ways to assess crimes, based on limited repeated measures research this study uses a per 1,000-population rate (Bogar & Beyer, 2015; Han, Cohen, Derose, Li, & Williamson, 2018). Once geographically assigned in the neighborhoods for the designated time period, crimes dropped (n = 40,423).

Prior to December 6, 2016, the City of Detroit classified some crimes using the Federal Bureau of Investigation (FBI) Uniform Crime Reporting categories (Federal Bureau of Investigation, n.d.) (see Appendix H). Following December 6, 2016, all crimes were classified using the FBI Uniform Crime Reporting categories. This earlier crime set was included despite it containing additional crimes such as escape of fugitives, immigration issues such as "illegal entry," and civil issues (e.g. walking away from mental health institutions) prior to December 6, 2016. For the full list, see Appendix H. During October 2015–September 2016, the City did not classify any crimes as "violent" based on the FBI Uniform Crime Reporting classifications. This difference was seen citywide, thus affecting all intervention and match park neighborhoods. A map of the 82 census tracts in this study is available in Appendix F.

Covariates. Based on literature reviews of the associations of crime and physical disorder with park redevelopment, the following variables were included as covariates: census tract proportions of NHB, proportion of tracts below 100% of the FPL, proportion of renter occupancy, proportion of children under 18 years of age, and proportion of vacant units (Bogar & Beyer, 2015; Branas et al., 2016, 2013; Price, 2016; Raleigh & Galster, 2015). Noted in the crime literature, but not in the physical disorder literature, are the covariates of proportion of females and the proportion of single-parent households (Branas et al., 2013; Raleigh & Galster,

2015), which were included here. Additional covariates included total park acres and total park features.

Data Analysis.

Extreme observations. The dependent variables, monthly average blight fine per parcel ($) and the monthly crime per 1,000-population, were not normally distributed. SAS reported extreme observations for the following variables, which were all evident in skewed histograms: 1) five instances of the monthly average of blight per parcel; 2) 25 park features and size measures; 3) eight monthly averages of crime per 1,000-population, and 4) 21 instances of the proportion of single parents. These extreme observations were removed to produce normally distributed data and maintain the original units of the measure.

Bivariate Analysis. The bivariate analysis detailed the relationships between all major study variables as a correlation. For the continuous variables, a Pearson correlation was completed. A polychoric correlation was used for the categorical variables. The correlation of the outcome variables for the five years (60 months) prior to the pre-redevelopment period was measured to account for changes in the crime and physical disorder that were external to the analysis, such as a new police chief or change in blight enforcement.

Repeated Measures Linear Mixed Model Regression. Interactions of the proportion of poverty, population density, proportion of vacancy, and proportion of children were tested.

Using a between-group design with repeated measures of pre- and post-redevelopment data, this study assesses the changes before and after park redevelopment with a repeated measures linear mixed regression model using the *proc mixed* procedure in SAS 9.4 64-bit for Windows ("SAS," 2011). Separate analyses were completed for 1) the monthly average of the

blight fine dollar amount per parcel, 2) monthly violent and non-violent crime per 1,000-population, and 3) monthly violent crime per 1,000-population.

The subscript *i* was used to indicate time and *c* to indicate census tract. Given the spatial nature of the data, a Moran's I in ArcGIS 10.4.1 for Windows will test the residuals for spatial autocorrelation. The formulas were:

$$Blight\ Fine\ Dollar\ Amount\ per\ Parcel_{cj} = \beta_0 + \beta_1\ Park\ redevleopment\ community_i + \beta_2\ Time_i + \beta_3\ Park\ redevlopment\ community_i * Time_i + \beta_4\ NHB\ proportion_c + \beta_5\ Vacancy\ proportion_c + \beta_6\ Renter\ occupied\ households\ proportion_c + \beta_7\ Children\ proportion_c + \beta_8\ Park\ features_c + \beta_9\ Park\ acres_c + \beta_{10}\ Poverty\ proportion_c + \epsilon_{ci}$$

$$Crime\ Rate\ per\ 1{,}000\ Population_{cj} = \beta_0 + \beta_1\ Park\ redevleopment\ community_i + \beta_2\ Time_i + \beta_3\ Park\ redevlopment\ community_i * Time_i + \beta_4\ NHB\ proportion_c + \beta_5\ Female\ proportion_c + \beta_6\ Vacancy\ proportion_c + \beta_7\ Renter\ occupied\ households\ proportion_c + \beta_8\ Children\ proportion_c + \beta_9\ Single\ parent\ household\ proportion_c + \beta_{10}\ Park\ features_c + \beta_{11}\ Park\ acres_c + \beta_{12}\ Poverty\ proportion_c + \epsilon_{ci}$$

Results

Table III.2 includes descriptive statistics for study variables for the blight research question.

Table III.2. Summary Statistics (Blight)

	N	Percent	Mean	Standard Deviation	Median	Minimum	Maximum

Monthly average fine dollar amount per parcel - removed outliers	1951		$1.57	$1.97	$0.98	$0.01	$30.94
Park redevelopment neighborhood by Tract	86	34.88%					
Proportion of census tract below 100% of the FPL	1952		0.42	0.11	0.41	0.09	0.67
Non-Hispanic Black proportion in census tract	1952		0.83	0.24	0.93	0.01	1.00
Proportion of renter-occupied housing units in census tract	1952		0.49	0.14	0.47	0.16	0.92
Proportion of vacant units in census tract	1952		0.32	0.12	0.31	0.08	0.62
Total features in census tract	1930		3.71	3.41	3.00	0.00	17.00
Total acres of parks in census tract	1928		6.90	11.58	3.82	0.23	66.71

Table III.3 includes descriptive statistics for study variables for the crime research question.

Table III.3. Summary Statistics (Crime)

Variable	N	Percent	Mean	Standard Deviation	Median	Minimum	Maximum
Monthly crime per 1,000-population in census tract - removed outliers	1645		11.30	8.48	10.16	0.17	63.71
Monthly violent crime per 1,000-population in census tract - removed outliers	1311		2.13	1.61	1.74	0.22	13.30
Park redevelopment neighborhood by census tract	82	37.80%					
Proportion of census tract below 100% of the FPL	1646		0.44	0.11	0.45	0.09	0.70
Female proportion in census tract	1646		0.53	0.05	0.54	0.41	0.65
Proportion of children in census tract	1646		0.25	0.06	0.24	0.14	0.41
Proportion of single parent households in census tract	1646		0.79	0.16	0.81	0.15	1.00
Non-Hispanic Black proportion in census tract	1646		0.84	0.24	0.94	0.02	1.00
Proportion of renter-occupied housing units in census tract	1646		0.52	0.14	0.51	0.24	0.89
Proportion of vacant units in census tract	1646		0.32	0.12	0.32	0.06	0.68
Total features in census tract	1646		3.94	4.28	3.00	0.00	27.00
Total acres of parks in census tract - removed outliers	1624		6.94	11.11	4.00	0.12	66.71

Bivariate Analysis. On the basis of previous research (Price, 2016), we conducted a bivariate analysis to examine the relationship between blight violations and crime. The bivariate analysis found that blight and crime were weakly (0.17) but statistically significantly correlated ($p < 0.001$), indicating that it suitable to test the outcomes separately.

Blight Fines. A bivariate analysis found that the average fine per parcel was not correlated from the five-year pre- to the one-year pre-intervention. Total acres in the census tract, the proportion of renters, the proportion of vacant property units, and the proportion of NHB were all statistically significant.

Table III.4. Bivariate Analysis of Park Redevelopment and Average Blight Fine per Parcel

	1	2	3	4	5	6	7	8
1. Monthly average fine dollar amount per parcel - removed outliers	1.00							
2. Park redevelopment neighborhood by tract	0.01	1.00						
3. Proportion of census tract below 100% of the FPL	0.00	-0.02	1.00					
4. Non-Hispanic Black proportion in census tract	-0.05*	0.12***	0.02	1.00				
5. Proportion of renter-occupied housing units in census tract	0.16***	-0.01	0.62***	-0.13***	1.00			
6. Proportion of vacant units in census tract	-0.10***	-0.21***	0.44***	0.19***	0.04*	1.00		
7. Total features in census tract	-0.0003	0.03	-0.21***	-0.03	-0.04	0.06*	1.00	
8. Total acres of parks in census tract	-0.08**	0.16***	0.01	0.06*	-0.02	0.01	0.61***	1.00

***p < 0.001, **p < 0.01, *p < 0.05

Reported Crime. A bivariate analysis found that violent crime was not correlated from the five-year pre- to the one-year pre-intervention; however, all crime was correlated. Park redevelopment was not significantly correlated with the total crime, but significantly correlated with violent crime (0.10, $p < 0.01$) (Table III.5). The proportion of females, the proportion of single parents, the proportion of NHB, as well as total park features in the tract, and total park size were all significantly associated with both total crime per 1,000-population and violent crime per 1,000-population.

Table III.5. Bivariate Analysis of Park Redevelopment and Reported Crime per 1,000-Population

	1	2	3	4	5	6	7	8	9	10	11	12
1. Monthly crime per 1,000-population in census tract - removed outliers	--											
2. Monthly violent crime per 1,000-population in census tract - removed outliers	0.70***	--										
3. Park redevelopment neighborhood by census tract	-0.03	0.10**	--									
4. Proportion of census tract below 100% of the FPL	-0.04	-0.03	-0.11***	--								
5. Female proportion in census tract	0.11***	0.06*	0.07**	-0.04	--							
6. Proportion of children in census tract	-0.08**	-0.02	-0.08**	0.26***	0.16***	--						
7. Proportion of single parent households in census tract	0.26***	-0.15***	-0.06*	0.17***	0.21***	-0.29***	--					
8. Non-Hispanic Black proportion in census tract	0.17***	0.11***	0.12***	-0.11***	0.27***	-0.40***	0.56***	--				
9. Proportion of renter-occupied housing units in census tract	-0.02	-0.08**	-0.20***	0.57***	0.21***	0.13***	0.08**	-0.14***	--			
10. Proportion of vacant units in census tract	0.04	0.14***	-0.18***	0.36***	-0.24***	-0.23***	0.31***	0.18***	0.04	--		
11. Total features in census tract	-0.15***	-0.10**	0.09***	-0.24***	-0.31***	-0.13***	-0.38***	-0.18***	-0.18***	0.01	--	
12. Total acres of parks in census tract	-0.14***	-0.15***	0.15***	-0.14***	-0.20***	-0.02	-0.30***	-0.09**	-0.13***	-0.11***	0.78***	--

***p < 0.001, **p < 0.01, *p < 0.05

Repeated Measures.

Blight Fines. Model 1 (Table III.6) presents the main independent variable model of the average fine dollar per parcel. The interaction of park redevelopment and time shows there was a statistically significant ($p < 0.01$) and positive association with the blight fine per parcel ($\beta = 1.03$, CI = 0.41, 1.65). This relationship remained statistically significant ($p < 0.01$) in Model 2 after the inclusion of the proportion of residents falling below the FPL ($\beta = 1.00$, CI = 0.30, 1.71). In Model 3, with the inclusion of neighborhood characteristics of the proportion of NHB residents, the proportion of the tract vacant, and proportion of renters, the interaction variable was no longer significant. In Model 4 the remaining covariates included were the proportion of children, the total features in the census tract, and the total park size in acres in the census tract. After the inclusion of all the variables the interaction of park redevelopment and time remained insignificant. It is important to note that the study was underpowered with a power achieved of 0.10.

The graphical representation (Figure III.2) shows that blight fines in intervention neighborhoods is increasing, while the neighborhoods without redevelopment is relatively stagnant. The dataset was split to assess the effect of the intervention. Average blight fines per parcel showed that the 12-month period before of the intervention with the inclusion of the first month of the intervention was significant ($p < 0.001$) and the first month of the intervention to the end of the post- time was significant ($p = 0.001$).

The Moran's I completed in ArcGIS 10.4.1 for Windows indicated that there was no spatial autocorrelation. Therefore, the mixed model repeated measures were sufficient to report.

Table III.6. Repeated Measures Mixed Model of Average of Assessed Blight Fines per Parcel and Park Redevelopment

	Model 1: Main Independent Variable, n= 31		Model 2: Main Independent Variable with SEP Covariate, n= 31		Model 3: Neighborhood with SEP Covariate, n= 31		Model 4: Full Model, n= 31	
	n obs = 1951		n obs = 1951		n obs = 1951		n obs = 1905	
	n tracts = 86		n tracts = 86		n tracts = 86		n tracts = 85	
	β (SE)	95% CI	β (SE)	95% CI	β (SE)	95% CI	β (SE)	95% CI
Intercept - monthly average fine dollar amount per parcel - removed outlier	1.41 (0.37)**	0.68, 2.14	1.38 (0.41)**	0.59, 2.18	0.99 (0.44)*	0.13, 1.85	0.80 (0.45)	-0.08, 1.68
Park redevelopment neighborhood by tract	0.10 (0.47)	-0.83, 1.02	0.10 (0.47)	-0.83, 1.02	0.05 (0.46)	-0.85, 0.96	0.16 (0.47)	-0.76, 1.07
Time	-0.20 (0.55)	-1.28, 0.88	-0.20 (0.55)	-1.28, 0.88	-0.15 (0.54)	-1.21, 0.90	-0.19 (0.54)	-1.25, 0.88
Interaction of park redevelopment neighborhood and time	1.03 (0.32)**	0.41, 1.65	1.00 (0.36)**	0.30, 1.71	0.57 (0.39)	-0.20, 1.34	0.47 (0.41)	-0.33, 1.27
Covariates								
Non-Hispanic Black Proportion in census tract					-0.16 (0.19)	-0.53, 0.21	0.12 (0.20)	-0.27, 0.51
Proportion of vacant units in census tract					0.19 (0.11)	-0.02, 0.40	-1.16 (0.48)	-2.19, -0.32
Proportion of renter-occupied housing units in census tract					3.76 (0.43)***	2.92, 4.61	3.08 (0.43)**	2.23, 3.93
Total features in census tract - removed outliers							0.04 (0.02)	0.01, 0.08
Total park size (acres) in census tract - removed outliers							-0.03 (0.01)***	-0.04, -0.01
Socioeconomic Position Covariate								
Proportion of census tract with residents below 100% of the FPL			0.07 (0.40)	-0.71, 0.84	-3.21 (0.59)***	-4.37, -2.05	-1.47 (0.65)*	-2.75, -0.19
								Power Achieved: 0.10

***p < 0.001, **p < 0.01, *p < 0.05

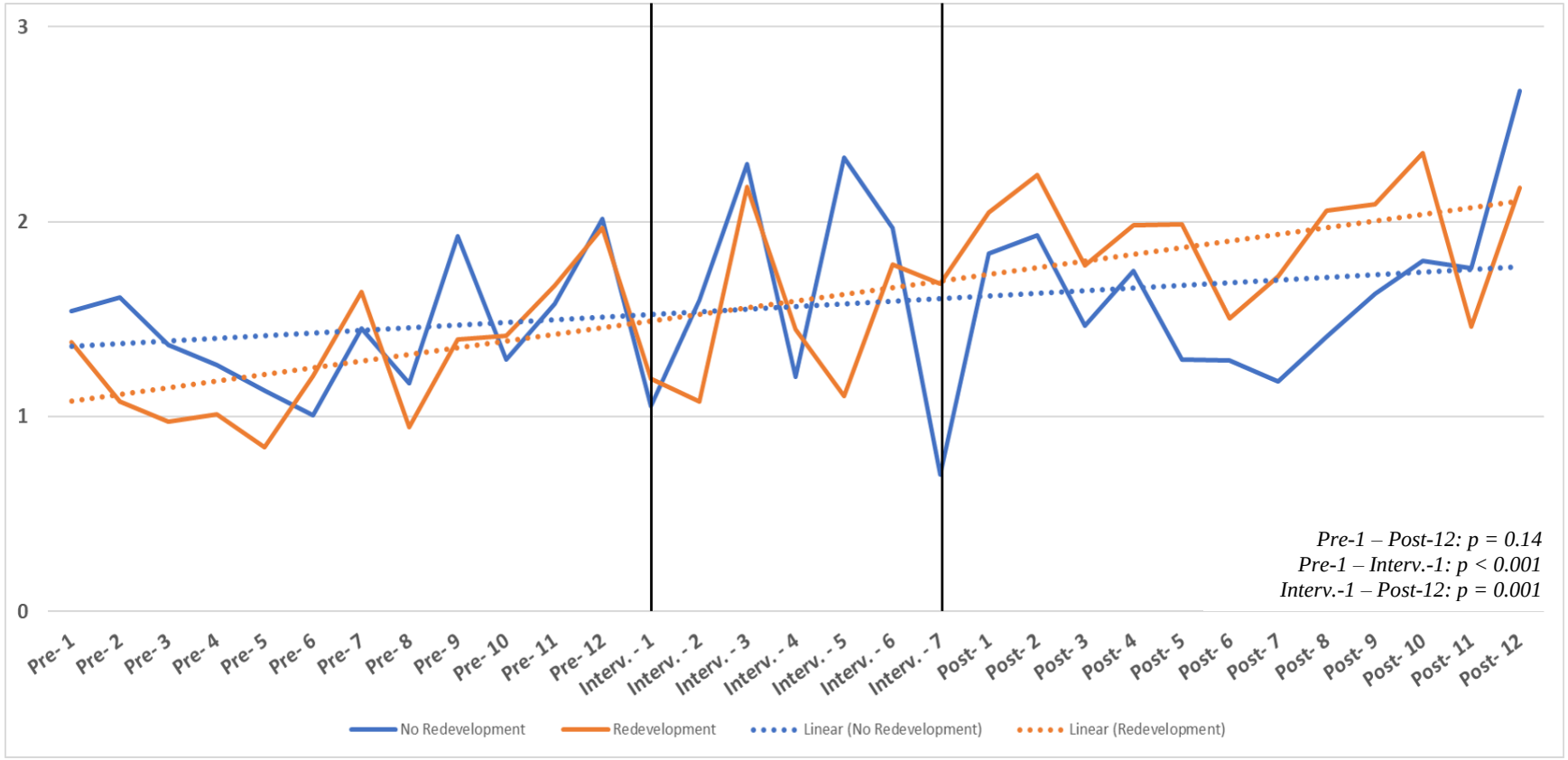

Figure III.2 Monthly Repeated Measures Average of Assessed Blight Fines per Parcel and Park Redevelopment

All Reported Crime. Model 1 (Table III.7) presents the main independent variable model. The interaction of park redevelopment and time shows there was a statistically significant ($p < 0.001$) and positive association with crime per 1,000-population ($\beta = 6.75$, CI = 4.19, 9.31). This relationship remained statistically significant ($p < 0.001$) in Model 2 after including the proportion of the tract in poverty ($\beta = 8.91$, CI = 5.92, 11.90). In Model 3 with the inclusion of neighborhood characteristics of NHB, proportion of females, proportion of the tract vacant, and proportion of renters, the interaction variable was no longer significant and became a negative association. Model 4 included the remaining covariates: the proportion of children, the proportion of single parents, the total features in the census tract, and the total park size in acres in the census tract. After the inclusion of all the variables, the interaction of park redevelopment and time was statistically significant with ($p < 0.01$) indicating that there is an association of park redevelopment and violent/non-violent crimes ($\beta = -9.29$, CI = -14.93, -3.64).

Figure III.3 shows that all crime per 1,000-population in both the intervention and match neighborhoods increased during the study period. In addition, there was a sharp increase in crime reporting in both the intervention and match neighborhoods during the month prior to the park redevelopment period. The dataset was split based on the intervention time. All crime per 1,000-population showed that the 12-month period before of the intervention with the inclusion of the first month of the intervention was insignificant and the first month of the intervention to the end of the post- time was also insignificant.

The residuals were tested for spatial autocorrelation, which was found to be insignificant, indicating the mixed model was sufficient to report. It is worth noting that this study was underpowered with a power of 0.10.

Table III.7. Repeated Measures Mixed Model of All Reported Crime and Park Redevelopment

	Model 1: Main Independent Variable, n= 31		Model 2: Main Independent Variable with SEP Covariate, n= 31		Model 3: Neighborhood with SEP Covariate, n= 31		Model 4: Full Model, n= 31	
	n obs = 1641		n obs = 1641		n obs = 1641		n obs = 1623	
	n tracts = 82		n tracts = 82		n tracts = 82		n tracts = 81	
	β (SE)	95% CI	β (SE)	95% CI	β (SE)	95% CI	β (SE)	95% CI
Intercept – Monthly crime per 1,000-population in census tract - removed outliers	0.48 (2.44)	-4.31, 5.27	2.38 (2.53)	-2.59, 7.34	-11.48 (3.22)**	-17.79, -5.16	-15.44 (3.42)***	-22.16, -8.73
Park redevelopment neighborhood by census tract	0.33 (3.04)	-5.64, 6.30	0.95 (7.17)	-5.52, 6.40	0.76 (2.98)	-5.09, 6.60	0.75 (2.84)	-4.82, 6.31
Time	5.92 (2.94)	0.14, 11.69	6.05 (2.94)	0.29, 11.82	5.81 (2.88)*	1.87, 27.57	6.69 (2.74)*	1.31, 12.06
Interaction of park redevelopment neighborhood and time	6.75 (1.30)***	4.19, 9.31	8.91 (1.52)***	5.92, 11.90	-4.92 (2.54)	-9.91, 0.07	-9.29 (2.88)**	-14.93, -3.64
Covariates								
Non-Hispanic Black proportion in census tract					4.24 (0.88)***	2.51, 5.96	0.75 (1.04)	-1.29, 2.78
Female proportion in census tract					18.12 (4.06)***	10.16, 26.09	1.96 (1.90)	2.89, 19.35
Proportion of vacant units in census tract					2.94 (1.83)	-0.64, 6.53	1.97 (1.90)	-1.77, 5.70
Proportion of renter-occupied housing units in census tract					-2.00 (1.81)	-5.56, 1.56	-1.07 (1.79)	-4.57, 2.43
Proportion of children in census tract							9.58 (4.10)*	1.54, 17.63
Proportion of single parent households in census tract							15.11 (1.60)***	11.97, 18.24
Total features in census tract							-0.13 (0.08)	-0.28, 0.02
Total acres of parks in census tract							-0.01 (0.03)	-0.07, 0.04
Socioeconomic Position Covariate								
Proportion of census tract below 100% of the FPL			-4.71 (1.72)**	-8.09, -1.33	-3.27 (2.28)	-7.75, 1.20	-12.23 (2.54)***	-17.21, -7.25
								Power Achieved: 0.10

***p < 0.001, **p < 0.01, *p < 0.05

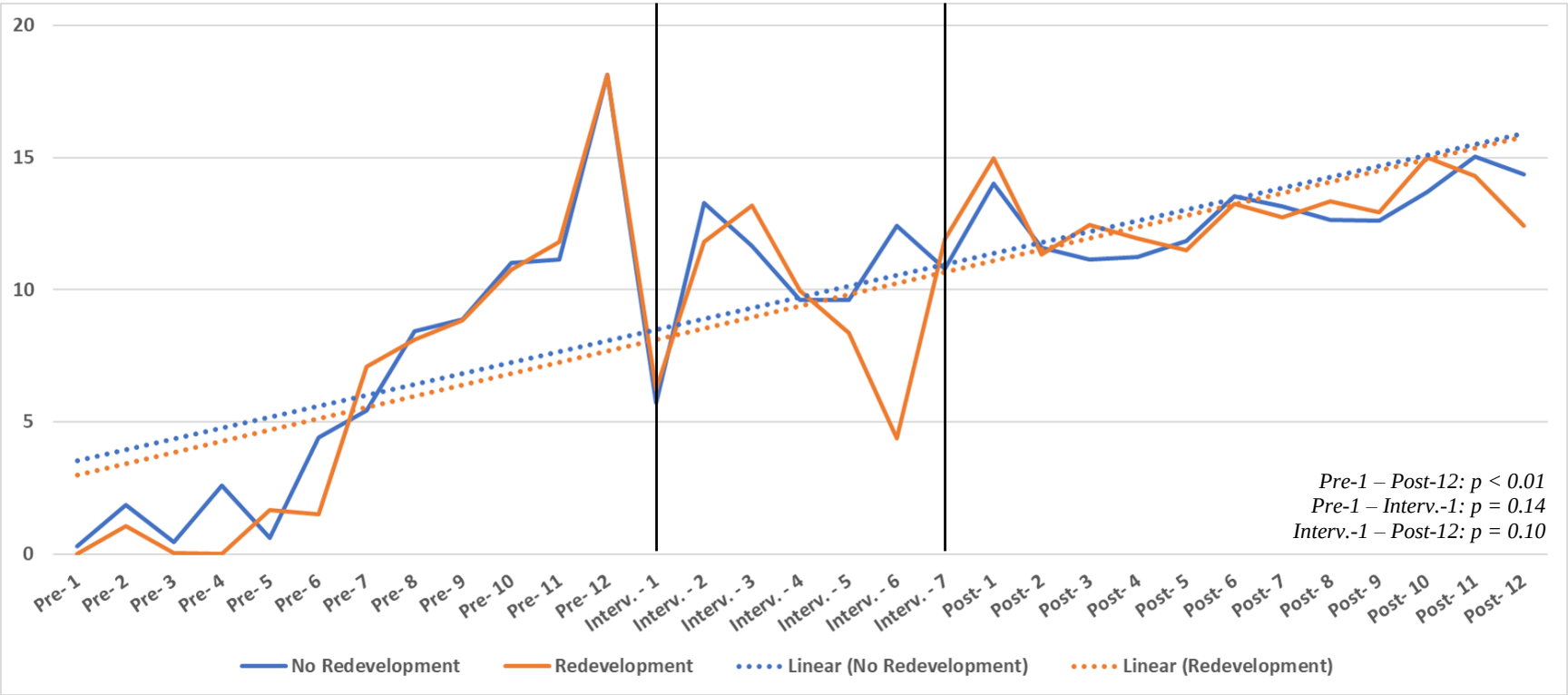

Figure III.3 Monthly Repeated Measures Mixed Model of Crime per 1,000-population and Park Redevelopment

Reported Violent Crime. Violent crime was separated and tested from total crime for associations with park redevelopment. Due to data limitations discussed above, crime could only have a pre-intervention period of 7 months instead of the 12 months selected for the other outcomes. Model 1 (Table III.8) shows that the interaction of the park redevelopment with time had a statistically significant ($p < 0.001$) and positive association with crime ($\beta = 1.46$, CI = 0.81, 2.10). This relationship continued to be statistically significant ($p < 0.001$) in Model 2 with the inclusion of the proportion of residents in the census tract falling below the FPL ($\beta = 1.81$, CI = 1.01, 2.60). In Model 3, with the addition of NHB proportion, proportion of females, proportion of the tract vacant, and proportion of renters, the interaction term was no longer significant ($\beta = -0.43$, CI = -1.60, 0.73). Model 4 included the remaining covariates of the proportion of children, the proportion of single parents, the total features in the census tract, and the total park size in acres in the census tract. The interaction of park redevelopment and time was moderately insignificant ($p = 0.519$). It is important to note that this study was underpowered, achieving a power of 0.10.

Figure III.4 illustrates that violent crime in both the intervention and match neighborhoods started at approximately the same point, and then started to increase. Similar to the violent and non-violent crime finding, there was a sudden increase in both the intervention and matched neighborhood the month before the intervention. The slope of these findings shows that the intervention neighborhoods had more reported violent crimes compared to the matched neighborhoods. The dataset was split based on the intervention time. Violent crime per 1,000-population showed that that the 12-month period before of the intervention with the inclusion of the first month of the intervention was insignificant and the first month of the intervention to the end of the post- time was also insignificant.

The residuals were tested for spatial autocorrelation, which was found to be insignificant, indicating the mixed model was sufficient to report.

Table III.8. Repeated Measures Mixed Model of Reported Violent Crime and Park Redevelopment

	Model 1: Main Independent Variable, n= 26		Model 2: Main Independent Variable with SEP Covariate, n= 26		Model 3: Neighborhood with SEP Covariate, n= 26		Model 4: Full Model, n= 26	
	n obs = 1312		n obs = 1312		n obs = 1312		n obs = 1290	
	n tracts = 82		n tracts = 82		n tracts = 82		n tracts = 81	
	β (SE)	95% CI	β (SE)	95% CI	β (SE)	95% CI	β (SE)	95% CI
Intercept - Monthly violent crime per 1,000-population in census tract - removed outliers	1.73 (0.29)***	1.56, 2.30	2.03 (0.36)***	1.33, 2.74	-0.18 (0.56)	-1.28, 0.91	-0.91 (0.65)	-2.18, 0.36
Park redevelopment neighborhood by census tract	0.82 (0.37)	0.08, 1.55	0.83 (0.40)*	0.50, 1.61	0.81 (0.37)	0.09, 1.52	0.69 (0.36)	-0.01, 1.40
Time	-0.37 (0.51)	-1.37, 0.63	-0.35 (0.54)	-1.42, 0.71	-0.48 (0.50)	-1.46, 0.50	-0.55 (0.49)	-1.50, 0.40
Interaction of park redevelopment neighborhood and time	1.46 (0.33)***	0.81, 2.10	1.81 (0.41)***	1.01, 2.60	-0.43 (0.59)	-1.60, 0.73	-1.33 (0.69)[a]	-2.68, 0.01
Covariates								
Non-Hispanic Black proportion in census tract					0.53 (0.22)*	0.10, 0.96	0.66 (0.26)*	0.16, 1.16
Female proportion in census tract					3.17 (0.91)**	1.38, 4.96	2.03 (0.96)*	0.15, 3.91
Proportion of vacant units in census tract					1.87 (0.41)	1.05, 2.69	2.09 (0.44)***	1.23, 2.95
Proportion of renter-occupied housing units in census tract					-1.25 (0.41)***	-2.06, -0.43	-0.89 (0.41)*	-1.70, -0.08
Proportion of children in census tract							3.37 (0.95)**	1.51, 5.23
Proportion of single parent households in census tract							1.25 (0.38)**	0.50, 2.00
Total features in census tract							-0.01 (0.02)	-0.04, 0.03
Total acres of parks in census tract							-0.01 (0.01)	-0.02, 0.001
Socioeconomic Position Covariate								
Proportion of census tract with residents below 100% of the FPL			-0.73 (0.42)*	-1.56, 0.11	-0.38 (0.53)	-1.42, 0.67	-1.95 (0.60)**	-3.12, -0.78
								Power Achieved: 0.10

***p < 0.001, **p < 0.01, *p < 0.05
a: p = 0.051

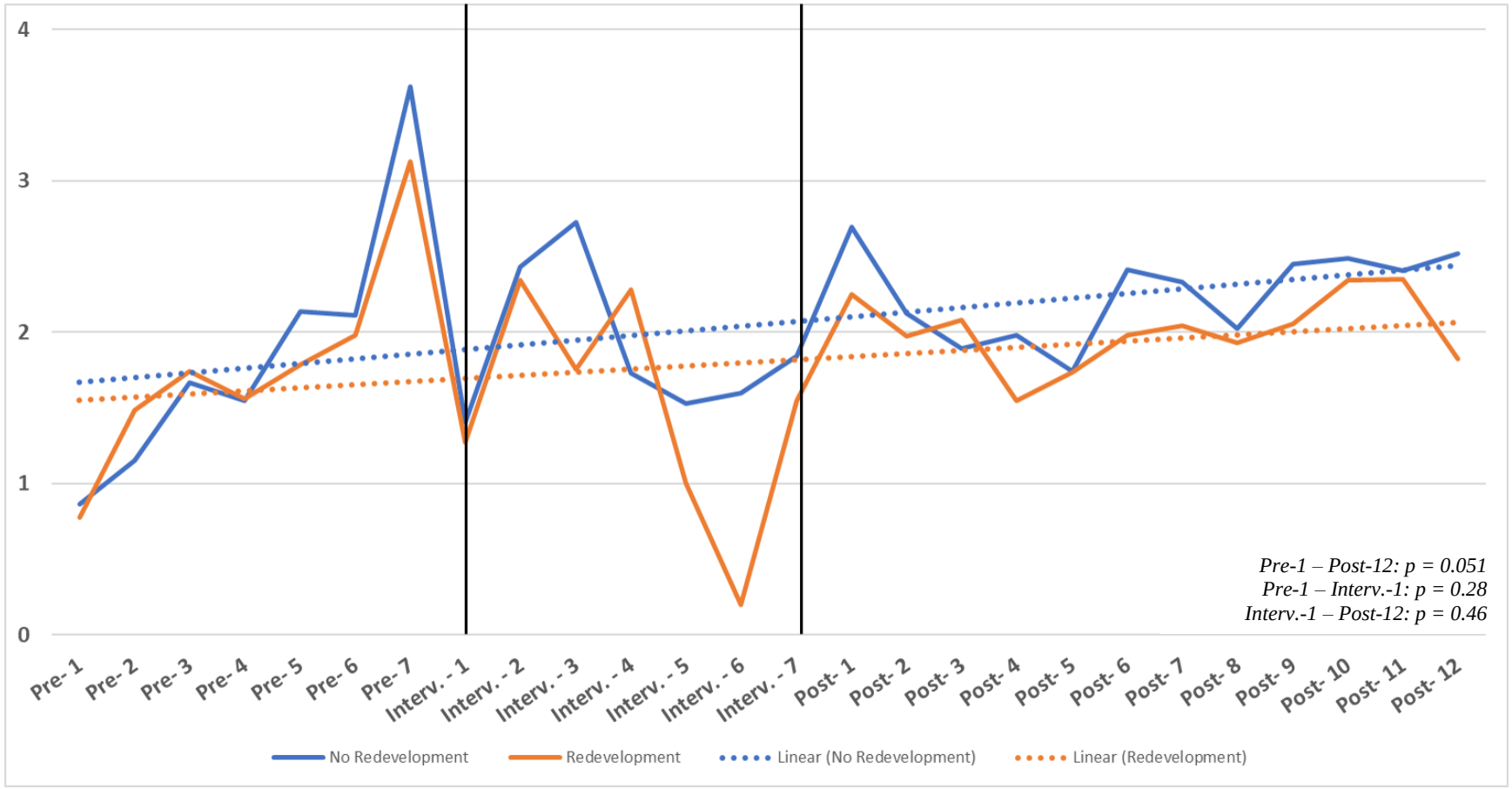

Figure III.4 Monthly Repeated Measures Mixed Model of Violent Crime per 1,000-population and Park Redevelopment

Discussion

The findings in this study suggest that park redevelopment is associated with more blight enforcement per parcel in neighborhoods with redeveloped parks, when we examined the time period following the start of the intervention. This association was insignificant when examining the entire time period starting with 12-months before the intervention and ending 12-months after the intervention.

The same study found that total reported crimes and reported violent crimes are not associated with park redevelopment, when we examined from the initiation of the park redevelopment to the conclusion of the post-period. However, the association was nearly significant for the total time period of neighborhoods with redeveloped parks, with fewer reported violent crimes per 1,000-population.

The inconsistent finding in the full models of these three outcomes compared to the split time graphical representations indicate that more research is needed.

Blight Fines. The bivariate analysis indicates that there no association between blight fines per parcel in the previous five-years and the start of the 12-month period before the intervention. It is unclear why this is insignificant; however, the department that primarily issues blight tickets expanded from the *Buildings and Safety Engineering Department* to the *Buildings, Safety Engineering, and Environmental Department* in recent years. This department change could also indicate changes in violation enforcement. Further, the bivariate analysis indicates that there is no association of park redevelopment and blight fines per parcel; however, this null association does not hold in the split time model due to the significant differences across time before and after the intervention.

The hypothesis that blight fines would decrease in intervention neighborhoods was not supported in the full model. Conversely, the findings show that the start of the intervention may trigger significant increases in average blight fines per parcel in neighborhoods with park redevelopment. This finding adds to mixed literature in urban neighborhoods. Community leaders in Detroit indicated that once-dilapidated places are no longer sources of blight or dumping grounds once redevelopment starts (BBC Research & Consulting, 2014). Further, work in Massachusetts found the redevelopment of pocket parks and community gardens worked to eliminate blight in the community. The author indicated that these reclaimed and redeveloped areas were a "positive neighborhood resource," bringing neighbors together for activities (Art, 2014). Given this, it is possible that the increases in fines deter blight in the neighborhoods and the increased enforcement in neighborhoods with redevelopment is part of a larger strategy to reclaim the neighborhood. This conjecture is supported in a recent news article indicating that the priority for blight enforcement in Detroit is in part based on neighborhood assets, including nearby parks (Ikonomova, 2018).

The potential strategy of deterring blight through assessed blight fines in the neighborhood has multiple benefits for residents. A systematic review which found that addressing the visual cues of blight can encourage residents to spend time in their neighborhood by reducing suspicion and distrust (Sreetheran & van den Bosch, 2014). Further, the visual cues of blight can impact cardiovascular health. In Philadelphia, the Philadelphia Horticulture Society remediated previous vacant lots into greened park-like lots. Following this process, the researchers found that those who walked in view of the greened lots had better cardiovascular heart rates compared to those walking in view of vacant lots (South, Kondo, Cheney, & Branas, 2015). Therefore, cities such as Detroit could consider using blight violations as part of renewal

efforts in the neighborhood, including the redevelopment of parks (Cell et al., 2017) and in turn can have health benefits to residents.

Reported Crime. The bivariate analysis found that violent crime was not associated in the previous five-years and the start of the 12-month period before the intervention. Further, while the violent crime bivariate analysis was positively and statistically significant with park redevelopment, no such association was found in the full model when split before and after the intervention. These findings are most likely due to crimes being classified differently due to the citywide failure to categorize any crimes as violent for a period of five months for this study.

The research in this dissertation examined all (violent/non-violent) crime and violent crime; however, crime may be more complex than bisected comparisons of all crime and violent crime to park redevelopment. Specifically, violent crime was nearly significant with findings indicating that neighborhoods without redevelopment have more violent crime following park redevelopment; therefore, park redevelopment may be protective. However, this must not be over-interpreted given the null findings. Thus, the findings of this work adds to the inconsistent literature of changes in crime following redevelopment (Bogar & Beyer, 2015) and more research is needed. In New Orleans researchers found that following the remediation of land into park-like areas that violent, property, and domestic crimes did not change; while drug crimes significantly decreased two years after the renovation (M. C. Kondo et al., 2018). Work out of Ohio using similar spatial and statistical methods found that after vacant land was greened into park-like areas, burglaries decreased in the neighborhood, but motor vehicle thefts increased (M. Kondo et al., 2016). Specifically, increases in motor vehicle thefts could be due to increases in visitor to the parks and therefore more targets. Both studies had longer post-intervention times

for their study and studied specific types of violent and non-violent crimes, thus could influence their findings when compared to this study.

Further research in Philadelphia found that creating park-like environments was associated with decreases reported gun assaults, robberies, burglaries, and nuisances analyzed over three years (Branas et al., 2018). The same study found that more visitors were observed using the redeveloped park-like environments. Connected to the Branas study, in urban Los Angeles found researchers that gun-related violent crimes had long-term negative associations of self-reported park use when measured during a two-year period (Han et al., 2018).

The work in this dissertation when considering previous literature indicates that crime is more complex and researching specific types of crime pertinent for the community along with the time for changes to occur could yield different findings. Therefore, the City of Detroit and other cities may want to add specificity of the timing and what types of crimes are related with park redevelopment before advertising the benefit of lower "crime."

Limitations. This work is not without its limitations. First, there are many ways to define a neighborhood in spatial terms, and one of those ways is the census tract. Though the census tract has visible boundaries (e.g., freeways), they may not represent residents' lived perceptions of neighborhood boundaries. Even with a mixed-methods study to define the neighborhood, there are doubts as to whether any representation is a true representation of the neighborhood. Therefore, using the census tract still provides findings as realistic and interpretable as any other spatial neighborhood definition.

Measures for the blight fines and crimes were sourced from the City of Detroit Data Portal. The Data Portal opened for public access in April 2018 based on a commitment from the Detroit City Charter (City of Detroit, 2012, 2018). Given the date of the opening, it is expected

that some data entry errors still exist, affecting its reliability. Moreover, the differences in crime categories, the absence of violent crimes during October 2015–September 2016 and suspected duplication present additional concerns in the reliability of the data. Though possible, it is unlikely that no violent crimes occurred in Detroit for one year. This likely data misclassification indicates that the results for violent crime presented here might have validity issues.

Further, there was a sharp spike in crime during the month prior to park redevelopment. Chief James Craig was quoted in the Detroit Free Press as saying that there was a period of time where duplicate data entry occurred (Baldas, 2017). This time period matches the sharp increase noted graphically. This problem raises the issue of using objective measures of crime. However, objective measures are those that are commonly reported by the news and national sources. Therefore, this work highlights the need for better reliability of data portal datasets, such as the City of Detroit Data Portal. Future research can couple these spatial methods with qualitative methods to tell a more detailed story, such as the types of crimes to be studied. These changes would mimic previous work on changes in crime following the redevelopment of neighborhood spaces (Branas et al., 2018).

The City of Detroit is one of a small but growing number of neighborhoods with open data portals. Previously cited research conducted in Philadelphia and Youngstown used data sourced directly from police departments, demonstrating the successful use of resources similar to the Detroit Data Portal.

The work on the blight study also had its limitations. It is possible that the research method of a between-group design with repeated measures pre- and post-intervention is the incorrect assessment for changes in blight. Based on the findings, the start of the intervention

appears to be the best time for the assessment of changes following park redevelopment, since the full model did not show any significant relationship.

The findings of this research study indicate that reported crime rates in the short-term are not altered. Further, it indicates that the City of Detroit may issue higher fines in neighborhoods with redeveloped parks as part of a renewal strategy. Therefore, the City of Detroit and other urban cities may need to express to residents' a different narrative that does not advertise reduced blight and crime in park redevelopment neighborhoods or provide more transparency on the timing needed for the changes.

Finally, both studies were underpowered, which is probable with a finite dataset, as is often the case with natural experiments. Future research will expand the time period to increase the power of the analysis, leading to more definitive findings. Though this study has its limitations, it is possibly the first study of its kind using a natural experiment of a large-scale citywide recreational improvement coupled with locally sourced data to assess changes in social environments.

Chapter IV

Paper III

Changes in Valid Arm's Length Residential Property Sales Price Following Park Redevelopment

Background and Hypothesis

Research documents that open green space increases property values (Anderson & West, 2006; Brander & Koetse, 2011; Poudyal, Hodges, Tonn, et al., 2009) and makes the neighborhood more desirable for other investment activities (Chrysochoou et al., 2012). At the same time, some neighborhoods find the maintenance costs of parks financially burdensome (Eisinger, 2014) and find ways to reduce this financial burden. In neighborhoods where low home values are coupled with low tax revenue, the money spent on recreation is lower compared to neighborhoods with higher home values (Joassart-Marcelli, 2010; Wolch et al., 2014). In contrast, wealthier neighborhoods view financially supporting parks and recreation as a way to increase property values and promote development (Joassart-Marcelli, 2010). Thus, lower investment based on lower property values may introduce a "chicken and the egg dilemma," in which lower park investment may coexist with lower property values.

There may be health benefits corresponding to living in neighborhoods with higher property values. Specifically, PA may be increased in neighborhoods with more park redevelopment and higher property values. In a cross-sectional study conducted in 32 neighborhoods in Baltimore, Maryland-Washington, DC and King County-Seattle, Washington,

researchers found that residents in the higher-income neighborhoods who indicated more favorable perceptions of safety from crime, aesthetics, and road hazards (e.g. traffic volume and speed) also lived in neighborhoods that encouraged PA (Sallis et al., 2011). In a series of brownfield redevelopment projects in Milwaukee, Wisconsin and Minneapolis, Minnesota, residents perceived that remediating the brownfields into residential and park projects would have the greatest impact on property values. The creation of parks in Milwaukee increased the property values of nearby homes by 11.7%, and in Minneapolis nearby home property values increased by 4.4% (De Sousa et al., 2009). It is probable that LTPA was encouraged, since parks are a common location for LTPA engagement in addition to social gatherings (Cohen et al., 2007; Evenson, Wen, Hillier, & Cohen, 2013).

This research study takes place in Detroit, Michigan, which has many neighborhoods with low home prices, less funding, and thus less park redevelopment. Lower property values are inevitable for some neighborhoods, such as Detroit. Starting in the early 1960s and continuing for decades, property values fell by 77%. In 2007 at the start of the housing crisis, foreclosures were rampant in Detroit in large part due to the disproportionate percentage of subprime loans (Deng et al., 2018; Sugrue, 2014). By some estimates, by 2014 there were on average over 90 foreclosed properties per square mile in Detroit, which is more than 1/6 of all parcels in the City (Cell et al., 2017; Sugrue, 2014). There is evidence indicating that foreclosures from 90–400 meters of a property for sale decrease the sales price between 1 and 3% for up to five years after a foreclosure (Biswas, 2012; Harding et al., 2009). Thus, in neighborhoods with higher foreclosures, there may be more challenges to overcome beyond the presence of parks and park redevelopment to increase property values. Studies rarely include the proportion of foreclosures as a covariate in their research, which is particularly impactful in

Detroit and other cities devastated by the collapse of industrialization and the housing market bubble.

This paper investigates changes in the housing prices based on living in census tracts with redeveloped parks. Examining data from Detroit, Michigan, we hypothesize that neighborhoods near recently redeveloped parks will see an increase in average valid arm's length (VAL)[7] residential property sales price compared to similar neighborhoods without redeveloped parks (Figure IV.1).

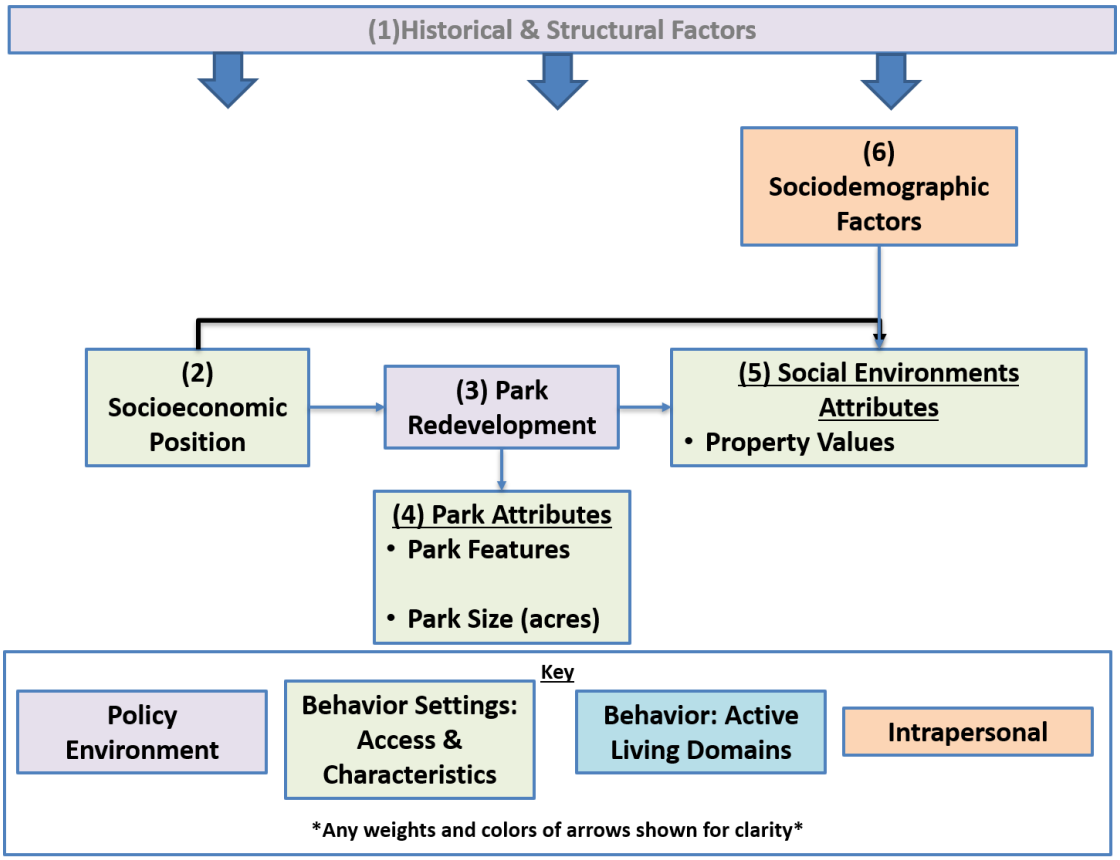

Figure IV.1 Conceptual model of association of park redevelopment and property values

[7] Sales where buyer and seller are both acting in their best interest to get the best deal possible (e.g., a buyer wanting to spend the least amount, while the seller desires to gain the most amount of money).

Methods

Geography. Detroit, Michigan (USA) is the largest city in the state of Michigan by both size and population. The total land area of Detroit is 138.75 square miles (359.36 square kilometers) (United States Census Bureau, 2017a), which would encompass Boston, Manhattan, and San Francisco combined. The City is estimated to have 690,000 residents, 80% of whom are non-Hispanic Black (NHB), and 39.8% of households living below the Federal Poverty Line (FPL) (United States Census Bureau, 2016). Detroit has 382,560 parcels, of which 104 have no listed ownership as of October 3, 2018 (City of Detroit, 2018).

Census tract boundary data from the 2010 Census for all tracts (n = 297) were obtained from the Census Topologically Integrated Geographic Encoding and Referencing (TIGER) products (United States Census Bureau, 2017b). There are four unpopulated tracts due to industry. A shapefile with all roads, residential roads, state roads, freeways, service drives and other roads in the City of Detroit was obtained from Esri Logistic Services (Esri, 2018). All spatial data from the City of Detroit was analyzed using ArcGIS 10.4.1 for Desktop ("ArcGIS 10.4.1 for Desktop," 2015). The spatial data was projected to the NAD 1983 Michigan meters projection, with the North American 1983 Geographic Coordinate System.

Matching comparison neighborhoods. Multiple steps were used to obtain the comparison group for the park redevelopment neighborhoods. There are multiple ways to define a neighborhood in spatial terms, with no universal standard (Poudyal, Hodges, Tonn, et al., 2009). In related VAL literature, researchers noted that both the block group and census tract provide similar estimates (Iceland & Steinmetz, 2003; Poudyal, Hodges, Tonn, et al., 2009; Shultz & King, 2001). This study uses census tracts as the neighborhood boundary, based on previous housing research in the City of Detroit (Deng et al., 2018). A census tract is a

reasonable approximation of a neighborhood due to the boundaries following "visible and identifiable features," such as a highway or river (United States Census Bureau (Commerce), 2018; United States Census Bureau, 2019). With this criterion set by the United States government, setting the neighborhood definition as the census tract is an appropriate approximation and is used in similar research (Boggess & Maskaly, 2014; Soltero et al., 2015).

The census tract where each park in the City of Detroit is located was provided by the Division of Parks and Recreation (City of Detroit, 2016; J. Fulton, personal communication, March 15, 2017). Using the *Join Feature* in ArcGIS 10.4.1 for Desktop parks (n = 308) were joined with the median household income for the census tracts in which they are located using the 2011–2015 five-year United States ACS estimates (United States Census Bureau, 2017c). The 2015 point-source data from the City of Detroit Data Portal (City of Detroit, 2018) was joined as a one-to-many with each census tract using the *Spatial Join Feature* in ArcGIS 10.4.1 for Desktop. This data was then exported to a Microsoft SQL Server 12.0.5207.0 ("SQL 12.0.5207.0," 2014) and averaged for each eligible census tract. The resulting table was exported to MedCalc 15.2 for Windows ("MedCalc," 2018). Census tracts with at least one Phase 1 park were matched with census tracts with at least one park, except tracts with any Phase 2 parks, using the *case-control* procedure in MedCalc. The matching was restricted to variables that were no more than one standard deviation away from the mean of the phase 1 park census tracts (Stuart, 2010; Stuart & Rubin, 2008). The matching hierarchy was: 1) averages of the dependent variable from 2015, 2) available acres of parks of the tract, and 3) median household income (Cohen et al., 2009).

Sample. This study analyzes VAL residential property sales price in 89 census tracts across the City of Detroit with 31 census tracts having at least one redeveloped park (parks, n =

36) and 58 census tracts having no redeveloped park (parks, n = 93) (See Appendix I). Some census tracts had multiple parks that were either redeveloped or not redeveloped, in which case all of the features and acres available to the public were summed.

Measures and data sources. Table IV.1 below details the dependent variable, independent variable, and covariates that will be used for this research question.

Table IV.1. Study variables

Variable Type	Variable Name/Coded	Description	Data Source(s)
Dependent variable	Post-redevelopment Valid Arm's Length (VAL) sales price (continuous)	The average VAL sales price per square foot (USD) for each study area of the redeveloped (n = 31) and matched (n = 58) neighborhoods during the 12-month post-redevelopment time period (T_2).	City of Detroit Open Data Portal (City of Detroit, 2018)
Independent variable	Park redevelopment neighborhood (dichotomous)	The City of Detroit provided a database indicating park redevelopment based on the phase. To create the neighborhood, the census tract where the park(s) is/are located will also serve as a neighborhood.	City of Detroit (City of Detroit, 2016; J. Fulton, personal communication, March 15, 2017)
Covariate	Pre- redevelopment Valid Arm's Length (VAL) sales price (continuous)	The average VAL sales price per square foot (USD) for each study area of the redeveloped (n = 31) and matched (n = 58) neighborhoods during the 12-month pre-redevelopment time period (T_1).	City of Detroit Open Data Portal (City of Detroit, 2018)
Covariate	Total park acres (continuous)	Total size of the park acres available in the census tract.	City of Detroit (City of Detroit, 2016; J. Fulton, personal communication, March 15, 2017)
Covariate	Total park features (continuous)	Count of the park features (e.g., play area, comfort station) available in the census tract.	City of Detroit (City of Detroit, 2016; J. Fulton, personal communication, March 15, 2017)
Covariate	Violent and non-violent crimes per 1,000-population (continuous)	A 1,000-population rate of violent and non-violent crimes for each census tract during the 12 months prior to redevelopment (T_1).	City of Detroit Open Data Portal (City of Detroit, 2018)
Covariate	Average blight fines per parcel (continuous)	Total blight fine dollar amount (USD) is averaged per parcel for each census tract during the 12 months prior to redevelopment (T_1).	City of Detroit Open Data Portal (City of Detroit, 2018)
Covariate	Proportion less than 18 years of age (continuous)	Proportion of children per census tract (B01001).	2011-2015 American Community Survey (ACS) estimates (United States Census Bureau, 2016)
Covariate	Proportion in poverty (continuous)	Proportion residents falling below the FPL in the past 12 months based on a ratio of income to poverty level per census tract (C17002).	2011-2015 American Community Survey (ACS) estimates (United States Census Bureau, 2016)
Covariate	Proportion of renter-occupied households (continuous)	Proportion of renter-occupied housing tenure per census tract (B25003).	2011-2015 American Community Survey (ACS) estimates (United States Census Bureau, 2016)
Covariate	Detroit Public Schools Community District (DPSCD) primary school (dichotomous)	Presence of a public Pre-K–12 grade school per census tract.	Detroit Public Schools Community District (Detroit Public Schools Community District, 2018)
Covariate	Suburban Mobility Authority for Regional Transportation (SMART) public bus stop (dichotomous)	Presence of a SMART bus stop per census tract.	SMART; City of Detroit Open Data Portal (City of Detroit, 2018; Suburban Mobility Authority for Regional Transportation, 2018)
Covariate	Non-motorized infrastructure (dichotomous)	Presence of greenways (linear green trail) in the census tract.	City of Detroit Open Data Portal (City of Detroit, 2018)
Covariate	Proportion of NHB residents (continuous)	Proportion of self-reported NHB residents per census tract (B02001).	2011-2015 American Community Survey (ACS) estimates (United States Census Bureau, 2016)

Covariate	Proportion of foreclosed properties (continuous)	Proportion of tax foreclosures to parcels during a five-year period (2011-2015) prior to redevelopment per parcel in the census tract.	(City of Detroit, 2018; Data Driven Detroit, n.d.; Loveland Technologies, n.d.)
Covariate	Proportion of vacant properties (continuous)	Proportion of vacancy per census tract (B25002).	2011-2015 American Community Survey (ACS) estimates (United States Census Bureau, 2016)
Covariate	Population density (continuous)	Total population divided by the tract size in square miles per census tract (B01003).	2011-2015 American Community Survey (ACS) estimates and Census TIGER products (United States Census Bureau, 2016, 2017b)

Valid Arm's Length Residential Property Sale Price. All VAL from June 29, 2010 to October 2, 2018 (n = 41,688) sales in Detroit were downloaded. Two datasets were obtained through the Open Data portal, one describing the property sales history by parcel and another detailing the size (square foot) of each parcel (City of Detroit, 2018). These datasets were merged in SQL ("SQL 12.0.5207.0," 2014) and the price per square foot was calculated. Once geographically assigned to neighborhoods for the designated time period, the total number of data points in the 89 census tracts decreased (n = 2,718).

Covariates. Based on the literature for property values, the following variables were included as covariates: public school presence, public bus stop presence, census tract proportions of NHB, proportion of tract below 100% of the FPL proportion of renter occupancy, age as the ratio of adults to children, proportion of vacant units, population density, non-motorized infrastructure (greenways), crime rate per 1,000-population, and blight fines per parcel (Cho, Poudyal, & Roberts, 2008; Poudyal, Hodges, & Merrett, 2009). Though not indicated in the previously mentioned literature, the proportion of tax foreclosures to parcels (2011-2015) were also included as a covariate given the importance to the City of Detroit. Finally, the total park acres and total park features for each census tract were included as covariates.

Data Analysis.

Extreme observations. The dependent variable, post-park redevelopment price per square foot, was not found to be highly skewed. However, SAS reported extreme observations for the following variables, which were all evident in highly skewed histograms: 1) sum park features in one census tract; and 2) park size in acres in one census tract. These extreme observations were removed to produce normally distributed data that can be interpreted based on the measure.

Bivariate Analysis. The bivariate analysis detailed the relationships between all major study variables as correlations. For the continuous variables, a Pearson correlation was completed, and for the categorical variables, a polychoric correlation was used. This bivariate analysis was used to determine the SEP variable by identifying what was most highly correlated with the outcome while also being more highly correlated with the other possible SEP variables. To account for changes in the VAL, the correlation of the outcome variables for five years (60 months) prior to the pre-redevelopment period was measured to examine whether factors external to the analysis existed (e.g. a housing program encouraging buying).

Linear Regression. Interactions of the proportion of poverty, population density, proportion of vacancy, nearby greenway, total available acres, and total available features were tested.

The pre-test post-test non-equivalent group design to measure changes in Valid Arm's Length following redevelopment used a regression model with the *proc reg* procedure in SAS 9.4 64-bit for Windows ("SAS," 2011). The subscript *c* indicated census tract. Given the spatial nature of the data, a Moran's I in ArcGIS 10.4.1 for Windows will test the regression residuals for spatial autocorrelation. The formula was:

$$Post\ VAL\ Sales\ Price_{cj}$$

$$= \beta_0 + \beta_1\ Park\ redevelopment\ community_j + \beta_2\ Pre\ VAL\ sales\ price_c$$

$$+ \beta_3\ NHB\ proportion_c + \beta_4\ Population\ Density_c$$

$$+ \beta_5\ Vacancy\ proportion_c + \beta_6\ Renter\ occupied\ households\ proportion_c$$

$$+ \beta_7\ Foreclosure\ proportion_c + \beta_8\ Pre\ Blight\ Fines_c + \beta_9\ Pre\ Crimes_c$$

$$+ \beta_{10}\ Children\ proportion_c + \beta_{11}\ Public\ school\ presence_c$$

$$+ \beta_{12}\ SMART\ bus\ stop_c + \beta_{13}\ Non\ motorized\ infrastructure_c$$

$$+ \beta_{14}\ Park\ features_c + \beta_{15}\ Park\ acres_c + \beta_{16}\ Poverty\ proportion_c + \epsilon_c$$

Results

Table IV.2 includes descriptive statistics for all study variables.

Table IV.2. Summary Statistics

Variable	N	Percent	Mean	Standard Deviation	Median	Minimum	Maximum
Post-park redevelopment price per square foot	89		$6.67	$3.60	$6.00	$1.41	$22.05
Park redevelopment neighborhood by tract	89	34.83%					
Pre-park redevelopment price per square foot	89		$6.88	$6.95	$5.58	$0.55	$58.50
Pre-park redevelopment crime per 1,000-population in census tract	84		44.38	36.73	51.01	0.00	160.63
Pre-average fine dollar amount per parcel	89		$0.20	$0.14	$0.18	$0.00	$1.12
Proportion of census tract below 100% of the FPL	89		0.42	0.11	0.42	0.09	0.70
Proportion of children in census tract	89		0.25	0.06	0.24	0.08	0.41
Non-Hispanic Black proportion in census tract	89		0.82	0.26	0.94	0.01	1.00
Population density (per sq. mile)	89		5341.00	2557.00	5023.00	527.12	17395.00
Proportion of renter-occupied housing units in census tract	89		0.49	0.14	0.47	0.16	0.99
Proportion of vacant units in census tract	89		0.32	0.13	0.31	0.06	0.68
Foreclosure proportion of parcels in census tract	89		0.15	0.07	0.15	0.01	0.41
Suburban Mobility Authority for Regional Transportation (SMART) public bus stop	89	25.71%					
Detroit Public Schools Community District (DPSCD) primary school	89	27.62%					
Non-motorized infrastructure (greenway)	89	33.33%					

Total features in census tract - removed outlier	88	5.50	6.94	3.00	0.00	34.50
Total park size (acres) in census tract - removed outlier	88	7.18	8.16	3.86	0.12	52.54

Bivariate Analysis. A bivariate analysis found that the VAL sales price was correlated from the five-year pre- to the one-year pre-intervention. The bivariate analysis (Table IV.3) of the study variables to the post price per square foot outcome found that park redevelopment was not correlated with post price per square foot, indicating there is no difference between neighborhoods with or without redeveloped parks. The correlation of the pre price per square foot to the post price per square foot was highly ($p < 0.001$) correlated at 0.79. As the proportion of NHB population increased, the post price per square foot decreased with highly significant correlation ($p < 0.01$) at -0.29. Additionally, neighborhoods with more vacancy had lower ($p < 0.01$) post price per square foot (-0.35). Higher foreclosure rates were correlated with lower price per square foot (-0.41, $p < 0.001$). Finally, the bivariate model found that having a Detroit Public Schools Community District (DPSCD) primary school in the census tract was significantly and positively ($p < 0.05$) correlated with the post price per square foot.

Table IV.3. Bivariate Analysis of Park Redevelopment and VAL Residential Property Sales Price

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Post-price per square foot	--																
2. Park redevelopment neighborhood by tract	.16	--															
3. Pre-price per square foot	.79***	.04	--														
4. Pre-park redevelopment crime per 1,000-population in census tract	.06	.03	.15	--													
5. Pre-average fine dollar amount per parcel	-.02	.07	-.02	.28**	--												
6. Proportion of census tract below 100% of the FPL	-.08	-.09	-.05	.06	.08	--											
7. Proportion of children in census tract	.05	-.11	.02	-.22*	.06	.24*	--										
8. Non-Hispanic Black proportion in census tract	-.29**	.10	-.13	.22*	.14	-.68***	-.51***	--									
9. Population density of census tract (per sq. mile)	.02	.22*	-.07	-.31**	.04	-.01	.26*	-.16	--								
10. Proportion of renter-occupied housing units in census tract	.18	-.02	.29**	-.02	.29**	.12	.30**	-.18	-.06	--							
11. Proportion of vacant units in census tract	-.35**	-.23*	-.24*	.21	-.09	.24*	-.28**	.15	-.42***	-.01	--						
12. Proportion of foreclosed units in census tract	-.41***	.11	-.34**	-.02	-.06	-.30**	-.15	.41***	.20*	-.17	.10	--					

13. Suburban Mobility Authority for Regional Transportation (SMART) public bus stop	.11	-.26*	.11	.08	.06	.09	.09	-.03	-.18	.00	.09	-.15	--				
14. Detroit Public Schools Community District (DPSCD) primary school	.23*	.10	.15	-.07	.09	.01	.08	-.07	.22*	.26*	-.06	-.05	.03	--			
15. Nearby non-motorized infrastructure	.16	.08	.06	.04	.07	.09	-.03	-.24*	.07	.03	-.13	-.30**	.14	.15	--		
16. Total features in census tract - removed outlier	.08	-.10	.14	.15	-.08	-.01	.00	-.02	.06	-.06	-.16	-.06	.24*	.12	.01	--	
17. Total park size (acres) in census tract - removed outlier	.21*	-.02	.35**	.17	-.08	-.03	.05	.10	-.08	.16	-.25*	-.08	.19	.14	-.08	.58***	--

***p < 0.001, **p < 0.01, *p < 0.05

Valid Arm's Length Sales Models. Changes in VAL following redevelopment were assessed in five distinct models building on related variables from previous models (Table IV.4). The Moran's I was not significant, indicating there was no autocorrelation of the residuals and therefore the linear regression models were sufficient for reporting.

Model 1 presents the null model with the intercept of post-park redevelopment VAL price per square foot. The model shows a significant intercept of an average of $6.67 price per square foot in the study census tracts. As indicated in the bivariate model in the main independent variable model, park redevelopment was not significant, showing no change in the average post price per square foot. Park redevelopment remained insignificant with the inclusion of the SEP variable of the proportion of residents below the FPL. Model 4 ($R^2 = 0.70$) included neighborhood covariates, notably the housing market disadvantage of foreclosure proportion. In this model, similarly to previous models, park redevelopment remained insignificant. Model 5 ($R^2 = 0.76$) included all study covariates and park redevelopment remained insignificant in its relationship to post-park redevelopment price per square foot. It is important to note that the study was underpowered with a power achieved of 0.58.

Finally, the interaction models indicated significant differences in park size (acres) in the census tract and greenways. The effect of park redevelopment on VAL differed based on acres, where once approximately five acres were available in the census tract, the VAL sales price increased in tracts without park redevelopment and decreased in census tracts with park redevelopment. The effect of park redevelopment on VAL also differed for a nearby greenway, where neighborhoods with both park redevelopment and a nearby greenway had a higher VAL sales price compared with neighborhoods that did not have park redevelopment but had a nearby greenway.

Table IV.4. Regression Models of Valid Arm's Length Residential Property Sales Price and Park Redeveloped, 2012-2015

	Model 1: Null, n=89		Model 2: Main Independent Variable, n=89		Model 3: Main Independent Variable with SEP Covariate, n=89		Model 4: Housing Market Disadvantage Covariates with SEP Covariate, n=89		Model 5: Full Model, n=75	
	β (SE)	95% CI	β (SE)	95% CI	β (SE)	95% CI	β (SE)	95% CI	β (SE)	95% CI
Intercept - Post-park redevelopment price per square foot	6.67 (0.35)***	5.97, 7.37	6.45 (0.43)***	5.60, 7.31	5.05 (1.49)**	2.10, 8.00	3.47 (4.30)	-5.07, 12.02	5.05 (4.93)	-4.83, 14.94
Park redevelopment neighborhood			0.65 (0.75)	-0.84, 2.13	0.70 (0.75)	-0.79, 2.18	0.14 (0.45)	-0.76, 20.5	0.40 (0.57)	-0.75, 1.55
Covariates										
Pre-park redevelopment price per square foot							8.95 (0.80)***	7.27, 10.54	8.39 (0.98)***	6.42, 10.36
Non-Hispanic Black proportion							0.13 (0.91)	-1.68, 1.93	-3.12 (1.30)*	-5.82, -0.61
Log-transformed population density (per sq. mile)							-0.57 (1.03)	-2.62, 1.48	0.01 (1.24)	-2.47, 2.48
Proportion of vacant units in census tract							7.06 (1.93)**	-10.89, -3.22	-7.17 (2.48)**	-12.13, -2.22
Proportion of renter-occupied housing units in census tract							2.98 (1.81)	-0.60, 6.57	2.81 (2.27)	-1.75, 7.36
Foreclosure proportion in census tract							-10.30 (2.63)**	-16.92, -3.67	-7.43 (4.07)*	-15.58, 0.72
Pre-park redevelopment average fine dollar amount per parcel									2.94 (2.17)	-1.40, 7.28
Pre-park redevelopment log-transformed crime per 1,000-population in census tract									-0.04 (0.15)	-0.34, 0.26
Proportion of children in census tract									-7.91 (5.18)	-18.28, 2.47
Detroit Public Schools Community District primary school									0.57 (0.57)	-0.58, 1.71
Suburban Mobility Authority for Regional Transportation (SMART) public bus stop									0.62 (0.56)	-0.49, 1.73
Non-motorized infrastructure (greenway)									-0.12 (0.57)	-1.26, 1.01
Total features in census tract - removed outlier									-0.03 (0.08)	-0.02, 0.13
Total park size (acres) in census tract - removed outlier									0.01 (0.03)	-0.06, 0.08

Socioeconomic Position Covariate							
Proportion of census tract below 100% of the FPL		3.30 (3.34)	-3.33, 9.93	2.07 (2.63)	-3.14, 7.29	2.56 (3.13)	-3.71, 8.83
R^2	0.01	0.02		0.70		0.76	
Adjusted R^2	<0.001	<0.001		0.67		0.70	
						Power Achieved: 0.58	

***p < 0.001, **p < 0.01, *p < 0.05

Discussion

This study found no evidence of changes in VAL sales price of residential properties in neighborhoods following park redevelopment. Further, findings indicated that park acreage and greenway availability in the census tract were positively associated with VAL in neighborhoods with and without park redevelopment. However, due to the extreme effects of post-industrialism, subprime mortgages, and the housing crash on Detroit, the overall findings indicate that more research is needed.

Valid Arm's Length Sales Price. The bivariate analysis indicates that property sales prices from the previous five-years and the T_1 measure before the intervention did not change significantly. Further, the lack of association of park redevelopment and VAL property sales prices and its agreement with the linear regression model reinforces the finding that park redevelopment and VAL are not associated.

Contrary to the study hypothesis, VAL sales prices did not increase following park redevelopment in the neighborhood. This finding contrasts with previous studies. For example, in both Milwaukee and Minneapolis, there were increases in housing prices following redevelopment of land to parks (De Sousa et al., 2009). The same higher housing prices were seen in Roanoke, Virginia, with buyers paying more in neighborhoods with neighborhood parks (Poudyal, Hodges, & Merrett, 2009). However, the sites of these studies are not fully comparable due to the more dramatic economic downturn of Detroit leading wherein too many other factors are driving VAL which parks may be unable to counter. Further, it appears that none of these studies specifically included foreclosures as a variable, though Poudyal and colleagues (2009) used vacancy. this could indicate that foreclosures were not an important contributor in their housing markets. The City of Detroit was hit particularly hard by the housing

bubble's burst in the late 2000s; coupled with vast population losses, vacancy, and the closure of multiple automotive plants, the City of Detroit is an extreme example of urban devastation in the United States (Sharkey, 2013; Sugrue, 2014). Therefore, the comparison to other neighborhoods may be premature. Though Detroit and other post-industrial neighborhoods may continue to engage in park redevelopment in expectation of predicted benefits such as increased property values, this study produced null findings. In time, as Detroit recovers economically, this study should be repeated to examine if the association of park redevelopment and VAL sales price mirror other cities. In the meantime, cities such as Detroit should take caution before making claims that parks are a catalyst for economic development when these effects may not yet exist.

Literature partially supports the observed interaction effect that increased park acres is associated with decreased VAL sales prices. Anderson and West found that park size was a disamenity, potentially due to the increased noise and traffic flow (Anderson & West, 2006). However, their work did not compare neighborhoods experiencing park redevelopment with other park neighborhoods, but the only the presence of any park. The finding here may indicate that, in neighborhoods without park redevelopment, increasing park acres may create a more desirable neighborhood reflected in VAL sales price. Extending the Anderson and West (2006) conjecture, newer, larger parks may attract more noise and traffic and become a disamenity reflected in VAL sales price. Somewhat contrary to previous inference, the interaction of greenways with park redevelopment may indicate that neighborhoods with park redevelopment that also offer other recreational options (i.e. greenways) see increased property values. In neighborhoods without park redevelopment, the price remains stagnant even with other recreational opportunities. This could encourage future development of greenways alongside park redevelopment in neighborhoods, which has the potential to increase property values and in

turn tax revenue. These interactions demonstrate the need for further research specifically on the interactions between housing prices and park redevelopment.

Moreover, more research is needed in Detroit and similar cities that experienced widespread economic devastation and are now recovering. While VAL sales prices did not change following park redevelopment, a repeat analysis may show different results a few years after additional park redevelopment and more economic recovery has occurred.

Limitations

There are multiple limitations in this study. Specifically, the City of Detroit did not have many property sales, which a recent review included studies with samples over 15,000 (Brander & Koetse, 2011) and could have contributed to the null findings. In addition to the low sampling of property sales, this study may have been improved with greater than a 2:1 match which could increase the sample size. However, as a natural study in a post-industrial city recovering from the housing market collapse, this work provides a realistic view of the current condition. In addition, defining the neighborhood using census tracts may not represent residents' lived experience of neighborhood boundaries. However, using other methods to define the neighborhood in spatial terms (e.g., radial boundaries, census block group) creates similar limitations. Therefore, using the census tracts provides findings as interpretable and realistic as any other method.

A further limitation is the use of the ordinary least squares (OLS) model to asses property values instead of the more common hedonic pricing regression method. Hedonic pricing is not without its criticisms. Since hedonic regression is used to estimate buyer demand for goods (e.g., properties), multiple variables are needed. Some of these variables can include whether the property has an enclosed porch, hipped roof, fireplace, and outdoor impervious or soil surfaces

(Cho et al., 2008; Ibes, 2015; Poudyal, Hodges, & Merrett, 2009). While the final estimate still indicates the difference in property values based on a main independent variable (e.g., parks, open space, brownfield remediation), the multiple additional variables needed to estimate buyer demand creates a model that is not parsimonious and can create a challenging interpretation. In contrast, the OLS model provides an easier, more parsimonious interpretation, which can be replicated by municipal leaders. The matching procedure captures some neighborhood factors and purchase preferences of buyers for parks.

Though this study has limitations, it adds to the literature by demonstrating that VAL sales price in cities experiencing a recovery following large-scale economic devastation, including bankruptcy, housing crisis, and post-industrialization may not mimic findings in current literature.

Chapter V

Discussion

The primary aim of this dissertation was to examine whether park redevelopment in a Midwest urban city were associated with increased levels of LTPA, decreases changes in crime and physical disorder, and increases in property values.

Summary of Findings

Chapter II examined the levels of LTPA in neighborhoods (census tract) with and without park redevelopment. This study took advantage of a recent dataset, 500 Cities, produced by the CDC Foundation and RWJF (Centers for Disease Control and Prevention, Robert Wood Johnson Foundation, & CDC Foundation, 2016). Park redevelopment was positively associated with LTPA in a bivariate analysis. However, in subsequent models with the neighborhood covariates of population density and the proportion of vacant property units, the association between redevelopment and LTPA was no longer significant. This same study found that park redevelopment was not done in neighborhoods with a high percentage of poverty.

Chapter III examined the association between park redevelopment and crime rates per 1,000-population. We found that neighborhoods with at least one redeveloped park had no significant differences in crime rates. The same insignificant association is the case in reported violent crime rate at one-year post-redevelopment. This study also examined whether blight fines per parcel was changed following park redevelopment; and we hypothesized that following park redevelopment blight fine per parcel would decrease in neighborhoods with redeveloped

parks. However, we found that blight fines per parcel increased in neighborhoods with redeveloped parks. These findings suggest that park redevelopment is not associated with changes in the crime rate but is in changes in blight fines per parcel.

Chapter IV examined valid arm's length (VAL) property sales price, which, similarly to Chapter III, was examined before and after park redevelopment. Though we hypothesized that property sales price would increase following park redevelopment, no such association was found. However, two interaction effects were significant. When neighborhoods had more than five acres of parks available, neighborhoods (census tracts) with at least one redeveloped park had a lower sales price compared to neighborhoods with no redeveloped parks. In addition, in neighborhoods with nearby greenways, the presence of at least one redeveloped park was associated with lower sales prices than neighborhoods without redeveloped parks.

These studies, when taken together, indicate that park redevelopment might increase assessed blight fines per parcel, and under some instances positively impact housing prices. Therefore, the central portion of the conceptual model based on the literature indicating that park redevelopment is associated with built and social environments (i.e. crime, physical disorder, and property values) and then associated with engagement in LTPA does not hold according to the three papers.

Limitations

This dissertation work is not without limitations. First, PA engagement is achieved through various means, not only in leisure time. Therefore, the data used in the literature reviews in some cases include occupational physical activity[8], transport physical activity[9], and

[8] Physical activity done in the primary location of the workplace or home.
[9] Physical activity done with the primary purpose to travel between destinations (e.g., home to work).

LTPA[10] and do not disentangle the different kinds of PA. However, recent studies find that LTPA engagement has increased beneficial effects compared to other forms of PA engagement (Hallman, Birk Jørgensen, & Holtermann, 2017; Holtermann et al., 2013; Richard, Martin, Wanner, Eichholzer, & Rohrmann, 2015). Therefore, focusing on LTPA and parks (which offer the potential for LTPA) is a particularly important area of inquiry in public health.

More importantly, the LTPA dependent variable in Chapter II is a model-based measure using demographics of the BRFSS survey. The use of a model-based measure introduces error since the measure was not directly collected from respondents but is based on the modeling assumptions of researchers. The researchers assumed that age, sex, race, education, and poverty were the correlates to predict LTPA. Though the SAE methods were validated, other sociodemographics and direct measures from the public could yield different findings.

Second, this dissertation utilized one definition of "neighborhood" though the definition varies in literature. There is no universal standard in research to define a neighborhood in spatial terms (Poudyal, Hodges, Tonn, et al., 2009). McCormack and Shiell (2011) found that studies use various methods of defining neighborhoods including local areas, transportation zones, census districts (e.g., tract, block group), and radial/network buffers. This dissertation uses census tracts as the neighborhood boundary although the use of administrative boundaries – while important for demographic data collection – may not represent the lived experience of residents (Branas et al., 2011). However, since a census tract follows reasonable "visible and identifiable features," such as highways or rivers (United States Census Bureau (Commerce), 2018; United States Census Bureau, 2019), it is an approximate representation of a neighborhood for research.

[10]Physical activity done in leisure-time away from school and work.

Third, due to the timing of the data collection and the focus on the census tract, not the park, as the unit of analysis, an assessment of pre- post- park quality could not be collected. The reality is that not all parks are created equal (Rigolon, 2016; Wolch et al., 2014). In part, the quality of a park is in the eye of the beholder. But in broader terms, natural features such as trees, native plant species, and streams can create parks that are more welcoming and are rated of higher quality (Joseph & Maddock, 2016a). In addition, the presence of equipment and features that are in good (usable) condition typically increase park quality compared to others (Kaczynski & Wilhelm Stanis, 2013). Further, there are characteristics that were beyond the scope of this research, such as congestion, that impact use and quality (Wolch et al., 2014).

Fourth, while a strength of this work is to include objectively collected data which is useful for municipal governments, the data is not without its limitations. Crime is underreported in urban neighborhoods due to the "stop snitchin'" culture which encourages urban residents, particularly African American residents, to not speak with the police, including not calling the police if an issue arises (Smiley, 2015). Furthermore, Detroit is home to a large undocumented immigrant population (American Immigration Council, 2017), and evidence shows that this population rarely contacts local police for fear of deportation from Immigration and Customs Enforcement (ICE) (Hacker et al., 2011). Lastly, this study used two categories of crime: 1) all crime (violent/non-violent) and 2) violent crime. Multiple studies specified types of violent crimes, property crimes, and nuisances instead of differentiating crime into two categories (Bogar & Beyer, 2015).

Further, this work assumes that parks are a selling point for Detroit real estate buyers without any qualitative interviewing to verify this assumption. While the proximity of parks is important to the market in general (Poudyal, Hodges, & Merrett, 2009), this work assumes that

Detroit buyers include parks in their decisions. Additionally, this work assumes that the City of Detroit Parks and Recreation Redevelopment Plan was widely disseminated to residents and potential residents to influence property values.

The use of objectively collected data has limitations. For instance, the City of Detroit Data Portal was recently released (City of Detroit, 2018) and data prior to the opening of the portal depended on a backlog of entry. An error in double-counting was acknowledged for crime causing a spike, but no such double-counting errors were acknowledged for blight or VAL – which does not mean that errors did not exist. Further, the geocoding of the latitude and longitude data indicated that the locations of some crimes, blight fines, and VAL sales were incorrect (e.g. geocodes for the Pacific Ocean and Antarctica).

The recreational spaces included in the dissertation are limited to spaces owned and maintained by the City of Detroit, which means that school playgrounds and privately owned spaces are not included. Not including these spaces may limit the spaces that have a relationship with the outcomes. Future research could include other publicly owned spaces, such as schools, greenways, and recreational centers. Further, public-private partnerships were intentionally excluded from this analysis. As a first step to this research to assess the viability of the methods, it was sufficient to analyze parks that are fully funded by the City of Detroit government and part of their master plan.

Additionally, all three studies were underpowered. This was a possibility, since each study is a natural experiment that takes advantage of a finite number of neighborhoods with park redevelopment and data points. All findings must be interpreted with caution.

Finally, the study city for this dissertation (Detroit, Michigan, United States of America), has a land area of 138.75 square miles (359.36 square kilometers) and publicly maintains over

300 parks along with other recreational spaces. Given this, the work proposed here may not be fully generalizable to neighborhoods that are smaller in area or more populous than the City of Detroit. Even so, other post-industrial cities may learn lessons from the renaissance of built and social environments in Detroit, with parks and recreation as a possible catalyst should they consider redeveloping their recreation systems.

Directions for Future Research

Following the methods and findings of this dissertation, multiple opportunities for future research were identified. The future impact of this dissertation work would be best evaluated using longitudinal data to investigate whether park redevelopment influences LTPA engagement in the longer term. Further, this research supports the need for a direct measure for LTPA. The 500 Cities Project is the only dataset, to my knowledge that provides census tract level data for health behaviors. However, with its limited interpretability, it demonstrates the improvement of a direct measure of citywide data could make over this model-based measure.

One such data set unavailable was a citywide measure of stormwater management issues and remediation. The City of Detroit did not have timely data on stormwater management. Ideally, cities experiencing stormwater management issues should have datasets of major flood events that impact homes and neighborhoods, for instance flooding basements and streets that prevent outdoor LTPA and potentially affect the quality of parks (e.g., increasing mud). As storms get more severe, issues of stormwater management become more important for residents (C. Tetteh, personal communication, February 28, 2019). As urban cities, Detroit in particular, engage in expansive plans to redevelop parks, the redevelopment theme of stormwater management infrastructure is widely emphasized (City of Detroit, 2016; City of Houston, 2015; City of Seattle, 2017). Expanding the purposes of urban greenspaces and parks can be used as

part of a redevelopment strategy to beautify neighborhoods, mitigate excess stormwater, and address multiple ecosystem issues, including urban heat islands and air pollution (Larsen, 2015; Meerow & Newell, 2017; Rigolon & Németh, 2018). Adequate stormwater management is instrumental in creating healthy, sustainable neighborhoods.

In addition, data on stray dogs was unavailable. The Positive Action for Today's Health (PATH) trial in South Carolina hosted a series of focus groups of predominantly low-income, African American attendees. The attendees were asked about barriers to participating in PA in their community. In addition to crime, the respondents also stated that stray dogs, lighting, and traffic were concerns and suggested interventions to alleviate these issues (D. K. Wilson et al., 2013). It was estimated at one point that there were over 50,000 stray dogs roaming Detroit, some of which have killed pets, bitten mail carriers, and mauled and killed children (Brand-Williams & Fournier, 2015; Langton, 2017; Memmott, 2013; Spruill, 2018). One resident in a Detroit neighborhood even stated, "I'm afraid for the kids and elderly (people) walking around here…these vicious stray pit bulls are around attacking people (Langton, 2017)." While this is a considerable problem in Detroit, no database is readily available to the general public of stray dog collections or violent incidents due to various independent collectors (i.e., Health Department, United States Post Office, Detroit Police Department), the possibility for vast errors in data, and the potential for unwanted negative attention (Anonymous, personal communication, February 8, 2019).

Further, future research using qualitative data could also create a more holistic picture and potentially remove the current null findings. Limited previous research of blight, crime, and property values has used both qualitative and quantitative data to tell a story from the aspect of the City and the residents living there (De Sousa et al., 2009; Garvin, Cannuscio, et al., 2013).

There are differences in subjective and objective data (Brownson, Hoehner, Day, Forsyth, & Sallis, 2009; Ma, Dill, & Mohr, 2014) with municipal governments leaning more towards objective data. In some cases there can be a disagreement between the two (Garvin, Cannuscio, et al., 2013). Ideally, future work can couple qualitative and quantitative data to determine a better dependent variables and additional covariates. For instance, there may be types of crime (e.g., murders, robberies, thefts), times of day of incidences, and measurements besides rates (e.g., continuous counts) that are most important to residents. Further, the same may be the case for blight fines, with the multitude of types of blight fines, residents in qualitative studies may indicate what types of violations impact their neighborhood more (e.g., illegal dumping, overgrown grass, trash cans left out too long).

The next stage of this research plans to deepen the understanding of what kinds of neighborhoods (e.g. those with more poverty) may benefit the most from park redevelopment; along with using qualitative data to narrow research questions and dependent variables. Such work requires larger data samples.

Implications

The research in this dissertation has important implications for future work in public health, urban planning, and public policy nationwide. Answers to the research questions on crime, blight, and VAL sales price inform the overarching goal of creating neighborhoods that encourage LTPA. Previous research indicates that LTPA engagement can prevent or reduce symptoms of obesity (Ferdinand et al., 2012; Sallis et al., 2012), CVD (Sallis et al., 2012), diabetes (Loprinzi, 2015), mental health disorders (Orstad, McDonough, Klenosky, Mattson, & Troped, 2017), and cancer (Haskell, Blair, & Hill, 2009), to name a few. This dissertation found that park redevelopment in the short term is not associated with crime, blight, and VAL sales

price, which all in the long-term has the potential to impact obesity, asthma, and mental health (Corburn, 2004).

Historically, some of the earliest programs (e.g. zoning laws) in public health and urban planning were successful because they focused cost-effective strategies to impact a specific place, health of residents, and then be scaled up for more of society to benefit (Branas & MacDonald, 2014). As time went on, public health professionals and urban planning professionals began to part ways when public health began to focus more on individual health outcomes and urban planning on economic development (Corburn, 2004). This separation of professions may manifest itself in plans published by urban planning professionals that advertise health-related outcomes, but not involving public health professionals (M. Elliott, personal communication, January 30, 2017).

Given the emphasis on place the professions of public health and urban planning are firmly intertwined. As urban planners publish master plans on park redevelopment, the advertisement of health-related outcomes indicate that the professions of public health and urban planning should share the responsibility of determining and evaluating the health-related outcomes following redevelopment. Even though this dissertation overwhelmingly produced null findings, if redevelopment plans advertise health-related outcomes, public health, public policy, urban planning, other professionals, and the general public should work collaboratively in identifying health-related outcomes towards eliminating health disparities (Corburn, 2004).

Further, this research demonstrates the benefits of using both statistical and spatial methods to respond to research questions related to LTPA about the built and social environments in the neighborhood. The use of spatial mapping is an increasingly effective and easy-to-understand tool used to communicate neighborhood health issues and needs visually to

lay audiences (Cromley et al., 2011; Glass, 2008; Mills & Curtis, 2008). In addition, as more cities release data that is open and accessible to the public, innovative studies of this kind can be easily replicated. The findings of this research encourage neighborhoods to not only use perceived measures of crime and blight, which are limited to study specific neighborhoods, but to use citywide data when available to tell a story that benefits a wider population. Therefore, decision-makers and community leaders nationwide can mimic the spatial methods, adapt the statistical methods as necessary, and use conclusions for future advocacy efforts.

Finally, for cities that are in the process of redevelopment, particularly post-industrial cities, this research found that short-term changes in crime and VAL sales prices are not associated with park redevelopment. Therefore, cities should take caution in advertising a wealth of positive effects to residents' that follow park redevelopment, such as economic development and changes to crime since these are inconsistently supported in the literature and produced null findings in this dissertation. As decision-makers continue the redevelopment of parks, multidisciplinary teams with the inclusion of residents, should co-lead the planning efforts to determine the best health-related outcomes, not exaggerate the benefits, and be transparent on the length of time needed for the benefits to take shape.

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Appendices

Appendix A

Table A.1. Phase I Parks

Park	Address	City Council District	Ground Breaking	Completion Date	Type	Acres	Improved 2006-2016	Capital Improvement Budget
30th-Herbert	5000 30th	6	4/3/2017	6/1/2017	Playground	1.04	0	$250,000
Boyer	6203 W. Vernor	6	7/1/2016	11/1/2016	Playground	1.77	0	$450,000
Calimera	19493 Joann	3	7/1/2016	11/1/2016	Playground	4.42	0	$300,000
Cook	16001 Fenkell	1	5/9/2017	7/1/2017	Playground	2.77	0	$300,000
Cross	8134 Manor	7	7/1/2016	11/1/2016	Playground	1.65	1	$150,000
Diack	13889 Curtis	2	6/5/2017	8/1/2017	Playground	3.49	1	$450,000
Doan	9946 Prest	7	4/17/2017	6/1/2017	Playground	2.90	0	$350,000
Dueweke	4975 Sheridan	5	6/19/2017	9/1/2017	Playground	3.73	0	$450,000
Fields	16601 Florence	1	7/1/2016	11/1/2016	Playground	4.00	0	$250,000
Gordon	1935 Atkinson	5	3/20/2017	6/1/2017	Playground	1.08	0	$450,000
Gorham	19969 St. Mary	2	5/22/2017	10/1/2017	Playground	3.13	0	$300,000
Greene	9177 Robson	7	4/27/2017	6/1/2017	Playground	3.49	1	$250,000
Hackett	17236 Avon	1	6/5/2017	8/1/2017	Playground	3.18	0	$375,000
Hansen	542 Drexel	4	7/1/2016	11/1/2016	Playground	2.20	1	$400,000
Kemeny	2260 S. Fort	6	7/1/2016	11/1/2016	Playfield	21.92	0	$1,000,000
LaSalle	2380 S. LaSalle Blvd.	5	5/4/2017	10/1/2017	Park	3.84	0	$300,000
Latham	5082 Seneca	5	7/1/2016	11/1/2016	Playground	2.96	0	$225,000
Liuzzo	20053 Winthrop	2	7/1/2016	8/31/2016	Playground	2.49	0	$350,000
Luce-St. Louis	13490 St. Louis	3	5/24/2017	7/31/2017	Playground	2.19	0	$250,000
Mansfield-Diversey	7753 Rutherford	7	7/1/2016	11/1/2016	Playground	1.82	0	$350,000
Nagel	3100 Wabash	6	6/7/2017	8/31/2017	Playground	4.70	0	$300,000
O'Brien	11938 E. McNichols	4	7/19/2017	9/30/2017	Playground	1.45	0	$300,000
Phelps	9982 Sorrento	7	9/21/2017	8/1/2017	Playground	3.99	0	$300,000
Reid	20625 Santa Clara	1	5/22/2017	6/1/2017	Park	1.23	0	$200,000

Richard Allen (Nardin)	9516 W. Grand River	7	6/26/2017	9/1/2017	Park	5.18	0	$300,000
Sak	4322 Kinsman	6	4/10/2017	6/1/2017	Playground	1.13	0	$250,000
Scripps	3666 W. Grand River	6	5/30/2017	10/1/2017	Park	1.25	0	$450,000
Simmons	19450 Chapel	1	7/1/2016	11/1/2016	Playground	3.60	0	$500,000
Stewart (DPS-Transfer)	12701 14th Street	5	7/6/2017	9/30/2017	Playground	5.57	0	$325,000
Tireman-Littlefield	8051 Littlefield	7	7/1/2016	11/1/2016	Playground	1.94	1	$150,000
Syracuse	19192 Syracuse	3	5/30/2017	8/1/2017	Playground	3.78	0	$300,000
Szafraniec	4513 Campbell	6	3/27/2017	5/1/2017	Playground	2.05	0	$275,000
Varier	15639 Thatcher	2	6/12/2017	8/1/2017	Playground	3.10	0	$200,000
Wells	20159 Griggs Ave.	2	7/1/2016	11/1/2016	Playground	3.89	0	$350,000
Yakisch	18160 Anglin	3	5/15/2017	7/1/2017	Playground	1.55	0	$250,000
Yates	2499 Blaine	5	6/5/2017	8/1/2017	Playground	2.36	0	$325,000

Appendix B

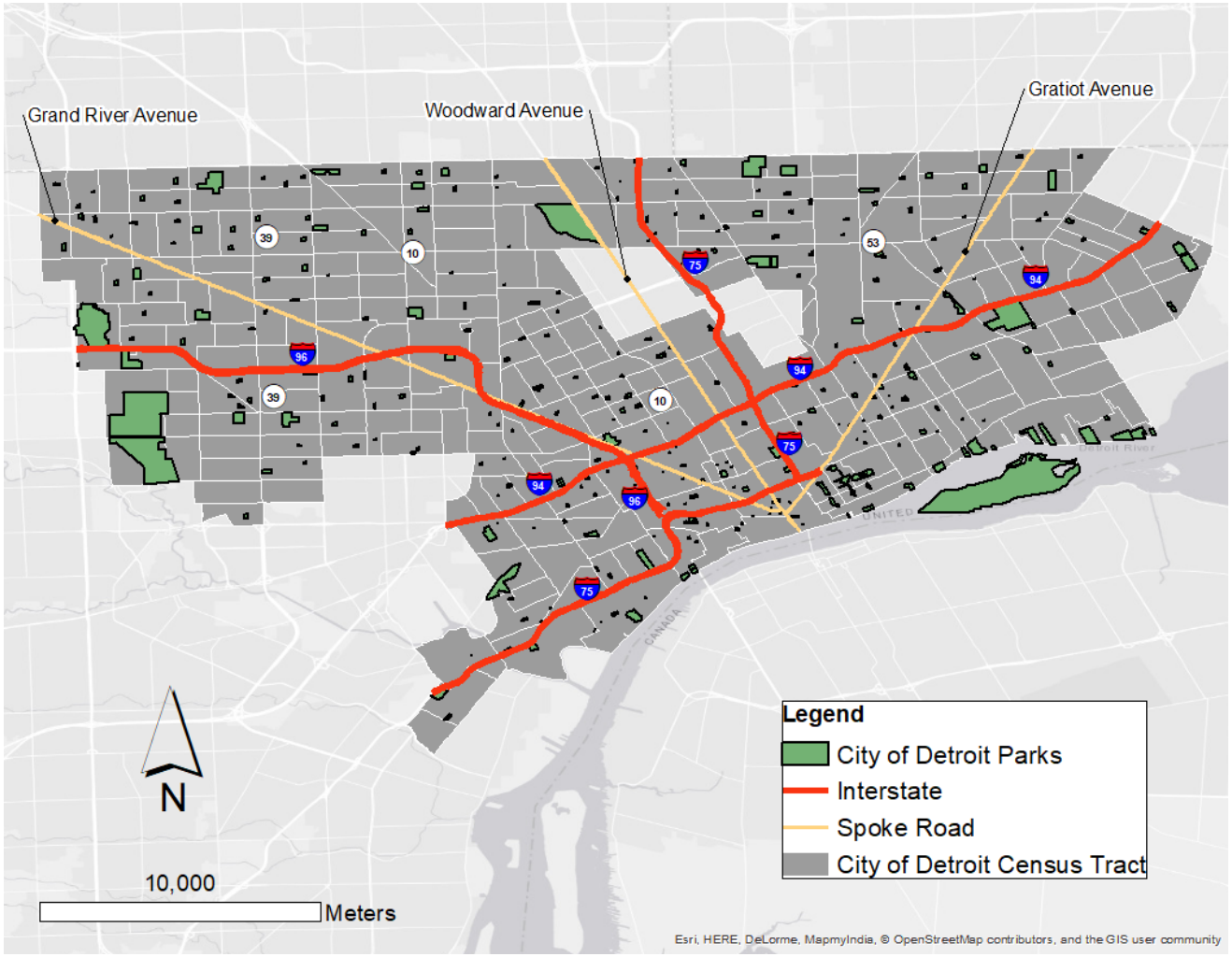

Figure B.1 City of Detroit Parks

Appendix C

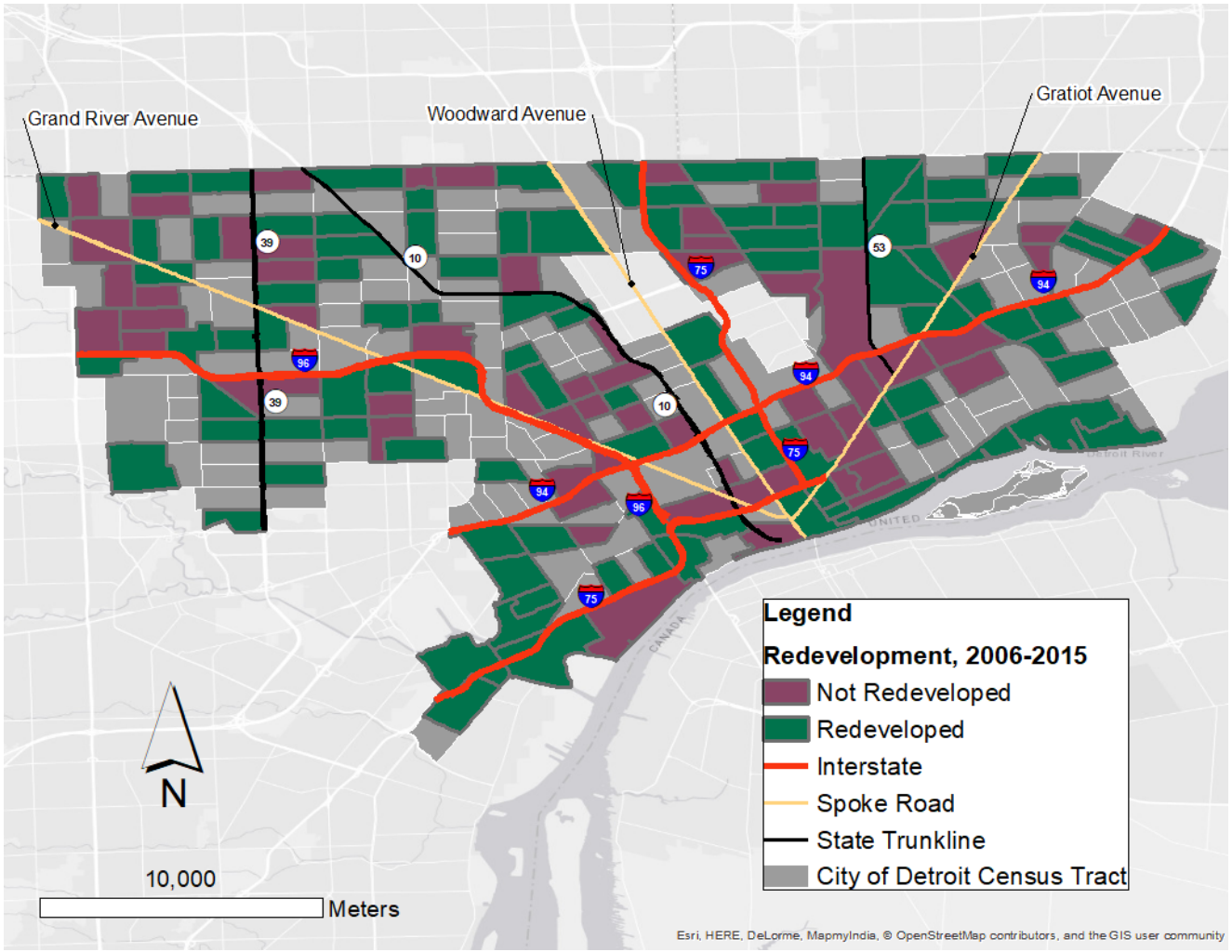

Figure C.1 Paper I Tracts, 2006-2015

Appendix D

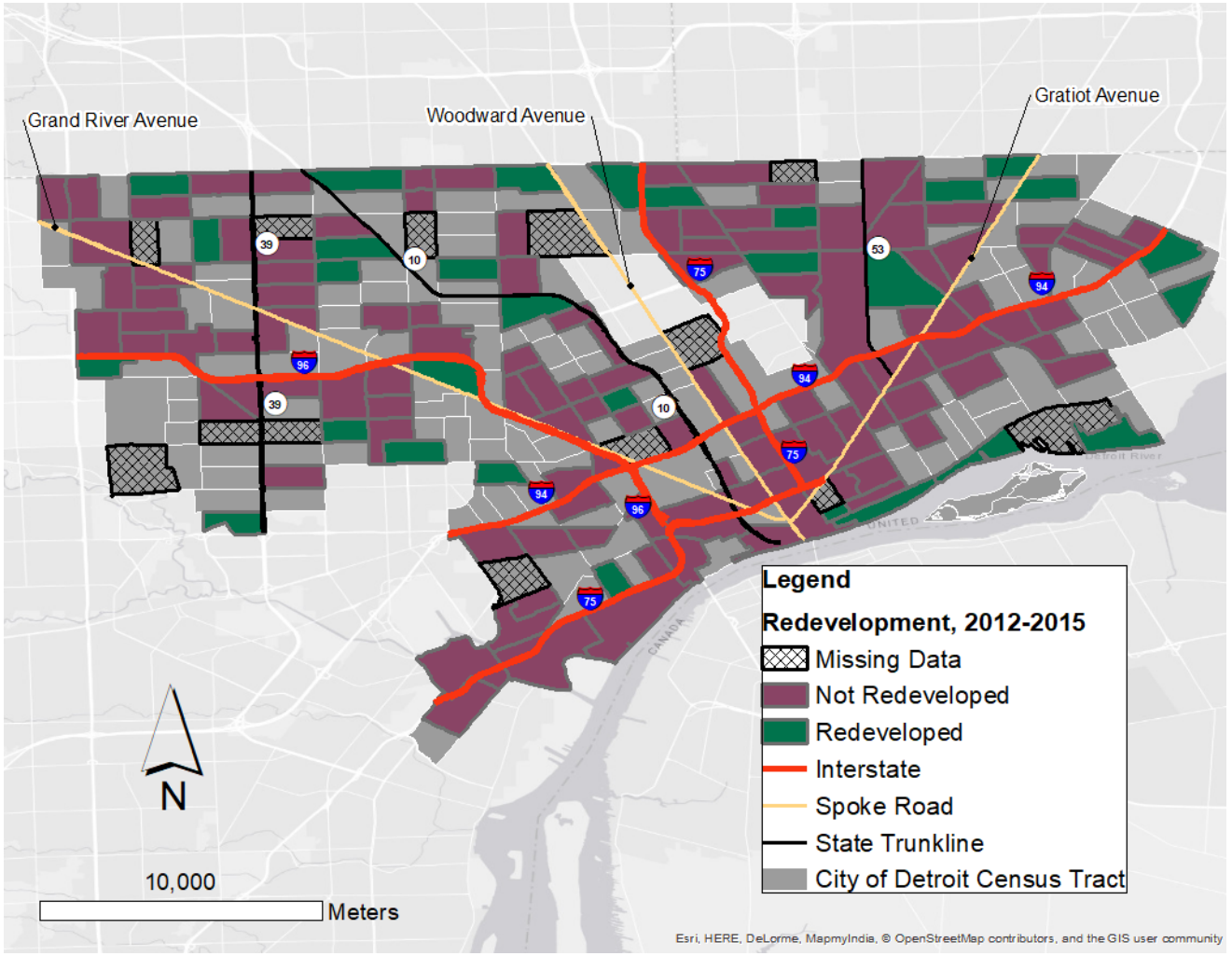

Figure D.1 Paper I Tracts, 2012-2015

Appendix E

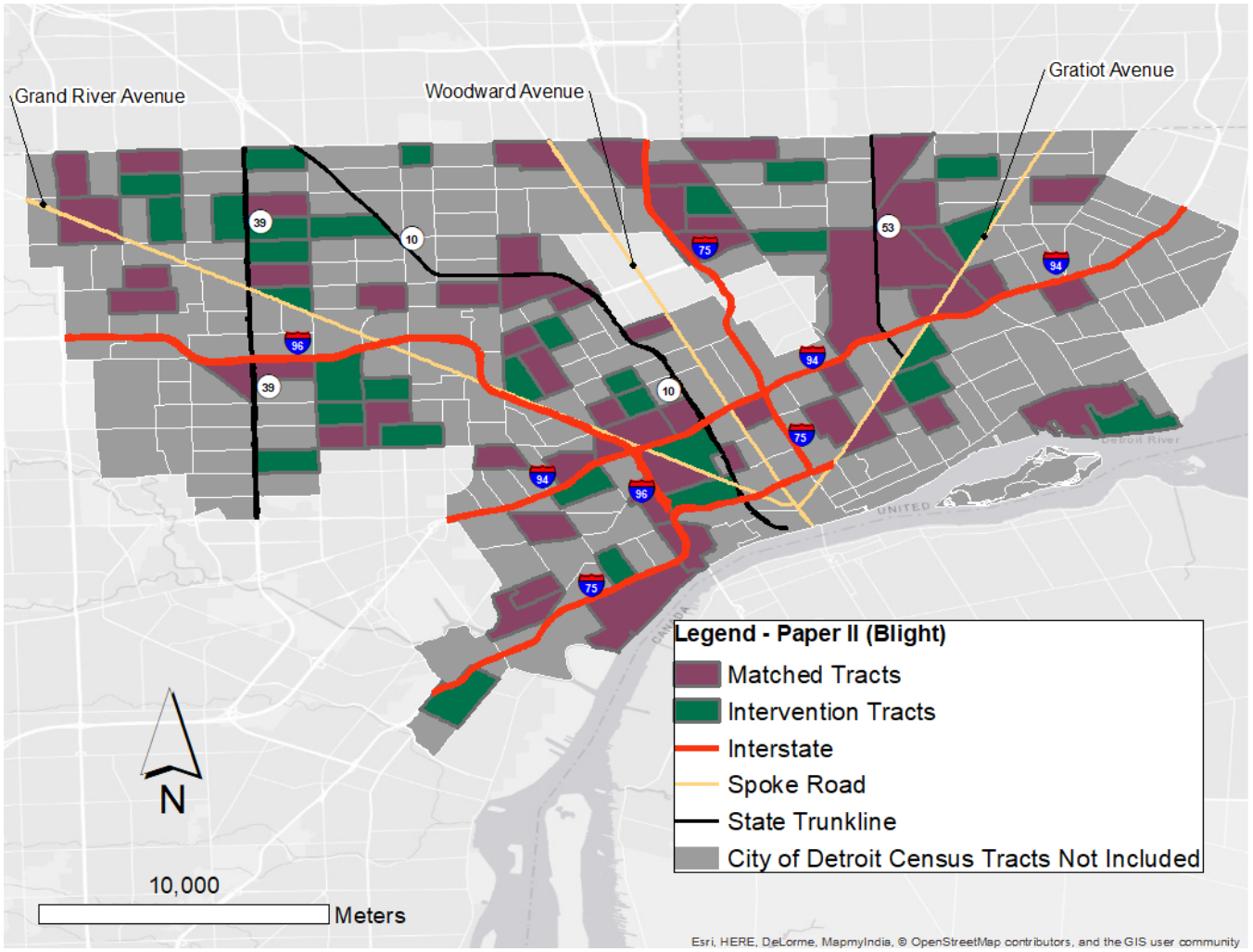

Figure E.1 Paper II Tracts for Blight Outcome

Appendix F

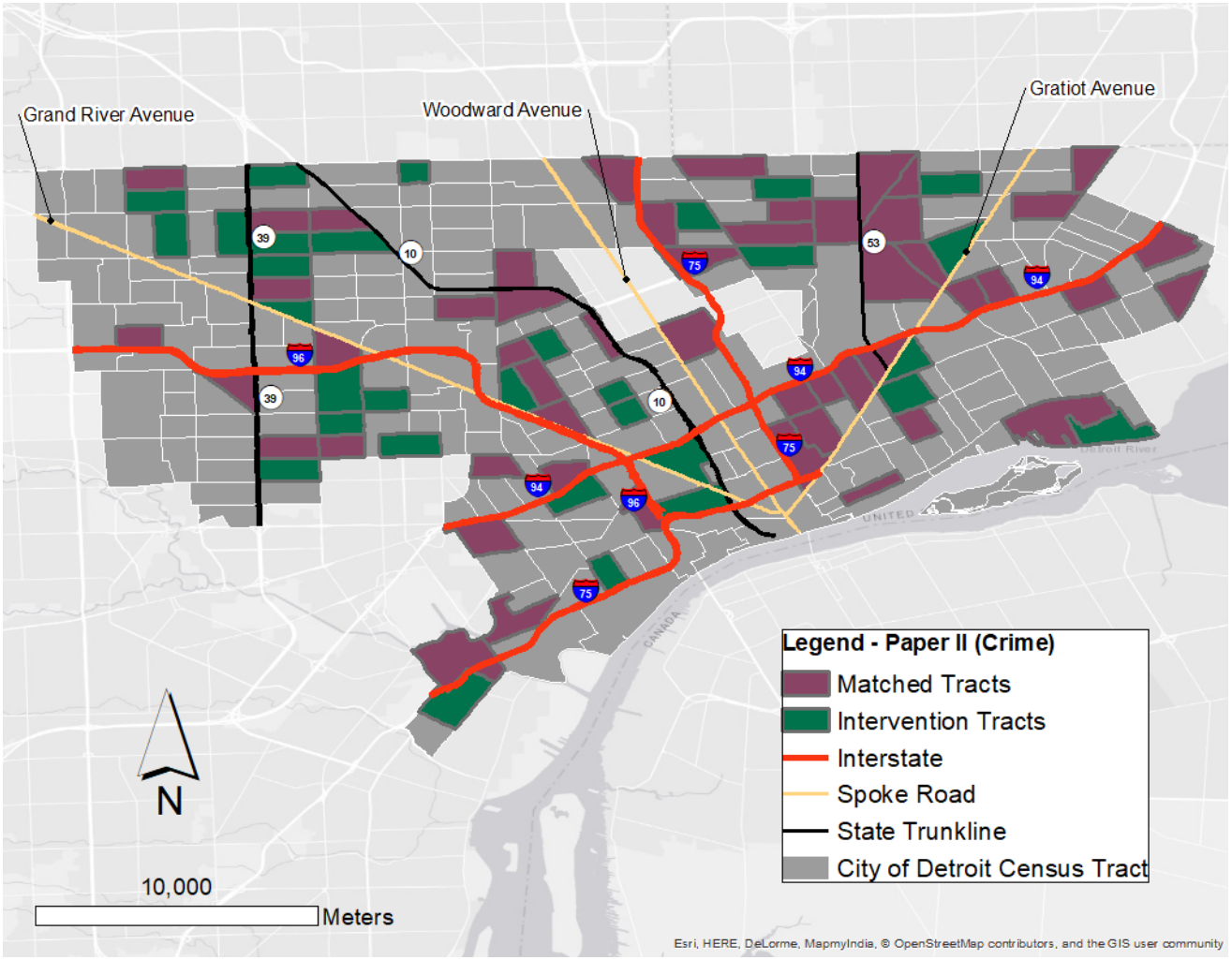

Figure F.1 Paper II Tracts for Crime Outcome

Appendix G

Table G.1. Blight Violation Type

Violation Code	Violation Description
22-2-16	Improperly stored or separated Solid Waste
22-2-17	Improper storage and separation of solid waste for collection day
22-2-18	Unapproved burning of waste
22-2-19	Unapproved burning of waste in open fire
22-2-20	Failure to remove dead animals
22-2-21	Failure to remove animal waste on public or private property
22-2-22	Bulk solid waste deposited more than 24 hours before designated time
22-2-23	Cuttings of brush, shrubbery, and tree branches
22-2-24	Infectious solid waste and other medical waste
22-2-25	Construction solid waste
22-2-38	Depositing domestic or commercial solid waste in containers owned, assigned to, or contracted for, by other persons or premises
22-2-41	Improper placement of Courville containers at residential structures containing one, two, three or four household units
22-2-42	Early placement of Courville Containers at residential structures with five or more household units
22-2-43	Improper placement of Courville container between collections
22-2-44	Improper placement of Courville containers for collection-commercial or residential
22-2-45	Violation of time limit for approved containers to remain at curbside - early or late
22-2-48	Portable containers: commercial establishments and industrial sites
22-2-49	Large movable or stationary containers; residential structures and commercial
22-2-53	Improper storage of containers between collection days
22-2-55	Improper location of containers for collection
22-2-56	Courville container left at curb early or improperly stored
22-2-61	Failure to secure City or Private solid waste collection containers and services
22-2-83	Dumping, storing or depositing solid waste on any publicly-owned property, or private property or water, without a permit
22-2-84	Owner or operator responsible for removal of solid waste; nuisance; placement in large movable container on private area of owner or operator's property, only, for eviction; tenant's personal property to be disposed of in large movable container only; removal of large movable container required within forty-eight (48) hours; owner, operator, or other person who fails to use a large movable container for the disposal of tenant's personal property is subject to immediate issuance of a blight violation notice
22-2-85	Hazardous and medical waste
22-2-87	Failure to remove, or cause to be removed, and properly dispose of solid waste before vacating private property or water
22-2-88	Duty of owner of vacant or occupied premises to keep premises, its sidewalks, and adjoining public property free from solid waste, medical waste, and hazardous waste; evidence of ownership and responsibility
22-2-91	Dumping or depositing solid waste from a motor vehicle
22-2-92	Solid waste haulers
22-2-93	Scrap tire haulers
22-2-94	Failure to transport and deliver scrap tires to proper disposal area or licensed transfer facility, or to use vehicle or container that does not leak or spill
22-2-96	Deposit of solid waste or hazardous waste in receptacles along public highways or city streets
22-2-97	Dumping of solid, medical, or hazardous waste in public waters

22-3-1	Unauthorized collection, distribution, and transportation of solid waste, medical waste, or hazardous waste
22-3-2	Vehicle specifications and inspections
9-1-101	Accumulation of solid waste prohibited; owner; occupants
9-1-102	Grading and drainage
9-1-103	Driveways, parking spaces and lots, sidewalks, stairs, walkways, and similar areas of traverse; removal of snow and ice from sidewalks
9-1-104	Weeds and plant growth
9-1-105	Rodent control and harborage; storage and handling of items, certification of buildings where food or foodstuffs are stored or processed; alteration of buildings and rat-proofing
9-1-106	Exhaust vent(s) or other means one- or tow-family dwelling or commercial building
9-1-107	Accessory structures
9-1-108	Defective gate(s)
9-1-109	Failure to maintain swimming pool(s)
9-1-110	Inoperable motor vehicle(s)
9-1-111	Failure of owner to remove graffiti or maintain or restore property free of graffiti
9-1-112	Failure to remove recreation equipment or furniture one- or tow-family dwelling or commercial building
9-1-113	Failure to maintain a vacant building or structure in accordance with the requirements of Section 9-1-113 of the Detroit City Code: (1) - (12)
9-1-12	Responsibility for maintenance; violations
9-1-13	Vacant buildings, premises, and structures generally
9-1-14	Workmanship
9-1-16	Device, equipment, safeguard or system in good repair
9-1-18	Sell or transfer of one- or two-family dwelling, building, premise or structure without copy of pending notice, order, violation notice or citation
9-1-201(a)	Maintain exterior of one- or two-family dwelling, building, premises or commercial structure in good repair, structurally sound or in a sanitary condition to prevent threat to the public health, safety or welfare
9-1-204	Defective foundation wall(s) one- or two-family dwelling or commercial building
9-1-205	Defective exterior wall(s) one- or two-family dwelling or commercial building
9-1-206	Defective roof or drainage one- or two-family dwelling or commercial building
9-1-207	Defective decorative features
9-1-208	Failure to maintain overhang extension(s) one- or two-family dwelling or commercial building
9-1-209	Failure to maintain balcony, deck, porch, or stairway one- or two-family dwelling or commercial building
9-1-210	Defective chimney(s) or tower(s) one- or two-family dwelling or commercial building
9-1-211	Defective handrails and guards
9-1-212	Defective door, skylight, or window frame(s) one- or two-family dwelling or commercial building
9-1-213	Defective glazing one- or two-family dwelling or commercial building
9-1-214	Defective window(s) or window hardware one- or two-family dwelling
9-1-215	Failure to provide approved insect screen(s) one- or two-family dwelling or commercial building
9-1-216	Defective door(s) one- or two-family dwelling or commercial building
9-1-217	Defective basement hatchways
9-1-218	Defective window(s) or window hardware of basement windows
9-1-221	Unlawful storage of items outside one- or two-family dwelling or commercial building
9-1-41	Failure to abate unsafe condition for Building, premises, structure(s), equipment or device(s)

9-1-42	Failure to abate unlawful occupancy of Building, Premises or Structure - Emergency Order - Less than 5 stories
9-1-43(a) - (Dwelling)	Failure to comply with an Emergency or imminent danger order concerning an unsafe or unsanitary structure or unlawful occupancy (1 or 2 family dwelling)
9-1-43(a) - (Dwelling)	Failure of owner of one- or two-family dwelling to comply with an emergency or imminent danger order concerning an unsafe or unsanitary structure or unlawful occupancy
9-1-43(a) - (Stories)	Failure of owner of a building with five (5) or more stories to comply with an emergency or imminent danger order concerning an unsafe or unsanitary structure or unlawful occupancy
9-1-43(a) - (Stories)	Failure to comply with an Emergency or imminent danger order concerning an unsafe or unsanitary structure or unlawful occupancy (Buildings with five (5) or more stories)
9-1-43(a) - (Structures)	Failure of owner of any other structure, except buildings with five (5) or more stories, to comply with an emergency or imminent danger order concerning an unsafe or unsanitary structure or unlawful occupancy
9-1-43(a) - (Structures)	Fail to comply with an Emergency or imminent danger order concerning an unsafe or unsanitary structure or unlawful occupancy (all other structures, except buildings with five (5) or more stories)
9-1-44	Not closing of unlawful and vacant buildings, premises, and structures
9-1-46	Imminent danger; emergency measures and safeguards; review of order
9-1-50	Requirement to register vacant buildings and structures; enforcement authority; establishment of annual fee

Appendix H

Table H.1. Types of Crime

Crime Type	
1	*AGGRAVATED ASSAULT
2	*SEX OFFENSES
3	*HOMICIDE
4	*ROBBERY
5	ARSON
6	ASSAULT
7	BURGLARY
8	DAMAGE TO PROPERTY
9	DANGEROUS DRUGS
10	DISORDERLY CONDUCT
11	EXTORTION
12	FAMILY OFFENSE
13	FORGERY
14	FRAUD
15	GAMBLING
16	JUSTIFIABLE HOMICIDE
17	KIDNAPPING
18	LARCENY
19	LIQUOR
20	MISCELLANEOUS (“miscellaneous criminal offense”)
21	OBSTRUCTING JUDICIARY
22	OBSTRUCTING THE POLICE
23	OTHER (e.g., narcotic equipment violations, violation of controlled substance act, drunkenness, entry without permission, embezzlement, trespassing, invasion of privacy, public nuisances, riot, possession of drug paraphernalia)
24	OPERATING UNDER THE INFLUENCE OF INTOXICATING LIQUOR
25	RUNAWAY
26	SEX OFFENSES – OTHER (e.g., commercialized sex, nonforcible penetration)
27	SOLICITATION
28	STOLEN PROPERTY
29	STOLEN VEHICLE
30	WEAPONS OFFENSES
31	†ABORTION (Abortifacient – selling, manufacturing)
32	†CIVIL (Civil custodies – divorce and support; walk away from mental institution)
33	†ESCAPE (Fugitive, prison, youth home)
34	†IMMIGRATION (“Illegal entry”)
35	†MILITARY (AWOL)
36	†MURDER/INFORMATION (Information)
37	†Traffic (Accidents; invalid insurance)

*Violent crimes based on FBI Uniform Crime Reporting (Federal Bureau of Investigation, n.d.)

† Additional crime types prior to December 6, 2016 (City of Detroit, 2018)

Appendix I

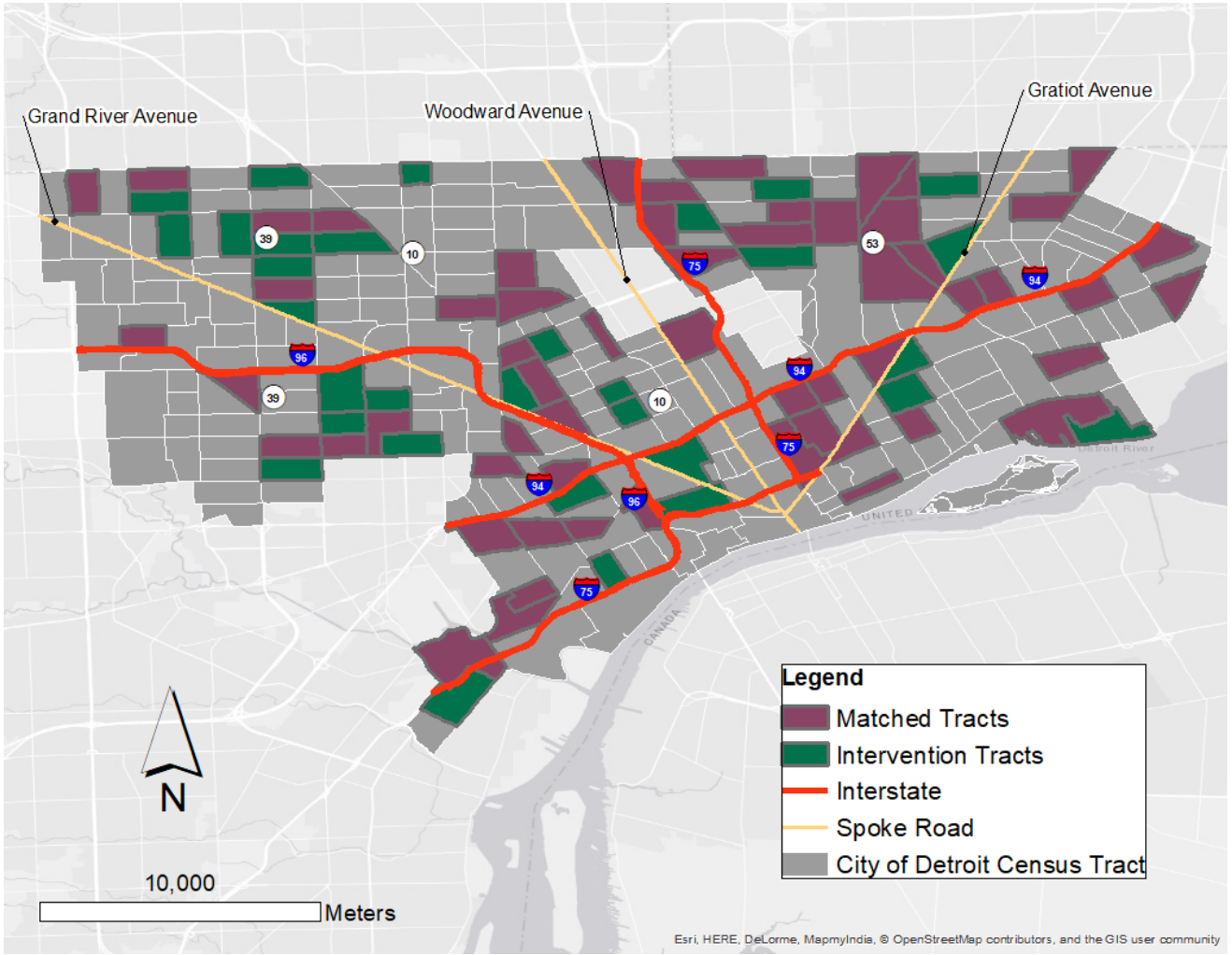

Figure I.1 Paper III Tracts