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Community engagement, greening, and violent crime: A test of the greening hypothesis and Busy Streets

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Abstract

Researchers have documented that vacant lot greening can reduce community-level crime and violence. *Busy Streets Theory* (BST) suggests that residents who are involved in the greening process can help to improve physical environments and build social connections that deter crime and violence. Yet few researchers have explored how community engagement in the greening process may affect crime and violence outcomes. We applied BST to test the effects of community-engaged vacant lot greening compared to vacant lots that received either professional mowing or no treatment, on the density of violent crime around study lots. Using mixed effects regression models, we analyzed trends in violent crime density over the summer months from 2016 to 2018 at 2102 street segments in Youngstown, OH. These street segments fell within 150 meters of an intervention parcel that was classified as one of three conditions: community-engaged maintenance, professional mowing, or no treatment (control). We found that street segments in areas receiving community-engaged maintenance or professional mowing experienced greater declines in violent crime density than street segments in areas receiving no treatment, and more decline occurred in the community-engaged condition compared to the professional mow

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condition. Our findings support BST and suggest that community-engaged greening of vacant lots in postindustrial cities with a concentrated vacancy can reduce crime and violence.

Keywords

community engagement; crime prevention; greening; violence

INTRODUCTION

Starting mainly in the 1960s, cities in the industrial Midwest and Northeast experienced manufacturing plant closures that resulted in significant job losses and economic decline. The loss of industry and incentives that encouraged suburbanization led to migration out of city centers (Dewar & Thomas, 2013). These trends, along with discriminatory lending practices (i.e., redlining), have led to deepening economic disinvestment and inequities experienced by the predominantly residents of color remaining in city centers (Dewar & Thomas, 2013; Lowe & Thaden, 2016). In recent decades, demolition has been a widely adopted, federally funded strategy to address deteriorating abandoned buildings in cities with a concentrated vacancy (U.S. Department of the Treasury, 2019). While demolition may be an efficient solution to some immediate safety risks associated with abandoned buildings (Spelman, 1993), if the resulting vacant lots created by mass demolition are not adequately managed and maintained, they can potentially become larger liabilities and hotspots for crime and violence (Branas et al., 2013). Neglected vacant lots often become crime attractors, increasing opportunities for activities that are unwanted by communities and providing hiding places for illegal weapons (Branas et al., 2013, 2018; Garvin et al., 2013). In a national survey of organizations charged with managing vacant properties, nearly two-thirds reported that their inventories of vacant lots have expanded over the past two years (O'Keefe et al., 2020). Structure-free vacant lots now make up 75% of vacant property inventories nationally, as compared to vacant buildings (only 25%). The vacant lots left behind after demolition are so numerous that organizations widely report they are unable to adequately maintain them with the limited funding available for vacant lot greening (O'Keefe et al., 2020). As a result, postindustrial cities across the United States are confronting a growing challenge of unmaintained vacant lots that can lead to violence and crime (Garvin et al., 2013; O'Keefe et al., 2020).

Vacant and neglected urban properties are associated with negative residential outcomes, such as increased perceptions of social disorder (Ross & Mirowsky, 1999; Taylor et al., 1985), fear of crime (Branas et al., 2018; Ross & Mirowsky, 1999), mental distress (South et al., 2018), and aggression in young males (Diez Roux & Mair, 2010; O'Brien Caughy et al., 2012). Indicators of physical deterioration (e.g., abandoned buildings) and vacancy (e.g., neglected empty lots) are also associated with crime, low neighborhood satisfaction, poor health outcomes, and reduced neighborhood investment (Branas et al., 2013; Dassopoulos et al., 2012; Immergluck & Smith, 2006).

Researchers have reported that improving vacant lots through greening can help to transform a neighborhood (Bowman & Pagano, 2000, 2004) and that well-maintained natural areas may improve physical and mental health (Branas et al., 2011; Groenewegen et al., 2006; South et al., 2015), and reduce fear of crime and violence (Branas et al., 2011, 2018; Burt et al., 2021; South et al., 2018). Greening is the process of restoring the landscaping and appearance of a vacant lot by mowing and maintaining it to control growth (Krusky et al., 2015). Greening can include simple measures such as cleaning, mowing, and maintaining vacant spaces, or more involved applications such as community gardens (O'Keefe et al., 2020). Residents have reported feeling safer when they were in open, mowed areas compared to densely vegetated, overgrown areas (Schroeder & Anderson, 1984). Resident fear of crime decreases as a function of open sight lines resulting from the removal of overgrown vegetation (Kuo & Sullivan, 2001). In a randomized control trial, residents living near newly greened lots reported reduced perceptions of crime, nuisances, and safety concerns than those living farther away (Branas et al., 2018). In this trial, they also found that police-reported crime, burglary, and gun violence decreased in areas with newly greened lots, which supports prior, controlled observation studies (Kondo et al., 2016). These findings are consistent with the *Busy Streets Theory* (BST).

BST posits that thriving urban spaces are those that include orderly, safe physical environments, socially connected and engaged residents, and positive neighborhood activity (Aiyer et al., 2015; Heinze et al., 2018). Improving physical conditions by greening and repurposing vacant lots may be one way to create safer neighborhoods as it signals social control and reduces residents' subjective perceptions of crime (Branas et al., 2018; Burt et al., 2021), and creates opportunities for health-promoting physical and social activities (De Sousa, 2014; Németh & Langhorst, 2014). Safety may be enhanced when residents work together to improve their neighborhoods because positive interactions help restore neighborhood relationships and community connectedness, which can attenuate crime and violence (Aiyer et al., 2015; Stafford et al., 2007).

Engaging residents in cleaning up, planting, and maintaining vacant urban properties may have positive effects on residents' mental and physical health, and reduce crime and violence because it sends the message that people in the neighborhood care about the area. In our prior work, we found that involvement in neighborhood gardens and beautification activities increased social capital, social support, neighborhood satisfaction, and informal social control, and improved intergenerational relationships (Alaimo et al., 2005). Residents involved in greening have also reported decreased litter, increased neighborhood interest and community pride (Alaimo et al., 2010), and an enhanced sense of community ownership (Rupp et al., 2020).

In the context of urban environments that experience a concentrated vacancy, significant structural disadvantage, and high rates of crime, community-engaged greening to improve the physical characteristics of a neighborhood may be one way to create *busy streets*. Community-engaged greening refers to collective greening efforts that involve residents working together to remediate and improve the appearance of vacant and neglected lots in their neighborhood. Community-engaged greening involves residents in the planning and implementation of greening projects such as mowing lots, planting a garden, or other vacant lot reuses (e.g., pocket park). Such an approach is promising for its potential to promote *busy streets*, where combining greening and community engagement may benefit crime and violence prevention above and beyond the greening treatment alone.

Yet, thus far, few researchers have used multiple study conditions to examine the potential effects of resident engagement in greening for crime and violence prevention. Heinze et al. (2018) found that street segments receiving vacant lot mowing performed by community groups in Flint, MI, reported a 40% reduction in assaults relative to street segments with vacant lots receiving no maintenance, but they did not consider professional mowing in their evaluation. Kondo et al. (2016) evaluated the association between both resident-led and professional contractor-led landscaping and crime, but they did not randomly assign professional and control conditions, nor did they focus on youth-specific crime or violence. We build upon the findings of these studies with our study by comparing the effects of community-engaged greening, professional mowing, and no greening intervention.

In this study, we examine the longitudinal association of three greening conditions implemented from 2016 to 2018 in Youngstown, OH, with violent crimes committed against people of all ages, as well as only youth. We use victimization as our outcome because this is the most complete data—police incident data have significant missingness regarding who committed acts of violence (over 50%). We intentionally compared the effects of community-engaged greening against professional mowing and hypothesized that community-engaged greening would be more effective in reducing violence and creating safer neighborhoods because it incorporates the previously described social benefits of resident engagement into greening for violence prevention. We also hypothesized that both greening strategies would be more effective in reducing violent crime and youth-related violence than no greening activity. We tested these hypotheses in a Midwestern city that has experienced significant disinvestment and physical decline in past decades.

METHODS

Study context

The study took place in Youngstown, OH, which covers almost 34 square miles. During the 1950s and 1960s, Youngstown was a prosperous metropolitan area due to many high-paying industrial jobs in steel mills. Since then, the loss of industry has contributed to a decline of more than 60% in the city’s population, which is now under 65,000 (U.S. Census Bureau, 1950, 2019). In 2019, US census data indicated that over half of the city’s population are people of color and 42% are African American; the mean household income was under $29,000, and 55% of residences were owner-occupied (U.S Census Bureau, 2019). Job and population loss led to abandonment, disinvestment, and physical deterioration, which can increase the risk of community violence (Branas et al., 2013; Spelman, 1993).

We collaborated with Youngstown Neighborhood Development Corporation (YNDC), a nonprofit organization that works to encourage investment in neighborhoods that have been economically and socially marginalized and partners with community groups to increase capacity for neighborhood revitalization. We examined the effects of YNDC’s Lots of Green Program (NEOSCC, 2012), which specifically supports community organizations that engage youth in repurposing and maintaining vacant lots that are in close proximity to their own neighborhoods. Lots of Green projects have included vacant lot clean-ups and stabilizations, community gardens, urban farms, wild-flower meadows, rain gardens, pocket parks, and urban orchards. We encouraged program staff to implement their programs as they normally would and did not attempt to interfere with other community efforts that might influence the study's outcomes. This allowed us to conduct a quasi-experimental study comparing the effects of their program to professional mow and control sites (selection described below) that did not receive their community-engaged programming.

Study design and sample description

Independent variable: Greening condition—YNDC requires community organizations to submit proposals to maintain parcels identified for improvement, so we could not randomly assign vacant lots to receive community-engaged greening through the Lots of Green program. After YNDC assigned vacant lots to the Lots of Green condition, our research team identified comparable vacant lots located in similar neighborhoods, defined by census block-group population and socioeconomic data (see below), for random assignment to the remaining two conditions (i.e., professional mowing, no greening). We classified each study parcel as receiving community-engaged greening, professional mowing, or no greening activity.

Greening activity for the two experimental conditions occurred during the summer months (April–September) from 2016 to 2018. We identified a total of 182 unique intervention parcels in Youngstown with a mean area of 580 m^2 for inclusion in the study (Figure 1). Over the course of three summers, 75 of these parcels (41.2%) received community-engaged greening in partnership with YNDC (i.e., Lots of Green condition), 54 (29.7%) received regular mows from a professional mowing company (i.e., professional mow condition), and 53 (29.1%) were chosen by the research team as controls that did not receive any greening activity.

While the intervention took place at the parcel level, our unit of analysis was the street segment, defined as both sides of the street from one corner to the other (usually a city block). Street segments were selected as the unit of analysis to capture the radiating effects of greening on the surrounding neighborhood. We selected all street segments within 150 meters (m) of each study parcel and assigned the study condition status to the segment. This approach resulted in 2103 total street segments across all three years, with 448 street segments in the community-engaged greening condition, 545 in the professional mow condition, and 1110 in the control condition. Table 1 reports the number of street segments by conditions by year and Figure 1 maps the location of intervention parcels in Youngstown.

A total of 183 street segments across three years (i.e., less than 3% of all noncontrol street segments) fell within 150m of two or more parcels with different conditions. To maintain well-defined nonoverlapping conditions, we dropped 22 street segments that had both professional mow and community-engaged intervention conditions. In cases where a control condition street segment overlapped with a professional mow or community-engaged condition street segment (n = 161), we assigned these to their respective intervention condition (i.e., not the control condition) as this was a more conservative test of our hypothesis. Our final analytic sample included 2103 street segments across all three conditions.

Dependent variable: Violent crime incident density—The density of violent crime incidents per square mile was our dependent variable. We created 50 m raster surfaces of kernel density crime estimates (a typical measure for spatial analysis) for each summer month over the course of the three study years using administrative crime reporting data provided by the Youngstown Police Department. Kernel density estimation *smooths* the point police incident data to reflect the density of crime incidents in the neighborhoods surrounding each study street segment. This helps address the zero-inflated nature of the violent crime (i.e., relatively rare event). Few street segments have zero values because crime incidents occurring on other, nearby street segments cause non-zero density estimates, allowing us to account for street segments in high crime areas without incidents.

Because BST relates to interpersonal neighborhood relationships, we included only interpersonal violent crimes in our analysis. We used crimes classed as Part 1 violent crimes (i.e., homicide, murder, assault, rape, and robbery) by the Federal Bureau of Investigation (FBI) Uniform Crime Report (FBI, 2004). We also examined these categories specifically for crime incidents involving youth as victims (below age 25). We extracted the crime density at the centroid of each street segment to use as the outcome value. Table 1 reports descriptive statistics for the dependent variable, and all study variables noted below, across each condition for each year of the study. All kernel density calculations were performed in ArcGIS Pro 2.7.1 (ESRI, 2020) and all other analyses were conducted in R (R Core Team, 2021).

Control variables

Neighborhood disadvantage and population density: We included several control variables to help ensure the comparisons across conditions were similar on neighborhood variables related to crime including disadvantage, population density, and prior crime. Using data from the U.S. Census Bureau, 2014–2018 American Community Survey (ACS; U.S. Census, 2019) to describe areas with pre-study data, we estimated measures of neighborhood disadvantage and population density for each street segment in the study. We calculated an index of neighborhood disadvantage using an approach applied by other researchers (Burt et al., 2021) that includes indicators relevant to environmental and economic conditions in neighborhoods. For each block group in Youngstown, we averaged the percentage of the population on public assistance, living in poverty, renting their home, and the percentage of vacant housing units (Burt et al., 2021). Then, we assigned disadvantage index values to street segments based on the block group with which each street segment had the largest intersection. We similarly assigned population density per square mile to each street segment using the 2014–2018 ACS data.

Crime incident density, previous summer: For each street segment included in the analysis, we controlled for the crime density value from the previous summer. This variable was calculated similarly to our dependent variable, and then summed across months to create a predictor for the entire summer.

Spatially lagged predictor: To control for spatial autocorrelation within our data, we calculated a spatially lagged version of our outcome variable to include as a predictor for each model using the spdep package in R (Bivand & Wong, 2018). When creating the spatial weights matrix to calculate this spatially lagged variable, we considered a street segment's neighbors to be all other street segments whose centroids fell within a 2000 m radius (1.24 miles).

Analytic strategy

We used linear mixed-effects models to examine the association between the greening condition and crime density. These models estimated crime density as a function of our sociodemographic control variables, time, and study condition, looking specifically at the interaction between the month and greening intervention. We included a random effect for the intervention parcel with which each street segment was associated, as well as a random effect for the cohort year of the intervention. This allowed us to examine the association between crime and greening condition over the course of the summer months for each year of the study. Our models included four steps for predicting crime incidents: (1) control variables; (2) control variables and time (month); (3) control variables, time, and greening condition; and (4) control variables, time, greening condition, and greening condition by month. When building our models, we specified the control greening condition as our reference group. We conducted this model testing for all Part 1 violent crime incidents, first for victims of all ages, then for youth (under age 25) victims. We report the R^2 value of the models to assess model fit. We fit all of our models using the lme4 package from R (Bates et al., 2015).

We conducted a supplemental analysis of crime displacement beyond 150 m from the greened intervention parcels. We selected a displacement sample composed of street segments that were more than 150 m and less than 300 m away from greened parcels and were outside of the 150 m buffer used for our analytic sample. For each displacement street segment selected, we calculated the slope per year of its crime density by summer month to represent yearly crime trends. We repeated this calculation with the control street segments in our analytic sample and used *t* tests to compare crime trends during our intervention period.

RESULTS

Table 1 displays descriptive statistics of all study variables across cohort year and treatment condition for our selected sample of street segments. We count the number of intervention parcels per cohort year and treatment condition and show the number of street segments selected from buffers around our intervention parcels. We also summarize our outcome variable (Part 1 crime density per street segment for all victims and youth victims), and our census control variables. Figure 2 shows the mean youth Part 1 crime density for each greening condition by month, aggregated from 2016 to 2018.

Two-sample *t* tests (results not shown) to test the equivalence of conditions on the control variables indicate statistically significant differences in the population density across the three treatment conditions: professional mow areas had the lowest average population density, and no treatment control areas had the highest average population density. Additionally, street segments in the no treatment control condition had a higher average disadvantage index than street segments within the professional mow condition and street segments in the community-engaged greening condition. We found no differences in neighborhood disadvantage between professional mow and community-engaged greening street segments.

Table 2 summarizes the regression coefficients of our constructed model, which predict monthly Part 1 violent crime density for all victims over the course of the summer during each of the study years. In Model 1, we predicted crime density via our control variables with a random effect for the intervention parcel associated with each street segment. Population density ($\hat{\beta} = .00038$, $p < .001$), neighborhood disadvantage ($\hat{\beta} = 6.24$, $p < .001$), and spatially lagged crime density ($\hat{\beta} = .92$, $p < .001$) all predicted violent crime. Model 2 included a time (month) predictor and a random effect for year. In Model 3, we added a main effect for greening condition, and in Model 4, we included an interaction effect between greening condition and month to model the different summer crime density trends between greening conditions.

The coefficients for the main effect predictors of the greening condition in Model 4 show a positive association between community-engaged greening street segments (compared to control segments) and violent crime (0.69 more incidents/mi^2), and a negative association between professional mow street segments (compared to control segments) and violent crime (0.72 less incidents/mi^2), though these associations were not statistically significant. The coefficient for month was positive, indicating that as the summer progresses, we expect a slight increase in violent crime density (0.098 more incidents/mi^2 each month, $p < .05$). The larger negative interaction coefficients between month and greening condition for both community-engaged and professional mow classifications indicates, however, that as the summer progressed we found a decrease in Part 1 violent crime density for these noncontrol street segments. Notably, community-engaged greening street segments had a larger decrease ($\hat{\beta} = -.36$, $p < .001$) than professional mow street segments ($\hat{\beta} = -.16$, $p < .05$). When we changed the reference condition within our models from control to professional mow to compare community-engaged greening street segments and professional mow street segments, we found the community-engaged greening condition and month interaction effect indicated larger decreases in violent crime incidents ($\hat{\beta} = -.20$, $p < .05$). Additionally, as shown in our tables, the standard errors of the coefficients for these conditions do not overlap.

We found similar results when considering Part 1 violent crimes involving youth victims using the same analytic approach as above. Effect estimates are shown in Table 3. Again, while the association between violent crime density and intervention condition for professional mows and community-engaged greening were positive though not statistically significant ($\hat{\beta} = .48$ and $\hat{\beta} = .11$ respectively), the coefficients for the interaction between both community-engaged conditions ($\hat{\beta} = -.23$, $p < .001$) and professional mow conditions ($\hat{\beta} = -.097$, $p < .001$) and violent crime were negative and signibcant. We changed the model reference condition from control to professional mow, and again found that community-engaged greening street segments showed larger decreases in violent crime incidents compared to professional mow street segments $\hat{\beta} = -.13$, $p < .01$).

In both Tables 2 and 3, we find that all model intercepts are negative. This is a result of the neighborhood characteristic control variables (disadvantage index and population density) within the models, as their values are 5-year aggregates that do not have any variation within a street segment between months or years. Though the explicit intercept value is not interpretable when negative, the units of the model coefficients are still consistent with our outcome variable (i.e., crime incident density per square mile).

Table 4 shows the results of our displacement analysis for Part 1 violent crime against all victims and for youth victims only. Though we found differences between the violent crime trends of the displacement areas and control areas in some years, we do not see an increase in violent crime in our displacement areas. In the displacement areas, violent crime trends tended to be more negative each year across the summer months than in control areas, which could be explained by further radiating effects of the greening intervention.

DISCUSSION

Our findings support the BST: community-engaged greening of vacant lots in postindustrial cities with a concentrated vacancy can reduce violence. This is evidenced by our finding that street segments around vacant lots cared for by community residents (i.e., community-engaged greening) had greater reductions in violent crime density for victims of all ages, as well as specifically youth victims, over the course of the summer, compared to lots that had no greening activity or that were mowed by professionals. The association between professional mow areas and a greater reduction in crime over the summer compared to the control areas adds to prior evidence supporting property maintenance and greening as a crime reduction strategy (Branas et al., 2018; Heinze et al., 2018; Kondo et al., 2016). The stronger effects of community-engaged greening compared to professional mowing could be accounted for in the active participation of residents in neighborhood activity, creating ongoing attention to the area (e.g., maintaining gardens or parks, neighbor interactions while working on the lot) that would not occur when professionals only mow sporadically. This ongoing activity helps create a busier street that is a less inviting environment for criminal and other nefarious activity.

The community-engaged greening effects that we observed may be due to an improvement in community relationships and engagement. Residents involved in greening have reported feeling better about—and more efficacious to make changes in—their neighborhood and more connected to their neighbors (Alaimo et al., 2010; Rupp et al., 2020). Participants in greening projects have reported advocating for organizational and municipal policies to support their activities, resulting in a city composting program, watershed improvements to reduce flooding, and the use of native plantings on city-owned properties (Reischl et al., 2010). Expanded involvement of community residents in greening can have a contagious effect, as witnessing neighbors implementing neighborhood improvements may encourage residents to increase their own property maintenance to meet a higher standard of care

(Krusky et al., 2015; Rupp et al., 2020; Troy et al., 2016). The development of new social resources and norms for maintenance may signal greater social control and help to attenuate crime and violence.

Our confidence in the results is strengthened by several factors. First, we observed associations between the professional mow and community-engaged greening conditions, timing, and violent crime even when controlling for population size, neighborhood disadvantage, and existing neighborhood crime. Second, our outcome variable does not suffer from self-report bias. It is also likely that given our focus on violent crimes which are relatively rare, our analysis is a conservative test of the effectiveness of the greening interventions on other crime and psychological outcomes found by other researchers (Branas et al., 2018; Kondo et al., 2016; Rupp et al., 2020; South et al., 2018). Third, our study incorporated random assignment of the professional mowed and control conditions. This random assignment helped to reduce some potential unmeasured confounding factors between these two conditions, such as greater police activity or community organization social events, that may explain the results. Fourth, the use of the street segment as our unit of analysis also generalizes the effects of the greening condition to a larger level than a specific parcel on the street. It also allowed us to more directly test BST because our analysis incorporated both the vacant lots and the surrounding social environments where more social activity, support, and capital could occur. The similarities in our model results for violent crime with victims of all ages compared to youth victims suggest that these findings are consistent for different methods of defining the dependent variable, particularly given that the smaller number of youth crimes reduces the amount of variance that could be explained (vs. all ages).

Another concern regarding greening interventions is that they simply displace crime from one area to another and do not prevent crime. Yet, similar to previous studies (Branas et al., 2018), our displacement analyses suggest otherwise. We did not find an increase in crime in areas adjacent to the intervention areas and crime trends tended to be more negative each year across the summer months than in control areas in these analyses.

Study limitations

Our study, however, has some limitations that require attention. First, although we employed a spatial lag model and included a spatially lagged version of our outcome variable as a predictor, we could not fully account for spatial autocorrelation in our data. We tested several methods of controlling for spatial autocorrelation and evaluated their effect on the Moran's I test result. These tests included spatial lag and spatial error models with varying nearest neighbor distances, k-nearest neighbor specifications, and trend surface generalized additive models (GAM) models. Each method returned similar results (i.e., significant Moran's I), but when we accounted for these effects using the different approaches the results of our analysis by condition were essentially the same. We chose to control for spatial autocorrelation via the spatial lag model method as it returned the smallest Moran's I test result difference. In addition, our comparison of the methods indicated that our spatial lag models fit the data more accurately than nonspatial OLS models which further enhanced our confidence in the results.

Our assessment of causal associations is also somewhat limited because we were not able to randomize all arms of the study. The community-engaged greening condition was not randomly assigned because YNDC had a selection process for identifying program groups that could not be disrupted. Neighborhood organizations had to intentionally submit a proposal that met program goals for transforming (i.e., planting, fencing, pocket park) the vacant lot and caring for the lot through the entire summer. Study areas receiving professional mowing or no greening did not have pre-existing groups that were interested in conducting community-engaged greening. We looked to account for these neighborhood differences by analyzing changes in crime density (as opposed to baseline differences in crime density) between street segments and controlled for several confounding factors associated with the neighborhood context and crime (i.e., population density, prior crime) and spatial autocorrelation. Additionally, our other two conditions were randomly assigned. Because our hybrid design was necessary given the community-engaged nature of our study, it also may have improved the external validity of our study while ensuring our confidence in its internal validity.

Our results, though statistically significant, represented very small effects. This is likely due to the relatively low base rate of Part 1 violent crimes (7–10 incidents per mi^2), and to a larger extent youth Part 1 violent crimes (1–2 incidents per mi^2), so we had less variance to explain initially. Since we found time by condition interaction effects in spite of this initial limited variance—and included control variables, and time and condition main effects, in our model—our results suggest that the effects of community-engaged greening (and greening more generally) might be particularly strong. In addition, a small effect may have significant health consequences as researchers have found that detrimental health and mental health sequelae are associated with victimization and exposure to community violence (Goldstick et al., 2018; Heinze et al., 2017; Hsieh et al., 2017, 2021; Lee et al., 2020). Thus, reduced exposure to even a single violent event can have important health consequences.

In addition, while this study and others have found neighborhood greening to have numerous benefits for residents, some concerns regarding consequent gentrification and displacement of community members can be raised. Our YNDC partners (as well as other vacant lot greening community partners) have noted that residents in neighborhoods that have experienced decades of vacancy, disinvestment, and decline often welcome investment in vacant land greening. Additionally, in many postindustrial cities, the cost of greening vacant properties is often greater than the potential resale value (Dewar, 2021). When demand for property is so low, concerns about gentrification are greatly diminished. Nevertheless, neighborhood improvement efforts could alienate or harm residents if they are controlled by external organizations that do not represent residents' interests, as occurred during the urban renewal programs of the 1950s and 1960s (Fullilove, 2004). Community-led efforts to green vacant properties in local neighborhoods can ensure these efforts are responsive to public needs, acceptable to residents, and sustainable (O'Keefe et al., 2020, 2021).

Another concern, however, is that the government and other community institutions might view residents' personal investments in abandoned land as an opportunity to further reduce services in neighborhoods with significant vacant land, or push the responsibility of neighborhood care to the residents most affected by policies that resulted in the pernicious conditions in the first place. Yet, our results suggest that programs that involve residents in vacant land greening and support their capacity for this study, such as YNDC's Lots of Green, may be effective violence prevention and community improvement strategies. In addition, resident engagement in the process of neighborhood revitalization is associated with personal and neighborhood benefits that increase pride in and connection to the neighborhood and community (Rupp et al., 2020). While we did not study specific programs such as grants awarded to community groups engaged in greening or land bank stewardship of vacant lots more generally, these strategies could facilitate community-engaged greening and therefore merit further study for violence prevention.

CONCLUSION

Our results support the notion that community-engaged greening can be an effective way to reduce community crime and violence. They are consistent with other researchers who have reported similar effects for general greening and particularly community-engaged greening and are consonant with BST. Our study builds on past work by including a focus on youth violence, comparing professional mowing versus community-engaged greening, and randomly assigning professional mow and control conditions. Greening interventions driven by community residents can be readily scalable to cover large areas, affect population-level change for improving community health and preventing violence, and are sustainable over time when they receive sufficient economic support (Branas & Macdonald, 2014; Frieden, 2010). Yet, it is also vital *not* to hold local residents wholly responsible for the quality of their neighborhoods, as many factors beyond individual and neighborhood control often drive the economic and policy decisions that result in neighborhood neglect and breakdown of social controls. In our research, we have found that resident engagement is vital to the sustainability of greening as it is associated with enhanced acceptability of programs, long-term buy-in and resident control of programs, and enhanced organizational functioning (O'Keefe et al., 2021; Rupp et al., 2021). When asking residents to participate in vacant lot care, however, Lowe and Thaden (2016) suggest that there is potential for community burn out when residents are asked to do too much with too few resources to support their work (Lowe & Thaden, 2016). Partnerships with local organizations (e.g., neighborhood associations) and institutions (e.g., local foundations, land banks) can help residents sustain locally driven greening programs by leveraging the capacity and resources necessary to maintain vacant properties. Policies that help organizations more efficiently acquire vacant properties before they enter tax auction are also vital to the capacity and sustainability of greening programs. These policies help organizations reclaim properties so they can maintain or repurpose them for community-driven needs before they deteriorate or are purchased by speculative buyers who frequently neglect them (Alexander, 2015; O'Keefe et al., 2021). Our results suggest that efforts emphasizing the collaboration of local organizations and institutions with residents for community improvement can assist residents in taking back their neighborhoods, and are a first step toward providing the support necessary to maintain and sustain busy streets.

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Highlights

- Greening of vacant lots is associated with decreases in violent crime.
- Community-engaged greening is associated with a greater decrease in crime than professional mowing.
- Community-engaged greening of vacant lots in cities can reduce violence.

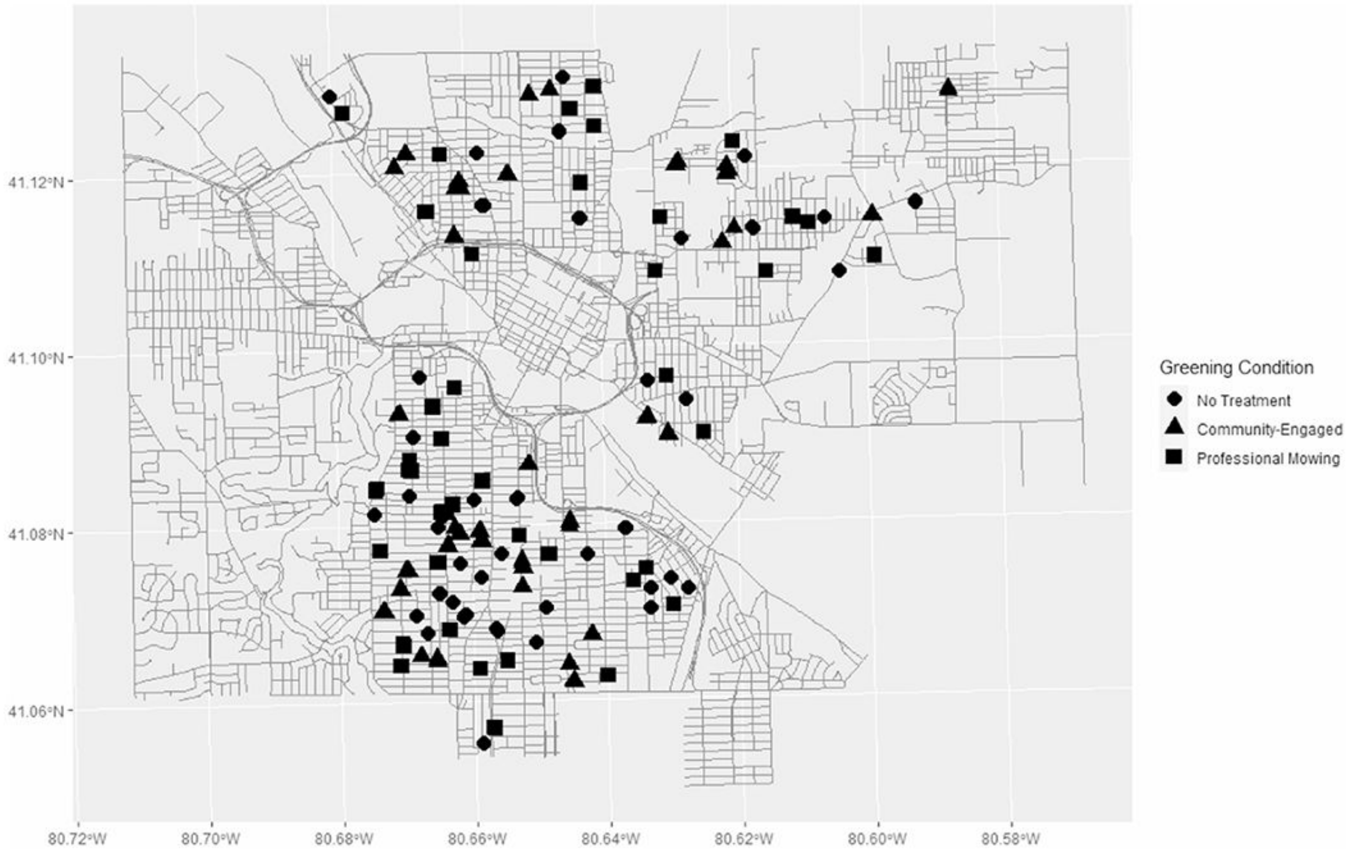

FIGURE 1.
Map of all intervention parcel locations by condition in Youngstown, OH

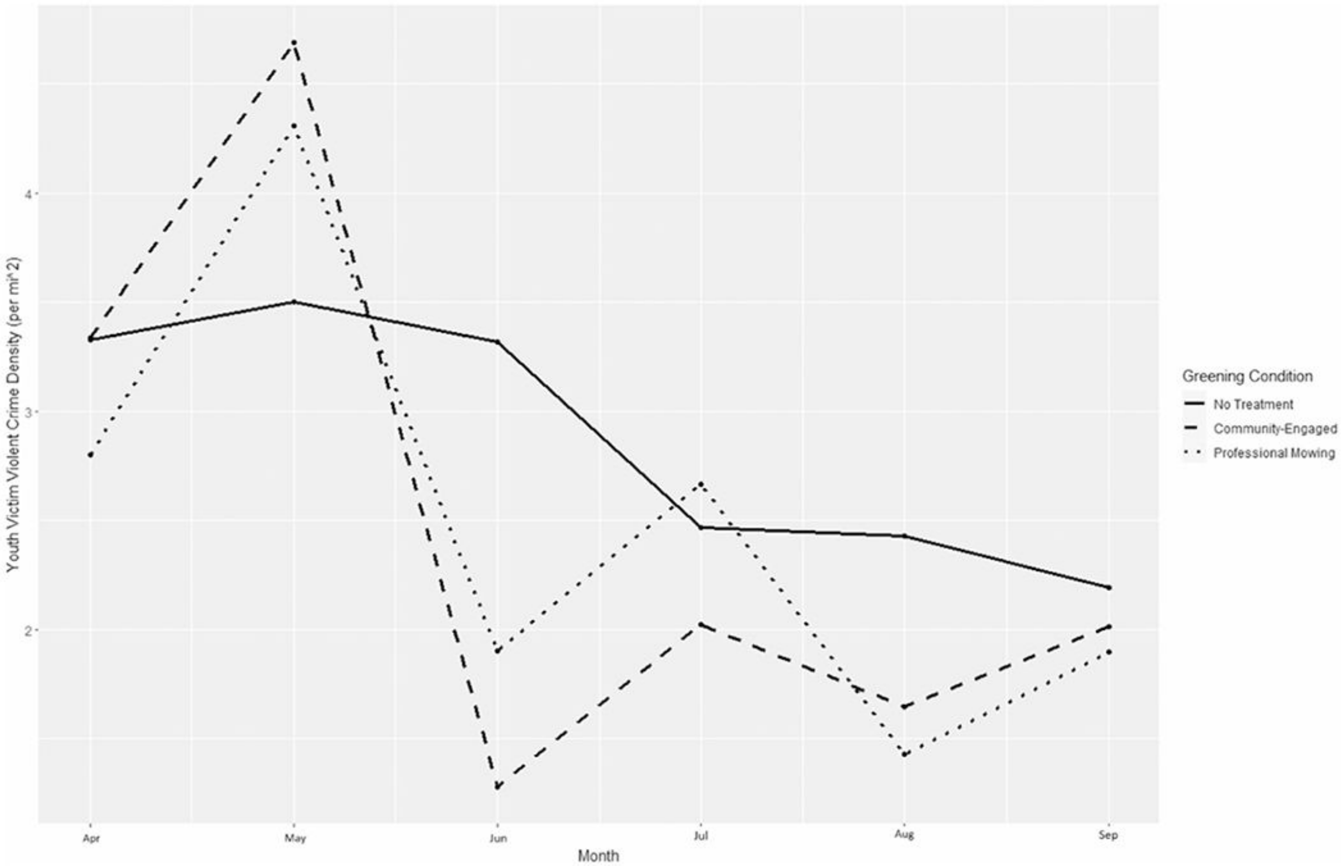

FIGURE 2.

Observed mean Part 1 violent crime density for youth victims (under age 25) across summer months from 2016 to 2018 in Youngstown, OH

TABLE 1

Mean (and standard deviation) and other descriptive statistics for all study variables across the type of greening condition and year

	2016			2017			2018		
	No treatment	**Professional mow**	**Community-engaged**	**No treatment**	**Professional mow**	**Community-engaged**	**No treatment**	**Professional mow**	**Community-engaged**
Measures									
Number of intervention parcels	53	22	35	53	14	20	51	18	20
Number of street segments	367	194	245	369	179	101	367	172	102
Mean summer crime density (per mi^2) per street segment									
Part 1 violent	9.41 (7.44)	8.20 (6.26)	8.45 (7.10)	10.50 (8.30)	9.02 (8.42)	8.33 (8.35)	9.70 (9.38)	6.80 (5.58)	9.53 (6.43)
Youth Part 1 violent	3.18 (3.53)	2.86 (3.39)	3.10 (3.66)	3.93 (4.32)	3.43 (5.01)	2.55 (4.15)	1.49 (3.78)	1.12 (2.64)	1.01 (2.17)
Mean neighborhood disadvantage per street segment	0.30 (0.095)	0.29 (0.072)	0.29 (0.072)	0.30 (0.094)	0.29 (0.074)	0.28 (0.079)	0.30 (0.095)	0.30 (0.092)	0.34 (0.079)
Mean population density (per mi^2) per street segment	2822.50 (1643.55)	1904.66 (954.48)	2468.88 (1844.38)	2815.78 (1641.83)	2421.87 (1948.02)	2481.44 (1804.69)	2818.07 (1645.44)	2682.83 (1238.98)	2543.80 (809.93)

Note: Parentheses () = standard deviation. Part 1 violent crimes are defined as the FBI Uniform Crime Report crimes that involve interpersonal violence (e.g., they exclude arson, burglary, and larceny). We scale our estimates of crime and population density values in units of incidents/people per square mile for interpretability.

TABLE 2

Estimates of association between the greening condition and summer Part 1 violent crime density for *all victims*

	Model 1: Controls	Model 2: Controls + Time	Model 3: Controls + Time + Main effect predictors	Model 4: Controls + Time + Main and interaction effect predictors
Fixed effects (estimates)				
(Intercept)	−2.71 (0.51)***	−2.63 (0.52)***	−2.20 (0.63)***	−2.45 (0.63)***
Population density (per mi^2)	0.00038 (0.000063)***	0.00038 (0.000063)***	0.00038 (0.000063)***	0.00038 (0.000063)***
Neighborhood disadvantage	6.24 (6.23)***	6.21 (1.34)***	6.22 (1.34)***	6.23 (1.34)*
Part 1 violent crime density, previous summer (per mi^2)	−0.0030 (0.0077)	−0.0016 (0.0077)	−0.0019 (0.0077)	−0.0027 (0.0077)
Spatially lagged Part 1 violent crime density (per mr^2)	0.92 (0.017)***	0.92 (0.017)***	0.92 (0.017)***	0.91 (0.017)***
Month	—	−0.023 (0.028)	−0.022 (0.028)	0.098 (0.039)*
Greening condition [Reference: Control]				
Community-engaged	—	—	−0.22 (0.55)	0.69 (0.58)
Professional mow	—	—	−1.12 (0.59)	−0.72 (0.61)
Month × *greening condition [Reference: Control]*				
Month × Community-engaged	—	—	—	−0.36 (0.072)***
Month × Professional mow	—	—	—	−0.16 (0.068)*
R^2	0.473	0.474	0.477	0.477
Random effects				
σ^2	29.67	29.66	29.66	29.66
$\tau_{00\ \text{intervention parcel}}$	8.84	8.87	8.78	8.78
$\tau_{00\ \text{year}}$	–	0.02	0.02	0.02

Note: Parentheses () = standard error.

* $p < .05$;

*** $p < .001$.

TABLE 3

Estimates of association between the greening condition and summer Part 1 violent crime density for *youth victims* (*under age* 25)

	Model 1: Controls	Model 2: Controls + Time	Model 3: Controls + Time + Main effect predictors	Model 4: Controls + Time + Main and interaction effect predictors
Fixed effects (estimates)				
(Intercept)	−1.04 (0.23)***	−1.08 (0.24)***	−0.99 (0.28)***	−1.19 (0.28)***
Population density (per mi^2)	0.00012 (0.000032)***	0.00012 (0.000032)***	0.00012 (0.000032)***	0.00012 (0.000032)***
Neighborhood disadvantage	3.49 (0.66)***	3.48 (0.66)***	3.47 (0.67)***	3.46 (0.66)***
Youth Part 1 violent crime density, previous summer (per mi^2)	−0.080 (0.0081)***	−0.081 (0.0082)***	−0.081 (0.0082)***	−0.079 (0.0082)***
Spatially lagged youth Part 1 violent crime density (per mi^2)	0.92 (0.014)***	0.93 (0.016)***	0.93 (0.016)***	0.93 (0.016)***
Month	—	0.014 (0.016)	0.014 (0.016)	0.090 (0.021)***
Greening condition [Reference: Control]				
Community-engaged	—	—	−0.11 (0.22)	0.48 (0.24)
Professional mow	—	—	−0.13 (0.23)	0.11 (0.25)
Month × Greening condition [Reference: Control]				
Month × Community-engaged	—	—	—	−0.23 (0.039)***
Month × Professional mow	—	—	—	−0.097 (0.036)**
R^2	0.412	0.413	0.414	0.417
Random effects				
σ^2	8.52	8.52	8.52	8.50
$\tau_{00\ \text{intervention parcel}}$	1.32	1.32	1.34	1.34
$\tau_{00\ \text{year}}$	—	0.00	0.00	0.00

Note: Parentheses () = standard error.

** $p < .01$;

*** $p < .001$.

TABLE 4

Violent crime displacement analysis—Compare Part 1 violent crime trends in street segments displacement area (150–300 m away from greened intervention parcel) to control areas

	Mean Part 1 violent crime density slope					
All victims						
	Displacement areas	**Control areas**	***t***	***df***	***p* value**	**95% CI**
2016	−1.27	−1.37	0.99	518.90	.32	(−0.093, 0.28)
2017	−1.58	−1.02	−5.65	791.69	<.001	(−0.76, −0.37)
2018	−1.12	−0.55	−4.97	744.30	<.001	(−0.80, −0.35)
Youth victims (under age 25)	**Mean Part 1 violent crime density slope**					
	Displacement areas	**Control areas**	***t***	***df***	***p* value**	**95% CI**
2016	−0.72	−0.30	−4.24	469.86	<.001	(−0.62, −0.23)
2017	−0.64	−0.42	−3.38	758.45	<.001	(−0.34, −0.090)
2018	−1.60	−1.74	1.58	602.46	.12	(−0.033, 0.30)