UNIVERSITY OF CALIFORNIA

Santa Barbara

Just Growing? Investigating Racial Inequity and Liberatory Potential in Brooklyn School Gardens

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Philosophy

in Geography

by

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September 2018

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ACKNOWLEDGEMENTS

I am immensely grateful to my advisory committee, Stuart Sweeney, David Pellow, and Susie Cassels, for their tremendous guidance and care throughout the stages of this process. The impact of their knowledgeable and kind mentorship cannot be understated and will leave a lasting impact.

I am grateful to those I served alongside in the UC Student Association, where we worked to improve the graduate experience for everyone and particularly for traditionally underserved student populations. I am grateful for the UCSB Black Resources Committee and the UCSB Multicultural Center, which were meaningful hubs during my time on campus.

In New York, I was fortunate to work at the NYC Department of Health and Mental Hygiene with guidance and technical assistance from Sophia Day and Kevin Konty. I appreciate the NYC Department of Parks and Recreation for sharing data on the school and community garden programs. I am grateful to the students and staff at the middle and high schools who shared their stories with me. I am very grateful to the friends I have met in New York who have supported my research and personal growth, and who are making meaningful positive changes in this world.

Thanks so much to the past and present graduate students in the UCSB Geography Department for all of the adventures and support along the way.

Thanks to the many AAG session conveners and participants who have provided a springboard for research and insight.

Thanks to the National Science Foundation and the UCSB Kennedy/Graves Fund for the immensely important provision of funds to do this work.

Thanks to my mom and my brothers - and a shout out to my dad, Sunday, who is also pursuing a Ph.D. right now.

I am grateful and lucky to know all of you.

VITA OF MICHELLE TOKUNBO OLUWASEYI OYEWOLE
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ABSTRACT

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Well-resourced urban school gardens can provide extensive and varying benefits for students, operating simultaneously within a tradition of community transformation through urban farming, and the U.S. public education system. Benefits of school gardens include empowering, affirming, and engaging activities and relationships; knowledge about food and environmental systems; improved nutrition; stress relief; increased physical activity; and experiential education – but these benefits occur within an unequal society in which certain benefits and harms are more likely to occur based on race, ethnicity, class, gender, and other identity markers. One of many disparate risks is the exposure to environmental toxins in urban landscapes.

Using statistical analysis of surveys from adult and student school gardeners, soil samples, NYC Department of Education School Survey data, and public inventories of hazardous waste sites; as well as qualitative analysis of adult interviews and student open-ended responses, this dissertation addresses the overarching questions: How do school gardens provide personal and social benefits to students while minimizing environmental risks? What factors affect the distribution of these outcomes, and is the distribution just?

Theoretical framing used to guide analysis is derived largely from social determinants of health, critical race theory, food justice, environmental justice, and social capital literature.

I investigate social, economic, and environmental disparities in Brooklyn, NY middle and high school gardens. Some of the main findings include: The budget and administrative support received by gardens increases with the school proportion of white students (n = 24 schools) (*Chapter 1*); White male students report the highest feelings of affirmation in the garden space, replicating a disparity that is also recurrent in classroom settings (n = 122 students) (*Chapter 2*); The number of hazardous waste sites near schools with gardens increases with the school proportion of Black and Hispanic/Latinx students, and with the proportion of low-income students (n = 31 schools) (*Chapter 4*). Lastly, in a chapter highlighting students' direct words, I explore the potential of school gardens to promote liberation for racially minoritized students, proposing a four-part framework that builds on movements for justice with which the garden intersects (*Chapter 3*). Overall, the dissertation explores the benefits and shortcomings of Brooklyn, NY school garden spaces with a focus on marginalized student populations.

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I. Chapter 1: Disparate funding and social support for school gardens by racial composition in Brooklyn, NY

Abstract

Well-resourced school gardens can help promote social, environmental, and nutritional equity amongst young people of color in U.S. cities. While federal Title I policy aims to "bridge the gap" for schools in high poverty areas, institutional inequalities are reinforced under this legislation, such that racially minoritized, low-income students have fewer and lower quality school resources. We seek to answer whether this trend persists in the funding and social support of school gardening programs, using surveys and interviews of school garden facilitators. In a sample (n =24) of Brooklyn, NY public middle and high schools with gardens, we found that garden budget increased with the school's proportion of white students. Garden facilitators also perceived support from the school administration to be higher in schools with more white students. While the proportion of white students in most Brooklyn schools is relatively low (9% median), our ANOVA analyses suggest the lowest support for racially minoritized student gardeners. We discuss these findings in the context of U.S. political economy, critical race theory, and social determinants theory, in order to begin elucidating possible impacts and strategic solutions within the current context.

Keywords: school gardens, racial inequality in education, school funding, social capital

Introduction

In underfunded city neighborhoods in the United States, well-resourced school gardens can provide varying and extensive benefits for young people. The positive effects of collective gardening include stress relief, improved nutrition, science achievement, agro/ecological immersion, community food security and food justice, and transformative social connection with peers (Blair, 2009; Groenewegen et al., 2006; Saldivar-Tanaka and Krasny, 2004). When young people value ecological places, they take steps to improve the environment and their community, and they expand ideas about their opportunities (Russ et al., 2015). Social capital development is a commonly named benefit of collective gardening, enabling people to form meaningful bonds that benefit them in educational, career, political, and social settings (Groenewegen et al., 2006; Saldivar-Tanaka and Krasny, 2004; Williams, 2014). Afterschool programs in general and garden programs in particular have benefits that for students of color can narrow the gap in educational achievement by providing more engaging methods of learning (ruiz-gallardo et al., 2013; wu and van egeren, 2010).

Government policies heavily shape the racial, and therefore socioeconomic composition of cities, causing disparities in housing, tax revenues, food access, and polluting sources by demography (Brulle and Pellow, 2006), which may result in uneven conditions that allow for school gardens to empower participants (Blair, 2009; Comer and Haynes, 1991; Warren, 2005). While school gardening programs exist in urban school districts, researchers have yet to probe whether gardens in schools with predominantly racially minoritized students are as financially and socially supported as urban schools that are predominantly white. In this study we ask: *Are school garden budget or social support lower*

at schools with more racially minoritized students; with more low-income students? What are the effects and mechanisms by which these inequalities operate?

Political economy, racial injustice, and social determinants of education quality

U.S. public education is characterized by policies and practices that are biased against racially minoritized and low-income students. In this study, we drew from political economy, critical race theory, and social determinants of health to understand and frame school inequality.

Public education is largely underfunded and reliant on unequal local and state tax revenues. The political economy of school funding in the United States perpetuates underinvestment in students who live in low-income, Black and Brown communities (Marable, 2015). Most students are forced to go to low-quality schools near where they live, and a fair school choice program in the U.S. is functionally mythical, even in districts with "open" choice programs, due to unenforced rules and loopholes, (Ryan and Heise, 2002; Warren, 2005). In recent history, supreme courts at the federal and state levels have limited integration and choice for students and parents, influenced by middle class white suburbanites who were relatively satisfied with their schools and unwilling to open them to poorer or urban districts (Ryan and Heise, 2002). There have been attempts at the federal level to address funding inequalities by administration of a program called Title I or the *Elementary and Secondary Education Act*, but it has had limited functionality in actually providing higher funding to schools in most need (Carmichael, 1997). Accordingly, there is

precedent in predicting that funding and social support for school garden programs is uneven as well.

Critical race theorists detail the historical antecedents to racial inequalities today and challenge the fallacy of meritocracy in the United States (Brown and Jackson, 2013; DeCuir and Dixson, 2004), which infiltrates into all public institutions. The U.S. Supreme Court ruled in Brown v. Board of Education (1954) that legal segregation of public institutions is unconstitutional based on the 14th amendment, but CRT highlights that this decision did not do much to change the economic and demographic persistence of segregation, nor stop the school-to-prison pipeline (Brown and Jackson, 2013; Howard, 2008). Nor did it augment public school choice to be expansive enough to integrate or sufficiently fund schools in segregated neighborhoods where choice has been restricted by predominantly white, upper-class suburbanites (Ryan and Heise, 2002). Critical race theory (CRT) started in response to critical legal studies, which failed to investigate the non-neutrality of policies that were racially discriminatory in effect (as opposed to in *intent)*. Past and pending lawsuits document that schools serving racially minoritized students have larger classes, fewer teachers, fewer and lower quality academic courses, fewer extracurricular activities, and fewer school materials and services (Darling-Hammond, 2004), which is likely to be directly translatable to the resources available for gardens at these schools, when present. At its core, CRT holds important counter storytelling to explicate the complex functioning of racism: the permanence of racism, Whiteness as property, and interest convergence (Crenshaw, 1988; DeCuir and Dixson, 2004). These tenets have been used to address educational inequality for over two decades (Ladson-Billings, 1998), and can be used to challenge which questions are chosen or omitted from research (Brown and Jackson, 2013); importantly, this is the first

known study to document racial inequalities in school gardens, an omission from hundreds of studies on the topic.

Social determinants of health is a framework that describes how social circumstances such as neighborhood, education quality, food and health practices, and employment opportunities determine health outcomes (Link and Phelan, 1995). In this framework, the problem with changing behavior, or proximate causes, to change health outcomes is that it may be ineffective without an understanding of the context and processes that lead to the poor outcome (Link and Phelan, 1995). Link and Phelan (1995) claim the social causes of inequality are access to economic, material, and social resources that either produce or mitigate health disparities. The social determinants framework can be applied to school gardens if we understand that social conditions like school culture, funding, and ties with community and parent support will affect outcomes of a gardening program. Evidence that neighborhood and community conditions influence school and program functioning abounds (Brooks, 2006). Income, education level, occupation, and other predictors of wealth and position (Barr, 2014; Moudon et al., 2011) can predict exposure to inadequate school facilities, environmental toxins, and lack of affordable basic needs such as food and housing (Mohai et al., 2009; Williams et al., 2010). Indeed, well-resourced school gardens in structurally disadvantaged neighborhoods may mitigate some of these inequities through changing certain behaviors (Evans et al., 2012; Somerset and Markwell, 2009). But the quality of a neighborhood may influence the visibility, perceived safety, administrative support, and therefore, may influence the general potential for use of the school garden space (Azuma et al. 2001).

Social context for school garden support

Social capital—the resources available from the presence of trust, reciprocity, safety, and cooperation in one's social network—can help in attainment of social and material support, especially connected to upward ties (Berkman et al., 2014; Corrigan, 2011). While government funding is a large part of a total school budget, much of funding and support for school gardening also comes from sources outside of tax revenue. White Supremacy and political economic inequality has allowed for maintenance of higher collective efficacy and social capital amongst whites and the upper class. In addition to better supporting a cohesive within-school network of parents, teachers, and staff, high social (and cultural) capital may manifest in a higher ability to obtain external resources that benefit a school garden (Ramírez, 2015; Williams, 2014).

Parents play an important role in the school social support network as students' key advocates (Epstein, 1995), as providers of the home and behavioral context that can reify lessons from the garden, and as potential garden volunteers (Ozer, 2007). In fact, in one Los Angeles study, one of the most common reasons for school garden closure was limited support from parents or volunteers, who many schools at least initially rely on for hands-on support (Azuma et al., 2001). Discrimination and bias are likely to affect students and parents of color, which reduces their likelihood of participation in school-centered activities (Comer and Haynes, 1991). Working parents sometimes have less time to participate in extracurricular activities, which would reduce their ability to form bonds and develop intergenerational closure and community at the school in support of a young person's growth (Freeman and Condron, 2011); they may also miss information flow in networks from which they are effectively prevented access (Berkman et al., 2014).

Enthusiastic support by the school community and administration (principals, vice principals) increases garden-related academic outcomes, particularly when integrated into a course curriculum (Blair, 2009; DeMarco et al., 1999; Graham et al., 2005). Factors limiting garden integration into instruction have included lack of time, funding, staff support, or curricular materials (Graham and Zidenberg-Cherr, 2005). Other limitations include teacher knowledge or expertise about gardening, with teachers and principals frequently reporting a desire for more training to run existing gardens (Azuma et al., 2001; Yu, 2012). Thus, successful implementation of a garden must involve the resources to ensure broad support from teachers, staff, parents, and the community (Ozer, 2007).

Methods and site description

This paper is part of a larger study on the racial, socioeconomic, and environmental disparities in Brooklyn school gardens. New York City has the largest and most diverse school population in the United States (1.1 million students). NYC also has the largest school gardening program in the country, including approximately 220 gardens in Brooklyn public schools. Brooklyn is a rapidly gentrifying borough with significant residential and school segregation (Anderson, 2012; DeSena, 2006). In this study, we look for the first time at racial and socioeconomic disparities in the funding of school gardens in a city in Brooklyn, NY middle and high schools.

Recruitment

The authors applied for and received research approval from the Offices of Human Subjects at the University of California, Santa Barbara and the New York City Department of

Education (DOE). After attaining principal approval, staff members who ran the garden programs at all public middle and high schools in Brooklyn were contacted via phone and email by the first author. The names of all 99 middle and high schools with potential active gardening programs were obtained from the Grow to Learn program within the Department of Parks and Recreation. The actual number of schools on the list indicating they had active gardening programs was 61 from 51 campuses. Schools are commonly collocated on one site, with one school primarily using the garden. The survey response rate was 24 of the 51 public schools/campuses serving middle and high school students in Brooklyn, NY (47%). Demographics characteristics of respondent and non-respondent schools are presented in Table 1.

Table 1. Demographics of Brooklyn middle and high schools with gardens, by survey response or nonresponse

	Respondents (n = 24 schools)			Non-respondents (n = 37 schools)		
Characteristics	**Mean (Std)**	**Min**	**Max**	**Mean (Std)**	**Min**	**Max**
Proportion Asian	0.09 (0.11)	0.00	0.45	0.03 (0.04)	0.00	0.23
Proportion Black	0.40 (0.31)	0.00	0.87	0.56 (0.30)	0.03	0.93
Proportion Hispanic	0.37 (0.25)	0.07	1.00	0.31 (0.26)	0.06	0.94
Proportion White	0.13 (0.14)	0.00	0.46	0.07 (0.12)	0.00	0.56
Proportion English Language Learners	0.15 (0.18)	0.02	0.86	0.11 (0.11)	0.00	0.42
Proportion in Poverty	0.79 (0.12)	0.53	1.00	0.79 (0.17)	0.16	1.00
Proportion Black + Hispanic	0.77 (0.23)	0.28	1.00	0.88 (0.16)	0.31	0.99

School garden descriptions and variation

Gardening programs varied in size and scope. The majority of programs were outdoor gardens, but some schools also housed farms (n=2), greenhouses (n=4), or hydroponic labs (n=6), exclusively or concurrently with an outdoor garden. Gardens ranged in age from 0-25 years; they grew an assorted mix of vegetables, native NYC crops, and flowers; and were used in a number of different courses (Table 2). There were other non-course uses for the

gardens, including counseling and afterschool programs. The final outputs for the garden produce included: class use, donation, sale, culinary arts program, feed zoology animals.

Table 2. Characteristics of School Gardens in Study, Split by Amount of Funding (n = 24)

	Low Funding (<$2,500 Budget) (n=12) (%)	High Funding (>$2,500 Budget) (n =12) (%)
School Curriculum Use		
Science	17%	50%
Agriculture/Horticulture	25%	8%
Art	0%	33%
Sustainability	0%	17%
Math	17%	8%
ELA	17%	17%
None	38%	13%
Funding and External Support		
School funding	67%	58%
External funding	33%	92%
Consistent non-profit support	33%	58%
Social Characteristics		
Above 2 adult workers	67%	67%
>15 students/week	42%	25%
Garden age > 5 years	67%	25%

Demographic information

Demographic information about students, including enrollment data, student race, gender, eligibility for free or reduced lunch, English language learning status, and other characteristics, were obtained from publicly available NYC DOE ("Data About Schools" n.d.). All schools in the sample were eligible for full Federal Title 1 funding, with free or reduced school lunch eligibility ranging from 53-100% ("Title I School Status Report:Title I, Part A:Accountability::NYSED," n.d., p. 1).

The majority of the adult survey respondents were from schools where teachers led the garden program (*n = 16*). In a few cases, a non-teaching garden or sustainability coordinator (*n = 4*), or other staff member (*n = 4*) completed the survey. In one case with a student

apprenticeship program, members of the external nonprofit and the student apprentices answered most survey questions, and their responses were averaged. One in three schools had a Black or Latinx adult support staff member.

Survey questions

Surveys were administered using Qualtrics, an online platform used by UCSB. In most cases, survey links were emailed to garden facilitators to be taken in their own time, but a few in person or phone surveys were conducted. In most cases, only one person responded per school, and the average response values were taken when multiple garden facilitators submitted a response from the same school.

We asked multiple-choice questions about resources, broadly defined, that the gardens had available during the past 1-2 years. We sought to understand how the structure and operation of school garden programs influence student social empowerment outcomes, based on our research questions, and survey constructs from other school garden research. Categories of the survey included financial/material support (grants and funding; materials donated/awarded), and social support (adult availability; parent/community engagement; structural support). A third section on soil management is not discussed in this paper.

We select a subset of the multiple-choice questions asked to capture how school inequality may affect student outcomes. Most questions were Likert scale from 1, “strongly disagree”, to 5, “strongly agree”. Other multiple-choice questions presented a linear range of possible responses (Table 3).

Survey validation

Survey questions were reviewed by three social science faculty members familiar with the nature of the project at University of California, Santa Barbara. Then, the survey was tested for clarity by a New York City garden facilitator in an outside borough.

Quantitative analysis

Analyses were performed in Matlab ® version 2015A. To test the relationship between school racial composition and the individual survey questions, which were split into the categories social and material support, we performed two sets of ANOVA.

Analyses presented use school racial composition as the independent variable, which we took as the proportion of white students at a school. This was split by the median (9%) into two groups of schools, with high and low proportions of white students, respectively. The dependent variables were the individual survey response questions about social and material support, all scaled to range from 0-5, to be combined into one additive index for each category, social or material support. As both social and material support categories contained 6 questions, the max value for each category was 30. The questions used in the analysis are presented in Table 3.

The Matlab code *anovan* was used to run ANOVA tests. The formula *boxplot* was used for visual presentation of the groupings, presenting means, 25^{th} and 75^{th} quartiles, extents, and outliers marked with red x's. The other set of analysis used school poverty level as the independent variable, which was based on the proportion of students eligible for free or reduced lunch, which was also split by the median into two groups of schools; since all

results for poverty level were insignificant, they are not discussed in the text. Likewise, because results of the ANOVA for the additive indexes—which combined individual survey questions based on groupings of either social or material support—were insignificant, they are not discussed.

Qualitative data collection and analysis

We randomly selected interviewees from the survey respondents, ensuring that we gathered a representative range of school demographic composition[1] (n = 13). In addition to standardized questions (Appendix Table A1), survey respondents were asked about the limitations and needs of their garden programs based on the items they deemed insufficient within the surveys. The interview purposes were twofold, 1) To elaborate upon supports needed or lacking within a subset of schools in different income areas, 2) To obtain the garden leaders' perspectives on empowerment among students in the garden.

To analyze qualitative data, interviews were split into four groups chosen to mirror the outcome variables we emphasized during quantitative analysis (material and social support). First, the schools were divided in two based on total garden budget (median: $500-$1,000). The two groups were further split into four by *social support* the gardens received. Social support was classified as either high or low based on a combination of: the number of adults working in the garden, affiliation with an external organization, and administrative support. Representative excerpts from the interviews are presented and elaborated upon as they relate to garden resources and limitations.

[1] Proportion Black and Hispanic: Mean, 66%; Standard Deviation, 28%; Range: 28-96%. Proportion in Poverty: Mean, 81%; Standard Deviation, 9%; Range, 69-97%.

Each interview took between 30-55 minutes. The first author conducted all interviews in person or on the phone.

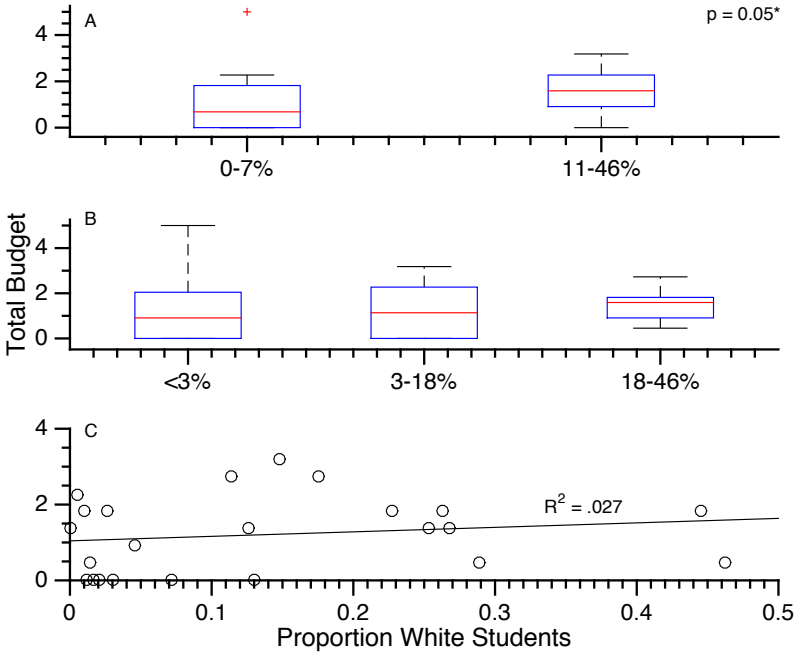
Results

Material support

Total garden budget was significantly higher at schools with percentages of white students above the median (9%), gradually increasing with the school proportion of white students (Figure 1). There were no significant differences observed for remaining questions on material support (Table 3). Both a low p-value and low R^2 indicate significant variation in the data, which could be reduced with more samples.

We observed no statistically significant relationships of material support based on proportion of students eligible for free and reduced lunch by school (n = 24 schools, not shown).

Figure 1. Bivariate associations between total garden budget, scaled to 5, and proportion of white students**,** by school [2]



Least squares regression line equation: y = 1.18 (1.55)x + 1.04 (0.30) + E

[2] With one high-funded outlier school omitted, as in Table 1. Total budget was scaled to 5 for comparison and inclusion in an additive index, but results of the index analysis were insignificant and are therefore are not shown. In this scheme, 0 is budget of $0, and 5 is the maximum budget reported, $60,000, the outlier value. The next highest value, scaled to 3.18, is $12,500.

Table 3. Garden Social and Material Support Questions; Adult Garden Leader Response by School Racial Composition (n=24)

Support category	Question	Question type	Mean response by % students racially minoritized, Mean (St.Dev.)	
			>90%	<90%
Social	First, calculate in your head the average ratio of students to adults in the garden at a given time. Please select the range within which your response falls below.	MC	3.89 (-0.85)	3.65 (-0.99)
	There are enough adults working in the garden to meet current needs.	Likert	3.40 (-1.1)	3.50 (-1.4)
	Parent involvement in the garden is enough to meet current needs.	Likert	1.86 (-0.85)	2.58 (-1.3)
	Public events are held at the garden frequently.	Likert	2.13 (0.96)	1.75 (0.96)
	The level of support from school administration enables gardeners to meet all current needs.	Likert	3.06 (-0.87)	3.75 (0.96)*
Material	What percent of teachers who work in the garden would you estimate have received financial compensation for this work (do not include regular salary for a teaching position)?	MC	0.83 (2.0)	1.29 (2.1)
	During the last academic year what was your annual total school garden budget (materials and support staff salary/stipend)?	MC	0.79 (0.89)%	1.59 (0.98)
	During the past year, how much external funding did the garden receive for garden materials and supplies (tools, soil, planters, etc)?	MC	1.83 (2.1)	1.92 (1.9)
	Has the school provided funds for garden supplies, materials, workshops, or trainings?	Y/N	2.50 (2.6)	2.92 (2.6)
Both	Are there any paid staff that manage the garden or teach in the garden outside of classroom teachers? Select yes if there are any (school or non-school) support staff that receive any types of funds for garden programming.	Y/N	1.25 (2.3)	1.67 (2.5)

- * p <0.1.
- % high-funded school farm ($60,000) outlier removed [3]

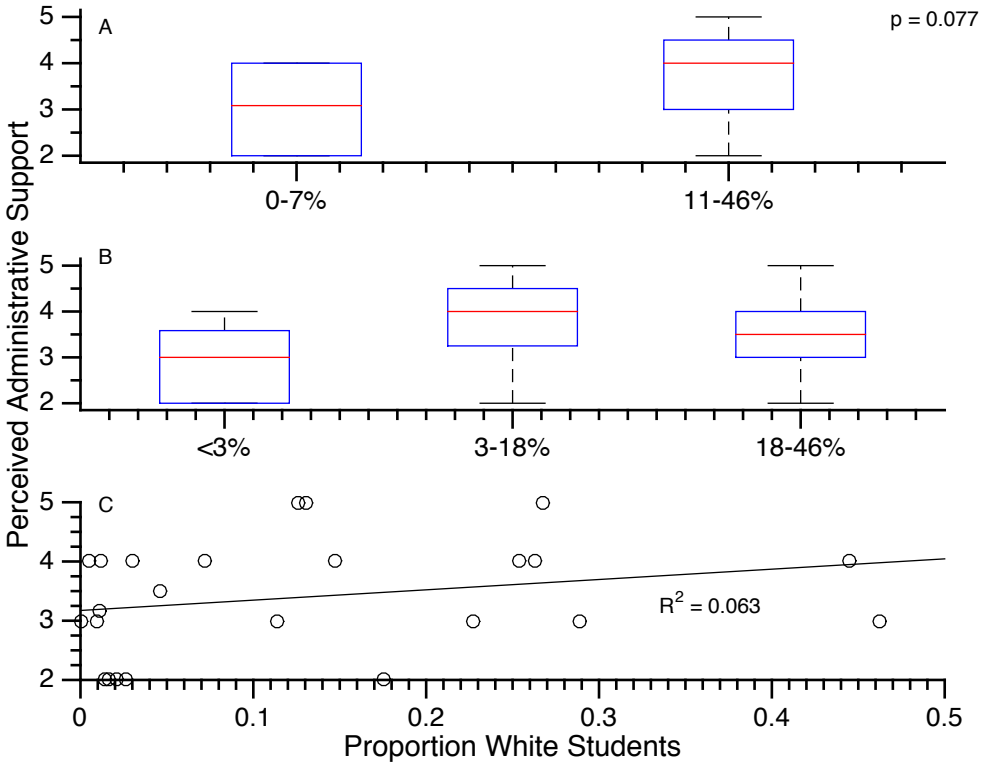
Social Support

Perceived support from school administrators (principal, vice principals[4]) is higher in schools with more white students (n = 24 schools, n = 31 facilitators) (Figure 2), while analyses of the other social support questions generated no significant results.

[3] Likert scale questions ranged from 1-5. Other multiple choice questions including amount of funding, percentage of teachers funded, and presence or absence were all scaled to 5 (presence 5, absence 0) for comparison and inclusion in an additive index that is not discussed.

Similar to the material support category, our statistically insignificant results suggest that social support for the garden is not related to the percentage of students eligible for or reduced lunch in this sample (n = 24 schools, not shown).

Figure 2. Bivariate associations between perceived administrative support and proportion of white students, by school (*n = 24*)

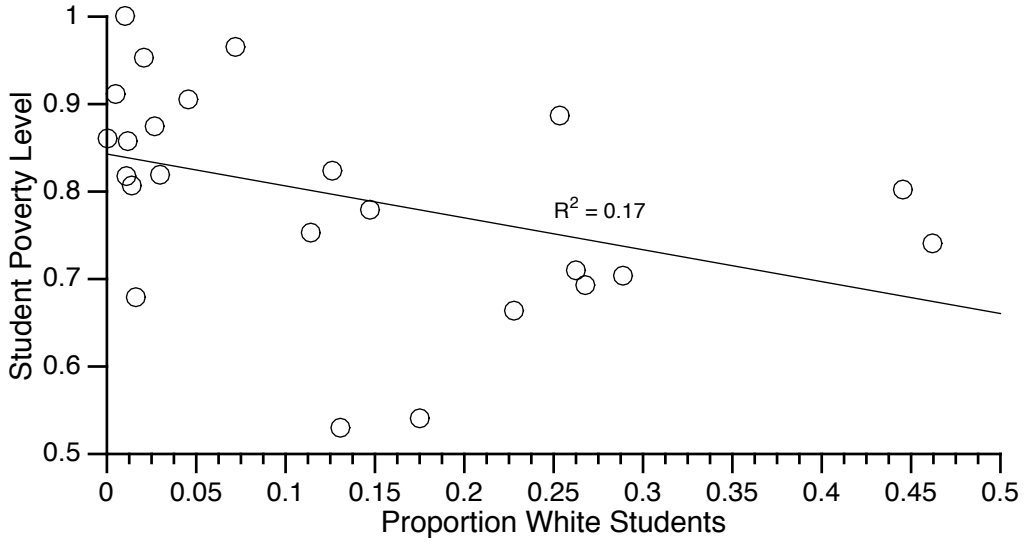


Least squares regression line equation: y = 1.74 (1.43)x + 3.17(0.27) + E

We did not observe funding or social support differences when comparing school level student poverty (eligibility for free or reduced lunch), but student race and student poverty are correlated (Figure 3).

[4] We asked about administration in reference to the principal and vice principal and did not ask about or distinguish between school- and district-level administrations.

Figure 3. Linear regression between student poverty level and proportion of white students, by school (*n = 24*)[5]



Least squares regression line equation: y = -.36 (0.17)x + 0.84 (0.03) + E

Additional analyses

We ran additional analyses to understand relationships between survey question responses (Table 4). Total budget is associated with the ability to pay teachers for their work; there is some evidence that external sources may have been a more important funding source than schools (Tables 2,4).

[5] FRL is free or reduced lunch eligibility, n = 24 schools. Data from the NYC Department of education on student race.

Table 4. One-way ANOVA between survey question responses, by school

Input	*ANOVA Results*			
Variables in Analysis	P-value	# Groups	Total D.F.	F
Total Budget: Percentage of Teachers Compensated for Garden Work (n =23)	0.039	4	22	3.41
Perceived Support From School Administration: Frequency of Public Events (n=24)	0.057	6	23	2.66
Comparison:				
Total Budget: External funding (n = 23)	0.17	6	22	1.77
Total Budget: School funding (n=23)	0.92	2	22	0.01

ø = not significantly different but included because of comparative benefit between the effects of school and external funding on budget differences.

The overall highest rated needs were funding, administrative support, technical assistance, professional development, and a garden coordinator staff position (Appendix Table A2). We also explored plausible mechanisms for low administrative support (Appendix Table A2), and while sample sizes are small, we learn: schools with more administrative support tend to be better funded, though they are just as likely to want more funding. Three of 12 schools with relatively higher administrative support use the garden in horticulture class (3 of 12), which denotes a level of leader expertise; further, unlike core subjects math, science or English language arts, it does not require an annual, standardized statewide exam required for graduation. Administrators tend to worry about gardens in courses with state test requirements (O'Callaghan, 2005); administrative concerns can structure the educational outcomes and potentials of the garden, as shown below.

Qualitative data

In the survey data, we observed that total budget and administrative support were different in groups of schools by racial composition.[6] To mirror quantitative analysis and focus, we split interview analyses by material and social support. Interview questions are presented in the appendix (Table A1). We observe that time, space, administrative support, visibility, and/or community engagement affect gardens in different ways.

Group 1: Low funding, low social support schools

Most of the gardens in this study fell into this group of low funding and low social support. They were in a mode of [re]building and sustaining—often starting anew, following a loss of funding, or a loss of staff with community ties. The leaders were often strained for time, with one teacher working on the garden in their free time, during lunch, or during class. They tended to have low public visibility - sometimes their location was hidden from the school and neighborhood communities (e.g. inner school courtyards).

A second-year teacher at a school with 96% Black and Latinx students (2% white students) discusses the unsustainability of relying on low- or no-pay workers, or relying on external programs that weren't built into the school's planning more holistically.

> Pete[7]: I guess that [the biggest] problem was that [the nonprofit] running it last year here was a total grassroots organization. So like totally built from the bottom up. [They] subcontract with the school and they couldn't afford to hire too many full time employees so there was only one guy that really came and worked with the farm…. I

[6] However, in all of these schools, the proportion of students of color is high, ranging from 54-100%.
[7] Names are changed. M is the first author.

may have seen like two volunteers ever there over the course of last year, so it wasn't like a lot; it depended a lot on [volunteers participating]. But they had to get a whole new employee last year right, so like somebody else was working on the farm and then they quit and then they had to hire someone who had no connections to the community and lost all those connections again and started all over. In previous years I think there was a food justice program here, but again it was like totally voluntary. I was told there was [an] alumni that was running it and when the alumni stopped coming they stopped doing it –and I was a first year teacher and similar to this year as a second year teacher I don't have any time to do like afterschool programs. I'm overwhelmed enough as it is with creating the basic lesson plans I have to do. So there was like nobody to really run the events because there was no money.

M: Ok. Yeah, so you're thinking if there were more people there would be more events and so how do you think there could be more people. [What] do you think is a good way to go forward in securing--

Pete: --Well paying them! I don't think that you can—you just can't depend on like a volunteer program as being like this sustainable program because it just wasn't. You need to have paid full-time employees getting enough money so that they can afford to live and [take] care of the farm.

At another point he mentions that when ties with the nonprofit, which had an indigenous Ecuadorean garden instructor, were cut through lack of funding, an important link to students who shared this cultural background was upended. He related that a more sustainable

mechanism for school funding relied on the school building the garden into its overall planning.

> Pete: [I think] that for anything in these schools to be long lasting--I really don't know… I think that it can't be reliant on grants that will run out eventually. Like if there's funding for the farm it should be built into the school's budget. It should be part of the school the same way as [the] cafeteria or the pool, you know or whatever it is because as you can see now the farm is like totally overgrown, not taken care of. No one is particularly motivated to do anything about it right now nor has the time to do anything about it.

At a different school in support group one (46% white students), a facilitator of a garden counseling program and occasional biology lessons highlights a positive feedback loop, wherein low social support leads to low funding, which exacerbates low social support.

> Tiffany: I think low funding creates all the other issues because if you had funding and you had, you know, more supplies, people would be more interested, I think. And, you know, you could get more involvement and stuff.

Conversation with Tiffany highlighted this school's missed opportunity to discuss topics of inequality in a meaningful way, where the teacher seemingly discounts students' observations of class inequality.

Tiffany: I kinda feel like…no matter what [the kids] would always come up with reasons to tell you things are not fair and equal. Like, they just always try and find the reason why, like, well, you know, rich people could get better vegetables, or you know, the rich people would have better soil. Like I feel the kids are always finding that reason why there's not equality, even if it is - even if you say like, you know, a bag of beans costs a dollar, so everybody could buy a bag of beans for a dollar. They'd say no, their bag of beans is better than mine…Our kids are always like that with school lunch. Everything is always like, well, other people get better food than we do. And it's just always - always what we don't have.

M: And are there ways that you can or anyone has been able to talk about this as it relates to broader [inequalities that you] see in the food system?

Tiffany: Um, I have not. Like I just basically tell them, you know, everybody has the same beans but um, I could try that.

This program without a justice component to the curricula, with low funding, low social resources, and no external partnerships, failed to go deeper into issues of class, race, or oppression, and may in fact perpetuate harmful normative constructs at the expense of more critical thinking. Most gardens with low social and financial support were tied to science classes, but none of the schools in support group one emphasized food or racial justice or societal inequality—topics that in other programs in this study have thoroughly engaged the students.

Group 2: Moderate to high funding, low social support

The ethos of gardens with moderate to high funding and low social support varied dependent on the mission. At a school with 92% Black and Latinx students (1% white students), even a program with nonprofit support found its staff seeking ways to expand their impact both inside and out of the school.

> Jordan: I guess I could say we could have more support from the school or from like teachers. We have our relationships that we've developed in the school but not everybody really cares that we're here…if that makes sense.
>
> M: So what are the consequences you think of [low] school and administration support and also low community involvement?
>
> Jordan: **[**I think] for us an impact is sort of just about our mission which is [to benefit] the community that we're in by providing fresh, local, organically grown produce. [With people] not knowing that we're here, they're not getting to [eat] the fresh food that we grow [or, benefit from] this space being here as a green space, [or] as a place that grows food…. [We haven't] received [specific grants] that we've applied for; possibly because of that lack of support from different community organizations who are [giving out] small grants and things like that, [even though] we feel we have really strong applications. [Also] we are a very small, [three] person, part-time organization, so you know because of how limited we are in funds and time ourselves we're sort of like always looking for [partnerships] and relationships with folks that would benefit from being able to use the space for whatever they are doing themselves, if that makes sense.

This nonprofit lacked sufficient community ties in this predominantly Black and Latinx neighborhood, such that even with a budget and staff, they were not able to fully meet their desired impact, despite providing services and education to the school community.

At another school, a teacher expressed that the neighborhood demographics and the limited opportunities for parent engagement prevented outreach.

Another garden leader at a school with moderate funding and low social support (3% white students) wished for more basic help, for the sake of the plants. He expressed that adult involvement had waned in his three years working there, that the socio-economic makeup of the community prevented parents from getting involved, and that his efforts to engage parents would be more or less futile. He elaborated on this point:

> Emanuel: And also I personally believe that most of our students that we serve, when you look at the socio-economic backgrounds, they're coming from pretty tough communities, and I believe the parents at this point are dealing with a lot of … difficulties whether they're financial or other very social difficulties. [And] therefore I believe they just didn't have the time to get involved with these kind of things and they… weren't aware of any of these efforts, I would say.

We continued on about the effects of low social support.

> M: And what are the effects and having a low number of adults working in the garden?
>
> Emanuel: Well, definitely the very first thing is the plants themselves. The quality of the products [and] health of the plants get affected because…if you don't have

enough workforce for it, it just falls onto like certain students or certain individuals and it's a lot of work. [And also] as far as the, you know, school community, the school culture goes, I believe that's been also affected …I believe it affects the school community like very neutral. It's not negative. They're just not benefiting from this. If [teachers] were to put a little bit more time we can positively be benefiting from this… They can incorporate it into their lessons as well.

M: I see. So you're saying that the effect of the garden currently is neutral, but has a potential to be positive with more adult support?

Emanuel: Absolutely.

These gardens are stifled from expanding outward when social support is low and the basic needs of sustaining a garden are not met. Despite a somewhat bleak view on potential community engagement, this garden *is* instrumental in preventing the school-to-prison pipeline; it operates within a transitional school for students who did not do well in traditional institutions. This extracurricular activity, according to the teacher, enables most of the participants to experience moments of relaxation within otherwise stressful neighborhoods.

Group 3: Low funding, moderate to high social support

The ethos of school gardens with moderate social support and low funding seemed to be inspired and ambitious, but also stifled. They were able to bring in nonprofits that educated students about sustainability and food justice; and there seemed to be excitement surrounding

the projects. Teachers in these schools had more time to delve into issues that were socially important.

A teacher with a fairly new garden and no school budget expressed that her class engages with the community by conducting surveys on sustainability, and by holding constructive meetings with cafeteria staff to reduce food waste (25% white students). At this school, a nonprofit group came in at the beginning to help instill direction within the program.

She has encouraged students to go outside of their comfort zones and employ leadership skills in construction, planting, art, and outreach.

> Christine: I've definitely seen other students as they take a more active role in these projects, you know, especially, I have one student one [Black] female student [who] is currently working on helping the group create the patio and at first she was working with the other group kind of painting the picnic table, but I think she really became intrigued with wanting to learn how to use certain tools and just do something that, you know, may be looked at as more of a, you know, traditionally [masculine] kind of thing. And she has really started to kind of take ownership of that project and kind of lead in a quiet way… And I think the class… has expanded the idea of, you know, any anyone can participate and get involved…. I think last trimester, and last year when we were working with reducing food waste, we definitely talked about… food scarcity, food deserts and food access, and students definitely became interested in the idea of, well, how do we get the food that that we want in either our communities, or more specifically our school cafeteria?

She states that specifically *long-term* funding enables *planning* for seasonal changes inherent in gardening:

> Christine: Well, I mean I think [funding] would just afford us the opportunity to really plan better for, you know, seasonal crops and [rotations]. Certainly once we have soil and compost, [having] students plan for what they want to grow would be great. [We lack] resources in terms of money; not knowing, [once this] grant runs out [where] I'm going to secure more money, is definitely a concern. You know, a lot of the tools can be used over and over but certainly plants, soil, compost, you know, seeds, those are all things that you need to purchase every single year.

At a different school, a teacher expressed that even though the school community and administration support the garden, low funding and time led to a lower ability to engage the students. These schools described varying relationships with administrators, who often gave free reign to develop projects without investing much material support into them.

Group 4: Moderate to high funding, high social support

By contrast, at a different school (15% white students), the presence of a paid sustainability coordinator allowed the garden to obtain even more help from teachers and to build connections within the community. At this school, a coordinator was paid to work in the garden because an oil spill occurred decades earlier, and the neighborhood banded together for funding from the offending company for community redevelopment. The

funding, however, came with some limitations in the focus of the curricula due to the nonprofit organization it was given to.

> Angela: We haven't talked about… food access, you know, who has access to quote real food, and we haven't talked about affordability in terms of food… And while we haven't addressed it at the school that I'm in we addressed it in the other school in Washington Heights. Access was a big part of what we talked about and equity was a big part of what we talked about. I brought in a farm worker organizer to talk to the kids. And they did a whole study on labor and the economics of food and issues of equity and they even went to different neighborhoods to compare the quality of the food network within the neighborhood. This program has not - has a [narrower] focus… when we talk about, you know, access and equity and that type of stuff. Remember [**redacted non profit name**] is basically focused on the environment and they put you know a real lens on it and requested that we beam in on that. They have aspirations to branch off into the other pillars of sustainability, but they have not yet.

Schools reliant on teachers or unpaid workers do not have the same amount of time to build connections. However, this *paid* coordinator describes her strategy for teacher engagement below.

> Angela: Basically, I look for the low hanging fruit who [are] real interested in gardening and they identify themselves fairly quickly…. it's through them that they encourage other teachers to come but I also will make a point of taking pictures during our volunteer day and posting them so that other teachers see as well. You know what's going on and say 'wow, oh okay'. There are harvest days and I usually

will come in and distribute the produce- take it from the classrooms and ask the teachers if they want it…. I encourage them to volunteer, you know? So, it's a process…. We do have, you know, five or six teachers who [have] come out and who will probably come out in the future and [that] number may grow, particularly once we get the [shade] structure out there, but they've been enjoying the bounty from the garden.

With time, the coordinator has attained teacher and even parent involvement, but structural limitations prevent the expansion of community access:

Angela: We toyed with the idea of it becoming a community garden, but there were some concerns about hours of access and people just coming in off the street into a school, you know what I mean? So that's still on the table. We just have to figure out the best ways to do it. And that may look like [open] volunteer days in the garden for the community [or] it may look like a membership in the garden. Right now, people who are part of the solar composting project will have access to the garden. And we have probably about 15 members, some of whom are teachers at the school and some of whom are staff from our co-located schools. But most of the membership [is] parents from our schools. So yeah [more] community involvement and community engagement would be a lovely thing.

Another school with moderate funding and social support echoed administrative and structural limitations to community engagement. The two coordinators there (one teacher,

one nonprofit leader) helped engage the school community through a culinary arts program (13% white students).

M: How do you think public engagement might benefit the garden?

George: It would benefit because of just, you know, more volunteers. I'm just not 100% sure if the principal would give approval on us [allowing] neighborhood residents on school property because the garden is located inside of the school fence.

M: I see. Are there other types of public engagement, then, that you would want to see?

George: Well, like I said, possibly with the residents directly across the street but that would need to be approved by the principal.

Tanya: We could even eventually, if it grew enough, do a farm stand where they could actually sell the produce to sustain the garden, to the community.

Many schools seemed limited by administrative regulations about public engagement.

A facilitator at a different program with high social and financial support spoke of being able to address issues of inequality in police violence with groups of garden apprentices. A lot of the students were engaged, saying this was their first time to have such conversations in a facilitated setting, and so the garden made these types of discussions regular.

Discussion

Funding

Higher funding for garden programs at schools with more white students has not been found in other studies to our knowledge. From our qualitative data, it seems that this is related to the same educational barriers faced in underserved schools generally: low school funding, limited teacher time, and limited pay. However, garden budgets here were more strongly associated with external than school funding, which underscores their reliance on resources outside of the school (Table 4). Limited foundational support in the gardens means limited resources to apply for and attain other funding, meaning some amount of initial help at the school level will likely go a long way (Norwood, 2016). Community gardens exhibit parallels: one NYC study showed that Hispanic/Latinx community gardens were supported by organizations who supply grants, purchase land, and provide assistance, but that most help goes to the well-organized gardens with charismatic leaders able to shrewdly communicate with funding organizations (Saldivar-Tanaka and Krasny, 2004). In Chicago, Black community gardeners struggled for even small amounts of corporate funding and heavily relied on the community for resources and information (Williams 2010).

Interviewees described that the consistency of funding is also important for school gardens, but this too was often inadequate; lack of consistent funding in this study was related to stifled and opportunistic decision-making within the garden. Unpredictable garden funding limits the ability to plan for the future, and consequently limits the visioning and impact of the space (Blair, 2009).

Administrative support

Published research comparing social support for school gardens by student race/ethnicity does not exist to our knowledge. Lower administrative support for gardens in schools with more racially minoritized students is significant because of how principal's regulations and enforcement shaped the garden. Public events were more frequent with more administrative support, and many garden facilitators suggested that with more publicity, the school community would more likely appreciate the benefits of the garden - the career potentials, community impact, and health benefits associated with these projects (Blair, 2009).

In other studies, principals have worried about incorporating gardens in schools for already "at-risk" students, knowing that standardized test scores must improve for school funding (O'Callaghan, 2005). Their apprehension may relate to a desire to focus on students "catching up" academically. Principals considering gardens have also been concerned about work overload, low funding, low staff support, and low experience (Graham et al., 2005; Graham and Zidenberg-Cherr, 2005; Yu, 2012). In a few interviews, the requirement of principal permission caused some garden facilitators to completely discount the idea of opening the garden to the public.

Further, our study suggests that the deepest and broadest impacts of school gardens occurs when the program is sustainably integrated into coursework or extracurricular programming, requiring multiple layers of approval between garden facilitators and administration. Teacher wage and work load are important factors in developing trusting relationships with school administration (Norwood, 2016), which may explain why the lower administrative support group of gardens felt this way; they had a lower median budget and were more likely to have $0 budget (Appendix Table A3).

General discussion

Overall schools had many constraints in expanding the scope of their work. Some of the most ambitious and creative approaches engaged students in nontraditional ways, using discussion of social and racial equality, or environmental sustainability, which were meaningful topics for many students. Often, this type of programming was not in schools with the highest proportions of racially minoritized students. Some schools missed the mark in expanding on issues of race or class due to organizational constraints or political standpoints; others simply did not have the time or money to expand on their progressive visions for education and food provision.

Even with high funding and administrative support, there may still be barriers of time, vision, or social capital, which make it so a garden program does not live up to its educational or empowerment potential, and this depends on the mission of the program – but societal inequities operating within the school cannot be meaningfully rectified or addressed in school gardens without the resources, permissions, and momentum.

Limitations, conclusions, and further research

The study is limited in a few key ways: there may have been selection bias in who responded to the survey. The low response rate was likely due to conducting outreach at the end of the school year. Demographics of the schools with gardens did not differ significantly between schools with and without a survey response, so we believe the sample obtained in this study to be representative for student demographics in Brooklyn school gardens (Table 1). Due to extensive notes, calls, and school visits, we know schools without survey responses also vary in scope (different courses, funding amounts, stages of development). But it is possible that non-respondents may differ from those who did respond in certain

ways: respondents may have had more time or flexibility at the end of the year, or more helpful personalities; they may have resonated more with the stated goals of the study; they may have had more freedom within their schools to participate.

Also, many wealthy, white Brooklyn residents have already segregated their children into private schools, perhaps minimizing the difference in school racial composition we observed (DeSena, 2006). Future studies would benefit from studying an even more racially/ethnically heterogeneous population, comparing schools in different boroughs and potentially including private schools. Interview and survey responses may have been skewed to be more socially acceptable. Relatedly, the interviewer is a Black, female academic from California, who asked questions to probe racial inequality in an indirect way so as to avoid alienation and subsequent non-response of garden leaders, who were predominantly white. There is the potential of insider-outsider bias, though many interviewees were also from out of state, and in some cases said they viewed the interviewer as a beneficial advocate for the gardens.

In addition to what we address in the limitations section, there is need for deeper understanding of administrative support in school gardens (Blair, 2009), including whether garden outcomes vary based on principals' relationships with garden facilitators, parents, and community, and the effects of school academics on administrative support. Though parent involvement is beneficial for student engagement, particularly for racially minoritized young people, we hypothesize that there may be barriers to involvement for these parents (Figure A1), and recommend research on reducing these barriers in school gardens (Townsend et al., 2014),. Perceived parent involvement was overwhelmingly low across schools, as well as engagement of the school and neighborhood communities. School racial composition,

sustainable funding, curriculum, workload, and structural ways to increase school and community connections, should be considered in planning and funding school gardens.

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Chapter 1 Appendix

Table A1. In-depth interview questions

1. Specifically, why did you deem this (e.g. funding, materials, parental involvement) low? How can this item be better allocated to your school? And, what are the effects of having this in low amounts?
2. Synthesize, generally –
    a. How do you think that these resources could be better allocated to your school?
    b. Who would need to do it?
    c. Why are the resources low?
3. Can you describe the aims of your school garden's curriculum?
4. Does the garden program curriculum include discussion of the food system?
5. Does your project incorporate environmental sustainability education?
6. Do students seem to grasp the role of the garden in their contribution to the food system? How do you know?
7. To what extent, if any, do you feel this gardening project helps students expand notions of fairness and equality necessary in the real world?
8. Can you describe the social dynamics of students within the garden?
9. How do students connect with each other in the garden?
10. How do students connect with adults, if at all?
11. Do they seem to gain confidence or skills from the garden? Which skills? How can you tell?
12. Do they seem to particularly enjoy the time spent in the garden? Why or why not?

Table A2. School characteristics, split by median perceived administrative support

Questions	Responses by perceived administrative support, by school	
	Below median support (n = 12)	Above median support (n = 12)
Total Garden Budget (Median)	$1,262.50	$3,750
$0 budget	6	4
% Students Who Have Used Garden--range//median	1-80//10	1-50//15.5
# Students Using Per Week--range//median	1-75+//10.5	6-75+//10.5
Regularly Involved External Organization?	5	5
Courses	Math, ELA, Science, Social Studies, No course, Agriculture/Health and Wellness, Visual Arts, Sustainability	Other, No Content, ELA, Science, ELA, Health, Horticulture(x3)
State Regents Exam for Garden Class	6	4
Adult Experience, mean (std)[L]	2.43(1.01)	2.75(1.06)
≥1 Black or Brown facilitator	2	4
Gender of ≥1 garden facilitator same as principal	7	9
Race/ethnicity of ≥1 garden facilitator same as principal	8	7
Garden facilitator years of involvement- range/median	1-16//6	1-8+//3.5
Avg. number of adult workers// volunteers per week –range/median	1-15+//2	1-10//2
Enough workshops and trainings for facilitators? mean(std) [L]	3.32(.96)	2.92(.90)
Parent Involvement Enough mean(std)[L]	2.21(.99)	2.17(1.0)
What 3 elements would most benefit your school garden (per school)?	11 of 12 schools	12 of 12 schools
Technical assistance	3	4
Funding	6	7
Garden coordinator staff position	3	4
Professional development	3	3
Administration support	4	3
Time scheduled in the school day	3	3
Community volunteers	3	1
Parent volunteers	3	3
Other, Paid marketing/outreach coordinator	1	0

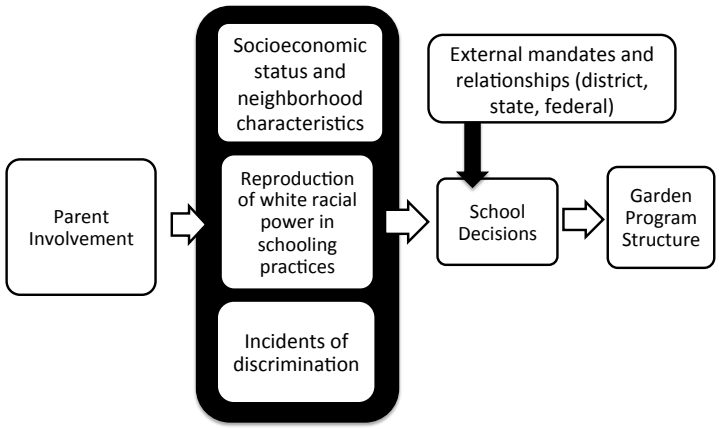
[L] Likert scale question

Table A3. Summary of comments on administrative support

ID#	Admin support	Summary of comments on admin support	Non-profit	Use
1	Low	Optional to use; principal facing pressures academically but should pay a nonprofit to coordinate regularly and/or make the farm part of elective science class	No, used to be	Science
2	Low	No specific stated complaints about admin but did mention that parent involvement could be higher but just starting up; parents seem to undervalue garden	No	Alternative-life skills
3	Low	Working as external organization; Funding could be higher to hire more people because a lot of students work here and not just from this school; have some admin support and teacher support could be higher to make garden a bigger deal because not everybody cares; need general support because people don't' quite realize all the work going into agriculture	Yes	Agriculture and health, art
4	Low	Culture of school supports other things; low visibility or hype of garden; causes low morale and low gardening success which is cyclical issue of lower visibility and cultural support	No	Therapy/counseling
5	High	Currently developing; Low funds mean use of limited tools in disrepair brought by garden facilitator; engagement of parents needed ; could coordinate with admin for organization of more science nights to engage parents (And parent volunteers); one teacher and one class; students doing a lot of work here	No	Horticulture
6	High	High support for the external org integrated into school and community, including local government; desired more parental involvement	Yes	Science, ELA
7	High	Strong admin support but need more funding; also would like time to be out there more often during the day; no state testing for these alternative assessment special education students who use the garden	No	Horticulture *(continued next page)*
8	High	Admin support is there; he as teacher works on garden and has seen lower adult support over the years; as charter school students aren't on exams – he finds time to attend workshops and trainings to receive needed tools; could use more help with parent outreach but doesn't seem super interested /hopeful about getting more parent support; didn't ask for funding	No	Alternative; transfer hs
9	High	Still in development and needs to take more root in school culture to engage more adults because she's done groundwork herself with partner; knowledge of the utility and viability would make it better to fully integrate into curriculum	No	Arts and sustainability
10	High	Low resources and time could be better handled by garden coordinator position; they've yet to appeal to principal for such	No	STEAM initiative

11	High	Use for pilot program, garden is new; support high for external org who has come in for this pilot program and culinary program, though funding could be increased	Yes	Pilot program for bigger garden; culinary arts
12	High	Heavily involved teacher who rates admin support high but in talking finds issues with culture surrounding garden, especially in acknowledgement of work involved; doesn't seem to have asked for much; the size of the undertaking and day to day work of garden maintenance is not acknowledged. Teacher engagement low after repeated asking, community engagement low; mentions garden knowledge not a part of state curriculum	No	Science

Figure A1. Possible barriers to racially minoritized parent involvement in gardens



II. Chapter 2: How do race and gender matter in the school garden? Unequal empowerment of students in Brooklyn middle and high school programs

Keywords: school garden, empowerment, survey, Brooklyn, social determinants, critical race theory, intersectionality, political economy, school engagement

Abstract

School gardens can genuinely engage and affirm students' identities, but little research has probed how this varies by gender or race. We analyze dimensions of student empowerment in the garden, guided by critical race theory and social determinants of health, to highlight the importance of political context and social constructs in shaping individual outcomes within middle and high schools in NY. Scores from a Supportive Environment Index (SEI)—created using NYC School Survey Data questions about intergenerational care, cultural affirmation, inclusion, engagement, and safety—decreased with the school proportion of Black, Latinx, and low-income students. Female students reported higher peer reciprocity, peer trust, identity affirmation and meaningful participation, while white students rated higher identity affirmation and peer reciprocity than students of all other racial/ethnic backgrounds (n = 122). White male students rated highest identity affirmation. These results suggest that there are unequal outcomes for students of color, and particularly males of color, in school gardens, which replicates inequalities generally found in school and societal contexts.

Introduction

> *"We are always practicing something. Without intention we are usually practicing what the dominant society wants us to practice – competing with each other to be cogs in a system that benefits the owning class, vaguely religious, vaguely patriotic. The invitation here is to 'transform yourself to transform the world' inside your collective or group work." – Adrienne Maree Brown, Emergent Strategy*

Brown's quote builds on scholarship in intentionality, a facilitating practice in fields ranging from outdoor education, to physics, to school counseling, to social justice practice (Bernhard, 2007; Brown, 2017; Singh et al., 2010; Thomas, 2008); included here because it is a reminder that despite the stated goals of a program or teaching methodology, without intentionality—or deliberate planning and action to achieve certain, explicit outcomes—a school garden can and likely will replicate race, class, and gender-based oppressions occurring within the school and societal contexts. This paper aims to uncover whether and how school gardens in Brooklyn provide ground to reverse unequal engagement and affirmation of students of color in public schools in the United States.

School gardens can promote personal empowerment that differs by student, which may depend on the goals of the garden program; the relationships between students, adults, and the broader community; the school and community's social and material resources; and the multiplicative effects of white supremacy and subordination on these sets of factors. In public schools, gardening programs tend to focus on furthering an aspect of traditional curriculum in math, English, or the sciences, but in some cases the garden is associated with

a unique elective class, an afterschool program, or even a student apprenticeship (Ray et al., 2016). These projects can vary in scope such that a single teacher facilitates the garden space with a class, volunteers come to help, or paid coordinators with external programs come in to mentor students. There is clearly significant variation in the possible impacts on the students, which is partially based on program capacity. In culturally diverse cities, schools with gardens host students of multiple racial backgrounds, who learn and interact with adult leaders and peers while collectively tending to plants for the benefit of themselves and their communities; this type of project is therefore fueled by the resources that the school program has available to accomplish their goals, and by the nature of relationships within (Cutter-Mackenzie, 2009).

Students are differentially empowered and disempowered in schools based on a number of factors, including identity markers that are socially-constructed, such as race[8], class, and gender. Empowerment includes tools that enable one to navigate in the world, such as confidence, engagement, critical thinking, intergenerational work, cooperation, and affirmation (Delpit, 2006; Townsend et al., 2014; Wong et al., 2010; Zimmerman, 1990). Engaging and affirming students is critical to their academic success but also their development as members of society, which makes the study of genuine connections in the school garden useful in understanding how the space may differentially affect students (Cooper, 2014; Nelson Laird et al., 2007). Social capital, the transferrable benefits accrued from social relationships, is frequently discussed in the study of collective gardening because the space provides relationships where trust, reciprocity, safety, mental health, and

[8] Race is a social construct based in the history of European exploration (Barr, 2010); due to the use of racial difference in the subjugation and disenfranchisement of people throughout history, it is a useful analytical category today in determining the populations of people in need of distributive equity at institutional levels (Rawls, 1958).

collective efficacy are built (Groenewegen et al., 2006; Saldivar-Tanaka and Krasny, 2004). In addition to social capital, cultural respect, experientially relevant pedagogy, genuine connections, and care are important in bridging gaps students of color face in education, particularly in urban areas, as discussed more below (Cooper, 2014; Ladson-Billings, 1995).

To understand how racial inequality is manifest at the scale of an individual person, we must look at the broader social, political, and economic contexts. In this paper we draw from critical race theory and scholarship on the social determinants of health, which enable observation of the racial and socioeconomic determinants of unequal outcomes, and how they may come to pass in the school garden.

Though there is not one monolithic critical race theory, in a compilation of key writings it was noted that these theorists are driven by understanding how a "regime of white supremacy and its subordination of people of color have been created and maintained in America" (Crenshaw et al., 1995), in part to unbind law and racial power (Ladson-Billings, 1998). In education, critical race theory can be used to assess the reasons behind and effects of: a traditional *curriculum* that glorifies certain aspects of European history, positing for example, that immigration through Ellis Island and slave ships are similar[9]; the effects of differential student *instruction* and *assessment;* the political causes of widely disparate *funding* per pupil; and to deconstruct the history of school *desegregation*, including the marginal benefits it provided to people of color versus the gains that whites attained socially, politically, and financially (Ladson-Billings, 1998). School quality follows the United State's ladders of socioeconomic and white privilege, such that schools with sufficient funds and staff support for programming tend to be in neighborhoods with higher median income

[9]Read: America is a melting pot of people with roughly similar immigration stories and therefore similar economic and social opportunities. This is a fallacious understanding of history.

and accordingly, more white people. Black, Latinx, and Indigenous students within these vastly unequal schools encounter unique and additional difficulty: lower expectations which actually lead to poorer academic performance, more strained teacher student relationships, reduced recommendations for higher education, unnecessary referrals for disciplinary action and special education, pathologizing of their family and community backgrounds – all very frequently judged by European American teachers (Delpit, 2006; Ladson-Billings, 1998; Nelson Laird et al., 2007; Nelson-Barber and Trumbull, 2007; Solorzano et al., 2000).

Asian American students are stereotyped as the "model minority" who have "made it" in the United States—which denies the complexity of their cultures, economic classes, immigrations statuses, and histories (Wing, 2007). Because of stereotypes claiming Asian students come from families that highly value education, excel at math, and are more readily obedient, some Asian students face academic difficulties that teachers fail to recognize or support—indeed social and political barriers (immigration, language barriers, etc.) obstruct their engagement in school in some cases (Lee, 1994; Wing, 2007). Using CRT we understand that the potential to empower through gardening in schools is likely subject to educational disparities based on how the U.S. political, legal, and social systems have co-created disparities in instructional care, teaching methodologies, content, assessment, expectations, discipline, and funding.

Similarly, we use social determinants of health to analytically place the garden outcomes in the scope of their school and community contexts. This theory originated as recognition that a negative health outcome cannot be remedied by personal factors alone, but through understanding and changing the social conditions that led to it (Link and Phelan, 1995). In this framework, the problem with changing behavior, or proximate causes, to

change health outcomes is that these changes may be ineffective without an understanding of the context and processes that lead to the poor outcome (Link and Phelan, 1995). Public schools in communities of color are more likely to suffer from lack of materials and staff support, inadequate and unhealthy conditions in the classroom, neighborhood disinvestment, and over-policing—which are all social conditions that are likely to lead to poorer health and academic outcomes (Barr, 2014; Williams et al., 2010). In a relatively advantaged neighborhood, students are more likely to have opportunities that endow them with self-efficacy, cooperation, and participation in school (Barr, 2014). Accordingly, a garden program's potential to empower and educate individual students is partially determined by contextual conditions such as the neighborhood conditions, or the resources the garden has, and is not adequately explained by the proximate cause of an individual's behavior.

In addition to racial disparities, the United States classroom is also a very gendered space. There is a disproportionately high number of female teachers in early childhood education (Basow, 2010). Aspects of teaching styles preference students socialized as females– namely, success comes to students who control impulses, comply with adult directions, and sit still for long periods. This may make school a more easily adaptable learning experience for girls than boys. Disciplinary actions are more extreme for Black and Latinx male students who, compared to White and Asian male students, are disproportionately punished and sent to special education or remedial classes (Basow, 2010; Noguera, 2003; Thomas and Stevenson, 2009). Black male students frequently express interest in performing well in their classes and eventually attending college, but are too often expected to swallow their identity to subsume into "raceless" expectations required for

academic achievement, in spaces where they do not feel that their teachers support or care about them (Noguera, 2003).[10]

In general, U.S. society skews power toward those who are *white* and *male.* Intersectionality theory brings to the fore the multiplicative impacts of discrimination and subordination faced by people of multiple identities, by gender, race, class, national origin, ability, and other descriptors. Crenshaw in a series of papers coining the theory, recognized the neglect of Black women *specifically* in both antiracist and mainstream (white) feminist theory and law; she noticed that legal redress for workplace discrimination focused on discrete problems that, due to a limited and incomplete construal of discrimination, did not intersect race and gender (Crewshaw, 1989). At the scale of the school garden in a racially diverse city, intersectionality theory is a lens that can be used to analyze what students take away from the experience based on the interaction of their multiple, intersecting identities. For example, reinforcing the racist and patriarchal leanings of society, white males in schools tend to be treated as more intelligent and capable (Noguera, 2003). This said, a classical intersectional analysis may miss how perceived criminality and general poor perceptions affects Black and Latinx males in school, or the reasons behind the relatively low number of Black and Latinx males in higher education compared to Black and Latinx females (Thomas and Stevenson, 2009).

[10] Noguera details the results of survey responses where Black males responded with the lowest scores to the survey question "My teachers support me and care about my success in their class", despite expressing like other groups of students that they cared about their education and wanted to go to college.

Noguera also details a story from a Bay Area high school, in which a teacher told students that in their essay responses to *Huckleberry Finn*—a book where a runaway slave named Jim is a main character—they should not focus on the racial aspects of the story, because the book is not about race. Further, when students expressed discomfort about the book's frequent use of the word "nigger", the teacher said that if they were going to keep making a fuss about it, the students could opt to leave the class. Two of the Black students left the class to go to a lower level English course, even though the class that they were originally in was a college preparatory class.

In this paper, we use critical race theory, social determinants of health, social capital, intersectionality, and literature on student engagement and affirmation to assess the school and school garden contexts and their effects on students of different identities in Brooklyn, New York. We ask 1) How is a supportive school community related to the racial or socioeconomic composition of school students? 2) Is social empowerment in the school garden dependent on social and material support[11] the garden receives? 3) And, is social empowerment in the garden different by student race or gender?

Methods

School selection and survey completion

The authors applied for and received research approval from the Offices of Human Subjects at the University of California, Santa Barbara and the New York City Department of Education (DOE). After contacting staff at all schools on a list provided by Grow to Learn within the NYC Department of Parks and Recreation, active gardening programs were found to exist at 51 campuses. Student surveys were obtained from 11 of the 51 public school campuses serving middle and high school students in Brooklyn, NY including 143 students who participated in surveys. After excluding students who did not respond to all questions included in the analysis, the number of student respondents to the garden survey used in this study was 122 (Table 1).

[11] Our definitions of support are defined in the next section.

Table 1. Summary Characteristics of Students in Garden Survey *(n = 122)*

Race/Ethnicity	Proportion	**Grade Level**	Proportion	**Gender**	Proportion
Asian/Asian Am.	0.24	Grade 6	0.32	Female	0.51
Black	0.30	Grade 7	0.11	Male	0.48
Hispanic	0.37	Grade 8	0.29	Nonbinary	0.01
White	0.11	Grade 9	0.09		
Black + Hispanic	0.62	Grade 10	0.02		
Other	0.02	Grade 11	0.07		
Other, Arab	0.02	Grade 12	0.09		

Recruitment flyers were left in the school offices, and students volunteered or were encouraged by garden facilitators to complete anonymous surveys about their experiences after completing consent forms. Using the web survey platform *Qualtrics*, students were asked multiple choice and open-ended questions about their feelings and social interactions in the garden space and their demographic characteristics. Multiple-choice responses are presented in this paper and the open-ended questions are presented in a forthcoming paper.

Student gardener empowerment categories

To create student gardener empowerment scores using responses to the gardener survey, the z-score was generated for each question, and the z-scores were averaged by category, similar to a composite percentile method of aggregation for analysis used in (D'Agostino et al., 2018). The eight category z-scores were each used as outcome variables. The outcomes measured are achievement, identity affirmation, cultural respect, peer trust, peer reciprocity, adult advice, intergenerational care, and meaningful participation (Table 2). Students also included their race, ethnicity, gender, age, and grade level.

Table 2. Survey Questions for Determining Student Gardener Empowerment

Theme	Analytical category	Questions
Self-work	Achievement	I feel I have achieved something personally meaningful after working in the garden.
		I feel a greater sense of achievement in the garden than in other places.
	Identity affirmation	My unique identity is valued while working in the garden.
		The garden enables me to express myself as an individual.
	Cultural respect	Fellow gardeners respect my racial/cultural identity.
		Adults in the garden respect my racial/cultural identity.
Collective-work	Peer trust	I have formed meaningful relationships with other students in the garden.
		Some of my closest friends are participants in the garden.
		Students in the garden treat each other with respect.
		I can trust other students in the garden with personal topics.
	Peer reciprocity	I am comfortable asking other students for help in the garden.
		Students regularly help each other out in the garden.
Mentorship	Adult advice	I have received helpful advice from adults in the garden about gardening.
		I have received helpful advice from adults in the garden about other things.
	Intergenerational care	The adults working in the garden respect me.
		Adults in the garden are excellent role models.
	Meaningful participation	My recommendations about crops/plants to grow in the garden are taken into consideration.
		My recommendations about the garden's appearance are taken into consideration.

Social and material support for the garden

Social and material support was reported by the leaders of the gardens in a survey that was separate from the students. The leaders included teachers, school counselors, school administrators, or external support staff.

Social support included an aggregated measure of responses to five multiple choice questions about: the adult to student ratio in the garden, whether there are enough adults working in the garden, the level of parental involvement, the number of public events, and whether paid staff work in the garden.

Material/financial support also included an aggregated measure of responses to five multiple choice questions about: whether teachers are compensated for their work, the total budget, whether external funding is received, whether school funding is received, and whether funding is sufficient for their needs.

Social environment index for NYC middle and high schools

For all middle and high schools in NYC, a supportive environment index score was created using school-level responses to certain questions from the NYC Department of Education's school survey, administered to middle and high school students, from the 2016-2017 school year (n =1,065 schools). This survey contains likert scale questions on a 1-5 or 1-4 point scale.

The proportion of students with positive responses to each question in the index (e.g. Agree or Strongly Agree), was divided by the total number of students who responded to the question. Then, these 3-4 values were averaged by the categories: intergenerational care, cultural affirmation, inclusion and engagement, and safety (Table 3). Finally, the category values were averaged to create the final index value. Characteristics of the schools involved in the study of school supportive environment are included in Table 4.

Table 3. Supportive Environment Index (SEI) from NYC School Survey, likert scale questions

Category (Weight)	Survey Questions
Intergenerational care (.25)	My teachers treat me with respect.
	My teachers support me when I am upset.
	There is at least one adult in the school whom I can confide in.
	In how many of your classes at this school do YOU feel [that] most students listen carefully when the teacher gives directions? (Responses: "None" "A Few" "Most" "All")
Cultural affirmation (.25)	I feel that my teachers respect my culture/background
	*At this school, students harass, bully, or intimidate each other because of their race, religion, ethnicity, national origin, or citizenship/immigration status. **Reverse weighting*
	My teachers use examples of students' different cultures/backgrounds/families in their lessons to make learning more meaningful for me.
	In general, my teachers treat students from different cultures or backgrounds equally.
Inclusion & engagement (.25)	This school offers a wide enough variety of programs, classes and activities to keep me interested in school.
	My teachers will always listen to students' ideas.
	At this school, students with disabilities are included in all school activities (lunch, class trips, etc.)
	In general, my teachers make their lessons relevant to my everyday life experiences.
Safety (.25)	*At this school students harass, bully or intimidate other students.(*Reverse weighting)
	I feel safe in the hallways, bathrooms, locker rooms, and cafeteria of this school.
	Discipline is applied fairly at my school.
Sum (1)	

Table 4. Descriptive characteristics of NYC middle and high schools in study

	NYC Middle and High Schools (n=1065)			Brooklyn Schools in Garden Study (n=11)		
Characteristics	**Mean (Std)**	**Min**	**Max**	**Mean (Std)**	**Min**	**Max**
Total Enrollment (# of students)	612 (552)	60	5682	603 (295)	194	1160
Proportion Asian	.10 (.14)	0.00	0.84	.10(.13)	0.01	0.45
Proportion Black	.35 (.26)	0.00	0.96	.37 (.32)	0.01	0.87
Proportion Hispanic	.43 (.25)	0.02	1.00	.39(.27)	0.07	0.82
Proportion White	.10 (.16)	0.00	0.86	.13(.14)	0.01	0.46
Proportion English Language Learners	.13(.15)	0.00	0.97	.16 (.11)	0.02	0.35
Proportion in Poverty	.77 (.18)	0.06	1.00	.81 (.09)	0.68	0.97
Proportion Black + Hispanic	.78 (.25)	0.03	1.00	.76 (.25)	0.28	0.96
School Survey Response Rate (%)	85 (14)	31	100	89 (11)	61	100
SEI Score (Max=100)	77 (7.7)	55	100	79 (8.0)	67	93

Statistical analysis of research questions

All statistical analyses were performed in Matlab version 2015a. Linear regression analysis was used to determine the relationship between proportion of Black and Latinx students and school Supportive Environment Index (SEI) score (Table 3), as well as the relationship between the proportion of students eligible for free and reduced lunch and SEI score, at the school level, for all NYC middle and high schools with NYC School Survey responses, using function *fitlm*. The results were plotted in a scatterplot.

To answer whether student empowerment in the school garden is dependent on social and material support the garden receives directly, or the school social and economic contexts, the 8 garden social empowerment categories (Table 2) were summed for each student to create an aggregate for the outcome variable. Then, a multiple linear regression was performed to determine the relationship between the four explanatory variables and the aggregated outcome variable. [12]

Finally, to determine whether student empowerment in the garden was different by student race or gender, student gardener responses (n=122) were compared by student race and gender in 8 categories of empowerment (Table 2) in the garden using ANOVA and corresponding ANCOVA (each controlling for covariates school ID, student grade, and gender). One gender nonbinary student responded to the survey; because one student was too small to form a group, this student's responses were placed in the group with female students.[13] Scores are reported as significantly different with p-values less than 0.1 in both

[12] We attempted fitting multi-level models to account for clustering of students in schools, and it did not appreciably change the results.

[13] The results in all tests were the same with and without the one nonbinary student, who gave higher (more positive) responses than both male and female group means.

the ANOVA and ANCOVA models. The Matlab functions used were *anova1* and *mancovan* for ANOVA and ANCOVA, respectively.

Results

School supportive social environment index

Figures 1 and 2 demonstrate that school supportive environment index (SEI) score is race and poverty dependent, decreasing with the school's proportion of Black, Latinx, and low-income students. This suggests that in schools with more students of color, students report receiving less care, cultural affirmation, inclusion and engagement, and safety at the school level.

Figure 1. Scatterplot of the proportion Black and Latinx students and supportive environment index in NYC middle and high schools (n = 1,065 schools)

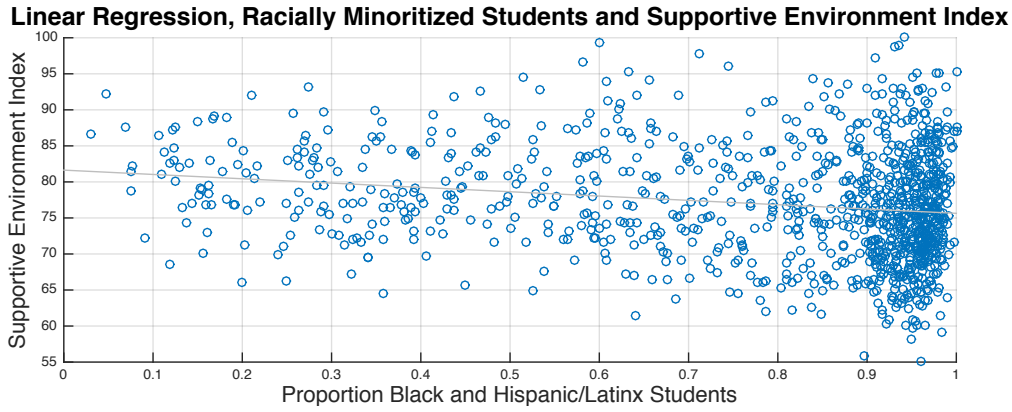


Figure Statistics: $R^2 = 0.04$, F-statistic = 40, $p<0.0001$

Least squares regression line equation: y = -6.0 (0.95)x + 81.64 (0.77) + E

Figure 2. Scatterplot of the students eligible for free or reduced lunch and supportive environment index in NYC middle and high schools (n = 1,065 schools)

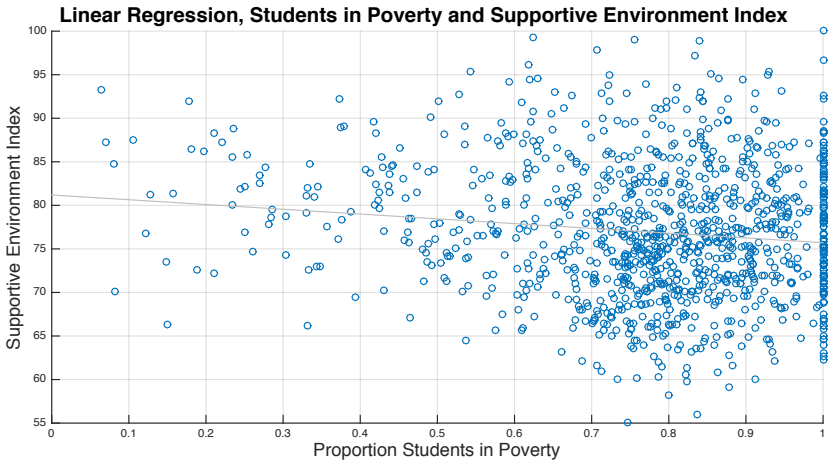


Figure Statistics: $R^2 = 0.02$, F-statistic = 17.8, $p<0.0001$

Least squares regression line equation: y = -5.5 (1.30)x + 81.20 (1.03) + E

Direct and contextual influences on student empowerment in the school garden

Table 5 displays the results of a multiple linear regression, demonstrating that of the variables 1) school-wide supportive social environment index (SEI) 2) school-wide student poverty level 3) garden-level social support and 4) garden-level material support, the most significant factor influencing empowerment for student gardeners is the level of social support the garden receives directly, which is the number and type of adults who work in the garden in relation to the number of students, as well as whether there are paid staff members and public events (Table 5). Unexpectedly, student empowerment seems to decrease by 1.1% for each 4.2% increase in garden social support (Table 5).

Table 5. Estimated Coefficients from Multiple Linear Regression on Variables Influencing student empowerment within the school garden (*n = 122*)

	Estimate	SE	tStat	pValue
Intercept	104.23	26.5	3.93	<0.001
School SEI	2.82	2.80	1.01	0.32
Garden Social Support	-1.16	0.56	-2.09	0.04
Garden Material Support	-0.21	0.48	-0.43	0.67
School Poverty Level	-4.55	25.71	-0.18	0.86

Number of observations: 122, Error degrees of freedom: 117
Root Mean Squared Error: 14.5
R-squared: 0.06, Adjusted R-Squared 0.03
F-statistic vs. constant model: 1.79, p-value = 0.14

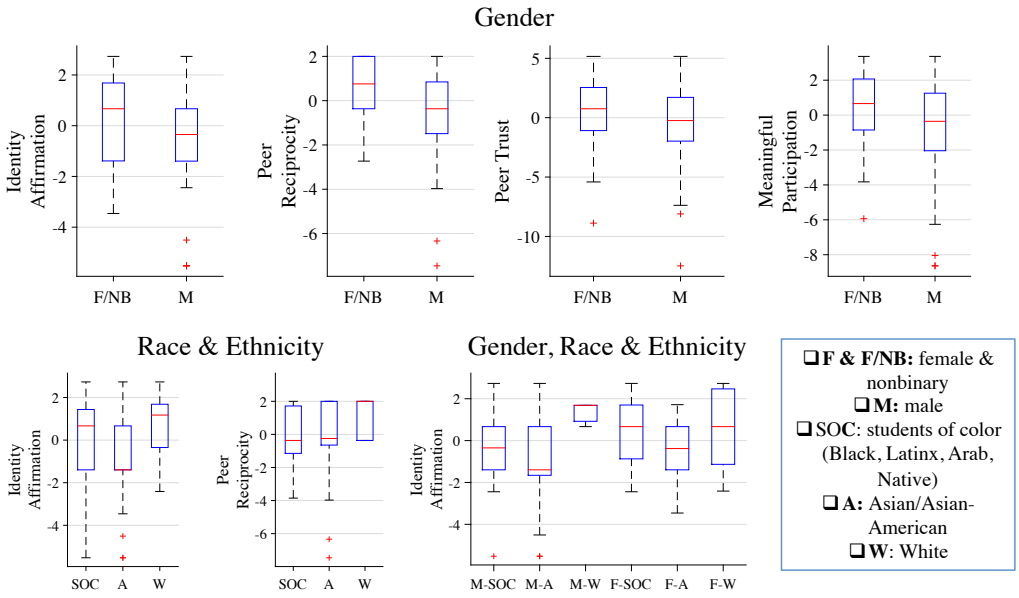
Empowerment in the garden: race and gender differences

Figure 3 demonstrates that in the garden, female/ nonbinary students[14] feel relatively higher empowerment than male students; they reported higher identity affirmation, peer reciprocity, peer trust, and meaningful participation than male students (of all races). In fact, gender based differences were higher in number than the differences by student race. And, while white students reported higher identity affirmation and peer reciprocity than all other students, white *male* students reported the highest feeling of identity affirmation compared to white women or any other student group. Followed by white males were, Black, Latinx, and Indigenous American female and non-binary, white females, Black, Latinx, and Indigenous American males, Asian/Asian American females, and Asian/Asian American males. The other tests run on garden empowerment by race/ethnicity, gender, or both were not statistically significant (n=122).

With ANCOVA we found that adult advice differed by student grade level, not race or gender, generally highest in grades 8 and 12; we notice that these grades are the highest within a middle and high school, respectively (Appendix Figure A1).

[14] The results were the same with and without the one nonbinary student, who was placed in the group of females; the student responded with higher values than both male and female group means.

Figure 3. Statistically significant differences in garden empowerment category z-scores (y-axis), by student identity group



Boxplots were generated with Matlab, where the central mark indicates the median, and the bottom and top edges of the box indicate 25th and 75th percentiles, respectively; whiskers extend to the most extreme data points not considered outliers; outliers are plotted individually using the '+' symbol ("Box plot - MATLAB boxplot," n.d.).

Discussion

At the school level, the supportive environment index (SEI) score decreased with the proportion of racially minoritized and low-income students. Specifically, students experienced less beneficial, less affirming relationships between peers and other adults, they were less genuinely engaged by and included in school activities, and they felt less safe, as the school's proportion of Black and Brown people increased. Sadly, this is as predicted based on the persistent and intentional inequality of schools in the United States based on race and class (Ladson-Billings, 1998). As student demographics are intricately co-created with school resources, school quality increases with local and tax revenue available. Thus, low income and racially minoritized young people disproportionately attend schools with

less support for their education, with higher teacher to student ratios, more unequal classroom treatment, and less investment in extracurricular activities, which may otherwise provide a more engaging and affirming school environment (Cooper, 2014). Relevance to lived experiences creates personal meaning for academic work, which standards-based education fails to promote for racially minoritized students (Conchas, 2001; Ladson-Billings, 1995). This pattern of lack of support may reflect how traditional curricula, standardized teaching methods and assessment, and inadequate focus on connective instruction fails to motivate young people from diverse cultural backgrounds given the other issues they face within the school, including coming to the school with less cultural capital and training in the language of power needed to engage in institutions judged by white standards (Cooper, 2014; Delpit, 2006).

In the garden, the most statistically significant predictor of student empowerment was the direct social support the garden received, but the relationship was negative, and in the reverse direction of what we predicted. Thus, a beneficial relationship for the students may be more about staff interest and expertise, curriculum, and whether the garden has beneficial partnerships with external organizations (Azuma et al., 2001), than a high number of paid staff and volunteers in and of itself. Social support for the garden in this study was also based in part on perceptions of the garden leaders, which may not adequately represent the conditions the students experienced.

The empowerment students experienced in the garden highlights its unique place within a school; when well-resourced, it works in aiding identity development and potentially serves as a buffer against the unengaging, unsafe, unaffirming character of public schools for many students. For these students, the garden is a place to build self esteem,

relieve stress, and accomplish new things (Thorp and Townsend, 2001; Waliczek et al., 2000). The feeling of safety reported by many young people replicates findings within neighborhood community gardens, where community gardening engenders social capital, intergenerational closure, and community safety (Groenewegen et al., 2006; Williams, 2014).

Overall, when analyzed by gender, female students and one gender nonbinary student were more likely than males to feel personally and collectively empowered in the garden space, which has not yet been observed in a study. Relatedly however, in a youth program at the Brooklyn Botanic Garden in New York City, girls who were outcast or shy were recognized for their unique talents in the kitchen and in the garden (Morgan et al., 2009), and a 4-H agricultural program in New York State helped increase self-esteem in girls who gardened with mentors (Lekies et al., 2006). Unlike this paper, however, in neither of these studies was there an explicit or quantitative comparison by gender in these agricultural learning opportunities.

Yet in the Brooklyn school gardens, when analyzed by both race *and* gender, those students who felt most comfortable expressing themselves and their individuality were white males, *replicating societal norms and expectations*. Related studies have found differences in self-esteem by gender and race, with males generally reporting higher self-esteem (Bachman et al., 2011) . However, by some metrics, Black male students have reported higher self esteem than white and Asian students, and studies have found that high self esteem for racially minoritized students can be related to strong ethnic identity development (Gray-Little and Hafdahl, 2000; Martinez and Dukes, 1997). Thus, in these schools there is opportunity to further engage students of color, not just in the classroom, but in the school

garden. Relevant, caring, affirming, understanding, and intentional activities in the garden could be derived from a number of pedagogies that are geared toward improving engagement among students of color, including culturally responsive education, informal education, or social justice education, as some examples (Cooper, 2014; Delpit, 2006; Ladson-Billings, 1995; Thomas, 2008).

The least affirmed groups of students were Asian, Black, Latinx, and Indigenous American males, suggesting that there are opportunities to explicitly engage these individuals in the garden space. Particularly important is devising education in the garden to genuinely connect with young males of color, and to decrease the practices that lead to their low educational attainment in the classroom, such as low expectations, heightened focus on order, unfair discipline, and lack of care (Ladson Billings, 2011; Noguera, 2003; Thomas and Stevenson, 2009).

That female and nonbinary students of Black, Latinx, Indigenous American backgrounds found the space affirming, but less so than white males, showed a garden serves an important role for these students but has the potential to be more liberatory for female students of color. The primary benefits that female students experienced were related to this space as a positive social ground for peer trust and reciprocity, as has been observed in social capital studies in community gardens (Groenewegen et al., 2006; Saldivar-Tanaka and Krasny, 2004). Additionally, female and nonbinary students were more likely to feel the work they were doing was meaningful – their sense of achievement perhaps leading to them feeling more affirmed in the space (Lekies et al., 2006; Van der Kolk, 2015). There are varying accounts of reasons for gender differences in gardening. In African American community gardens, women were more likely to use the garden to build personal resilience

and social ties; another study found females in general more likely to grow and consume their own food in urban gardens (Williams, 2014; Zypchyn, 2012). Another study of elementary-aged students found more expressiveness in females in school gardens, and similarly suggested that practitioners find ways to engage boys (Lekies and Sheavly, 2007).

This paper reveals that female students were generally more supported than male students, and specifically, male students of color. We laud the accomplishments of the garden for female students and recommend future research focus on ways the garden space could further reverse misogyny and patriarchy. Further research can also be used to probe the interpersonal dynamics in the garden, perhaps seeing how instruction, curriculum, assessment, disciplinary practices, or gender similarities between garden instructors and students may play a role in empowerment (Lekies and Sheavly, 2007). We also laud the potential of the garden to promote collective action and reciprocity in a generally competitive society. It is troubling but not unexpected to learn that the garden seems to replicate certain racial and gender inequalities observed in schools in general, and therefore, there is a need to intentionally engage racially minoritized students, and particularly racially minoritized male students, with a pedagogy that is relevant, engaging, understanding, and caring about students as individuals.

Our study is limited in that we have a relatively small number of respondents to the garden survey, a nonrandom response driven by the strictures of conducting research in public schools, and a reliance on self-selection. More student respondents and full randomness would help strengthen the statistical robustness of the study – perhaps with an organizational partnership inside of the schools, or regular surveys and interviews

administered in partnership with garden administrators within culturally diverse cities. It may also be beneficial to perform ethnographic research to ascertain the effects of direct social and material support for the garden, rather than relying solely on reports from garden leaders. Our supportive environment index (SEI) is limited to questions provided in the ongoing NYC School Survey, but the questions did address a range of topics we hoped to assess.

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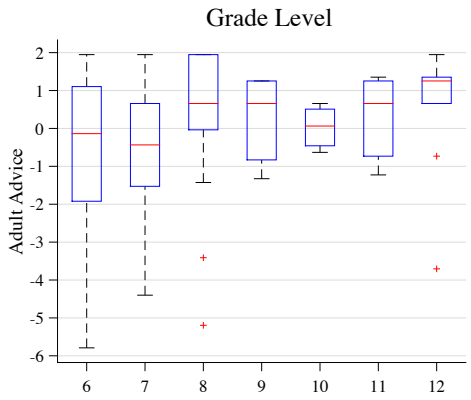
Chapter 2 Appendix

Figure A1. Z-scores of grade level difference in adult advice received by student gardeners



III. Chapter 3: The Liberatory Potential of School Gardens for Racially Minoritized Young People

Abstract

School gardens provide ground for social and emotional growth of young people, operating within a tradition of community transformation through urban farming, and the U.S. education system. This paper asks: what current liberatory practices are happening in school gardens, particularly for young, racially minoritized people, and what is the potential for building upon these activities? This includes liberation for self, community, society, and the broader environment, *from* negative forces like state violence, capitalism and disposability politics, White Supremacy, internalized oppression and discrimination, and injustices in food, environment, and health. To answer these questions, a four-part liberatory framework for school gardening aimed at garden participants (students, facilitators, and collaborators) is outlined using perspectives from Brooklyn, NY students and facilitators. As a whole school gardens imbued students with skills for liberation of the self through personal achievements, skill development, and stress relief; provided liberation in group setting through mentorship, peer bonding, and identity affirmation, as well as work toward community transformation; and provide liberation for the environment by reforming students' relationships with the natural world into one of more understanding and stewardship. Some programs provide societal liberation by intersecting with certain issues of social justice, but there is great potential to expand this, particularly through partnership with external organizations with more social and material power and time than teachers alone.

Keywords: liberation, school gardens, emergent strategy, political organizing, self-love, environment, race

Introduction

School garden: A place of immense community potential

School gardens foster unique relationships and educational experiences for young people of color, simultaneously operating within a tradition of community transformation through urban farming, and the U.S. educational system. School gardens provide a range of benefits to individuals and communities, including healthy food, stress relief, engaging methods of learning, and pride in self and collective work. They are used to grow food and other plants, to sustain the local ecology, for restorative justice, for healing and therapy, to develop social capital and intergenerational ties, and in community revitalization (Williams, 2014).

The school garden as an intentional and unique place of liberation for young people of color, however, has not been wholly conceptualized. Through the collaboration of young people, school staff, parents, external organizations, and communities, the school garden can serve as a seed of change for many challenges of racial and societal injustice with which it intersects. [15] This paper asks: what current liberatory practices are happening in school gardens, particularly for young, racially minoritized people, and what is the potential for building upon these activities?

Based on literature analysis and fieldwork in Brooklyn middle and high schools, a liberatory framework for school gardens is outlined. The paper uses perspectives from students and facilitators, and lessons from movements for food, environmental, and racial

[15] Be grounded in what is possible; imagine what is yearning to come – this was my mantra for writing the paper.

justice, and self love, as ongoing sociocultural transformations with potential to more deeply intersect with liberatory impacts of the school garden.

Background

Liberation: theory, movements, and strategies

Liberation is the release from oppression within individuals, communities, and worlds; it is a goal of movements for justice, for which there are many theories. Justice as fairness is based on each individual having the most extensive basic liberties and goods, under a situation in which decision-making power is open to all (Rawls, 1958). Sen has conceived of justice as the freedom people actually have to carry out a life that they have reason to value, as there is interpersonal variability in the ways people convert resources into freedom (Sen, 1990). Schlosberg also disputes a strictly distributional version of [environmental] justice, offering that justice includes equity in the distribution of environmental risk, recognition of the diversity of actor motivations and experiences, along with a focus on including the most affected groups in decision-making (Schlosberg, 2004). Nancy Fraser has observed that justice seen *solely* as recognition tends to invite solutions that are incapable of redistributing power and transforming systems of oppression (Fraser, 2001). Liberation also involves the practices we can employ to rid ourselves of the emotional trauma and limits which stifle our happiness, well-being, and balance; this includes investing ourselves radically in love (Williams et al., 2016).

Movements intersecting with school gardens

Civil Rights movement and young people

Advocacy for racial justice came to a confluence during the Civil Rights era, which mobilized people around the need to improve institutional, political, economic, and social outcomes for various groups, including multiple groups of racially minoritized people. These movements ignited public recognition of injustices, largely through the use of civil disobedience tactics, including sit-ins, marches, boycotts, and grassroots community revitalization and development (Albert and Albert, 1984). Adults and young people of color advocated for improvements in their life chances, championing the need for reform in U.S public education, the legal system, and equal access to housing, transportation, commercial establishments, and other institutions. Strategies were developed and shared largely from the Black Power movement, which emphasized pride in racial identity; human rights and dignities; recognition of and action to remediate institutional racism in the prison- industrial complex; improved and equal livelihoods; and critique of institutions of global imperialism.

During this same period, the American Indian Movement encouraged public and political recognition of their history with the land—movement work often centered enforcing treaty rights and tribal sovereignty, with groups of activists focused on issues of discrimination faced by those in reservations or urban communities, including bias in the labor market, education, housing, and from law enforcement (Langston, 2003). They supported Black Civil Rights groups and used similar rhetoric (e.g. “fish-ins” as opposed to sit-ins). Participants in this movement also performed physical rebellious occupations (e.g. Alcatraz Island and Wounded Knee, the Bureau of Indian Affairs building), and protested national sites and symbols.

Asian American and Chicano movement activists sometimes merged to combat immigrant rights abuses. They responded to discriminatory racial quotas in immigration, deportations, detentions, lack of public benefits, voter disenfranchisement, farmworker injustice, housing discrimination, and language supremacy, as well as U.S. imperialism in the global South (Fujino, 2008; Johnson, 2004; Romero, 2005; Tamayo, 1995).

Regarding youth, the American Indian, Asian American, Black, and Chicano movements all critiqued unequal school quality, school-based discrimination and segregation, a culture of White Supremacy, and lack of ethnic studies in American education (Davis, 2001; Fujino, 2008; Schroeder et al., 2016; Stovall, 2016). The Black Panthers worked to feed young people in their infamous, radical antihunger Free Breakfast for Children program (Heynen, 2009). Youth leadership has always played a role in advocacy for racial justice, from the Student Nonviolent Coordinating Committee (SNCC) during the Civil Rights Era, to advocacy by undocumented and immigrant youth for immigration reform and community health (Negrón-Gonzales, 2015; Romero, 2005). Civil Rights era movement work by and for young people has helped promote a variety of positive changes for individuals and communities, through changes in public opinions and policy.

Food justice and school food movements

The food system is comprised of the activities and relationships that make up various food pathways. Its injustices include "maldistribution of food, poor access to a good diet, inequities in the labor process, [unfair] returns for key suppliers along the food chain" (Gottlieb and Joshi, 2010), poor treatment of nonhuman animals, and degradation of the environment. School gardens help remedy some of these issues in dense, unevenly resourced

cities, by increasing access to food that is often grown in relatively ethical and environmentally responsible ways, and by educating young people about the processes by which food is produced.

Many urban agriculturalists try to bridge a gap in food access, in order to reduce reliance on institutions that do not effectively serve people. Innovative solutions include school and community gardening, food policy councils, and food microenterprise development. While some such projects are prohibitively expensive or otherwise exclusionary to low-income people or people of color, many projects take influence from the Civil Rights movement, intentionally incorporating race and class in the reformation of food issues, including The Food Project in Roxbury, MA or Grace Lee Boggs' Detroit Summer Organization (Gottlieb and Joshi, 2010).

A $40 billion global advertising budget for corporate food facilitates rampant junk food marketing, targeted at Latinx and African American children at higher prevalence than white children (Gottlieb and Joshi, 2010; Kumanyika and Grier, 2006). Fast food marketing campaigns, lack of affordable grocery stores, and the ubiquity of junk foods in stores and schools, help create conditions where it is acceptable for many to eat an unhealthy excess of sugar, salt, and fat at any time, particularly in low-income communities and communities of color. School gardens are one place where the dominant and unhealthy narratives are reversed through hands on growing, tasting, and food preparation.

School gardening also teaches about agricultural labor and suitable alternatives. There is a dissociation between how well-fed the country is as a whole, yet how poorly-treated the predominantly racially minoritized, immigrant workforce is treated. Workers can be subject to deportation threats, slavery, coercion, unsanitary living conditions, sexual

assault, and irreversibly harmful chemical toxins (Alkon and Agyeman, 2011). Black, Latinx, and Indigenous farmers and ranchers have been disenfranchised by discriminatory lending practices and legal land removal ("Congress Fails To Fund Settlement For Black Farmers," n.d., "National Black Farmers Association," n.d.). Mainstream concerns about farmer working conditions were not prevalent until the 1960s, when activists like Dolores Huerta and Cesar Chavez helped organize the working poor with the United Farm Workers. Farmworker struggles are fought intensively today by multi-ethnic coalitions such as the Coalition of Immokalee Workers, who organize boycotts, marches, and hunger strikes to change working conditions of some of the leading food producers and restaurants (Gottlieb and Joshi, 2010; "In New York City, farmworkers are hunger-striking to protest Wendy's," 2018).

Some movements have helped students develop a more critical understanding of food inequalities within schools. Many schools enable corporations to fill vending machines, have supplied and wasted nutritionally-poor cafeteria food, have perpetuated corruptly determined nutritional recommendations, and have employed tactics that marginalize or embarrass low-income students who receive free or reduced priced school lunches (Gottlieb and Joshi, 2010; "Sugar Coated Documentary," n.d.). Success in school food movements has occurred where complementary goals are pursued that support multiple stakeholders (the school *and* local farmers, for example) who can work together to implement changes, which enables a broader coalition to reform local school policy. School food organizing has included farm-to-school programs, garden-to-café programs, food justice lessons, indigenous farming practices, environmental sustainability lessons, culinary classes, campus use of SNAP/EBT, and reducing the marketing and availability of unhealthy food. Powerful

youth-centered food movements also exist outside the school, in networks of community gardeners, nonprofits, and conferences; they often include mentorship and leadership training to empower young people to contribute to social change ("About Us | The Food Project," n.d.; Gottlieb and Joshi, 2010).

Environmental justice, coexistence, and planetary protection

Ecological projects like school gardens provide hands-on education that increases one's ability to participate in remedying climate change, waste management, and other environmental problems (Russ et al., 2015). Lessons on composting, recycling, plant photosynthesis, and respiration inform young people about the roles of humans in the use and cycling of living organisms and non-living materials. Though gardens can provide healing psychological effects and herbal medicines, indigenous, sustainable ways of interacting with the environment are deemed unimportant in favor of a neoliberal dependence on corporate health and pharmaceutical industries, which are often biased against and inaccessible to low-income and racially minoritized people (Barr, 2014a; Nettleton et al., 2007).

Some gardens provide education about environmental injustices occurring within low-income communities and communities of color. Environmental justice (EJ) organizers advocate for community revival, sustainable livelihoods, and reducing disproportionate burdens that cause health disparities – including in residential neighborhoods, farms, and a variety of workplaces—making EJ highly linked to the food justice movement (Brulle and Pellow, 2006; Gottlieb and Joshi, 2010). Environmental toxins, air and noise pollution, overcrowded and damp housing, poor waste management, and pests are more likely to occur in communities of color and low income communities, and are associated with higher rates

of illness (Barr, 2014a; Bullard, 1993; Du Bois and Eaton, 1899; Harvey, 2010). Environmentally hazardous work is channeled to nonwhite, non-privileged peoples within the U.S.; it is also outsourced to other countries, in cases like the widespread disposal and production of hazardous materials in Asia and Africa (Peet et al., 2010), the dangerous working conditions of mainly female immigrants in the electronics industry (Brulle and Pellow, 2006), Black workers in South African gold mines (Braun, 2014), and 2.2 million human beings incarcerated in U.S. prisons, many of whom are poor, illiterate, mentally disabled, and forced to work in for-profit operations owned by corporations such as the Corrections Corporation of America or the GEO Group (Downs, 2013; Initiative and Sawyer, n.d.). Environmental justice education initiatives are important as a preventive measure as well; the state often fails to expressly protect [young] people in cities from unsafe soil or water in their schools or communities.

Social justice, education, and young people

School gardens have the potential to activate school communities on other issues faced in low-income communities and communities of color, though a logical development upon the social networks and issues with which the school and the garden intersect. Youth organizing for educational justice has included marches, school walkouts, and other forms of civil disobedience to address school discrimination; increased police presence in schools; unfair suspension, expulsion, and imprisonment of young people; unhygienic conditions; poor school food; and lack of gun regulation (Ginwright et al., 2006; Gottlieb and Joshi, 2010; Lalas and Valle, 2007; "Our Mission to End School Shootings | March For Our Lives - March 24, 2018," n.d.). Coalitions with parents and teachers have also successfully

employed political advocacy, hunger strikes, and marches, to address underfunding, safe neighborhoods, transit time, overcrowding, and biased standardized testing (Schroeder et al., 2016; Stovall, 2013).

Alternatives to incarceration are important in helping young people lead successful and free lives. Youth imprisonment is one unjust portion of an overall highly discriminatory, destructive, and deranged system of incarceration, which threatens the lives of young people and our society as a whole. Over 40 states instituted policies that make it easier for youth to be tried in adult courts, challenging the precedent of special measures to protect young people in the court system (Winner et al., 1997). No Child Left Behind (NCLB) imposed punitive measures without addressing the causes of school weaknesses, leading to rising dropouts, suspensions, and failures without increasing opportunities (Ginwright et al., 2006). Changing school policies and engaging young people authentically, inside and outside of the school, are important measures in preventing youth imprisonment. Collective gardening, restorative justice, and art therapy are programs that have been successful in preventing the (re)incarceration of young people ("A Collaboration Thrives in the South Bronx," 2015; Evans and Didlick-Davis, 2012; Van der Kolk, 2015).

Self-love and self-care

> *"There is no greater work than the work of self-love because that lies at the heart of our liberation from ignorance. I show up because of love. I am present because of love. I am alive because of love. I thrive because I am loved. Radical presence is born out of love." – Lama Rad Owens, Radical Dharma*

Black mental health practitioners noticed the increasing association of blackness with shame and self-hatred in the 60s and 70s. This was combatted by Black and Latinx activists who emphasized pride in racial/ethnic identity, championing the deliberately antiracist revolutionary refrains "Black is beautiful" and "Brown is beautiful" in movements for self-love (bell hooks, 2001; Romero, 2005).

Audre Lorde, Alice Walker, and other second wave Black feminist and LGBTQ activists conceived of self-love as necessary, healing, and revolutionary against a state with ideologies that try to quell or police you (Nash, 2013). bell hooks describes the importance of decolonization in Black children, so to not accept patriarchal, white supremacist, and classist images of Black or poor people as portrayed in the mass media and replicated in society (bell hooks, 2001). Hooks, having gone to public school before and after racial integration, noticed that self-hatred and low self-esteem were perpetuated within integrated schools whenever teachers expected less of Black students, or gave preferential treatment to fair-skinned Black students or Black women; these are well-established phenomenon in educational research (Ford, 1998; Obiakor, 1999).

Emotional healing can take place anywhere we are genuinely cared for and solutions can be found to problems we face, and anywhere we create oppositional spaces where we can be self- loving (bell hooks, 2001; Van der Kolk, 2015). Building community, as is done in school gardens, increases psychological and material resilience in a society that for many is explicitly harmful (Poortinga, 2012; Williams, 2014). In the garden, understanding the power, beauty, and capacity of one's body can take place through feeling pride in one's achievements (Blair, 2009). Self-love can also be bolstered in gardens through positive

representation of the cultures of racially minoritized people, psychological empowerment, supportive community, and education about social constructs and oppressions.

School gardens promote self-care by encouraging healthy eating habits, focused attention, mindfulness, and stress relief (Blair, 2009; Evans et al., 2012; Groenewegen et al., 2006; Murray, 2012). Rising critique of medical practice and health care occurred during the Civil Rights era, coinciding with interest in natural healing methods like aromatherapy, herbalism, yoga, and community and occupational health movements (Ziguras, 2004). Herbalism and apothecary projects are increasingly included in school gardening, though these programs have a harder time obtaining program funding that focuses on STE(A)M education. Mindfulness, meditation, and other forms of emotional regulation are increasingly included in schools, which help in overcoming life traumas from abuse, abandonment, neglect, and violence (Van der Kolk, 2015).

Normative standards of beauty, health, and behavior deny the multiplicities of humans and their biology, and contribute to low self-worth in young people by perpetuating *sizeism*, *colorism* or European standards of beauty, sometimes under the guise of improving health; certain standards disregard the tremendous role of government and corporate partnerships in enabling / creating certain health outcomes like obesity and diabetes (Guthman, 2014; Link and Phelan, 1995).

Mental colonization may occur when agricultural activities are solely linked to oppressive conditions of poverty and subjugation—slavery, sharecropping, unsafe labor conditions, and restrictions of racially minoritized farmers from equal participation in the market. This concept of mental colonization is linked to internalized inferiority, when members of an ethnic minority group internalize narratives from the dominant group and

believe that their own culture and practices are somehow inferior (Du Bois and Marable, 2015; Quintana and Segura-Herrera, 2003). The lasting impacts of oppressive policies may thereby strip young people of their positive ancestral connections to land and its associated benefits (Finney, 2006; Mancini, 1996; "What happened to America's black farmers?," 2015). School gardening can help to undo some of these effects and foster reconnection with the earth. Indeed, some scholars believe the reversal of mental colonization occurs through the transformation of self and identity (Quintana and Segura-Herrera, 2003), and therefore, prideful re-appropriation of agricultural ties may help to undo its association with oppression among racially minoritized people.

Outlining a framework for school garden liberation

The school garden as Emergent Strategy

According to emergent strategists, effective organizing toward a shared vision is an emergent and powerful result of 1) close relationships, 2) engaging chaos and change, and 3) sharing information. This movement organizing strategy draws inspiration from biomimicry, or using natural systems to describe human systems, such as the mutualistic relationship between fungi and plants, or a flock of birds following decentralized leaders (Brown, 2017). Elements of emergent strategy are: the relationship between small and large (fractal), the nature of change (adaptation), who we are and how we share (interdependence, interconnectedness, and decentralization), the pace and pathways of change (non-linear and iterative), how we recover and transform (resilience and transformative justice), and how we move towards life (creating more possibilities) (Brown 2017). In this paper, principles of

emergent strategy are used to help construct a framework wherein the school garden is cast as a small locus of larger change.

As a whole, emergent strategy is a paradigm shifting vision of organizing for social and planetary change. In her description of the element "resilience and transformative justice", Brown (2017) presents rules we tend to unknowingly abide by that particularly inform the strategies for liberation presented in this paper. Specifically, Brown lists, among other points, that in the Unites States:

- We are socialized to live our lives against each other and against the world.
- We learn to disrespect Indigenous and direct ties to land.
- We learn to be quiet, polite, indirect, and submissive – not to disturb the status quo.
- We learn facts out of context of application in school (how will these things show up in our lives?).
- We learn to compete in a scarcity-based economy that denies and destroys the abundant world we are in.
- We learn to deny our longings and skills, doing work that occupies our hours without inspiring our greatness.
- We learn to manipulate each other and sell to each other, rather than to collaborate and evolve together.
- We learn that the natural world is to be manicured, controlled, or pillaged to support consumerist lives – even the natural lives of our bodies are pathologized, medicated, altered.

- That we should swallow our tears and any other inconvenient emotions, and as adults that translates into working through red flags, value differences, pain, and exhaustion.
- That we should be really good at what's already possible, and leave the impossible alone (Brown, 2017).

The liberatory potential of school gardens

The framework below is developed iteratively from scholarship, political movements, and student and facilitator responses collected in this study. Namely, scholarship on the benefits of gardening guided the development of questions asked of students and adults to detail whether students felt empowered in the space. To develop the four-part framework, the known benefits of gardens were considered along with their expected potential, with a specific emphasis on liberatory political movement work with which the garden intersects. Student responses were then placed into categories. I outline potential goals of school garden work that are most liberatory at the scales of the self, group, community/society, and the planet. The four categories are not entirely separable, and must include intentionality in addressing inequalities. The framework is for the young participants in school gardens, the facilitators, external organizations working with them, funders, parents, and all those interested in transformation through the medium of the school garden.[16]

[16] From these people I especially welcome constructive additions and collaboration in framework expansion.

Self work

Self- care, -love, and -efficacy: recognition of self as whole, capable, interconnected, loved; remediating and healing stress or traumas from White Supremacy, capitalism, marginalization and abuse writ large; recognition that identity is beautiful but not all-encompassing or constraining; selection of food that nourishes; stress relief through being outside and working with hands; belief in individual potential and achievement (Brown, 2017; Groenewegen et al., 2006; Van der Kolk, 2015; Ziguras, 2004).

Group work

Social connection and collective growth: setting the groundwork with radical connections, cooperation, and collective joy developed within and between peers and facilitators; there is reciprocity, bonding, and collective efficacy; vulnerability to be wrong and supported in the presence of a group; inclusion and affirmations of all identities, abilities, and dreams; students decide, plan and use the skills needed to maintain, build, and outreach, sustainably; facilitators and other groups increase capacity of students; the garden is a safe space (Barr, 2014b; Brown, 2017; Ozer, 2007).

Community/societal work

*Shifts toward food, racial, social, and economic justice**:** the garden itself is a home for change through transformative, culturally uplifting education, grassroots organizing, and civil disobedience; momentum from school garden spreads through*

social connections, genuine invitations—of parents, community, and organizations—and engaging events; the students become the teachers in their neighborhoods and demonstrate what they've learned; movements are intentionally geared to decrease reliance on systems that do not serve them; advocacy against state violence and harm, disengaging, standardized, racist education, and food produced with unethical, unsustainable, or unhealthy practices (Brown, 2017; Gottlieb and Joshi, 2010; Hoglund et al., 2015; Ladson-Billings, 1998; Meiners, 2011).

Earth work

Environmental sustainability, justice, and coexistence: recognize intrinsic value of nature and organisms; recognize and use sustainable indigenous, non-Western practices (e.g. herbalism); increasing sustainability by recycling, composting, building solar panels; cultivating life, recognizing sentient beings as similar, recognizing plants as similar; remedying injustice in access to safe, stress-relieving environments; lasting shifts in environmental ideology and behaviors (Brennan and Lo, 2002; Brown, 2017; Brulle and Pellow, 2006; Groenewegen et al., 2006; Heynen et al., 2006).

Study methods

Recruitment

The author applied for and received research approval from the Offices of Human Subjects at the University of California, Santa Barbara and the New York City Department of Education (DOE). Based on a list provided by the Grow to Learn program within the NYC Department of Parks and Recreation, schools responding that they had active

gardening programs was 61, at 51 campuses. The student surveys were from 11 of the 51 public schools/campuses serving middle and high school students in Brooklyn, NY including 143 students who participated in surveys. Schools ranged from 49 to 100% racially minoritized students. Flyers were left in the school offices for student participants to complete, and students volunteered or were encouraged by garden facilitators to complete anonymous surveys about their experiences after completing consent forms.

Survey data collection and analysis

Using web survey platform Qualtrics, students were asked multiple choice and open-ended questions about their feelings and social interactions in the garden space, and their identity/demographics. The student quotes below include their answers to the open-ended questions: "What do you like best about the school garden? Feel free to provide a list if it helps." "What would an ideal school garden look like, with unlimited money, time, and people to support it?" and "Finally, how do you feel in the garden? Please take a few sentences to describe."

The open-ended questions were used to further probe what students gain, enjoy, and find lacking in the garden space. Student quotes are selected for representativeness and appropriateness toward the aim of liberation of young people of color. Insights about program elements described by adult garden leaders during separate interviews or surveys are also discussed below.

Student responses and program elements

Self work

The calm pace of gardening and being outside provided students space to take care of their mental health while at school. Students often found the garden more engaging than classroom learning. One student explained how it felt like a break from a factory like system of education. Additionally, students felt accomplished when they had a positive impact on people around them:

"I feel at ease, better than a classroom." (Male, Black, 18)

"I honestly love the garden. I love the fresh air, and the smell of the flowers. In addition, I can relax in the garden; it calms me down unlike other places. I feel at peace..." (F, Asian/Asian American, 13)

"I feel like I am doing something great for the community that is a small gesture but means a lot. "(F, Latina, 17)

"I also feel more calm in the garden and I feel more connected you can say to my peers because we're all helping each other and having a good time ." (F, Latina, 14)

Students were happy to pursue many individual interests. Their accomplishments included learning a new skill and seeing a project to completion. Some expressed finally being able to learn a skill that they enjoyed.

"For the first time I have [experienced] how it feels to actually grow your own plants and I feel proud…. I did hard work and I had patience to see the progress of the plants." (F, Latina, 17)

Of the elements listed in the framework, achievement, stress relief, interdependence, genuine engagement, and skill development were aspects of the garden experienced by varying degrees, by many students, but within all of the programs.

Group work

Students felt pride in the work they achieved collectively. They often had ambitions for how the garden could help their communities and those they care about; they wrote about how their collaborative efforts were part of the reason that the garden produced meaningful outcomes.

"The garden was a success because every student participated and helped in some way." (M, Asian American, 14)

"I like that we get to have fun while gardening and get to be with our friends and that it is helping the community." (M, Black/Multiracial, 11)

"I think that working in the garden helps everyone get along more. I also feel that seeing [what] we planted grew into flowers made me really proud of myself. " (F, Asian American, 13)

Many young people reported that their strongest takeaway from the garden was being free to open up about other topics in this space with peers and adults. Confiding in others

was important in helping students to come out of their shells (Van der Kolk, 2015; Ziguras, 2004).

> **"I like how I can share my ideas and people will listen." (M, Black and American Indian, 11)**
>
> **"Alongside having teachers who care about our education, we've been able to grow a garden out of literally just a piece of land. To me it's a great accomplishment." (M, Asian American, 14)**
>
> **"I feel like the garden is a place where you can share things you like that don't even involve gardening. A place where you can enjoy the time with your friend whether they are young or old." (F, Latina, 11)**

The garden brought people together in a unique way. The students' ability to express themselves confidently and to develop the ability to collaborate towards a shared goal may have been in part due to the feeling of safety many students cited about their respective garden spaces, which they largely attributed to their ability to open up with others and be at peace with their thoughts in the space; in another study, garden coordinators perceived that the pace of the garden was also physically safer for some students than in the playground (Craig et al., 2008; Ozer, 2007) Of the elements in the framework, the strongest takeaways of group work were safety, collective efficacy, cooperation, and reciprocity, while some students discussed the sense of inclusion or feeling welcome.

Community/societal work

" I love the garden. It has taught me a lot about farming and healthy food choices." (Female, Black, 18).

"[An ideal would be] a community that has everyone's interest and that has a special goal which is gardening and helping others." (Female, Black, 14)

"[What I like best is] the free food." (F, Asian/Asian American, 11)

The programs had many different focal points relevant to political and societal transformation, including nutrition, food access, and sustainability. Below are some notable examples of these themes as described by the facilitators:

- One organization hosted a *weekly farmers market* at the school with food grown by students; their mission was to *provide food to communities with less acces*s in Brooklyn.
- At one school, *food justice lessons* led some students to question the quality of cafeteria food they were being served, which began to worry the administration.

Some young people converted the food they grew into profit or value through creative, empowering means:

- One school had a *garden to school café* program.
- Another program sold low-cost produce in schools, and helped students to get *horticultural internships*, where *students taught younger elementary school students* about health and nutrition through demonstrations.

- One school's *culinary arts program* supplied vegetables to the cafeteria, which was a source of pride for the school community.
- In one *garden apprenticeship* program aimed at increasing access to fresh food and green space in the city, metro cards were provided to student participants to enable them to come outside of school hours to grow food, weigh produce, and bundle it for sale. The school noticed that young Black males were not graduating at as high a rate as their counterparts, and engaged many of them in their education through the garden apprenticeship program. The program coordinators tried once to host a *support group for students to talk about racism*, including police violence, which for some students was the only place they had talked about this in an organized group setting; their valuation of this support group led the garden to make these discussions more regular. The program brought students on their first *camping trips*, taking them outside the city. The paid facilitators in this program stressed a feeling of community and family in this program. As students advance in this apprenticeship, they are *entrusted with more leadership tasks and responsibilities*.

Connections to external organizations often allowed innovative leadership projects by youth. External support was often successful when well-funded because of direct involvement with consistent organizations and people who could dedicate ample time to the students and the garden work, which enabled students to develop skills and education to enact societal change. From the framework, the most frequent elements were shifts toward food justice and in some cases economic justice, engagement of the school community[17],

[17] However, in just as many cases the school community at large had little knowledge or interest in the garden.

student leadership, and in one case, a student support group on racism held within the garden space.

Earth work

Many students became environmental stewards after learning about organisms that inhabit living ecosystems, and how humans are a part of changing them. Gardening seemed to imbue a sense of compassion for the planet, and in some cases, action toward issues like climate change, ecosystem destruction and waste, and environmental pollution.

> **"By planting and harvesting we are not only eating good food but not polluting the environment." (F, Asian/Asian American, 11)**
>
> **"I think the garden is lacking in animal feeding stations. Bees, birds and other animals deserve to have food stored for the winter." (Nonbinary, Latinx/White, 12)**
>
> **"[My favorite part is] finding bugs in the garden to help our compost such as worms, spiders, rolly pollys, etc." (M, Black, 12)**
>
> **"I feel great in the garden and it has taught me that plants are living things… and we need to be careful with them." (F, Asian/Asian American, 14)**
>
> **"I [learned] why it is important to take care of the earth and recycle." (F, Black, 12)**

Ecological place meaning has been described as valuing ecological aspects of cities and expanding ideas of how they can be improved. Interpretive signage, discussions of relevant media, and meaningful storytelling can help strengthen these attachments (Russ et al., 2015).

"The garden is a place where you kind of take in nature and appreciate more. It makes me feel happy and warm because it's just a peaceful place to get to know people and learn more and more everyday about growing crops; and it's a safe place where you can leave your thoughts and feelings behind." (F, Latina, 15)

"I like to see the plants and flowers grow in the spring because the plants make me feel energetic." (F, Asian/Asian American, 13)

Many programs taught about natural processes like photosynthesis and decomposition, using class lessons, signage in greenhouses or plots, and composting programs.

One organization led a project where the students were asked to identify an area of great waste in the community, in order to target and abate it - the students chose the cafeteria. In many schools in the city, students are encouraged to take school lunch regardless of whether they'll eat it because of how schools are compensated for meals. Students at this school built a composter and held monthly conversations with the person in charge of the cafeteria, and they made plans to gather waste from the surrounding neighborhood. They appreciated the autonomy and collective leadership the teacher and the organization allowed.

One program is building the garden into a community center, with solar powered movie screens and outdoor shade covers. They taught about toxins in the city and natural processes of bioremediation (e.g. using fungi), for which they brought in experts to speak, due to its location at the site of a major oil spill.

Other progressive elements included in some of the programs included lessons on herbalism and indigenous farming methods: One school had a Quechua farmer teach about

indigenous Ecuadorean agricultural practices, which enabled students with the same cultural background to see themselves in this occupation.[18]

Many schools recycled, composted, planted different types of trees, and had other unique programmatic elements:

- Insect farming to feed to animals like frogs and fish in a *school zoology* program.
- A *seasonal butterfly garden*.
- Indoor growing systems that could persist in the cold New York City winters, including *hydroponics, greenhouses, and fish farms.*

Through small-scale projects, the students learned about and worked toward remediation of large environmental issues. All elements of earth work included in the framework were displayed at one school or the other, save lasting shifts in environmental ideology, which would need to be measured over a longer time period; but like all of the other components of the framework, the elements with the highest prevalence or impact on students varied by school.

Room for improvement from the student perspective

Students and staff alike felt there were some areas that the garden could improve; overall, they requested more space, more people to help, and more funding for equipment. Students wanted to increase the capacity of their gardens to better satisfy themselves, their peers, their communities, and the other inhabitants of the planet. Adults also frequently cited programmatic support and funding as severely limited (Oyewole, unpublished; Blair 2009).

[18] This school also at one point had a food justice component. This entire program was ultimately cut due to lack of funding and inadequate school planning and prioritizing.

The other suggestions varied, including planting more flowers, visibility, information sharing, tools, and fewer insect bites.

Some representative responses to "*What, if anything, do you feel that the school garden is lacking? Why*?" and "*What would an ideal school garden look like, with unlimited money, time, and people to support it?"* were:

- **"I think it is lacking care because sometimes after we take care of the garden once, we don't look back on it again."**
- **"I think the fullness of it is lacking because we haven't finished it yet so the area isn't truly what we want it to be. I personally think it is lacking tables and sitting space for students to really enjoy it."**
- **"I guess we would have better tools to help us harvest and grow. More people coming in to work and helping to make the garden grow more and more each day. Even might be easier to know we won't have to worry about not having this or the other. It would just help a lot conserving not only the plants and crops, but the people would more likely come more into the garden and purchase our products, and see we care for their produce very well."**
- **"[We would ideally have a] great farmers market, lots of crops, and lots of farm classes."**
- **"There would be more gardens around the school, outdoors ecology classes and, lots of extracurricular activities that involve the garden(s)."**
- **"It [would] also grow many fruits, vegetables, and medication plants. I believe that the most ideal garden should be helpful to everyone."**

Discussion: Liberatory elements in garden work

This paper explored the liberatory potential of school-based agriculture for young people of color in Brooklyn, NY.

The gardens had varying programmatic efforts and impacts. Schools with partnerships were able to derive lessons and programmatic support from external organizations and delve into a wide range of important topics; some others incorporated the garden into lesson plans of existing standard classes like science and English; other course work included the garden as a focal point in unique classes or clubs focused on sustainability, culinary arts, or job skills in horticulture. The efforts largely depended on the staff in charge, the resources available, and student participation.

Self work: While many programs enabled self-care and achievement, an element of racial identity and decolonization that is intentional would improve the liberatory potential of garden projects, and increase a garden's ability to rectify racial injustices that are perpetuated at the level of the self through encouraging self-love. At these predominantly Black and Latinx schools, a lot of the teachers were white, and U.S. public education curriculum tends to emphasize normative, European-American, male history and politics, science, and mathematics at the deficit of other cultures and systems. Uplifting young people of color in the garden may occur through culturally affirming activities. Only one garden mentioned above hosted discussions on issues of racism experienced by the students; other ideas include field trips to farms and non-European countries, visionary fiction and essay writing, creating art and plays, family trees to tie people to agrarian backgrounds and histories, and seeking positive media portrayal of farmers of color.

There are many ways the garden did and did not promote health. Many students expressed that they were happy to eat healthy foods they grew, and at a few schools, culinary arts programs empowered students with the life skill of cooking. Similarly, a garden-based nutrition program in Los Angeles was found effective in increasing preference for garden-grown fruits and vegetables in Latinx 4th graders after a 12-week period (Gatto et al., 2012) Herbalism and plant medicine courses were underrepresented but would be a critical way of tying young people to other forms of health care and ancestral practices in the Caribbean, Latin America, Africa, Asia, and Indigenous America. Mindfulness and emotional regulation are skills suited to natural spaces, and could be more explicitly taught in these programs, to heal trauma and to encourage liberatory thinking (Gatto et al., 2012). A related example is a successful program which has helped youth to overcome trauma through theater, which enables them to safely manage conflict and convey deep, personal truths to audiences (Van der Kolk, 2015). Additionally, a study of an intentionally designed one-year school garden program showed that students improved in self and collective dimensions of "working with groups" and "self understanding" (Robinson and Zajicek, 2005). There did not seem to be any discussions of body image or normative beauty standards, which could couple well with work in the garden space, when handled with sensitivity and compassion.

Group work: Cooperation and collective efficacy in small group settings facilitated by an uplifting mentor was a critical component of garden success and enjoyment. Collective efficacy has also been observed in community gardens, enabling participants to work together to address meaningful community issues (Ozer, 2007; Saldivar-Tanaka and Krasny, 2004). The ability of students to plug into multiple things they were interested in,

like building, planting, painting, and cooking, and free time to talk in a safe space, made them excited about cooperation with peers. In one study of school gardens, eating vegetables in groups was reported to promote higher consumption of vegetables and to improve health; further, students collectively achieved tasks they would not have in a regular classroom, enabling students who did not traditionally excel in the classroom to "shine" (Ozer, 2007). In these programs, leadership development was most observed in the apprenticeships, horticultural internships, and in the example of students abating waste in their community. Students can further their impact by using these skills and others to explicitly challenge community/societal inequalities and environmental issues that intersect with their schools, as discussed below.

Community/societal work: By providing food for the schools and the community, the programs reduce reliance on unfair food, but at what scale is this achieved? As size, support, and funding are frequently cited issues at school gardens, low-cost methods to scale up food production may expand impact; this could mean using hydroponic or aquaponic systems for year round growth, or using sub-irrigated planters during the summer when fewer staff and students are around.

Coalition building with community gardens and local farms in which both organizations benefit from involvement, is a strategy for success in changing local policies, but this often requires overcoming bureaucratic hurdles to working in schools (Gottlieb and Joshi, 2010). Organizing boycotts, sit-ins, marches, and informational campaigns are successful and established techniques in the food justice movement, and can be employed by school gardeners eager to change school and community food systems. Some school gardens currently donate produce and earnings from sales to homeless shelters and other community

based organizations (Ozer, 2007). In Oakland, CA one school opened a peace garden wherein a local sculptor and students worked together to construct a sculpture of guns, highlighting a pressing issue in this community (Ozer, 2007). These types of projects highlight successful school-community relationships facilitated by having a school garden.

Prison abolition organizing exists in agricultural and nonagricultural spaces, but work of this sort was not observed in these school gardens. Outside of this study, there is an alternative to incarceration program at Brook Park Garden in the South Bronx, where students work in a community garden under the guidance of mentor Ray Figueroa, instead of going to prison, in a successful model of reducing the number of young people of color in prison ("A Collaboration Thrives in the South Bronx," 2015). Soul Fire Farm in upstate New York has curricula for youth farmers, which connects land work to prison abolition, noting the historical ties between land, labor, prisons, and profit. They also teach about media images of food; organizing and leadership; psychological connections to land; art; and soil science ("Youth Program," 2014). In Philadelphia, a group of young people converted vacant land into Life Do Grow farm, and through a leadership program, they have reduced recidivism and nearly halved violent crime in the neighborhood ("EDUCATE," n.d.). Emphasis on youth incarceration was lacking in all of these school gardens, but in the future, prioritizing a decrease in [youth] imprisonment through education, advocacy, and incarceration alternatives, could be a transformative way for a school to manifest its commitment to the lives of young people of color.

Earth work: Many schools used food waste in their schools and turned it into an educational tool through composting. Similar to the section above, this work could span beyond re-use through organized student-led advocacy to *prevent* the generation of more

waste than can be used, which was done at some schools. Some school garden curricula have emphasized the efficacy of hands-on educations for teaching sustainable practices like recycling and composting (Blair, 2009; Gatto et al., 2012; Ozer, 2007).

Students also learned about the connection of insects, plants, soil, and themselves. Soil health campaigns could be a larger component of the garden outreach work, as only one school with a history of an oil spill in the community was currently heavily performing community environmental justice work; due to 20th century additions of toxic chemicals into everyday products, soils are toxic in many parts of the city (Cheng et al., 2015). [19]

Conclusion

There is great potential to pursue liberation for students of color within the school garden, and in so doing, to make the school work *for* the students and communities they serve, rather than requiring students to fit into a school's existing way of operating. School gardens in Brooklyn are engaged in many liberatory activities for students of color, including student leadership, stress reduction and improved nutrition, collective efficacy and collaboration, food justice work, environmental justice work, and environmental sustainability. There is room for improvement and intentionality in working toward these and other liberatory aims listed in the framework—particularly those that confront unjust social realities faced by communities of color[20]. In this study, education of this sort was

[19] The Principles of the Youth Environmental Justice Movement declared that government funded institutions work to incorporate environmental justice principles that perpetuate issues affecting marginalized youth (of color indigenous, immigrant, and undocumented), as well as putting more emphases on the histories and practices of people of these identities (Youth Environmental Justice Program, 2002).

[20] James Baldwin has made a similar call: "Now if I were a teacher in this school, or any Negro school, and I was dealing with Negro children, who were in my care only a few hours of every day and would then return to their homes and to the streets, children who have an apprehension of their future which with every hour grows grimmer and darker, I would try to teach them - I would try to make them know – that those streets, those houses, those dangers, those agonies by which they are surrounded, are criminal. I would try to

strengthened at a few schools, especially those in collaboration with external organizations, but there is room for improvement in promotion of things like self-love among students of color, reconnection to ancestral and indigenous practices, abolition work, and community organizing. Capacity and resources must be provided to the gardens to do this work. To fully understand the impact of these programs, further research should involve longitudinal assessment of student gardeners, including how a garden program has affected their engagement with diverse peers, with their communities, and their advocacy on societal and planetary issues. The next most elegant step[21] may be to use these insights to develop a strategic, customizable template to engage students of color in liberatory practices through the garden.

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make each child know that these things are the result of a criminal conspiracy to destroy him. I would teach him that if he intends to get to be a man, he must at once decide that his is stronger than this conspiracy and they he must never make his peace with it. And that one of his weapons for refusing to make his peace with it and for destroying it depends on what he decides he is worth. I would teach him that there are currently very few standards in this country which are worth a man's respect. That it is up to him to change these standards for the sake of the life and the health of the country. I would suggest to him that the popular culture – as represented, for example, on television and in comic books and in movies – is based on fantasies created by very ill people, and he must be aware that these are fantasies that have nothing to do with reality." ("'A Talk to Teachers' James Baldwin, 1963," n.d.)

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IV. Chapter 4 - Dirt Don't Hurt? Unearthing Disparities in Lead and Toxic Site Exposure in Brooklyn School Gardens

Keywords: school garden; lead; incinerator; GIS; remediation sites; environmental justice; urban

Abstract

Environmental toxins are distributed unevenly throughout urban soils, such that low-income and racially minoritized communities are often disproportionately exposed. Due to the detrimental effects of lead (Pb) on the cognitive development and health of young people, it is important to assess environmental safety within schools where students spend most of their days, and in school gardens, which have the potential to improve or worsen health depending on soil quality. In Brooklyn, a borough of New York, NY with complex histories of manufacturing, migration, discrimination, and displacement, we use GIS, web surveys, and statistical analysis to assess the relationships between marginalized populations and toxins in sampled public schools with gardens ($n = 31$). Using ANOVA, we found that the number of pollutant sites near schools with gardens increases with a school's proportion of Black and Hispanic/Latinx students ($p = 0.02$), and with the proportion of low-income students ($p = 0.09$), with the highest polluting site densities in the north, northeast, and northwest regions of Brooklyn. Using linear regression, we observed *statistically insignificant differences* in the relationship between a) school demographics and garden lead concentration, and b) school demographics and garden management practices, likely due to a small sample size of paired lead samples and survey responses ($n = 20$). The school garden

lead concentrations appear inversely related to the use of certain soil management practices that researchers and practitioners have observed to reduce lead concentrations, such as the use of raised beds or regular soil replacement.

Introduction

"In a pure economic sense, the costs of eradicating lead paint from houses is more onerous than the costs to treat persons diagnosed to have lead poisoning." – A member of the Property Owner's Association During a meeting of Maryland State's Lead Study Group in September 1984

Historically, the response of government agencies and corporations to lead poisoning has been painfully slow in the U.S., causing larger consequences to those communities and populations who are low-income, racially minoritized, and young (Brulle and Pellow, 2006; Bullard, 1993a; Fee, 1990; Harvey and Braun, 1996a; Markowitz, 2000; Peet et al., 2010). Lead (Pb) causes severe health impacts in the development of young people, from short-term issues like poor appetite, frequent severe stomach aches, and lack of focus, to long-term issues like poor academic performance, cancer, stress, asthma, and cognitive impairment (Barr, 2014; Fee, 1990; Markowitz, 2000; Mohai et al., 2011). In spite of this, 20 states in the U.S. have no laws restricting school siting near health hazards, and only 10 states expressly prevent it (Center for Health, Environment & Justice, 2011). Legacies of historical activities result in varying concentrations of heavy metals in urban agriculture (Cheng et al., 2015; McClintock, 2012), but there are few studies of heavy metal concentrations at urban schools and particularly, in urban school gardens.

Because lead binds strongly with soil particles, and it is not a necessary micronutrient for most plants or soil fauna, lead persists in areas of previous dispersal for decades (Laidlaw and Filippelli, 2008; Mielke et al., 1983; Unuabonah et al., 2007). Lead is released by a number of point and non-point sources, including roadways, old house-paint, and industrial facilities such as waste incinerators, recycling plants, and smelting operations (Campanella and Mielke, 2008; Diawara et al., 2006). Accordingly, proximity to industrial point sources is a correlate of heavy metal concentrations in soils (Nuckols et al., 2004). Furthermore, absent necessary preventive support, gardens in resource-poor schools may not be able to remediate environmental toxins. The distribution of lead is therefore based on historic and modern sources of pollution, access to social and economic resources for safe soil management, and resuspension and redesposition of polluted dust (Bullard, 1993a; Laidlaw and Filippelli, 2008; Mielke et al., 2010, 1983).

The spatial distribution of lead has arisen from a market economy built with an extensive history of institutional racism (Brulle and Pellow, 2006; Harvey, 2010; Harvey and Braun, 1996b; Williams et al., 2010). This history makes it particularly difficult for people of color to move out of neighborhood exposed to environmental risk (Charles, 2003), who are doubly-penalized because they less often have equal social and political capital to mobilize in opposition to these practices.

Debates persist about whether race or class ultimately determines the siting of unwanted facilities. The minority move-in hypothesis posits that people of color move into neighborhoods with unwanted facilities because of low prices, but evidence often shows that specific communities are being selected for location of these facilities (Brulle and Pellow, 2006; Bullard, 1993b). The history of lead poisoning provides one example of race being a

better predictor than class: race/ethnicity was the only variable that significantly correlated with child blood-lead levels in the Center for Disease Control's National Health and Nutrition Examination Survey (NHANES) III, with 28.4% of low-income Black children lead-poisoned compared to 9.8% low-income white children (Bullard, 1993b). In the U.S. as a whole, almost half of Black inner-city children are exposed to dangerous lead levels compared to 16% of their white counterparts (Harvey and Braun, 1996b). Latino children are more likely to suffer from asthma and lead poisoning than white counterparts (Brulle and Pellow, 2006). Indigenous American communities contend with the disparate siting of unwanted facilities such as lead smelters, landfills, radioactive disposal, and recycling facilities (Bullard, 1993b).

Though late 20th century policies have recognized and addressed some environmental inequality, environmental remediation is often slowed by bureaucratic processes (De Sousa, 2006). Communities of color may also experience slower or less complete remediation than white communities still today (Holifield, 2004). One contemporary example is the fact that the predominantly Black community of Flint, MI still does not have clean water, after a city official changed the city's water source from the Detroit River to the Flint River in 2014, which caused corrosion of lead pipes into residents' drinking water. Additionally, some critics of research on environmental racism obscure the debate by focusing on intentionality in siting practices rather than injustice in outcome (Pulido, 2000), a theoretical debate which also delays immediate action at a political level.

In Brooklyn, NY—a borough which would be the third most populous city in the U.S. if it were not a part of New York City—industrial sites like incinerators, mills, and textile factories opened and closed while numerous, overlapping demographic shifts occurred.

Industrialization and then deindustrialization between the 19th to 20th centuries coincided with changes in housing markets and residential patterns. Because of Brooklyn's location near a major port and waterways, it housed many sugar refineries and oil mills requiring labor, and by the late 18th century, migration patterns resulted in ethnically divided neighborhoods, mostly from European countries like Germany, the Netherlands, and Ireland. On the northern and western edges of Brooklyn, many sources of industry like textile factories and the largest shipbuilding center in the world emerged (Warf, 1990). Brooklyn's global linkages facilitated migration that was propelled by culturally and economically significant events, including but not limited to the Irish potato famine, and the exodus of Black Americans from the U.S. south in the 1920s (Warf, 1990). Contemporary residential patterns are linked to the specific migration patterns and ethnic segregation histories of each neighborhood (Warf, 1990).

Increased migration of Blacks from the south coincided with a decrease in real estate values as public services were removed in Bed-Stuy and surrounding communities like Bushwick, East New York, Flatbush, Crown Heights and Brownsville (Botein, 2013; Chronopoulos, 2016). Many whites fled from these neighborhoods as Blacks and Hispanics moved in, leaving to other Brooklyn neighborhoods like Canarsie (southeast), Boro Park, Bensonhurst (southwest), Gravesend, Sheepshead Bay, and Marine Park (south) (Warf, 1990). White-collar employment and middle-class status were more common in inland areas like Park Slope, further from the industrial zones. Unemployment, redlining, and withdrawal of public services caused impoverished living conditions in the urban, racially minoritized core. Many Puerto Ricans arrived by air following deindustrialization and 'white flight', which was a time of depressed property values and relatively affordable residence in

northern/central communities like Bushwick, Williamsburg, and Sunset Park. Other newer immigrants include people from China, who increased in numbers and gradually replaced Puerto Ricans, producing the third largest Chinatown in the city in Sunset Park (southeast Brooklyn) (Warf, 1990). Brooklyn is also the largest West Indian city in the world, mostly localized in Flatbush and surrounding areas, and spurred in part by Carter era policies raising immigration quotas from the Caribbean (Warf, 1990). As financial and business services have grown, racially minoritized populations have been displaced from communities like Fort Greene, Williamsburg, and Greenpoint (Anderson, 2012; Chronopoulos, 2016; Warf, 1990).

Residential proximity to polluting sites by race/ ethnicity varies within each borough of New York. Overall, and particularly within Brooklyn, Hispanic/ Latinx populations live nearest Toxic Remediation Inventory and other environmentally undesirable sites, which was found using generalized linear modeling with census tracts as a unit of analysis (Fricker and Hengartner, 2001). In a different study, economic factors and zoning were found to create a situation where Black communities were increasingly pushed toward manufacturing zones between 1970-1990 (Talih and Fricker, 2002). Redlining and subprime mortgage lending to Blacks in Bed-Stuy illustrates how these discriminatory practices decreased personal wealth. and how serial payment of high interests rates gradually decreased future mobility, ossifying Black communities in locations that were becoming more environmentally hazardous (Botein, 2013). In Brooklyn, eight municipal incinerators operated for varying periods of time and reached a peak in the 1920s, alongside thousands of domestic incinerators (Walsh et al., 2001). Though many of them closed within the decade, some persisted into the 1980s, leaving many tons of particulate matter in the surrounding

environment. Today caution is especially recommended in cities when handling soils for gardening, work, or play due to concentrated remnants of these toxins on the earth's surface.

Accordingly, safe management practices in urban gardens include using raised beds, importing fresh soils, and performing regular soil tests (Brady and Weil, 1996; Mitchell et al., 2014a). These procedures may be cost- and labor-prohibitive to some, including community or school gardens that lack sufficient programmatic resources (Mitchell et al., 2014a; Ryan and Heise, 2002; Warren, 2005). Lead concentrations are high in soils of many vacant land and gardens in NYC, often exceeding the New York State Soil Cleanup Objectives of 400 ppm for soils that grow edible crops (Mitchell et al. 2014;Cheng et al., 2015). Existing research about soil lead concentrations in NYC has not focused on school soils, nor has it been compared by demographic characteristics like race/ethnicity or income. In this study, we ask: 1) To what extent are there disparities in school proximity to polluting sites by student race/ethnicity, or income? 2) To what extent are there disparities in lead concentrations in school garden soils? 3) And, how do financial means, social resources, or safe management practices help to reduce soil lead concentrations within school gardens?

Methods

Site selection

The authors applied for and received research approval from the Offices of Human Subjects at the University of California, Santa Barbara and the New York City Department of Education (DOE). After calling the main offices at all schools on a list provided by Grow to Learn—the city government subdivision responsible for school garden administration within the NYC Department of Parks and Recreation—schools on 51 campuses responded

that they have active gardening programs. Recruitment flyers were left in the school offices, and adult staff members who led the garden programs volunteered to complete anonymous surveys about their experiences after completing study consent forms.

Survey questions

Staff members were asked survey questions with an online questionnaire through Qualtrics. The questionnaire asked about management and site characteristics, attention to soil health, and garden site descriptions. The material support questions asked about budget, constraints, and funding sources; the social support questions were about the number of adults, whether they were compensated, and whether there were staff, teachers, and volunteers who regularly participated in the garden. Soil management questions were chosen to understand whether schools were taking safe soil management against lead poisoning (Table 1). The responses to these four multiple-choice questions were evenly weighted and combined to create one value for safe soil management practices per school.

Table 1. Equally-weighted multiple-choice survey questions about soil management practices (20 point scale; each question is worth 5 points)

During the past 2 years, how frequently have soils been tested for heavy metals?
During the past 2 years, how frequently have fresh soils been added/imported?
How frequently do garden administrators document management practices in the garden?
What features does your garden have? [a]

[a] For this question, if "in the ground" was the only place where planting took place, the score was 0; if "in the ground" was selected along with other locations (e.g. raised beds), the score was 2.5, and if "in the ground" was not selected, the score was 5.

Polluting site data and geostatistical analysis

Polluting source data was derived from 1) environmental remediation site data from the New York State Department of Environmental Conservation (DEC) in the State Superfund,

Environmental Restoration, Brownfield Cleanup, and Voluntary Cleanup programs and 2) NYC historic waste incineration locations (Walsh et al., 2001).

School coordinates were obtained from the New York City Department of Education. Longitude and latitude were converted into the appropriate datum for the project (NAD 83/ UTM 18), and were combined and analyzed in QGIS version 3. Using the geostatistical processing package, one-mile buffers were created around each school, and polluting sources within each buffer ring were counted. Proximity analysis provides a surrogate for the area of impact surrounding a polluting source, which is a more accurate measure of exposure than simply determining whether the polluting source is in the same administrative boundary (e.g. ZIP code), but it is limited in that all polluting sources do not pollute in equal intensity or geographic range (Maantay, 2002).

Soil sampling and analysis

For soil sampling, after including all schools where garden leaders completed surveys, a random sample from the remainder of garden schools stratified by student racial/ethnic composition was selected, totaling 31 schools. Soil samples were taken in the gardens and school grounds for lead analysis. Five replicate samples per school to 5 cm depth in the school garden were sampled with hand trowels and homogenized for analysis in a bucket before placing a subsample into a plastic bag. School ground samples were obtained approximately 15 meters from the garden from uncovered soil, though in some cases the locations had minimal grass cover. The differences between school ground lead concentrations and soil garden lead concentrations were calculated at each school as a proxy for lead remediation within the garden, but these results were not significantly significant in

regressions by race or class (Appendix Tables A1, A2). Accordingly, in this paper, we focus on the analysis of garden lead concentrations, and proximity to polluting sources by race and class, while presenting summary statistics for the school ground lead concentrations in Table 2, and results from additional analyses in the appendix.

Soils were analyzed for lead concentration at Brooklyn College Urban Soils Institute. Each sample was measured in three replicates, and the average of the three was taken for statistical analysis.

Statistical analysis

Using Matlab version 2015a function *fitlm,* regression analyses were conducted to determine the relationship between number of polluting sources within a one-mile radius and 1) school ground heavy metal concentration, 2) garden heavy metal concentration, and 3) proportion of Black and Hispanic/Latinx students and 4) proportion low-income students (n=31 schools). School-level demographic information was obtained from the NYC Department of Education, and eligibility for free or reduced lunch was used as a proxy for low-income status.

ANOVA (function *anova1*) was used to assess the following relationships:

- Proportion racially minoritized students and soil management score
- Proportion low-income students and soil management score
- Proportion racially minoritized students and garden lead concentration
- Proportion low-income students and garden lead concentration

For the smaller number of schools with matched soil and survey data (*n = 20*), the relationships between garden lead concentrations and the variables 1) soil management, 2) material support, and 3) social support were compared using linear regression analyses.

A summary of school demographics, soil lead concentrations, hazardous sites located within a one-mile radius of the school, and soil management score is presented in Table 2.

Table 2. Descriptive Characteristics of Brooklyn Schools in Study *(n = 31*)*

Characteristics	**Mean (Std)**	**Min**	**Max**
Proportion Students in Poverty	0.81 (0.11)	0.53	1.00
Proportion Black + Hispanic Students	0.81 (0.21)	0.28	1.00
Garden Lead Concentration (ppm)	73.70 (62.21)	13.33	300.33
School Ground Lead Concentration (ppm)	146.72 (86.06)	35.00	393.00
Hazardous Sites in 1 Mile Radius	9.00 (8.90)	0.00	39.00
Soil Management Score* (n = 20)	9.10 (3.28)	2.50	14.00

Results

Polluting sites are clustered along the edges of Brooklyn, particularly in the north, northwest, and east (Figure 1). Figure 1 displays a map of the polluting sources and one-mile buffers around the schools, without point locations of the schools for privacy as mandated in our human subjects protocol.

A statistical increase in the proportion of Black and Hispanic/Latinx students corresponds with an increase in the number of polluting sources within one mile of schools (Figure 2). The same is found with poverty to a degree, though there are outliers, and poverty does not correspond perfectly with race (Figure 3).

Figure 1. Polluting sites near Brooklyn, NY middle and high schools with gardens

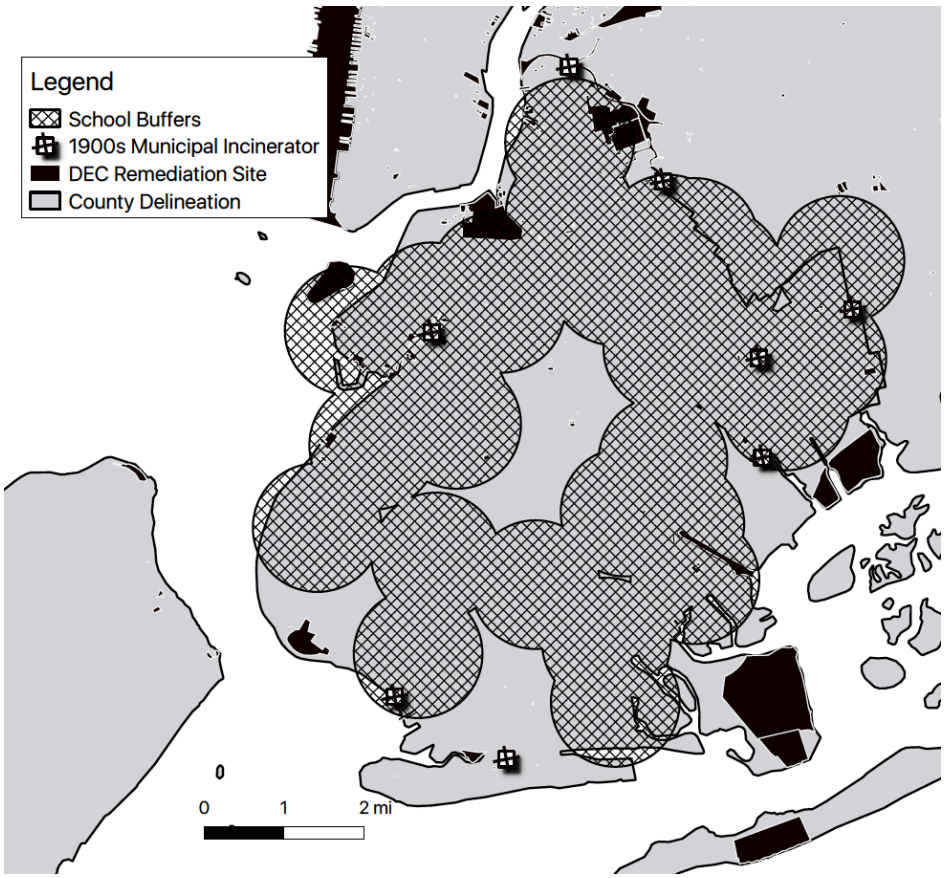
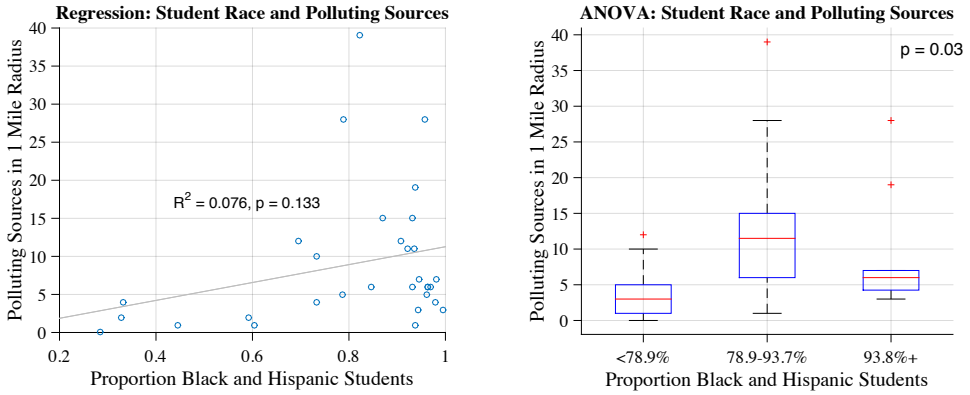


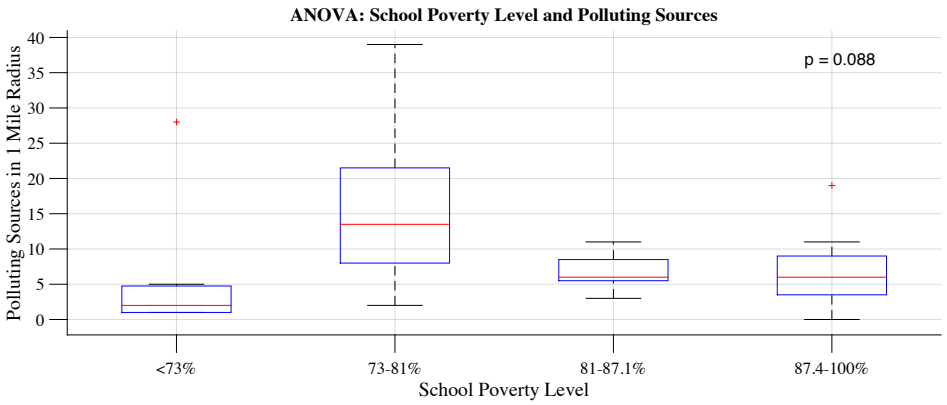
Figure 2. Regression and ANOVA comparing student race/ethnicity and number of polluting sites within a 1-mile radius



In the ANOVA, schools are split into thirds by racial/ethnic composition.

Least squares regression line equation: $y = 11.75\ (7.61)x\ -\ 0.49(6.34) + E$

Figure 3. ANOVA comparing number of polluting sites within a 1-mile radius by school poverty level

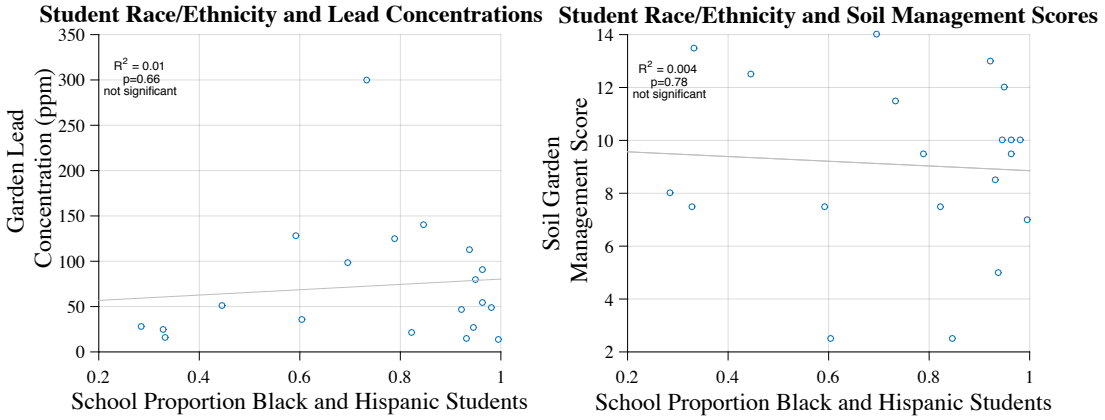


In the ANOVA, schools are split into fourths by poverty level.

The average lead concentrations in the gardens and school grounds were 73.70 ppm (std. 62.21) and 146.72 ppm (std. 86.06), respectively (Table 2). Using linear regression, garden lead concentrations gradually increase with the proportion of Black and Hispanic/Latinx students, though this increase was not statistically significant. This overall increase in lead concentration appears to correspond with an overall decrease in safe soil management practices (Figure 4).

In our analysis, there was no statistically significant relationship between garden resources (social, material, management score) and lead level in the garden according to a multiple linear regression (Appendix Table A3). Further, there is not a significant relationship between the number of pollutant sites and the garden or school lead concentrations (Appendix Tables A4, A5).

Figure 4. Linear regression of student race/ethnicity, garden lead concentration, and garden management score



Least squares regression line equation (Lead): $y = 29.40\ (65.74)x + 50.95\ (51.87 + E$

Least squares regression line equation (Management): $y = -0.89\ (3.20)x + 9.75(2.52) + E$

In our analysis, there was no statistically significant relationship between garden resources (social, material, management score) and lead level in the garden according to a multiple linear regression ($p = 0.722$, $n = 20$). Further, there is not a significant relationship between the number of pollutant sites and the garden or school lead concentrations.

Discussion

The number of polluting sites increased with the proportion of Black and Hispanic/Latinx students, which is expected given the typical siting of polluting sites in relation to racial or ethnic minorities. Studies on environmental racism within schools are somewhat limited but in the Los Angeles Unified School district it was found that racially minoritized students and particularly Hispanic/Latinx students are more likely to attend schools near toxic facilities, exposing them to higher health risks (Pastor et al., 2002). In Sacramento, a significant positive relationship was also found between schools serving

Black and Hispanic students, and PM 2.5 emissions from road traffic at school sites (Gaffron and Niemeier, 2015).

The density of polluting sites was highest in areas of north, northeast, and northwest Brooklyn, and lowest in the southeast and southwest. This too roughly coincides with the demographics of Brooklyn such that high proportions of Black and Hispanic/Latinx people live in north and northeast in neighborhoods like Bushwick, East New York, and Brownsville, and the proportions of European Americans and Asian Americans is generally higher in the southern parts of the borough, in neighborhoods like Bensonhurst Marine Park, and Brighton Beach (Brown and Wyly, 2000; Warf, 1990).

These patterns in Brooklyn can be said to reflect a mix of multiple factors. At times polluting sources are deliberately cited in neighborhoods with more people of color, capitalizing on their lower social and political capital to resist the racist citations of pathogenic facilities (Bullard, 1993a); there are other times when whites have moved out of areas where they used to live, close to industrial work sites (Austin and Schill, 1994); and at times, housing intended for low-income Hispanic/Latinx and African-American communities is built next to polluting facilities because of the cheaper cost of land (Austin and Schill, 1994).

In this study, we observed that garden leaders may perform fewer designated safe management practices (Table 1), and the lead concentrations of gardens increase as the proportion of Black and Hispanic/Latinx students increased; however, neither of these trends were statistically significant, likely due to our low sample size. The opposition of these trends lines however suggests that management may be important in remediating soil lead concentrations (Figure 4). However, low average garden soil lead concentration relative to

average school ground soil lead concentration suggests that many school gardens are already employing healthy management practices (Table 2); and this may be aided by the fact that the administrative organization Grow to Learn recommends management practices to all of the schools that have registered their gardens with the city. Few schools had plants only in the ground (n = 2), but many schools had not conducted soil tests (n = 16) or replaced soils (n = 5) in the past 2 years. In cities, the redesposition of lead from air particulates likely necessitates regular replacement of soils to avoid surface dust accumulation of lead (Laidlaw and Filippelli, 2008; Mitchell et al., 2014a). Overall, the garden leaders seem to be managing soils in ways that reduce exposure to lead, but there does appear to exist a marginal racial/ethnic disparity in both the lead levels and the garden soil management; the scope of our survey questions, or our small sample size, were perhaps not adequate in capturing [the reasons behind] this possible trend.

Thus, our study is limited in a few ways: It is limited by a small sample size in which statistically significant differences were not observed for some possible trends. It is possibly limited by a question scope that did not capture the full range of management practices that would lead to soil lead concentrations being high or low. For example, it is possible that a comparison of the physical realities of the gardens would garner better correlations with the lead concentrations, such as the presence or absence of wall debris with lead-based paint (Mitchell et al., 2014b), or the garden proximity to roadways (Gaffron and Niemeier, 2015). Still the study demonstrates preliminarily that environmental injustice exists at the school level in the number of potentially hazardous sites near young people of color in schools. Our study is also limited in that we did not analyze toxic chemicals other than lead, of which there are many. Future research may look at atmospheric deposition in a longitudinal study

of many sites, in an attempt to gather recommendation for *how often* soil replacement should occur, because it seems that already many gardens are performing best practices of using raised beds and frequently importing fresh soil[22]. Finally, one limitation of simple proximity analysis is that we are unsure of the chemical compositions of the incinerations, spills, or other sources of pollution – lead is not the only chemical in these contaminants and may be a small or large proportion of their composition, as our findings of non-significance of lead concentration by proximity to polluting sites implies (Appendix Tables A4, A5), suggesting a need to study additional chemical analytes.

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[22] Indeed, one Brooklyn school on the site of a former oil spill has hired a mycologist to demonstrate fungal remediation of soil toxins to students – a practice that could be expanded to other polluted sites in the borough.

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Chapter 4 Appendix

Table A1. Estimated Coefficients from Linear Regression, Effect of Proportion Black and Hispanic Students on Difference in Lead Concentration (School Ground - Garden)

	Estimate	SE	tStat	pValue
Intercept	136.28	72.7	1.87	0.07
Difference: School Ground - Garden	-78.37	87.24	-0.9	0.37

Number of observations: 31, Error degrees of freedom: 29

Root Mean Squared Error: 101

R-squared: 0.0271, Adjusted R-Squared -0.00648

F-statistic vs. constant model: 0.807, p-value = 0.376

Table A2. Estimated Coefficients from Linear Regression, Effect of Proportion Students in Poverty on Difference in Lead Concentration (School Ground - Garden)

	Estimate	SE	tStat	pValue
Intercept	10.669	131.83	0.08	0.94
Difference: School Ground - Garden	11.04	161.3	0.48	0.64

Number of observations: 31, Error degrees of freedom: 29

Root Mean Squared Error: 102

R-squared: 0.0078, Adjusted R-Squared -0.0264

F-statistic vs. constant model: 0.228, p-value = 0.637

Table A3. Estimated Coefficients from Multiple Linear Regression on Variables Influencing Lead Concentration within the School Garden (n = 20)

	Estimate	SE	tStat	pValue
Intercept	44.94	77.97	0.58	0.57
Soil Management	-1.18	5.99	-0.2	0.85
Material Support	3.33	2.9	1.15	0.27
Social Support	0.15	4.71	0.03	0.98

Number of observations: 20, Error degrees of freedom: 16

Root Mean Squared Error: 70.9

R-squared: 0.0774, Adjusted R-Squared -0.0956

F-statistic vs. constant model: 0.447, p-value = 0.722

Table A4. Estimated Coefficients from Linear Regression, Effect of Polluting Sources in 1-mile radius on Garden Lead Concentration

	Estimate	SE	tStat	pValue
Intercept	72.28	16.21	4.46	<0.0001
Garden Lead	0.16	1.28	0.12	0.9

Number of observations: 31, Error degrees of freedom: 29

Root Mean Squared Error: 63.3

R-squared: 0.000516, Adjusted R-Squared -0.0339

F-statistic vs. constant model: 0.015, p-value = 0.903

Table A5. Estimated Coefficients from Linear Regression, Effect of Polluting Sources in 1-mile radius on School Ground Lead Concentration

	Estimate	SE	tStat	pValue
Intercept	154.49	22.34	6.92	<0.001
School Ground Lead	-0.86	1.77	-0.49	0.63

Number of observations: 31, Error degrees of freedom: 29
Root Mean Squared Error: 87.2
R-squared: 0.00812, Adjusted R-Squared -0.0261
F-statistic vs. constant model: 0.238, p-value = 0.63