Waste Not

Schools as Agents of Pro-Environmental Behavior Change in Chicago Communities

RACHEL WHALEY, AB '15

I. Introduction

As cities across the United States struggle to balance their budgets many question the cost-effectiveness of offering municipal recycling services. The city of Chicago recycles only 11 percent of its solid waste through its municipal residential-recycling program, which is less than the 34 percent average recycling rate for cities across the United States (Tweed 2013). This low rate is troubling for many reasons, not least because studies show that recycling is most cost-effective when at least one third of the waste stream is being recycled. In order to make Chicago's recycling program financially sustainable, the city must increase its recycling rate. One of the reasons for Chicago's low overall recycling rate is that this rate varies widely within the city. The city's North Side recycles nearly 20 percent of waste, while the South Side recycles a little over 5 percent of its waste (Chicago Data Portal n.d.).

At the end of 2013 two important recycling initiatives occurred in Chicago: the Blue Cart residential-recycling program was expanded to the entire city and the Chicago Public Schools (CPS) signed a five-year contract with Lakeshore Recycling Systems to offer recycling in all public schools (Chicago Board of Education 2013). For the first time it is

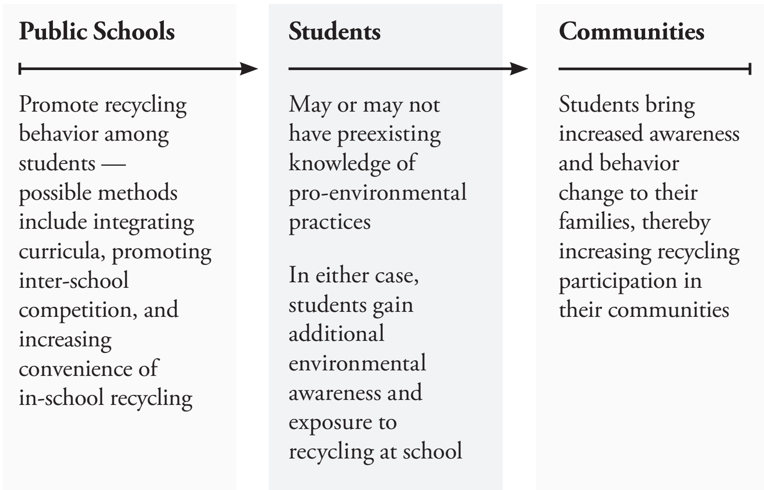

Figure 1. Theory of Change for Community Environmental Behavior

possible to compare recycling rates in schools to those in the surrounding communities. This study combines these two data sources with demographic data to create a more nuanced picture of Chicago's recycling trends and argues that schools can positively affect recycling behavior in communities. Ultimately, I make recommendations about how the city and schools can best work together to increase pro-environmental behavior among Chicagoans and reap the financial and environmental benefits of sending less waste to landfills.

My study will analyze and compare data from Chicago's Blue Cart recycling program with neighborhood demographics and public school recycling programs to assess the following questions: whether schools recycle at rates comparable to the neighborhoods in which they operate; how neighborhood demographics correlate with recycling rates; and whether school recycling programs are effectively instilling recycling habits in students. I will put forward a theory of change (Figure 1) that proposes a series of conceptual links between student experiences with

recycling in schools and improved recycling outcomes in the community. The following analysis will test this theory using recent data from Chicago's Blue Cart and public school recycling programs.

By approaching public schools as a mechanism to improve community recycling behavior, this study will also reflect upon a set of larger policy questions: whether efforts to promote recycling in public schools will allow the city of Chicago to reap greater environmental benefits, increase community participation, and improve the economic sustainability of its Blue Cart recycling program.

II. Background

Federal waste-management policy has delegated most of the responsibility for waste management and recycling to state and local governments. Due to this delegation of responsibility, Chicago has a history of municipal recycling programs that have come and gone. Today, Chicago operates its Blue Cart recycling program under tough scrutiny of the costs and benefits for communities. This section explores three critical areas for understanding present-day recycling in Chicago: the history of federal waste-management policy; contemporary studies of the costs and benefits of recycling; and the evolution of recycling policies in Chicago in response to these pressures.

Role of Federal Government in Promoting Recycling in the United States

In the early twentieth century, after the federal government began to regulate the disposal of waste in waterways, land disposal became the most common fate of solid wastes (Phillips 1998, 22). Practices typically consisted of open-pit dumps that left garbage to accumulate without any oversight or management (Hunsaker-Clark 2012, 839). By the 1950s Americans began to realize that the "throwaway culture" of single-use disposable products was generating a massive amount of solid waste

(Jacobson 1993, 120). Amid postwar prosperity, many Americans, who had lived through the economic necessity of reusing household materials during the Great Depression and the civic duty during the war of recycling materials to support the armed forces, reveled in the ease, convenience, and modernity of disposables (Weeks 2007, 1046). This expanded as "industry… sold the idea that single-use, throw-away items were absolute necessities of a modern lifestyle" (Strong 1997, 32). In response, the environmental movement of the 1960s worked to promote solid-waste management as an important health and pollution-control problem rather than just an aesthetic one (Hunsaker-Clark 2012, 840).

Increasing urbanization and suburban sprawl in the postwar era also contributed to waste-management policy. Growing cities scrambled to find ways to manage waste in high-density areas, resorting to large landfills or incinerators just outside city limits (Weeks 2007, 1,045). But city residents complained about the smell and appearance of these sites, and neighborhood groups lobbied local governments against locating these facilities in their neighborhoods. For example, in 1953, when residents became alarmed at the untreated runoff from a landfill on the South Side of Chicago, they organized to push the city to improve its operating procedures and to open an incinerator, which was less of a nuisance to residents than the landfill (Pellow 2004, 42). Environmental groups, as well, pushed for the expansion and improvement of recycling programs in Chicago, citing the lack of landfill space in Illinois and especially in Cook County (IL EPA 2014). Cities across the nation witnessed similar protests throughout the 1950s and 1960s (Pellow 2004).

Strict zoning regulations in the rapidly expanding suburbs forced cities to look farther and farther outside city limits for landfill sites (Pellow 2004, 44). Influenced by the environmental movement and citizen complaints about pollution, city public officials began to realize that existing waste-management practices were posing public-health risks. Many local officials began to call for federal regulatory action on waste management (Phillips 1998, 26). Beginning in 1963 mayors of Chicago, New York, and other cities called on the federal government to act on solid-waste management (Phillips 1998, 22). President Lyndon B. Johnson supported their concerns. He saw pollution as one of the many serious social issues he hoped to address with his Great Society programs (Hunsaker-Clark 2012, 840). Johnson recommended that Congress pass legislation to "assist the states in developing comprehensive programs for some forms of solid waste disposal [and] provide for research and [the] demonstration of projects leading to more effective methods for disposing of or salvaging solid wastes" (1966, 163). The president's support, combined with his argument that improved waste management was an important part of his overall social reforms, led to the passage of the Solid Waste Disposal Act (SWDA) in 1965.

The most important contribution of the SWDA was that it thrust solid-waste management into public consciousness as a major issue affecting public health and environmental well-being. The SWDA and its amendments allocated federal funding for research on waste-management practices to promote improvements in waste-management technology. This funding led state and local governments to pay unprecedented attention to solid waste-management practices. Through many subsequent amendments and new pieces of legislation, the SWDA (and federal solid-waste policy more generally) has upheld the principle that local and state governments should deal with waste management (US EPA, ORCR 2011, 17). The first amendment to the SWDA was the 1970 Resource Recovery Act, which shifted the focus of the federal government's involvement away from waste disposal towards "recycling, resource recovery, and conversion of waste to energy" (Roberts 2011). In the same year the U.S. Environmental Protection Agency (EPA) was created to oversee federal waste-management policy (US EPA 2014). The Resource Recovery Act represented the first significant support from the federal government for policies that recovered materials rather than disposed of them (Gumm 2012, 750). With resources provided by the SWDA and the Resource Recovery Act, all fifty states had adopted solid waste regulations by 1975 (Phillips 1998, 26). This was major progress, since no state had been regulating solid-waste disposal just one decade earlier (Phillips 1998). However, as the environmental movement grew alongside consumerism and throwaway culture through the 1970s it became clear that the federal government would need to play a greater role in regulating solid-waste management nationally.

The Resource Conservation and Recovery Act (RCRA), which passed in 1976 as another amendment to the SWDA, became the most comprehensive federal action on solid-waste management. RCRA gave the EPA authority to spell out "explicit, legally enforceable requirements for waste management" as well as "guidance documents and policy directives [to] clarify issues related to the implementation of the regulations" (US EPA, ORCR 2011, I–2). The scope of the RCRA, which included all hazardous- and nonhazardous-waste management, created vast new domains of responsibility for the EPA. Even with this increased scope, the EPA maintained the role originally laid out for the federal government in the SWDA: making recommendations, setting minimum federal criteria for waste-management practices, and providing information to local and state governments; states and regional offices still managed implementation and enforcement (US EPA, ORCR 2011, I-4). In part the RCRA was successful: by 1986, two thirds of the nation's landfills closed (Phillips 1998, 31). In part it was unsuccessful: a Government Accountability Office study reported that the Department of Commerce, which was supposed to stimulate and develop markets for recycled materials (subtitle E, RCRA), had yet to act (Stephenson 2006, 5).

No additional federal laws or amendments related to solid-waste management have been passed since minor amendments to the SWDA and RCRA in 1984, 1992, and 1996 (US EPA, OSWER 2013). Today, the regulations of the SWDA and its amendments continue to govern solid-waste management in the United States (US EPA, OSWER 2013). As such, there is no federal legislation or policy in the United States that addresses solid waste recycling in homes, cities, or schools, leaving cities like Chicago to develop and manage their own programs.

The SWDA and its amendments brought improvements to waste-management practices in individual cities, but these pieces of legislation

do not form a comprehensive solution. They fall short in many ways of their stated goals of decreasing waste and protecting human and environmental health. None of this legislation has changed or challenged American consumption habits, which means that the consumption of disposable goods has continued to increase over time (Pellow 2004, 58). Manufacturers continue to extract larger and larger quantities of natural resources to meet consumer demands, with little oversight from the Department of Commerce, which has failed to stimulate the market for recycled materials. In response to DOC inaction, President Clinton issued an executive order in 1998 requiring that paper and other goods purchased by federal agencies contain a minimum percentage of post-consumer waste, which provides a small amount of much-needed stability for recycled-materials markets (Executive Order 13101 1998, 49,649). Many state governments, including Illinois, have followed suit, and these practices have played a small but important role in developing markets for goods made from recycled materials (Weeks 2007).

In spite of these efforts, the global demand for recycled materials remains unstable, leaving many American cities, states, and recycling companies operating recycling programs at a loss (Weeks 2007, 1,052). In 2002, responding to a tight city budget, New York City cut its recycling program for two years, and other cities have also cut back on recycling in response to financial pressures (Weeks 2007, 1,045). Scholars continue to debate whether solid-waste recycling is financially sustainable, especially as more cities and states delegate recycling to private contractors (Bohm, Folz, Kinnaman, & Podolsky 2010). Another concern is large waste-management corporations involved in recycling who are motivated by profits, sometimes at the expense of the best environmental practices (Weeks 2007, 1,051).

Congress has recently considered a few federal waste-management-related bills, including a national program for recycling computers and other electronics and a national "bottle bill" to expand existing programs to recycle plastics and aluminum (Weeks 2007, 1,050). However, since existing legislation delegates most responsibility for waste management to local governments, city and state officials must also increase efforts to improve waste management and recycling rates in their communities.

Recycling Benefits Communities

In the 1970s activists promoted the practice of bringing waste to recycling centers more as an effort to raise environmental consciousness than to make recycling a self-sustaining practice (Gottlieb 1993). Today, global markets for recycled materials, especially metal, make recycling a theoretically attractive revenue generator for local governments. However, market volatility can make recycling less attractive to local governments on tight budgets (Stephenson 2006).

Local governments can maximize cost-effectiveness by the economies of scale: the decrease in operating costs that occurs once the quantity of recycled materials passes a certain threshold. Even critics of recycling concede that once recycling programs reach a certain volume municipalities can save money over disposing of all of their wastes (Bohm, Folz, Kinnaman, & Podolsky 2010). A recent study of a New York municipality indicates that approximately 31 percent of total waste must be diverted into recycling programs for cities to see the most financial benefit (Tonjes & Mallikarjun 2013). In 2014 Chicago recycled on average only 11 percent of waste, proof that the city needs to promote recycling if it is to realize profits (City of Chicago 2015). Additionally, exposing individuals to recycling can cause them to adopt other pro-environmental behaviors, including water and energy conservation practices (Thomas and Sharp 2013). The city may reap additional environmental and financial benefits by devoting public-outreach resources toward recycling.

Pro-environmental policies and practices have other indirect benefits. Cities that promote environmental sustainability are attracting larger proportions of more young adults (Juday 2015). Cities that promote recycling along with other environmental initiatives present an image of modernity and sustainability that is important to young professionals as they choose where to live and work. In this way, Chicago can both improve its environmental reputation and foster economic growth.

Recycling in Chicago

Chicago currently operates a "Blue Cart" program, as distinguished from its previous "blue bag" program, which was ineffective and too costly given its limited environmental impact (Weinberg, Pellow, & Schnaiberg 2000). The Blue Cart program is single-stream; all recyclable materials are collected in the same bin, which attracts higher participation rates than programs that require residents to separate materials (City of Chicago 2015). The pilot began in 2007 in seven Chicago communities and was expanded over a period of seven years. By the end of 2013 the city collected recyclables every other week from all single-family homes and two-, three-, and four-flat buildings in Chicago at no charge (City of Chicago 2015).

Chicago's Department of Streets and Sanitation (DSS) oversees recycling. The DSS divides the city into six zones; the city collects in zones two and four and contracts collection to private companies through a competitive bidding in the remaining zones (City of Chicago 2015). Waste Management, Inc., collects in zones one, three, and six, and Simms Metal Management Recycling collects in zone five (City of Chicago 2015). Landlords of multiunit buildings (five flats or larger) must contract with a private hauler; DSS does not track or report on multiunit recycling rates (City of Chicago 2015). The Chicago Public Schools (CPS) contracts with Lakeshore Recycling Systems, another private waste-management company, to offer recycling services to all 658 public schools in Chicago (Engineer 2014). Lakeshore Recycling Systems publishes data on recycling in public schools as part of its contract with CPS.

III. Literature Review

The Blue Cart recycling program is an exciting opportunity to engage all city residents in recycling. However, given Chicago's low recycling rate compared to other major U.S. cities (Table 1), the city will need to review and improve its current strategies for public outreach about recycling.

To explain Chicago's low rate, this section closely examines the roles of attitudinal, demographic, and behavioral factors in shaping individuals' participation in recycling. I will also explore the connection between public-school and community recycling behaviors in order to determine how the city can more effectively target outreach efforts to improve recycling citywide.

Schools as Mechanism for Promoting Pro-Environmental Behavior

The city needs to promote both institutional change and behavior change, especially in the neighborhoods with the lowest recycling rates. Public-school systems are in the unique position of both benefitting financially from recycling and helping to instill recycling habits in the community's youngest members. The Chicago Public Schools (CPS) offers recycling services in all of its schools, but recycling rates vary widely from school to school, indicating that some schools and communities are not supporting recycling efforts as much as others. The potential benefits of recycling for schools are significant: a 2014 study in Minneapolis shows that raising the rate of recycling in public schools can cut the waste-management budget of a large public-school system in half (Chavez 2014). Chavez's analysis finds that the district pays less landfill tipping fees associated with bringing waste to a landfill. Though haulers may have to pay recycling tipping fees instead, these are typically much less than landfill tipping fees (Chavez 2014, 54).

Table 1. Recycling Rates in Select U.S. Cities
(Tweed 2013; City of Minneapolis n.d.)

City	Solid-Waste Recycling Rate
Seattle (2013)	60%
National Average (2013)	34%
Minneapolis (2014)	25%
New York City (2013)	15%
Chicago (2014)	11%

A large body of research indicates that schools have the capacity to instill behavioral patterns in students that differ from behavioral norms in surrounding neighborhoods (Chavez 2014). A comparative study of Colorado high schools has shown that schools that make an integrated effort to introduce environmental awareness into school culture see significant increases in pro-environmental behavior at an individual level, as well as significant financial savings from decreased school energy costs (Schelly et al. 2011). The integrated approach succeeds when school leaders focus on environmentalism, the school adds an ecology and environmental-science curriculum, and a teacher spearheads the effort and encourages fellow teachers to participate (Schelly et al. 2011, 329). Vaughn Occupational High School in Chicago followed the integrated approach. Math and science teachers use recycled materials in class projects, which the school's building engineer supports by storing eco-friendly cleaning supplies in reusable containers (Chicago Public Schools n.d.). CPS could promote pro-environmental behavior change in thousands of Chicago students each year by expanding these practices across the district.

Some scholars argue that promoting recycling behavior in schools is only effective if students' parents also encourage pro-environmental behaviors at home (Thomas & Sharp 2013). However, studies of in-school behavioral interventions suggest that the positive effects can flow in the opposite direction, back to the home environment. A study of a school-based obesity-prevention program (with curricular and behavioral components) found that the program had a positive impact on children's behavior, eating, and exercise habits overall, even outside of school

(Hollar et al. 2010). An environmental-education program in Tokyo elementary- and junior-high-school science classes promoted behavior change in children, which lead to increased awareness and behavior change in their families (Hiramatsu et al. 2014). In this first major evaluation of the effects of children's environmental education on families, Hiramatsu et al. found that children's increased awareness of environmental issues, increased knowledge of the effectiveness of pro-environmental practices, and increased practice of pro-environmental behavior (as promoted by the program) led families to report increased levels of interest and pro-environmental behavior. The authors identify two mechanisms for these changes in families' behavior: (1) families hearing from the children directly about the benefits of pro-environmental behavior; and (2) families observing pro-environmental changes in their children's behavior. In particular, the study found "the higher the awareness of the child, the greater the spillover effect on the family as a result of education" (2014, 49). While results of public outreach campaigns on recycling have been mixed, this encouraging new research shows that spreading pro-environmental behavior through existing channels at public schools can be more effective (Sidique, Joshi, & Lupi 2010).

Schools can take many different approaches to integrate environmental awareness into their curricula. A 2014 study found that the most important factor determining pro-environmental behavior is a person's attitude toward nature; environmental knowledge was a secondary factor in influencing behavior. Individuals are more likely to seek out pro-environmental behaviors after achieving "a certain level of appreciation for the environmental system" (Roczen, Kaiser, Bogner, & Wilson 2014, 978), and individuals who read pro-environmental literature (for example, Rachel Carson's *Silent Spring* or Aldo Leopold's *The Sand County Almanac*) are more likely to engage in more pro-environmental behavior (Mobley, Vagias, & DeWard 2010). Schools could incorporate grade-level pro-environmental texts into existing curricula, though more research is needed to determine how much exposure to this type of literature is necessary to promote behavioral change.

While school leaders and teachers who are personally invested in environmentalism can be successful in promoting pro-environmental behavior in their schools, Schelly et al. argue that inter-school competition over pro-environmental behavior, introduced through a simple mechanism such as a report comparing the performance of schools on environmental and energy-use metrics, "seems effective in motivating behavioral change in a school setting" (2011, 338). With so many possible strategies to promote recycling behavior among students and schools, more research is needed to determine which of these practices would be most effective if expanded across the district.

Demographic and Neighborhood Factors that Effect Environmental Behavior

A neighborhood's rate of participation in recycling programs is typically correlated with race, income, and education level (Pellow 2004). The mechanisms at work here are complex. Environmental attitudes matter for behavior (as will be discussed in the next section), but these attitudes also vary along racial and socioeconomic lines. There is strong historical evidence to suggest that the environmental attitudes of racial and ethnic groups have been shaped by decades of environmental racism, a term used to describe how racial and ethnic groups are disproportionately subject to environmental deterioration and mismanagement (Pellow 2004, 8). Dozens of studies published throughout the 1990s show that racial and ethnic minorities (primarily African Americans, but also Latinos and Native Americans) are significantly more likely to reside near a waste-management facility, near a hazardous waste-disposal site, near an incinerator, and in areas with high levels of pollution, high incidences of lead poisoning, and high levels of illegal garbage dumping (Pellow 2004, 69), which result from racially biased decisions about the siting of these facilities (Pellow 2004, 9). In his 1994 executive order, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," President Clinton stating that "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States" (Clinton 1994), but this did little to alleviate existing social patterns of environmental inequity (Pellow 2004, 71).

Robert Sampson describes pro-environmental attitudes and recycling behavior as "social indicators at the upper end of what many would consider progress," which are distributed disproportionately across neighborhoods (2012, 46). These indicators are not clustered in lower socioeconomic neighborhoods of racial and ethnic minority populations, who suffer from higher rates of crime and health problems as a result of "concentrated disadvantage" in the neighborhood (Sampson 2012, 46). However, collective efficacy, or "social cohesion combined with shared expectations for social control" in a neighborhood, can help to counteract some of the effects of concentrated disadvantage; some neighborhoods achieve high levels of collective efficacy in spite of their concentrated disadvantage (Sampson 2012, 27). This concept has encouraging implications for achieving recycling progress in neighborhoods that face concentrated disadvantage.

Social capital, a close relative of collective efficacy, has also proven to be an important predictor of environmental behavior. Sampson defines social capital as "a resource embodied in the social ties among persons—networks, norms, and trust"; he argues that the study of social capital is useful as part of neighborhood-level analysis (2012, 38). If social capital can be fostered in a neighborhood of concentrated disadvantage, it can help alleviate some of the neighborhood effects that seem to be related to low rates of recycling (Sampson 2012, 178). Macias and Williams found that individuals who spend social evenings with their neighbors (as compared to family or friends) are much more likely to engage in pro-environmental behavior, even when controlling for demographic characteristics and environmental attitudes (2014). The highly variable distribution of recycling participation in Chicago (with lower rates of

recycling in predominantly black and predominantly Latino areas) begs further investigation of the causes of this disparity.

The ways that community members interact with each other are closely linked to the level of social capital in the neighborhood. Nation, Fortney, and Wandersman show that race is correlated with how one is likely to engage with one's neighbors: people identifying as white are significantly more likely to engage in social activities with neighbors, while people identifying as black are more likely to engage with neighbors by watching each other's property (2010, 581). If true, this would suggest that black communities, which are more likely to be located in higher-crime neighborhoods, may be less likely to engage in the type of neighborly interaction linked to pro-environmental behavior.

Clarke and Maantay compared recycling rates in New York City communities along four demographic indicators: the percentage of the population lacking a high-school diploma; the percentage living below the poverty level; the percentage of female-headed households with children; and the percentage of minority population. They found each of these four factors to be closely correlated (r-squared values > 0.8) with the recycling rate in each of the fifty-nine community areas in New York (2005). Interestingly, Laidley found civic action and advocacy groups related to environmental sustainability occurred in many neighborhoods, without correlation to demographics (2013). This suggests that action, advocacy, and social capital are effective in disadvantaged communities and can help promote social progress in spite of the challenges these communities face.

Effects of Environmental Beliefs and Attitudes on Behavior

Adults with stronger pro-environmental attitudes are likely to engage in pro-environmental behavior, but studies of young children have not found the same relationship. Evans et al. find that parental environmental attitudes and behavior did not effect their children (2007). The data may have been skewed by self-reporting; it is also possible that the effect of children's environmental attitudes do not manifest until later in life, as posited by Larson Green, and Castleberry (2011). Children with strong pro-environmental attitudes may be constrained by external factors, for example, whether their home has a recycling bin (Larson, Green, & Castleberry 2011). Many studies suggest that the apparent disconnect between pro-environmental attitudes and behavior is related to the logistical and social challenges of engaging in behaviors that are not prioritized in society; removing a logistical barrier to recycling and providing a recycling bin to this type of individual increases engagement in pro-environmental behaviors (Guagnano, Stern, & Dietz 1995).

Behavioral Economics of Recycling

Behavioral and social factors effect an individual's recycling behavior much more than most financial incentives (Mueller 2013). These factors fall into two broad categories: (1) choice architecture, as described by behavioral economists, refers to the various ways that the presentation of an individual's options effects behavior; and (2) factors that pressure individuals to behave in a socially desirable manner (Houde & Todd 2011).

City officials and waste-management providers must ensure that recycling services are as convenient and reliable as the default option, which is to not to recycle at all. Convenience is by far the most important factor, even more so than a financial incentive or penalty (Jenkins et al. 2003; Mueller 2013). A convenient program provides clear and current information and minimizes the effort required by the individual (Wagner 2013). Programs that are unreliable and irregular and that force individuals to seek out alternative services or give up on recycling until services resume are least successful (Martin, Williams, & Clark 2006).

Increased spending on public outreach can increase recycling, depending on how funds are spent (Sidique, Joshi, & Lupi 2010). A review of several different programs shows that the four most effective practices are easing the process; providing information about why

recycling is important (justification for the behavior); addressing cognitive dissonance (encouraging an individual to bring recycling behavior in line with beliefs and attitudes); and asking individuals to commit to practicing recycling informally for a period of time (Osbaldiston & Schott 2012). Programs that place an informational sign on each recycling bin do not change behavior unless combined with supplemental outreach. Funds are perhaps better spent stressing convenience, publicizing the importance of recycling, and encouraging citizens to bring actions in line with existing beliefs (Andrews et al. 2013; Osbaldiston & Schott 2012).

The motivation to act in a socially desirable manner, even without financial benefit, can be a strong incentive for individuals to maintain a new behavior. Houde and Todd show that an effective method of social motivation is to let individuals know whether they are meeting pro-environmental standards (2011). How individuals are motivated by social pressure, however, depends on their perceptions of what socially desirable behavior is. When policymakers and program implementers provide information about the behaviors of one's peers or neighbors, they help shape perceptions and thereby encourage the adoption of behaviors seen as socially desirable (Houde & Todd 2011). When an energy company sent letters to its customers telling them how their usage compared to their neighbors', they found that consumers decreased their energy usage by 2 percent, and that this method was more cost-effective than financial-incentive programs (Alcott 2011). Social pressure from neighbors influences both the probability that an individual will recycle and will take responsibility for the environmental impacts of her/his own behavior (Thaler & Sunstein 2009, 267). These findings suggest that an effective way for the city or a school to promote recycling is to inform individuals about the recycling behavior of fellow citizens or other schools (Thaler & Sunstein 2009, 268).

The argument against social motivations is that such "nudges" toward pro-environmental behavior are "unacceptably intrusive forms of paternalism" (Thaler & Sunstein 2009, 239). To address these concerns, letters can include clear and simple instructions to opt-out of receiving future mailings. An initial action of not sending letters can be considered a nudge in the opposite direction, by encouraging individuals to not change their behavior. A city or other body choosing to send letters is actively selecting the behavioral nudge that is overall more beneficial for individuals, the city, and the environment (Thaler & Sunstein 2009, 240).

Few financial incentives effectively increase recycling behavior. Imposing a variable pricing scheme for residential waste increases the rate of recycling, but may encourage illegal dumping of garbage (Sidique, Joshi, & Lupi 2010; Fullerton & Miller 2010). Fullerton and Miller advocate levying "advance disposal fees," or fees that apply at the time of purchase of a waste-generating product, in order to encourage consumers to reevaluate their purchases rather than only consider wastefulness at the end of a product's life (2010). However, financial-incentive programs or advance disposal fees can be more difficult to implement than a thoughtfully designed publicity or education campaign. By applying principles of choice architecture and pro-social motivations, designers and implementers of recycling programs can expect to see significant increases in the rate of recycling in their programs.

Political and Financial Obstacles to Recycling

Recycling programs, like many programs whose primary benefits cannot be measured in dollars, often suffer at the hands of governments narrowly focused on revenue. If governments were more amenable to employing shadow pricing (the practice of accounting for social and environmental factors when performing cost-benefit analysis), recycling would have clearer benefits for cities, since landfills have high environmental costs (Weinberg, Pellow, & Schnaiberg 2000, 179). There are two primary obstacles to the use of shadow pricing: disputes about how to measure nonmonetary costs and benefits, and the organization of cities into separate departments that manage their own budgets (Weinberg, Pellow, & Schnaiberg 2000, 193–94).

Considering only direct monetary costs and benefits, residential recycling programs are intended to save cities money by diverting waste from landfills and incinerators and bringing in revenue from the sale of recycled materials. The less waste the city sends to landfills, the less it pays in tipping fees, which are one of the costs rolled into the price of a contract with a waste-disposal service (IL EPA n.d.). Whether these savings are enough to compensate the city depends on the difference between the cost of tipping fees and the cost of sending items to a recycling plant. Cities must consider three other factors beyond tipping fees when calculating costs of a recycling program: participation rates (cities with low rates will not have enough recycled materials to make a profit); the quality of the recycled materials (lower-quality material is worth less); and the volatile global market for recycled materials (Stephenson 2006). Cities must also consider start-up costs, tax revenue, and the job creation of the recycling program (DSM Environmental 2010). Since the federal government have not stabilized markets for recycled materials, the economic viability of recycling programs can only be measured in terms of cost savings over landfill costs (Stephenson 2006). When markets for recycled materials stabilize, either through federal policy or through the stabilization of international demand, then revenue from sales can be figured into overall cost and benefits of recycling programs.

Evaluating the benefits of recycling depends in part on accurately measuring waste produced and materials recycled. Accurate measurement (weighing collection trucks and collecting data from each waste hauler) and errors inherent in these processes make it logistically difficulty to determine whether a municipality is meeting environmental goals (Chowdhury 2009). Both Chowdhury and DSM Environmental call for improved collection and management of waste-management data in order to more accurately assess progress toward municipal goals and to identify possible areas for improvement (DSM Environmental 2010). Until this happens, cities must be aware that data likely carries some margin of measurement error.

IV. Methodology

To conduct my analysis of recycling trends in Chicago, I used data from Chicago's Blue Cart program, which divides the city into six zones and reports recycling rates by zone. I also used data from Lakeshore Recycling Systems, the vendor for CPS, which consists of school-level data on recycling rates and total waste for 589 of CPS's 658 schools. Both datasets cover the time period January–December 2014. The Blue Cart program was phased in over several years and only expanded to all households at the end of 2013,[1] and CPS data only exists beginning in January 2014. I used census socioeconomic data to compare school recycling performance to neighborhood demographics.

This approach is as an alternative to survey-based research on recycling behavior, which relies on individual self-reporting and is likely to contain biases. A meta-analysis of self-reported data found that nearly half of survey results were effected by the tendency of a respondents to give answers that are more socially desirable than how they really think or behave (Van de Mortel 2008). Environmental-behavior surveys are usually administered by pro-environmental groups, making the risk of bias particularly high. The opportunity to investigate recycling behavior without self-reporting biases is significant and may offer a more accurate view of recycling practices in schools and communities.

Gathering School and Blue Cart Data

To synthesize the school-recycling data with the residential-recycling data, I used a publicly available map of Chicago's six Blue Cart recycling zones to divide all public schools into the six Blue Cart zones. To produce conclusions about the relationship between recycling behavior in schools

1. The Blue Cart pilot included wards in each of the six current recycling zones (City of Chicago 2015). Each zone had a similar exposure to the program, thus differences in rates between zones are not attributable to the timeline of the program's pilot or expansion.

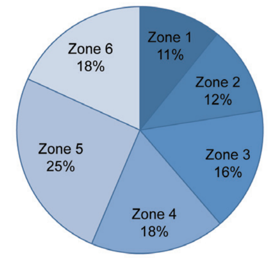

Figure 2. Distribution of Neighborhood Elementary Schools Among City Recycling Zones

and recycling behavior in that school's community, I narrowed my focus to what the CPS calls "neighborhood schools"[2] rather than "selective schools" that take students from anywhere in the city (Chicago Data Portal n.d.). I studied only elementary schools because of the prevalence of "selective schools" among Chicago's high schools. My research also excludes charter schools, which may also draw students from anywhere in the city.

These limits identified 351 neighborhood elementary schools,[3] which I mapped onto the six recycling regions to determine how they are divided among the six Blue Cart zones (Figure 2). I then selected ten schools from each recycling region to investigate in more detail using a random-number generator, for a total sample of sixty schools. The baseline characteristics of the sample of schools closely match those of the district on the whole (Table 2).

I gathered the publicly available data for each of the sixty sampled schools on the total volume of waste (in cubic yards), volume of

2. "Neighborhood schools" draw students from a specified attendance boundary that surrounds the school.

3. There are five schools that appear in the list of neighborhood schools but not in the master list of school locations; these schools are not included in this count because I was unable to confirm their locations and status as neighborhood schools.

Table 2. Baseline Characteristics of Sampled and District Schools (2014–15)

School group	Students eligible for free or reduced-price lunch	Enrollment
Sampled Schools (sample average)	82.19%	612
All CPS Schools (district average)	86.02%	627

contaminated recyclables (in cubic yards), and the net volume of recycled material (total recycled material minus the contaminated portion) for each month in 2014. Approximately one third of schools do not have complete recycling data available for 2014; so I randomly selected other schools to build a sample of sixty schools with complete data.[4] To allow for enrollment fluctuations in the first few weeks of the school year, I referred to the CPS website for twentieth-day enrollment, which I used to calculate the annual waste generated per student (comparing waste per student prevents biasing results toward larger schools).

To establish the community context of each school I used the U.S. Census Bureau's Geocoder (an online application that translates addresses to census geographies) to identify the census tracts in which the each of the sampled schools is located. While census tracts are only a rough approximation of a school's surrounding community (for example, a school's attendance boundaries may include many surrounding census tracts) this information can provide important characteristics of the community in which a school operates. I collected demographic data[5]

4. It is unclear why some schools have incomplete recycling data: they may have begun participating midyear or perhaps had difficulty measuring waste (Chowdhury 2009).

5. Median income, total population, racial and ethnic minority population, total number of households, number of individuals living below the poverty line, number of female-headed households with children under age eighteen, total number of adults over age eighteen, and number of adults without a high-school diploma.

on each of these census tracts from the 2013 American Community Survey five-year estimates. Finally, I collected data on recycling rates from the Blue Cart program. The city publishes monthly reports, available online, on waste volume and recycling rates in each of the six Blue Cart recycling zones.

Measuring Recycling and Pro-Environmental Behavior

I will use three metrics to analyze to what extent schools and communities are recycling and exhibiting pro-environmental behavior:

1. Recycling rate (sometimes called the diversion rate or the percentage of the total waste stream that is recycled) is calculated by dividing the volume of recycled material by the volume of all waste material. This data is available for both the Blue Cart program and for each school.

2. Waste volume per capita measures the ability of schools to lower overall waste and increase recycled waste. This data is available at the school level only.

3. Recycling contamination rate measures the efficacy of a school's recycling program; schools with a low contamination rate are educating students well about recycling. This data is available at the school level only.

School-level data means that this study can search for correlations between community-level factors and school-recycling performance. Correlations would indicate that schools that recycle at a low rate need to counteract the effects of their surrounding communities to encourage pro-environmental behavior in their students. A lack of correlation between schools and community-level factors would indicate that schools are not subject to neighborhood effects where environmental behaviors and practices are concerned. This would make a strong case for the expansion of environmental education and other efforts to increase the rates of recycling within their walls (Clarke & Maantay 2005).

In order to determine how school-recycling rates effect residential-recycling rates I will compare school recycling with community recycling for each month in 2014. I will then look for changes in the relationship between the two in each zone in July, when most schools are closed and their total waste levels and recycling rates are close to zero. If the residential-recycling rate drops in July when schools are not in session, this would suggest that schools are having a positive, but not habit-forming, effect on community recycling. If there is no change in the residential recycling rate, this would indicate that schools are not having a significant effect on encouraging students and families to translate recycling habits into their homes.

V. Analysis

Given Chicago's low recycling rate, I consider Chicago's public schools a potential agent of behavior change, as schools have the capacity to

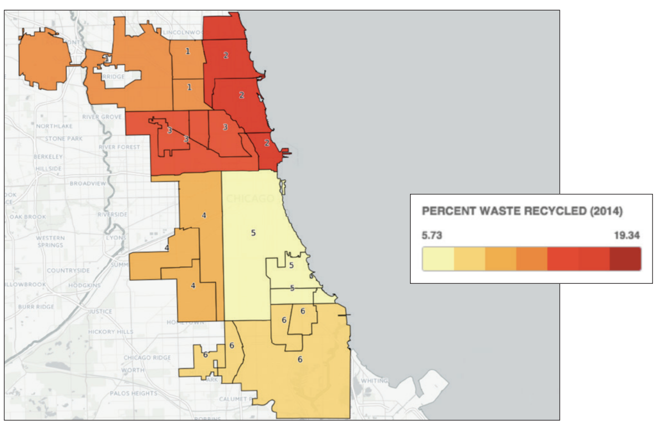

Figure 3. Residential Recycling Rate by City Recycling Zone

teach children about pro-environmental behavior, shape their environmental attitudes, and make recycling a habit that students will bring to their communities. My analysis examines three related questions: whether Chicago's schools engage in the same patterns of recycling behavior that exist in city communities; whether recycling patterns in Chicago schools follow the same demographic trends that the literature predicts for residential recycling; and whether Chicago's schools act as agents of change for community recycling behaviors. I also outline some of the financial implications for CPS of increasing recycling in schools.

Do schools follow the recycling patterns of the surrounding communities?

The recycling rate in Chicago varies widely across the city's recycling zones (Figures 3 and 4). The three zones in the northern half of the city

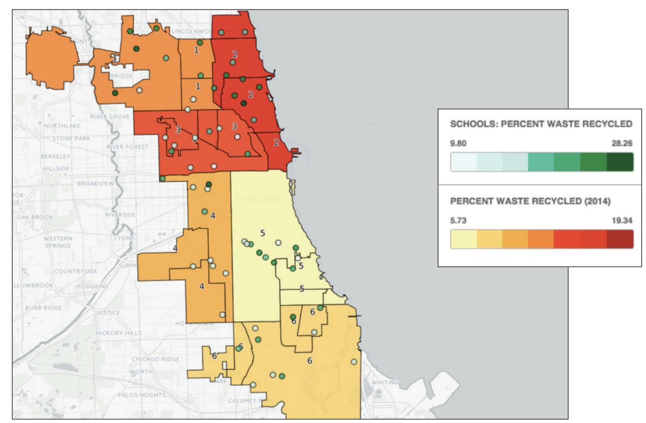

Figure 4. School Recycling Rates and Residential Recycling Rates by City Recycling Zone*

Note: This map represents a sample of sixty randomly selected Chicago public elementary schools.

*See rachelwhaley.github.io for a dynamic version of this map with a zoom feature, separate layers, school details (name, recycling rate, percent of students eligible for free and reduced-price lunch, waste volume per student, and median income of the surrounding census tract).

(1–3) recycle at a higher rate than the three zones (4–6) in the southern half of the city (Table 3). The sampled schools in the three northern zones with the highest recycling rates in the Blue Cart program also have the lowest average recycling contamination rates. This suggests that schools in zones 1, 2, and 3 are educating their students better about recycling or implementing the program better; it may also suggest that students arrive with more knowledge about recycling or come from homes with pro-environmental behaviors. In all zones, schools on average recycle at a higher rate than residents who participate in the Blue Cart schools program. The percentage-point variance across zones averages less for schools (5.3) than variance across Blue Cart zones (13.6). These findings indicate that recycling rates in schools are much more consistent across neighborhoods than recycling rates in the Blue Cart program.

To identify how much schools recycle relative to their recycling zones I calculated the difference between each school's recycling rate and the recycling rate of the zone in which each school is located. Most schools (42 of 60) recycle at noticeably higher rate (greater than two percentage points) than the recycling zone in which they are located; the rest of the

Table 3. City Recycling Zones Ordered by Percent Residential Waste Recycled

RESIDENTIAL		SAMPLED SCHOOLS IN ZONE			
Recycling Zone	% Waste Recycled (Blue Cart)	Average % Waste Net Recycled	Average % Recycling Contaminated	Average % Receiving Free/ Reduced Price Lunch	Average Waste Volume Per Student (cubic yards)
2	19.3%	18.7%	2.4%	61.9%	2.98
3	12.6%	13.9%	2.2%	93.5%	2.86
1	11.6%	19.7%	2.4%	58.3%	2.55
Average	7.25%	8.72%	1.17%	35.62%	1.4
4	10.3%	15.1%	4.4%	96.8%	3.44
6	9.1%	16.6%	10.1%	85.2%	2.76
5	5.7%	13.4%	13.4%	97.5%	3.10

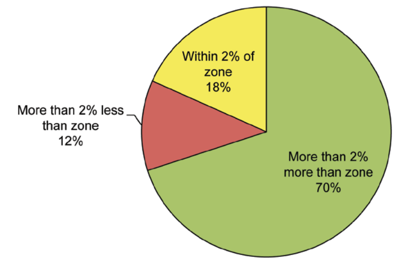

Figure 5. Recycling Rates: Difference Between Sample Schools and City Zone

schools (18 of 60) recycle at a similar or lower rate compared to their recycling zone (Figure 5). All schools in the three lower-performing recycling zones are recycling at a higher rate than their zones, while schools in the two highest-performing recycling zones are recycling at rates closer to or less than the recycling rate of their zones (Figure 6). This indicates that schools are not only capable of outperforming recycling patterns of their surrounding neighborhoods, but that most schools are already doing so.

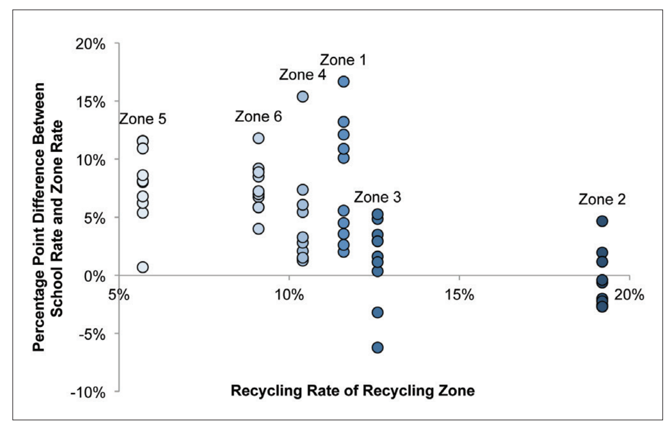

Figure 6. Difference Between School and Residential Recycling Rate By Zone

In summary, schools tend to report better recycling rates than their communities, and recycling trends in schools are not closely tied to residential recycling trends.

Do schools follow the recycling patterns that demographics would predict?

The literature suggests that recycling behavior in communities is correlated with a number of demographic factors: communities of racial and ethnic minorities and lower incomes are likely to recycle at a lower rate than more affluent and white communities. I analyzed the four factors that Clarke and Maantay identify as correlated to a community's recycling rate: percent of adults below the poverty line, percent of adults without a high-school diploma, percent of female-headed households with children, and percent of racial minorities in the population (2005). I apply their framework to outcomes in schools rather than outcomes in communities. I used census data for the four factors (hereafter, the Clarke-Maantay factors) to look for correlations between the demographics of the surrounding communities and the recycling habits of students. The census tracts of sampled schools vary widely along each of these factors; tracts range from zero percent to 99.96 percent non-white and zero percent to 100 percent living below poverty level (Table 4). Bearing in mind that the use of census tracts is a rough estimate of a school's community, this analysis sheds light on which of the Clarke-Maantay factors matter most for recycling in schools.

Table 4. Descriptive Statistics of Demographic Variables of Sampled School Census Tracts

Variable	Min.	Max.	Range	Mean	Median	S.D.
Adults without H.S. diploma (%)	0.00	65.71	65.71	21.54	18.22	13.37
Persons below poverty level (%)	0.65	100.00	99.35	24.78	21.53	17.30
Female head with children (%)	0.00	90.23	90.23	38.57	30.34	28.40
Minority population (%)	0.00	99.96	99.96	70.07	88.60	32.81
School recycling rates (%)	6.38	28.26	21.88	16.81	16.49	4.01

I generated a linear regression for each of the Clarke-Maantay factors (Table 5). The null hypothesis for these analyses is that the Clarke-Maantay factors do not affect school recycling rates. Each factor is negatively correlated to the school's recycling rate, though only two of the factors (percent adults without a high-school diploma and percent of minority population) are significant at the $p < 0.05$ level. For each of the factors, the r-squared value is relatively low, meaning that each factor explains relatively little of the overall variation in school-recycling rates. The most significant factor of the four is the percent of minority population of the census tract, which accounts for 11.3 percent of the variance in school-recycling rates. This is consistent with findings from the literature that racial and ethnic minority groups are less likely to engage in pro-environmental behavior for a variety of social and historical reasons (Pellow 2004).

Scatterplots for each of the Clarke-Maantay factors versus school recycling rates indicate the strength of the correlations (Figure 7). For all four factors the slope of the correlation is negative, indicating that a higher level of any of these factors in a community is linked to a lower rate of recycling in the community's neighborhood elementary school.

Table 5. Linear-Regression Analysis of Clarke-Maantay Factors

Variable associated with diversion rate	r2-value	Intercept	Slope	p-value
Adults without H.S. diploma (%)	0.088	0.187	-0.089	0.022*
Persons below poverty level (%)	0.049	0.181	-0.051	0.090
Female head with children (%)	0.017	0.175	-0.018	0.321
Minority population (%)	0.113	0.197	-0.041	0.009*

* indicates significance at the $p < 0.05$ level

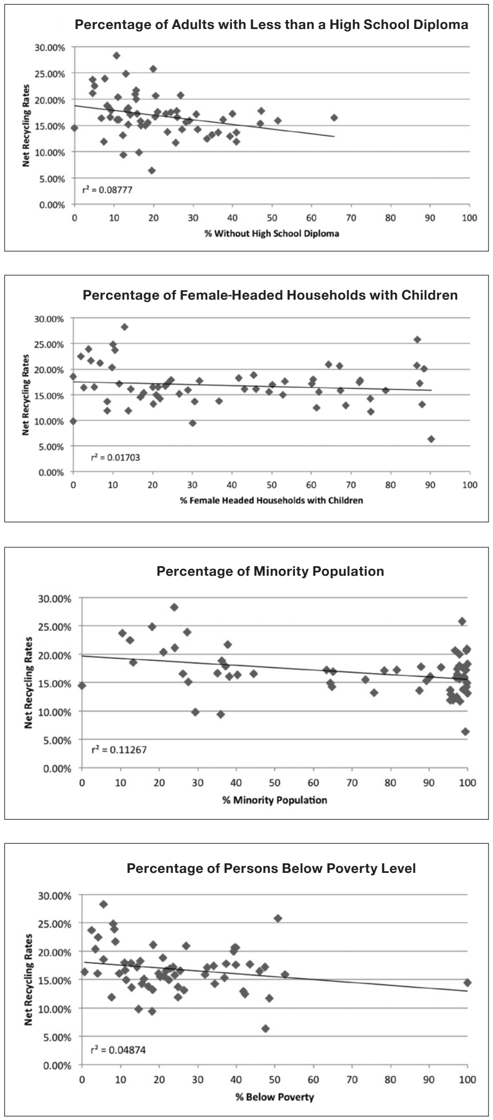

Figure 7. Linear Regressions of Community Clarke-Maantay Factors on School Recycling Rates

These findings suggest that percent minority population and percent adults without a high-school diploma did influence recycling at the school level. Percent population below the poverty level and percent of households with children headed by a single female did not significantly influence school-recycling rates.

Because Blue Cart recycling data is not available at the census-tract level, it is not possible to calculate the effects of the Clarke-Maantay factors on residential recycling. The study by Clarke and Maantay in New York suggests a significant correlation between each of these factors and the residential recycling rate, but a similar analysis for Chicago would require Blue Cart data in smaller geographic units (2005). The lack of a strong correlations with these factors in the sampled public schools leads me to conclude that demographics do not influence school recycling in the same ways as demographics influences residential recycling.

Some schools in the sample recycle at much higher rates than others. To explore this differences we can compare school-level characteristics. The ten sample schools with the highest recycling rates have a higher-average median income, a lower average percentage of students receiving free or reduced price lunch, and lower average waste per capita than the ten schools with the lowest recycling rates in the sample (Table 6). Schools that recycle more are producing less waste (trash and recycling

Table 6. Top-Ten and Bottom-Ten Schools from Sample by Recycling-Rate Characteristics

School Group	Average % Students Receiving Free or Reduced Price Lunch	Average Median Income of Census Tract of Schools	Average Waste Volume Per Student	Average % Waste Net Recycled
Top-10 Schools by Recycling Rate	51.54	56,096	2.62	23.33
Bottom-10 Schools by Recycling Rate	91.93	47,369	3.18	11.27

combined) overall, suggesting the presence of an overall pro-environmental attitude at these schools.

Another important aspect of pro-environmental behavior is minimizing the volume of waste overall. Pellow suggests that the volume of waste in a community is positively correlated with the community's income level (Pellow 2004). I analyzed the income level of each school's census tract alongside the waste volume per student at each school to determine whether there is a correlation between the school's volume of waste and the community's income level. There is a loosely negative correlation (r-squared value = 0.09) between the median income of a school's census tract and the school's annual waste per student (Figure 8). Two possible explanations for the loose negative correlation are: (1) more affluent schools exhibit more pro-environmental behavior and thereby produce less waste overall; or (2) some schools in lower-income neighborhoods produce higher waste due to factors correlated with location in a lower-income area; for example, disposable cafeteria trays or more disposable goods, such as fast-food packaging. While the negative correlation found here conflicts with Pellow's suggestion that higher-income schools produce more waste overall, and may be due to factors beyond low-income schools'

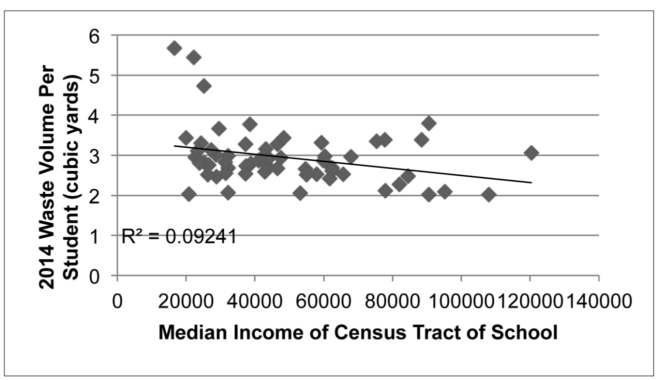

Figure 8. School Waste by Median Income of School Census Tract

control, it remains an important metric for determining a school's overall adoption of pro-environmental behavior.

Are schools effecting recycling behavior in the community?

As a means to explore whether schools are influencing the recycling rate in the surrounding communities, I compared the summer residential-recycling rate with the school-year residential-recycling rate in each Blue Cart zone to determine whether the absence of reinforcement in school effects community participation. The school year extends into mid-June and begins in August, so I have used data only from the month of July. The monthly Blue Cart recycling rate for each zone in 2014 indicates that the summer recycling rate is among the lowest for each zone (Figure 9, grey highlight). I compare the July recycling rate for each Blue Cart zone with the average rate for the rest of the year (Figure 10). In every zone, the community's recycling rate is slightly lower in July than the average for January through June and August through December. These findings suggest that schools have an effect on student (and therefore community) recycling behaviors during the school year, but that some other factor

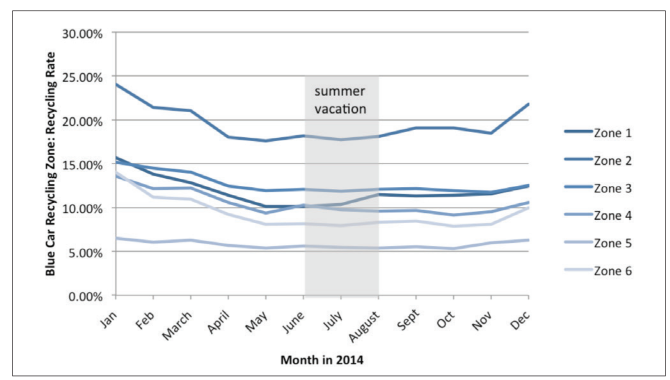

Figure 9. Blue Cart Residential Recycling by Zone by Month in 2014

affects the summer recycling rate. It is possible that recycling fades in the summer when students' recycling habits are not being reinforced at school, that students use different kinds of products in the summer, which may not be recyclable, or that students who are most likely to recycle are also the most likely to travel during the summer.

Costs savings of recycling for the Chicago Public Schools

The Illinois Environmental Protection Agency sets the statewide municipal landfill tipping fee at $1.051 per cubic yard for landfills receiving more than 150,000 cubic yards of waste annually (IL EPA n.d.). Since Lakeshore Recycling Systems, CPS's waste services provider, does not operate its own landfill, it is subject to these fees, which are typically passed on to the customer in the contract. For the sixty schools sampled for this analysis, the average volume of total waste in 2014 was 1,761.9 cubic yards. Less the average volume of recycling among these schools (287.2 cubic yards), each of the sampled schools sent an average of 1,474.7 cubic yards of waste to landfills in 2014. Assuming this average holds for all 658 CPS schools, CPS schools sent approximately 970,353

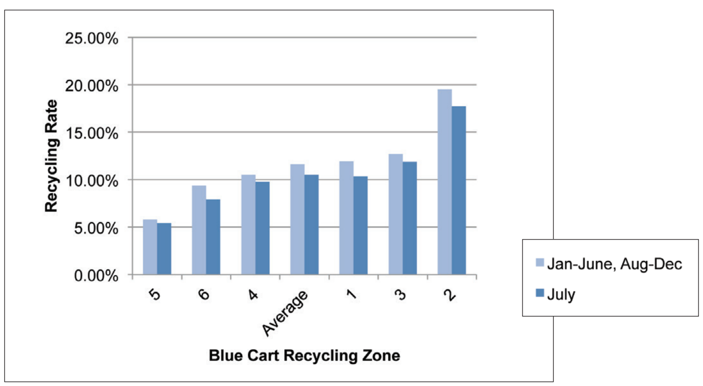

Figure 10. Recycling Rate in July Compared to Other Months by Recycling Region

cubic yards of waste to landfills in 2014. In tipping fees alone, this cost CPS $1,019,841. The five-year contract between CPS and Lakeshore Recycling Systems stipulates that CPS will pay Lakeshore "approximately $3,784,600 annually, total cost not to exceed $18,923,000 for the five year term" for waste and recycling disposal services; based on my calculations, slightly more than one quarter of the annual contract amount covered landfill tipping fees in 2014 (Chicago Board of Education 2013). If CPS is able to increase recycling (and send less waste to landfills), the district would likely be able to negotiate a more advantageous contract for waste services, as the hauler would pay less in landfill tipping fees. This potential cost savings provides financial motivation for CPS to work toward increasing recycling in its schools.

VI. Policy Recommendations

The following recommendations outline methods for increasing the rate of residential recycling in Chicago, based on the results of my analysis and findings from the literature. The Department of Streets and Sanitation (DSS) will need to work with the Chicago Public Schools (CPS) and Lakeshore Recycling Systems to implement these recommendations. However, plans to implement policies jointly often fail due to unclear definitions of roles (Pressman & Wildavsky 1984). In anticipation of this complication, I recommend that the DSS lead the implementation of the following recommendations, collaborating with Lakeshore Recycling Systems and the CPS as needed. The DSS is responsible for Chicago's residential-recycling rate; this rate that should be used to assess the effectiveness of each of the following methods over time.

Recommendation #1: Focus on increasing recycling in public schools.

This analysis shows that schools can improve residential-recycling rates for three reasons: school demographics do not effect school-recycling rates in the same way that community-demographic factors effect residential-recycling rates; most schools (and especially schools in communities with low recycling rates) already outperform their communities; and schools already increase community-recycling rates. Focusing on outreach to schools will be more efficient than outreach to each residence citywide, or even to a subset of residences, as schools already have existing channels for communicating with students and families and implementing programs. In addition, as more students learn and absorb these practices through expanded efforts by schools, they will be more empowered to act as agents of pro-environmental change in their communities. The next three recommendations suggest methods for increasing rates of recycling in schools.

Recommendation #2: Use comparative feedback and competition to motivate schools.

Behavioral economics shows that individuals will change their behavior when they know how their peers are behaving (Schelly et al. 2011; Thaler & Sunstein 2009). Lakeshore Recycling Systems does provide online reports of each school's recycling habits at www.cpsrecycles.com, but only reports each individual school's information over time. A comprehensive public website that allows schools to compare themselves to other schools, the district, and district goals, combined with a monthly e-mail newsletter to schools highlighting high-performing schools and suggesting activities to engage students in recycling, would, as suggested by the literature, increase recycling rates. Lakeshore already collects the data so the additional costs of a website and e-newsletter would be minimal, involving a side project for an existing employee of Lakeshore or a team of interns.

Recommendation #3: Promote the integration of pro-environmental education into curricula.

The literature suggests a significant correlation between attitudes toward nature and behavior. School should prioritize the integration of ecology (and specifically individual and social interconnection with nature) into the existing curricula in environmental education and science, as well as English, social studies, or elective courses (Schelly et al. 2011; Chavez 2014; Mobley, Vagias, & DeWard 2010). These studies do not specify how much environmental education is necessary to encourage pro-environmental behavior in students; in the absence of this information, if we presume a continuous relationship between the amount of environmental education and engagement in pro-environmental behavior, schools could choose to start small. For example, English teachers could assign environmentalist texts for a few reading exercises, or a science teacher could assign a laboratory exercise on ecology or environmental sustainability. As an extra step, if CPS collected information from schools and teachers who chose to increase the amount of environmental education in their curricula, CPS would be able to analyze this data over time to identify specific curriculum-integration practices.

This method will likely require professional development for teachers. Given that interested teachers are likely to have some background knowledge in the subject, a session would take a half day or one full day. The Illinois State Board of Education requires that teachers accrue 120 hours of professional development every five years, with considerable flexibility for the creation of professional-development sessions; thus the overhead for offering these sessions is low (ISBE 2015). If CPS were already working closely with Streets and Sanitation, the DSS could support this professional development by providing educational materials on recycling. Additionally, CPS and the DSS could collaborate with a pro-environmental nonprofit to offer the sessions, since ISBE allows a variety of providers to offer professional development (ISBE 2015). These three actors would need to coordinate their efforts in order to implement these sessions: CPS would need to approve the nonprofit organization to provide the sessions, and the DSS would need to collaborate with the nonprofit to help design the curriculum.

Recommendation #4: Make recycling easier and more convenient in schools.

Schools would benefit from making recycling as convenient as possible for students, teachers, and staff (Jenkins et al. 2003; Mueller 2013; Wagner 2013). Lakeshore Recycling Systems and the DSS could support schools by working with school building engineers to ensure that every trash bin is paired with a recycling bin and posting clear signage on every bin. Schools could work to enlist student volunteers to make presentations at school assemblies about the importance of recycling, how to separate recyclables from trash, and the importance of translating pro-environmental attitudes into behavior, all factors that increase recycling behavior (Osbaldiston & Schott 2012).

If resource limitations make it infeasible to implement these changes in all schools, CPS and the DSS should work together to identify a group of target schools. There are many possible strategies for identifying this group. One method would be to focus on schools located in Blue Cart zones four, five, and six, which have the lowest average recycling rates. Another possible method would be to compile the recycling data from all of the schools and rank schools by three criteria: recycling rate, recycling contamination rate, and waste volume per student. A group of target schools could then be selected from the schools that rank near the bottom for each of these criteria.

VII. Conclusion

This study finds that promoting recycling in schools is an effective way to increase recycling rates in Chicago communities. While this analysis has identified comparative feedback, curriculum integration, and increased convenience as effective methods of increasing recycling rates in schools and thus in communities, more research is needed on what specific implementations of these methods are most effective. For example, future research is needed to determine whether comparative feedback is more effective in changing behavior when made available online or when announced at school assemblies and whether particular methods of curriculum integration are more effective than others. In working with the DSS to implement these recommendations, CPS has the opportunity to pilot different methods in different groups of schools, compare the results, and implement the best methods across the district.

The 2013 contract between CPS and Lakeshore Recycling Systems that made school-level data on recycling rates publicly available was a positive policy step in itself, but Lakeshore and CPS need to take additional steps to make this data more easily accessible and to promote more data-driven improvements in recycling practices. This should be part of the growing movement toward open civic data and civic technology. "The use of technology to make cities more transparent and better coordinated" promotes public sharing of data on civic issues (like recycling) by researchers and curious citizens and holds governing bodies and public institutions more accountable for their performance (Deng 2014). Online recycling data is available for the city by recycling zones and for individual schools, but is posted in a series of separate files for each school, making it tedious to access data for multiple schools (Sunlight Foundation 2014). Aggregated data would allow researchers and citizens to analyze trends more easily and draw useful conclusions from the data about other possible methods of improving recycling performance.

The DSS must also be careful not to overburden schools in the process of implementing these recommendations. The notion of the school as an effective agent for community change is not new, but the implications of this idea for policy are endless; therefore, when promoting pro-environmental behavior in schools, the DSS should shoulder most of the responsibility for implementation of these recommendations. In general, local governments and school districts must exercise restraint in considering how to enlist schools in the implementation of social-change programs, given the limited resources of schools. However, schools are an extremely powerful channel for promoting pro-environmental behaviors and ideas to thousands of children. If the promotion of these behaviors can be implemented by the DSS without imposing significant burdens on schools, teachers, and staff, then other city governments may also benefit from working with their school systems to implement these recommendations.

Additionally, it is important to consider the circumstances of Chicago's public schools. In 2014, the year from which data for this study was drawn, Chicago had just closed dozens of neighborhood elementary schools. Even the most well-intentioned education plans and programs suffer when implemented in the face of turnover and chaos, and the pro-environmental programming laid out in the recommendations of this study is no exception. This perhaps puts special emphasis on the DSS and other city agencies to support implementation of these initiatives, to minimize distraction for CPS teachers and leaders focused on more immediately pressing issues in the school system.

This study addresses two previously unanswered questions about municipal recycling policy: how recycling in public schools compares with residential recycling in neighborhoods in Chicago, and whether schools are able to effect pro-environmental behavior change in their communities. By evaluating data on recycling in schools and communities, this analysis finds that public schools follow general neighborhood trends in recycling, with schools consistently outperforming their communities in recycling. Since the literature suggests that students who learn a

particular behavior in school are likely to spread that behavior to their families and neighborhoods, I compared residential recycling rates during the summer with residential recycling rates during the school year. This analysis found consistently lower residential recycling rates during the summer, providing suggestive evidence that schools are successfully instilling pro-environmental behavior change in students, and that students are spreading this behavior to their families and others in their neighborhoods during the school year.

In order to apply these findings toward improving recycling in Chicago, I recommend that the city, through its Department of Streets and Sanitation, focus its recycling outreach efforts on public schools. I recommend three approaches for effectively promoting recycling in schools, inspired by research in behavioral economics. First, I recommend motivating schools to promote recycling by providing schools with comparative feedback on their recycling rate and encouraging friendly competition for high recycling rates in schools. Second, I recommend that schools work to integrate pro-environmental education into existing curricula, in order to teach students that pro-environmental behavior is socially desirable. Finally, I recommend that the DSS work with Lakeshore Recycling Systems to make recycling more convenient in schools, since the literature shows that convenience increases recycling rates. Further research on the relative effectiveness of each of these methods is needed before selecting a single CPS-wide approach or combination of approaches. However, given the availability of data on recycling in Chicago, the success of each of these methods can be quantitatively evaluated, and the method or methods deemed most effective can be shared with other cities seeking to improve their recycling rates.

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