Published in final edited form as:
Popul Environ. 2015 September ; 37(1): 1–21. doi:10.1007/s11111-014-0228-x.

Chicago Residents' Perceptions of Air Quality: Objective Pollution, the Built Environment, and Neighborhood Stigma Theory

Katherine E. King

Abstract

Substantial research documents higher pollution levels in minority neighborhoods, but little research evaluates how residents perceive their own communities' pollution risks. According to "Neighborhood stigma" theory, survey respondents share a cultural bias that minorities cause social dysfunction, leading to over-reports of dysfunction in minority communities. This study investigates perceptions of residential outdoor air quality by linking objective data on built and social environments with multiple measures of pollution and a representative survey of Chicago residents. Consistent with the scholarly narrative, results show air quality is rated worse where minorities and poverty are concentrated, even after extensive adjustment for objective pollution and built environment measures. Perceptions of air pollution may thus be driven by neighborhood socioeconomic position far more than by respondents' ability to perceive pollution. The finding that 63.5% of the sample reported excellent or good air quality helps to explain current challenging in promoting environmental action.

A large body of literature has found that Hispanics and Blacks are disproportionately exposed to potentially hazardous conditions near their residences, including pollution (Mohai, Pellow, & Roberts, 2009), deleterious physical conditions (Perkins & Taylor, 1996; Skogan, 1990), and social disorder and crime (Morenoff & Sampson, 1997; Sampson & Groves, 1989). Research also demonstrates that these minorities have lower exposure to potentially beneficial conditions such as supermarkets and recreational facilities (Smiley et al., 2010). In short, research has shown that under the enduring legacy of racial/ethnic segregation, social groups experience vastly different living conditions in the places that form the backdrops for their daily lives. Contemporary theory positions the neighborhood as an important influence on individual well-being, and researchers are increasingly recognizing that due to the widely divergent contexts in which different social groups live, neighborhood effects are key sources of social disparities in outcomes ranging from health to social mobility.

Perceptions of neighborhoods may affect residents in ways that transcend the effects of objective conditions. Stigmatized minorities tend to perceive their neighborhoods more negatively than do people in other neighborhoods. While it is true that on average, physical conditions are objectively worse in minority communities, it has been argued that

*Direct all correspondence to: Katherine King, U.S. Environmental Protection Agency, 104 Mason Farm Road, Chapel Hill, NC 27599, kk183@duke.edu, (919)843-6804. .

disadvantaged social composition appears to contribute independently to negative perceptions of these communities. In research on neighborhood stigma, Sampson and Raudenbush (2004) relate how racial and economic context heavily influence perceptions of physical disorder at equivalent levels of objectively measured physical disorder. The finding was true for Blacks and Whites, as well as for community leaders. Sampson and Raudenbush's narrative sheds new light on the nature of the link between perceived disorder and health or social behavior: it demonstrates that remedying objective problems might not achieve the desired social benefits. The objective remedies may be inadequate because residents' perceptions of their living conditions are largely structured by implicit biases arising from racialized stigmatization of places. Changing objective conditions may not fully change residents' perceptions of their neighborhoods.

This paper evaluates how the neighborhood stigma framework may apply to residents' perceptions of air quality. Air pollution differs from measures that have previously been used to evaluate stereotype amplification in that poor air quality in a locality is less likely than crime or disorder to result from the actions of residents themselves. The existence of neighborhood stigma in air quality would suggest that respondents might not be practicing statistical discrimination directly with respect to neighborhood racial/ethnic composition or poverty. Rather, survey respondents might not be able to easily distinguish among distinct domains of neighborhood risks (e.g. pollution, crime, disorder, poverty). All of these perceived risks may blur together to create a generalized perception of a neighborhood's relative position in the overall city hierarchy. Thus, study's respondents perceive their neighborhood with respect to their view of their neighborhood's relative position compared to the city's other neighborhoods..

The analysis links air quality self-reports from the Chicago Community Adult Health Study (CCAHS) with multiple objective data sources on (1) pollution and (2) pollution-related aspects of the built environment (transportation, industrial land use and facilities, and urban form). In addition, the analysis links air quality self-reports with (3) the social measures previously used to indicate stigma potential (percentages of residents who are Black and Hispanic, percentages of residents who live in poverty, and objective levels of disorder) to shed light on the contextual correlates of individual perceptions of neighborhood air quality. Significant associations of stigmatized social characteristics, after adjusting for objective pollution and built environment cues of pollution, would be consistent with the view that neighborhood stigma plays a role in residents' perceptions of air pollution.

Stereotype Amplification and Neighborhood Stigma

Urban sociologists have treated differences between objective and perceived measures as a meaningful way to understand the process of cognition itself. Most work in this area has investigated implicit bias in respondents' responses to their neighborhoods, a bias which is assumed to be triggered by visual cues that the respondent processes by drawing on heuristics such as racial stereotypes (Sampson & Raudenbush, 2004). Shared cultural cognitive biases have developed such that when respondents associate a social trait with a social behavior or outcome, they may impute or expect higher values of the behavior or outcome in communities where the trait is prevalent; this tendency is known as

Author Manuscript
Author Manuscript
Author Manuscript

"neighborhood stigma" (Sampson & Raudenbush, 2004) when the social trait in question is a stigmatized one.

Stereotypes link disadvantaged minorities to negative images of neighborhoods, as well as to crime and disorder. These racially charged beliefs stem from the concentrated poverty that has its historical origins in enforced racial segregation, a legacy of intentional disinvestment in minority communities, and subsequent urban neighborhood decline. Quillian and Pager (2001) found that perceptions of greater crime risk in the presence of greater proportions of young Black men persisted even with controls for police-recorded crime rates, victimization surveys, and measures of neighborhood deterioration. Sampson and Raudenbush (2004) questioned what makes disorder a problem and whether stigma against disadvantaged population groups might play a role in disorder effects on downstream outcomes. To investigate this idea, they created an index of neighborhood physical disorder, now widely used, that was based on the "broken windows" theory (Kelling & Coles, 1996; Wilson & Kelling, 1982). This theory posits that visible signs of social disorder serve as cues that, within the vicinity of those visible signs, social norms can be violated with impunity. Sampson and Raudenbush found that as the proportions of Blacks, Hispanics, and households in poverty increased, residents perceived greater disorder even after extensive individual and neighborhood controls and regardless of the respondent's own race.

The neighborhood stigma argument incorporates ideas about neighborhood variation in the types of behaviors that constitute disorder and crime, so that objective measures of both crime and disorder may still be racially biased to some extent. Although raters in systematic social observations are trained to assess their observation sites objectively, the stigma theory itself suggests that some bias might come through in their reports. Likewise, differential reporting of crimes that are prevalent among various social groups results in biased objective crime rates across places (Skogan, 1990). Because both perceived and objective measures can be racially biased (Sampson & Raudenbush, 2004), each of the neighborhood quality domains, crime and disorder, pose a challenge in the evaluation of neighborhood stigma. More profoundly, some behaviors that are socially constructed as disorder are merely the practice of doing in public what would be more generally acceptable if done in private (e.g. loitering, public drunkenness), with public rather than private performance of these behaviors resulting from differing material conditions across neighborhoods rather than actual cultural differences (Sampson & Raudenbush, 2004). Air quality provides an excellent case study of stigma theory in that objective measures of air quality exposure are developed using automated methods, which are blind to social compositions of locations in a way that even trained raters might not be. Likewise, stigma theory provides a strong framework for evaluating the potential for social construction of air quality.

Air Pollution Perception and Race/Ethnicity

Researchers find that socioeconomically disadvantaged households and communities experience greater exposure and vulnerability to hazardous pollution (Morello-Frosch & Lopez, 2006). Substantial race/ethnic disparities in pollution exposures nationally persist even after controlling for economic factors (Crowder & Downey, 2010; Mohai & Saha, 2007), although the extent and nature of environmental inequalities vary by metropolitan

area and region (Downey, 2007; Downey & Crowder, 2011) as well as exposure type. Race/ ethnic differences in exposures probably have origins both in real estate valuation and in more explicit environmental racism, such as facility siting decisions and political processes (Saha & Mohai, 2005; Wolverton, 2009). Another factor that plays a role in generating social differences in exposures is differential residential mobility with respect to pollution sources (Crowder & Downey, 2010), but it is not known how households may evaluate environmental quality when choosing where to live. Almost all the research on sources of environmental inequality has considered objective pollution measures without investigating how members of the public perceive these risks, even though differences in the behaviors and practices that may in part generate these disparities likely influence perceptions of pollution. Indeed, environmental activists generally believe that minorities may be less aware of either the level or consequences of nearby pollution risks (Laurian, 2003), and thus may be both more willing to live in polluted areas and less likely to mobilize against existing and new sources of pollution. However, this view has not been explicitly evaluated in the literature.

Some research has investigated the extent to which sub-populations may differently perceive the environment. Data from the 1972–2002 General Social Survey and other studies show consistently small or non-significant racial differences (Mohai & Bryant, 2003) in attitudes about pollution. In the Detroit Area Study, Blacks were more likely to rate air pollution as “very serious” and air quality in their neighborhood as “poor” or “very poor,” with air quality ranking as the environmental domain with the largest racial gap (Mohai & Bryant, 2003). Non-Whites were more likely than Whites in a national sample to oppose siting a coal-fired or natural gas-fired power plant or wind-power facility (but not a nuclear plant) within 25 miles of their homes (Ansolabehere & Konisky, 2009). One prior study did posit a link between objective and perceived measures: analysis of the 1990 Detroit Area Study (Mohai & Bryant, 1998) found that a bivariate difference between Blacks and Whites in perception of the importance and seriousness of environmental pollution was accounted for when measures of the neighborhood’s physical environment were controlled. A methodologically strong study using Madrid census data found that residents of wealthier neighborhoods did not perceive worse air quality even in the presence of objectively worse pollution, a finding that was attributed to a “halo effect” such that wealthier residents have better overall perceptions of their neighborhoods (Chasco & Gallo, 2013).

Public opinion and survey data on environmental perception is not particularly common. Some research has connected air pollution risk perception with health, in ways that likely are partly or entirely independent of actual risk. For instance, a perceived measure of traffic stress interacted with a simple objective measure of neighborhood vehicular burden when predicting health effects of living in a high-traffic area (Gee & Takeuchi, 2004). In a Swedish dataset collected before and after a plant closure (Stenlund, Lidén, Andersson, Garvill, & Nordin, 2009), perceptions of pollution and of health risks were related to annoyance and health symptoms when objective measures were controlled. A study in Texas (Peek, Cutchin, Freeman, Stowe, & Goodwin, 2009) found that perceived risk from petrochemical facilities was related to perceived health when controlling for the association between exposure and immune functioning. Meanwhile, a recent Gallop poll (2014) shows

that neither public rating of overall environmental quality in the United States as a whole nor respondents' personal worries about air pollution changed much between 2001 and 2014.

Data and Methods

Chicago Context

Through most of the 20th century, Chicago's role as a transportation and materials-processing hub caused the city to rank among the worst in the United States for air pollution. By the 1990s, due to local regulations and deindustrialization, Chicago had shown comparative improvement (Stradling, 2005). Still, in 2003, Cook County (which includes Chicago) ranked among the worst 10% of counties for 7 of 12 domains of air quality (Scorecard, 2011). The county maintains a substantial industrial presence, with heavy traffic along its multiple highways and railways. The same industrial prowess that polluted Chicago has made it a destination for both immigrants and emigrants of the Great Migration, many of whom are African-American and Hispanic. Redlining and urban renewal have exacerbated consistently high levels of racial/ethnic segregation. In this context, the communities in Chicago have developed distinct identities, and these communities have inspired much of the research on place cognition from the early Chicago School to the present (Sampson, 2012).

Nationally and in city-level case studies, the environmental justice literature has documented worse exposures for minority populations. In contrast to the national trend, Chicago's non-Hispanic Blacks are slightly less likely than other groups to live near toxic-releasing facilities (Baden & Coursey, 2002; Hunter, 2000; Scorecard, 2011; Wang & Feliberty, 2010). On the other hand, Chicago Hispanics are more likely to be so exposed, consistent with a national tendency for higher environmental risk near concentrations of immigrants. Figure 2 shows a complex picture: Chicago tracts with greater proportions of non-Hispanic Blacks are more exposed to particulate matter (due to proximity to transportation land uses) than are Hispanic-concentrated tracts, and Hispanic-concentrated tracts are more exposed than those with non-Hispanic Whites. Although exposure to transportation-related pollution (PM 10 and ozone) is generally lower for the half of neighborhoods with more Whites, industry-related pollution risk (cancer, respiratory, and neurological) increases with the neighborhood proportion of White or Hispanic residents.

Chicago Community Adult Health Study

The CCAHS is a multi-level study of the impact of individual, social, and built environmental factors on health and how they contribute to socioeconomic and racial-ethnic disparities in health. This 2001–2003 multistage probability sample of 3,105 adults aged 18 and older in the city of Chicago has a response rate of 71.8% for face-to-face interviews of one adult per household. The sample is drawn from the 343 neighborhood clusters (NCs) of contiguous tracts covering the entire city of Chicago, developed and characterized by the 1995 Project on Human Development in Chicago Neighborhoods (PHDCN). On average, 9 respondents were sampled from each NC, with up to 21 respondents per NC (King, 2013a). Analyses were weighted to represent Chicago's 2000 Census population in terms of age,

race/ethnicity, and sex. As part of the Community Survey portion of the questionnaire, respondents answered the prompt

> Some neighborhoods have problems with air quality because of things like exhaust from cars, trucks, and buses; smoke from nearby industrial areas; or dust and dirt from trash or construction. How would you rate the quality of the air in this neighborhood?

on a four point scale, including “Excellent,” “Good,” “Fair,” and “Poor.”

Sociodemographics

Our sociodemographics are coded in a series of dummy variables. Four *race/ethnic categories* are used: non-Hispanic Whites (the reference), non-Hispanic Blacks, Hispanics, and other non-Hispanics. *Gender* is coded such that males are treated as the reference category. Dichotomous variables represent different *age groups* (30–39, 40–49, 50–59, 60–69, and 70 years and over), with 18–29 as the reference group. Three dichotomous categorical variables measure years of *education*, 0–11, 12–15, and 16 or more. *Household income* is also represented by dichotomous indicators of income less than $5,000, $15,000-$39,000, $40,000 or more, and missing income, with $5,000-$15,000 as the reference category.

Neighborhood Social Environment Measures

Following Sampson and Raudenbush (2004), census-based neighborhood *percent non-Hispanic Black*, *percent Hispanic*, and *percent of families in poverty* are used as measures of neighborhood stigma. *Physical disorder* is one of the most frequently studied neighborhood constructs (Diez Roux & Mair, 2010). The disorder measure used here comes from the systematic social observation (SSO) component of the CCAHS, in which trained raters assessed ecological conditions using standardized criteria. CCAHS SSO-trained raters also assessed the area around respondents’ homes for noxious smells, although noxious smells turned out to be relatively rare. These measures were allocated to respondents by aerial apportionment from block group data, or aggregated to the NC level.

Built Environment Data

Four measures of the built environment that might serve as visual cues of air pollution are used: polluting facilities, walkable urban form, industrial land use, and transportation land use. Built environment data are measured separately in 1-km buffers around the respondents’ homes and at the NC level. The analyses consider a measure of the proportions of land in the surrounding 1 km or NC that is used by *industry* and by *transportation* according to urban planning data (Chicago Metropolitan Agency for Planning, 2006; King, 2012b). A composite measure of *walkable urban form* based on a literature (e.g. Frank et al., 2009; King & Clarke, 2014) on how environmental features predict walking is constructed as a principal components factor of residential density, street connectivity, and land use mix (King, 2013b). Urban form is closely related to transportation mode choices, and thus may both proxy for traffic and influence how respondents interact with their surroundings by walking near traffic.

Toxics Release Inventory (TRI) facilities from 2002 are included here because respondents may be aware that some facilities are more likely than others to release toxics. TRI facility locations have been used as a proxy for risk in earlier environmental health and justice research (Bolin et al., 2002; Crowder & Downey, 2010; Dolinoy & Miranda, 2004; Mohai, Lantz, Morenoff, House, & Mero, 2009; Sicotte & Swanson, 2007), and are used in the National Air Toxics Assessment (below). The TRI is a list of industrial facilities (in manufacturing, mining, electricity-generating facilities that combust coal or oil, chemical wholesale distributors, petroleum terminals, bulk storage, and even dry cleaners) that meet certain thresholds for the disposal or other release of listed toxic chemicals, released annually (U.S. Environmental Protection Agency, 2002b). Being listed in the TRI does not necessarily mean that a facility has released toxics into the neighborhood. Also, releases that occur may not be hazardous to humans, and the quantity of toxics released may not match reports. Figure 1 shows the locations of TRI facilities, along with industrial and transportation land uses.

Objective Measures of Air Pollution

The pollutants considered here are 2 of the 6 “criteria air pollutants” for which the Clean Air Act requires the EPA to set standards, and the three categories of health risks are from air toxics. Measures of estimated health risks (of *cancer, respiratory disease*, and *neurological disorder*) come from the 2002 National Air Toxics Assessment (U.S. Environmental Protection Agency, 2002a). These measures are estimated based on reported toxic releases by facilities in the National Emissions Inventory; they are also based on detailed analyses of literature on the diverse health risks of each toxic, rather than on observed health outcomes.

All three forms of estimated health risks are elevated in the downtown area, while the risks of respiratory disease and cancer trace the patterns of Chicago’s main highways, and neurological and cancer risks are raised near the East Side. Measures of ambient *particulate matter* less than 10 micrometers in diameter and ambient daily *ozone* means (10 am-6 pm) from the EPA’s Air Quality System were obtained from RAND at the tract level (Escarce, Lurie, & Jewell, 2011). Because of the limitations involved in modeling air pollution, the EPA (U.S. Environmental Protection Agency, 2011) cautions that at small scales such as the tract level, the data are estimates modeled with imperfect measures and methods; nevertheless, the data are widely used in research and are the best available for this time period. Both NATA and RAND provided data at the tract level. The NC-level models’ tract data is aggregated to the NC level in proportion to the land area of the tract.

Analytical Plan

This paper has two aims: (1) to assess the relationship between perceived air quality and five commonly used objective measures (cancer risk, neurological risk, respiratory risk, particulate matter (PM10), and ozone), and (2) to build on Sampson and Raudenbush’s (2004) neighborhood stigma framework and the literature on environmental justice by investigating neighborhood correlates of perception of air quality; this includes social features suggested by the neighborhood stigma framework when adjusted for built features that may visually cue pollution.

To assess the association of stigmatized neighborhood social composition with air quality perception, multivariate ordered logit models are used. The ordered logit model assumes that a continuous latent variable underlies the response categories, but also that the distances between the categories are unknown. Three types of models are used in accordance with methods commonly employed in modeling urban neighborhoods: (A) an unclustered individual-level model, (B) a "within-neighborhood" model, and (C) multilevel models nesting respondents within neighborhood clusters. Because this is a representative sample, analyses are weighted to represent the adult population of Chicago in the 2000 Census. The single-level model (models 1 in Table 3) used the ologit model (Long & Freese, 2006) in Stata, version 13 (StataCorp, 2013), with standard errors not adjusted for the clustering of individuals within neighborhoods. The multilevel models were estimated using the GLLAMM routine in Stata with an ologit link (Rabe-Hesketh & Skrondal, 2012).

To assess the associations of pollution and built-environment proxy measures with perceived air quality, and to evaluate whether neighborhood stigma plays a role in the perception of air quality, multivariate statistical models are employed. The first model (model 1 in Table 3) estimates individual-level disparities in air quality perception, focusing on differences across groups defined by race/ethnicity, gender, immigrant status, education, and income. The extent to which disparities in perceived air quality are attributable to differences in residential locations between groups can be assessed by comparing models 1 and 2. Model 2 reports estimates that adjust for neighborhood context using a multilevel model with neighborhood random effects (in which each covariate is centered around its neighborhood mean and no neighborhood covariates are included) so that the coefficients represent "within-neighborhood" estimates of individual-level disparities in perception of air quality. This approach is similar to adding a dummy variable for each neighborhood but avoids the severe bias that may occur in non-linear fixed effect models with many strata (Breslow & Day, 1980; Cox & Hinkley, 1974; Morenoff et al., 2008).

Models 3–5 separately estimate effects of social, built, and pollution environments, while model 6 brings these domains together in a single model. These models provide signals about the underlying sources of respondents' environmental perceptions. If respondents have scientifically informed knowledge of local pollution levels, their reports will be closely related to objective pollution levels. If objective perception of air quality is driven primarily by domain-specific visual cues in the neighborhood, built environment pollution proxies will closely predict perceptions. However, if neighborhood stigma is the overriding factor in perception, not only will respondents' reports be closely linked with stigmatized social characteristics, but the social context will remain strongly related to perception even as the pollution and built proxy measure effects attenuate in the combined model.

Results

Descriptive Results

The majority of respondents reported that the air quality in their neighborhood was excellent (11.3%) or good (52.2%), with fewer choosing fair (31.3%) or poor (5.1 %). Summary statistics for individual variables are reported in Table 1. The distributions of the contextual variables presented in Table 2 are a study in extremes. Put another way, the composition of

the 1-km area around a Chicago resident's home is 33% non-Hispanic Black, 26% Hispanic, and 16% poor, but some residents do not live near any Blacks, Hispanics, or poor, while others almost exclusively do so. There are also wide ranges in the walkability of the urban form and the percent of land that is industrial or transportation-related (0–57%; 0–59%). Strikingly, while most residents live near three facilities that may release toxics, one-quarter do not live near any, while 3 respondents live within 1 km of 22 such facilities (not shown). In bivariate unweighted ANOVA models not shown, pollution levels significantly differ ($p <$ 0.0001) by report category except for respiratory risk. Respondents reporting worse air quality live in areas with lower ozone levels. Differences in pollution levels by air quality report are small.

When respondent air quality reports are aggregated[1] to the neighborhood cluster level (to maintain anonymity) and mapped (Figure 1), reports display substantial spatial clustering, with the worst perceived air quality reported in Chicago's Central, West, and Lake Calhoun areas. Visual inspection suggests that perceptions of air quality are related to industrial land use, and to a lesser extent, highways and railways. The NC-level intraclass correlation[2] (ICC) of the four-category air quality measure is 0.154 in the CCAHS, indicating that neighbors generally agree somewhat on air quality. To assess how geographically similar air quality perception is with other familiar measures studied in a neighborhood context, consider that the univariate ICC for air quality is roughly of the same magnitude as the ICC for social cohesion (0.14) in the same dataset, and much larger than for individual-level health measures (i.e. systolic blood pressure, 0.042; diabetes diagnosis, 0.032) (King, 2012a), but smaller than for perceived disorder (0.36) (King & Ogle, 2014).

Figure 2 gives standardized levels of pollution by four quartiles of race/ethnic composition for non-Hispanic Blacks, non-Hispanic Whites, and Hispanics. Here the measures have been standardized, giving them a mean of 0 and standard deviation of 1 so that they can be compared with each other; they are interpretable only within the Chicago context. Across four quartiles of race/ethnic composition, differences in pollution levels are less than 0.6 SD. To some extent, cancer, neurological, and respiratory risks track together, separately from ozone and particulate matter.

Social Disparities in Perceived Air Quality

The results in model 1 of Table 3 are given as ordered log-odds (logits). Blacks and Hispanics report worse air quality than Whites do. Sociodemographic covariates are *not shown* in the table and remain relatively constant across individual-level models. Specifically, those with more education (12 years $\beta=-.37$ and 13+ years $\beta=-.55$ vs. <12 years, $p<.001$) report better air quality. Income, age, and immigrant status do not appear to be closely linked with perceptions of air quality, although respondents over age 70 report better air quality (vs. 18–29 years $\beta=-.58$, $p<.005$). Most prior studies have represented age

[1]The aggregated measures are constructed using HLM software, version 6, and are the neighborhood level residuals when controlling for the standard demographic variables used in model 1, using empirical Bayes estimation (Mujahid, Diez Roux, Morenoff, & Raghunathan, 2007).

[2]The intraclass correlation for ordinal logit models is calculated as $\tau/(\tau + 3.29)$, where τ is the variance of the random intercepts (Skrondal, A. and S. Rabe-Hesketh. 2004. Generalized Latent Variable Modeling: Multilevel, Longitudinal, and Structural Equation Models. CRC Press.)

with a linear term that makes interpretation difficult, but perceived seriousness of neighborhood environmental problems may be lower at older ages (Mohai & Bryant, 1998). Women report worse air quality than men do (β=.23, p<.005), consistent with prior research in which women typically report more concern for the environment (Mohai, 1997).

Model 2 shows "within-neighborhood" estimates of social disparities, calculated by centering covariates around their group means and including neighborhood effects in a multilevel model with no neighborhood covariates. This approach is preferable (Breslow & Day, 1980) to including fixed effects for every neighborhood, given the large number of neighborhoods. Within neighborhoods, non-Hispanics of other races report marginally better air quality, while Blacks and Hispanics do not differ from Whites. In subsequent models, Blacks report significantly worse air quality than Whites when built environment or pollution measures are included in the model, but not when neighborhood social characteristics are included in the model. This pattern suggests that while racial/ethnic and social groups have different perceptions of the air quality in their neighborhoods, this is apparently due mainly to the different neighborhoods in which they live, with social conditions playing a key role in perceptions of air quality.

Objective Pollution and Built Environment Pollution Proxies

Models 3–6 present multilevel models of three sets of contextual features on perceived air quality when taking into account individual sociodemographics. The coefficient indicates the expected change in the air quality report (e.g. "Excellent"=1, "Poor"=4) for a one-standard-deviation increase in the neighborhood predictor. Because contextual measures were standardized, the magnitude of the effect sizes can be directly compared. Four stigmatized contextual characteristics (concentration of non-Hispanic Blacks ((β=.31, p<.05), and of Hispanics (β=.27, p<.01), proportion of families in poverty (β=.31, p<.001), and objective physical disorder (β=.15, p<.05) were significantly associated with worse air quality reports in model 3. When pollution-related features of the built environment were considered in model 4, only transportation land use proportion (β=.16, p<.05) was associated with worse air quality perception. Associations of objective pollution measures with perceived air quality are presented in model 5. Particulate matter is highly associated with perceived worse air quality (β=.24, p<.001), as were cancer (β=.13, p<.01) and respiratory risk (β=.15, p<.05), but ozone was inversely associated with worse air quality (β=−.22, p<.001).

When social, built, and pollution contextual measures are considered together in model 6, the associations of objective pollution measures with perceived air quality are attenuated. Meanwhile, the social environment coefficients change little. Transportation land use and particulate matter (which is associated with vehicle emissions) remain predictive of perceived worse air quality, consistent with a role for sensory clues in environmental perception. However, social cues emerge as the key predictors of air quality perception even after adjustment for extensive pollution and built environment correlates, a finding that is consistent with a neighborhood stigma interpretation.

To evaluate whether results are influenced by the specification of neighborhood, in models not shown, models 3–6 were repeated in a single-level framework with contextual features

measured at 1 km from the respondent and pollution at the tract level. The main pattern of results is concordant between the individual and multilevel models. Physical disorder is not significantly predictive of worse air quality in the single-level models, while walkable urban form is. Meanwhile, neurological and cancer risks are also significant in the full multilevel model but not in the full individual model; multilevel models with NCs as neighborhoods show stronger associations with objective pollution measures.

Sensitivity analyses did not reveal excessive multicollinearity or substantive outliers. In models (not shown) that were stratified by or interacted with respondent race/ethnicity, the association of contextual social composition is strongest among Black respondents. However, stratified models attenuate sample size, and Chicago's segregation means that most respondents live in co-ethnic majority neighborhoods, further complicating inference.

Discussion

Contemporary research on environmental justice and residential mobility assumes that neighborhood residents consider environmental quality in decision-making, but the literature rarely discusses cognitive nuances of risk perception development. The results here show that perceptions of air quality do track somewhat with objective measures of air quality, especially particulate matter (but are inversely related to ozone in some models), as well as transportation land use. However, residing near people who have stigmatized social characteristics very consistently predicts worse air quality reports even after adjustment for objective measures of pollution and potential built environment cues of air quality. Indeed, the models that include social composition but not built environment or pollution predictors have the best model fit (assessed by AIC). Social composition, the built environment, and objective pollution are intricately intertwined. The results are consistent with the neighborhood stigma theory, even though air quality is not a construct for which local residents are likely to be exclusively blamed.

This insight suggests a minor modification or clarification of the neighborhood stigma argument. Elevated reports of crime and disorder in the neighborhood stigma literature have previously been interpreted as evidence of cognitive bias by respondents who subconsciously assume that minorities they see in their area will produce crime and disorder. Air pollution, however, poses an interesting test case in that air pollution is not assumed to be caused by minorities but rather inflicted on them. If respondents report worse air quality in areas with high concentrations of Blacks (even though air quality is not worse in those locations according to measures derived scientifically without reference to race-linked phenomena), this will indicate racial stigmatization of the place. However, in this revised model, neighborhood reputation is viewed as an unobserved latent variable that, in turn, respondents use to impute the unknown neighborhood domain-specific characteristic (e.g. air pollution, disorder, or crime). They do not directly use racial composition in imputing air quality.

Rather than being a simple bias against a population's social identity, neighborhood stigma is likely the present state of a complex evolving historical process in which specific places have spatially and temporally lagged reputations. These reputations are shared or negotiated

by residents and outsiders, and are likely to be informed somewhat by prior objective reality. To some extent, place reputations may be domain-specific (e.g. “a crime-ridden area”). This framework suggests that once a place acquires a negative reputation (e.g. “a bad neighborhood”), respondents will tend to rely heavily on that evaluation when inferring neighborhood characteristics, particularly in the absence of domain-specific information or experience. Present social composition heavily informs place reputation, but along historically contingent pathways. In some places, notably Chicago, place reputation appears to be dependent on the racial/ethnic phenotype of people visible in those areas, while in metropolitan areas with dissimilar ethnoracial trajectories or neighborhoods outside the U.S., material resources (Franzini, Caughy, Nettles, & O’Campo, 2008) or other considerations may be more salient.

This modification of the neighborhood stigma framework proposes that, rather than residents keeping careful track of individual domains of neighborhood quality, they appear to calculate a latent variable generalization about place reputation. When asked about their neighborhoods, respondents then may impute their domain-specific response based on a combination of place reputation and available domain-specific information. Domain-specific information may have come from the respondent’s personal observation and conversational partners, or might have been informed by trusted authorities such as the neighborhood watch, police, public health or school officials, community activists, grassroots environmental movements, the media, academics, congregations, or other community educators. Recently, objective community measures have become increasingly available online, which may result in better-informed respondents over time. Online neighborhood pollution and crime data might also increase social disparities in the relationship between publicly available objective measures and respondent perceptions because only some members of the public have access to Internet resources or seek them out.

The idea that racial/ethnic composition influences domain-specific perception indirectly through place reputation also explains why studies (Quillian & Pager, 2001; Sampson & Raudenbush, 2004) find that racial composition drives neighborhood perception for all racial/ethnic groups. Because the stigma is shared rather than individual, personal characteristics such as racial attitudes only partially filter the influence of neighborhood reputation on an individual’s perceptions. Likewise, the finding by Franzini and colleagues (2008) that stereotypes about minorities may not always be the key correlate of place-based cognitive bias suggests contextual variation in the sources of neighborhood stigma, yet reinforces that such stigma can exist even when racial motivations are not primary.

The study has several limitations. While the sample represents adults in Chicago in 2001–03, changes in both data collection methods and methods by which the public can access environmental information may mean results would differ today. Results might vary across the country, in highly polluted cities globally, in rural areas, and among populations facing particular environmental and social challenges. Moreover, respondents were asked a single question at one point in time, so it is unknown whether their perceptions change to adjust to daily or seasonal fluctuations, to reflect current news cycles, or with mood. It is not clear how externally valid this survey response might be; responses may not reflect behaviors. Likewise, measures of local variation in air quality are coarse, with many researchers feeling

that more air quality monitors are needed to improve measurement in studies like this. Coarse measures may be particularly problematic if respondents have differential likelihood of living near emissions sources. However, finer measures might influence individual-level results more than neighborhood coefficients. Meanwhile, we have positioned respondents at their home addresses even though people are known to spend much of their time outside the residential environment, and ideas of what constitutes a “neighborhood” vary. Thus, issues of measurement may complicate the interpretation of findings. Future data collection should report on a broader range of environmental perceptions and attitudes simultaneously, and qualitative research on environmental risk perception can offer a lot. In addition, the use of wearable personal sensors as they become available may greatly facilitate population-based pollution research (King, 2014).

These results have clear implications for the political discourse on environmental quality, as well as informing the discussion of how perceived and objective measures of places may differentially relate to individual well-being. First, while population groups do not considerably differ in their perceptions of air quality when in the same places, social groups are differentially exposed to neighborhood conditions which lead to their concern about air quality. The finding that even within a large city that heavily relies on manufacturing and transportation, 11.3% of Chicago residents felt comfortable reporting their air quality as “excellent,” suggests the difficulty of persuading affluent members of the public and key stakeholders to be concerned about air pollution.

A second implication of these results is that although respondents’ perceptions do match up to some extent with objective measures, available objective measures actually line up rather poorly with the general public’s perceptions of their own risks. It is possible that vehicle exhaust is particularly noticeable to respondents, given the significant associations of worse air quality self-reports with transportation land use and particulate matter air pollution. Some of the earlier environmental justice literature proxied pollution exposure by proximity to TRI facilities, but in Chicago, TRI facility density near the home was not an especially salient correlate of residents’ perceptions of air quality. Residents may not be particularly aware which facilities are more likely to release toxics, but indeed industrial land use was not particularly salient to air quality reports, either. This finding suggests that respondents may not be aware of air pollution risk from industrial emissions. The need to consider which kinds of air quality can be perceived is particularly salient in studies of how pollution influences residential mobility.

The complexity of the findings here aligns with prior hedonic pricing models of air quality. Studies of air quality often have “change of support” problems, in which air quality and other variables of interest are measured at differing spatial scales (Anselin & Gallo, 2006) due to the irregular locations of air quality monitors. Estimates of willingness to pay for air quality in models of home prices sometimes find non-significant or negative values for air quality, which may be due to methodological challenges or (more likely) because unmeasured characteristics that are positively correlated with pollution drive housing demand (Kim, Cho, Lambert, & Roberts, 2010). The findings in hedonic pricing models may also result from buyers’ limited awareness of small-scale variation in air quality. Considered in light of this background, the present finding that higher ozone levels are

associated with better air quality reports must be interpreted cautiously. Given that higher ozone levels in Chicago occurred on the outskirts of the city, where single-family housing is more common and neighborhoods are more affluent, the sign of the association with ozone likely is consistent with the stigma theory: "better" (single-family home neighborhoods) may be viewed as better in individual domains of neighborhood quality even in the presence of small deficits according to the objective measure of ozone.

Quillian and Pager (2001) were concerned that one finding in particular boded poorly for racial integration, specifically the finding that the influence of racial composition on perceptions of crime was larger than that of real crime rates. If neighborhood stigma is not precisely driven by implicit bias due to racial composition, but rather is a result of a shared bias about a place that only correlates highly with racial composition, this finding may be a hopeful one. It suggests that if community opinion leaders work to spread more objective domain-specific knowledge and promote a more dynamic and nuanced view of neighborhood quality, they may help residents and outsiders to more accurately understand where objective challenges exist-and where they do not.

Acknowledgments

This work was supported in part by an appointment to the Research Participation Program for the US Environmental Protection Agency, Office of Research and Development, administered by the Oak Ridge Institute for Science and Education through an interagency agreement between the US Department of Energy and the EPA and in part by the Michigan Center for Integrative Approaches to Health Disparities (P60MD002249) funded by the National Center on Minority Health and Health Disparities. The author gratefully acknowledges use of the services and facilities of the Population Studies Center at the University of Michigan, funded by NICHD Center Grant R24 HD041028. This work does not represent the official policies of the Environmental Protection Agency.

References

Anselin L, Gallo JL. Interpolation of Air Quality Measures in Hedonic House Price Models: Spatial Aspects. Spatial Econometric Analysis. 2006; 1(1):32–52.

Ansolabehere S, Konisky DM. Public Attitudes Toward Construction of New Power Plants. Public Opinion Quarterly. 2009; 73(3):566–577. doi: 10.1093/poq/nfp041.

Baden BM, Coursey DL. The Locality of Waste Sites within the City of Chicago: A Demographic, Social, and Economic Analysis. Resource and Energy Economics. 2002; 24:53–93.

Bolin B, Nelson A, Hackett E, Pijawka KD, Smith CS, Sicotte D, O'Donnell M. The Ecology of Technological Risk in a Sunbelt City. Environment and Planning A. 2002; 34:317–339.

Breslow, NE.; Day, NE. Statistical Methods in Cancer Research: Volume 1: The Analysis of Case-Control Studies. International Agency for Research on Cancer; Lyon, France: 1980.

Chasco C, Gallo JL. The Impact of Objective and Subjective Measures of Air Quality and Noise on House Prices: A Multilevel Approach for Downtown Madrid. Economic Geography. 2013; 89(2): 127–148. doi: 10.1111/j.1944-8287.2012.01172.x.

Chicago Metropolitan Agency for Planning. Data Bulletin: 2001 Land-use Inventory for Northeastern Illinois. 2006. Retrieved April 2010, from http://www.cmap.illinois.gov/LandUseInventory2005.aspx?ekmensel=c580fa7b_8_16_15051_4

Cox, DR.; Hinkley, DV. Theoretical Statistics. Chapman and Hall; London: 1974.

Crowder K, Downey L. Inter-Neighborhood Migration, Race, and Environmental Hazards: Modeling Micro-level Processes of Environmental Inequality. American Journal of Sociology. 2010

Diez Roux AV, Mair C. Neighborhoods and Health. Annals of the New York Academy of Sciences. 2010; 1186:125–145. [PubMed: 20201871]

Dolinoy DC, Miranda ML. GIS Modeling of Air Toxics Releases from TRI-Reporting and Non-TRI-Reporting Facilities: Impacts for Environmental Justice. Environmental Health Perspectives. 2004; 112(17):1717–1724. [PubMed: 15579419]

Downey L. US Metropolitan-area Variation in Environmental Inequality Outcomes. Urban Studies. 2007; 44(5/6):953–977. [PubMed: 21909171]

Downey, L.; Crowder, K. Using Distance Decay Techniques and Household-Level Data to Explore Regional Variation in Environmental Inequality. In: Maantay, JA.; McLafferty, S., editors. Geospatial Analysis of Environmental Health. Vol. 4. Springer; Netherlands: 2011. p. 373-394.

Escarce, JJ.; Lurie, N.; Jewell, A. RAND Center for Population Health and Health Disparities (CPHHD); Data Core Series: Inter-university Consortium for Political and Social Research (ICPSR) [distributor]; 2011.

Frank LD, Sallis JF, Saelens BE, Leary L, Cain K, Conway TL, Hess PM. The Development of a Walkability Index: Application To the Neighborhood Quality of Life Study. British Journal of Sports Medicine. 2009

Franzini L, Caughy MOB, Nettles SM, Campo P. Perceptions of Disorder: Contributions of Neighborhood Characteristics to Subjective Perceptions of Disorder. Journal of Environmental Psychology. 2008; 28(1):83–93. doi: 10.1016/j.jenvp.2007.08.003.

Gallop. Environment. 2014. Retrieved April 9, 2014, from http://www.gallup.com/poll/1615/environment.aspx

Gee GC, Takeuchi DT. Traffic Stress, Vehicular Burden and Well-Being: A Multilevel Analysis. Social Science & Medicine. 2004; 59(2):405–414. [PubMed: 15110429]

Hunter LM. The Spatial Association between U.S. Immigrant Residential Concentration and Environmental Hazards. International Migration Review. 2000; 34(2):460–488.

Kelling, GL.; Coles, CM. Fixing Broken Windows: Restoring Order and Reducing Crime in Our Communities. Touchstone; New York: 1996.

Kim SG, Cho SH, Lambert DM, Roberts RK. Measuring the value of air quality: application of the spatial hedonic model. Air Quality, Atmosphere & Health. 2010; 3(1):41–51.

King KE. Aggravating Conditions: Cynical Hostility and Neighborhood Ambient Stressors. Social Science & Medicine. 2012a; 75(12):2258–2266. [PubMed: 22995667]

King, KE. Comparison of Systematic Social Observation and Aerial Photography Data on Land Use in Chicago. Population Studies Center; University of Michigan: 2012b.

King KE. Jane Jacobs and 'The Need for Aged Buildings': Neighborhood Historical Development Pace and Community Social Relations. Urban Studies. 2013a; 50(12):2407–2424.

King KE. Neighborhood Walkable Urban Form and C-Reactive Protein. Preventive Medicine. 2013b; 57(6):850–854. [PubMed: 24096140]

King KE. Dr. King Responds to "History of Place, Life Course, and Health Inequalities". American Journal of Epidemiology. 2014 doi: 10.1093/aje/kwu315.

King KE, Clarke PJ. A Disadvantaged Advantage in Walkability: Findings From Socioeconomic and Geographical Analysis of National Built Environment Data in the United States. American Journal of Epidemiology. 2014 doi: 10.1093/aje/kwu310.

King KE, Ogle CM. Negative Life Events Vary by Neighborhood and Mediate the Relation between Neighborhood Context and Psychological Well-Being. PLoS ONE. 2014 doi: 10.1371/journal.pone.0093539.

Laurian L. A Prerequisite for Participation: Environmental Knowledge and What Residents Know about Local Toxic Sites. Journal of Planning Education and Research. 2003; 22:257–269.

Long, JS.; Freese, J. Regression Models for Categorical and Limited Dependent Variables Using Stata. Second Edition. Stata Press; College Station, Texas: 2006.

Mohai P. Gender Differences in the Perception of Most Important Environmental Problems. Race, Gender, and Class. 1997; 5(1):153.

Mohai P, Bryant B. Is There a "Race" Effect on Concern for Environmental Quality? Public Opinion Quarterly. 1998; 62:475–505.

Mohai P, Bryant B. Dispelling Old Myths: African American. Environment: Science and Policy for Sustainable Development. 2003; 45(5):10–26.

Mohai P, Lantz PM, Morenoff J, House JS, Mero RP. Racial and Socioeconomic Disparities in Residential Proximity to Polluting Industrial Facilities: Evidence From the Americans' Changing Lives Study. American Journal of Public Health. 2009; 99(S3):S649–S656. [PubMed: 19890171]

Mohai P, Pellow D, Roberts JT. Environmental Justice. Annual Review of Environmental Resources. 2009; 34:405–430.

Mohai P, Saha R. Racial Inequality in the Distribution of Hazardous Waste: A National-Level Reassessment. Social Problems. 2007; 54(3):343–370.

Morello-Frosch R, Lopez R. The Riskscape and the Colorline: Examining the Role of Segregation in Environmental Health Disparities. Environmental Research. 2006; 102(2):181–196. [PubMed: 16828737]

Morenoff JD, House JS, Hansen BB, Williams D, Kaplan G, Hunte H. Understanding Social Disparities in Hypertension Prevalence, Awareness, Treatment, and Control: The Role of Neighborhood Context. Social Science & Medicine. 2008; 65:1853–1866. [PubMed: 17640788]

Morenoff JD, Sampson RJ. Violent Crime and the Spatial Dynamics of Neighborhood Transition: Chicago, 1970–1990. Social Forces. 1997; 76(1):31–64.

Mujahid MS, Diez Roux AV, Morenoff JD, Raghunathan T. Assessing the Measurement Properties of Neighborhood Scales: From Psychometrics to Ecometrics. American Journal of Epidemiology. 2007; 165(8):858–867. [PubMed: 17329713]

Peek MK, Cutchin MP, Freeman DH, Stowe RP, Goodwin JS. Environmental Hazards and Stress: Evidence from the Texas City Stress and Health Study. Journal of Epidemiology & Community Health. 2009; 63:792–798. [PubMed: 19282316]

Perkins DD, Taylor RB. Ecological Assessments of Community Disorder: Their Relationship to Fear of Crime and Theoretical Implications. American Journal of Community Psychology. 1996; 24:63–107. [PubMed: 8712188]

PHDCN. Project on Human Development in Chicago Neighborhoods. http://www.icpsr.umich.edu/icpsrweb/PHDCN/about.jsp

Quillian L, Pager D. Black Neighbors, Higher Crime? The Role of Racial Stereotypes in Evaluations of Neighborhood Crime. American Journal of Sociology. 2001; 107(3):717–767.

Rabe-Hesketh, S.; Skrondal, A. *Multilevel and Longitudinal Modeling Using Stata* (3rd ed. Vol. Volume II: Categorical Responses, Counts, and Survival). Stata Press; College Station, TX: 2012.

Saha R, Mohai P. Historical Context and Hazardous Waste Facility Siting: Understanding Temporal Patterns in Michigan. Social Problems. 2005; 52:618–648.

Sampson, RJ. Chicago and the Enduring Neighborhood Effect. University of Chicago Press; Chicago, IL: 2012.

Sampson RJ, Groves WB. Community Structure and Crime: Testing Social Disorganization Theory. American Journal of Sociology. 1989; 94:774–802.

Sampson RJ, Raudenbush SW. Seeing Disorder: Neighborhood Stigma and the Social Construction of "Broken Windows". Social Psychology Quarterly. 2004; 67(4):319–342.

Scorecard. Criteria Air Pollutant Report: Cook County, IL. 2011. from http://scorecard.goodguide.com

Sicotte D, Swanson S. Whose Risk in Philadelphia? Proximity to Unequally Hazardous Industrial Facilities. Social Science Quarterly. 2007; 88(2):515–534.

Skogan, WG. Disorder and Decline: Crime and the Spiral of Decay in American Neighborhoods. Berkeley; University of California Press: 1990.

Smiley MJ, Diez Roux AV, Brines SJ, Brown DG, Evenson KR, Rodriguez DA. A Spatial Analysis of Health-Related Resources in Three Diverse Metropolitan Areas. Health & Place. 2010; 16(5):885–892. [PubMed: 20478737]

StataCorp. Stata Statistical Software: Release 13. StataCorp LP; College Station, TX: 2013.

Stenlund T, Lidén E, Andersson K, Garvill J, Nordin S. Annoyance and Health Symptoms and their Influencing Factors: A Population-Based Air Pollution Intervention Study. Public Health. 2009; 123(4):339–345. doi: doi:10.1016/j.puhe.2008.12.021. [PubMed: 19344922]

Stradling, D. The Electronic Encyclopedia of Chicago. Chicago Historical Society; 2005. Air Quality.

U.S. Environmental Protection Agency. National Air Toxics Assessment. 2002a. from http://www.epa.gov/ttn/atw/natamain/

U.S. Environmental Protection Agency. Toxics Release Inventory. 2002b

U.S. Environmental Protection Agency. An Overview of Methods for EPA's National-Scale Air Toxics Assessment. Office of Air Quality, Planning, and Standards; Research Triangle Park, North Carolina: 2011.

Wang, F.; Feliberty, YC. Spatial Distribution of Toxic Release Inventory Sites in Chicago Area: Is There Environmental Inequity? Geospatial Techniques in Urban Hazard and Disaster Analysis. In: Showalter, PS.; Lu, Y., editors. Vol. 2. Springer; Netherlands: 2010. p. 157-177.

Wilson JQ, Kelling G. The Police and Neighborhood Safety: Broken Windows. The Atlantic Monthly. 1982; 127:29–38.

Wolverton A. Effects of Socio-Economic and Input-Related Factors on Polluting Plants' Location Decisions. The B.E. Journal of Economic Analysis & Policy, Berkeley Electronic Press. 2009; 9(1):14.

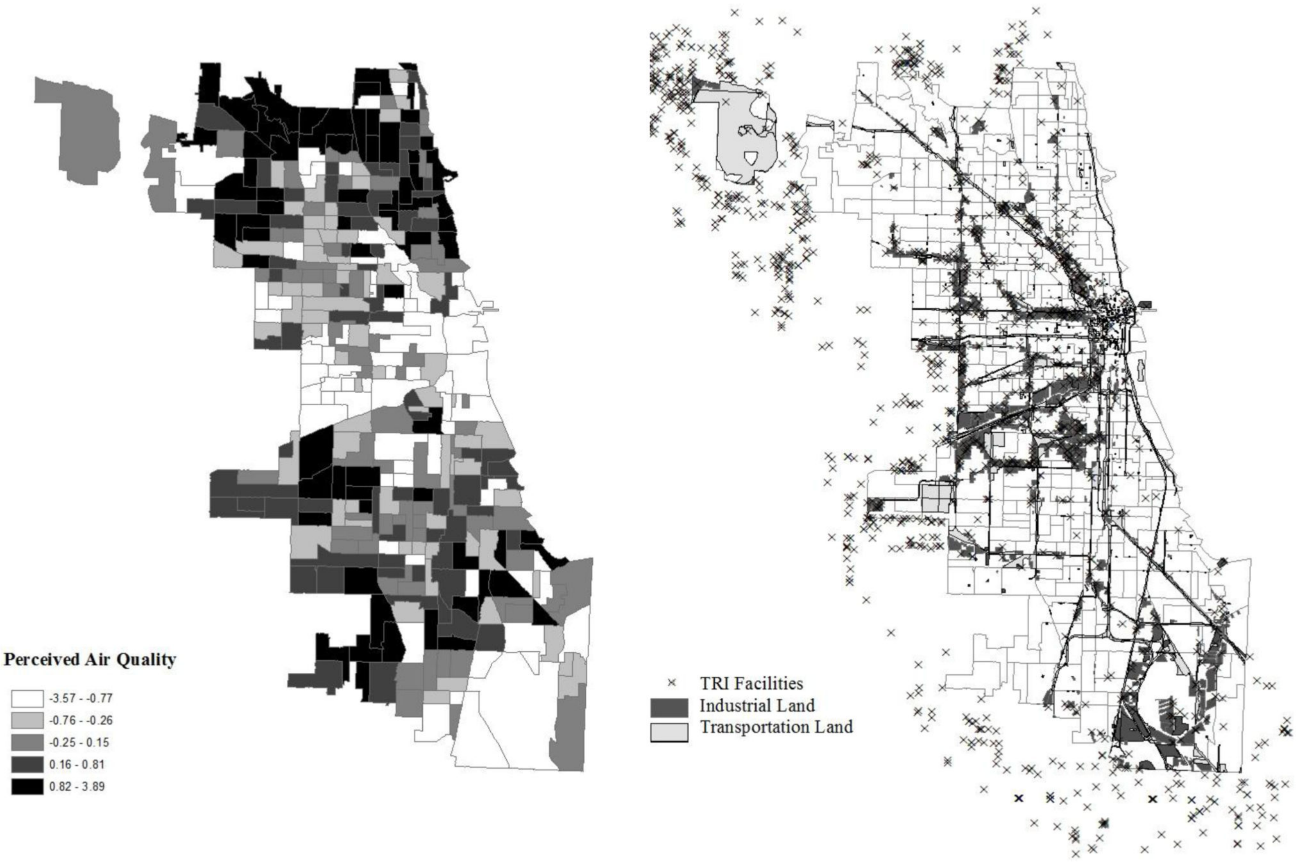

Figure 1. Maps of Perceived Air Quality and Potential Pollution Sources

Left: Maps of Quintiles of Neighborhood Aggregated Perceived Air Quality, Empirical Bayes Estimates of NC-level Residuals Adjusted for Sociodemographics, CCAHS (343 Neighborhoods)

Right: Industrial and Transportation Land Uses (2001) in Chicago, Shown with Toxic Release Inventory Industrial Facilities within 4 KM of Chicago (2002)

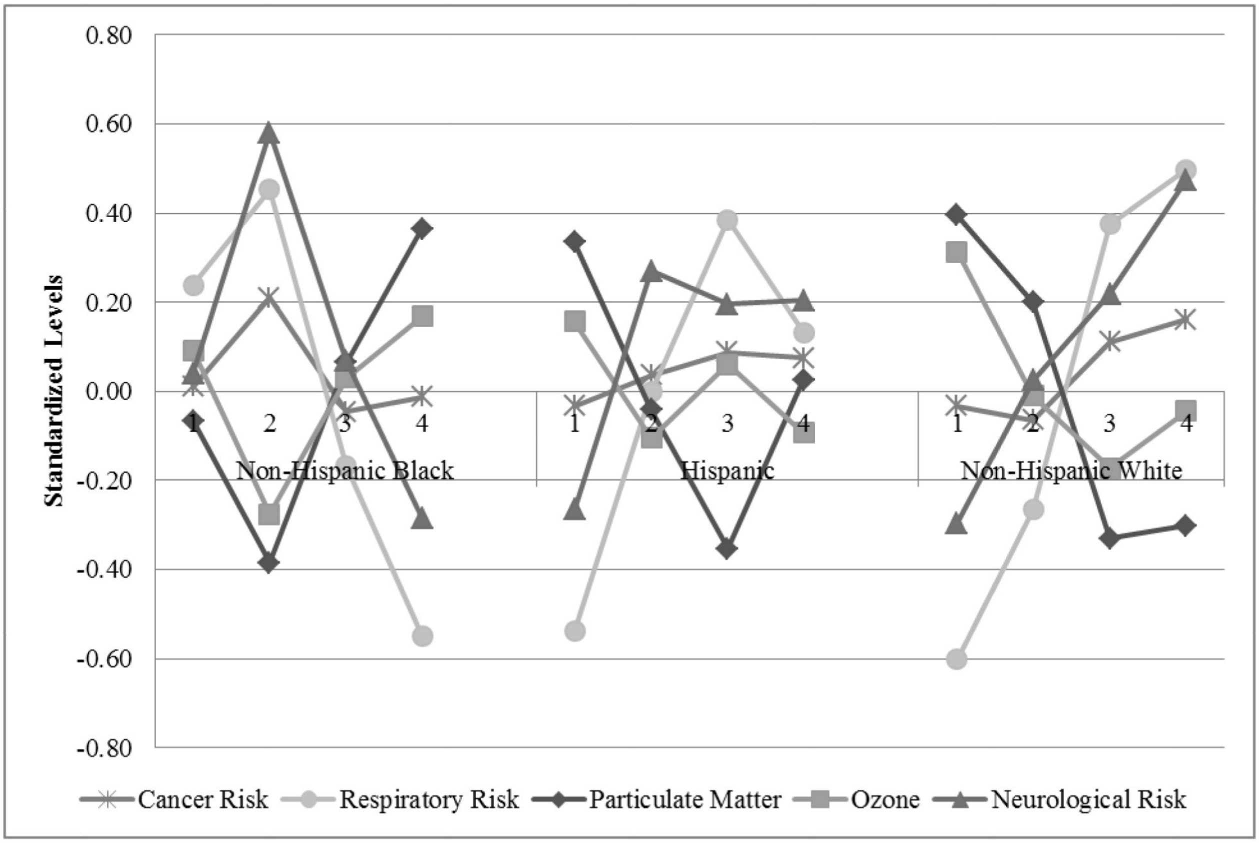

Figure 2. Pollution Levels by Tract Racial/Ethnic Composition (n=854)

To some extent, cancer, neurological, and respiratory risks track together, separately from ozone and particulate matter. Across four quartiles of race/ethnic composition, differences in pollution levels are less than 0.6 SD.

Table 1

Summary Statistics for Individual Sociodemographics

	Unweighted Frequency	Population-Weighted Percent of Sample	Population-Weighted % Who Report Fair/Poor
Sex			
Male	1,235	47.4	33.4
Female	1,870	52.6	39.2
Age			
18-29	800	27.6	37.7
30-39	748	22.7	36.5
40-49	608	18.7	39.7
50-59	402	12.9	33.2
60-69	286	9.0	35.7
70+	261	9.1	31.1
Race/Ethnicity			
Non-Hispanic Black	1,240	32.1	43.4
Non-Hispanic White	983	38.4	27.2
Hispanic	802	25.8	43.5
Non-Hispanic Other	80	3.8	23.0
Immigrant Status			
1st Generation	773	26.9	38.1
2nd or Higher	2,332	73.1	35.8
Education (Years)			
<12	792	23.3	46.9
12-15	1,576	48.7	36.0
16+	737	28.0	28.4
Income			
$0-4,999	185	5.2	40.3
$5,000-14,999	501	14.9	43.0
$15,000-39,999	894	26.4	39.7
$40,000+	948	34.9	30.7
Missing	577	18.6	36.5

Table 2

Summary Statistics for Neighborhood Measures and Weighted NC Means by Respondent Air Quality Rating (CCAHS, 343 Neighborhood Clusters)

	Mean	SD	Minimum	Maximum	Excellent	Good	Fair	Poor
Social Environment								
% Non-Hispanic Black	42.42	42.75	0	100.00	22.54	30.90	40.59	37.87
% Hispanic	24.59	28.61	0	96.61	20.91	23.77	27.33	33.64
% Families in Poverty	18.85	13.78	0.49	80.69	10.96	13.77	18.81	21.50
Disorder (Std)	−1.87	1.42	−7.10	1.75	−2.65	−2.25	−1.70	−1.60
Built Environment								
Walkable Urban Form (Std)	0.00	1.00	−2.29	3.91	−0.81	−0.38	0.21	0.45
Toxic Releasing Facilities	1.97	3.46	0	27	1.63	2.00	2.46	3.18
Industrial Land (%)	7.46	11.31	0	56.61	4.72	5.72	7.36	9.71
Transportation Land (%)	5.48	8.18	0	59.30	4.00	5.07	6.29	7.57
Pollution								
Respiratory Risk	5.74	0.87	4.21	9.30	5.98	5.86	5.85	5.91
Neurological Risk	0.11	0.03	0.08	0.37	0.11	0.11	0.12	0.12
Cancer Risk	0.000057	0.000000	0.000056	0.000057	0.000055	0.000056	0.000058	0.000059
Particulate Matter (μg/m3)	25.31	0.62	24.27	28.42	25.13	25.20	25.31	25.45
Ozone (ppb)	0.0379	0.0000	0.0378	0.0379	0.0380	0.0379	0.0377	0.0378

Table 3

Ordinal Logit Regressions on Perceived Worse Air Quality (CCAHS, n=3,097) Adjusted for age, gender, first generation immigration, education, and income

	Without Clustering	GMC	NC, GLLAMM			
	Model 1 β	**Model 2** β	**Model 3** β	**Model 4** β	**Model 5** β	**Model 6** β
Individual Level						
Race/Ethnicity (ref=NH White)						
Non-Hispanic Black	0.52 ***	−0.30	−0.26	0.34 **	0.30 *	−0.23
His panic	0.27 *	−0.25	−0.20	0.03	0.02	−0.21
Non-Hispanic Other	−0.07	−0.49 +	−0.29	−0.32	−0.34	−0.31
Neighborhood Level						
Social Environment						
% Non-His panic Black			0.31 *			0.32 *
% His panic			0.27 **			0.25 **
% Families in Poverty			0.31 ***			0.30 ***
Disorder			0.15 *			0.15 *
Built Environment						
Industrial Land (%)				0.14 +		−0.02
Transportation Land (%)				0.16 *		0.17 **
Toxic Releasing Facilities				0.07		0.09
Walkable Urban Form				0.02		−0.13 +
Pollution						
Particulate Matter					0.24 **	0.15 **
Ozone					−0.22 ***	−0.05
Respiratory Risk					−0.07	0.07
Cancer Risk					0.13 **	0.07 *
Neurological Risk					0.15 *	0.16 **
Constant 1	−2 34 ***	−3.16 ***	−2.86 ***	* −2.66 ***	−2.62 ***	−2.86 ***

	Without Clustering	GMC	NC, GLLAMM			
	Model 1 β	**Model 2** β	**Model 3** β	**Model 4** β	**Model 5** β	**Model 6** β
Constant 2	0.37 *	2.54 ***	0.14	0.32 +	0.36 *	0.14
Constant 3	279 ***	5.41 ***	2.75 ***	2.93 ***	2.97 ***	2.77 ***
ICC		0.030	0.025	0.026	0.025	0.019
AIC	6724.75	6616.78	6503.63	6568.36	6540.69	6466.23

All contextual measures are standardized.

GMC: Multilevel Group-Mean Centered model estimates results "within neighborhood"

GLLAMM: Multilevel model adjusts for clustering of responses within Neighborhood Clusters

+ p <.10

* p < .05

** p < .01

*** p < .001