BIOLOGICAL, PSYCHOSOCIAL, AND SOCIAL CAPITAL IMPLICATIONS OF THE NEIGHBORHOOD BUILT ENVIRONMENT

by

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AL	allostatic load
CBR	cumulative biological risk
CCAHS	Chicago Community Adult Health Study
CRP	C-reactive protein
DBP	diastolic blood pressure
HbA1c	glycosylated/glycated hemoglobin
HLM	hierarchical linear model
HDL	high-density lipoprotein cholesterol
ICC	intra-class correlation
NC	neighborhood cluster
NHANES	National Health and Nutrition Examination Study
NSR	neighborly social relations
PHDCN	Project on Human Development in Chicago Neighborhoods
RHR	resting heart rate
SBP	systolic blood pressure
SEBAS	Social Environment and Biomarkers of Aging Study
TC	total cholesterol
WS	waist size

ABSTRACT

BIOLOGICAL, PSYCHOSOCIAL, AND SOCIAL CAPITAL IMPLICATIONS OF THE NEIGHBORHOOD BUILT ENVIRONMENT

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Co-Chairs: James S. House and Jeffrey D. Morenoff

Understanding which features of the urban built environment contribute to human health and well-being is a major target for health policy research aimed both at reducing social disparities in health outcomes and at preventing the onset of chronic disease population-wide. At the same time, changes in urban planning policy have been targeted as a possible strategy for environmental, social, fiscal, transportation and other policy improvements as well. In an innovative application of ecological, biomarker, and social survey data for Chicago, this dissertation explores the implications of residential location for individual biological, psychosocial, and social well-being in terms of (1) the accumulation of biological risk factors for disease, (2) cynically hostile personality, and (3) perception of neighborhood social relations. Chapter 2 examines how sorting into residential neighborhoods explains black-white disparities in the accumulation of biological risk factors. The third chapter first examines social disparities in cynical

hostility and the extent to which neighborhoods can explain them, before demonstrating that cynical hostility is much more spatially clustered than had been previously realized. Ambient stressors related to traffic (noise, traffic danger, and air quality) are the most likely explanation for this clustering. Chapter 4 investigates how physical features of urban neighborhoods including housing and walkable urban form, along with social composition and residential stability, predict perceived neighborhood social relations (cohesion, control, intergenerational closure, and reciprocal exchange) previously linked with downstream health, social, and behavioral risks. Housing building types, especially detached houses and high-rise apartments, significantly predict social relations, both independently and through their association with residential stability. Housing and urban form also have differential associations with social relations outcomes according to the socioeconomic status of area residents. A gradual pace of redevelopment resulting in historical diversity of housing strongly and significantly predicts social relations. Walkable urban form (residential density, mixed land use, and street connectivity) appears comparatively less important but shows promise in predicting reciprocal exchange. The finding that physical conditions like housing and urban form have implications for social relations should encourage efforts to develop urban planning policies designed to foster neighborly social relations in concert with other related beneficial outcomes.

CHAPTER 1

INTRODUCTION

Technological change has instigated a sea change in the relationship between individuals and their environments over the last 200 years resulting in an entirely new kind of physical environment our bodies have not evolved to inhabit. An unprecedented and dramatic change has occurred in daily living conditions and the relationships among people, nature, and created objects. In wealthy nations, many people spend most of their days in highly artificial environments. Even today's landscapes have "architects."

Technological changes and the social revolutions they set off somehow brought about a dramatic reduction in morbidity and mortality, with many of these changes yet unexplained. Advances in public health measures, sanitation, nutrition, housing, socioeconomic conditions, and other public health interventions have made major contributions to population health improvements over time within societies (McKeown 1976; McKeown 1988; McKinlay and McKinlay 1977) and to changes in differences among societies.

A convention in popular discussions of historical population health improvement has been to refer to "rising living standards," and to then measure these living standards in monetary terms. But this practice frustrates rather than facilitates inquiry. Income and wealth have no salubrious effect in themselves, but rather are only valuable for the benefits they provide access to; thus, an important goal would be to identify the

independent and interactive causal effects of the artifacts, services, rights, and emotions available for purchase. Each person's consumption decisions, within the broader framework of their society's production and transportation systems, influence local and global environmental quality and resource use. The term "ecological footprint" captures the amount of biologically productive land and sea area needed to produce the materials demanded by a person, group, or population and absorb and render harmless the waste they produce.

While wealth and ecological footprint are both positively correlated with national-level health metrics, some countries have managed to achieve high levels of population health at low levels of income and/or with low ecological footprints (McMichael and Butler 2011). But we do not understand well what this income buys which produces these disparities, and we have little access to information about whether the specific technological changes this income buys are unilaterally "good for us." Specifically, we do not know how to evaluate the relative costs and benefits of technological changes associated with development. Indeed, some negative health outcomes such as obesity are more common in wealthy and resource-intensive regions, and both global hunger and obesity are often regarded as resulting from agricultural policy and land use in complex ways (Elinder 2005). Other causes of a large footprint, such as industrial and automobile pollution, sprawling land uses requiring passive transport, and aging infrastructure designed at large scales, suggest an opportunity for greater resource efficiency in the pursuit of well-being.

Cities, which are at once the growth engine for the great technological and cultural changes and also the site of increasing consumption of resources, may hold the

key to a sustainable future, if we learn how to make them sustainable. As the proportion of the world living in cities reaches 70% by 2050, learning how to increase densities while maintaining quality of life is a key challenge. Residential sorting both into (Eberhardt and Pamuk 2004) and within cities (Williams 2001) is a key determinant of multiple biological, psychosocial, and social outcomes.

Neighborhoods and Health

Spatial segregation by income and race/ethnicity has created pockets of socially isolated and underserved communities within cities. Minorities are particularly likely to live in these communities, and to spend longer periods there (Sampson and Sharkey 2008; Sharkey 2008b). The underprivileged thus spend more time in environments which expose them to risk of biological and social stressors (Boardman 2004; Evans and English 2002; Williams 2001) and which are less likely to offer beneficial buffers such as support for healthy behaviors and positive social relations. Such variations in neighborhood environment seem to contribute to health disparities (Morenoff, House, Hansen, Williams, Kaplan, and Hunte 2008).

Substantial racial, socioeconomic, and spatial disparities in health in the United States are a major public health concern in that they reveal an underlying inequity in our society. On the bright side, they are also an opportunity in that they can be a roadmap for how preventive changes in social management of resources can contribute to health improvements without the need for costly and unnecessary health care. Variations in one's socioeconomic surroundings predict a complex set of other social processes including physical disorder (Skogan 1990), violations of social norms (Galster and

Santiago 2006), and crime (Taylor, Gottfredson, and Brower 1984), which overload the body's ability to cope with stressors, resulting in an accumulation of regulatory dysfunctions across multiple physiological systems (King, Morenoff, and House 2011; McEwen and Stellar 1993).

Explanations of geographic disparities in health and behavioral outcomes often focus on the role of community socioeconomic status in variation in "social capital" and social disorder. Social capital is composed of features of social relations including interpersonal trust, secondary organizations, and the strength of bonds within and across social groupings, that facilitate communication and collective action for the benefit of individuals and the community (Putnam 1993). Access to these networks, then, potentially provides access to resources, and these resources are different from those provided by more formal institutions, so that the ability of social capital to predict a wide variety of health outcomes is a matter of substantial interest to public health researchers (Cagney and Wen 2008; Giordano and Lindström 2011; Kawachi, Kennedy, and Glass 1999; Pearce and Smith 2003). Social interaction within the neighborhood also has implications for buffering against crime, physical deterioration and hazards, and social disorder.

The Role of the Physical/Built Environment

A body of literature mostly in criminology and health policy, a literature which is generally separate from research on social factors addresses features of the physical environment such as land use, accessibility, access to goods and services, exposure to physical hazards, and "walkability." The "built environment" consists of the human-

modified components of the physical environment, such as housing and commercial land use, transportation networks, landscape design, etc., and the accompanying benefits and risks (e.g. traffic risks, access to parks). Walkability, the ease and attractiveness of navigation through this environment, has been the most commonly used theoretical framework for associating built environment features with health outcomes, particularly those related to obesity (Berke, Koepsell, Moudon, Hoskins, and Larson 2007; Booth, Pinkston, and Poston 2005; Casagrande, Whitt-Glover, Lancaster, Odoms-Young, and Gary 2009; Cerin, Leslie, du Toit, Owen, and Frank 2007; Frank, Saelens, Powell, and Chapman 2007; Gordon-Larsen, Nelson, Page, and Popkin 2006; Harrington and Elliott 2009; Leslie, Coffee, Frank, Owen, Bauman, and Hugo 2007; Lovasi, Moudon, Pearson, Hurvitz, Larson, Siscovick, Berke, Lumley, and Psaty 2008; Mujahid, Diez-Roux, Cooper, Shea, and Ni 2006; Smith, Brown, Yamada, Kowaleski-Jones, Zick, and Fan 2008). Walkable streets may also encourage the development of social ties (du Toit, Cerin, Leslie, and Owen 2007; Leyden 2003; Wood, Frank, and Giles-Corti 2010).

Evidence from a growing body of studies suggests that the neighborhood environment plays an important role in determining the health and well-being of residents. Prior research shows that individuals living in socioeconomically disadvantaged neighborhoods are at increased risk for hypertension (Morenoff et al. 2008; Mujahid et al. 2006), diabetes (Diez Roux, Jacobs, and Kiefe 2002), obesity (Do, Dubowitz, Bird, Lurie, Escarce, and Finch 2007), and depression (Mair, Diez Roux, and Galea 2008) even after individual characteristics are considered. Conceptualizing and measuring these neighborhood conditions, then, is central to understanding the implications of residential

context for individual outcomes, identifying the relevant mechanisms, and prioritizing potential health interventions.

Still, the physical environment is a quite understudied component of overall potential contextual influences. Focusing on one dimension of the physical environment for brevity's sake, land use is hypothesized to affect health through a number of mechanisms, including access to health opportunities, quality of social relations, and exposure to crime and pollution. A sizeable literature documents a relationship between urban form and physical activity, such as a street connectivity pattern that fosters walking (Frank, Sallis, Conway, Chapman, Saelens, and Bachman 2006; Lee and Moudon 2006; Lee and Moudon 2008; Saelens and Handy 2008), access to recreational spaces (Kaczynski and Henderson 2008; Smiley, Diez Roux, Brines, Brown, Evenson, and Rodriguez 2010; Tilt, Unfried, and Roca 2007; Witten, Hiscock, Pearce, and Blakely 2008), and commercial destinations to walk to (Cummins and Macintyre 2006; Inagami, Cohen, Finch, and Asch 2006; Moudon, Lee, Cheadle, Garvin, Johnson, and Schmid 2007; Powell, Slater, Mirtcheva, Bao, and Chaloupka 2007). Large areas that are devoted almost exclusively to residential land use have fewer near destinations and are therefore characterized by less walking and biking and more use of cars and other forms of passive transport. Neighborhood designs that allocate significant amounts of space to parking, as well as land use patterns where commercial destinations are not clustered together, such as those found in conventional suburban designs, encourage the use of personal vehicles rather than public transportation or walking.

Traffic accidents are the sixth-leading cause of preventable deaths in the US (Mokdad, Marks, Stroup, and Gerberding 2004), but indirect effects of urban design and

the transportation system on other health and quality of life outcomes are also substantial. By influencing physical activity, land use patterns may contribute to population weight gain and obesity (Corburn 2007; Frank et al. 2006) and other conditions linked to physical activity such as depression (Berke, Gottlieb, Moudon, and Larson 2007). Promotion of low-cost physical activities such as walking among disadvantaged persons is seen as one route to reducing disparities in health outcomes and obesity. Simple interventions such as sidewalk and bike lane construction, as well as larger scale changes to urban transit patterns, are a major policy priority for health policy researchers.

Urban land use configuration also can present direct risks for chronic disease and stress – such as exposure to pollution (Havard, Deguen, Zmirou-Navier, Schillinger, and Bard 2009; Schweitzer and Zhou 2010), traffic risk (Frank 2000), noise (Moudon 2009), and higher small-area ambient temperatures (Arnfield 2003). Compared to "sprawl," compact, intensive, mixed-use land use designs are likely to reduce regional air pollution due to reduced vehicle usage, but density can increase traffic congestion even with reduced vehicle usage, concentrating harmful emissions (Frank and Engelke 2005) and the resultant risk of respiratory and cardiovascular disease (Chen, Goldberg, and Villeneuve 2008; Hoffmann, Moebus, Dragano, Stang, Möhlenkamp, Schmermund, Memmesheimer, Bröcker-Preuss, Mann, Erbel, and Jöckel 2009). Pollution exposures tend to be higher in disadvantaged communities (Grineski, Bolin, and Boone 2007; Hoffmann, Robra, and Swart 2003; Houston, Wu, Ong, and Winer 2004; Linder, Marko, and Sexton 2008; Schweitzer and Zhou 2010), and this is likely true of other traffic problems as well. These traffic-related ambient stressors such as noise, poor air quality, and perceived traffic danger are associated with lower health status and higher depression

(Gee and Takeuchi 2004; Song, Gee, Fan, and Takeuchi 2007), higher cynical hostility (King 2011), and could affect cognitive development in children (Stansfeld, Bergland, Clark, Lopez-Barrio, Fischer, Ohrstrom, Haines, Head, Hygge, Kamp, and Berry 2005). Compact urban design has been proposed as a policy target both to reduce global warming and to reduce traffic stress and pollution-related disease.

Another element of urban design considered to be related to human health and well-being and transportation issues is the allocation of land across usage categories, especially the proximity of commercial and institutional facilities to residences and the co-location of worksites and homes. Mixed land uses such as shops near housing are said to deter crime and social disorder by facilitating "eyes-on-the-street" (Jacobs 1961), a neighborly social interaction in which residents both observe and participate in activities occurring on their streets. Some evidence suggests that walkable neighborhoods are associated with higher levels of neighborhood social ties, trust, and civic participation (Grannis 2009; Leyden 2003) and may be more likely to be socially diverse (Talen 2006), suggesting interaction may foster social tolerance. Places with more high and low-rise apartments compared to single-family homes experience lower levels of crime (Glaeser and Sacerdote 2000). Urban designs that foster casual social interaction may also facilitate neighborhood improvements, the spread of health information, and provision of neighborly care and social support (Brownson, Hoehner, Day, Forsyth, and Sallis 2009; Klinenberg 2002).

Although these two dimensions (social and physical) are considered to be interlinked spatial and temporal processes, very little work has investigated the complex interactions among neighborhood-level characteristics. More importantly, little research

focuses on specifically elaborating the role of the built environment in potentially structuring social organization, despite long-standing social and urban planning theory implying such effects.

Much of the research linking social relations in neighborhoods with neighborhood physical form has involved speculation and outmoded research designs or non-US contexts, but the development of geographic information system (GIS) technologies and data sources has touched off a growing wave of well-designed empirical tests of built environment effects on specific health measures. At present, the outcomes studied in spatial context tend to be limited to the most conventionally studied physical and mental health outcomes. Due to limitation in existing survey and contextual datasets, most studies focus on cross-sectional associations. There is also considerable room for improvement in articulating and testing complex mechanisms by which precise neighborhood characteristics influence specific outcomes, as establishing these pathways is a major goal of neighborhood research. I believe that many of these mechanisms are psychosocial in nature. Few surveys with a multistage clustered sampling design include psychological measures, so establishing to what extent psychological constructs are spatially patterned is a crucial step in arguing for the collection of data which must be collected in order to establish psychosocial mechanisms. Another important step in identifying mechanisms is to take an exploratory approach to systematically assess multiple competing hypotheses rather than only confirming one. Because neighborhood variables tend to be highly correlated, we often find what we look for.

While a large number of studies have linked both neighborhood social composition (especially disadvantage) and social relations (especially social cohesion and

control) with health, behavioral, and cognitive outcomes (Browning and Cagney 2002; Cagney and Wen 2008; Diez Roux, Chambless, Merkin, Arnett, Eigenbrodt, Nieto, and al. 2002; Geronimus 1992; Giordano and Lindström 2011; Kawachi, Kennedy, and Glass 1999; Pearce and Smith 2003; Sampson, Raudenbush, and Earls 1997b; Sharkey and Elwert 2011), and a growing number connect built environment measures with health (Casagrande et al. 2009; Matthews and Yang 2010; Saelens and Handy 2008; Wen and Zhang 2009), very little work has investigated the associations among the built environment, social composition, and social relations. The existing work has tended to focus on the roles of either physical features of neighborhoods, or of social composition, and this bifurcation has existed for decades. Indeed, some neighborhood processes which quite plainly are a function of both built environments and how populations sort into places, particularly variables describing occupancy patterns have been seen by sociologists as mainly social (particularly residential stability), or mainly physical (population density; vacancy rates.)

Older theories of neighborhood change involving the built environment have fallen by the wayside, even as they increase in importance. Beginning with the early Chicago School and continuing until the failure of urban renewal became apparent, neighborhoods were often seen as having life cycles, with the stage depending on the age of the housing stock, which was typically seen as continually declining. The wartime influx of African Americans may have altered the predominating nature of neighborhood change to a dominantly race-based paradigm, manifest in explicit policies and household motives which reinforced racial segregation. Lately, however, explicitly racial policies and racially motivated intraurban migration patterns have begun to wane, revealing again

the underlying importance of urban planning policies as a source of and remedy to segregation.

In controlling residential sorting, these urban planning policies also hold the key to two crucial aspects which we must get right in order to insure the well-being of our cities. First, residential location choice within cities is crucial to neighborhood stability and arresting the outward flow of affluent households, which then have tended to self-isolate rather than participating in the creative and progressive life of cities. There is hopeful evidence of a return to valuing urban amenities and the possibility of a revitalization of urban centers. Fostering rather than frustrating this trend is vital. The initial goal of research on neighborly social relations may have been to arrest this process by understanding how some communities have the collective willpower to overcome neighborhood decline. A return to investing in research on human social ecology may yield social dividends if we learn to forestall and reverse neighborhood decline and with it the factors which push and pull the ends of the economic spectrum to live (and work and play) apart.

Second, while it may be very difficult to stop the trend toward rising income inequality which may be creating increasing tensions in our society, we may be able to address health inequalities by better understanding how health may be influenced by inequality in the built environment which extends beyond pollution. This inequality is manifest in transportation and housing infrastructures as well as access to nature and recreation, healthy foods, and meaningful social interactions.

The Present Study

I divide this dissertation into three substantive chapters, each one dealing with a different domain of quality of life: the biological, the psychological, and the social. The first study (Chapter 2) examines the role of neighborhood context in the accumulation of biological risk factors and racial/ethnic and socioeconomic disparities therein. Data come from face-to-face interviews and blood collection on a probability sample of adults (*n*=549) in the 2001-03 Chicago Community Adult Health Study. Following the approach of prior studies, this analysis uses a constructed index of cumulative biological risk by counting how many of eight biomarkers exceeded clinically-defined criteria for "high risk": systolic and diastolic blood pressure, resting heart rate, hemoglobin A1c, C-reactive protein, waist size, and total and HDL cholesterol. Non-Hispanic blacks, Hispanics, and people with low and moderate education had significantly higher numbers of biological risks than their respective reference groups. Black-white and Hispanic-white disparities in cumulative biological risk remained significant after adjusting for individual-level socioeconomic position and behavioral factors, while individual-level controls substantially diminished the low/high and moderate/high educational differences. Estimating "within-neighborhood" disparities to adjust for neighborhood context fully explained the black-white gap in cumulative biological risk and reduced the Hispanic-white gap to borderline significance. Neighborhood affluence predicted lower levels of cumulative biological risk, but neighborhood disadvantage was not significantly associated with cumulative biological risk. All three studies give attention to social disparities, but Chapter 2 focuses on how neighborhood environments appear to play a pivotal role in the accumulation of biological risk and disparities therein.

Chapter 3 is the first investigation of neighborhood clustering of a personality trait, while also moving toward more explicit focus on the physical environment, a focus which becomes central to Chapter 4. The analysis in Chapter 3 examines the associations of a variety of neighborhood physical and social conditions (especially ambient stressors) with individual cynical hostility, controlling for individual sociodemographics. Variation by neighborhood in cynical hostility is larger than neighborhood variation in other selected health outcomes that are commonly studied using ecological methods. Controlling for neighborhood context reduces the black/white cynical hostility disparity by one-third. A measure of neighborhood ambient stressors (notably noise) significantly predicts cynical hostility, even after individual characteristics are controlled for, and the effect size is larger than that of other contextual predictors. These health-related psychosocial variables and personality traits may cluster in neighborhoods. Neighborhood characteristics may also explain social disparities in health outcomes. Neighborhood deleterious physical conditions may influence health-relevant psychological characteristics, thereby influencing health outcomes and social disparities in these outcomes, even after other sources of life stress are considered. Because residential choice and neighborhood physical conditions are both modifiable, research on how ambient stressors influence health psychology may be particularly fruitful for health policy and practice.

In Chapter 4, I investigate how the built environment (housing and urban form), social composition, and residential stability, may influence neighborly social relations. Housing building types, especially detached houses and high-rise apartment buildings, significantly predict social relations, both independently and perhaps even more through

their association with residential stability. Housing building types and urban form also have differential associations with social relations by outcome and according to the socioeconomic status of the area's residents. A gradual pace of redevelopment resulting in historical diversity of housing units was strongly significantly associated with social relations. It may be that gradual redevelopment preserves community ties, which may take decades to form and which new residents may "inherit" from previous neighbors. Walkable urban form features (residential density, mixed land use, and street connectivity) appear comparatively less important than housing, but this may be due to the limited variation in walkable urban form provided by this large and dense urban setting. However, urban form features show promise in explaining reciprocal exchange. The finding that physical conditions like housing and urban form have implications for social relations should encourage efforts to develop urban planning policies designed to foster neighborly social relations in concert with other related beneficial outcomes.

CHAPTER 2

NEIGHBORHOOD CONTEXT AND SOCIAL DISPARITIES IN CUMULATIVE BIOLOGICAL RISK FACTORS[1]

A growing body of research demonstrates that having multiple adverse biological risk factors – such as hypertension, obesity, high blood sugar, and elevated cholesterol – increases the risk of morbidity, functional and cognitive decline, and mortality (Carlson and Chamberlain 2005; Crimmins, Kim, and Seeman 2009; Crimmins, Kim, Alley, Karlamangla, and Seeman 2007; Geronimus, Hicken, Keene, and Bound 2006; Goldman, Turra, Glei, Lin, and Weinstein 2006; Goldman, Turra, Glei, Seplaki, Lin, and Weinstein 2006; Gruenewald, Seeman., Ryff, Karlamangla, and Singer 2006; Hu, Wagle, Goldman, Weinstein, and Seeman. 2007; Karlamangla, Singer, McEwen, Rowe, and Seeman. 2002; Karlamangla, Singer, and Seeman. 2006; Sabbah, Watt, Sheiham, and Tsakos 2008; Seeman, Singer, Rowe, Horwitz, and McEwen 1997; Seeman, Singer, Ryff, Dienberg Love, and Levy-Storms 2002; Seplaki, Goldman, Weinstein, and Lin 2006; Seplaki, Goldman, Weinstein, and Lin 2004; Taylor, Lerner, Sage, Lehman, and Seeman. 2004). Such research also suggests that racial/ethnic minority groups and people with lower levels of education and income tend to accumulate more biological risk factors (Carlson and Chamberlain 2005; Crews 2003; Crimmins et al. 2007; Geronimus, Bound, Waidmann, Colen, and Steffick 2001; Geronimus, Hicken, Keene, and Bound 2006;

[1] This chapter is reproduced from a late draft of King, Katherine E., Jeffrey D. Morenoff, and James S. House. 2011. "Cumulative Biological Risk Factors: Neighborhood Socioeconomic Characteristics and Race/Ethnic Disparities" *Psychosomatic Medicine: Journal of Biobehavioral Medicine*, doi: 10.1097/PSY.0b013e318227b062.

Kaestner, Pearson, Keene, and Geronimus 2009; Peek, Cutchin, Salinas, Sheffield, Eschbach, Stowe, and Goodwin 2009; Sabbah, Watt, Sheiham, and Tsakos 2008), making the cumulative toll of such "wear and tear" to the body a potentially critical, though not yet widely recognized, facet of health disparities in the United States.

In an influential essay on the pathways from stress to disease, McEwen and Stellar (1993) coined the term allostatic load to describe the harmful effects of physiological response patterns that can ensue from prolonged exposure to stressful environments or being highly reactive to stressors. They described a process in which the body responds to physical, psychosocial, and environmental stressors by producing hormones and neurotransmitters that help the body respond to stress by coordinating physiological responses across multiple biological systems, thus achieving stability through change (McEwen, Seeman, and Allostatic Load Working Group 2009). In the face of severe or prolonged stress, dysfunctions can result from physiological systems being activated too frequently, not having a chance to return to their setpoints, or ceasing to activate adequately. Moreover, dysfunctions of one physiological system can spillover into related systems. For example, exposure to stress can trigger surges in blood pressure, which in turn can accelerate atherosclerosis or interact with metabolic processes to produce Type II diabetes (McEwen, Seeman, and Allostatic Load Working Group 2009). Thus, the theory of allostatic load offers a framework for understanding not only the pathways between stress and disease but also how physiological pathologies can spread across systems and cumulatively affect health.

There is a growing literature on how to measure allostatic load in population-based research. Most studies of this kind create indices of allostatic load from biomarkers

of metabolic, inflammatory, cardiovascular, and neuroendocrine processes. There is substantial variation across studies in how many biomarkers are included in such indices, which physiological systems are represented, and how the indices are formulated [for a comprehensive review, see Juster, McEwen, and Lupien (2010)]. In this study we follow an approach similar to prior studies but use the term "cumulative biological risk" (CBR) rather than allostatic load to describe indices of this kind to acknowledge that they are indirect indicators (at best) of the underlying processes that generate allostatic load. That is, like other studies, we do not have measures of primary stress mediators and instead have secondary outcomes that reflect adaptive physiological responses to stress and other adverse stimuli but which also can arise from other etiologies. Although some scholars use the term "allostatic load" in reference to similar measures, we did not want to give readers the impression that we were directly operationalizing the concept of allostatic load and thus preferred the term CBR. It is worth noting that metabolic syndrome describes a cluster of risk factors that overlaps considerably with those in our measure of CBR, although conceptually allostatic load addresses a broader array of systems in dysregulation. Both of these concepts describe a potentially interrelated set of physiological conditions that may have cumulative and interactive effects on health.

Several studies show that racial/ethnic minorities and/or people of lower social status experience a greater accumulation of biological risk factors (Crimmins, Kim, and Seeman 2009; Kubzansky, Kawachi, and Sparrow 1999). For example, in an analysis of the Normative Aging Study, Kubzansky and colleagues (1999) found that respondents with lower levels of education experienced higher levels of cumulative biological risk. In Weinstein and colleagues' study using both the MacArthur Study of Successful Aging

and Taiwan Social Environment and Biomarkers of Aging Study (SEBAS) cohorts (Weinstein, Goldman, Hedley, Lin, and Seeman 2003), income and education were inversely related to CBR. Likewise, higher levels of education and income were associated with lower CBR in Seeman and colleagues' (2008) analysis of the National Health and Nutrition Examination Study (NHANES III). Respondents with a poverty-income ratio less than 1.85 were more likely than the non-poor to have high CBR in Geronimus and colleagues' analysis of NHANES III, and they also found racial differences in CBR, with higher risks for respondents in the non-poor black category compared to poor whites (Geronimus, Hicken, Keene, and Bound 2006). Several other studies have also shown that blacks (Crimmins et al. 2007; Geronimus, Hicken, Keene, and Bound 2006; Peek et al. 2009; Seeman et al. 2008) and Hispanics (Crimmins et al. 2007; Peek et al. 2009) have significantly more risks than whites, independent of education and income.

Neighborhood environments are often invoked as a possible explanation for social disparities in health. In their study of NHANES III, Bird and colleagues (Bird, Seeman, Escarce, Basurto-Davila, Finch, Dubowitz, Heron, Hale, Merkin, Weden, and Lurie 2009) found that neighborhood socioeconomic status was associated with a higher count of biological risks after adjustment for age, gender, race/ethnicity, marital status, nativity, education, and an income to poverty ratio. Merkin and colleagues (2009) expanded on the analysis by Bird and colleagues, using models stratified by race/ethnicity to show that the relationship between neighborhood disadvantage and CBR is strongest among blacks and, to a lesser extent, Mexican Americans. Neither study assessed the degree to which neighborhood factors explain racial/ethnic differences in CBR; Merkin and colleagues

cite insufficient overlap in the distribution of neighborhood disadvantage between blacks and whites as an obstacle to such an analysis using the NHANES data (Merkin et al. 2009). Thus, to date, no study has provided a systematic account of how much individual-level disparities are a function of or conditioned by neighborhood context (Morenoff et al. 2008).

This paper (1) assesses the contribution of neighborhood environments to racial/ethnic and socioeconomic disparities in CBR, using data from a population-based study of adults in Chicago, and (2) shows that the relationship between neighborhood socioeconomic position and CBR may be driven less by the factors that indicate neighborhood disadvantage (e.g., aggregate income levels and rates of poverty, unemployment, public assistance) and more by factors that may be more indicative of relative neighborhood affluence (e.g., aggregate education levels, occupational composition, and home values).

MATERIALS AND METHODS

Data

Data come from the Chicago Community Adult Health Study (CCAHS), a multi-level study designed to understand the role of residential context, as well as individual and household factors, in affecting both self-reported and biomedical indicators of adult health. A probability sample of 3,105 adults age 18 and older living in the city of Chicago was interviewed and their physical health measured between May, 2001 and March, 2003. The sample was stratified into 343 neighborhood clusters (NCs), previously defined by the Project on Human Development in Chicago Neighborhoods (PHDCN) (Sampson,

Raudenbush, and Earls 1997a), such that each NC usually included two census tracts (roughly 8,000 people) with meaningful physical and social boundaries. One individual was interviewed per household, with a response rate of 71.8 percent.

Persons in 80 focal areas previously defined by the PHDCN were sampled at twice the rate of those in the rest of the city and invited to contribute saliva and blood samples. The focal NCs are a stratified random sample of the 343 NCs, where the strata were defined to reflect racial/ethnic composition (seven categories representing admixtures of whites, blacks, and Hispanics) and socioeconomic status (three categories representing low, medium, and high), resulting in a socioeconomically and racially-ethnically heterogeneous subset of Chicago's neighborhoods (Sampson and Raudenbush 1999). Of the 1,145 respondents who lived in the 80 focal NCs, a blood sample was obtained for 629 (55 percent), and 549 of the resulting blood samples yielded valid data for all measures. In this analytical sample, there were between 2 and 12 people per NC, with a mean of 6.9.

All data and analyses are weighted to account for different rates of subsampling for final intensive interview completion efforts, non-response, and the unique sociodemographic composition of the 80 focal NCs, such that the weighted sample matches the 2000 Census population estimates for the city of Chicago in terms of age, race/ethnicity, and sex. Comparisons of the sociodemographic composition of the analytic sample with the full samples of 1,145 in the focal NCs and 3,105 in the city of Chicago found little difference among them. The original data collection for the CCAHS study was approved under the University of Michigan Behavioral Sciences and Health Sciences Institutional Review Boards.

Outcome Measure

Following an approach used in similar studies, we constructed an index of CBR by counting, for each subject, the number of biomarkers that exceeded clinically-defined criteria for "high risk," as follows: systolic blood pressure (SBP) ≥ 140 mm Hg (Chobanian, Bakris, Black, Cushman, Green, Jr., and al. 2003); diastolic blood pressure (DBP) ≥ 90 mm Hg (Chobanian et al. 2003); resting heart rate (RHR) ≥ 90 beats/minute (Seccareccia, Pannozzo, Dima, Minoprio, Menditto, Noce, and Giampaoli 2001); glycosylated/glycated hemoglobin (HbA1c) ≥ 6.4% (Golden, Boulware, Berkenblit, Brancati, Chandler, Marinopoulos, and al. 2003; Osei, Rhinesmith, Gaillard, and Schuster 2003); C-reactive protein (CRP) ≥ 3 mg/dL (Ridker 2003); total cholesterol (TC) ≥ 240 mg/dL (National Cholesterol Education Program (NCEP) Expert Panel 2001); high-density lipoprotein cholesterol (HDL) ≤ 36 mg/dL for men and ≤ 46 mg/dL for women (Abbott, Wilson, Kannel, and Castelli 1988); and waist size (WS) > 102 cm for men and > 88 cm for women (Guagnano, Ballone, Colagrande, Vecchia, Manigrasso, Merlitti, Riccioni, and Sensi 2001). We imputed waist size for 10 respondents whose measures were outside the range of 25-50 inches (interviewers wrote notes about each of these cases indicating that the measurement was inaccurate) using predicted values from a regression model that included sex, age, immigrant status, race, and birth parity for women. The results reported below are based on the sample of 549 subjects with non-missing data on all eight biomarkers. However, in supplemental analysis we imputed values on all biomarkers for respondents with missing data, constructed a revised index of CBR based on the imputed data, and replicated all of the models. We chose not to

report the results based on the revised CBR scale because (a) they produced no notable differences and (b) the missing values we imputed for this analysis were very likely to be missing at random due to laboratory error in processing blood samples. Although measures of CBR used in prior studies vary considerably (Juster, McEwen, and Lupien 2010), the eight biomarkers that comprise our index include indicators of three major physiological systems – cardiovascular (SBP, DBP, and RHR), metabolic (HbA1c, TC, HDL, WS), and immune (CRP) – and overlap substantially with the biomarkers used to construct indices of CBR in recent comparable studies (Bird et al. 2009; Merkin et al. 2009). We also examined the robustness of our results to alternate specifications of the index by serially excluding each item and reconstructing the index.

A recent review of the research on allostatic load by Juster, McEwen, and Lupien (2009) examined 58 studies analyzing outcomes that we would call measures of CBR. The number of biomarkers included in these CBR indices ranged from 4 to 16, and 51 different biomarkers were used in at least one of these 58 studies. Like the CCAHS, about 25% of the studies reviewed did not include a measure of neuroendocrine function in their index. Our CBR measure is very similar to those used in recent studies of neighborhood context and allostatic load/CBR by Merken et al. (2009) and Bird et al. (2009), both of which used almost the same set of biomarkers as ours, with the only differences being (a) their inclusion of albumin (an immune measure) and (b) their use of the waist-hip ratio rather than waist size (we use the latter).

Independent Variables

In all of our regression models we control for a core set of individual-level sociodemographic variables that include measures of race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, and non-Hispanic other), gender, age (18-29, 30-39, 40-49, 50-59, 60-69, and 70 and older), immigrant generation (first, second, and third or more), educational attainment (less than 12 years, 12-15 years, and 16 or more years), and income ($0-9,999, $10,000-29,999, $30,000-49,999, $50,000 or more). In some models we also introduce controls for health behaviors including measures of physical activity (whether the respondent reports either engaging in light-moderate activity four or more times per week for 20 minutes or more or vigorous activity at least two times per week regardless of duration), fruit and vegetable intake (whether the respondent reports usually eating at least two servings of fruit and/or vegetables per day), smoking (current smoker, former smoker, or never smoked regularly), and drinking (never a regular drinker; no longer a regular drinker; "moderate" drinker, defined as .5 to 60 drinks/month for women and .5 to 90 drinks/month for men; and "heavy" drinker, defined as more than 60 drinks/month for women and more than 90 drinks/month for men). We also included a dichotomous variable to indicate respondents whose income was missing (n=146). Small numbers of missing values were imputed for physical activity (n = 1), fruit and vegetable consumption (n = 1), and smoking (n = 3).

We use two measures of neighborhood socioeconomic position in our analysis, both constructed by calculating the average value of a set of standardized variables for each NC. Our decisions of which census variables to include in each scale were informed by an exploratory factor analysis with an orthogonal varimax rotation. The first scale

(Cronbach's alpha=0.96) is referred to as "neighborhood socioeconomic disadvantage" because it combines measures of the proportion of households with incomes of less than $15,000, the proportion with incomes of at least $50,000 (reverse coded), the proportion of families in poverty, the proportion of households on public assistance, the unemployment rate, and the proportion of vacant housing units. The second scale (Cronbach's alpha=0.94) is called "neighborhood affluence" because it combines measures of the proportion employed civilians ages 16 and over in professional/ managerial occupations, the proportion of individuals ages 25 and over who have completed 16 or more years of education, and median home values. Because these two neighborhood scales are somewhat highly correlated (r = -0.49), we show results from regression models when they are entered one-at-a-time and simultaneously.

Analytic Plan

Our central analytic aim is to assess the extent to which taking group differences in neighborhood context into account in multilevel models changes estimates of racial/ethnic and socioeconomic disparities in CBR. In all of our multivariate models we use Poisson regressions because the outcome is a count of health risk factors. Tests for overdispersion and zero-inflation were not significant, and results from Poisson models were consistent with those from negative binomial models. Models without neighborhood random effects (models 1-4 in Table 2.4) were run in Stata, version 11, with standard errors adjusted for the clustering of individuals within neighborhoods; while models that include neighborhood random effects (models 5-8 in Table 2.4) were run in HLM, version 6 (using a generalized linear model with a Poisson link function and

population-average estimates with robust standard errors). To ease interpretation of our results, we present the incidence rate ratios (IRRs) (UCLA: Academic Technology Services Statistical Consulting Group), which for a unit change in a given covariate, Δx_i, is calculated as $e^{\beta_i \Delta x_i}$ and interpreted as the change in the expected number of risk factors per person associated with a one unit change in the covariate.

We first estimated individual-level disparities in CBR, focusing on differences across groups defined by race/ethnicity, immigrant status, education, and income (Table 2.4, models 1-4). These models all controlled for sex and age and introduce the following blocks of variables, separately and in combination: (a) race, ethnicity, and immigrant status; (b) education and income; and (c) behavioral factors that could potentially mediate either racial/ethnic or socioeconomic disparities, including physical activity, fruit and vegetable intake, smoking, and drinking. We then adjusted for neighborhood context by running multilevel models with neighborhood random effects (Table 2.4, models 5-8), taking two different approaches to model specification. First, we present a multilevel model that has no neighborhood-level covariates but in which each covariate is centered around its neighborhood mean so that the coefficients represent "within-neighborhood" estimates of individual-level disparities in CBR. This approach is similar to adding neighborhood fixed effects but avoids the problem that non-linear fixed effect models can become severely biased with many strata (Breslow and Day 1980; Cox and Hinkley 1974; Morenoff et al. 2008). Next, we examine the relationship between measures of neighborhood socioeconomic position – disadvantage and affluence – and CBR, adding each measure separately and then combining them in the same model to

estimate the degree to which they may explain racial/ethnic and socioeconomic disparities.

RESULTS

Table 2.1 shows the percentage of sample members who were coded as "high-risk" on each of the biomarkers included in the CBR scale. The most common risk factor was high waist size (46.8%), followed by high CRP (41.0%), and low HDL cholesterol (25.0%). The mean number of risk factors is 1.83, with a standard deviation of 1.50, while the median is two risk factors. Table 2.2 shows the frequencies of the resulting index of CBR; almost half of the respondents have either no risk factors (n=127) or one risk factor (n=126). Descriptive statistics on the predictor variables are presented in Table 2.3. Being representative of Chicago, our sample contains a substantial share of first generation immigrants and persons with low education and income, slightly more women than men, and an average age of 43.0 years.

We present the results of our multivariate analysis of CBR in Table 2.4. The first model estimates disparities in CBR by race/ethnicity and immigrant generation, adjusting for age, and sex. The results show that blacks had 1.48 times as many risk factors per person as whites and that Hispanics had 1.59 times as many as whites, but there were no significant differences between non-Hispanics of other races and whites. CBR increased with age but did not significantly vary by sex or immigrant generation. The second model estimates disparities by education and income. Having higher levels of education was associated with lower CBR, as people with 0-11 years of education had 1.62 times as many risk factors compared to people 16 or more years of education, while people with

12-15 years of education had 1.48 times as many risk factors as those in the highest education group. There were no significant differences by income in model 2 or any of the other models. Differences by age were smaller in model 2 than in model 1, suggesting some confounding of the age differences by age-graded socioeconomic variables. When measures of race/ethnicity/immigration and individual socioeconomic position were controlled simultaneously, in model 3, the education gaps were reduced substantially (the gap between the lowest and highest educational categories was reduced by 44 percent), and the gap between Hispanics and whites was reduced by 13 percent, but the black-white gap did not change. (Percentage changes are based on changes in raw coefficients between models 2 and 3; Table 2.4 reports the exponentiated coefficients.) In model 4 we introduced controls for health behaviors, which reduced the black-white gap by 23 percent (based on changes in the raw coefficients between models 3 and 4), while the Hispanic-white gap remained unchanged, and educational disparities were further reduced. Engaging in high levels of physical activity and drinking moderate amounts of alcohol were each associated with lower CBR in model 4, but neither smoking nor fruit-and vegetable consumption was significantly associated with CBR.

Model 5 presents the within-neighborhood estimates of individual-level differences in CBR from a random-effects model in which all covariates are centered around their neighborhood cluster means. The results from model 5 suggest that when blacks and whites shared the same neighborhoods, they did not have significantly different incident rates of CBR. The CBR gap between Hispanics and whites was also reduced in model 5, with the raw coefficient dropping by 37 percent between models 4 and 5, but the effect remained marginally significant ($p<.10$). The incidence rate was

also significantly lower among second generation immigrants compared to third or higher generations in model 5, but this relationship did not remain significant in subsequent models.

Next we introduced measures of neighborhood disadvantage and affluence, first separately (in models 6 and 7) and then together (in model 8). Interestingly, there were no significant relationships between neighborhood disadvantage and CBR, but neighborhood affluence was associated with significantly lower CBR even after controlling for neighborhood disadvantage in model 8. Moreover, the estimated black-white, Hispanic-white, and educational disparities in CBR were much smaller after controlling for affluence in model 7 than they were after controlling for neighborhood disadvantage in model 6, with only the Hispanic-white difference remaining even marginally statistically significant in models 7 and 8.

DISCUSSION

This study explored the role of neighborhood characteristics in accounting for the cumulative incidence of biological risk factors and social disparities therein. We found that there were significant black/white and Hispanic/white disparities in CBR that were not fully explained by individual-level socioeconomic position and behavioral factors. There were also significant educational differences in the incidence of CBR but these were largely explained by adjustments for individual-level race/ethnicity/immigrant status and behavioral factors. We found no significant associations between individual-level income and CBR in any of our models. We are reluctant to make strong claims about the effects of income on CBR based on this study or findings from previous studies

because of the measurement error inherent in survey reports of income and differences in the way studies construct income measures. Still, we note that there is a growing body of research showing that education is more predictive of the onset of chronic conditions, while income is more predictive of the course a condition takes (Herd, Goesling, and House 2007).

Perhaps the most striking finding was that the black-white gap in CBR was essentially eliminated after adjusting for neighborhood context, whether by estimating within-neighborhood differences (in Table 2.4, model 5) or controlling for neighborhood socioeconomic conditions (Table 2.4, model 8). The Hispanic-white gap in CBR also became substantially smaller and was no longer significant at the .05 level after adjusting for neighborhood affluence or after centering individual-level covariates around their neighborhood means. Thus, one of the central conclusions from our study is that racial/ethnic group differences in neighborhood environments appear to play a pivotal role in generating racial/ethnic disparities in CBR.

In their study of CBR using data from NHANES, Merkin and colleagues (Merkin et al. 2009) noted that there is insufficient overlap between blacks and whites in the distribution of neighborhood socioeconomic status to form adequate black-white comparisons within levels of neighborhood socioeconomic status. This reflects a more general issue, often referred to as "structural confounding," which is that high levels of race and class segregation in many American cities make it difficult to disentangle individual from contextual effects of socioeconomic factors on health (Messer, Oakes, and Mason 2010; Morenoff, Roux, Hansen, and Osypuk 2008; Oakes 2006). Although our study is not immune to this problem, a close inspection of our analytic sample

revealed a substantial number of neighborhoods in which both blacks and whites were included in the sample, and considerable overlap between whites and blacks in their distributions of neighborhood socioeconomic conditions. For example, our sample of 549 adults includes 24 blacks and 105 whites in the highest (most affluent) quartile of neighborhood affluence; and 55 blacks and 12 whites in the lowest (least affluent) quartile. We also found comparable representations of blacks and whites at quartiles of the disadvantage scale. For example, our sample of 549 adults includes 24 blacks and 105 whites in the highest (most affluent) quartile of neighborhood affluence; and 55 blacks and 12 whites in the lowest (least affluent) quartile. Even in the extreme quartiles of neighborhood disadvantage and affluence, each major race-ethnic group (whites, blacks, Latinos) never constitutes less than 10% of the sample (or 12+ actual cases). Thus, race-ethnicity is, of course, related to these two neighborhood socioeconomic scales, but not to a degree that precludes validly estimating the effects of all variables. Moreover, our exploratory analysis revealed that there is no significant CBR gap between blacks and whites who live in neighborhoods that occupy quintiles 1 through 3 of the affluence distribution (the lowest levels of neighborhood affluence).

We also assessed the relationship between CBR and two key dimensions of neighborhood socioeconomic differentiation – disadvantage and affluence – and found that only affluence was significantly (and inversely) related to CBR. Most research on neighborhoods and health continues to rely primarily on measures of disadvantage (similar in construction to ours) to characterize neighborhood environments, but a growing number of studies are finding that neighborhood affluence is positively related to health, even after adjusting for neighborhood disadvantage (Browning, Cagney, and Wen

2003; Freedman, Grafova, Schoeni, and Rogowski 2008; Wen, Browning, and Cagney 2003). The notion that neighborhood affluence and disadvantage may be independently and differently related to CBR (or other health outcomes) is difficult to accept if one considers the two measures to be capturing opposite tails of an underlying continuum of neighborhood socioeconomic position. Alternatively, if one views affluence and disadvantage as capturing somewhat separate dimensions of neighborhood socioeconomic position – much like income, education, and occupational status all represent different dimensions of individual socioeconomic position – then it becomes more conceivable that neighborhood affluence and disadvantage do not always move hand-in-hand.

To further elucidate this finding, we present in Figure 1 a scatterplot of z-scores of neighborhood disadvantage and affluence for all 343 neighborhoods in Chicago, with the 80 neighborhoods used in our sample shown in asterisks. The plot shows that there is substantial variation in affluence among non-disadvantaged neighborhoods, and conversely, substantial variation on disadvantage among less affluent neighborhoods. Our affluence scale may be tapping a critical source of variation among neighborhoods that are not highly disadvantaged. For example, perhaps neighborhoods characterized by the demographic mix that we are calling "affluence" (e.g., those with highly-educated, young adults in professional occupations and high rates of residential mobility) promote better health by attracting certain institutions (e.g., food stores, places to exercise), offering physical features conducive to physical activity (e.g., well-maintained buildings, parks, and streets), and fostering a set of norms that emphasize healthy behaviors (e.g., exercise and good nutrition). This all suggests that future research into the ecological

features that differentiate neighborhood affluence and disadvantage could advance our understanding of the specific mechanisms through which neighborhood effects operate on health.

Another aspect of our study that deserves more attention in future research is the benefit and importance of pooling together indicators of high risk from multiple biomarkers into an index of cumulative biological risk. In supplemental analysis, we found that neighborhood affluence was more strongly associated with the CBR index than with any of the separate biomarkers that were used to construct it, suggesting that neighborhood conditions may have a simultaneous influence on multiple biological systems. As a further check on the robustness of our results to changes in the composition of the CBR measure, we repeated the analyses by excluding one biomarker at a time from the cumulative measure; no single measure emerged as especially influential in that findings remained generally consistent across various compositions of the CBR measure.

We also note several important limitations of our study. First, although much of the theory motivating the study of CBR – especially the concept of allostatic load – is about repeated exposure to environmental stimuli that could lead to physiological dysregulation, it is possible that the people who accumulate the most "risk" across a wide range of biomarkers are not the same ones who experience the most chronic "wear and tear" on any given physiological system over time. Fluctuation over time induces biological remediation (McEwen 1998; McEwen 2008) in a way that our cross-sectional data cannot capture. Moreover, the biomarkers used in our study and many similar studies are secondary, sub-clinical outcomes of the kind of adaptive physiological

responses that the body's regulatory systems make to stress and other adverse stimuli, rather than measures of primary stress mediators(such as hormones secreted by the hypothalamic–pituitary–adrenal axis and sympathetic nervous system). Previous research suggests that aggregate measures of multiple risk factors such as our measure of CBR can be useful in detecting individuals at high risk of clinical diseases and disorders, although significant challenges remain in developing appropriate measures and understanding the biology of stress (Juster, McEwen, and Lupien 2010; McEwen and Seeman 1999).

We also acknowledge that although our sample is large compared to many studies that collect biomarkers, and representative of an important and diverse population (the city of Chicago) it does not provide sufficient power to support more detailed analyses of neighborhood context, including subgroup analyses (e.g., by gender or race/ethnicity). Another important limitation that our study shares in common with all observational research on neighborhoods and health is that there may be unmeasured factors that determine both where people live and how healthy they are. Although we controlled for a fairly broad set of socioeconomic, demographic, and behavioral factors (including additional measures of medical care, wealth, and residential tenure in supplemental analysis) and are aware of no prior research or theory that would identify what omitted variables could confound our results, we nonetheless acknowledge that we cannot make strong causal inferences about neighborhoods from such a study.

We found significant racial/ethnic disparities in cumulative biological risk factors even after controlling for individual sociodemographics and health behaviors, but these disparities disappeared after controlling for neighborhood socioeconomic status. These

findings are consistent with the view that neighborhood effects on health risks operate as an accumulation of risks across multiple physiological systems and confirm the importance of both residential context and health behaviors to explaining social disparities in health. They also support the view that neighborhood features associated with affluence may play a protective role not fully captured by the absence of disadvantage. Future research should continue to disentangle the mechanisms through which local socioeconomic conditions influence cumulative health risks.

Table 2.1. Frequency of Individual Biological Risks

Biological Measure	Number at Risk	Weighted % at Risk
Systolic Blood Pressure	108	19.1
Diastolic Blood Pressure	94	14.6
Resting Heart Rate	42	7
C-Reactive Protein	25	37.7
HbA1c	65	12.9
HDL Cholesterol	137	24.3
Total Cholesterol	76	13.1
Waist Size	258	44.9

HDL = High-density lipoprotein; HbA1c = Hemoglobin A1c

CCAHS 2001-03, n=549

Table 2.2. Frequency of Cumulative Biological Risk/ Allostatic Load Scores

Risk Factors	Frequency	Weighted Frequency
0	127	23.8%
1	126	26.2%
2	120	21.6%
3	107	17.1%
4	38	6.1%
5	21	3.0%
6	9	1.8%
7	1	0.3%
8	0	0.0%
Total	549	100%

CCAHS 2001-03, n=549

Table 2.3. Summary Statistics for Analytical Sample

	Unweighted *n*	Weighted %
Race/Ethnicity		
Non-Hispanic Whites	187	35.7
Non-Hispanic Blacks	200	39.7
Hispanics	149	20
Non-Hispanic Others	13	4.7
Sex		
Male	231	46.1
Female	318	53.9
Age		
Age 18-29	133	23.5
Age 30-39	123	20
Age 40-49	118	21.2
Age 50-59	82	16.4
Age 60-69	52	7.7
Age 70+	41	11.1
Immigrant Status		
1st Generation	123	20.2
2nd Generation	79	14.7
3rd + Generation	347	65.1
Education		
<12 Years	134	21.3
12-15 Years	275	49.4
16+ Years	140	29.3
Income		
$0-9,999	75	13.7
$10,000-29,999	69	12.6
$30,000-49,999	147	26.8
$50,000+	112	20.4
Physical Activity		
Less Than Highly Active	296	51.9
Highly Active	253	48.1
Fruits/Vegetables		
Consumed >= 2	359	66.7
Consumed < 2	190	33.3
Smoking		
Never Smoker	299	55.3
Current Smoker	100	26.2
Former Smoker	150	18.5
Drinking		
Always Abstained	100	16
Currently Not/Rare	132	23.1
Moderate	294	57.8
Heavy	23	3.1

CCAHS 2001-03, n=549

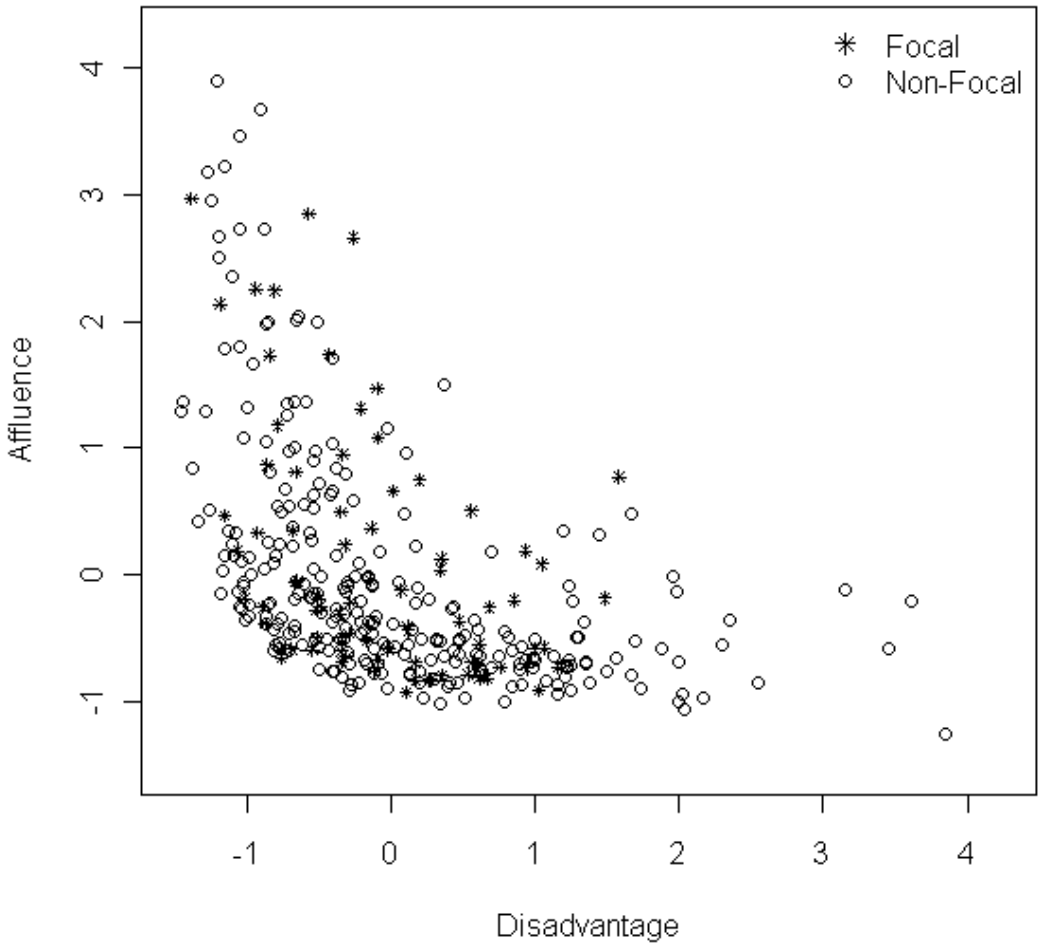
Table 2.4. Incidence Rate Ratios from Weighted Poisson Regressions of Cumulative Biologic Risk on Individual- and Neighborhood-Level Predictors

	No Random Effects								With Neighborhood Random Effects							
									All Covariates Centered around Neighborhood Cluster Means		No Centering					
	1		2		3		4		5		6		7		8	
	IRR	(SE)	IRR	(SE)	IRR	(SE)	IRR	(SE)	IRR	(SE)	IRR	(SE)	IRR	(SE)	IRR	(SE)
Female	1.13	(0.13)	1.12	(0.12)	1.14	(0.12)	1.09	(0.12)	1.13	(0.10)	1.10	(0.11)	1.08	(0.11)	1.08	(0.11)
Age (ref=18-29)																
30-39	1.18	(0.17)	1.13	(0.18)	1.13	(0.17)	1.12	(0.15)	1.00	(0.12)	1.12	(0.13)	1.12	(0.13)	1.11	(0.13)
40-49	1.77	(0.30) ***	1.69	(0.31) **	1.69	(0.29) **	1.61	(0.24) **	1.42	(0.13) **	1.60	(0.15) **	1.52	(0.15) **	1.52	(0.15) **
50-59	1.95	(0.30) ***	1.85	(0.31) ***	1.84	(0.30) ***	1.73	(0.27) ***	1.58	(0.15) **	1.73	(0.16) ***	1.72	(0.16) ***	1.72	(0.16) ***
60-69	2.55	(0.41) ***	2.30	(0.46) ***	2.38	(0.43) ***	2.16	(0.36) ***	2.10	(0.14) ***	2.19	(0.16) ***	2.22	(0.16) ***	2.22	(0.15) ***
70+	2.83	(0.47) ***	2.30	(0.45) ***	2.63	(0.50) ***	2.20	(0.38) ***	1.96	(0.18) ***	2.22	(0.16) ***	2.18	(0.17) ***	2.18	(0.17) ***
Race (ref=Non-Hisp. White)																
Non-Hisp. Black	1.48	(0.21) **			1.47	(0.20) **	1.36	(0.19) *	0.90	(0.17)	1.27	(0.15)	1.17	(0.14)	1.16	(0.15)
Hispanic	1.59	(0.26) **			1.50	(0.24) *	1.51	(0.25) *	1.32	(0.14) +	1.52	(0.16) **	1.31	(0.15) +	1.31	(0.15) +
Non-Hisp. Other	1.11	(0.20)			1.14	(0.19)	1.02	(0.19)	1.04	(0.12)	1.08	(0.16)	0.99	(0.16)	0.99	(0.16)
Immigrant Status (ref=3rd Gen.)																
1st Gen	0.95	(0.11)			1.01	(0.12)	0.92	(0.12)	0.96	(0.12)	0.91	(0.13)	0.94	(0.12)	0.94	(0.12)
2nd Gen	0.90	(0.12)			0.91	(0.12)	0.86	(0.12)	0.70	(0.17) *	0.82	(0.14)	0.81	(0.13)	0.81	(0.13)
Education (ref=16 + Years)																
0-11 Years			1.62	(0.26) **	1.31	(0.20) +	1.24	(0.19)	1.25	(0.16)	1.21	(0.14)	1.09	(0.15)	1.09	(0.15)
12-15 Years			1.48	(0.16) ***	1.32	(0.15) *	1.28	(0.16) *	1.33	(0.12) *	1.29	(0.12) *	1.17	(0.13)	1.17	(0.13)
Income (ref=$0-9,999)																
$10,000-29,999			1.11	(0.15)	1.05	(0.14)	1.10	(0.15)	1.13	(0.15)	1.08	(0.13)	1.11	(0.13)	1.11	(0.13)
$30,000-49,999			1.01	(0.12)	0.95	(0.12)	0.97	(0.10)	1.08	(0.13)	0.99	(0.10)	1.02	(0.10)	1.02	(0.10)
$50,000+			0.92	(0.13)	0.89	(0.11)	0.98	(0.13)	0.98	(0.14)	0.96	(0.13)	1.01	(0.13)	1.01	(0.13)
Physical Activity (ref=Not Highly Active)																
Highly Active							0.69	(0.05) ***	0.70	(0.08) ***	0.69	(0.08) ***	0.72	(0.08) ***	0.72	(0.08) ***
Fruit/Veg. >= 2 Servings							1.07	(0.08)	1.03	(0.07)	1.06	(0.07)	1.07	(0.07)	1.07	(0.07)
Smoking (ref=Non-Smoker)																
Former Smoker							1.01	(0.13)	0.99	(0.12)	0.99	(0.12)	1.00	(0.12)	1.00	(0.12)
Current Smoker							0.95	(0.08)	0.88	(0.09)	0.93	(0.08)	0.92	(0.08)	0.92	(0.08)
Drinking (ref=Always Abstained)																
Currently Not Currently/Rarely							0.96	(0.10)	0.97	(0.11)	0.95	(0.10)	0.95	(0.10)	0.95	(0.09)
Moderate							0.79	(0.10) *	0.77	(0.12) *	0.78	(0.12) *	0.79	(0.12) *	0.79	(0.12) *
Heavy							1.04	(0.29)	0.90	(0.32)	1.03	(0.29)	1.08	(0.30)	1.08	(0.30)
Neighborhood Characteristics																
Disadvantage											1.05	(0.09)			1.00	(0.07)
Affluence													0.82	(0.09) *	0.82	(0.09) *
Constant	0.77	(0.13)	0.72	(0.13) +	0.63	(0.11) *	0.90	(0.21)	1.57	(0.07) ***	0.95	(0.23)	1.07	(0.23)	1.07	(0.23)

+ $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

IRR = incidence rate ratio; CCAHS, 2001-03, n = 549

Figure 2.1. Two Dimensions of Socioeconomic Status in Chicago Neighborhoods



Focal n=80; Non-Focal n=263

CHAPTER 3

AGGRAVATING CONDITIONS: CYNICAL HOSTILITY AND NEIGHBORHOOD AMBIENT STRESSORS

Cynical hostility is well-established as an important predictor of coronary heart disease and all-cause mortality (Boyle, Williams, Mark, Brummett, Siegler, Helms, and Barefoot 2004; Miller, Smith, Turner, Guijarro, and Hallet 1996) and has been associated with inflammation (Graham, Robles, Kiecolt-Glaser, Malarkey, Bissell, and Glaser 2006) and poor pain management (Fernandez and Turk 1995). Prior research shows social and racial/ethnic disparities in cynical hostility similar to those for cardiovascular outcomes (Scherwitz, Perkins, Chesney, and Hughes 1991), and social disparities in cynical hostility and other negative emotions are considered to be important contributors to social disparities in downstream health outcomes (Gallo and Matthews 2003). The Cook-Medley cognitive hostility construct incorporates three sub-component beliefs: "that others are motivated by selfish concerns" (cynicism, the present focus), "that others are likely to be provoking and hurtful" (mistrust), and that others are "dishonest, ugly, mean, and nonsocial" (denigration) (Smith 1994). Cynical hostility (a sense of mistrust of others amplified by suspicious antagonism) is important because it influences one's social relationships (Chen, Gilligan, Coups, and Contrada 2005; Gallo and Smith 1999; Hardy and Smith 1988), sense of well-being, and biological health (Boyle et al. 2004;

Graham et al. 2006; Hardy and Smith 1988; Miller et al. 1996; Ranjit, Kaplan, and House 2005; Shekelle, Gale, Ostfeld, and Paul 1983), is correlated with key health behaviors (Hermann, Kivimaki, Sabia, Dugravot, Lajnef, Marmot, and Singh-Manoux 2008; Siegler 1994; Williams 2009), and seems likely to engender crime and discourage civic engagement and social responsibility.

Over the last 15 years, studies of the potential roles of residential neighborhoods as predictors or causes of health and health disparities have become common, due to a growing awareness that there are important determinants of health which cannot be captured by individual-level predictors, that variation in neighborhood conditions by race/ethnic and social groups may play an important role in social disparities in health, and that efforts to improve population health may benefit from looking beyond the traditional boundaries of the public health field to investigate the effects of policies in other areas such as urban planning. Meanwhile, methods for neighborhood research such as multilevel modeling, geographic information systems, and systematic social observation have been developed which facilitate quantification of neighborhood conditions (Diez Roux and Mair 2010). Neighborhood effects on a variety of physical health outcomes have been well-documented, and the initial use of socioeconomic and racial composition variables as proxies for unknown processes has given way to an exploration of specific, policy-relevant, and potentially causal neighborhood conditions. Both the physical and the social features of residential neighborhoods are hypothesized to affect health by acting on stress responses, by influencing health-related behaviors such as physical activity, nutrition, and social interaction, and by affecting exposure to hazardous substances.

This paper seeks to determine whether neighborhood context may also shape personality variables, in particular cynical hostility. Such personality variables are usually thought of as psychological traits developed early in life that individuals carry with them as they move across social contexts, rather than as psychological states that are significantly affected by the contemporaneous contexts in which people may live or be embedded.

Neighborhoods and Personality

Many of these neighborhood studies have focused indirectly on stress processes; recent research on biological reactivity in response to stress has outlined central neural and peripheral neuroendocrine response patterns which function to prepare an individual for a challenge or threat (Boyce and Ellis 2005). Both genetics and developmental experience shape individuals' stress reactivity profiles, and these response patterns are context dependent. According to Boyce and Ellis (2005), people exposed to either high or low levels of adversity in early life are more likely to develop high reactivity phenotypes; under adverse conditions they are at increased risk of disease, but they also experience a greater benefit from positive conditions.

Hostility is linked with stress reactivity. Laboratory research has shown that hostile individuals are more likely to display angry behavior and increased blood pressure when provoked, although they show no differences when at rest (Fredrickson, Maynard, Helms, Haney, Siegler, and Barefoot 2000; Suarez and Williams 1989). Hostility also moderates the relationship between social support and coronary heart disease; individuals with higher hostility levels display greater cardiovascular reactivity in the presence of

social support (Chen, Gilligan, Coups, and Contrada 2005; Vella, Kamarck, and Shiffman 2008).

It seems likely that connections may exist between stress-inducing features of the neighborhood environment and health-relevant personality and psychological measures. Overall, there are two potentially causal relationships between neighborhood conditions and personality: (1) personality formation as a result of *social* conditions accompanying neighborhood socioeconomic composition, and/or (2) personality formation as a stress or cognitive response to exposure to deleterious *physical* conditions. Some non-causal explanations for associations between neighborhood conditions and personality include: (1) neighborhood composition (persons with similar sociodemographic traits both live in similar places and have similar personalities, creating a spurious association), (2) selective migration into neighborhoods on the basis of psychological traits, and (3) a contagion process in which a psychological trait spreads within a community. To understand the distinction between composition and selection, consider the personality trait "openness to new experience," which is prevalent among young adults. Clustering of open individuals might be due to selection (because individuals migrated to a vibrant neighborhood seeking a diversity of experiences) or composition (because jobs were available in large cities, those who in-migrated for work were young, and young people tend to be open to experience.)

Personality features might also mediate or moderate effects of neighborhood conditions on other outcomes. Wen, Hawkley, and Cacioppo (2006) found that psychosocial attributes including hostility partly explain the effects of perceived neighborhood environment quality on health. Bush, Lengua, and Colder (2010) found

that temperament (fear and irritability) moderate the associations of neighborhood disadvantage with some developmental outcomes in children.

Sorting into residential neighborhoods has been shown in several studies to partly or fully explain race/ethnic disparities in health outcomes such as hypertension (Morenoff et al. 2008) and the accumulation of dysregulations across multiple physiological systems (King, Morenoff, and House 2011). While some of this association is likely spurious due to composition and selection, the large body of literature linking neighborhoods and social disparities is predicated on the view that differential place-based exposures by social groups are an important reason for health disparities. Attention has now turned to elaborating specific psychosocial and stress processes as potential mechanisms, and it makes sense to first investigate whether social disparities in psychological constructs such as cynical hostility which have already linked to distal health outcomes in prior research may be implicated in social disparities in those downstream health outcomes.

Very little research has investigated the potential effects on personality of even neighborhood socioeconomic conditions, much less community social relations or physical conditions. Research on links between social relations and personality could benefit from additional elaboration of hypothesized mechanisms. Hart, Atkins, and Matsuba (2008) found that neighborhood economic deprivation significantly increased maladaptive personality changes in preschool children; they hypothesized that neighborhood informal collective enforcement of norms (social control) might be a factor, but their analysis did not support this. In one of the only neighborhood studies of a closely related outcome, Ross, Mirowsky, and Pribesh (2001) present mistrust as an outcome of competition in resource-scarce neighborhoods, where individuals feel

powerless to avoid or manage threats from crime. Mistrust is also higher in the presence of physical disorder. They also discussed social cohesion and control, crime, tolerance of deviance, and institutional resources as arising from disadvantage and leading to disorder and subsequently mistrust, but apparently did not test these variables as independent mechanisms for the production of mistrust. Their explanation seems to suggest that mistrust is a rational response to the prevalence of threats due to norms violations (Ross and Jang 2000; Ross and Mirowsky 2009).

Neighborhood Physical Hazards and Personality

Within the neighborhood effects literature, studies of effects of neighborhood physical conditions on emotional well-being are rare. Most of the work on residential context and mental health has been limited to a few outcomes, primarily depression, which has been linked to features of the physical environment (perception of physical disorder, poor quality of the built environment, traffic problems, lack of green space or services, and lower walkability) and the social environment (community socioeconomic status and social capital, exposure to violence and social hazards, and residential stability) (Mair, Diez Roux, and Galea 2008). Indeed, in a review Entwisle (2007) called neighborhood toxins and physical hazards the "least studied neighborhood attribute" and argued that more studies of neighborhood poverty (the most studied attribute) should consider hazards, given that hazards are likely to be concentrated in poor communities (Havard et al. 2009; Oakes, Anderton, and Anderson 1996; Saha and Mohai 2005). Two neighborhood-based studies have linked physical hazards and mental health, and in both cases, the environmental hazards were industrial facilities. Boardman and colleagues

(2008) used a spatial analysis of industrial activity and an environmental risk/social stressor framework to examine the relationship between proximity to industry and the psychological well-being of nearby residents. Downey and Van Willigen (2005) found proximity to industrial activity was negatively related to mental health, both directly and mediated by perceived neighborhood disorder and personal powerlessness, with a greater impact for the poor and minorities.

Other research focused on psychology and ambient stressors in the environment – including noise, air quality, traffic danger, crowding, and weather has suggested that our surroundings may have surprising subconscious psychosocial effects. Substantial research documents the psychological consequences of crowding (Gove and Hughes 1983; Wells and Harris 2007). Dense traffic areas produce noise, air pollution, and a perception of traffic danger (Frank et al. 2006) – all potentially aggravating conditions. Vehicular burden, density of major streets, and green parkland ratio predict increased depressive symptoms and worse general health status (Gee and Takeuchi 2004; Song, Gee, Fan, and Takeuchi 2007). Weather (temperature, wind power, and lack of sunlight) influences negative affect (Denisson, Butalid, Penke, and Aken 2008), suggesting that other ambient conditions may be relevant to emotion.

Research specifically focusing on the psychosocial and health effects of environmental noise has increased more slowly than research on other built environment-related issues in recent years (Moudon 2009) despite the ubiquitous nature of noise and the tendency of noise levels to be higher in poorer areas (Evans and Kantrowitz 2002), although the quality of existing work tends to be good. Aircraft noise outside schools inhibits cognitive development and increases overall annoyance (Stansfeld et al. 2005),

blood pressure, and the stress markers epinephrine and norepinephrine, but not cortisol (Evans, Hygge, and Bullinger 1995). In a prospective study of adult males, road traffic noise did not predict incidence of overall minor psychiatric disorder, but there was some evidence for a relationship with anxiety levels (Stansfeld, Gallacher, Babisch, and Shipley 1996). Environmental noise (along with poor housing quality and crowding) raised physiological stress markers in a low-income, but not in a middle-income, sample of children (Evans and Marcynyszyn 2004). Few studies have explicitly linked noise and psychosocial outcomes, but one study did show that boys living in disorganized, noisy home environments (in comparison with boys in calm homes) became more negative in affect with age (Matheny and Phillips 2001). A Swedish study found an association between road traffic noise at high average levels and self-reported hypertension in middle-aged adults (Bodin, Albin, Ardö, Stroh, Östergren, and Björk 2009), a linkage which is particularly relevant given the association already discussed between cynical hostility and cardiovascular disease. Both theory and limited empirical evidence suggest that noxious physical environments may contribute to stress and arousal that could inhere cynical hostility.

Readers may be skeptical of environment-personality links in adults because of a claim (Terracciano, Costa, and McCrae 2006) that with respect to the deep structure of personality, relative position within an age cohort changes little after age 30. However, this view has been questioned on empirical grounds and for defining personality too narrowly (Field and Millsap 1991; Helson and Stewart 1994; Roberts and DelVecchio 2000). Evidence from intervention research and common sense shows that some features of personality can change in later adulthood. Moreover, studies of personality

development over time reveal substantial unexplained variation even after age 30, despite increasing stability with age (Roberts and DelVecchio 2000). In a study of genetic and environmental influences on personality trait stability in the transition to adulthood, genetic and shared environmental factors became less closely linked to personality over time. Increasing stability with age may itself partly be explainable by the tendency of individuals to experience similar contexts over time (Quillian 2003), which tends to lead to underestimated contextual effects when context is measured at single time points (Crowder and South 2011). There is also substantial variation in age trajectories according to the personality dimension being measured (Hopwood, Donnellan, Blonigen, Krueger, McGue, Iacono, and Burt 2011).

The Present Investigation

Using cross-sectional clustered individual data representative of Chicago and a diversity of ecological measures, this study documents and suggests an explanation for the spatial patterning of cynical hostility. The analysis first documents the extent to which hostility varies by neighborhood and among social groups, how stressful life experience reports relate to cynical hostility, and how race/ethnic and socioeconomic disparity patterns differ when local context is held constant. It then investigates whether local ambient stressors (e.g. noise, dangerous traffic, and poor air quality), predict cynical hostility after individual and neighborhood socioeconomic statuses have been controlled for. Because neighborhood conditions are highly inter-correlated, this study compares the size of the association between cynical hostility and ambient stressors with the effect sizes of other alternate ecological predictors. The results suggest that putative personality

variables such as cynical hostility are substantially a function of contemporaneous residential environments, and hence may be modifiable by changes in residential environment.

Method

Participants and Procedures

The Chicago Community Adult Health Study (CCAHS) is a prospective multi-level study of the impact of individual and social environmental factors on health, their contribution to socioeconomic and racial-ethnic disparities in health, and the biological, psychosocial, and behavioral pathways that are involved. The CCAHS is a probability sample of 3,105 adults age 18 and older in the city of Chicago who were interviewed in person in 2001-3, with a response rate of 71.8% (Morenoff et al. 2008). The entire city of Chicago was stratified into 343 neighborhood clusters (NCs). previously characterized by the Project on Human Development in Chicago Neighborhoods (PHDCN). Each NC typically contains two census tracts with socially meaningful physical boundaries and relatively homogeneous in terms of socioeconomic status. On average 9 respondents were included from each NC, which typically contained around 8,000 residents. Data collection for the CCAHS study was approved under the University of Michigan Health Sciences and Behavioral Sciences Institutional Review Boards. Analyses are weighted to represent Chicago's 2000 Census population in terms of age, race/ethnicity, and sex.

Measures

Adult cynical hostility. There are a number of scales measuring facets of negative affect and trust; the CCAHS relied on the work of Miller and colleagues (Miller, Jenkins, Kaplan, and Salonen 1995; Miller et al. 1996), who analyzed the psychometric properties of the 50-item Cook-Medley hostility scale (Cook and Medley 1954) and reviewed 45 studies of its relationship with physical health. The dependent variable is a principal components factor of responses to five questions[2] from the cynicism subscale of the Cook-Medley hostility scale: (a) Most people inwardly dislike putting themselves out to help other people, (b) Most people will use somewhat unfair means to gain profit or an advantage rather than lose it, (c) No one cares much what happens to you, (d) I think most people would lie in order to get ahead, and (e) I commonly wonder what hidden reasons another person may have for doing something nice for me. These questions were coded on a four-point scale from strongly disagree to strongly agree, are coded so that higher scores are associated with higher hostility, and showed good internal reliability (Cronbach's alpha = .73). The use of a widely validated measure for the outcome variable facilitates comparison with the considerable literature using this well-validated measure and thus is a key asset of the present study. Table 3.1 shows the levels for cynical hostility for major sociodemographic subgroups.

<Table 3.1 about here>

[2] Survey staff selected eight of the thirteen questions on the Cook-Medley cynical hostility subscale for a pretest of over 200 respondents; analyses of the pretest results suggested that the scale could further be narrowed to five items.

Sociodemographics. Gender is coded such that males are treated as the reference category. Race/ethnicity is coded as non-Hispanic white (the reference), non-Hispanic black, Hispanic, or other non-Hispanic. Dummy 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; number of years of education, (12-15, and 16 or more), with 0-11 as the reference category; and first and second generation immigrants, with immigration status of third generation and beyond as the reference category. Finally, the annual income of the respondent (and the respondent's spouse, if any) is represented by dummy indicators of $15,000-$39,999, $40,000 or more, and missing income, with less than $15,000 as the reference category. In bivariate analyses (Table 3.1), non-Hispanic blacks, Hispanics, and others report more hostility than non-Hispanic whites, and males more than females. Hostility declines with education, income, and immigration generation, and non-monotonically between ages 18 and 59, with modest declines thereafter.

Neighborhood ambient stressors. A measure of the neighborhood's perception of ambient environmental stressors is aggregated from the responses of all respondents in the NC to community survey questions about the noise level, air quality, and traffic danger in the respondents' neighborhoods, rated on 4-point Likert scales:

> 1. 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?
>
> (1 = Excellent, 2 = Good, 3 = Fair, 4 = Poor)
>
> 2. How dangerous do you think traffic is in your neighborhood either to people driving in cars or walking on the street?
>
> (1 = Very dangerous, 2 = Somewhat dangerous, 3 = Not very dangerous, 4 = Not dangerous at all)

3. Some neighborhoods are noisier places to live than others. Noise can come from people living nearby, people walking or hanging out on the street, traffic, or construction. How noisy would you say your neighborhood is?

(1 = Very noisy, 2 = Somewhat noisy, 3 = Not very noisy, 4 = Not noisy at all)

Given that using respondent perceptions of neighborhood quality might bias investigations of psychosocial outcomes, this study aggregates reports from several respondents within the NC, minimizing the importance of each respondent's own response. The NC-level ambient stressors measure is composed of the neighborhood residuals of an empirical Bayesian hierarchical linear model of a factor composed of these three items (Raudenbush and Bryk 2002). This process also controls for individual socioeconomic characteristics, adjusts for missing items, and improves neighborhood-level estimates by borrowing information from across locations (Mujahid, Diez Roux, Morenoff, and Raghunathan 2007; Raudenbush and Bryk 2002). These three questions (about noise level, air quality, and traffic danger) tap into related constructs (Allen, Davies, Cohen, Mallach, Kaufman, and Adar 2009) – an index derived from a principal components analysis of noise, traffic, and street condition measures has a Cronbach's alpha of .75, and factor analysis suggests a single dimension.[3]

[3] No previous reports of validation of these community survey noise, traffic, and air quality questions exist. The perceived noise measure was validated in separate analyses (not shown) by comparing noise reports with trained interviewer ratings of related built environment variables (noise, traffic, pollution, and poor street condition (which may cause noise), measures of nearby construction based on aerial photography King, Katherine E. and Jennifer A. Ailshire. 2010. "Comparison of Systematic Social Observation and Aerial Photography Data on Land Use in Chicago.", and the NC-level observed traffic measure), when controlling for sociodemographics and ability to hear in a noisy room. Results show that while race/ethnicity, age, and income disparities in perception of noise exist, controlling for neighborhood context reduces disparities and the NC-level measures tested are highly predictive of reports of noise. Traffic and air quality measures are similarly validated - pollution measures from the National Air Toxics Assessment U.S. Environmental Protection Agency. 2002. "National Air Toxics Assessment." strongly predict perception of air quality. Standard sociodemographic controls were used when creating the measures, but this is done to take a conservative approach to only capturing neighborhood-level shared variance. Racial and income disparities in perceptions may also reflect variation in residential exposure levels within the NC if certain groups within the NC live nearer to sources of stress.

Other contextual measures. The CCAHS contains other widely used NC-level measures of neighborhood quality which could be hypothesized to relate to cynical hostility. Perceived measures are used because perceptions of neighborhood quality have been found to be an important pathway between neighborhood conditions and health, and this seems particularly likely for psychosocial outcomes. Like the ambient stressors measures, the neighborhood social and physical conditions measures selected are scales of multiple questions related to a single perceptual construct: social cohesion, social control, collective efficacy, reciprocal exchange, violence, and physical disorder. Appendix 3B reports descriptions of these variables, each of which is commonly used in neighborhood studies and is based on questions from the PHDCN (Earls, Brooks-Gunn, Raudenbush, and Sampson 2007). They are also neighborhood level measures which derive from the residuals of multilevel models using the empirical Bayes method described above for ambient stressors.

A number of recent studies have recognized the multidimensional nature of community socioeconomic status by incorporating measures of both neighborhood disadvantage and affluence (Finch, Do, Heron, Bird, Seeman, and Lurie 2010; Sampson, Morenoff, and Earls 1999) developed using principal components factor analysis and 2000 Census NC-level measures (Morenoff et al. 2008). The neighborhood disadvantage factor loads positively on low family incomes, high levels of poverty, public assistance, unemployment, and vacant housing, and negatively on high family incomes. The affluence factor loads positively on measures of the proportion of employed civilians ages 16 and over in professional/ managerial occupations, the proportion of individuals ages 25 and over who have completed 16 or more years of education, and median home

values. The sampling structure of the Chicago Community Adult Health Survey Neighborhoods provides substantial numbers of blacks and whites, even in the upper and lower quartiles of disadvantage and affluence (King, Morenoff, and House 2011).

Statistical Analysis

This analysis focuses on spatial clustering of individual cynical hostility and how neighborhood ambient stressors may explain the spatial clustering. The extent to which cynical hostility varies by neighborhood is quantified by computing the intra-class correlation (ICC). So that the size of the ICC can be interpreted, Table 3.2 reports the ICC for cynical hostility along with ICCs for other health-related variables in the CCAHS. Next, the first model in Table 3.3 estimates patterns of standardized cynical hostility by race/ethnicity, socioeconomic status, and immigrant generation, adjusting for age and sex in an OLS model estimated in the Stata software package (StataCorp 2009). Then, using a group-mean centered multilevel model (which is analogous to a fixed-effects analysis adding a dummy variable for all but one NC) estimated in the HLM software package (SSI: Scientific Software International), version 6.0, for hierarchical linear modeling, Model 2 shows how consideration of clustering within neighborhood contexts changes estimates of disparities. The group-mean centering is then removed for Model 3, while an NC-level measure of ambient stressors is added. Models 2 and 3 also report the proportion of neighborhood-level shared variance explained by the models (adjusted ICC).

Recent social researchers have tended to focus on social explanations for psychosocial constructs rather than physical environmental influences. Table 3.4

compares NC-level coefficients from multilevel models evaluating associations with cynical hostility of ambient stressors and of several neighborhood social processes, with controls for individual sociodemographics not shown. Each neighborhood-level predictor is considered separately. The predictors are standardized so that their coefficients can be directly compared, in the search for the strongest ecological predictors of cynical hostility. This is important because many neighborhood studies have been reporting relationships between a single predictor and an outcome, without considering whether another highly correlated variable might be a better or equally valid predictor.

Results

Table 3.2 shows that a substantial proportion of the overall variation in cynical hostility was attributable to differences between neighborhoods. Table 3.2 also lists ICCs of selected measures based on author calculations from the CCAHS using the same method. The ICC is calculated by running a HLM model which clusters individuals by neighborhood but includes no predictors, and then dividing the within-neighborhood variance by the sum of the within- and between-neighborhood variances (Merlo, Chaix, Yang, Lynch, and Råstam 2006). Specifically, the intra-class correlation of cynical hostility is 0.093, comparable to that for very good or excellent self-rated health and pessimism, and higher than that for many other health-related measures, such as systolic blood pressure, depression, and anxiety, though not as high as for neighborhood social processes such as social cohesion and perception of disorder. Current neighborhood context is an impressive predictor of cynical hostility, as cynical hostility shows strong spatial clustering not only in comparison with other personality measures, but also

clustering in line with or stronger than that of various other health measures which are often studied in the neighborhood effects literature.

<Table 3.2 about here>

Consistent with Table 3.1, individual results in Model 1 of Table 3.3 shows that females report a 0.25 standard deviation (SD) lower cynical hostility. Blacks (0.59 SD), Hispanics (0.23 SD), and non-Hispanics (0.30) of other race report more cynical hostility than do non-Hispanic whites. Cynical hostility is not significantly different across younger age groups, but decreases sharply at ages 60 and over within this cross-sectional sample, so that respondents 70 and older report one third of a standard deviation lower cynical hostility compared to those 18-29. Compared to those with 0-11 years of education, having 12 years (-0.15 SD) or 13 or more years (-0.38 SD) of education results in reports of less cynical hostility, while those earning $40,000 or more report (-0.22 SD) less cynical hostility than those earning less than $15,000.

Model 2 presents a random-effects model in which all covariates are centered around their neighborhood cluster means, giving the within-neighborhood estimates of individual-level differences in cynical hostility. Inclusion of neighborhood context in model 2 markedly changes the estimates of disparities by race/ethnicity compared to model 1, decreasing the black-white disparity by 37% and the Hispanic-white disparity by 22%, while explaining 26% of the gap between those with more than 12 compared to 0-11 years of education. The results from model 2 suggest that when different social groups shared the same neighborhoods, their reports of cynical hostility were more similar.

Model 3 shows that a one standard deviation increase in neighborhood ambient stressors significantly predicts a 0.12 standard deviation increase in cynical hostility; this association does not change substantially when controls are introduced for neighborhood disadvantage and affluence (not shown). Each of the scale components (NC-level perceptions of noise, air quality, and traffic) was also independently strongly associated with cynical hostility in the presence of individual sociodemographic controls, as were trained rater assessments of noisy streets, noxious smells, and heavy traffic (not shown). Although neighborhood disadvantage (but not affluence) was independently significantly related to cynical hostility, when ambient stressors were included in the model disadvantage was not significant (not shown). In fact, nearly all of the variation in cynical hostility which is shared across neighborhoods appears to be mediated by ambient environmental stressors, as shown by the changes in the adjusted ICCs: the group-mean centered model (Model 2) shows that a considerable portion of the variance is at the NC level (adjusted ICC = 0.013), while consideration of NC ambient stressors in Model 3 reduces the adjusted ICC considerably (to 0.006). Introducing controls for a variety of individual-level characteristics, including sleep difficulties, financial stress, stressful life events, social support, parental abuse, parental affection, or discrimination due to race/ethnicity or other causes also does not substantially change the association between ambient stressors and cynical hostility (not shown), suggesting that the neighborhood variation in cynical hostility is not a function of factors which may shape "personality" and hence predict selection into neighborhoods.

<Table 3.3 about here>

The analysis continues by evaluating whether ambient stressors are the most appropriate proximate available measure to the underlying mechanism relating neighborhoods and cynical hostility. Table 3.4 shows standardized coefficients of conventional measures of neighborhood social conditions which might be theoretically related to cynical hostility. The predictors include community-survey derived measures of physical disorder, violence, social cohesion, social control, collective efficacy, and reciprocal exchange. Standardizing the coefficients across NCs allows comparison of the magnitude of the effects across measures (although each construct is measured with error, so small relative differences in effects should not be interpreted deterministically.) The ambient environmental stressors measure emerges as the strongest predictor. A number of the neighborhood quality measures are also significantly associated with cynical hostility (Table 3.4), especially perceived disorder (positive), perceived violence (positive), and social cohesion (negative). However, each of these variables loses significance when placed in a regression with ambient environmental stressors, while the ambient stressors measure retains its effect (not shown). The ambient stressors measure also results in the greatest reduction to the adjusted ICC, which can be interpreted as meaning that it explains the highest proportion (44%) of the shared variance at the neighborhood-level. This is consistent with a potential mediating role of ambient stressors.

<Table 3.4 about here>

Because the ambient stressors measure (like all the measures in Table 3.4) is based on pooled self-reports, two additional cross-checks were employed. First, a

composite measure was constructed based on trained observer ratings of noise, smells, and heavy traffic on blocks in the NCs, and this measure was found to be significantly associated with cynical hostility ($p<0.05$; not shown), although the perceived measure was preferred because of the greater sensitivity of the perceived measure and its stronger association with other related objective measures. Second, an additional measure was created which removed each respondent when calculating the NC-level measure; the association remained (not shown), but it was unclear how to control for spatial autocorrelation when using that method.

This finding of the robust predictive power of ambient stressors with respect to cynical hostility suggests that while other significant ecological predictors are close correlates of cynical hostility, the relationships may primarily be indirect through their correlations with ambient stressors or with other neighborhood physical and social conditions (e.g. violence, disorder, low social cohesion) which are also related to ambient stressors.

Discussion

Adult cynical hostility is spatially patterned within the city to an extent comparable to health outcomes commonly studied at the neighborhood level, and appears to be correlated with features of the residential physical environment. Results are consistent with a view of personality as a contextual and not solely individual construct. Personality dimensions are not independent of the individual's surroundings, but exist within a social and physical structure in time and space. This suggests that personality and spatial context may together mediate social disparities in health.

The analyses above also form the first population-based assessment of the potential role of ambient environmental stressors in individual personality. The comparison of the predictive abilities of ambient stressors and social processes for cynical hostility highlights the importance of comparing multiple theoretical approaches and predictors when analysis is undertaken at the neighborhood level. Any of the social process variables in Table 3.4 could have been theorized to predict cynical hostility, and are in fact significantly predictive, but may not be the best predictors. When variables are as highly correlated as neighborhood features are, the path toward causality needs to take a comparative route.

This same approach might be applied to other psychological outcome measures, which are also closely related, although that analysis is beyond the scope of the present study. Supplementary analysis shows that the measure of trust available for a sub-sample of the CCAHS shows a relationship with ambient stressors similar to that of cynical hostility, and this may be true of other psychological measures as well. It also would be desirable to develop more precise measures of ambient physical hazards aimed at isolating the potential roles of noise, traffic danger, pollution, or other related exposures.

The broader finding that psychological traits can display strong geographic patterning suggests that health psychology researchers engaging in the neighborhood effects literature should devote more attention to neighborhood context, and in particular physical as well as social conditions in communities which may influence psychological processes. Further research should also address the potential for linkages between selective migration into or out of neighborhoods and psychological measures. The surprisingly large ICCs for some psychological characteristics compared to other health

measures in Table 3.2, if they can be replicated in other neighborhood samples, merit an explanation. While explaining only a tenth of the overall variance in an outcome at the neighborhood level might seem trivial, the actual proportion of variance explained by neighborhoods may in fact be underestimated in cross-sectional data because individuals are exposed over their entire lifetimes (Sharkey 2008a), and exposures in areas away from the residence may suppress or modify neighborhood exposures (Inagami, Cohen, and Finch 2007).

Personality factors may also be an important pathway through which neighborhood processes create health and socioeconomic disparities. Spatial patterning partly explains a racial/ethnic disparity in cynicism. Evidence for spatial patterning in cynical hostility has implications for understanding racial/ethnic disparities in psychological measures and downstream health outcomes. Current spatial context can account for at most about one-third of the black/white gap in cynical hostility based on the changes in the race/ethnicity coefficients between Models 1 and 2 of Table 3.3 resulting from the inclusion of neighborhood context, suggesting that researchers should investigate other social differences as sources of these gaps. One potential factor might be racial/ethnic discrimination (Williams, Neighbors, and Jackson 2008): although self-reports of prejudicial treatment would be difficult to disentangle from cynicism in cross-sectional data, investigation using other data and methods might facilitate understanding the role of psychological factors and in race/ethnic health disparities through psychosocial pathways.

Future research should pay careful attention to the possible roles of personality and emotion in both mediating and moderating neighborhood effects on physical health

In particular, psychosocial characteristics may moderate the effects of neighborhood conditions on well-being (Diez Roux and Mair 2010; Wen, Hawkley, and Cacioppo 2006).

Table 3.1. Frequencies and Mean Cynical Hostility Scores for Individual Data	Frequency	Population-Weighted Percent of Sample	Mean Score on Short Cook-Medley Scale
Sex			
Male	1,235	47.4	2.59
Female	1,870	52.6	2.46
Age			
18-29	800	27.5	2.58
30-39	748	22.7	2.54
40-49	608	18.7	2.49
50-59	402	12.9	2.55
60-69	286	9.0	2.50
70+	261	9.2	2.40
Race/Ethnicity			
Non-Hisp. Black	1,240	32.1	2.73
Non-Hisp. White	983	38.4	2.30
Hispanic	802	25.8	2.60
Non-Hisp. Other	80	3.8	2.55
Immigrant Status			
1st Generation	773	26.9	2.56
(ref=2nd or Higher)	2,332	73.1	2.55
Education (Years)			
<12	792	23.4	2.68
12-15	1,576	48.7	2.56
16+	737	27.9	2.33
Income			
$0-14,999	686	20.1	2.68
$15,000-39,999	894	26.4	2.56
$40,000+	948	34.9	2.40
Missing	577	18.6	2.55

Chicago Community Adult Health Survey, 2001-03, n=3,105

Table 3.2. Neighborhood Intra-Class Correlations for Selected Items

Measure	Intraclass Correlation
Physical Disorder	0.365
Ambient Stressors	0.263
Violence	0.228
Social Cohesion	0.140
Social Control	0.130
Cook-Medley Cynical Hostility	0.093
Pessimism	0.091
Reciprocal Exchange	0.089
Anxiety	0.068
Depression	0.063
Pulse	0.063
John Henryism	0.059
Pearlin Mastery	0.057
Waist to Hip Ratio	0.049
Inward Anger	0.042
Systolic Blood Pressure	0.042
Optimism	0.039
Self-Esteem	0.037
Hopelessness	0.026
Outward Anger	0.022

† Descriptions of these measures are given in Appendices 3A and 3B.
Chicago Community Adult Health Survey, 2001-03
n=3,105 except Systolic Blood Pressure n=2,860

Table 3.3. Sociodemographics, Neighborhood Ambient Stressors, and Standardized Cynical Hostility

	OLS		Hierarchical Linear Models			
			Group-Mean Centered[a]		Random Effects	
	1		2		3	
	Coef.		Coef.		Coef.	
Neighborhood Level						
Ambient Stressors					0.12	***
Individual Level						
Race (ref=Non-Hispanic White)						
Non-Hispanic Black	0.59	***	0.37	***	0.53	***
Hispanic	0.23	***	0.18	*	0.19	**
Non-Hispanic Other	0.30	*	0.15		0.29	*
Female	-0.25	***	-0.31	***	-0.26	***
Age (ref=18-29)						
30-39	-0.04		-0.05		-0.04	
40-49	-0.11	+	-0.09		-0.11	+
50-59	-0.04		-0.04		-0.04	
60-69	-0.21	**	-0.21	**	-0.18	*
70+	-0.33	***	-0.34	***	-0.31	***
First Generation Immigrant (ref=2nd or Higher)	0.10	+	0.09		0.11	+
Education (ref=0-11 years)						
12 Years	-0.15	**	-0.14	*	-0.12	*
13+ Years	-0.38	***	-0.28	***	-0.34	***
Income (ref=$0-14,900)						
$15,000-39,000	-0.10	+	-0.10		-0.09	
$40,000 +	-0.22	***	-0.18	**	-0.19	**
Income Missing	-0.06		-0.03		-0.03	
Intercept	0.17	*	-0.08	**	0.16	*
R^2	0.12		-		-	
Adjusted ICC	-		0.013		0.006	

*** $p<.001$, ** $p<.01$, * $p<.05$, + $p<.1$ (two-tailed tests)

a In this group-mean centered model, all covariates were centered around their neighborhood cluster means so that they reflect within-neighborhood effects.

Chicago Community Adult Health Survey, 2001-03

Table 3.4. Standardized Coefficients and Adjusted ICCs of Neighborhood-Level Potential Predictors of Standardized Cynical Hostility

Survey-Based Perceived Measures	Coef.		Adjusted ICC
Ambient Stressors	0.116	***	0.0058
Disorder	0.099	***	0.0104
Violence	0.094	***	0.0105
Social Cohesion	-0.088	***	0.0083
Collective Efficacy	-0.079	***	0.0092
Social Control	-0.060	**	0.0109
Reciprocal Exchange	-0.048	*	0.0115

(adjusted for individual sociodemographics)
*** $p<.001$, ** $p<.01$, * $p<.05$, + $p<.1$ (two-tailed tests)
† Descriptions of these measures are given in Appendix B.
Chicago Community Adult Health Survey, 2001-03

Appendix 3A. Descriptions of Supplementary Measures in Table 3.2

Community Survey

For *Perceptions of Neighborhood Physical Disorder, Violence, Social Cohesion*, *Social Control*, and *Reciprocal Exchange*, refer to Appendix B. For *Ambient Stressors*, refer to the data section.

Biomeasures

Systolic Blood Pressure and *Pulse* each report the mean across three consecutive measurements. *Waist to Hip Ratio* is calculated from interviewer measurements.

Psychological Scales

The *Pessimism* (Earls, Brooks-Gunn, Raudenbush, and Sampson 2007) measure is based on a respondent's agreement with the statements

(1) "If something can go wrong for me it will,"
(2) "I hardly ever expect things to go my way,"
(3) "I rarely count on good things happening to me."
(1 = Almost never, 2 = Sometimes, 3 = Often, 4 = Almost always)

Depressive Symptoms (Radloff 1977) were assessed with an 11-item version of the Center for Epidemiologic Studies-Depression (CES-D) scale.

Anxiety (Derogatis 1983) was measured using questions about how often a respondent

(1) had fear of the worst happening,
(2) was nervous,
(3) felt their hands trembling,
(4) had a fear of dying,
(5) felt faint during the previous week.
(1 = Never, 2 = Some of the time, 3 = Most of the time, 4 = Always)

John Henryism (James, Hartnett, and Kalsbeek 1983) is conceived as a measure of extra effort expended to overcome social discrimination, resulting in a physiological toll to the

body. The measure includes a respondent's evaluation of the extent to which four propositions are true for them personally:

> (1) "Once I make up my mind to do something, I stay with it until the job is completely done,"
> (2) "When things don't go the way I want them to, that just makes me work even harder,"
> (3) "In the past, even when things got really tough, I never lost sight of my goals,"
> (4) "Hard work has really helped me to get ahead in life."
> (1 = Completely true, 2 = Somewhat true, 3 = Somewhat untrue, 4 = Completely untrue)

Pearlin Mastery (Pearlin, Lieberman, Menaghan, and Mullan 1981) is an assessment of the extent to which individuals perceive themselves in control of forces that significantly impact their lives, measured according to a respondent's agreement with four propositions:

> (1) "I have little control over the things that happen to me,"
> (2) "There is really no way I can solve some of the problems I have,"
> (3) "There is little I can do to change many of the important things in my life,"
> (4) "I often feel helpless in dealing with the problems of life."
> (1 = Almost never, 2 = Sometimes, 3 = Often, 4 = Almost always)

Inward Anger (Spielberger, Johnson, Russell, Crane, Jacobs, and Worden 1985) is an assessment of the extent to which respondents may internalize anger, and is measured according to a respondent's agreement with four propositions:

> (1) "When I am feeling angry or mad, I keep things in,"
> (2) "When I am feeling angry or mad, I withdraw from people,"
> (3) "When I am feeling angry or mad, I am irritated more than people are aware,"
> (4) "When I am feeling angry or mad, I am angrier than I am willing to admit."
> (1 = Almost never, 2 = Sometimes, 3 = Often, 4 = Almost always)

Optimism (Scheier and Carver 1985) is an assessment of the tendency to expect positive rather than negative outcomes, and is measured according to the respondent's agreement with six propositions:

> (1) "If something can go wrong for me it will,"

(2) “I'm always optimistic about my future,”
(3) “In uncertain times, I usually expect the best,”
(4) “Overall, I expect more good things to happen to me than bad,”
(5) “I hardly ever expect things to go my way,”
(6) “I rarely count on good things happening to me.”
(1 = Strongly agree, 2 = Agree, 3 = Disagree, 4 = Strongly disagree)

Self-Esteem (Rosenberg 1989) is measured according to a respondent’s agreement with four propositions:

(1) “I take a positive attitude toward myself,”
(2) “On the whole, I am satisfied with myself,”
(3) “I certainly feel useless at times,”
(4) “At times I think I am no good at all.”
(1 = Strongly agree, 2 = Agree, 3 = Disagree, 4 = Strongly disagree)

Hopelessness (Beck, Weissman, Lester, and Trexler 1974) is measured according to a respondent’s agreement with four propositions:

(1) “I feel it is impossible for me to reach the goals that I would like to strive for,”
(2) “The future seems hopeless to me and I can't believe that things are changing for the better,”
(3) “I don't expect to get what I really want,”
(4) “There’s no use in really trying to get something I want because I probably won't get it.”
(1 = Strongly agree, 2 = Agree, 3 = Disagree, 4 = Strongly disagree)

Outward Anger (Spielberger et al. 1985) is an assessment of the extent to which a person may externalize anger, and is measured according to the respondent’s agreement with four propositions:

(1) “When I am feeling angry or mad, I argue with others,”
(2) “When I am feeling angry or mad, I strike out at whatever infuriates me,”
(3) “When I am feeling angry or mad, I say nasty things,”
(4) “When I am feeling angry or mad, I lose my temper.”
(1 = Strongly agree, 2 = Agree, 3 = Disagree, 4 = Strongly disagree)

Appendix 3B. Descriptions of Neighborhood-Focused Supplementary Measures

(Based on Earls, Brooks-Gunn, Raudenbush, and Sampson 2007)

Social Cohesion is a measure of the sense of shared values within the neighborhood, based on the agreement of all respondents in a given neighborhood with the statements:

(1) "This is a close-knit neighborhood,"
(2) "People around here are willing to help their neighbors,"
(3) "People in this neighborhood generally get along with each other,"
(4) "People in this neighborhood can be trusted,"
(5) "People in this neighborhood share the same values."
(1 = Strongly agree, 2 = Agree, 3 = Disagree, 4 = Strongly disagree)

Social Control measures willingness by neighbors to intervene with respect to neighborhood problems, based on the agreement of all respondents in a given neighborhood with the statements:

(1) "If a group of neighborhood children were skipping school and hanging out on a street corner, how likely is it that your neighbors would do something about it?",
(2) "If some children were spray-painting graffiti on a local building, how likely is it that your neighbors would do something about it,"
(3) "If a child was showing disrespect to an adult, how likely is it that people in your neighborhood would scold that child?",
(4) "If there was a fight in front of your house and someone was being beaten or threatened, how likely is it that your neighbors would break it up?",
(5) "Suppose that because of city budget cuts the library or fire station closest to your home was going to be closed down by the city. How likely is it that neighborhood residents would organize to try to do something to keep the fire station or library open?" (1 = Strongly agree, 2 = Agree, 3 = Disagree, 4 = Strongly disagree)

Collective Efficacy is a combination of social cohesion and social control, designed to assess neighbors' willingness to intervene on behalf of community well-being.

Reciprocal Exchange taps into social interaction and support, based on the responses of all respondents in a given neighborhood to the questions:

> (1) "About how often do you and people in your neighborhood do favors for each other? By favors we mean such things as watching each other's children, helping with shopping, lending garden or house tools, and other small acts of kindness,"
> (2) "When a neighbor is not at home or on vacation, how often do you and other neighbors watch over their property?",
> (3) "How often do you and other people in the neighborhood ask each other advice about personal things such as child rearing or job openings?",
> (4) "How often do you and people in this neighborhood have parties or other get-togethers where other people in the neighborhood are invited?",
> (5) "How often do you and other people in this neighborhood visit in each other's homes or on the street?"
> (1 = Strongly agree, 2 = Agree, 3 = Disagree, 4 = Strongly disagree)

Violence measures the awareness of all respondents in a given neighborhood of violent incidents in their neighborhoods in the previous six months, based on reports of how often there was:

> (1) a fight in this neighborhood in which a weapon was used,
> (2) a violent argument between neighbors,
> (3) a gang fight,
> (4) a sexual assault or rape,
> (5) a robbery or mugging.
> (1 = Often, 2 = Sometimes, 3 = Rarely, 4 = Never)

The *Perception of Neighborhood Physical Disorder* measure is based on the reports of all respondents in a given neighborhood of:

> (1) broken glass or trash on sidewalks and streets,
> (2) graffiti seen on buildings and walls in the neighborhood,
> (3) vacant or deserted houses or storefronts,
> (4) frequency of seeing people drinking in public places,
> (5) frequency seeing unsupervised children hanging out on the street in the neighborhood.
> (1 = A lot, 2 = Some, 3 = A little, 4 = None)

CHAPTER 4

CONCENTRATION OF POVERTY OR ISOLATION BY DESIGN? ASSOCIATIONS OF HOUSING, URBAN FORM, AND SOCIAL COMPOSITION WITH NEIGHBORLY SOCIAL RELATIONS

A large literature in social science and public health documents the importance of social relations in residential communities for physical health (Franzini, Caughy, Spears, and Esquer 2005; Kawachi, Kennedy, and Glass 1999), mental health (Mair, Diez Roux, Shen, Shea, Seeman, Echeverria, and O'Meara 2009), mortality (Lee 2010), physical activity (Brownson et al. 2009; Franzini, Taylor, Elliott, Cuccaro, R.Tortolero, Gilliland, Grunbaum, and Schuster 2009; Saelens and Handy 2008; Wen and Zhang 2009), obesity (Cohen, Finch, Bower, and Sastry 2006), crime (Browning, Feinburg, and Dietz 2004; Hawdon and Ryan 2009), education and cognition (Sampson, Sharkey, and Raudenbush 2008; Sastry and Pebley 2010), the collective management of resources (Pretty 2003), democratic governance (Putnam 2002; Putnam, Leonardi, and Nanetti 1994), and other outcomes. Some of this work is motivated by a claim that community social networks may be weakening (Putnam 1995) within and across all social groups, and concern that changes in community social networks will hurt members of the poorest urban communities (Klinenberg 2002) who may lose networks they previously relied on without gaining access to emergent social relational formats.

Less well understood, though hardly understudied, are the more distal and/or exogenous factors that shape social relations in residential communities. Two approaches

to this issue are the best developed at this time, yet have rarely intersected, one focusing on the impacts of social composition on neighborly social relations, the other on the import of the urban built environment.

The concentrated poverty perspective, promoted most prominently by Wilson (1987), argues that urban disadvantage, and more particularly the absence of middle class residents and businesses (Logan and Molotch 1987), creates a social context that fosters crime and physical and social disorder, dispelling hope and compelling a withdrawal from community life and concomitant increase in antisocial behaviors. This idea suggests that if poor people were distributed more evenly among non-poor and middle-class neighbors, their frames of reference would change, inspiring them to aspire to middle class norms, while less-stressed institutions such as local schools would be better able to provide assistance when fewer students were experiencing poverty. The concentrated poverty perspective has been particularly influential in public health as well as in urban sociology, and is widely referenced in policy circles, notably by President Obama during the 2008 election. Critics argue that policy agendas aimed at reducing the concentration of poverty both draw attention away from efforts to reduce the overall poverty rate through more dispersed means such as reducing unemployment, and also justify large-scale redevelopment projects which would break up and disperse functioning communities, disrupting social support systems and institutional investments (Gans 2010).

In describing the process of poverty concentration as triggering disinvestment in neighborhood commercial and institutional environments and declining job opportunities, the theory does implicitly recognize some connection with the built environment. But while Wilson describes the factors pushing middle-class and affluent households from

central neighborhoods, he pays relatively little attention to the housing market factors pulling households to their destination homes. Here, the literature on the social implications of the concentration of poverty could benefit from recent work re-emphasizing how housing development patterns and urban planning drive continuing race/ethnic and income segregation (Brown and Chung 2008; Hirsch 1983; Massey, Domina, and Rothwell 2009; Taub, Taylor, and Dunham 1984). Zoning ordinances prescribing low density and separation of residences from other land uses tend to result in highly affluent and typically white compositions (Rothwell and Massey 2009; Rothwell and Massey 2010). In recent decades, buyers of new homes have been increasingly affluent; relatively little housing has been designed for lower income households. Affluent households that abandon older homes to lower-status groups may form even tighter affluent enclaves (Dwyer 2007) in their destinations, while leaving vacant homes in their origin neighborhoods. On a more hopeful note, Brown and Chung (2008) also describe how market-led development strategy focusing on mixed land use and diversity of housing choices can aim for socially diverse communities, detailing a successful case study in Ohio.

This recent work demonstrating the importance of housing markets and local government interventions in housing supply emphasizes a shift in the causes of racial/ethnic segregation over time from deliberate discrimination to more subtle market positioning. Given this evidence on the increasing relevance of housing and other urban planning features for the resulting social composition of neighborhoods, it is time to expand this focus on linkages between the built environment and social composition to other areas of neighborhood research.

There is good reason to believe that the built environment may have important implications for neighborly social relations. Research in a variety of literatures, including urban planning, criminology, environmental psychology, landscape architecture, and early work from the Chicago School describe implications of urban design for person-environment interaction by influencing opportunities for surveillance and casual encounters. Widely discussed theories such as New Urbanism and defensible space, along with research on the health effects of housing, transportation, and commercial development, have implications for research on neighborly social relations. One reason these findings have not achieved prominent attention in urban sociology may be that each literature tends to be fairly self-contained, with limited and non-standard sets of predictors and outcomes and diverse research settings and methods.

This paper investigates: (1) whether features of the built environment are significantly associated with neighborly social relations, (2) how built environment features and neighborhood disadvantage and affluence may interactively predict neighborly social relations, and (3) how housing and residential stability may relate when predicting neighborly social relations. Linking a representative survey of Chicago in 2001-3 with multiple innovative data sources, the analysis examines how four measures of perceptions of neighborhood social relations (cohesion, control, intergenerational closure, and reciprocal exchange), which have been previously linked with downstream health and social risks, may relate to features of neighborhood housing and urban form. Included in this analysis is a new urban design measure of the historical diversity of housing stock which operationalizes Jacobs' ideas about the benefits of gradual evolutionary redevelopment. Housing building types, especially detached houses and

high-rise apartment buildings, significantly predict social relations, both independently and perhaps even more through their association with residential stability. Housing building types and urban form also have differential associations with social relations by outcome and according to the socioeconomic status of the area's residents.

Neighborhood Composition and Neighborly Social Relations

Given the importance of community social capital, considerable research has been devoted to understanding the social forces at work in generating neighborly social relations. Like Putnam today (2002), several earlier sociological theorists were concerned with implications of changes in modes of living for social relations, and how differential physical conditions might result in spatial variation; this theme has recently been rediscovered. Simmel (1903 (1950)) theorized that the size, heterogeneity, and density of cities leads to impersonalized social interactions and a disconnect with social norms, echoed by Wirth (1938). Park and colleagues (1925) drew on the new science of ecology, proposing that just as animals are dependent on the natural resources in their habitats, human populations also take root and communities evolve in ways shaped by their surroundings. They also recognized that these social interactions can vary spatially within a city: community social disorganization (Shaw and McKay 1942), a condition characterized by lack of trust, empathy, or adherence to social norms, was especially common in the urban core near areas of mixed commercial and residential land uses according to Park (1936), but also affected by social homogeneity, residential stability, and community age (McKenzie 1925).

Neighborhood population density remains negatively associated today with social relations measures such as informal neighboring (Swaroop and Morenoff 2006) and intergenerational closure, reciprocal exchange, and child-centered social control (Sampson, Morenoff, and Earls 1999). However, density is not itself significantly associated with the kinds of social participation and civic engagement outcomes Putnam had in mind in Bowling Alone (Glaeser and Gottlieb 2006), and Kasarda and Janowitz (Kasarda and Janowitz 1974) demonstrated that a related concept, residential stability, appears more relevant. Density can also be considered as a proxy variable for other neighborhood (probably built) features, which are often not specified.

Since the 1980's, sociology has focused on the social composition of the neighborhood when considering neighborhood social relations. The concentrated poverty perspective would suggest that heavily black and low-income neighborhoods might have low levels of social relations, but neighborhood proportion black did not significantly predict social interaction, organizational development, or knowing the names of neighbors in Seattle when individual and neighborhood predictors were controlled for (Guest, Cover, Matsueda, and Kubrin 2006). Hispanic and immigrant neighborhoods historically were seen as tight-knit (Park 1925; Park, Burgess, and McKenzie 1967), but more recent studies suggest negative or no relationships between immigrant concentration or Hispanic population and social relations (Almeida, Kawachi, Molnar, and Subramanian 2009; Guest, Cover, Matsueda, and Kubrin 2006; Sampson, Morenoff, and Earls 1999).

Recent studies have tended to approach neighborhood social composition by using factor analysis of census social composition data to compose scales, most often

disadvantage and affluence, but also including Hispanic/foreign born composition, family structure, and older age composition (Sampson and Morenoff 1997). Disadvantage (characterized by large positive loadings on measures such as low income, public assistance, unemployment, female-headed households, low education, and young age structure), and affluence (characterized by large positive loadings on measures such as high education, professional/managerial occupation, and middle age composition) are not merely opposites: although almost no neighborhoods are both affluent and disadvantaged, a substantial proportion of neighborhoods have low levels of both (see Figure 2.1). While the concentration of poverty perspective understandably focuses on poverty, incorporating the affluence dimension captures important variation in neighborhood socioeconomic composition; affluence is a powerful predictor of health and health behavior and racial disparities therein. Neighborhood affluence appears to have strong positive associations with intergenerational closure, reciprocal exchange, and social control (Sampson, Morenoff, and Earls 1999), and social interaction (Guest, Cover, Matsueda, and Kubrin 2006), while control is lower in disadvantaged areas (Sampson, Morenoff, and Earls 1999).

Along with the concentrated poverty perspective and the Wirthian emphasis on the negative externalities of urban living itself, three other sociological approaches are often mentioned (Swaroop and Morenoff 2006). The "systemic" or "social disorganization perspective" emphasizes the role of residential stability in supporting social relations (Kasarda and Janowitz 1974; Shaw and McKay 1942), particularly for informal exchanges (Sampson 1988; Sampson and Groves 1989). The "social needs" perspective suggests that challenged communities may actually interact more in the

attempt to resolve problems or seek protection (Kasarda and Janowitz 1974), although this view has had mixed empirical support (Woldoff 2002). The "limited liability" approach suggests that instrumental participation and tie formation can be seen as a strategy to protect household personal and property safety and well-being and solve collective problems (Greer 1972; Guest, Cover, Matsueda, and Kubrin 2006).

As predicted by social disorganization theory, residential stability is significantly positively related to intergenerational closure, reciprocal exchange, and social control (Sampson, Morenoff, and Earls 1999) and informal neighboring (Swaroop and Morenoff 2006) in Chicago, as well as local social ties in Great Britain (Sampson 1991). Return on investment in social ties is higher when one expects to stay in place longer and when mobility of others is low as well (David, Janiak, and Wasmer 2010). Neighborhoods with strong social capital may be difficult to leave, whether because they are pleasant or because ties with others pull one back. Residential stability is often measured as a composite of population turnover and home ownership. Residents are more likely to know names of neighbors in more stable neighborhoods in Seattle, but social interaction and organizational development are not associated with stability (Guest, Cover, Matsueda, and Kubrin 2006).

Social integration patterns by living arrangements, which are likely closely connected with both housing units and neighborhood choice, have been studied with respect to social integration but rarely for neighborhood social relations. Persons living alone, who are often never-married, divorced, or widowed, may compensate for fewer social contacts at home by engaging in more social interaction outside (Alwin, Converse, and Martin 1985; Hughes and Gove 1981). Young children form most of their

friendships with neighboring children, and these friendships result in contacts between adults as well; Grannis (2009, p. 137) found that 85% of neighbor ties were between households with children.

Homeownership is positively associated with neighborhood satisfaction, although this may be less true when homeowners are less common in the neighborhood (Parkes, Kearns, and Atkinson 2002). The limited liability perspective suggests that homeowners, after tending to choose low density areas where they can have more privacy and control over their living spaces, may establish neighborhood social ties as an instrumental investment in protecting their assets rather than simply from an expressive desire for social connection (Greer 1972; Guest, Cover, Matsueda, and Kubrin 2006). This view is supported by the finding that homeowners have more total social capital resources and more neighborhood social capital resources than do renters (Manturuk, Lindblad, and Quercia 2010).

Broken windows theory links physical and social context with individual social behavior by suggesting that physical disorder such as physical damage, litter, and graffiti is not only a consequence of neglect but also provides cues that behavioral norms of orderly conduct have been relaxed and further transgressions would not prompt reprisal. This linkage is supported by several experimental studies demonstrating that violations of norms (such as anti-littering norms) becomes more common in the presence of signs of previous violations (Cialdini, Reno, and Kallgren 1990; Keizer, Lindenberg, and Steg 2008) and that when a car appears to be abandoned, vandalism is likely, even in low-poverty areas (Zimbardo 2004).

The associations between the physical surroundings of homes and area social composition as they jointly predict social relations is a common thread lying just below the surface of many of these studies, a thread which has rarely been pulled into the focus. Given that neighborhood variation in social relations cannot be fully explained by social composition (Subramanian, Lochner, and Kawachi 2003), it makes sense to look elsewhere for complementary alternative explanation. Much of the sociological literature has considered the physical environment primarily through a limited set of independent variables, such as physical disorder, or by employing proxy variables such as population density (Sampson, Morenoff, and Earls 1999). The next section reviews relevant literature from fields outside urban sociology which have offered theoretical or empirical explanations for linkages between the built environment and social relations among neighbors.

Urban Planning, Place Attachment and Social Behavior

By contrast to research focusing on neighborhood social composition, a number of literatures describe implications of urban form for person-environment interaction by influencing opportunities for surveillance and casual encounters. Urban form refers to "the spatial pattern of the large, inert, permanent physical objects in a city" (Lynch 1981, p. 47) such as land use patterns, transportation system, and urban design. Urban planners and environmental psychologists/landscape architects have given a good deal of consideration to conceptual descriptions of how features of urban morphology predict human behavior, and researchers on active living have established linkages that are to some extent causal between urban form and active transportation choices such as walking.

However, much of the research and ideology linking the physical environment and community sociality has focused on abstract notions most frequently operationalized as "sense of community," often without careful discussion (Talen 1999) distinguishing the precise nature of the types of neighboring behaviors (Swaroop and Morenoff 2006) and attitudes, social capital (Portes 1999; Putnam 1995), environmental perception and cognition, and other components of neighborly social relations.

Urbanism and Theories of Neighborhood Change

Jacobs' work The Death and Life of Great American Cities (1961) described the importance of "eyes on the street," emphasizing the importance of sidewalks for casual chance encounters ("an intricate sidewalk ballet") leading to community ties, and how these outdoor community ties were different from friendships. Large-scale low-rise and high-rise apartment projects were particularly problematic in that they faced inward and were far from the pedestrian routes around shops and transit. Proprietors of storefront businesses, she noted, played a crucial role in crime prevention, child socialization, and as repositories of local information. A mix of workplaces and homes on the same streets provided an even distribution of pedestrian traffic through the day, facilitating public safety and allowing small businesses to thrive from the foot traffic all day, according to Jacobs and the Urbanists. In the absence of shared public pedestrian spaces facilitating casual social control, communities may create exclusionary strategies to protect public safety, including gang warfare and gated communities.

Jacobs' narrative describing the benefits of gradual evolutionary redevelopment is testable, yet has received little attention. Jacobs argued that grand planning schemes

intending to redevelop large swaths of a city according to a central theoretical framework fail because planners do not understand that healthy cities are organic, spontaneous, messy complex systems which result from evolutionary processes. This suggests that neighborhoods which have experienced gradual redevelopment of land uses rather than construction concentrated at only a few time points due to government or private planning would experience better allocation of land uses, and that this better allocation would result in lower transaction costs, perhaps including increased walking. The idea of the possibility of stable evolution goes against other existing theories of neighborhood change which emphasize how neighborhoods may naturally decay as their housing units age and returns to capital reinvestment decline (Hoover and Vernon 1959; Hoyt 1933) (Park 1936) In the 1970's, an era of declining population across many urban areas, the U.S. Department of Housing and Urban Development attempted to speed the process of getting to urban renewal by encouraging a decline in land values in declining neighborhoods and encouraging out-migration to make way for large-scale redevelopment (Metzger 2000).

Jacobs argued that grand planning schemes intending to redevelop large swaths of a city according to a central theoretical framework fail because planners do not understand that healthy cities are organic, spontaneous, messy complex systems which result from evolutionary processes. This suggests that neighborhoods which have experienced gradual redevelopment of land uses rather than construction concentrated at only a few time points due to government or private planning would experience better allocation of land uses, and that this better allocation would result in lower transaction costs, perhaps resulting in increased walking, less vacant area, and greater diversity of

uses. Encouraging disinvestment rather than fostering small-scale reallocation of buildings and land uses would also break up existing social relationships. Other more recent urban policy researchers, including Galster (1987), have also emphasized the importance of neighborhood reinvestment.

Jacobs' narrative describing the benefits of gradual evolutionary redevelopment is testable, yet has received little attention. It remains to be seen whether the diversity of forms created by gradual development in fact predicts better neighborly social relations. Some recent work has described a possible change in the worth of older housing not reflected in the earlier neighborhood change models. While affluent households still choose newer housing, and moderately older housing still portends a neighborhood economic decline, older housing is becoming more attractive for gentrification (Rosenthal 2008), even as demand for access to the consumption benefits (including certain types of social relations) provided in denser cities increases (Glaeser and Gottlieb 2006), Aside from a considerable body of descriptive analysis of specific redevelopment projects, especially public housing, little work has considered implications of housing age and development trajectories at larger spatial scales for social relations. In one study, older age of local housing was positively related to social interaction and organizational participation (Guest, Cover, Matsueda, and Kubrin 2006).

New Urbanism

Urbanist ideas have received a fresh frame in New Urbanism (Duany, Plater-Zyberk, and Speck 2001; Leinberger 2009), which promotes the creation of pedestrian- and public transport-friendly neighborhoods characterized by mixed residential, business,

and retail developments, individualized design featuring porches and windows facing narrow streets to integrate residential space with surrounding accessible and appealing public spaces along with clearly demarcated neighborhood or town boundaries. New Urbanist theory predicts that walkable urban form promotes neighborly social relations by promoting walking, thus facilitating impromptu conversations between residents or general awareness of and attachment to the neighborhood (Sander 2002). In one study (Boer, Zheng, Overton, Ridgeway, and Cohen 2007), some but not all features of New Urbanist design were associated with greater levels of walking.

While some studies (Plas and Lewis 1996) have shown that residents of New Urbanist communities reported a stronger sense of community, this may be because residents moved to planned New Urbanist towns such as Seaside, Florida seeking neighboring relationships. More direct tests of New Urbanist principles have had mixed results: the few studies linking walkability and social relations either tend to be quite limited with respect to predictors and outcomes, creating a fragmented picture, or to use problematic research design, including comparing only two or more sites. Leyden (2003) showed that respondents in walkable (compared to car-oriented) neighborhoods in Ireland were more likely to report that they "knew their neighbors," although neighborhood characteristics were subject to reporting bias. Freeman (2001) found car-reliance, but not residential density, was associated with neighborhood social ties in Atlanta, Boston, and Los Angeles. Lund (2002) found higher sense of community in a pedestrian-friendly than in a car-oriented neighborhood, and that perception of desirability of walking and walking behavior were also related to sense of community, but that eight neighborhoods with varying walkability did not differ notably in unplanned encounters, local social ties, and

supportive acts of neighboring (Lund 2003). In more a methodologically sophisticated study, Wood, Frank, and Giles-Corti (2010) found sense of community was positively associated with leisurely walking (days/week), home ownership, seeing neighbors when walking and the presence of interesting sites. Urban form features such as setback of retail from the street, the amount of surface parking, mixed land use, and perceived steep hills were also related to sense of community, but street connectivity and residential density were not.

Urban Form, Walking, and Casual Meetings

Walking behavior is positively associated with place attachment, including neighborhood satisfaction (Patterson and Chapman 2004; Wood, Frank, and Giles-Corti 2010) and sense of community (du Toit, Cerin, Leslie, and Owen 2007). The pace of walking matters – leisurely walking, but not brisk walking, was strongly associated with sense of community in Atlanta (Wood, Frank, and Giles-Corti 2010). In network censuses of neighborhoods in Los Angeles and in a college town, most of the neighbors with whom Grannis' respondents formed instrumental ties originated as passive contacts, the relationship having evolved over repeated chance encounters. Walking dogs was the most common way neighbors met who did not meet through their children in a network census in Los Angeles and a college town (Grannis 2009).

While the evidence directly evaluating associations of urban form with actual social ties among neighbors is not strong, the literature linking specific features of urban form with physical activity and obesity is much stronger (Gordon-Larsen, Nelson, Page, and Popkin 2006). The extent to which streets are connected by intersections (rather than

dead ends, cul-de-sacs, and T-intersections), is associated with higher levels of walking (Frank et al. 2006; Lee and Moudon 2006; Lee and Moudon 2008; Saelens and Handy 2008). Access to recreational spaces (Kaczynski and Henderson 2008; Smiley et al. 2010; Tilt, Unfried, and Roca 2007; Witten, Hiscock, Pearce, and Blakely 2008), proximity to or density of nearby commercial destinations and public spaces (Cummins and Macintyre 2006; Inagami, Cohen, Finch, and Asch 2006; Moudon et al. 2007), an overall mixture of land uses, and other pedestrian draws inspire walking trips. The ratio of commercial building floor area to total lot size (Frank, Sallis, Saelens, Leary, Cain, Conway, and Hess 2009) and the presence of sidewalks have also been demonstrated to indicate pedestrian-friendly design. These variations in urban form have important health consequences: Fan and Song's (2009) national study of urban–suburban mortality gaps found that in sprawling metropolitan areas, urban residents have significant higher mortality rates than suburban residents, while urban-rural differences are non-significant in compact metropolitan areas. This large body of promising research has inspired behavioral medicine researchers and community activists to give "[s]imple interventions such as street lighting, pavements/ sidewalks, street trees, benches, bike lanes or trails, bike racks, and traffic-calming devices" (Lee and Moudon 2008) a prominent place on the public health policy agenda.

Housing and Social Behavior

A few studies have examined how housing building types predict NSR. Compared to residents of detached houses, respondents in townhouses/villas reported higher and, those living in duplexes and apartments/flats, lower, levels of social capital in

Australia (Wood, Shannon, Bulsara, Pikora, McCormack, and Giles-Corti 2008). Glaeser and Sacerdote (2000) found more social connections among residents of large apartment buildings, but that apartment residents are less involved in local politics, while that areas around apartment buildings were subject to more robberies and auto thefts. Public housing developments may have stronger social interaction when low-rise buildings are close together, compared to high rise buildings set far apart (Amick and Kviz 1975). Positioning of doors, paths, and common spaces have been shown to predict social contacts (Festinger, Schachter, and Back 1950; Gans 1962; Michelson 1977; Michelson 1970; Talen 1999).

Integrating the Social and the Physical

Ironically, these multiple literatures tend to develop in isolation, barricaded by disciplinary walls. Not surprisingly, researchers focusing on social behavior have developed careful discussions and survey instruments to capture specific dimensions of neighboring behaviors and perceptions and descriptions of their social antecedents. Although much of the best progress in systematic measurement of variation in physical conditions has also come from urban sociology and public health, non-sociologists have begun taking seriously the potential role of physical context in social processes while the built environment has been almost forgotten in sociology (Hillier 2008).

In distinguishing between built and social environments, this analysis makes a departure from conventional approaches in considering occupancy features as combined effects of neighborhood built and social environments (as well as broader processes within the city) which also moderate the effects of built and social environments on NSR. Residential stability and population density have often been considered either as social or

built features of neighborhoods when in actuality they are functions of the way people sort into built environments. Just as households of different sizes may move into identical housing units, neighborhood population size, density, and stability are constrained but not fully determined by the housing stock available. More than a quarter of the nation's housing stock was at least 50 years old in 1999 (U.S. Department of Housing and Urban Development and the Bureau of the Census). Changes in population occur much more rapidly than changes in housing stock, and increases in supply of housing in response to rising demand occur far faster than decreases in response to drops in demand (Glaeser, Gyourko, and Saks 2006).

We should explore density levels as they differ from the levels expected given housing stock rather than using density as a proxy for unexplored variation in the built environment. Higher than expected density, for instance, could indicate aspirational locational attainment in which residents trade off living space for better physical and social conditions. Lower than expected density could result from "empty nest" households, a desire for privacy manifest in large yards, high levels of vacancies due to neighborhood decline, or other meaningful explanations. Residential stability also results from both built and social environments: areas composed of stand-alone single-household units (houses) offered for sale are almost always going to be highly stable, as are areas with large proportions of older adults, while small apartments close in dense areas are likely to turn over quickly. Neighborhoods near universities or military installations or designed for roommates or late-life adults are also likely to be less stable. While residential stability is generally supportive of good social relations in well-functioning neighborhoods, variation in stability which results from characteristics of housing and

social composition is not what is interesting. Rather, what we should seek to understand is levels of stability which are greater or less than expected given built and social compositional characteristics of places, along with how stability moderates these features.

Linking a representative survey of Chicago in 2001-3 with multiple innovative data sources, this paper examines four measures of perceptions of neighborhood social relations (cohesion, control, intergenerational closure, and reciprocal exchange) previously linked with downstream health and social risks to investigate whether variation in the built environment is significantly associated with neighborhood social relations (NSR). Two domains of the built environment are considered: housing (building type, public ownership, and historical diversity of housing) and urban form (residential density, mixed land use and street connectivity). Finally, the analysis considers how estimates of associations of social composition and built environment features with neighborly social relations change with both are considered in the same model, as well as how the potential contribution of residential stability.

DATA AND METHODS

The theoretical framework presented above calls for consideration of multiple commonly used measures of perceived neighborhood social relations, linked to objective measures of key aspects of neighborhood built environment and social composition.

Survey Data

The Chicago Community Adult Health Study (CCAHS) is a multi-level probability sample of 3,105 adults age 18 and older living in the city of Chicago, with a

response rate of 71.8% for face-to-face interviews. Content includes the impact of individual socioeconomic, psychosocial, and behavioral factors on health, social and physical characteristics of neighborhoods, and their combined contributions to explanations of health disparities. The CCAHS built on the clustered sampling framework of the Project on Human Development in Chicago Neighborhoods (PHDCN), drawing an average of 9 respondents from each of the 343 neighborhood clusters (NCs) covering the entire city; these NCs are groups of contiguous census tracts grouped to reflect physical barriers, local cultural knowledge, and cluster analyses of census data so that the NCs are relatively homogeneous (Sampson, Morenoff, and Earls 1999). An important component was the community survey, a portion of the questionnaire which covers perceptions of the respondents' neighborhoods.

Observational and Archival Data

Further ecological data for the NCs come from multiple sources. A systematic social observation (SSO) (Sampson and Raudenbush 1999) was performed between May 2001 and March 2003 in which at least one trained observer rated each of the 1,662 blocks on which at least one sampled respondent lived (Sampson, Morenoff, Raudenbush, and Swaroop 2007). Block ratings included assessments of the physical condition of the buildings, street, amenities, and perceived physical and social conditions, as well as housing, commercial, and overall land use typologies (Bader, Ailshire, Morenoff, and House 2010; Sampson and Raudenbush 1999). The street connectivity measure is calculated from RAND Corporation's Center for Population Health and Health Disparities' dataset (Escarce, Lurie, and Jewell 2011). Information on public ownership

of housing units comes from the U.S. Department of Housing and Urban Development (HUD 2000).

Multiple Dimensions of Neighboring

Social cohesion assesses closeness and shared values among neighbors, a form of bonding capital which emphasizes the social networks among individuals who agree to a shared system of norms, at times to the exclusion of individuals on outer rings of a concentric network of trust (Fukuyama 2000). *Informal social control* taps into the shared beliefs and expectations of a community that they can and will intervene for the collective good. When social cohesion and control are combined, they are considered a shared willingness to take action to enforce collective norms is called "collective efficacy" (Sampson, Raudenbush, and Earls 1997b). *Intergenerational closure* assesses the extent to which adults and parents in the neighborhood are aware of and looking out for local children. *Reciprocal exchange* focuses on the exchange of favors, advice, material goods and information which make up a social support network within the community; the exchange is reciprocal because of the tacit expectation that this care may be repaid in the future, although possibly in a different mode and by unspecified neighbors (Portes 1999).

The four continuous neighborhood social relations outcomes each come from principal components factor analysis of five items measured on Likert scales, with missing data imputed. Scale component item descriptions and summary statistics are given in Table 4.1, and scale summary statistics are reported in Table 4.2. Scale items display acceptable levels of internal reliability (Cronbach's alpha, 0.79-0.83). Scales

have acceptable levels of reliability of OLS estimates across neighborhoods based on the random effects of level 1 intercepts (0.47-0.60). The intraclass correlations of 0.09 (exchange) to 0.14 (control) indicate considerable agreement about social relations within neighborhoods.

<Tables 4.1 and 4.2 about here>

Individual Sociodemographic and Household Controls

Individual-level controls are included to account for factors which may affect reports of neighborly social relations: race/ethnicity (non-Hispanic black, Hispanic, non-Hispanic other, with non-Hispanic white as the reference category), variables indicating whether the respondent is female and is an immigrant, and dummy variables for age (30-39, 40-49, 50-59, 60-69, and 70 years and over, with 18-29 as the reference group), education (12-15 years or 16+ years, with 0-11 years as the reference category) and annual income (of respondent and their spouse if applicable) (less than $5,000, $15,000-$39,999, and $40,000 and over, with $5,000-$15,000 as the reference category).

Individual-level measures consider features of the respondent's household which may influence the respondent's awareness of or quality of experience with social relations in the neighborhood. Household assets and residential tenure are important pathways between individual sociodemographics and neighborhood choice and experiences which are conventionally included as controls. Binary dummy variables indicate respondents whose households own assets which may need protection (homes or cars). Residential tenure is measured in years, and model-based imputation was performed for 16 respondents with missing data on tenure. A dummy variable is

included for respondents who live alone, because the respondent may gather information or meet neighbors through other members of the household. The presence of minor children may inspire investment in child-centered social ties, so the presence of one or more children in the respondents' household is represented by a dummy variable.

Neighborhood Social Composition

To understand how social composition and built environment differentially predict neighboring, four measures of socioeconomic composition are included which use 2000 Census NC-level measures and are informed by prior exploratory factor analysis (Morenoff et al. 2008). The scales used here were constructed by calculating the average value of a set of standardized variables for each NC. Of these, disadvantage and affluence are the primary neighborhood variables of interest in that they are central to discussion of concentration of poverty, while residential stability is included because of its close connection with both housing type and NSR. The socioeconomic disadvantage scale (Cronbach's alpha=0.96) loads positively on low family incomes, high levels of poverty, public assistance, unemployment, and vacant housing, and negatively on high family incomes. The affluence scale (Cronbach's alpha=0.94) consists of three components: the proportions of the population with professional/managerial occupation, with less than 12 (reverse coded), and with more than 16 years of education. Residential stability, or the proportion of residents in place for 5 or more years, is obtained from the 2000 Census via NCDB.

Neighborhood Built Environment

Housing. The census housing building type categories include buildings with 50 or more units (also called high-rises), with 3-4 units, duplexes/townhouses, detached single unit homes, and non-standard types (units attached to non-residential buildings, mobile homes, boats and motor vehicles, and other types of housing), with buildings with 5-49 units (also called low-rises) as the reference group. The spatial distributions of three housing types (houses, buildings with 3-4 units, and buildings with 50 or more units) are shown in Figure 1, based on data from the 2000 Census (Neighborhood Change Database: Geolytics Inc. 2004). The maps show a clear concentric ring pattern, with high rises concentrated along Lake Michigan (and a slight spoke-and-hub pattern around highways), 3-4 unit buildings in a smooth ring distant from The Loop, and a gradual transition to single family houses toward the city outskirts.

Walkable Urban Form. The three urban form measures (residential density, mixed land use, and street connectivity) capture elements of the physical layout and content of the built features of the neighborhood and are commonly used in measuring urban design and are considered key features of walkability (Frank et al. 2009). Rather than measuring *population* density (in which the land area in the denominator is composed of all land within the designated neighborhood boundaries), this study measures *residential* density (the density of residents within only residential areas.) Residential density is the ratio of population size to residential land area within an NC, measured using land use data from the Chicago Metropolitan Authority for Planning (2006).

Numerous studies have shown linkages between the number and variety of potential walking destinations in a neighborhood and walking (Cerin et al. 2007; Duncan, Winkler, Sugiyama, Cerin, duToit, Leslie, and Owen 2010; Lee and Moudon 2006; Rodríguez, Evenson, Roux, and Brines 2009). One conventional measure of land use mix is an entropy measure which captures the evenness of allocation among five categories (residential, commercial, institutional, open, and other), calculated by $-[\Sigma_k (P_k \ln P_k)] / \ln N$, where N is the number of land use categories and P_k is the proportion of land in each category k. The measure used is based on data from remote sensing (Chicago Metropolitan Agency for Planning 2006), although an alternate measure based on the SSO was investigated in supplemental analyses and gave similar results.

Street connectivity measures the extent to which it is possible to travel directly and along a variety of routes. More connected street grids make a city more permeable to walking by reducing the time necessary to reach any potential destination. The gamma index is a ratio of the number of street segments to the maximum possible number of segments between intersections, which is 3 * (# intersections – 2), so that values for the gamma index range from 0 to 1 (Dill 2004). The gamma street connectivity measure used here is highly correlated ($r>.98$) with other alternate measures such as street length or link to node ratio.

Redevelopment Pace/Historical Diversity. Next, I propose and implement a measure which captures an element of urban design suggested by Jacobs as important to neighborhood social relations but rarely subjected to empirical analysis, the historical diversity of housing stock. Jacobs argued that diversity of physical form, especially the gradual repurposing, reconstruction, and infilling of newly developing properties, is

essential to maintaining a dynamic flexibility necessary to keep an urban neighborhood thriving. The gradual redevelopment of housing properties is captured by applying a common measure of ecological diversity (Talen 2010), the Simpson diversity index (Simpson 1949). The Simpson index is calculated by $S = \Sigma k\ [(nk/N)^2]$, where nk is the number of units in a category and N is the total number of units, and measures the diversity of a distribution among categories. Here the categories represent the number of housing units in each NC constructed (1) during the 1930's and before, (2-6) in the 1940's, 1950's, 1960's, 1970's, and 1980's, and (7) from 1990 to 2000, using aggregated data from the 2000 Census via NCDB.

The spatial distributions of construction of housing units by decades are shown in Appendix 4A. Housing remaining from before 1940 is more common in the north side of Chicago, Uptown and curving along the river, as well as in Hyde Park and Beverly. Housing from the 1940's is more spatially dispersed, but located away from The Loop. Fifties' era construction occurred at a fairly even level across the city, but with concentrations on the outskirts of the city. The 1960's and 1970's saw considerable investment in the waterfront and The Loop and redevelopment in the South Side and outskirts, especially both around Lake Calhoun and near Ashburn and Belmont. Waterfront redevelopment continued in the 1980's and in the 1990's spread to the west away from the waterfront.

Analytical Plan

Linking a representative survey of Chicago in 2001-3 with multiple innovative data sources, this paper examines four measures of perceptions of neighborhood social

relations (cohesion, control, intergenerational closure, and reciprocal exchange) previously linked with downstream health, social, and behavioral risks to investigate whether variation in housing and urban form is significantly associated with neighborhood social relations (NSR). Next, the analysis continues by examining how estimates of associations of either housing and urban form or social composition with NSR may change when both are considered in the same models, and then investigates what effects residential stability may have beyond built features and social composition. The specification of housing includes a new measure inspired by the writings of Jacobs on the benefits of gradual rather than large-scale development for neighborhood social vitality. Finally, further analysis considers how social composition may moderate the associations of built features with NSR.

Results

Descriptive Analyses of Independent Variables

Summary statistics on individual sociodemographics controls for the total study sample (n=3,105) are given in Table 4.3. Because the sample is representative of Chicago's adult population in terms of age, race/ethnicity, and sex (Morenoff et al. 2008), there are substantial proportions of blacks (32.1%), Hispanics (25.8%), first-generation immigrants (26.7%), and persons with annual income less than $15,000 (20.1%), and slightly more than half are female (52.6%). Car ownership (58.0%) is more prevalent than home ownership (41.1%). Only half of respondents had lived in their homes for 5 years or more, and one quarter of respondents had lived in their homes for less than 2 years. After the imputation, the mean tenure was 9.7 years (SD 12.0), and the longest

tenure was 83 years. Respondents living alone comprised 26.9% of households, while 35.7% of respondents lived with one or more minors.

<Table 4.3 about here>

Summary statistics for neighborhood-level variables are given in Table 4.4, and correlations among neighborhood-level variables are reported in Figure 4.2. On average within NCs, buildings of 5 units or more were the most common building type (31%), while 16% of units were in buildings containing 3-4 units, 22% were in groups of duplexes, and stand-alone single-household houses (28%) and 4% more were in less standard building types (mobile units, housing attached to non-residential properties, and other units). Public housing is present in 27% of NCs. Street connectivity and mixed land use measures and the Simpson diversity index theoretically range from zero to one. In this urban sample, street connectivity fell near the middle of the possible range (0.38-0.60) and land use mix showed a wide range (0.20-0.97). The modal housing unit was built in the 1930's or earlier (39%), with on average more than 10% of units built in each of the 1940's, 1950's, and 1960's, and little construction thereafter. However, some NCs were substantially redeveloped in any of the post-war decades, ranging as high as one NC in which 64% of units were constructed in the 1960's. This results in an average of 0.38 for the historical diversity index (the Simpson diversity index for housing construction decades) and a range of 0.13 to 0.54. The measures of disadvantage and affluence are similar to those used in prior studies but have not been rotated to achieve orthogonality and so have a correlation of -0.49. Residential stability is measured as the proportion of respondents in place for 5 or more years. On average, 56% of respondents had been in

their homes for at least 5 years, but some neighborhoods had as many as 83% or as few as 20% of their residents staying in a home that long.

<Table 4.4 about here>

Housing and Urban Form, Social Composition, Residential Stability, and Neighborly Social Relations

Table 4.5 shows associations of NC-level variable blocks describing (1) housing and urban form, (2) socioeconomic composition, (3) both the built and social measures from the previous two models, and (4) those variables with residential stability added. All models are population-weighted population-average random-effects models with robust standard errors which control for individual sociodemographic and household measures, but the individual-level coefficients are not shown. NC-level predictors and outcomes are standardized, except for building types. The first models in Table 4.5 for each outcome show associations of built environment features (housing stock and urban form) with NSR, omitting the proportion of buildings with 5-49 units (low-rises) and controlling for individual sociodemographics and household characteristics. For each outcome, detached houses have a significant positive association with NSR ($p<0.05$ except exchange $p<0.10$). High-rise buildings positively predict cohesion, control and exchange ($p<0.05$ except cohesion $p<0.10$), while 3-4 unit buildings (which may tend to be houses converted into apartments) are positively associated with cohesion and closure. The presence of public housing in an NC has a negative relationship with all outcomes ($p<0.05$ except closure $p<0.10$). Historical diversity of housing stock is significantly associated with all outcomes (ranging from closure: 0.05 SD, $p<0.05$; exchange: 0.11 SD, $p<0.001$). Of the measures of walkable urban form, only residential density is

significantly (negatively) associated with all outcomes, while both mixed land use (0.06 SD) and connectivity (-0.06 SD) are associated with exchange and mixed land use has a marginal positive relationship with closure.

<Table 4.5 about here>

The second models for each outcome show associations of social composition with NSR, controlling again for individual sociodemographics and household characteristics. Cohesion, control, and closure have large negative associations with disadvantage; a one SD increase in disadvantage significantly predicts a 0.29 SD drop in cohesion, and 0.31 SD drop in control, but a 0.17 SD drop in closure (all $p<0.001$). Affluence is also negatively associated with closure (-0.09 SD, $p<0.01$) and marginally negatively with cohesion (-0.05, $p<0.01$).

When aspects of the built and social environments are jointly considered in Models 3, associations of building types with NSR change in different ways with respect to the omitted category of proportion of units which are in buildings of 5-49 units (generally low-rise apartment housing). The association of detached houses with cohesion drops from 0.71 to 0.52 SD, with control drops from 0.42 to a non-significant 0.10 SD, with closure remains steady at 0.75 SD, and with exchange grows stronger grows stronger and more significant from 0.25 to 0.41 SD. The associations of 3-4 unit housing with cohesion, closure, and exchange remain fairly constant across models. For buildings of 50 units or more, inclusion of social composition increases the estimate of the effect on control, but the marginally significant association with cohesion remains steady and the association with exchange drops to marginal significance. Associations

with public housing presence drop for cohesion and control, and slightly increase for exchange. Historical diversity coefficients drop slightly for cohesion, control, and closure. The associations of disadvantage drop for cohesion and control while remaining highly significant, but the social composition associations with closure are completely eliminated by the incorporation of built environment measures. Adjustment for built features reduces the initial highly significant disadvantage coefficients by 38% for cohesion, and 16% for control, and completely eliminates the association of disadvantage with closure.

Adding residential stability in Models 4 further attenuates housing building type coefficients, so that only the high-rise (50+ units) association with control is significant, and the proportions of units in buildings of 3-4 units are marginally significant for cohesion and closure. Presence of publicly owned units also weakens for all outcomes. Historical diversity remains steady for cohesion, control, and exchange, but not closure. Residential stability itself (defined as the percent of residents who lived in the same housing units 5 years previously) is significantly associated with all outcomes, ranging from 0.10 SD for control and exchange to 0.18 SD for closure.

Table 4.6 shows the interactive effects of affluence and disadvantage with built environment features. Affluence significantly interacts with detached housing such that the detached housing is beneficial for cohesion, control, and closure only in affluent neighborhoods. Likewise, high-rise buildings in NCs exert most of their significance in disadvantaged neighborhoods for all outcomes, although the main effect is also highly significant and positive for control. Urban form measures density and mixed land use interact positively with disadvantage for control, while the typically negative effect of

street connectivity for exchange is neutralized when interacted with disadvantage. Including the interaction terms weakens the effects of historical diversity for cohesion and control but not exchange.

<Table 4.6 about here>

Several other aspects of the variation of the housing environment within neighborhoods were investigated, but not included in the models finally reported. The diversity of building types was measured using Census building type measures and the Simpson diversity index, and was significantly negatively related to control (-0.54 SD, $p<0.05$) when social composition was not included in the model. It may be that residents are less likely to intervene in parts of the city in which housing types do not match their own; for instance, homeowners may not consider nearby apartment-dwellers to be their neighbors. Second, the diversity of the number of bedrooms in units was considered as a possible indicator of variation in household types, but found not to significantly relate to the outcome measure. Third, housing age was examined aside from the diversity measure. NCs with higher proportions of housing built in the 1950's were found to have the highest levels of NSR for all outcomes, while NCs with more housing from the 1960's and 1980's were least amenable to NSR. When housing construction decades were factor-analyzed, one factor seemed to indicate the recentness of construction, with another capturing construction during the 1950's-1970's and loading most strongly on the urban renewal decade of the 1960's (Appendix 4B). When these factors were included in models controlling for housing features (Census or SSO) and urban form along with individual sociodemographics but not considering housing historical diversity, the urban

renewal factor was significantly negatively related to social control, although this effect became non-significant when the presence of public housing was considered. Newer housing was significantly associated with lower levels of exchange. When housing historical diversity was considered, these factors became non-significant for all models. It appears that while there may be effects of housing eras in themselves, it is the diversity of the timing of construction rather than either the age of housing itself or unknown features of housing associated with planning paradigms from particular decades which most strongly predicts NSR.

Discussion

Residential stability has strong positive associations with NSR which above and beyond the associations of building types with NSR, and the generally non-significant associations of building types with NSR when controlling for stability seems to suggest that housing is unimportant. However, over half of the variation (adjusted $R^2 = 0.515$) in residential stability is explained by housing building types, another 8.4% (adjusted $R^2 = 0.596$) by housing age factors (Appendix 4B), and a further 8.1% by a factor of the number of bedrooms (adjusted $R^2 = 0.680$), but only another 10.8% (adjusted $R^2 = 0.788$) by the inclusion of five social "structural" features (disadvantage, affluence, % 65 or older, % younger than 18, and a Hispanic/foreign born factor), results shown in Appendix 4C. Moreover, combining the two sets of features attenuates the social compositional effect sizes while increasing the coefficients for housing variables.

The strong and substantial predictive ability of housing features for residential stability and of residential stability for NSR suggests that while housing features,

especially detached houses and high-rises, public housing, and the diversity of ages, are significantly associated with NSR, much of this is through residential stability rather than direct effects. In considering the social and built environments, there is no "chicken or egg" conundrum. Before residents move into their homes, the homes are first constructed. Certainly, homes are constructed with particular market segments in mind, and neighborhoods do have historical social meanings. With around 40% of housing units in Chicago constructed in the 1930's and before, and many of even those older units built within an existing framework of streets and fixed land uses, the built environment has to be considered as the setting into which populations sort. Neighborhood social composition certainly has important implications for individual and community well-being, and may be growing in importance as differences between milieus increasingly dominates within-place inequality as a driving force behind overall inequality. Just as segregation sorts households into neighborhoods of differing social composition, it also sorts people into built environments, and these built environments have a strong and potentially causal linkage to health-related social capital, but much of these effects are indirect through their associations with neighborhood composition and mobility patterns. But recent research suggests that the sources of continuing segregation (and increasing plurality) are transitioning from overtly race-specific agendas to more subtle market-driven mechanisms which indirectly structure neighborhood social composition through the actions of developers, lenders, and local governments to control the structure of housing markets (Brown and Chung 2008; Massey, Domina, and Rothwell 2009). More research is necessary using longitudinal data at a smaller spatial scale to capture the pathways between built features and neighborhood mobility patterns.

An additional goal was to assess the potential contribution of a concept from Jacobs' The Death and Life of Great American Cities, the importance of gradual rather than large-scale redevelopment (resulting in historical diversity). Consideration of the historical construction trajectory of NCs was quite promising. Historical diversity of housing units was strongly significantly associated with exchange, cohesion, and control in the full models, and in supplemental models not shown this was independent of the proportions of housing built in each decade. It may be that gradual redevelopment preserves community ties, which may take decades to form and which new residents may "inherit" from previous neighbors. Alternatively, the significant association of historical diversity may not be due to Jacobs' explanation and instead have other interpretations. Historical diversity may (1) result in attractive neighborhoods which are pleasant to walk in, (2) result from the continued vibrancy of neighborhoods across previous decades (a reciprocal effect of social relations). Historical diversity may (3) arise in smaller neighborhoods which contain more be local physical or social barriers to large-scale redevelopment. The finding should be repeated in other contexts and for other outcomes to better understand whether this finding should be interpreted as evidence that Jacobs' narrative was correct.

Walkable urban form features (mixed land use and street connectivity) appear comparatively less important than housing, but this may be due to the limited variation in walkable urban form provided by this large and dense urban setting. Reciprocal exchange behaviors have been very difficult to explain at the neighborhood level by socioeconomic composition or housing features despite showing a sizeable neighborhood component (ICC=0.09), and urban form turns out to be a very promising direction for

future investigation. Among the four outcome measures, reciprocal exchange may be most closely conceptually linked to the kinds of community behaviors New Urbanists hope to foster through urban form. It may well be appropriate to consider, however, whether urban form does indeed have effects on other important neighboring behaviors and attitudes urban planners hope to foster as well.

The finding that physical conditions like housing and urban form have implications for social relations should actually be seen as a ray of hope. When poverty and stigma are seen as the sole source of disparities, the problem looks irremediable; features of the legal and social superstructure resulting in rising inequality are not likely to change soon. But when material conditions can be specified under which social outcomes might be different, and these conditions are under the purview of local governments and developers and federal public housing authorities who care to at least some extent about producing viable communities, this is a valuable finding. In fact, as it happens, it may be that some of the same built features which would be supportive of thriving community social life would also support environmental sustainability, reduced costs of local infrastructure provision, active living and reduced health-care expenses, and other agendas which might receive more attention in national and local policy circles. This said, while changes in urban form might have benefits across multiple outcomes, we also should not expect too much from the built environment. Effect sizes in existing studies have not typically been large.

In the previous pages, I evaluated some ideas of Jacobs and others about how physical features of places predict local social relations, but in evaluating the results, I hope to avoid what Glaeser (2011) calls the "edifice complex," the idea that built features

are sufficient in themselves to bring about desired outcomes. The analyses presented here do not establish any kind of causality, and it would be dangerous to attempt to dictate precise policy prescriptions based on descriptive analysis. Rather, in evaluating current conditions with a view to informing urban planning, health, and social policy, to goal is to work with natural patterns of human-environment interaction rather than against them, and to this end, to seek to better understand those patterns.

Social science is an interesting field of knowledge in that lay theories and ideas generated by previous generations of researchers and theorists, sometimes without evidence, can take on a life of their own; as social theories become common "knowledge," they may become self-fulfilling (Thornton 2001). The popular ideals of the "white picket fence" suburb as the ideal place to rear children, for instance, likely results in migration of family- and community-oriented households to locations which look like they fit the picture, and those residents then may themselves create the child-friendly community life promised by the call of the cul-de-sac. In studying intra-urban migration patterns, sociologists have focused on neighborhood social composition rather than prior decisions such as building type and proximity to key locations. With cross-sectional data, and with little understanding of residential sorting, we are ill-equipped to distinguish among direct causal effects of the built environment, causal effects of social composition, selective migration in pursuit of built-environment-induced social support or privacy, and other reasons for statistical associations. Pursuing causality is not impossible, however, as built environment research also lends itself comparatively well to intervention and quasi-experimental research designs.

This study contributes theoretically to a growing literature on the role of residential neighborhoods in explaining race/ethnic disparities in health outcomes (Do 2008; King, Morenoff, and House 2011; Morenoff et al. 2008), which has often focused on social composition and social relations and rarely on aspects of the physical environment aside from physical disorder. It also supplements a substantial environmental justice literature documenting race/ethnic and socioeconomic differences in potentially hazardous or beneficial neighborhood physical conditions (Frumkin 2005; Gordon-Larsen, Nelson, Page, and Popkin 2006; Hood 2005; Mohai, Lantz, Morenoff, House, and Mero 2009; Morello-Frosch and Lopez 2006; Neckerman, Lovasi, Davies, Purciel, Quinn, Feder, Raghunath, Wasserman, and Rundle 2009; Rauh, Landrigan, and Claudio 2008; Romley, Cohen, Ringel, and Sturm 2007; Schweitzer and Valenzuela Jr. 2004), with these environmental problems especially prevalent in the most disadvantaged communities. Within these literatures on racial/ethnic disparities in health and well-being, the role of housing has rarely been considered, while urban form has sometimes been considered, but typically with respect to physical activity or by comparing a limited number of settings. Yet an emphasis on housing both resonates with and builds on previous experiences in Chicago both with public housing projects which failed because of poor design and with problematic neighborhood redevelopments, each of which should lead us to look to housing, urban planning, and development processes in seeking to explain neighborhood social processes relevant to health and well-being.

There are several limitations to this research. First, while urban planning and social policy can benefit greatly from research on the effects of the built environment on quality of life, evidence is needed at the "design level" – the level at which intervention

in the built environment is possible. The present analysis may cover larger neighborhood sizes which also may not match up well with what residents consider as their neighborhoods, although these larger spatial units may do a better job than building-level studies of capturing the neighborhood context into which buildings and block faces are set. This study has made no effort to consider the spatial context of the NCs, either by controlling for the context of surrounding NCs, or by specifying aspects of location such as distance to downtown or from Lake Michigan. In decontextualizing context, this study lines up beside the literature it seeks to inform. While there is much need for future research on the social capital implications of additional built environment features such as transportation, commercial, and institutional features of places, the focus here was on investigating how housing and walkable urban form explain disadvantage and affluence effects on NSR.

This study demonstrates strong associations between features of the built environment and neighborly social relations which appear to mediate what was previously argued to be the effects of neighborhood social composition on social capital. Based on multiple innovative data sources, a large sample, and state-of-the-art methods, this finding contributes most significantly to literatures in urban sociology, urban planning, and public health. Researchers should continue to dig into the built environment as a policy-relevant source of social behavioral explanation.

Table 4.1. Item Content and Summary Statistics for Dependent Variables

Social Cohesion Scale (All items have been recoded such that 1=disagree strongly, 2=disagree somewhat, 3=agree somewhat, 4=agree strongly)	N	Mean	SD	Range
This is a close-knit neighborhood	2,983	2.26	0.80	[1,4]
People around here are willing to help their neighbors	2,978	2.03	0.63	[1,4]
People in this neighborhood generally get along with each other	3,025	1.96	0.58	[1,4]
People in this neighborhood can be trusted	2,939	2.24	0.73	[1,4]
People in this neighborhood share the same values	2,844	2.38	0.75	[1,4]
Social Control Scale (How likely is it your neighbors would do something about it? All items have been recoded such that 1=very unlikely, 2=unlikely, 3=likely, 4=very likely)	N	Mean	SD	Range
A group of neighborhood children were skipping school and hanging out on a street corner	2,961	2.29	1.05	[1,4]
Some children were spray-painting graffiti on a local building	3,026	1.73	0.90	[1,4]
A child was showing disrespect to an adult	2,965	2.33	0.95	[1,4]
A fight in front of your house and someone was being beaten or threatened	2,986	2.11	0.98	[1,4]
Neighborhood residents would organize to try to do something to keep the fire station or library closest to your house open if the city were going to close it for budget cuts	2,982	1.80	0.86	[1,4]
Intergenerational Closure Scale (All items have been recoded such that 1=disagree strongly, 2=disagree somewhat, 3=agree somewhat, 4=agree strongly)	N	Mean	SD	Range
Adults in this neighborhood know who the local children are	2,929	1.99	0.77	[1,4]
There are adults in this neighborhood that children can look up to	2,877	2.01	0.69	[1,4]
You can count on the adults in this neighborhood to watch out that children are safe and don't get in trouble	2,927	2.12	0.71	[1,4]
Parents in this neighborhood know their children's friends	2,663	2.11	0.63	[1,4]
Parents in this neighborhood generally know each other	2,835	2.08	0.61	[1,4]
Reciprocal Exchange Scale (All items have been recoded such that 1=never, 2=rarely, 3=sometimes, 4=often)	N	Mean	SD	Range
About how often do you and people in your neighborhood do favors for each other?	3,072	2.29	1.01	[1,4]
When a neighbor is not home or on vacation, how often do you and other neighbors watch over their property?	3,064	2.14	1.16	[1,4]
How often do you and other people in the neighborhood ask each other advice about personal things such as child rearing or job openings?	3,072	2.75	1.07	[1,4]
How often do you and people in this neighborhood have parties or other get-togethers where other people in the neighborhood are invited?	3,083	2.82	0.99	[1,4]
How often do you and other people in this neighborhood visit in each other's homes or on the street?	3,087	2.53	1.02	[1,4]

CCAHS 2001-03

Table 4.2. Summary Statistics for Outcome Measures at Individual Level

	Social Cohesion	Social Control	Intergenerational Closure	Reciprocal Exchange
Mean	3.04	3.20	2.98	2.86
S.D.	0.13	0.15	0.10	0.12
Minimum	2.70	2.68	2.62	2.55
Maximum	3.45	3.60	3.35	3.26
Cronbach's alpha	0.83	0.79	0.79	0.80
Individual-Level Variance	0.21	0.34	0.22	0.50
Neighborhood-Level Variance	0.03	0.05	0.03	0.05
Intraclass Correlation	0.14	0.13	0.14	0.09
Reliability	0.60	0.59	0.57	0.47

CCAHS 2001-03

Table 4.3. Individual-Level Sociodemographic and Household Summary Statistics

Variable	Categories	Frequency	Population-Weighted Percent of Sample
Race/Ethnicity	Non-Hisp. White	1,240	38.36
	Non-Hisp. Black	802	32.07
	Hispanic	983	25.81
	Non-Hisp. Other	80	3.76
Sex	Female	1,870	52.62
Immigrant Status	First Generation	773	26.89
Age	Age 18-29	800	27.51
	Age 30-39	748	22.69
	Age 40-49	608	18.74
	Age 50-59	402	12.90
	Age 60-69	286	8.98
	Age 70+	261	9.19
Education	<12 years	792	23.42
	12-15	1,576	48.68
	16+	737	27.90
Income	$0-4,999	185	5.17
	$5,000-14,999	501	14.94
	$15,000-39,998	894	26.44
	$40,000+	948	34.85
	Missing	577	18.60
Household Assets	Owns Home	1,190	41.13
	Owns Car	1,698	57.98
Residential Tenure	0-1 years	777	26.12
	2-4 years	758	23.66
	5-13 years	797	24.81
	14+ years	757	25.02
	Missing	16	0.39
Household Composition	Single, Living Alone	803	18.21
	Minor(s) Present	1,108	32.06

CCAHS 2001-03, n=3,105

Table 4.4. Neighborhood-Level Variable Summary Statistics

Variable	Mean	SD	Range
Housing			
Building Types (Census)			
% 5 Units or More	0.31	0.27	[0.01, 0.99]
% 3-4 Units	0.16	0.10	[0, 0.50]
% Duplexes	0.22	0.15	[0, 0.61]
% Detached Single-Household	0.28	0.26	[0, 0.94]
% Non-Standard	0.04	0.06	[0.00, 0.58]
Public Housing Present	0.27	0.44	[0,1]
Housing Historical Diversity	0.28	0.08	[0.13, 0.54]
Housing Construction Decade			
1930's and Earlier	0.39	0.16	[0.01,0.72]
1940's	0.16	0.06	[0.00, 0.46]
1950's	0.18	0.10	[0.03, 0.57]
1960's	0.13	0.08	[0.02, 0.64]
1970's	0.07	0.05	[0.01, 0.45]
1980's	0.03	0.03	[0, 0.27]
1990's and 2000	0.04	0.05	[0, 0.33]
Urban Form			
Residential Density (p/sq. mi)	13115.17	8436.83	[3121.95, 68976.95]
Street Connectivity	0.52	0.03	[0.38, 0.60]
Mixed Land Use	0.61	0.16	[0.20, 0.97]
Social Composition			
Disadvantage	0.00	0.92	[-1.45, 3.85]
Affluence	0.00	0.95	[-1.26,3.90]
% In Place 5 Years or More	0.56	0.12	[0.20, 0.83]

CCAHS 2001-03, n=343

Table 4.5. Associations of Housing/Urban Form, Social Composition, and Occupancy with Neighborly Social Relations

	Social Cohesion				Social Control				Intergenerational Closure				Reciprocal Exchange			
	Model 1 β	Model 2 β	Model 3 β	Model 4 β	Model 1 β	Model 2 β	Model 3 β	Model 4 β	Model 1 β	Model 2 β	Model 3 β	Model 4 β	Model 1 β	Model 2 β	Model 3 β	Model 4 β
Built Environment																
Housing																
Unit Building Types																
% Detached Houses	0.71 ***		0.52 **	0.10	0.42 **		0.10	-0.21	0.74 ***		0.75 ***	0.20	0.27 +		0.41 *	0.10
% Duplexes	-0.28		-0.07	-0.22	-0.41 +		-0.24	-0.35	0.13		0.22	0.02	0.23		0.21	0.10
% 3-4 Units	0.78 *		0.78 *	0.64 +	0.23		0.31	0.20	0.92 *		0.87 *	0.69 +	0.77 +		0.71 +	0.60
% 50+ Units	0.51 +		0.52 +	0.34	0.77 **		0.94 ***	0.81 **	0.46		0.37	0.14	0.73 *		0.61 +	0.48
% Non-Standard (% 5-49 Units Omitted)	0.45		0.54	0.24	-0.27		-0.09	-0.30	0.77		0.74	0.35	0.37		0.28	0.07
Public Housing Present	-0.14 **		-0.09 +	-0.05	-0.23 ***		-0.17 **	-0.14 *	-0.11 +		-0.10 +	-0.05	-0.15 **		-0.17 **	-0.14 *
Historical Diversity	0.08 ***		0.06 **	0.05 *	0.09 **		0.07 *	0.06 *	0.05 *		0.05 +	0.03	0.10 ***		0.10 ***	0.10 ***
Urban Form																
Residential Density	-0.07 *		-0.09 **	-0.07 *	-0.14 ***		-0.17 ***	-0.16 ***	-0.10 **		-0.10 **	-0.08 *	-0.09 **		-0.08 *	-0.07 +
Mixed Land Use	0.00		0.01	0.00	-0.01		0.00	0.00	0.05 +		0.05	0.04	0.06 *		0.06 +	0.06 +
Street Connectivity	-0.03		-0.03	-0.03	-0.02		-0.02	-0.02	-0.02		-0.03	-0.03	-0.06 *		-0.06 *	-0.06 *
Social Environment																
Disadvantage		-0.29 ***	-0.18 **	-0.21 ***		-0.31 ***	-0.26 ***	-0.28 ***		-0.17 ***	0.00	-0.05		0.04	0.10 +	0.07
Affluence		-0.05 +	0.01	0.05		-0.03	-0.04	-0.01		-0.09 **	0.03	0.08		0.01	0.03	0.06
Occupancy																
% In Place 5 Years or More				0.14 ***				0.10 *				0.18 ***				0.10 *

NC-Level Coefficients from Weighted HLM Regressions with Individual Sociodemographic and Household Controls Not Shown
+ $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$
CCAHS 2001-03 and Census 2000

Table 4.6. Interactive Associations of Housing/Urban Form and Social Composition with Neighborly Social Relations

	Social Cohesion			Social Control			Intergenerational Closure			Reciprocal Exchange		
	Model 1 β	Model 2 β	Model 3 β	Model 1 β	Model 2 β	Model 3 β	Model 1 β	Model 2 β	Model 3 β	Model 1 β	Model 2 β	Model 3 β
Built Environment												
Housing												
Unit Building Types												
% Detached Houses	0.22	0.01	0.08	-0.07	-0.33 +	-0.24	0.37	0.11	0.20	0.14	0.04	0.13
% Duplexes	-0.10	-0.04	0.61 +	-0.21	-0.13	0.14	0.18	0.21	0.68	0.15	0.22	0.60
% 3-4 Units	0.59 +	0.65 +	0.32	0.15	0.19	0.75 **	0.63	0.74 +	0.14	0.59	0.60	0.51
% 50+ Units	0.43	0.26	-0.12	0.90 ***	0.68 **	-0.17	0.26	0.09	0.12	0.51	0.42	0.14
% Non-Standard	0.44	0.43	0.36	-0.07	-0.11	-0.04	0.62	0.62	0.46	0.14	0.18	0.21
(% 5-49 Units Omitted)												
Public Housing Present	-0.05	-0.06	-0.06	-0.13 *	-0.15 **	-0.16 **	-0.04	-0.06	-0.06	-0.14 *	-0.14 **	-0.15 **
Historical Diversity	0.04 *	0.03	0.04 +	0.06 *	0.04	0.05 +	0.03	0.02	0.02	0.10 ***	0.09 **	0.10 ***
Urban Form												
Residential Density	-0.06 *	-0.04	-0.05	-0.15 ***	-0.11 ***	-0.11 ***	-0.07 +	-0.06	-0.06	-0.07 +	-0.05	-0.06
Mixed Land Use	0.00	0.00	0.01	0.00	0.00	0.02	0.04	0.04	0.05	0.06 +	0.06 +	0.06 +
Street Connectivity	-0.02	-0.03	-0.02	-0.01	-0.02	-0.01	-0.02	-0.03	-0.02	-0.06 *	-0.06 *	-0.06 *
Social Environment												
Disadvantage	-0.21 ***	-0.41 ***	-0.23 ***	-0.28 ***	-0.51 ***	-0.34 ***	-0.05	-0.28 **	-0.06	0.07	-0.05	0.08
Affluence	-0.01	0.07	0.05	-0.08 +	0.01	-0.01	0.00	0.10 +	0.09	0.04	0.08 +	0.07
Occupancy												
% In Place 5 Years or More	0.10 *	0.13 ***	0.14 ***	0.06	0.10 *	0.10 *	0.13 **	0.16 ***	0.18 ***	0.09 +	0.10 *	0.10 *
Interactions												
Detached*Affluence	0.34 *			0.40 ***			0.47 ***			0.11		
% 3-4 Units*Disadvantage		0.71 +			0.70 +			1.04 *			0.39	
% 50+ Units*Disadvantage		0.43 *			0.56 ***			0.43 *			0.29 *	
Density*Disadvantage			0.03			0.06 *			0.04			0.02
Mixed Land Use*Disadvantage			0.04			0.11 **			0.02			0.03
Connectivity*Disadvantage			0.02			0.06 +			0.01			0.06 *

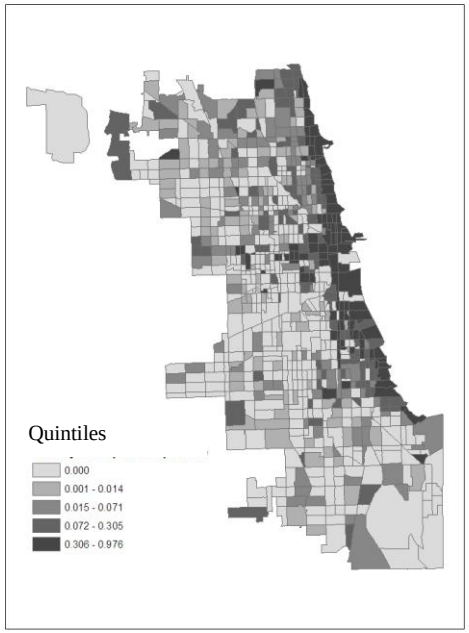
NC-Level Coefficients from Weighted HLM Regressions with Individual Sociodemographic and Household Controls Not Shown
+ $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$
CCAHS 2001-03 and Census 2000

Table 4.7. Correlation Matrix for NC-level Measures

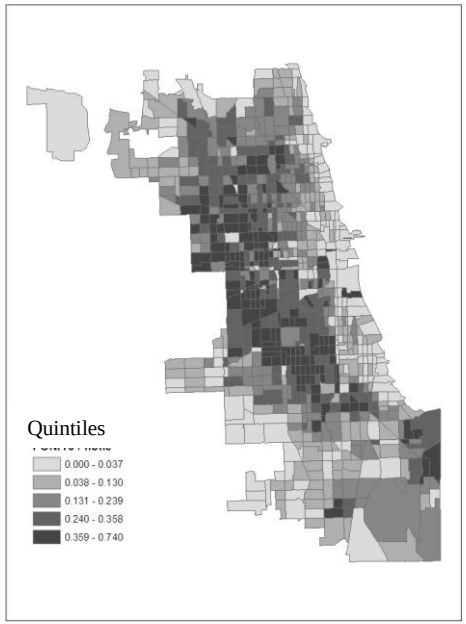
	% Detached Houses	% Duplexes	% 3-4 Units	% 5-49 Units	% 50+ Units	% Non-Standard	Public Housing Present	Historical Diversity	Residential Density	Mixed Land Use	Street Connectivity	Disadvantage	Affluence	% In Place 5 Years
% Detached Houses	1													
% Duplexes	-0.20	1												
% 3-4 Units	-0.45	0.59	1											
% 5-49 Units	-0.60	-0.33	0.05	1										
% 50+ Units	-0.43	-0.49	-0.40	0.21	1									
% Non-Standard	-0.02	-0.23	-0.13	-0.09	0.05	1								
Public Housing Present	-0.27	-0.21	-0.01	0.16	0.35	0.18	1							
Historical Diversity	-0.16	0.26	0.40	0.10	-0.26	-0.11	-0.10	1						
Residential Density	-0.61	-0.12	0.10	0.30	0.65	-0.11	0.24	0.04	1					
Mixed Land Use	-0.34	-0.08	-0.04	0.09	0.41	0.18	0.26	-0.02	0.29	1				
Street Connectivity	0.22	0.19	0.06	-0.11	-0.32	-0.21	-0.26	-0.03	-0.18	-0.48	1			
Disadvantage	-0.41	0.18	0.12	0.10	0.22	0.13	0.28	-0.21	0.08	0.30	-0.16	1		
Affluence	-0.21	-0.46	-0.19	0.33	0.48	0.01	0.06	0.11	0.34	0.12	-0.12	-0.49	1	
% In Place 5 Years	0.65	0.15	-0.18	-0.59	-0.42	0.10	-0.21	-0.14	-0.59	-0.14	0.11	0.16	-0.59	1

CCAHS 2001-03 and Census 2000, n=343

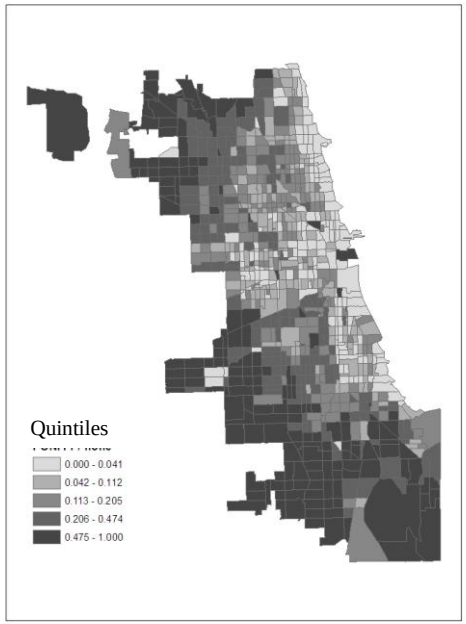
Figure 4.1. Spatial Distributions of Selected Housing Types in Chicago, Quintiles of Percent of Units in NC



Buildings with 50+ Units



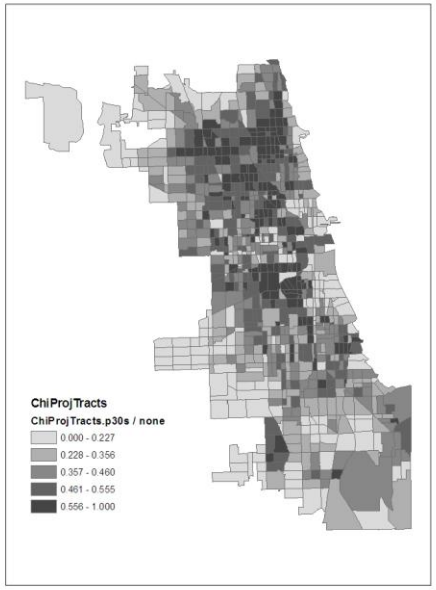
Buildings with 3-4 Units



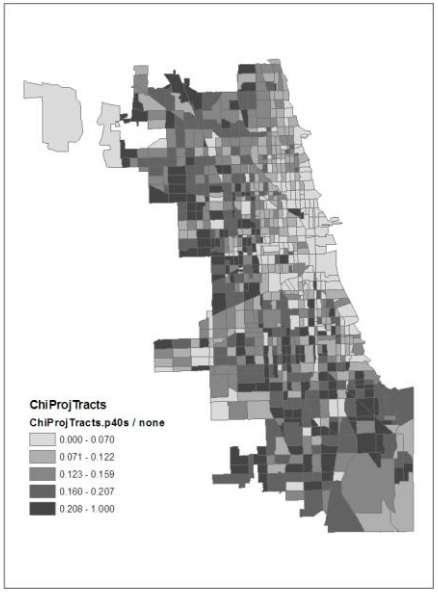
Single-Unit Houses

Census 2000 and CCAHS 2001-3

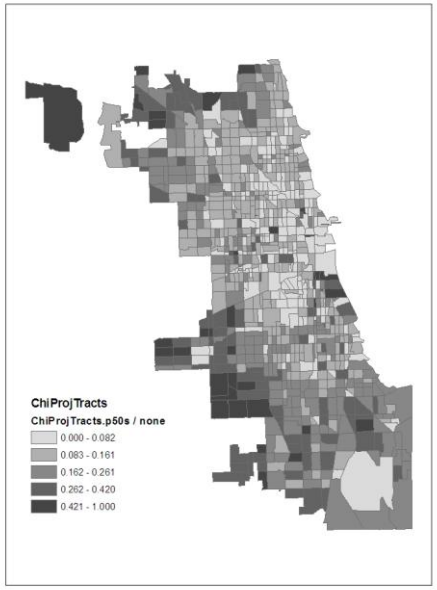
Appendix 4A. Spatial Distributions of Housing Construction Decades in Chicago, Quintiles of Percent of Units in NC



1930's and before



1940's

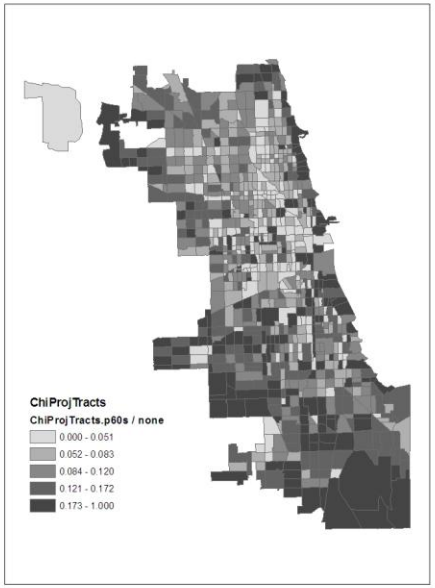


1950's

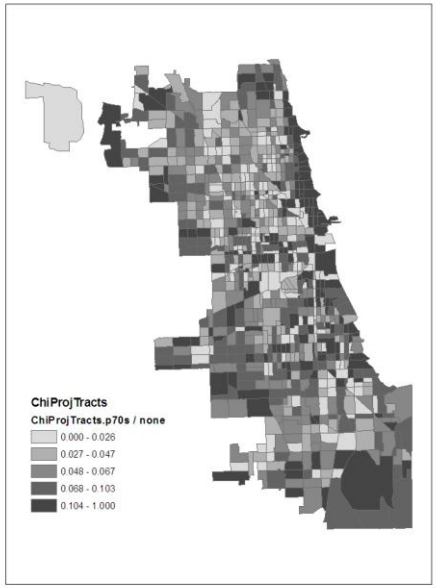
Census 2000

(page 1/3)

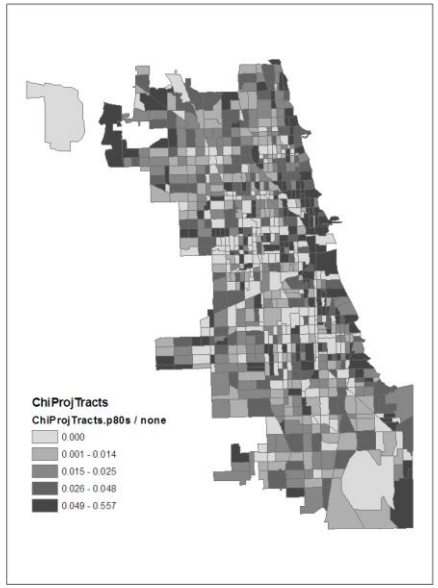
Appendix 4A, Continued. Spatial Distributions of Housing Construction Decades in Chicago, Quintiles of Percent of Units in NC



1960's



1970's

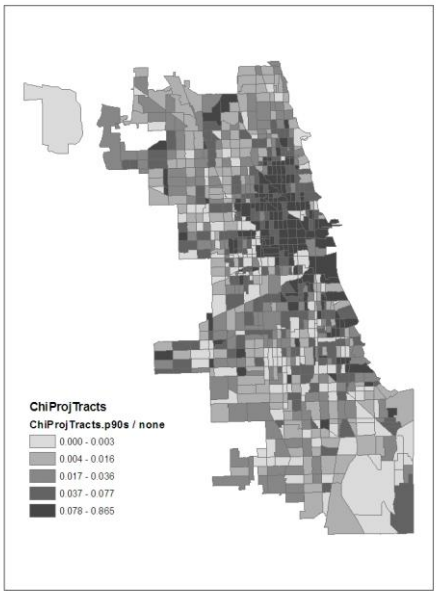


1980's

Census 2000

(page 2/3)

Appendix 4A, Continued. Spatial Distributions of Housing Construction Decades in Chicago, Quintiles of Percent of Units in NC



1990's

Census 2000

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Appendix 4B. Factor Structure of Additional Housing-Related Factors

	Construction Decade		Housing Building Type		Bedroom Count
	Recent	Urban Renewal Era	Medium Buildings	Large vs. Small Buildings	More Bedrooms
Rotated Factor Loadings					
Construction Decade					
(1930's and Earlier Omitted)					
1940's	-0.77	0.08			
1950's	-0.36	0.65			
1960's	0.24	0.84			
1970's	0.74	0.41			
1980's	0.77	-0.07			
1990's and 2000	0.52	-0.54			
Housing Building Type					
(5-49 Units Omitted)					
Single Unit			0.00	-0.86	
Duplex			0.69	0.20	
3-4 Units			0.70	0.47	
50 or More			-0.78	0.41	
Number of Bedrooms					
(2 Bedrooms Omitted)					
Studio					0.00
1 Bedroom					0.69
3+ Bedrooms					0.70
Eigenvalue	2.38	1.79	1.62	1.13	2.53
Weighted Correlations					
Cohesion	-0.07 ***	0.04 *	-0.07 ***	0.19 ***	-0.13 ***
Control	-0.08 ***	0.04 *	-0.09 ***	0.17 ***	-0.11 ***
Closure	-0.12 ***	0.05 **	-0.01	0.21 ***	-0.21 ***
Exchange	-0.03	0.00	-0.03	0.07 ***	-0.07 ***

CCAHS 2001-3, Census 2000; Orthogonal varimax rotations for construction decade and housing building type

Appendix 4C. Cross-sectional Associations of Residential Stability with Housing or/and Social Composition

	Model 1 β	Model 2 β	Model 3 β	Model 4 β	Model 5 β
Housing Building Type					
% Detached Houses	2.99 ***	2.62 ***	0.45		1.62 ***
% Duplexes	2.68 ***	2.53 ***	0.89 **		0.92 **
% 3-4 Units	-0.06	0.86	-0.64		1.32 **
% 50+ Units	0.49	0.84 *	1.05 **		1.45 ***
% Non-Standard	3.37 ***	3.11 ***	1.03 +		1.74 ***
(% 5-49 Units Omitted)					
Housing Age					
Recent Housing		0.17 ***	0.09 *		-0.08 *
Urban Renewal Era		-0.26 ***	-0.23 ***		-0.15 ***
Bedrooms					
More Bedrooms			-0.66 ***		-0.19 *
Social Composition					
Disadvantage				-0.59 ***	-0.10
Affluence				-0.46 ***	-0.29 ***
Std. % 65 and Over				0.35 ***	0.27 ***
Std. % Under 18				0.63 ***	0.25 **
Hispanic/Foreign Born				-0.45 ***	-0.26 ***
Constant	-1.57 ***	-1.60 ***	-0.35	-0.03	-1.09 ***
Adjusted R^2	0.52	0.60	0.68	0.71	0.79
Akaike Information Criterion	722.43	670.57	591.20	558.88	455.34

CCAHS 2001-3, Census 2000

CHAPTER 5

CONCLUSION

This dissertation examines associations of neighborhood built and social environments with biological, psychosocial, and social outcomes. The second chapter examines the role of residential neighborhoods in the accumulation of biological risk factors across physiological systems. Neighborhood context statistically explains sizeable social disparities in biological risk which were not fully accounted for by controlling for health behaviors, and neighborhood affluence also significantly predicts biological risk. The third chapter contains one of the first empirical examinations of neighborhood clustering of personality, and shows that spatial similarities in cynical hostility are on par or higher than those of many health-related outcomes often considered to be linked to residential environments. The analysis considered associations of cynical hostility with a number of possible environmental variables and found the closest links with a measure of perceived ambient traffic stressors, particularly noise, demonstrating stronger empirical support for this hypothesis than for potential social relational explanations.

The fourth chapter focuses more explicitly on the need to distinguish between the physical and social domains of context. While conventional discussions of how neighbors interact to provide health- and well-being- relevant social support have often taken a "systemic" approach focused on the social environment in terms of local social

composition and residential stability, the analysis in Chapter 4 demonstrates that simple measures of housing and urban form have important linkages with neighboring perceptions and behaviors. In particular, housing building types are associated with neighborly social relations independently, in interaction with social composition, and through their role in shaping residential stability. Reciprocal exchange behaviors have been very difficult to explain at the neighborhood level despite showing a sizeable neighborhood component, and urban form turns out to be a very promising direction for future investigation. Finally, the finding that neighborhoods in which construction was more evenly distributed over time, rather than those which had experienced large redevelopments in particular decades, fared better, merits attention. For one thing, if it is really the gradual evolutionary pace of redevelopment which matters for NSR, massive interventions to redevelop troubled areas may not succeed as well as small projects, even evidence-based communities built along New Urbanist lines. Also, large-scale zoning frameworks which discourage transitions (such as the current trend to redevelop industrial spaces as loft apartments) may be even more problematic than previously thought, and infill development even more promising. However, further investigation is necessary in order to more fully understand the association between construction patterns and social outcomes before concrete policy recommendations can be made.

The results of the factor analyses in Appendix 4B and the associations of these factors with residential stability in Appendix 4C suggest the need for a new factorial ecological approach. As explained by Sampson and Morenoff (1997), sociologists of the early Chicago School promoted theoretical approaches which took seriously the role of the physical environment in shaping social processes over time. Of course, these physical

ecological dynamics are themselves molded by the local governments, institutions, social movements, developers, and others who influence policy and market structure to shape neighborhood trajectories (Brown and Chung 2008; Massey, Domina, and Rothwell 2009; Rothwell and Massey 2009; Rothwell and Massey 2010; Sampson and Morenoff 1997; Taub, Taylor, and Dunham 1984). These ecological approaches have not been lost, and indeed the ability to measure physical characteristics of neighborhoods has undergone a revolution due to advances in geoprocessing and neighborhood-based survey methodology (Diez Roux and Mair 2010).

But while measurement has improved, theory has not kept pace. It is true that neighborhood poverty, racial isolation, and disadvantage predict a stunning array of negative outcomes for individuals and places. But documenting this point over and over does not suggest a solution, or worse, suggests the same solutions (e.g. urban renewal) which have already been shown counterproductive. Aside from policy-centered problems with this approach, another drawback is that some aspects of neighborhood social composition effects (e.g. Hispanic concentration) remain underexplained despite extensive consideration, while the precise meaning of others (e.g. older age composition, affluence) has rarely been explored. Even as leading figures in neighborhood research call for more precise elaboration of the pathways and processes by which residential environments "get under the skin," and lists of variables under consideration proliferate, very basic explanation of what some of our most powerful predictors really mean on the ground is rare.

In the introduction I mentioned that income can never explain health effects. Income might proxy for social position leading to certain emotions and rights, or it might

enable the holder to exchange those funds for health-promoting (or unhealthy) goods and services. Likewise, neighborhood aggregate income is also not in itself a great place to look for causality. First, neighborhood socioeconomic status is not causal in that it itself results from social processes sorting individuals into households and households into housing units with certain addresses. Second, neighborhood socioeconomic status is difficult to remedy by feasible direct local policy. Third, communities with equal resources might spend those funds to produce wildly varying social and physical environments which would have quite different effects for quality of life outcomes. So it makes sense to focus on policy-modifiable attributes which influence social sorting into places and which can be hypothesized to have specific and measurable direct or indirect effects on precise outcomes.

We need to delineate more clearly the complex patterns of interrelated processes which generate the social from the physical and the physical from the social. An important aspect to this agenda would be to link research on the way individual households select housing units, regardless of their position in the market, with research on spatial stratification. Sociologists need to better understand residential selection in terms of the characteristics households use to evaluate potential homes. This does include conventionally studied measures such as the sensory environment and perceptions of social relations and safety, but should focus as well on factors basic and primary to residential selection such as housing unit features, transportation choices, and proximity to key destinations such as employment and schools. Much of this research has been left to real estate economists, interested in pricing public goods, but sociologists need to reapproach from a sociological perspective. These features, aside from being

central to residential selection and neighborhood vitality, also are integrally linked to environmental and economic outcomes – some of the most pressing issues facing the United States today. The quality of the places we stay in and move through is central to quality of life.

The housing factors presented in Appendix 4B and which are linked with residential stability in cross-sectional models in Appendix 4C are a good place to start. Features of the built environment, particularly housing, endure for decades or centuries and either attract or repel potential residents differently according to their social identities. While the social area analysis approach, which emphasizes purely social attributes of places has its appeal (for instance the large percent of variance "explained" by social factors alone in model 4 of Appendix 4C), the fact that a simple set of housing factors can be approximately equally predictive should give pause and inspire attempts to reconcile these two approaches.

Housing, along with the resulting transportation needs, forms the largest expense for many households, but social scientists and health researchers have provided little guidance about how best to spend income – or trade-off income – among housing features, transportation, work hours, school quality, and other possibilities in order to pursue quality of life throughout the lifecourse. And an evidence base centered on quality of life may also uncover other features of neighborhood quality which can easily be incorporated into community, local government, developer, and household plans. Like housing interventions to reduce asthma triggers which then reduce Medicaid-funded emergency room visits, any number of possible interventions may reduce the prevalence rather than the course of disease. Some of these may pay for themselves – a

consideration which may become increasingly vital to implementation in today's fiscal climate.

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