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Divergent Pathways of Gentrification: Racial Inequality and the Social Order of Renewal in Chicago Neighborhoods

Jackelyn Hwang^a and Robert J. Sampson^a

Abstract

Gentrification has inspired considerable debate, but direct examination of its uneven evolution across time and space is rare. We address this gap by developing a conceptual framework on the social pathways of gentrification and introducing a method of systematic social observation using Google Street View to detect visible cues of neighborhood change. We argue that a durable racial hierarchy governs residential selection and, in turn, gentrifying neighborhoods. Integrating census data, police records, prior street-level observations, community surveys, proximity to amenities, and city budget data on capital investments, we find that the pace of gentrification in Chicago from 2007 to 2009 was negatively associated with the concentration of blacks and Latinos in neighborhoods that either showed signs of gentrification or were adjacent and still disinvested in 1995. Racial composition has a threshold effect, however, attenuating gentrification when the share of blacks in a neighborhood is greater than 40 percent. Consistent with theories of neighborhood stigma, we also find that collective perceptions of disorder, which are higher in poor minority neighborhoods, deter gentrification, while observed disorder does not. These results help explain the reproduction of neighborhood racial inequality amid urban transformation.

Keywords

gentrification, neighborhoods, racial inequality, disorder, urban change

Many scholars of the city depict the past two decades as a period of profound social transformation characterized by widespread gentrification (Ellen and O'Regan 2008; Hackworth 2007; Hyra 2008, 2012; Wyly and Hammel 1999). These changes have launched highly contentious debates over the costs and benefits of gentrification, especially for poor minority residents (e.g., Atkinson 2004; Freeman 2005; Pattillo 2007; Smith 1996; Vigdor 2002).

Contemporary pathways of neighborhood gentrification—a process of neighborhood

change—are not well understood, however, especially their coexistence with the *persistence* of neighborhood inequality by race and class. Most quantitative studies of gentrification tend to rely on census and

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administrative measures that lack direct indicators of neighborhood upgrading. In particular, census-based strategies neglect the distinctly visible changes to the urban landscape produced by changes in the built environment that are inherent to gentrification (Krase 2012; Kreager, Lyons, and Hays 2011; Papachristos et al. 2011; Smith and Williams 1986). Traditional data sources also do not usually capture political and economic forces, such as large-scale private developers, city capital investments, and public housing policies, which increasingly play critical roles in facilitating or stalling gentrification.

Moreover, although most scholars agree that gentrification is a temporally uneven process across neighborhoods, quantitative research has rarely examined variation in the evolution of gentrification's properties and expansion over time or how this relates to the persistent forms of racial segregation and neighborhood inequality that characterize U.S. cities (Massey and Denton 1993; Sampson 2012; Sharkey 2013). Studies show that poor neighborhoods adjacent to gentrified or high-income neighborhoods are likely to upgrade (Guerrieri, Hartley, and Hurst 2013; Hackworth 2007). Considerable evidence also demonstrates the powerful role of race and ethnicity in neighborhood selection, shaping residential patterns of segregation and neighborhood decline (Charles 2003). Yet, until recently, scholarship on gentrification has not systematically incorporated racial stratification in shaping the trajectory of gentrifying neighborhoods and their surrounding areas (Anderson and Sternberg 2013).

We address these gaps by joining research on gentrification with sociological literature on neighborhood racial preferences and residential selection to build a testable conceptual framework for understanding how gentrification plays out over time. To assess our framework, we propose a novel method for measuring gentrification that exploits the technology of Google Street View to provide estimates of recent gentrification trajectories. We then integrate data from an influential field survey of gentrification conducted in

1995 with additional data sources to assess how racial and ethnic composition shapes the future trajectories of neighborhoods that were either gentrifying in 1995 or were adjacent to these neighborhoods and disinvested. We find that gentrification is racially ordered in a distinct way, with both percent Hispanic and percent black attenuating neighborhood trajectories of reinvestment and renewal. Percent black operates nonlinearly, however, having the strongest effect on gentrification only beyond a threshold of about 40 percent. Perceptions of disorder, but not observed disorder, also deter the process of gentrification. These findings enhance our understanding of pathways of contemporary gentrification and help explain the mechanisms by which neighborhood inequality persists in an era of urban transformation in Chicago.

GENTRIFICATION AND RACIAL STRATIFICATION

For our purposes, we adopt Smith's (1998:198) influential definition of gentrification: "the process by which central urban neighborhoods that have undergone disinvestments and economic decline experience a *reversal*, *reinvestment*, and the *in-migration* [emphasis added] of a relatively well-off middle- and upper middle-class population." This definition does not require that displacement or racial turnover occur, which are still widely debated empirical questions (see Atkinson 2004; Freeman 2005; Pattillo 2007). By defining gentrification in this way, we focus on the social process of neighborhood renewal as it unfolds over time.

Prominent theoretical perspectives explain gentrification in terms of consumption and production attracting the middle and upper-middle classes (Ley 1986; Smith 1982). Economic forces (e.g., a tight housing market) and state or corporate actors (e.g., universities or large-scale developers) can play important roles in advancing gentrification, but these actors require demand by a neighborhood's potential residents and businesses to secure stability in their investments (Hamnett 1991).

As a reversal of the invasion-succession process described by the early Chicago School, or the last stage of the neighborhood life cycle, gentrification involves affluent movers who have virtually unlimited choices in the housing market (Laska, Seaman, and McSevency 1982).

Taken together, these perspectives argue that social processes of neighborhood selection interact with political and economic forces to simultaneously shape both the supply and demand for potential neighborhood reinvestment. Visible signs of neighborhood reinvestment further facilitate upgrading as neighborhood identities and reputations are reconstituted. Whether new construction or rehabilitation is driven by households, developers, investors, or policies, the decision to move to or invest in a neighborhood—or *neighborhood selection*—is an important social process with emergent consequences for a neighborhood's trajectory. Research on gentrification, segregation, and disorder implicate racial composition in neighborhood selection but in different ways. Integrating this literature provides a basis for theorizing how gentrifying neighborhoods evolve over time.

Diversity and the Neighborhood Tastes of Gentrifiers

Consumption-side perspectives of gentrification emphasize the unique cultural tastes of gentrifiers. Stemming largely from qualitative inquiry, research indicates that gentrifying residents, especially in the early stages, are attracted to bohemian-like settings that tolerate diversity and thus are likely to have greater predilections toward racial integration and higher thresholds for out-group neighbors than would the general population (Brown-Saracino 2009; Ley 1996; Zukin 1987). Gentrifiers also appear to have a higher tolerance for risk and seek out “gritty” areas, often on the edge of “ghetto” neighborhoods (Anderson 1990; Lloyd 2005), with this preference varying by the timing in which a gentrifier enters a neighborhood (Clay 1979). Research using survey data shows that preferences for

gentrifying neighborhoods extend to minority renters, who are particularly attracted to racially diverse neighborhoods, although white survey respondents report that proximity to amenities and housing characteristics, rather than racial mix, is the attraction of redeveloped neighborhoods (Bader 2011). Gentrifiers have thus been portrayed in heterogeneous ways—as risk-takers who are not deterred by predominantly minority and poor neighborhoods (Clay 1979), as in-movers who have negative intentions to take over the neighborhood (Smith 1996), and as “social preservationists” who embrace diversity and have positive intentions (Brown-Saracino 2009). Whatever the motivations of individual gentrifiers, the literature generally portrays contemporary gentrification as a process of middle- and upper-middle-class whites moving into poor, and often minority, neighborhoods.

Race-Based Neighborhood Selection

Stratification-based explanations for residential selection and segregation center on housing market discrimination and racial composition preferences (Charles 2003; Massey and Denton 1993). All race groups prefer integrated neighborhoods with a substantial presence of same-race neighbors, with whites having the strongest preference for same-race neighbors and blacks having the weakest (Charles 2003). Latinos and Asians favor integration when potential out-group neighbors are white, but when potential out-group neighbors are black, they tend to favor co-ethnic neighbors over integration. These preferences reflect an imposed neighborhood racial hierarchy where white neighborhoods are most favored, black neighborhoods the least, and Asian and Latino neighborhoods in the middle, paralleling the racial ordering of inequality generally found in contemporary U.S. society (Charles 2000). Using vignettes and video-computer-assisted self-interviews, recent research shows the effect of race on residential preferences after accounting for social class, crime, school

quality, and housing values, suggesting that whites' out-group prejudices toward blacks and Latinos, rather than in-group preferences by any racial group, are at work in residential segregation (Krysan et al. 2009; Lewis, Emerson, and Klineberg 2011).

Crime, Disorder, and Neighborhood Stigma

Although not usually linked to gentrification debates, relevant research demonstrates that implicit biases or stereotyping toward minorities and minority neighborhoods are significant in shaping residential decisions. Ellen (2000) argues that whites avoid integrated neighborhoods through the mechanism of race-based neighborhood stereotyping; rather than exercising explicit racial prejudice, whites associate blacks with low neighborhood quality and predict that integrated neighborhoods will eventually turn entirely black. She specifically argues that decisions about neighborhood entry, or "white avoidance," reflect a distinct social process that is perhaps more influential in contributing to contemporary residential segregation than "white flight." Studies by Quillian and Pager (2001) and Sampson and Raudenbush (2004) support this cognitive expectations hypothesis with respect to perceptions of crime and disorder. Their evidence shows that perceptions are shaped by racial-ethnic composition, independent of socioeconomic standing, actual crime rates, objective measures of disorder, and respondents' race or ethnicity, suggesting that this relationship stems from neighborhood stigma or implicit biases rather than overt prejudice. Because particular minority groups, especially when poor, induce stereotypes in the U.S. context and are easily observable, racial composition tends to map onto perceptions of disorder, triggering implications for gentrification.

America's legacy of racial stratification and pervasive segregation further suggests that perceptions are resistant to short-term changes or even contrary evidence. For example, despite the decreasing "blackness" of neighborhoods with the arrival of immigrants, and the increasing heterogeneity of social

class and residential location of African Americans, Anderson (2012) emphasizes the persistent stereotype of "iconic" black ghettos. Sampson (2012) argues that perceptions—rather than visible (or "objective") cues—cohere into a meaningful social property of an environment when reinforced through social interactions, institutional practices, and collective reputations. These perceptions, in turn, influence both individual- and neighborhood-level outcomes, mediating or explaining in part the effects of racial and class composition. This neighborhood version of the self-fulfilling prophecy is characterized as the "looking-glass neighborhood" (Sampson 2012:365; see also Krysan and Bader 2007).

HYPOTHESES AND STRATEGY

The persistence of disadvantaged minority neighborhoods and a durable neighborhood hierarchy implies that residential selection and stratification mechanisms continue to shape the contemporary urban landscape. Yet despite much research on race and neighborhood *decline*, few studies have empirically examined how these processes work within the broader context of neighborhood *ascent* (Owens 2012). Some studies show that minorities play an important role as gentrifiers (Bostic and Martin 2003; Pattillo 2007), but this form of gentrification constitutes a small proportion of socioeconomic ascent (Owens 2012). Studies that examine patterns of neighborhood ascent across large samples find associations with race-related factors, but overall, they do not advance a theoretical account of racial mechanisms in gentrification processes. Helms (2003), for example, shows that the proportion of black residents in 1990 predicts housing renovations on Chicago blocks, based on filed building permits from 1995 to 2000. In another study, Galster and colleagues (2003) find that in neighborhoods with poverty rates greater than 20 percent in 1980, percent minority positively predicts reductions in poverty from 1980 to 1990, especially in neighborhoods with relatively lower proportions of low-income households. Building on Galster and colleagues'

(2003) analysis, Ellen and O'Regan (2008) find a positive association between the share of black residents among the poorest quintile of central city tracts and relative changes in income during the 1990s, which may be attributable to welfare reform or the widespread demolition of high-rise public housing. These are important findings, but these studies use measures that capture only narrow or correlated aspects of the gentrification process.

Furthermore, although gentrifiers may have preferences for racial or ethnic diversity or a greater tolerance for minority neighbors, the durability of race-based residential stratification suggests that gentrifiers' preferred level of diversity is limited. In *Paths of Neighborhood Change*, Taub, Taylor, and Dunham (1984) show that racial preferences and tolerance for risk are neither uniform across residents nor the only influences on neighborhood selection (other factors include affordability and location). While gentrifiers' tolerance for diversity may indeed be greater than that of the general population, such preferences may be limited to the extent that they generate *aggregate patterns* of neighborhood inequality (cf. Schelling 1971) that do not necessarily reflect the cultural accounts of individual gentrifiers.

Synthesizing these ethnographic and large-sample studies, we propose a theoretical account of gentrification as embedded in a process of neighborhood sorting whereby selection is shaped in important ways by racial composition and shared evaluations of a neighborhood's disorder. Following previous findings on residential preferences by race, we accept that residents, and especially gentrifiers, report favoring integrated over homogeneous neighborhoods. But while gentrifiers may prefer integrated neighborhoods, we hypothesize that the processes driving gentrification follow a racialized social hierarchy—specifically, that percent black and percent Hispanic will attenuate the degree of gentrification among neighborhoods that either showed signs of gentrification in 1995 or were adjacent to these neighborhoods and still disinvested, controlling for alternative neighborhood characteristics associated with

desirability. Second, based on threshold processes posited in research on residential segregation (e.g., Schelling 1971), we test the hypothesis that the negative effect of percent black on gentrification is nonlinear and increases at higher levels.

Third, we extend the idea of the looking-glass neighborhood and disorder-induced stigma to hypothesize that the pace of gentrification is slowed by inter-subjectively shared perceptions of disorder. We specifically predict that collective perceptions of disorder will reduce the pace of gentrification among neighborhoods that either previously showed signs of gentrification or were adjacent to these neighborhoods, independent of socioeconomic conditions, crime, and importantly, observed disorder. Fourth, we hypothesize that collective perceptions of disorder partially mediate the influence of neighborhood racial, ethnic, and poverty composition on the degree of gentrification through the mechanism of implicit bias (see also Sampson 2012:131–32).

In evaluating these hypotheses, we take into account proximity to jobs, institutions, physical amenities, public housing, and state investment practices. A number of studies argue that proximity to jobs in the growing professional and managerial sectors and neighborhood stability and reinvestment afforded by large institutions, such as universities, hospitals, and downtown businesses, as well as the attractiveness of amenities such as transportation centers, waterfronts, and parks, help explain the uneven geography of gentrification (Ley 1996; Taub et al. 1984). In addition, recent work emphasizes the increasing role of the state in gentrification. Lees and Ley (2008), for example, declare the gentrification of the 1990s and 2000s as fully intertwined with public policy, while others point to the role of the state in the allocation of housing and direct investments in city infrastructures and other public provisions (Hackworth 2007; Hyra 2012; Wacquant 2008; Wyly and Hammel 1999). State actions in housing policy, such as the large-scale demolition of public housing projects and capital investment in infrastructure, also offer signals to developers, corporate actors, and individuals that

encourage further investment. More than demographic and socioeconomic neighborhood characteristics, institutional and state factors are *external* to a neighborhood; yet, they may have real implications for gentrification and can influence race-based reputations through their power to reconstitute neighborhood identities (Anderson and Sternberg 2013). We therefore consider institutions, physical amenities, and “state effects” in addition to sociodemographic factors in assessing our theoretical framework.

In summary, our overarching thesis is that racial-ethnic composition and perceived neighborhood disorder intervene in the urban landscape to influence gentrification in a way that sustains and helps explain the durability of neighborhood hierarchies amid the social transformation of Chicago in the 1990s and 2000s. We further propose that visible aspects of gentrification express the social transformation of a neighborhood and offer a way to observe a process that is facilitated by a complex combination of actors (Beauregard 1986; Smith 1996). Studies focusing on single neighborhoods capture qualitative changes but cannot draw quantitative inferences over time and across neighborhoods, and large sample studies, which typically rely on census and administrative data, cannot distinguish gentrification from other forms of neighborhood change and typically do not capture important qualitative or visible aspects of reinvestment, neighborhood upgrading, and hence renewal. Perhaps it is not surprising that many studies yield mixed results on the causes and consequences of gentrification. To address these challenges, we assess our theoretical account with an observational method tailored to our theoretical objectives of capturing the *visible cues* and *degree* of gentrification across *multiple* neighborhoods.

RESEARCH DESIGN

The first building block of our research design is the large-scale effort by Hammel and Wyly (1996) (hereafter HW), who conducted gentrification field surveys during the

1990s in several U.S. cities, including Chicago (see also Wyly and Hammel 1998, 1999).¹ Using a working definition of gentrification similar to ours, HW surveyed tracts that experienced prior decline resulting from urban dislocations and disinvestment and were thus “gentrifiable,” defined as tracts with median incomes below the citywide median in 1960. HW then reviewed archival sources, such as scholarly research, city planning documents, and local press, to develop a list of gentrified neighborhoods. They triangulated these sources with block-by-block field surveys, in which raters walked through neighborhoods documenting visible evidence of housing reinvestment and class turnover, giving particular attention to residential structural improvements and new construction for each block.²

Census tracts categorized as “core gentrified” had at least one improved housing structure on most blocks, with at least one-third of all structures in the tract showing evidence of reinvestment. Areas categorized as “fringe gentrified” had a minimum of one improved structure on a majority of blocks, and at least one block in the tract with at least one-third of the structures improved. Gentrifiable neighborhoods without these criteria of reinvestment were rated as “poor.” After completing field surveys, HW attempted to distinguish gentrified areas from other urban neighborhoods using census variables. Although gentrified tracts correlated with expected socioeconomic variables, HW found that a large number of tracts were incorrectly classified as gentrified when using only census indicators. This finding demonstrates the shortcomings of relying on census data alone (e.g., class composition) and the importance of visible cues for detecting gentrification.

Our second building block comes from the suite of studies conducted by the Project on Human Development in Chicago Neighborhoods (PHDCN)—particularly the systematic social observation of Chicago streets (for more details, see Sampson 2012:77–90). Observer logs and videotapes of block faces were recorded from a sports utility vehicle driven slowly down city streets during 1995 in

a stratified sample of neighborhoods. Raters later systematically coded tapes and investigator logs for aspects of physical and social disorder. In an extension of the PHDCN, a follow-up study in 2002 incorporated the same observation methods but used trained observers to walk around Chicago neighborhoods and assess street-block indicators.

Our third and major building block extends these methods by exploiting Google Street View to systematically detect the visible character and degree of gentrification. Google Street View is free, fully accessible to the public, and provides nearly full-rotation panoramic views at the street level that are updated every one to four years, giving viewers the virtual experience of walking down the street. In essence, Google Street View, while not intended as such, provides a convenient tool for assessing neighborhood gentrification by capturing reliable observational data in concordance with in-person audits—information on which administrative data are limited. A small but growing literature provides encouraging results on the validity and inter-rater reliability of using Google Street View for measuring other neighborhood characteristics (Clarke et al. 2010; Odgers et al. 2012; Rundle et al. 2011).

Observing Gentrification with Google Street View

HW identified 30 “core gentrified” and 36 “fringe gentrified” tracts in their original observations in 1995 of Chicago’s 402 “gentrifiable” (median income below the citywide median in 1960) tracts. To examine our outcome of interest—variation in trajectories of gentrification—we systematically observed and coded street level images from 2007 to 2009³ in a random sample of blocks stratified by 140 Chicago census tracts that were selected to match the 66 core and fringe gentrified tracts and the 74 “gentrifiable” tracts that were adjacent to these core and fringe gentrified tracts and rated as “poor” in 1995.⁴ This population of tracts allows us to examine how gentrification evolved since HW’s observations in 1995, including the spread of gentrification into adjacent gentrifiable tracts.⁵

After completing pretests in two cities other than Chicago, a trained observer implemented the same coding rules across all sampled block faces in the 140 census tracts. A census *block* is the smallest areal unit used by the U.S. Census Bureau and is typically a three- or four-sided geographic area bounded by streets, railroads, bodies of water, or other physical features. Chicago census tracts typically contain 10 to 20 blocks that have building properties (rather than rivers, railroads, and lots). Within each tract, the coder observed a random sample of blocks. The unit of observation was the *block face*, a single segment of a block, or one side of a street. For each sampled block, the coder observed all block faces that contained residential or commercial units. When at least 10 block faces were coded from at least four different blocks from a tract, observations were considered complete for the tract.

The coder virtually toured each block face using panoramic, rotation, and zoom features of the Google Street View application and recorded observations for each block face using an instrument we designed to detect theoretically driven indicators of gentrification.⁶ Our final sample of observations consists of 2,709 block faces, of which 1,905 contain the required residential or commercial properties for coding gentrification.

Definition and Reliability of Gentrification Measures

The substantive goals of our measurement method are to capture the visible aspects of gentrification—reinvestment, renewal, and in-migration of middle- and upper-middle-class residents—and to identify a neighborhood’s degree of gentrification. Hoover and Vernon’s (1959) life cycle theory of neighborhood change describes urban neighborhoods as experiencing various stages from decline to renewal to class turnover, providing a useful starting point for operationalizing gentrification’s evolving stage-like pattern.

We measure three main characteristics that, taken together, define a neighborhood’s stage of gentrification: (1) the “structural

mix” of an area—the combined condition of older structures, which indicates an area’s preexisting socioeconomic status, and the degree of new structures and rehabilitation; (2) visible beautification efforts; and (3) lack of disorder and decay. These characteristics provide conceptually sound measures of visible neighborhood transformations consistent with our working definition of gentrification.

Because the population of coded neighborhoods experienced disinvestment after major urban transformations of the mid-twentieth century, the condition of existing structures and the presence of new construction or rehabilitation serve as direct indicators of physical reinvestment. We specifically consider both the condition of older building structures and the degree of structures that appear to be new or rehabilitated in the past 10 to 15 years in the area observed. Using the Google Street View survey, we measure the condition of preexisting structures as a binary indicator for whether most or all structures on the block face that are not new or rehabilitated appear to be well-kept, attractive, and sizable.⁷ We measure the degree of new structures and rehabilitation with the following indicators: the amount of new or rehabilitated building structures, new traffic signs/structures, new public courtesies, new large developments, and new construction for sale. This measure focuses on various aspects of new construction and rehabilitation, capturing both public and private reinvestment and small- and large-scale development. A disinvested and declined area with no signs of gentrification would have neither new structures being built nor older structures in good condition; an area beyond the final stage of gentrification would have all of its older housing structures in good condition and may or may not have new or rehabilitated structures. An area undergoing gentrification would have some degree of new structures with not all, if any, of its older structures in good condition.

Our second and third measures of gentrification—visible beautification efforts and lack of disorder and decay—are conceptually distinct elements of reinvestment in the aesthetics of a neighborhood, beyond the building stock, that further reflect social transformation.

Beautification efforts are visible cues of the presence of community investment that, in turn, attract further reinvestment. We combined the following binary indicators to capture beautification: efforts discouraging disorder (e.g., painting over graffiti), personal frontage beautification, and vacant/public space beautification. By contrast, physical signs of disorder and decay, such as trash and unkempt vacant lots, are visible cues that signal neighborhood disinvestment and deter reinvestment. We combined the following binary indicators to measure the lack of disorder and decay in a neighborhood: lack of physical disorder, lack of unkempt vacant/public space, and lack of decaying structures.

All indicators were originally recorded at the block-face level. For each block face, we combined the relevant indicators to calculate a summary score for each of our three measures. We define the overall gentrification stage score for a block face as the average of the three summary measures. The block-level score for each indicator is the average of its block-face scores, and each tract-level score is the average of its randomly sampled blocks’ scores.

Instrument details, item frequency distributions, descriptive statistics by census tract, and a detailed description of how we calculated the three measures from the indicators are available in the online supplement (<http://asr.sagepub.com/supplemental>). The supplement also contains a coding guide and visual demonstration with detailed descriptions of the coding process and the purpose of each instrument item, giving the reader concrete exposure to actual coding decisions and the basics for conducting Google Street View gentrification observations (hereafter GGO) in other cities.

Figure 1 presents a conceptual typology by which our three summary measures capture a neighborhood’s stage in the life cycle of neighborhood change, and Table 1 displays descriptive statistics for the three measures of gentrification and the overall gentrification stage scores at the tract level for all observed tracts, as well as hierarchical linear model variance and measurement properties. The average gentrification stage score for the 140

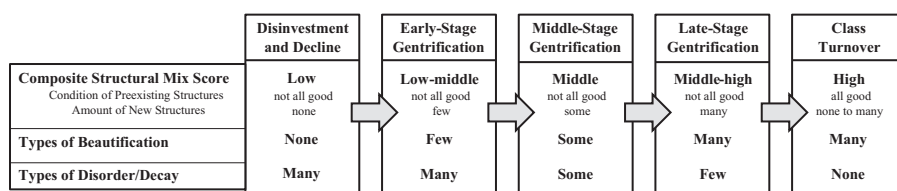


Figure 1. The Neighborhood Life Cycle of Gentrification: Conceptual Typology and Measures

Table 1. Descriptive Statistics for Tract-Level Gentrification Measures and Hierarchical Linear Model Variance and Measurement Properties for GGO Stage Scores for Block Faces within Blocks and for Blocks within Tracts

Measure	Mean	SD	Min.	Max.
Structural Mix	.533	.187	.121	1.000
Beautification Efforts	.658	.115	.289	.909
Lack of Disorder and Decay	.808	.152	.303	.996
Total Stage Score	.666	.115	.352	.953
Block faces (level-1) within blocks (level-2)				
Variance		.028		
Reliability		.613		
Intraclass correlation		.385		
Blocks (level-1) within tracts (level-2)				
Variance		.016		
Reliability		.726		
Intraclass correlation		.367		

Note: Census tract units, $N = 140$; between block-face units, $N = 682$; between block units, $N = 140$.

tracts was .67 with a standard deviation of .12. Tracts with stage scores below approximately .50 tend to be disinvested or in the early stage of gentrification (left portion of Figure 1), having little to no signs of reinvestment and renewal. Tracts with scores ranging from around .50 to .65 are in the middle stage of gentrification, having a mix of decline and renewal. Scores ranging from around .65 to .80 indicate the late stage of gentrification, having high levels of reinvestment and renewal but some evidence of prior decline. Tracts with stage scores above around .80 tend to be entirely middle- and upper-middle-class neighborhoods with little to no signs of disinvestment and decline (see the online supplement for visual examples).

The reliability coefficients in Table 1 measure the precision of the stage scores in detecting variance *between* blocks and tracts,

with block faces and blocks as the level-1 units nested within blocks and tracts, respectively; thus, they are the proportion of the observed variance explained with the true between-block or between-tract variance. The intraclass correlations indicate how strongly units in the same group resemble each other, thus indicating the reliability of our measures in detecting block- and tract-level differences. Reliability estimates are relatively strong and intraclass correlations are high compared to prior studies using systematic social observation (e.g., Raudenbush and Sampson 1999).⁸

Construct Validity

To assess the construct validity of the GGO stage score, we first used demographic data from the 2005 to 2009 American Community Survey, in addition to 1990 and 2000 census

data. We find that stage scores are moderately to highly correlated with characteristics often associated with gentrification—percent whites, blacks, college graduates, and persons below poverty (correlations of .49, $-.45$, .61, and $-.46$, respectively, for 2005 to 2009). Gentrification has lower but still significant correlations with ownership rate, income, housing value, and rent: .27, .34, .34, and .30, respectively.⁹ While capturing a broad array of demographic and economic transformations, decennial census variables do not tap the qualitative aspects unique to gentrification (Hammel and Wyly 1996; Ley 1996).

We therefore examined two alternative measures that capture more qualitative characteristics of gentrification—the locations of green roofs and Starbucks. Research and media often refer to “green consumption” and the appearance of coffee shops, particularly Starbucks, as cultural symbols of gentrification (e.g., Papachristos et al. 2011; Quastel 2009). We obtained green roof addresses from the City of Chicago Data Portal (<https://data.cityofchicago.org/>) based on 2011 satellite imagery, and Starbucks locations from the company website (<http://www.starbucks.com/>), geocoding each to the census tracts in our study. Adjusting for the number of housing units and population density, we used Poisson regression models to predict the number of green roofs and Starbucks. Our GGO score positively predicts both outcomes, with coefficients of 3.59 (s.e. = .88) and 6.60 (s.e. = 1.17) in each model, respectively. Because the GGO scores strongly predict both green roof and Starbucks counts, we also constructed a principal component score based on the logged counts of the two indicators. Modeling a linear regression model of the first principal component on the GGO score, population density, and housing units, we find that the GGO score positively predicts the first principal component, having a coefficient of 1.75 (s.e. = .53).

We further assessed how well our GGO score compares to traditional census variables measured more or less contemporaneously. When we add American Community Survey

estimates for 2005 to 2009 of proportion black, proportion Hispanic, and poverty rates to these models, the GGO score has coefficients of 1.99 (s.e. = 1.06) and 4.80 (s.e. = 1.34) in the Poisson regression models for the number of green roofs and Starbucks, respectively. In the linear regression model of the first principal component of logged green roofs and Starbucks counts, the GGO score has a coefficient of 1.34 (s.e. = .62). In all three models, the GGO score has substantively greater explanatory power compared to racial composition and poverty. Moreover, likelihood ratio tests between models excluding and including the GGO score lend support for the added power of the GGO score in capturing gentrification beyond demographic characteristics.

SUPPLEMENTARY DATA SOURCES

We integrated several additional data sources with our GGO scores. Census data are based on the Geolytics Neighborhood Change Database with 2000 normalized census tract boundaries. All measures were linearly interpolated for 1995 based on the 1990 and 2000 censuses. We assess racial-ethnic composition with proportion *non-Hispanic black* and proportion *Hispanic*.¹⁰ Because socioeconomic and housing conditions may account for variation in neighborhood trajectories (Crowder and South 2008), we also included census variables for *poverty* rate (measured as the proportion of the population in families with incomes below the federal poverty line), *homeownership* rate (measured as the proportion of housing units that are owner-occupied), and *vacancy* rate (measured as the proportion of housing units that are unoccupied).¹¹

We geocoded *homicide* incidents recorded by the Chicago Police Department from 1995 through 1997 to construct logged average annual rates per 100,000 at the tract level.¹² Because crime rates are highly variable from year to year, we used three-year averages, but results are similar using only 1995 data. Systematically *observed disorder* comes from the

Chicago Community Adult Health Study, an affiliated study of PHDCN. These observations were collected in 2002 (and thus prior to our GGO) by trained raters who recorded observational data on the characteristics of the block around the 3,105 survey respondents' homes using a modified version of the instrument used in the PHDCN observational study conducted in 1995.¹³ The observed disorder measure is a multi-item scale based on the presence or absence of the following items: cigarette/cigar butts, garbage/broken glass, empty bottles, graffiti, abandoned cars, condoms, and drug paraphernalia. Block-face scaled scores were aggregated to the tract level using empirical Bayes estimates to account for measurement error (Sampson and Raudenbush 1999).

We measured inter-subjective *perceptions of disorder* using the PHDCN survey of 8,782 adult residents who were interviewed in person in 1995 using a stratified, multistage probability sampling design.¹⁴ Residents were asked to rate "how much of a problem" various social and physical incivilities were in their neighborhood—including drinking in public, selling/using drugs, teenagers causing a disturbance, litter, graffiti, and vacant housing. We used perceived disorder scores aggregated to the tract level, again using empirical Bayes estimates to adjust for measurement error.

Finally, we deployed 10 indicators from a variety of sources to assess proximity to jobs, institutions, and amenities, as well as two distinct kinds of "state effects." Using data gathered from the City of Chicago Data Portal, we calculated the distance of each tract in our sample to the nearest university or hospital, and we constructed a dummy variable for whether a tract falls within one mile of Chicago's central business district, known as the Loop. We also constructed dummy variables for whether a tract contains a rapid transit station, whether it is located on Lake Michigan's waterfront, and whether it contains a park. Altogether, these indicators represent direct controls for proximity to Chicago's major institutions, downtown, and various amenities.

To assess public housing policy, we used a geographic shapefile of Chicago public housing in 2000 and created a dummy variable for

whether at least 10 percent of the spatial area of a tract was occupied by public housing. We chose a threshold of 10 percent to identify large housing projects, which have since been demolished as part of an effort in Chicago to rehabilitate and redevelop its entire public housing stock.¹⁵ To capture state investment policy, we constructed measures of capital expenditures by the city of Chicago for each of its 77 community areas, which average about 38,000 residents and are widely recognized by local authorities and residents (Sampson 2012). Because large investments in capital infrastructure extend across multiple tracts, our intent was to capture the "investment profile" of the larger community surrounding gentrified and gentrifiable tracts. Investment data containing the dollar amount, year, and budget category of the approximately 2,450 capital projects in the city budget from 1995 to 2002 were coded under contract by the Neighborhood Capital Budget Group, a nonprofit organization concerned with budgetary issues in Chicago. We then classified the data into two broad categories: (1) *neighborhood space and infrastructure*, which includes amenities such as school parks, greenways, neighborhood parks, street resurfacing, and lighting; and (2) *other capital*, which includes economic development, municipal facilities, transportation, sewers, and water. For each category, we geocoded the project dollar amounts and constructed 1995 baseline expenditures as logged rates per 100,000 residents, along with the residual change scores from 1996 to 2002 with 1995 expenditures as the baseline predictor. The latter procedure captures changes not explained by the larger dynamics of city budgeting and capital investment.

Of the 140 tracts in our GGO data, 99 contain data on all measures and thus form the basis of our analysis. The reduction is because tracts with low residential populations, such as commercial areas or areas experiencing major housing transformations, do not contain measures for perceived and observed disorder from the PHDCN. Logistic regression models using the 140 tracts from the GGO data confirm that only population size

was significant in predicting which tracts were sampled in the PHDCN. Table 2 presents descriptive statistics for the 99 tracts used in our analysis, which consists of 26 core gentrified, 16 fringe gentrified, and 57 adjacent “poor” tracts, and are compared with all Chicago tracts for 1995 (linearly interpolated) and 2005 to 2009. These 99 tracts had higher percentages of whites and college graduates; higher median incomes, housing values, and rents; and lower percentages of Hispanics and owner-occupied units than the city in both 1995 and recent measures. In 1995, the 99 tracts had similar shares of blacks and poverty rates to Chicago overall but had lower levels by 2005 to 2009.¹⁶ Over time, the 99 tracts had greater increases than Chicago overall in their percentage of whites and college graduates and greater decreases in their percentage of blacks and persons below poverty—characteristics often associated with gentrification.¹⁷

PATHWAYS OF GENTRIFICATION

Figure 2 presents maps of Chicago with HW’s 1995 field survey results using their gentrification typology (left) and GGO neighborhood stage score results from 2007 to 2009 (right). Among the tracts in our analysis, which either showed visible signs of gentrification in 1995 or were neighboring gentrifiable tracts and thus had a high likelihood of experiencing the spread of gentrification from neighboring tracts, the correlation between HW’s gentrification categories and the GGO stage scores is positive and significant (.45).¹⁸

The boxplots in Figure 3 display GGO stage score distributions by the HW gentrification categories and illustrate how neighborhoods at similar baselines have fared over time, revealing both a general upward trajectory and significant variation among tracts with similar baselines. Neighborhoods that had already tipped, or were “core gentrified” by 1995, tend to have higher GGO stage scores relative to the other groups—nevertheless, there is still variation from the

middle- and late-stages of gentrification in the rightward direction of our typology of the neighborhood life cycle of gentrification (see Figure 1). Poor or fringe gentrified neighborhoods exhibit greater variation in their GGO stage score distributions and yield a wide range of scores, indicating that while many of these tracts remained disinvested or in early stages of gentrification (left portion of Figure 1), several gentrified rapidly in this period.

Bivariate correlations between prior racial-ethnic composition characteristics and neighborhood gentrification provide an initial picture of the racialized structure of neighborhood change. Table 3 compares the 1995 HW gentrification categories and our 2007 to 2009 stage scores. For the 99 tracts in our analysis, gentrification levels in 1995 have a significant positive correlation with percent white and a negative correlation with percent black in 1980. The correlations with percent Latino and Asian are weaker and not statistically significant but are similarly rank-ordered to prior findings on residential racial preferences (Charles 2003).¹⁹ The 2007 to 2009 GGO stage scores exhibit a similar pattern of racial ordering, except correlations for percent black and Hispanic are similar to each other and much stronger.

Although several studies suggest that recent immigration has reshaped neighborhoods in several positive ways, including through renewal and revitalization (e.g., Sampson 2012), we find no correlation with gentrification scores and percent foreign-born within our 99 tracts, most likely because these tracts do not contain either immigrant areas that may have gentrified after HW’s 1995 field surveys or Chicago’s large immigrant pockets on the southwest and northwest sides (e.g., only one tract is majority foreign-born). We also examined racial-ethnic heterogeneity to consider both cultural accounts of gentrifiers’ preferences for diversity and evidence that residential racial preferences for nearly all racial groups favor some level of integration (Brown-Saracino 2009; Charles 2003). We calculated heterogeneity using the commonly employed diversity index, defined as $D = 1 - \sum p_i^2$, where p_i denotes the proportion

Table 2. Descriptive Statistics for 99 Analysis Tracts and City of Chicago

Census Variables	1995 Census (interpolated)		2005 to 2009 ACS	
	Chicago	Analysis	Chicago	Analysis
Total population	3,285	3,398	3,266	3,468
Percent non-Hispanic white	31.9*	45.5	29.4*†	49.9
Percent non-Hispanic black	41.9	37.1	39.9*†	31.1
Percent Hispanic	20.7*	10.9	23.0*†	8.9
Percent Asian	3.8*	6.1	4.6*†	8.5
Percent foreign-born	16.0	13.4	16.9	15.5
Diversity index	.280*	.356	.313*	.421
Percent college graduates	20.0*	44.2	29.2*†	57.9
Median household income (\$)	50,225*	62,526	46,758*	58,878
Percent below poverty	23.5	24.6	22.8*†	19.2
Ownership rate	.409*	.263	.460*†	.397
Vacancy rate	.098*	.123	.142†	.137
Median housing value (\$)	174,574*	339,755	274,780*†	352,944
Median rent (\$)	721*	834	856*	982

Additional Variables	Chicago		Analysis	
	Mean	SD	Mean	SD
GGO stage score (2007 to 2009)			.666	.115
Prior gentrification (1995)			.687	.865
Logged murder rate (mean, 1995 to 1997)	2.388*	1.836	1.863	1.840
Observed disorder (2002)	-1.649	1.497	-1.906	1.170
Perceived disorder (1995)	2.276	.465	2.223	.461
Distance to hospitals and universities (miles)	.832*	.772	.384	.297
Chicago Loop (within 1 mile) (dummy)	.053*	.224	.202	.404
Chicago El station (dummy)	.117	.321	.162	.370
Lakefront (dummy)	.046*	.210	.202	.404
Park (dummy)	.545*	.498	.687	.466
Public housing (dummy)	.036*	.186	.111	.316
Neighborhood space and infrastructure investments (logged) (1995)	2.552	.762	2.622	.758
Other capital investments (logged) (1995)	3.865*	1.224	4.561	1.456
Residual change in neighborhood space/ infrastructure investments (1996 to 2002)	-.136	.625	-.135	.749
Residual change in other capital investments (1996 to 2002)	-.024*	.697	.146	.804

Note: All dollar values are in constant 2009 dollars. Non-analysis tracts in the rest of Chicago vary by dataset and range from 697 to 866.

*Chicago tracts statistically different from analysis tracts at the $p < .05$ level (two-tailed tests).

†Chicago change from 1995 to 2005–2009 statistically different from analysis tract change at the $p < .05$ level (two-tailed tests).

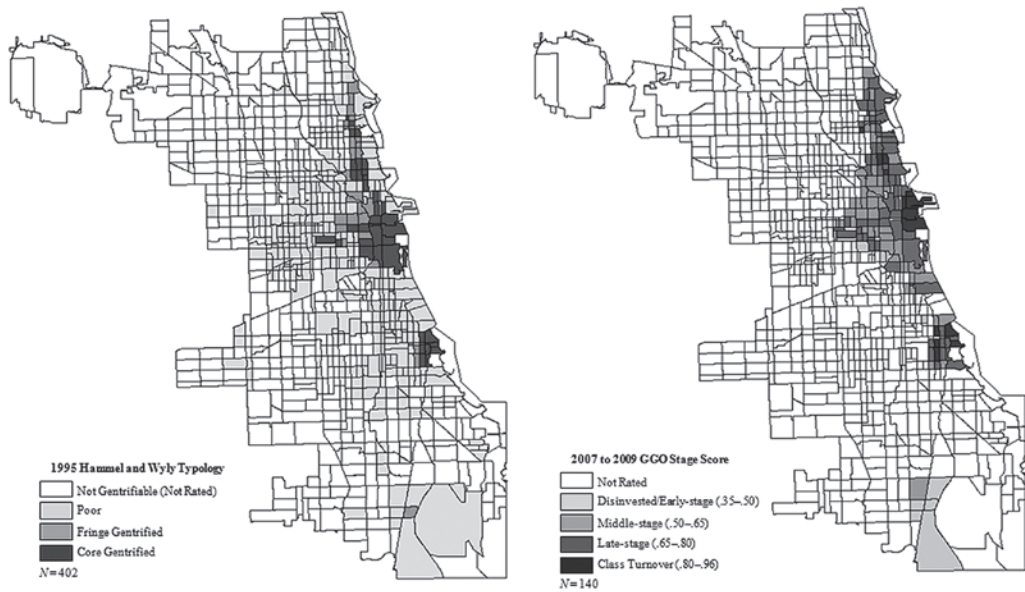


Figure 2. Gentrification in Chicago in 1995 and 2007 to 2009

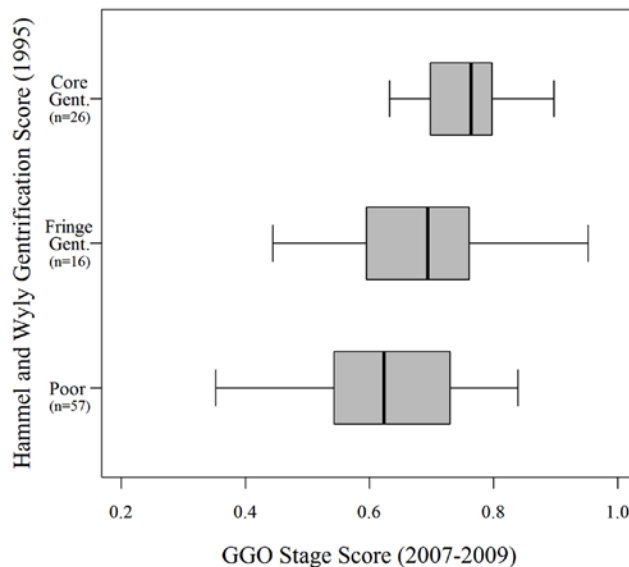


Figure 3. Boxplots of GGO Stage Scores (2007 to 2009) by Hammel and Wyly Gentrification Typology (1995); $N = 99$

of the race-ethnic group i in a census tract, with $i = \{\text{non-Hispanic black, Hispanic, Asian, non-Hispanic white, other race}\}$. Racial heterogeneity is indeed positively and significantly correlated with gentrification,

although weak for present-day GGO stage scores (see Table 3).²⁰

Prior research on neighborhood segregation and residential racial preferences and accounts of gentrifiers' preferences

Table 3. Correlations with Gentrification Scores by Prior Racial and Ethnic Composition and Heterogeneity Variables for 99 Analysis Tracts

	1995 HW Typology	2007 to 2009 GGO Stage Scores			
	1. 1980	2. 1980	3. 1990	4. 2000	
Racial/Ethnic Composition					
Percent non-Hispanic white	.305**	.556**	.567**	.544**	
Percent Asian	.037	.065	.130	.229*	
Percent Hispanic	-.154	-.321**	-.368**	-.358**	
Percent non-Hispanic black	-.199*	-.337**	-.339**	-.403**	
Racial/Ethnic Heterogeneity					
Percent foreign-born	-.076	-.062	-.073	.034	
Diversity index	.298**	.178†	.215*	.208*	

Note: N = 99.
†p < .10; *p < .05; **p < .01 (two-tailed tests).

for diversity also suggest that racial-ethnic composition may matter in nonlinear ways (Schelling 1971). Consistent with this expectation, exploratory analysis indicated a negative quadratic-like relationship between the GGO stage score and proportion black.²¹ In assessing competing hypotheses, we thus include a quadratic term for proportion black. Our full specification yields the following model, which we estimate with weighted least squares regression:²²

$$\begin{aligned} GGO_{2007-09} = & \beta_0 + \beta_1 G_{95} + \beta_2 B_{95} \\ & + \beta_3 B_{95}^2 + \beta_4 H_{95} \\ & + \sum_{k=5}^n \beta_k Z_k + \epsilon, \end{aligned} \tag{1}$$

where $GGO_{2007-09}$ is the continuous standardized gentrification stage score for each tract measured for 2007 to 2009; β_0 is the intercept; G_{95} is the 1995 HW gentrification category (poor, fringe, or core) with associated coefficient β_1 ; B_{95} and B_{95}^2 are each tract's 1995 proportion black and squared proportion black (centered) with associated coefficients β_2 and β_3 , respectively; H_{95} is a vector of tracts' proportion Hispanic with associated coefficient β_4 ; Z is a matrix of control variables with associated coefficients β_k ; and ϵ is the error term.

ASSESSING COMPETING EXPLANATIONS

Table 4 presents regression results for a series of theoretically relevant models predicting the standardized GGO stage score. Model 1 begins with a neighborhood's prior state of gentrification in 1995 to provide a baseline from which we can assess trajectories of neighborhood gentrification over time. The 1995 baseline category of gentrification for tracts accounts for approximately 20 percent of the variation in GGO stage scores, which differ, on average, by .53 standard deviations (mean = .67; s.d. = .12) between 1995 gentrification categories.

Model 2 introduces the major racial-ethnic composition variables for our analysis—proportion black, proportion black-squared, and proportion Hispanic. The relationship between prior gentrification and GGO stage scores declines substantially, and the model accounts for over 29 percent of additional variation in the GGO stage scores. All composition variables are negatively associated with GGO stage scores, controlling for baseline gentrification. Estimates indicate that a neighborhood with 10 percent more Hispanics than another has a lower gentrification stage score by .31 standard deviations at all levels of Hispanic composition, holding proportion black, proportion black-squared, and prior gentrification constant. The association

Table 4. Weighted Least Squares Regression Estimates for Predicting 2007 to 2009 Neighborhood Gentrification Stage Scores

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Baseline Gentrification	Racial Composition	Structural Factors	Perceived Disorder	Institutions/ Downtown	Amenities Proximity	Public Housing	City Budget
Prior gentrification (1995)	.526** (.103)	.155 (.100)	.144 (.099)	.141 (.097)	.133 (.098)	.171† (.099)	.133 (.097)	.167† (.100)
Proportion non-Hispanic black (1995)		-.910** (.307)	-.373 (.411)	-.316 (.405)	-.685† (.345)	-.637† (.340)	-.596† (.336)	-.539 (.349)
Proportion black-squared (1995)		-2.273* (.990)	-2.460* (1.026)	-2.433* (1.009)	-2.366* (.993)	-2.308* (1.041)	-2.505* (1.035)	-2.059* (1.001)
Proportion Hispanic (1995)		-3.088** (.479)	-2.731** (.537)	-2.473** (.543)	-2.866** (.599)	-2.558** (.528)	-2.605** (.527)	-2.229** (.546)
Proportion below poverty (1995)			-1.613* (.669)	-.870 (.754)				
Ownership rate (1995)			-.472 (.602)	-.286 (.599)				
Vacancy rate (1995)			1.974 (1.251)	2.295† (1.240)	1.961 (1.238)	1.633 (1.168)	1.324 (1.269)	2.387† (1.347)
Logged murder rate (mean, 1995 to 1997)			-.045 (.052)	-.051 (.051)				
Observed disorder (2002)			-.031 (.068)	.005 (.079)				
Perceived disorder (1995)				-.492* (.244)	-.657** (.211)	-.541* (.219)	-.649** (.212)	-.814** (.233)
Alternative Factors								
Institutions/downtown					.204 (.282)			
Distance to hospitals and universities (miles)					-.163 (.186)			
Chicago Loop (within 1 mile)								

(continued)

Table 4. (continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Baseline Gentrification	Racial Composition	Structural Factors	Perceived Disorder	Institutions/ Downtown	Amenities Proximity	Public Housing	City Budget
Amenities Proximity								
Chicago El station						-.145 (.197)		
Lakefront						.315 (.203)		
Park						-.167 (.161)		
Public housing								
Public housing (2000)							.176 (.327)	
City Budget								
Neighborhood space and infrastructure investments (logged) (1995)								-.181 (.140)
Other capital investments (logged) (1995)								.073 (.076)
Residual change in neighborhood space/ infrastructure investments (1996 to 2002)								-.368* (.178)
Residual change in other capital investments (1996 to 2002)								.141 (.147)
Adjusted R^2	.203	.491	.507	.524	.525	.528	.524	.548

Note: N = 99.
† $p < .10$; * $p < .05$; ** $p < .01$ (two-tailed tests).

of race with GGO stage scores, however, is considerably greater in neighborhoods with relatively more blacks. For example, a neighborhood that is 15 percent black has a stage score .14 standard deviations lower than one that is 5 percent black, but a 45 percent black neighborhood has a stage score .27 standard deviations lower than one that is 35 percent black—nearly double the effect.

Model 3 controls for structural features of neighborhood social differentiation that are commonly posited to shape neighborhood trajectories. Specifically, we include socioeconomic and housing characteristics using interpolated 1995 measures of poverty, ownership, and vacancy rates, as well as controls for logged average annual homicide rates from 1995 to 1997 and a measure of systematically observed neighborhood disorder in 2002. Poverty has a negative association with gentrification—the GGO stage score is estimated to be lower by .16 standard deviations in a neighborhood with a poverty rate 10 percentage points higher than another one. The linear estimate for proportion black is reduced, but the negative estimates for proportion black-squared and proportion Hispanic remain. Observed disorder appears to play no role in predicting gentrification trajectories. Overall, the addition of these control variables in Model 3 explains an additional 2 percent of the variation in GGO stage scores.

Model 4 adds a neighborhood-level measure of collectively perceived disorder to assess the hypothesized pathway by which racial, ethnic, and socioeconomic contexts shape neighborhood trajectories beyond actual crime and observed disorder. Consistent with prior findings by Sampson (2012:141–45), perceived disorder is racially ordered and linked to poverty among the 99 tracts, having the following correlations: $r_{\text{white}} = -.64$ ($p < .01$); $r_{\text{Asian}} = -.19$ ($p < .10$); $r_{\text{Hispanic}} = .15$ ($p > .10$); $r_{\text{black}} = .54$ ($p < .01$); and $r_{\text{poverty}} = .74$ ($p < .01$). Moreover, adding perceived disorder reduces the coefficient estimates for poverty and racial-ethnic composition, mediating their effects to a degree, but both the nonlinear black and linear Hispanic effects remain significant. Controlling for other local

conditions, a neighborhood with a share of Hispanics 10 percentage points higher than another is estimated to have a gentrification stage score .25 standard deviations lower at all levels of Hispanic composition, and a neighborhood that is 45 percent black, for example, has a stage score .23 standard deviations less than one that is 35 percent black. Vacancy becomes significant at the $p < .10$ level, suggesting that conditioned on other neighborhood characteristics, vacancies provide increased entry points into neighborhoods for gentrifiers. Finally, the coefficient for perceived disorder is statistically significant and substantively large—a one-unit increase in collectively perceived disorder (mean = 2.22, s.d. = .46) decreases the stage score by .49 standard deviations, independent of observed disorder, which is measured at a later point in time and remains insignificant.²³

Institutions, Amenities, and State Effects

Although the results presented thus far underscore the role of neighborhood racial-ethnic composition and perceived disorder in shaping contemporary trajectories of gentrification in Chicago, the question remains: What about external institutions, amenities, and state-driven policies that influence neighborhoods? We examine several new predictors to answer this question. Because of the modest sample size, we estimate a series of reduced models. We control for baseline gentrification for theoretical purposes, and we retain racial-ethnic composition, vacancy rate, and perceived disorder variables based on results from Models 1 through 4.

Models 5 and 6 examine proximity to Chicago's major institutions, downtown, and amenities. The coefficients for key variables further support our findings. However, proportion black has a stronger negative effect and is significant at the $p < .10$ level. Although the vacancy rate is no longer significant, the coefficient for perceived disorder is also slightly stronger.

We assess “state effects” in Models 7 and 8. Model 7 includes the dummy variable for

public housing. Again, results are nearly identical for our key variables, although proportion black-squared has a stronger negative effect. Model 8 introduces the new capital expenditures variables, with 1995 data and residual changes from 1996 to 2002.²⁴ The addition of capital expenditures and residual changes attenuates the effects of racial-ethnic composition and strengthens the effects of perceived disorder and vacancies. Residual change in neighborhood space and infrastructure spending also has a statistically significant negative effect on neighborhood trajectories, reducing the gentrification stage score by .37 standard deviations with a one-unit increase (mean = $-.14$, s.d. = $.75$). This counterintuitive result may reflect that disproportionate changes in capital investments by the city are spread in complex ways that require further exploration beyond the purpose of our study. Nonetheless, our key estimates of racial-ethnic composition—including the nonlinear pattern for percent black—and perceived disorder remain largely the same and substantively large. Despite various local amenities and the increasing hand of the state, racial-ethnic context and perceptions of disorder remain robust in shaping gentrification trajectories.

A LIMIT TO PREFERRED DIVERSITY?

Results to this point consistently reaffirm the strength of racial-ethnic contexts and collectively shaped perceptions in shaping divergent neighborhood trajectories of renewal. Summary results for racial composition are presented visually in Figure 4. The left panel displays the partial residual plot for tracts' share of blacks in 1995, predicting standardized GGO stage scores after removing the effects of prior gentrification, proportion Hispanic, socioeconomic and housing conditions, crime, observed disorder, and perceived disorder. The dashes at the bottom of the plot indicate each tract's 1995 proportion of blacks. The plot demonstrates the nonlinear pattern—the relationship between proportion black and

GGO stage scores becomes negative at a faster rate in neighborhoods that are around 40 percent black. Although the additional control variables mediate some of the relationship between proportion black and neighborhood trajectories, a negative influence of proportion black appears to be operating beyond a threshold. Residents, developers, and institutions may make neighborhood selection decisions using neighborhood stereotyping based simply on a neighborhood having a relatively high proportion of blacks, believing they have sufficient "evidence" to make judgments about the neighborhood. On the other hand, the curve in the left panel of Figure 4 is flat when a neighborhood has a lower proportion of blacks, which indicates that the proportion Hispanic, vacancies, and perceptions of disorder play a greater role in neighborhood trajectories. The partial residual plot for tracts' share of Hispanics predicting GGO stage scores (not shown) reveals a steep initial decline that becomes relatively flat as the number of tracts with relatively large shares of Hispanics decreases substantially.

To further assess our findings on racial composition, we included proportion white instead of proportion black to predict GGO stage scores. The partial residual plot for proportion white, which is displayed in Figure 4 (right), reveals a quadratic relationship between GGO stage scores and proportion white, after removing the effects of all control variables used in Model 4, and is nearly symmetric to the partial residual plot for proportion black. The steeply increasing curve flattens around .35, indicating that for tracts with relatively low proportions of whites, an increase in the share of whites has a strong positive effect on GGO stage scores after controlling for other variables, and tracts have their highest GGO stage scores beyond this threshold. Other control variables, including proportion Hispanic and perceived disorder, account for much of the variation in GGO stage scores in neighborhoods beyond this minimum share of whites.

Altogether, these results suggest that racial heterogeneity works in a particular way to

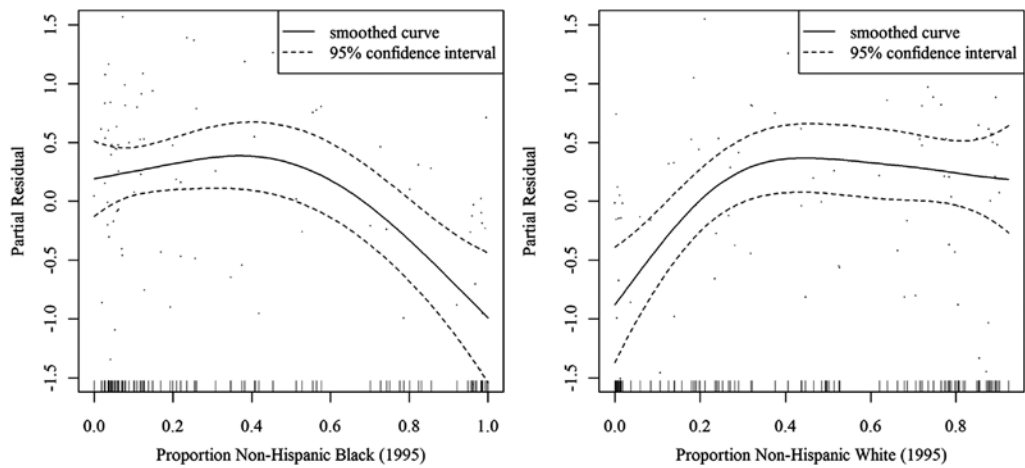


Figure 4. Partial Residual Plot for Proportion Black (left) and Proportion White (right) Predicting 2007 to 2009 Neighborhood Gentrification Stage Scores

shape neighborhood trajectories among gentrifying tracts and their initially low-income adjacent tracts. Upward neighborhood trajectories tend to follow a pattern of black and Hispanic neighborhood avoidance, such that gentrification trajectories are less pronounced in neighborhoods with a substantial proportion of black residents and as the proportion of Hispanics increases. In addition, gentrification trajectories favor neighborhoods with a minimum share of whites. These results suggest that preferences for diversity are contextual in nature and have limits.

IMPLICATIONS

The past two decades have been characterized by extensive gentrification, often depicted as an influx of white middle-class residents invading poor, minority neighborhoods. Yet, a hierarchy of neighborhood socioeconomic status remains surprisingly persistent in Chicago (Sampson 2012) and nationally (Owens 2012; Sharkey 2013). This article offers a plausible mechanism by which these seemingly contradictory accounts of the contemporary city coexist. Extending prior work on racial preferences and neighborhood selection, we find that the evolution of gentrification is governed by a hierarchy in which poor

black and Latino neighborhoods are least likely to continue to gentrify and are more likely to experience depressed trajectories among neighborhoods that showed signs of gentrification in 1995 or were adjacent to these neighborhoods and disinvested. We also find that collective perceptions of disorder deflect gentrification above and beyond systematically observed disorder. These results held when we controlled for poverty, vacancy rates, ownership, and crime; proximity to institutions, jobs, and amenities; and state-driven policy external to the neighborhood.

Consistent with our main thesis, black and Latino neighborhoods in Chicago were less likely to experience the potential spread of reinvestment or renewal from neighboring tracts or to continue on upward trajectories if they had shown signs of reinvestment in 1995. Counter to prior evidence that residential preferences favor Latinos over blacks as neighbors, the Hispanic estimate was more negative than the black effect in neighborhoods that were less than about 40 percent black. While these results suggest a need for updated studies on race-based residential preferences in light of the drastic rise in immigration and signs of nativism in the United States, the black compositional effect is stronger beyond a threshold of about 40

percent. Because blacks and Hispanics tend to be segregated from one another in Chicago, however, these results suggest it is minority neighborhoods overall—both black and Latino neighborhoods—that are driving the slowed pace of gentrification in different parts of the city.

On the flip side, gentrification tends to favor neighborhoods beyond a substantial share of white residents, around 35 percent. The threshold effects for black and white neighborhoods help resolve another seemingly contradictory account in the urban literature—they are consistent with prior research on the cultural aspects of gentrification, which depicts gentrifiers as tolerant and keen to living in minority neighborhoods, but they demonstrate an observed limit.

Rather than a process of race-based neighborhood selection, one might argue that the neighborhoods that showed signs of gentrification in HW's 1995 field surveys and had higher proportions of minorities reflect gentrification by minority gentrifiers. If so, our results indicate that these neighborhoods had lower or slower degrees of reinvestment and upgrading relative to neighborhoods with larger white populations, which may be due to factors such as racial inequalities in wealth or biases by external sources of reinvestment. From this perspective, the role of racial-ethnic composition is even more striking, as these neighborhoods' rates of change slowed or stagnated despite initial signs of upward trajectories.

Our data suggest that minority gentrification does not result in substantial neighborhood reinvestment overall, a finding consistent with recent research in Chicago (Anderson and Sternberg 2013) and Owens's (2012) national-level results, which show that only about 11 percent of metropolitan-area neighborhoods experiencing socioeconomic ascent from 1990 through 2009 were predominantly black. Our results also highlight the staying power of neighborhood stigma and collective negative appraisals, even for neighborhoods inclined to changing reputations. Although perceived disorder mediates the effect of poverty and, to a small degree,

racial-ethnic context, it maintains a direct link to lower gentrification trajectories. In a context where perceived disorder is not tightly bound to observed disorder, the power of shared expectations is enhanced.

Technology and Advances in Measurement

Our study offers an alternative conceptual and methodological approach for capturing gentrification, an area of research that has struggled with measurement. Following arguments that visible cues tap into cultural aspects of gentrification, as well as mechanisms of neighborhood perceptions and residential selection, we took advantage of recent technological developments that have made systematic field surveys a more feasible means for tracking neighborhood change over time. The GGO approach to gentrification is a natural extension of a wider effort to develop sound "ecometric" measures (Raudenbush and Sampson 1999) for ecological contexts using cost-effective online tools that have become widely available. Other investigators are also using Google technology as a new means for understanding neighborhood contexts (e.g., Odgers et al. 2012).

In particular, for measuring gentrification, GGO provides an alternative to census data, from which neighborhood changes are difficult to disentangle, or investment indicators like building permits or home loans, which impose limited definitions of gentrification. We note, too, that urban features widely associated with gentrification, such as density of green roofs and Starbucks locations, are significantly related to our measure of gentrification, even after controlling for poverty and racial composition. Furthermore, the GGO strategy captures a wide range of elements that incorporate the complexities of contemporary gentrification—public and private and small- and large-scale reinvestment, as well as neighborhood aesthetics. Finally, it permits direct assessment of the evolving and expanding nature of gentrification, incorporating the *degree* of gentrification—an important and

often overlooked aspect in assessing this phenomenon.

Limitations and Future Research

Nonetheless, the GGO approach is clearly limited. Although we made every effort to follow systematic rules for coding, and inter-rater reliability was comparatively high, there is an undeniable level of subjectivity in determining the nature and condition of visible street-level features. In addition, for theoretical reasons and for comparability with HW's prior gentrification measures, our approach undoubtedly favors physical forms of reinvestment and renewal as important cues of gentrification. While our approach provides a means for capturing visual forms of contemporary gentrification, further research is needed to examine how GGO interacts with changing class composition, community activities, and local discourse about gentrification.

Beyond the limitations of the GGO method, the data-intensive nature of these assessments limited our analysis to one city, and with a small sample and nonexperimental methods, we could not definitively assess causality. In particular, Chicago has a history and geography of racial strife and segregation that may intensify race-based residential preferences. Given the time frame of our observations, from 1995 to 2007 through 2009, our results also likely reflect the larger effect of economic downturns at the beginning and end of the 2000s on minority neighborhoods. For example, because Google Street View images were taken from 2007 to 2009, our data may reflect higher instances of disorder and decay and lower levels of reinvestment resulting from the disproportionate impact of the housing crisis in these neighborhoods. Future research should explore the role of racial-ethnic composition and neighborhood perceptions, as well as the role of immigrants in neighborhood revitalization, in other cities and time frames.

Spatial aspects beyond the local neighborhood are another area of research we were unable to explore in depth. Our results may reflect a re-concentration of poverty as residents of gentrified neighborhoods are displaced

to neighboring minority tracts, or a process of boundary maintenance between disadvantaged minorities and gentrifiers—a reactive process illustrated in Anderson's (1990) ethnographic account of gentrification. In addition, Crowder and South (2008) find that the changing racial composition of contiguous neighborhoods predicts neighborhood out-migration after controlling for local neighborhood conditions and correlates of mobility. An examination of how the composition of surrounding neighborhoods matters for in-migration would provide further insight. Finally, while we incorporated institutional and state effects arising from forces external to the neighborhood, we recognize that our indicators were not exhaustive. Future research should assess additional extra-local factors, such as zoning changes, political coalitions for development, and school reforms.

CONCLUSIONS

Our results shed new light on debates about gentrification, racial stratification and the changing U.S. city, and urban social policy. Laissez-faire or state-sanctioned policies that rely on gentrification to improve declining cities and neighborhoods may not reduce concentrated neighborhood poverty if reinvestment occurs far less, or to a lesser degree, in poor, minority neighborhoods. Such a pattern perpetuates, and perhaps worsens, urban inequality. Whiter neighborhoods that tend to gentrify and continue on upward trajectories offer the potential for original low-income residents to receive the benefits of gentrification, although negative consequences such as displacement may be part of the bargain. By contrast, nearby minority neighborhoods tend to remain disadvantaged and isolated, and areas that do show signs of gentrification experience weaker trajectories of reinvestment and renewal compared to their white counterparts. The reality of gentrification is problematic for low-income minorities, and contrary to many claims, not solely due to displacement—the aspirations of individual gentrifiers notwithstanding, the racialized social order of gentrification leads most poor minority neighborhoods to remain so.

Findings from this study are particularly sobering because a clear implication is that racial integration that satisfies particular thresholds is the norm, at least in Chicago, before meaningful reinvestment takes place. Interventions that promote racial integration yet protect against displacement and the loss of affordable housing may therefore be necessary to create the possibility for substantial reinvestment. More generally, if urban policy increases its reliance on market-based interventions, with gentrification a leading favorite of city leaders, our findings imply that urban racial inequality will persist, leaving the condition of disadvantaged minorities in place and suppressing opportunities for systemic improvements.

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Notes

1. Taub and colleagues (1984) was one of the first studies to address the shortcomings of administrative data for identifying gentrification; they used systemized observation instruments in eight Chicago neighborhoods to assess neighborhood levels of deterioration and upgrading.
2. HW's (1996) instrument identified improved structures by the presence of the following indicators for single-family homes: structural soundness; reconstruction of latticework, gutters, steps, porches, windows and frames, and fences; renovations to accessory structures; and a security system. For multiple-family buildings, they also assessed sandblasted brick, prominent entryway and signage, lobby and foyer appointments, and porch furniture.
3. Google images for Chicago vary between 2007 and 2009. Some block faces had more years to change

than others, limiting our method, but because we are comparing these observations to 1995, we still capture general trends of neighborhood change. We included dummy variables for image years in preliminary analyses, but they were unrelated to measurement properties of the gentrification stage score used in this study.

4. We coded 140 census tracts to align with HW and our theoretical interest in gentrification trajectories, but we are expanding this effort within Chicago and to other cities.
5. Like HW, we operationalize neighborhoods using census tracts. Comparability with independent data sources gives the analysis power to assess each census tract over time and with more degrees of freedom than would larger aggregate levels. In addition, ecological variables overlap much less at the tract level than at larger aggregations, helping to deal with multicollinearity.
6. We tested the inter-rater reliability of our gentrification instrument on street-level images in Chicago, which were updated to 2009 through 2012, using two raters. In 103 block faces from 78 tracts, the blinded raters had an average agreement rate of 83 percent and average kappa score of .50 across the 12 instrument indicators, and Pearson and intraclass correlations of .68 and .68, respectively, for the final stage scores. This level of agreement compares favorably with other studies of inter-rater reliability using Google Street View (e.g., Odgers et al. 2012).
7. For brevity, we refer to this descriptive condition—well-kept, attractive, and sizable—as “good” through the rest of the article.
8. In our study, gentrification is an outcome rather than a predictor variable assumed to be measured without error, hence we do not incorporate the full item-response methodology of Raudenbush and Sampson (1999).
9. Census indicators of poverty and racial composition were highly correlated across census years (e.g., from 1995 to 2005 through 2009). Perhaps not surprisingly then, GGO scores are weakly and insignificantly correlated with changes from 1995 to 2005 through 2009 in proportion black, proportion college-educated, and poverty rate (with correlations of $-.04$, $-.19$, and $.15$, respectively). Correlations with changes in housing value and rent were also less than .25.
10. Results do not change when we include proportion Asian; we thus exclude it for parsimony.
11. We also considered alternative measures of neighborhood conditions (median household income, median housing values, median rent, logged population, population density, percent over 65 years old, and percent under 18 years old). Results were similar; we exclude them for parsimony.
12. We use homicide incidents because they are more accurately reported and “visible” in media outlets. Burglary rates were not statistically significant and produced similar results.
13. The 1995 video-taped disorder observations were collected in fewer than 200 of Chicago's more than

- 860 tracts, and thus only a small proportion of the tracts in our GGO study.
14. A pooled measure of perceived disorder over the 1995 and 2002 survey waves weighted by sample size was correlated over .97 with the 1995 measure and produced similar results.
 15. A percentage-based measure for the area in a tract occupied by public housing yielded similar results.
 16. The 57 "poor" tracts in the analysis had substantially higher rates of poverty and percent black than the gentrified tracts in 1995.
 17. Compared to all of HW's 402 gentrifiable tracts, these 99 tracts had larger proportions of whites and college graduates; higher median incomes, housing values, and rents; lower poverty; and lower shares of blacks and Hispanics in both 1995 and 2005 through 2009. Both groups, however, experienced similar changes over time for these variables.
 18. We coded poor, fringe, and core gentrified tracts as 0, 1, and 2, respectively.
 19. Among the 402 gentrifiable tracts examined, bivariate correlations are similar to the 99 tracts used in our analysis, except percent Asian and percent Hispanic have statistically significant correlations of .12 and -.12, respectively, at the $p < .05$ level.
 20. We also used proportion foreign-born and the diversity index instead of the racial composition variables in our analysis; neither alternative variable was statistically significant when we controlled for baseline gentrification.
 21. Proportion Hispanic also revealed a quadratic-like relationship with the GGO stage score, but very few tracts had high proportions of Hispanics. Introducing a quadratic term for proportion Hispanic induced high levels of multicollinearity and is therefore excluded.
 22. Because the number of blocks used to create the GGO stage score varied by tract, we use weighted regressions to induce homoscedasticity of error variances. Following Raudenbush and Sampson (1999), each case is weighted by the square root of the number of assessed blocks to give more weight to tracts with more coded data. We also estimated separate unweighted models with robust standard errors using the "Sandwich" package in R, which yields heteroskedasticity-consistent standard errors, and results were similar.
 23. As a further check on key results, we estimated models using 1995 gentrification categories as dummy variables (with "poor" as the reference category) to account for the possibility that the HW field survey categories are nonlinear, and we constructed a variable of the average of the 1995 gentrification scores of adjacent tracts, weighted by the proportion of shared boundaries to examine the relevance of spatial proximity. Regression results are substantively similar to the models presented.
 24. Results were not affected when we employed a total budget variable and its residual change instead of

its component budget categories. We also tested for evidence of multicollinearity, and variance inflation factors were under four in all models.

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