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SORTING OR STEERING:
EXPERIMENTAL EVIDENCE ON THE ECONOMIC EFFECTS OF HOUSING DISCRIMINATION

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Sorting or Steering: Experimental Evidence on the Economic Effects of Housing Discrimination
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ABSTRACT

Housing discrimination is illegal. However, paired-tester audit experiments have revealed evidence of discrimination in the interactions between potential buyers and real estate agents, raising concern about whether certain groups are systematically excluded from the beneficial effects of healthy neighborhoods. Using data from HUD's most recent Housing Discrimination Study and micro-level data on key attributes of neighborhoods in 28 US cities, we find strong evidence of discrimination in the characteristics of neighborhoods towards which individuals are steered. Conditional upon the characteristics of the house suggested by the audit tester, minorities are significantly more likely to be steered towards neighborhoods with less economic opportunity and greater exposures to crime and pollution. We find that holding location preferences or income constant, discriminatory steering alone can explain a disproportionate number of minority households found in high poverty neighborhoods in the United States and could be an important contributor to the gap in intergenerational income mobility found between black-white households. The steering effect is also large enough to fully explain the differential found in proximity to Superfund sites among African American mothers. These results have important implications for the analysis of neighborhood effects and establish discrimination as a mechanism underlying observed correlations between race and pollution in the environmental justice literature.

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A HDS 2012 data and documentation are publicly available here
https://www.huduser.gov/portal/datasets/hsg_discrimination.html
A data and programs used in this paper will be made available here
https://github.com/peterchristensen/Sorting-or-Steering

1 Introduction

The choice of residential location is a critical economic decision for households in the United States. It affects the neighborhood with which one interacts on a daily basis, which can have important implications both in the short-run and long-run. Impacts can even accumulate across generations. Over the past decade, a growing body of evidence has found neighborhood poverty (Chyn, 2018, Chetty and Hendren, 2018a, Chetty et al., 2016, Kling et al., 2007), employment (Bayer et al., 2008), school quality (Chetty et al., 2011), violent crime (Kling et al., 2005), and health outcomes from pollution exposures (Currie et al., 2015) to be important, elevating concern about whether certain groups are systematically excluded from beneficial neighborhood effects (Chetty et al., 2018). A large body of observational research has also documented that patterns of residential sorting are strongly correlated with economic disparities and pollution exposures between racial groups in the United States (Alexander and Currie, 2017, Currie, 2011, Mohai et al., 2009). However, it has been challenging to disentangle the effect of discrimination from preference-based sorting in evaluating these persistent disparities.

This paper experimentally evaluates the effect of racial discrimination on neighborhood choice using experimental evidence from a nation-wide paired-actor study that was conducted by the Urban Institute in conjunction with the Department of Housing and Urban Development (Turner et al., 2013). The 2012 Housing Discrimination Study utilized a matched-pair block randomized design that simulates the housing search process for a matched pair of "testers" who are assigned attributes that make them equally qualified to purchase a particular house or rent a particular unit. Paired testers are matched to an advertised listing and randomly assigned to a real estate agent; different aspects of their search experience are then documented. According to evidence from 3 prior HUD audit studies beginning in 1997 and findings from the 2012 audit reported by Turner et al. (2013), incidence of the most blatant forms of housing discrimination has declined dramatically in the period following the Fair Housing Act (FHA) of 1968, but it is less clear that the same is true of more subtle forms of discrimination.[1]

With respect to location choice, prior studies of discrimination have described the process of steering buyers into same-race neighborhoods and exacerbating historical racial segregation in the housing market (Galster and Godfrey, 2005, Ondrich et al., 2003). The steering of buyers into same-race neighborhoods persisted in the 2012 experiment that we analyze (Turner et al., 2013). However, from the perspective of a minority buyer's preferences and welfare, the implications of locating in a same-race neighborhood are ambiguous. The question of whether discriminatory steering constrains the access of mi-

[1]Housing discrimination is illegal according to the Fair Housing Act of 1968, which was amended in 1988. Blatant forms of discrimination include denial of appointments with a housing provider or refusal to show an advertised house. Less blatant forms include disparities in the number of houses shown or in the condition of the houses that are recommended.

nority buyers to neighborhood amenities such as high quality schools, safe spaces, and clean air remains untested, limiting evaluation of the impacts of discrimination that may operate through neighborhood effects channels.[2] Understanding the origins of disparities in neighborhood exposures requires disentangling the effect of discrimination from preferences and income constraints that also underlie the sorting patterns of minority households (Logan, 2011). By experimentally isolating differences in the characteristics of neighborhoods that are shown to white versus minority buyers during a housing search, this paper provides direct evidence that discrimination could be a root cause of adverse neighborhood effects in minority populations. To our knowledge, this paper also provides the first experimental test of the "racial discrimination thesis" of environmental injustice, which posits that housing discrimination could contribute to the race-gap in pollution exposures in the US (Crowder and Downey, 2010).

Our results indicate that even holding income and preferences constant, systematic differences in the homes shown to minority versus white testers impart a number of critical disadvantages. Minority testers are (relative to their white counterparts) recommended homes in neighborhoods with higher poverty rates, fewer college educated families, and fewer skilled workers. Important for the analysis of environmental injustice, they are also steered towards neighborhoods with higher concentrations of Superfund sites and releases from the Toxic Release Inventory (TRI). Disparities are present for African American, Hispanic/LatinX, and Asian households and are consistent across specifications, though they are stronger in the case of African American testers and become more pronounced when tester pairs signal preferences for the neighborhood characteristic in question. In addition, African American testers are more likely to be recommended houses in neighborhoods with higher assault rates. While only statistically significant for African Americans with children, all minority groups are also more likely to be recommended houses in neighborhoods with lower quality schools. Consistent with prior evidence on segregation-based steering, we find that minority testers are less likely to be recommended houses in white neighborhoods. However, our evidence suggests that segregation-based steering (i.e., directed by persistent differences in neighborhood racial composition) cannot explain the disparities in pollution exposures resulting from discrimination.

We find that the differences in steering are magnified for minority families and particularly for mothers, which is important for understanding and interpreting long-run outcomes affecting minority children. We interpret our results on families in light of recent evidence that suggests that access to low poverty neighborhoods may be important for narrowing the black-white gap in intergenerational income mobility (Chetty and

[2]Much of the literature on housing market discrimination precedes the recent empirical work on neighborhood effects and long-run damages of pollution exposures. Turner et al. (2013) provide a test of steering into higher poverty census tracts that is discussed in Appendix D.

Hendren, 2018a).[3] When interpreted together with the results on the long-run effects, we estimate a $2,488 per year permanent income reduction for an African American adult who was raised in a neighborhood chosen as a result of discriminatory steering. In recent work, Chetty et al. (2018) find that black-white gaps in income mobility are smaller in neighborhoods with lower poverty rates and intact families, suggesting that discriminatory steering may be relevant for understanding persistent black-white gaps *within* neighborhoods. The effect on African American mothers is large enough to fully account for higher rates of sorting among African American mothers into homes near Superfund sites, as has been found in previous research on in utero pollution exposures (Currie, 2011).

A final analysis examines the interaction between discrimination and buyer preferences. We make use of a unique feature of the 2012 HDS design where the preferences of buyers are conveyed via the characteristics of a listing that is presented in a first meeting with a real estate agent. Similar to a design first introduced by Ondrich et al. (2003) to examine discriminatory behavior in real estate marketing efforts, we examine heterogeneity in steering behavior as a function of the implied preferences for key attributes of neighborhoods. We find that real estate agents tend to discount the neighborhood preferences of African American clients relative to white buyers, which may be important for explaining the adverse constraints that minority buyers face in a housing search. We also find that steering effects are often stronger for African American buyers who express interest in higher priced homes and in white neighborhoods. This suggests that housing discrimination could be a relevant factor for understanding constraints to upward mobility that specifically affect African American households (Chetty et al., 2018).

This paper proceeds as follows. Section 2 discusses empirical findings on neighborhood effects and linkages to housing discrimination. Section 3 provides a background on housing discrimination audit designs and the 2012 Housing Discrimination Study (HDS), which is the source of experimental data in this study. Section 4 describes our empirical design, data, and sample balance. Section 5 reports results that characterize the effects of discriminatory constraints on access to advantaged neighborhoods and discusses specific implications for children. Section 6 concludes.

2 Housing Discrimination and Neighborhood Effects

If housing market discrimination constrains a household's choice set during a search, then discriminatory behavior will impact the likelihood that minority households locate

[3] Graham (2018) illustrates why understanding sorting behavior is important for identifying/interpreting outcomes associated with neighborhood exposures and re-location programs. The findings reported in the present study indicate that discriminatory constraints likely also affect the empirical identification of neighborhood effects.

in disadvantaged neighborhoods. A large body of evidence suggests that such constraints could impact labor market outcomes, educational attainment, criminal activity, physical safety and environmental health.

2.1 Poverty, School Quality, Skill, and Violence

Much of the experimental evidence on neighborhood effects has come from programs that provide re-location assistance to residents in disadvantaged neighborhoods. The "Moving to Opportunity" (MTO) program is the largest such program in the United States, providing housing vouchers to public housing residents that can be used to secure a residence in a neighborhood with a lower than 10% poverty rate.[4] The MTO experiment has demonstrated that the poverty level of a neighborhood is a key determinant of long-run outcomes such as mental and physical health (Ludwig et al., 2013, Kling et al., 2007), earnings (Chetty et al., 2016), economic self-sufficiency (Clampet-Lundquist and Massey, 2008), and participation in violent crime (Kling et al., 2005).[5] Housing assistance programs that do not significantly improve the neighborhood characteristics of participants do not result in positive effects on outcomes, suggesting that the neighborhood effects themselves may matter more than the subsidy and related assistance provided by these programs (van Dijk, 2018, Jacob et al., 2014).

The effects of high poverty neighborhoods revealed by the MTO experiments likely capture a set of mechanisms that have been independently shown to have effects on human capital formation, including crime/public safety (Sharkey, 2010, Sampson et al., 1997), school quality (Chetty et al., 2011), and neighborhood peer effects that can impact college attendance and job referrals (Carrell et al., 2009, Bayer et al., 2008). The available evidence indicates that discrimination may be particularly important for households who face constraints before pregnancies or while raising young children. Research that follows children in moves across the US indicates that child exposure to high levels of poverty and low levels of adult skill/college attendance is highly correlated with intergenerational income mobility (Chetty and Hendren, 2018a,b).

2.2 Pollution: Chemical Toxics, Superfund Releases and PM2.5

A separate but related literature demonstrates that exposure to local pollutants can significantly impact health outcomes (Almond et al., 2018, Almond and Currie, 2011). This evidence indicates that exposures at critical developmental stages (pre- and post-

[4] A second treatment group in these studies was randomized to receive a Section 8 voucher with no constraints on use and a third treatment group simply retained access to public housing.

[5] Several studies also find null effects of MTO treatment. For instance, Sanbonmatsu et al. (2006) look four to seven years after the MTO treatment and find little to no evidence of impacts on test scores for children treated by MTO. Kling et al. (2007) similarly find little evidence of impacts on physical health or economic outcomes of adults.

natal) are especially important, again highlighting the importance of residential location choices of (prospective) families. Households living in close proximity to toxic plants are shown to have a lower incidence of gestation and lower birth weights (Currie et al., 2015, 2009).[6] In a cohort study in Florida, Persico et al. (2016) find that children conceived to mothers living in close proximity (within 2 miles) of an untreated Superfund site are more likely to repeat a grade (+7.4 pp), to be suspended from school (6.6 pp), and have lower test scores (-0.06 std dev) than siblings who were conceived after clean-up. Children conceived to mothers living in even closer proximity (within 1 mile) are 10 percentage points more likely to be diagnosed with a cognitive disability. Exposures to small particulate matter have also been shown to have important effects on infant mortality and test scores (Sanders, 2012, Chay and Greenstone, 2003).[7]

2.3 Race-Gaps in Neighborhood Effects: Sorting or Steering?

Several papers have also posited that differences in household location decisions can contribute to persistent forms of racial inequality in the United States (Currie, 2011). Using the universe of health records of children born in New Jersey between 2006 and 2010, Alexander and Currie (2017) find that the two-fold differential in asthma rates between African American and other racial groups disappears when the sample is split to examine differences within versus outside majority African American zip codes. Chetty et al. (2018) find that the income mobility gap between black and white children who grow up in the same neighborhood are the smallest for those who grow up in low-poverty neighborhoods.

Graham (2018) shows that identification of neighborhood effects, particularly when evaluated in the context of racial inequality, must address potential biases arising from sorting and matching behavior. Housing discrimination itself could have non-negligible effects on household sorting behavior, highlighting the need for research designs that can isolate tests of discriminatory constraints from observed sorting behavior. Models of preference-based sorting that examine differences in the location choices of households

[6] Currie et al. (2015) find that pollution levels from nearby toxic plants have important effects on infant health, which correspond to a 3% increase in the incidence of low birth weight within 1 mile of a plant. In prior research at the county level, Currie and Schmieder (2009) demonstrate that fugitive emissions of toxic pollutants such as cadmium and toluene have important impacts on infant birth weight. In a study of twins, Black et al. (2007) find that a 7.5 percent increase in birth weight results in a 1.8 percent increase in earnings among men and a 1 percentage point increase in high school completion among women.

[7] Chay and Greenstone (2003) show that a 1% reduction in exposures to Total Suspended Particulates during the recession of 1980-1981 resulted in a 0.35% effect in infant mortality while Sanders (2012) finds that a one standard deviation decrease in particulate matter exposure results in a reduction in high school test scores equal to 2% of a standard deviation. Instrumenting for changes in pollution using county-level changes in manufacturing employment, that number rises to 6%. Local exposure to PM2.5 has also been shown to have large effects on the contemporaneous productivity in outdoor workers (Chang et al., 2016).

have often overlooked housing market discrimination because it cannot be easily identified from observational data in housing markets (Bayer et al., 2007, Calabrese et al., 2006, Holmes and Sieg, 2015). It is commonly assumed that the disparities in neighborhood effects discussed above are the result of location choices of households. For instance, Currie (2011) provides evidence that mothers who are most likely to live within the vicinity of a Superfund site after cleanup are more likely to be white and college educated. Similarly, white mothers are less likely to reside within the vicinity of a plant that emits toxic pollutants after emissions are disclosed. While these estimates suggest differential patterns of sorting in response to changes in the level or information about pollution exposures, it is not clear whether all households in these samples had access to the same choices during their search.

3 Measuring Discrimination with an HDS Audit

The United States Department of Housing and Urban Development has conducted four major, multi-city audit studies that are designed to measure the incidence of discrimination against African American, Hispanic, and Asian and Native American minority testers (relative to a white control) in the context of a rental housing or real estate search. The first such study was conducted in 1977, with successive iterations occurring in 1989, 2000, and 2012. Audit studies have similarly been used to study bargaining at car dealerships (Ayres and Siegelman, 1995), gender discrimination in hiring at restaurants (Neumark et al., 1996), and the combined effects of race and criminal record on hiring (Pager, 2003). Bertrand and Duflo (2017) summarize the growing literature that uses field experiment techniques for detecting discrimination, focusing on the difference between audit and correspondence studies. Audit studies typically employ a matched-pair randomized design, where a pair of actors or "testers", differing only in the characteristic of interest (e.g., race), is sent into the field to carry out an economic activity. In a correspondence study, fictitious applicants correspond only by mail or internet.

Audit studies are designed to fully simulate engagements between individuals in a market, often involving a series of in-person interactions and involving a full representation of racial identity. As a result, they provide a more complete characterization of discriminatory behavior as it operates in many markets. However, this also makes them much more expensive to implement at powered scales (and therefore less common). Siegelman and Heckman (1993) and Heckman (1998) describe other limitations of audit studies – for instance, it is unlikely that testers will be identical in all respects except for the attribute of interest. Testers are cognizant of their roles and may act in such a way as to try to sway the results towards or against finding evidence of discrimination. The investigator retains more control in a correspondence study, as testers do not actually exist and their attributes can therefore be more easily controlled.

Since the HDS research design focuses on discrimination that occurs at the point of initial contact with the real estate agent – i.e., the point at which recommendations are given and the choice set is narrowed – the results of HDS analyses describe one particular form of housing market discrimination that could be compounded by other forms of discrimination – e.g., at the financing[8] or purchasing stage (Aaronson et al., 2017, Zhao et al., 2006, Ondrich et al., 2003, 1998, Yinger, 1995). Prior literature has included arguments in favor of and against the reliable extension of inferences from partial audit studies to estimate the full extent of compounded impacts, though it is generally agreed that the direct results of the HDS provide a lower bound.[9]

Within the economics literature, HDS audits have primarily been utilized to study the persistence of discriminatory behavior and examine underlying behavioral mechanisms such as animus-based versus statistical discrimination (Guryan and Charles, 2013, Dymski, 2006, Zhao et al., 2006, Ondrich et al., 2003, 1998). The consistency of the HUD design (especially 1989, 2000, 2012) allows for comparisons of discriminatory behavior over time, with results generally indicating a decline in exclusionary practices over the past five decades (Turner et al., 2013, 2002, Page, 1995, Yinger, 1986).[10] An initial evaluation of discriminatory behavior using the HDS 2012 data documents a reduction in the number of tests that disadvantage African Americans on some measure from 0.04 in the 2000 audit to 0 in 2012. The fraction for Hispanic testers fell from 0.05 to 0.02 Turner et al. (2013). Differences in the number of units inspected by African American testers also fell in the 2012 audit relative to 2000. All differences were substantially smaller than those documented in 1989, providing evidence of a downward trend in certain discriminatory types of practices. According to the comparative work done across HDS studies, the single persistent form of discrimination in the housing market is "discriminatory steering" of minority testers into minority neighborhoods (Dymski, 2006, Galster and Godfrey, 2005, Yinger, 1995). Turner et al. (2013) find that minority buyers did not have a more difficult time securing an appointment with a real estate agent

[8]There is a large body of evidence that documents the presence of discrimination in mortgage and other lending markets (Dymski, 2006). It is possible (indeed likely, based on prior evidence) that discrimination also occurs in the mortgage lending industry. Official government guidance for mortgage lenders in the 1930's suggested that neighborhoods with a high percentage of people of color constituted risky loans, drawing a red line around those areas and steering funds away (Aaronson et al., 2017). If minority home buyers were steered towards those neighborhoods, red-lining would make home-ownership more difficult, or at least more expensive.

[9]Yinger (1997) builds on the analysis of Courant (1978) to develop a full model of housing search, where discrimination affects the surplus that homebuyers receive through five separate mechanisms: (1) the number of houses shown, (2) the amount of assistance and encouragement received, (3) assistance in the loan application process, (4) loan approval, and (5) physical moving costs. Calibrating the model, he finds that these mechanisms collectively result in a $4,000 lower expected surplus for black homebuyers from the housing search process.

[10]Using data from a paired-tester audit study in Boston in 1981 that considered white and black renters, Yinger (1986) finds that black renters are informed about 30% fewer rental units than their white counterparts, who are also invited to inspect 57% more apartments. Page (1995) finds that black and Hispanic testers are shown 80% to 90%, respectively, of the number of units shown to white testers.

in 2012, but documented evidence of steering for African American and Asian testers. Both groups received recommendations that were, on average, in census tracts with a lower share of white households. These studies provide important motivation for research on the relationship between steering behavior and the specific channels through which neighborhood choice can affect long-run outcomes. Using data from the same 2012 experiment, the present study begins with a re-analysis of the evidence on neighborhood racial composition and then examines an expanded set of hypotheses that directly link discrimination to neighborhood effects channels.

Implementation of the 2012 Housing Discrimination Study (HDS)

The 2012 Housing Discrimination Study was conducted in 28 metropolitan areas, with sampling designed to represent the racial/ethnic composition of the national housing market based on the geographic distribution of each minority group as documented in the 2010 US population census. The 2012 HDS utilized a matched-pair block randomized design, where recruitment and assignment were conducted in each of the 28 metropolitan area field offices. Testers were blind-matched to a partner based on their age and gender. They were both then provided with a profile of characteristics to use throughout the study: income, assets, debt levels, family circumstances, job characteristics, education levels, and housing preferences. The design involved randomly sampling the distribution of rental and real estate advertisements available for the market at the time of the study. After each draw of a listing and corresponding local real estate office or rental housing provider, a pair of testers was randomly assigned and underwent a housing search process.[11] Income, asset and debt levels were assigned to make testers unambiguously well-qualified for the advertised listing.[12] Housing preferences and family/job characteristics were assigned to match the characteristics of the advertisement.

The matched-pair block randomized design employed by HDS 2012 contains a number of advantages and also some limitations for studying the relationship between discriminatory steering versus steering into disadvantaged neighborhoods. The audit does not measure the observed incomes and preferences of buyers who are making choices in a market, but rather controls these parameters in a housing search process using scripted profiles and preferences.[13] The matched design also eliminates noise in the behavior of agents that might arise as a result of heterogeneity in the advertisements, providers, and

[11] Testers met independently with a local test coordinator to review test protocols and receive an assigned listing/office.

[12] 2012 HDS documentation states that the assignment of qualifications errs on the side of making minority testers slightly better qualified than their white counterparts for an advertised listing.

[13] Buyers are instructed to express zero geographic preference aside from that which might be inferred from their interest in the advertised listing.

characteristics that are assigned to testers of different races. Given the matched-pair block randomized design, within-trial differences in the selection of homes recommended to testers of different races reduce to:

$$\Gamma_i^* | (trial_f, z_i^{race}) \rightarrow \tilde{\Gamma}_i \tag{1}$$

where Γ_i^* denotes the set of available homes that match the income and preferences of tester i and $\tilde{\Gamma}_i$ denotes the set of homes recommended to a tester i. In this study, the null hypothesis of a test of differences in the recommended sets ($\tilde{\Gamma}$) will take the general form:

$$H_0 : \tilde{\Gamma}_i - \tilde{\Gamma}_j | trial_f = 0 \tag{2}$$

In the HDS design, testers are instructed to limit all discussion about housing preferences or neighborhood preferences to what is conveyed by the advertised listing that they have been assigned. The advertised listing therefore provides a key indicator of the tester's optimal choice, and from the real estate agent's perspective, is the best indicator of the tester's preferences for a given neighborhood characteristic. All preferences are set equal for tester pairs ($i = minority$, $j = white$) within a given trial f. However, it is not necessarily the case that real estate agents will interpret information about preferences equally for all groups. Ondrich et al. (2003) find that real estate agents tend to make recommendations that are at odds with housing preferences of minority buyers. In the present study, the characteristics of the advertised house and surrounding neighborhood provide us with control over the information about the tester's preferences and allow us to test for differential treatment to equivalent neighborhood preferences. This is important, because the effects of choice set constraints on buyers ultimately depend on preferences. More generally, this information allows us to test whether buyers with certain types of housing preferences are more likely to face discriminatory constraints.

4 Empirical Design

Our baseline specification tests for differences in the neighborhood attributes of homes recommended to minority testers relative to their paired white counterparts:

$$A_{i,k,f} = \psi_1 Race_i + \psi_2 Trial_f + \tilde{A}'_{i,k,f}\psi_3 + \ \mathrm{W}'_{i,k,f}\psi_4 + \nu_{i,k,f} \tag{3}$$

where $A_{i,k,f}$ is the attribute of interest of house k shown to tester i in trial f. *Race* is an indicator of the self-identified race of tester i. *Trial* is a vector of fixed effects that controls for differences across trials, absorbing differences across tester pairs, housing providers, and markets. $\tilde{A}_{i,k,f}$ controls for the corresponding attribute of the advertised home (and possibly other attributes of that home) that tester i brings to the appointment and is the

primary piece of information that a real estate agent can use to infer the preferences of that tester. $W_{i,k,f}$ is a vector of controls containing characteristics of the actor who is serving as a tester,[14] characteristics that are assigned to the tester,[15] and characteristics of the search.[16] $W_{i,k,f}$ also includes a control for the housing market (defined as an MSA in the HDS) where a trial/search takes place.

4.1 Data from the HDS Audit

The HUD buyer audit results in data on the locations and attributes of advertised listings (assigned to buyers) and a set of listings that are recommended to a buyer. Figure 2 illustrates the search process for trials in Chicago and in Los Angeles, each involving a white and a paired Asian tester. In both of these cases, the housing search process yielded two independent sets of listings that were recommended to the testers. In each map, the black point references the location of the advertised listing that was requested by each tester. Red points indicate houses recommended to the white tester, and blue points indicate houses recommended to the Asian tester. Green points indicate houses that were recommended to both testers. The maps illustrate that recommended properties for both testers tend to fall in a relatively tight geographic zone, suggesting that the common advertised house orients the recommendation set. We find that 33% of the recommendation sets in the 2012 HDS audit fall within a single census tract, suggesting that high-resolution neighborhood data may be important for detecting differences in heterogeneous neighborhoods. Second, while all of the recommended properties fall within relatively close proximity to one another, they do exhibit some spatial clustering by race. Third, we note that there may be overlap in recommended houses. In Los Angeles, 5 out of 23 total recommendations are shared between the two testers. However, this varies substantially across trials. The white and Asian tester share just one common recommendation out of 15 total recommended houses in Chicago.

The full sample of properties from the buyer study contains 6,962 advertised listings and 21,496 recommendations. Basic characteristics and price information are taken from the HUD study data files. The HUD data files also contain extensive data on the true and assigned characteristics of testers, the timing and sequence of appointments, characteristics of the agents and representatives, and the quality of interactions between testers and agents during the study. Table 1 reports descriptive statistics on the general characteris-

[14] Actor Characteristics: tester income, tester household income, gender of tester, age of tester, month of test, total number of homes recommended to tester, educational attainment of tester, and current lease assigned to tester.

[15] Assigned Characteristics: household members, current home ownership status, current lease type, car ownership status, reason for moving, years in current residence, length of employment at current job, and reason tester can afford down payment.

[16] Search Characteristics: month of test, sequence of tester appointments, time of the appointment (am/pm), type of recommended building, total number of homes recommended to tester, and availability of advertised home as stated by agent.

tics of testers recruited into in the sample. The average age of testers in the study is 41 and about two-thirds of them are female. Home-owners and renters are well-represented among those working as testers, though the majority are renters at the time of their participation in the study. The median tester in the sample has a bachelor's degree and more than half of the sample earns less than $30,000 per year in personal income.

Table 2 reports characteristics of the advertised listings that are assigned to testers as part of the study. These advertised listings are presented to real estate agents to initiate a search in the first stage of a trial. They are not representative of the set of all homes. More than 70% of the listings assigned to testers are single-family homes. The remaining listings are primarily for town-homes (13%) and some multi-family buildings (10.4%). The average list price of advertised homes in the sample is just over $300,000. The racial composition of the census block group of an advertised listing has, on average, 67% White, 9% African American, 7% Asian, and 15% Hispanic (and 2% other). On average, advertised listings are in neighborhoods where 9% of the households have incomes at or below the poverty line, 50% have at least one member with a college degree, and 47% have a member that is in a high skilled job.

4.2 Data on Neighborhood Characteristics

We geocode the addresses of advertised and recommended homes reported in the 2012 HDS and merge them with contemporaneous data at the census block group level from the American Community Survey (ACS). The 2008-2012 5-year moving average ACS provides data on: (1) the share of households at or below the poverty line, (2) the share of households with at least one member with a college degree, and (3) the share of households with at least one member who is employed in a high skilled occupation (defined as management, business, science, and arts occupations). We also obtain ACS data on the share of white, African American, Asian, and Hispanic households at the census block group level.

Advertised and recommended homes are also merged with information about local pollution exposures/sources from monitoring programs conducted by the US Environmental Protection Agency (EPA). For each home in the sample, we create measures of: (1) the number of Superfund sites within a 5 km radius using the exact location and extent of sites throughout the United States,[17] (2) the risk of exposure (in 2012) to industrial chemical releases from facilities monitored by the EPA's Toxics Release Inventory,[18] and

[17]The exact location and extent of Superfund sites is identified using data processed by the Socioeconomic Data and Applications Center at Columbia University: http://sedac.ciesin.columbia.edu/data/collection/superfund/sets/browse

[18]https://www.epa.gov/sites/production/files/2018-01/documents/rsei_methodology_v2.3.6.pdf

(3) particulate matter (PM2.5) concentrations taken from satellite data.[19]

Finally, we merge information about crime (count of violent assaults)[20] and school quality ("GreatSchools" ratings)[21] that are scraped from the platform of a major online real estate service. We scraped data for each property using the addresses of houses listed in the HUD study and both measures relate to the property-level characteristic of the home. The GreatSchool rating measures the quality of the school that a home is districted for or, in cases of no location-based assignment, takes the average of nearby schools. Data collection for these variables was conducted in December 2017 and measures relate to the time of collection. Neighborhood and district-level data for 2012 were not available for HDS markets. Differences in these outcomes therefore reflect school ratings and neighborhood assault counts 5 years after a housing search was conducted.

4.3 Balance Tests

Tables 3 and 4 report the results of balance tests for within-tester pairs, including (1) true characteristics of testers (i.e., actor characteristics), (2) characteristics assigned to testers, and (3) characteristics of advertised homes. Tests for balance suggest that paired actors are not perfectly equivalent in all real-life dimensions, but do not reveal strongly significant differences in characteristics. African American actors have a lower likelihood of being homeowners than their white tester counterpart (15% lower, significant at $p<10\%$). The number of African American testers with personal incomes in the \$20,000-29,999 range is lower than their white counterparts (21% lower, significant at $p<5\%$), but is higher in both the \$10,000-19,999 and the \$30,000-39,999 ranges. Similar differences in bin matching are also present for other groups. Hispanic actors tend to have a lower probability of having a bachelor's degree (25% lower, significant at $p<10\%$), but a higher probability of having an associate's or a graduate/professional degree (non-significant). Asian actors are more likely than their counterparts to have a high school diploma (12% higher, significant at $p<10\%$).

The HUD design intentionally constructs assignment profiles that err on the side of providing minority testers with slightly higher qualifications. For example, minority testers in all groups have been employed for 1-2 years longer and have lived for 1-2 years longer at their current address than their white counterparts. All actor and assigned

[19] PM2.5 can be an important factor in mortality from cardiovascular and respiratory diseases. Satellite data are taken from Van Donkelaar et al. (2016), who use Aerosol Optical Depth (AOD) retrievals from the NASA MODIS, MISR, and SeaWiFS to recover ground-level PM2.5 concentration. Data have a grid cell resolution of 0.01 degree.

[20] Assault counts are drawn from multiple sources, including CrimeReports.com, EveryBlock.com and SpotCrime.com.

[21] GreatSchools is a private ratings service that combines information on test scores, student progress, and "other factors that make a big difference in how children experience school" to generate a score on a 1-10 scale. Details on the GreatSchools rating system can be found at https://www.greatschools.org/gk/ratings. District boundaries are provided by Boundaries by Maponics.

characteristics are included as controls in the tests for discrimination. Balance tests reveal that advertisements for single-family homes are assigned at slightly higher rates and multi-family advertisements at slightly lower rates to Asian testers. There is no evidence of differences in the pollution levels, block group characteristics, or listing prices of homes assigned within tester pairs.

5 Results

This section reports the results of a series of tests of hypotheses that arise from the model discussed above. Specifically, we test for effects of the tester's race on choice set size and composition while also exploring the role of the information provided by the tester in the form of the advertised house.

5.1 Are Minority Buyers Given Fewer Choices in a Search?

A first-order question regarding the effect of housing discrimination concerns the effect of real estate agent behavior on the number of recommendations provided to the minority tester relative to a white counterpart. A simple model of housing search presented in Appendix A illustrates that the expected utility of a buyer's choice set will be unambiguously lower when fewer homes are offered as available choices. In their evaluation of the HDS 2012 experimental data, Turner et al. (2013) do not find evidence of significant differences in the *number of trials* where African American or Hispanic/LatinX are told that a homes is available, relative to a white tester. To ensure consistency with the primary results reported in the sections that follow, we test alternative specifications of the same hypothesis:

$$H_0 : \left[\#(\Gamma_j^*) - \#(\tilde{\Gamma_j})\right] - \left[\#(\Gamma_i^*) - \#(\tilde{\Gamma_i})\right] = 0$$

where $i = minority$, $j = white$. Noting that $\#(\Gamma_i^*) = \#(\Gamma_j^*)$ under the assumptions of the audit experiment, this hypothesis simplifies to:

$$H_0 : \#(\tilde{\Gamma_i}) - \#(\tilde{\Gamma_j}) = 0$$

Table 5 reports estimates from two variants of this test. A row in the table presents estimates of differences between a minority tester and a white tester, where minority is defined as self-identified as African American, Hispanic, or Asian. The first two columns test for differences in the total number of recommendations provided to minority testers relative to the white tester in the same trial, whereas the third and fourth columns test for differences in the availability (communicated by the agent) of the advertised home. Columns 2 and 4 add controls for differences that may be due to a buyer's implied

preference for price and neighborhood characteristics using the listing price and racial composition of the neighborhood where the advertised listing is located. While point estimates indicate that African American and, to a lesser extent, Asian buyers receive fewer recommendations than their white counterparts. These findings are consistent with estimates reported by Turner et al. (2013), who find that African Americans are shown .5 fewer homes than a white tester and no difference for Hispanic testers. None of the differences are statistically significant in our model, which includes additional controls and clusters standard errors by trial. We find no significant difference in the likelihood of the advertised home being available. This is important, as refusing to suggest a property or making a claim that a particular property is unavailable is a more blatant form of discrimination that had been prevalent in previous HDS studies. While differences may still exist, they are not statistically significant in this sample. This test does not, however, imply anything about differences in the *quality* of the houses or neighborhoods that are being recommended.

5.2 Are Minority Buyers Steered into Minority Neighborhoods?

We begin our discussion of steering by examining the channel that has been the focus of research in prior decades (Yinger, 1995, Galster and Godfrey, 2005) as well as results from the 2012 audit in the Turner et al. (2013) report. In particular, we consider the extent to which the racial composition of neighborhoods differs for homes recommended to minority testers relative to a white counterpart.

$$H_0 : \frac{\sum_{k \in \tilde{\Gamma_i}} \%white_k}{\#(\tilde{\Gamma_i})} - \frac{\sum_{k \in \tilde{\Gamma_j}} \%white_k}{\#(\tilde{\Gamma_j})}$$

where again, $i = minority$, $j = white$. Table 6 reports estimates of differences in the share of white households in the block group of a home recommended in a trial. Columns I - V introduce additional controls for attributes of the advertised house, which capture the implied preferences of the testers for housing price and neighborhood characteristics, such as neighborhood racial composition and the share of households below the poverty line. In each case, homes recommended to African Americans contain a lower share of white households than those recommended to their white counterparts. This difference of -0.042 – approximately 6% of the white comparison mean of 0.6952 – does not change when we control for the neighborhood racial composition, poverty rate, or price of the advertised listing that a tester presents to their agent.[22] These estimates confirm the finding documented in prior studies on steering and segregation, providing strong evidence

[22]In Appendix C, we report results of tests that examine steering into neighborhoods by the share of households from each of the three minority groups in the HDS study. These results demonstrate that African American testers are more likely to be steered towards neighborhoods with a higher share of African American households, but evidence of steering into same-race neighborhoods is not as evident for the other groups.

that a tester's race directly influences the racial composition of the neighborhoods that define his choice set. This occurs in the absence of any explicit information about preferences for demographic or other neighborhood characteristics and is directly attributable to a buyer's race. The effect persists irrespective of information about neighborhood preferences implied by an advertised listing presented to an agent.

Point estimates in Table 6 suggest a stronger steering effect for African American buyers away from white neighborhoods (4.16% [0.166]) than was reported in the initial report of findings from the 2012 audit (1.8% [0.8]) (Turner et al., 2013). Differences may result from the specification of tests, since the characteristics of recommendation sets are aggregated by tester in the HDS report. They could also result from differences in the level of geographic variation in the data on racial composition. Whereas the present study makes use of data on racial composition and other neighborhood characteristics measured at the census block group level, previously reported estimates relied on data at the census tract level. As described above, housing recommendation sets in the 2012 HDS were highly localized. Appendix D examines the effects of neighborhood measures at different levels of geographic aggregation by replicating our tests using census block group and tract measures. We find smaller differences when we use census tract data. Estimates of tester-mean differences with census tract data indicate that the African American testers receive recommendations for homes in tracts with a 2.8% [0.87] smaller share of white households than a white tester, which is slightly larger than by not different from the 1.8% [0.8] difference reported in Turner et al. (2013). These comparisons highlight the potential importance of heterogeneity at fine neighborhood scales in audit studies, since real estate agents may engage clients in a highly localized search. Census tract measures provide zero variation in the one-third of housing searches conducted within a single census tract in the HDS 2012. Comparisons reported in Appendix D provide evidence of substantial within-tract heterogeneity in the sample of major metropolitan housing markets.

While steering into same-race neighborhoods certainly provides evidence of discriminatory behavior that could exacerbate segregation, the ultimate effects on the outcomes of buyer households are not obvious. Recent literature suggests that exposure to within-group social models may have important (positive) effects on economic mobility and such recommendations could conform with homophily preferences of minority homebuyers (Chetty et al., 2018). As a result, while discriminatory steering itself is illegal, it is not clear whether increasing access to minority neighborhoods and restricting access to white neighborhoods will generate advantage or disadvantage for a minority household. Digging deeper, the estimates presented in Table 7 indicate that the results found in Table 6 are primarily driven by steering of African American buyers away from *high income* white neighborhoods. The steering effect is strong in high income white neighborhoods and is present for the minority group as a whole. It persists when we control for the

listed price, the neighborhood racial composition, and the poverty rate of the advertised listing. These differences become much smaller for African American testers in medium-income white neighborhoods and disappear for the group of minority testers as a whole. The effect actually reverses for low-income white neighborhoods, such that Hispanic and Asian testers are *more* likely than their white counterparts (with the same income) to receive recommendations in a low-income white neighborhood.

5.3 Are Minorities Disadvantaged by Neighborhood Steering?

This section presents the core tests of our study, which build on the existing body of evidence on discriminatory steering to analyze a set of key neighborhood characteristics that have been shown to have important effects on short- and long-run economic outcomes. When interpreted in the context of the literature on neighborhood effects, these tests reveal the specific channels through which discriminatory steering can constrain to certain types of neighborhoods to affect the lives of buyer households. Revealed preference evidence indicates that buyers have clear preferences for these characteristics. We therefore assume that the average buyer in the sample of HUD markets will have preferences for these neighborhood attributes and that discriminatory constraints along these dimensions will have a non-trivial impact on expected utility. We test for the effect of discriminatory behavior on recommendations of homes with each of the following neighborhood characteristics described above.

$$H_0 : \frac{\sum_{k \in \tilde{\Gamma}_i} X_k}{\#(\tilde{\Gamma}_i)} - \frac{\sum_{k \in \tilde{\Gamma}_j} X_k}{\#(\tilde{\Gamma}_j)}$$

where $X =$ *(poverty rate, %high skill, %college, elementary school quality, assaults, air toxics, particulate matter)*. The two panels of Table 8 present core results from tests of differences between the homes recommended to minority versus white testers along key neighborhood dimensions. Differences are reported in levels, with the mean value of the comparison group (white tester) reported at the bottom of the table. All estimates include controls for characteristics of advertised homes, and for tests that use census block and pollution variables we report sharpened q-values using a Hochberg adjustment to control for the family-wise false discovery rate (Benjamini and Hochberg, 1995).[23] We find substantial disparities in the attributes of neighborhoods recommended to minority testers relative to their white counterparts. The first panel of Table 8 shows that minority testers (as a whole) are recommended homes in census block groups with higher poverty rates (1.25%) and fewer high skilled neighbors (-2.28%).[24] Considering the average values

[23]Hochberg-adjusted p-values are provided for tests of differences between minority and white testers (census block and pollution variables) at the bottom of Table 8. Standard test statistics are reported for assault counts and school ratings.

[24]High skill is share of census block group employed in American Community Survey defined Management, business, science, and arts occupations.

of these neighborhood attributes in the white tester comparison group (8.2% and 48.2%), these impacts are substantial (especially poverty). We do not find statistically significant differences in the percentage of college educated residents in neighborhoods recommended to minorities when considered as a whole.

Below the estimates of differences between white testers and minorities, we report differences by racial group using a specification that includes terms for each. Overall, these estimates indicate that African American testers are shown homes that are in census block groups characterized by higher poverty rates (+1.24%), lower shares of skilled workers (-2.72%), and lower shares of college educated neighbors (-3.04%), although the result for poverty is not statistically significant. In their initial evaluation of steering using the 2012 HDS audit data, Turner et al. (2013) find smaller (0.2% [0.2]) differences for steering into high poverty neighborhoods using measurements at the census tract level. Appendix D discusses a replication of that test with the tract-level poverty measure, which indicates that differences become smaller in magnitude (0.27% [0.32]) when evaluated using tester-mean recommendations and the census tract measure. This mirrors the finding in racial composition in the previous section. We note that while the tract and block-group poverty rates are nearly identical in the average trial (8.5% vs. 8.6%), the within-trial standard deviation is much smaller for the tract-level measure (3.79% vs. 5.02%).

The disparities between white and Hispanic testers are even larger in terms of the poverty rate and high-skill neighbors but smaller and insignificant for college share. Differences between white and Asian testers are markedly lower and are not significant along any of the dimensions of neighborhood capital that we study. Column 4 of the first panel describes school quality as measured by the "GreatSchools" index. While the houses recommended to every minority group reflect a lower school quality than that of the houses recommended to their paired white testers, none of these differences are statistically significant. We note, however, that our sample size is approximately halved owing to data loss when merging HUD house addresses with information scraped from the online realty platform.

The second panel of Table 8 focuses on neighborhood disamenities – assaults and three measures of pollution exposure – proximity to Superfund sites, air toxics (as measured by the EPA's RSEI model), and PM2.5, an important criteria pollutant with substantial long run health effects. Considering all minority groups as a whole, we observe statistically significant differences in the proximity to Superfund sites and air toxics relative to the houses recommended to white testers. The difference in assaults is positive, although not statistically significant. However, considering only African Americans, we find the difference in assaults to be positive and statistically significant. The magnitude of that difference (+23.80) is large compared to the average in the white tester comparison group (80.43). The same is true for Superfund proximity (a difference of +0.12 relative to an average of 0.35) and air toxicity (a difference of +915.45 relative to an average of 5,079.6).

Asians show similar statistically significant differences for Superfund proximity and air toxics. Point estimates for Hispanics are positive, but estimates are smaller in magnitude and statistically insignificant.

In contrast to air toxics, results with respect to particulate matter suggest very little difference across testers. The average value of particulate matter in the sample of advertised houses is 9.283. Asian testers do exhibit a statistically significant difference with their white counterparts of -0.1283, but this difference is very small in magnitude. None of the other race groups exhibit statistically significant differences within tester pairs. We suspect that this is due to an important difference between particulate matter and air toxics. In particular, spatial variation in particulate matter concentrations occurs over large geographies, whereas air toxics can vary from neighborhood to neighborhood. Because real estate agents do tend to recommend houses within relatively small buffers around the advertised house to both testers within a pair, the scope for steering with respect to particulate matter is far lower than that with respect to air toxics.

These estimates indicate that minority buyers are steered toward neighborhoods that could disadvantage them in multiple dimensions. Furthermore, these differences do not appear to be affected by the preferences that minority buyers communicate regarding these very same neighborhood characteristics, the racial composition of neighborhoods, or home price. Appendix F reports estimates with/without these controls. We do not find evidence that differences reported in Table 8 are driven by a steering process where real estate agents discount the financial credentials of minority testers and simply steer them towards lower income neighborhoods where housing is more affordable. Table E.1 presents results of tests for differences in home prices, which suggest no significant differences in the listing price of homes recommended to each group. We perform an additional test to rule out this potential mechanism in Appendix Table F.1.

It is also possible that minorities are steered away from high amenity neighborhoods as a result of historical/existing segregation, which could either bias the assumptions of real estate agents about buyer preferences or could induce steering irrespective of buyer preferences. Table 7 suggests a more complicated picture, demonstrating that steering does not occur solely into same-race neighborhoods and but rather depends on the interaction between race and neighborhood income. In order to more directly test the effects of prior segregation steering behavior, we estimate the main effects from Table 8 including additional controls for the lagged racial composition of each block group from the 2000 Census. Appendix Table F.2 reports the results from these tests, which indicate that differences remain even controlling for these historical patterns. Differences in the poverty level, skill level, and level of college attainment of neighborhoods recommended to African American households can be partially but not fully explained by lagged racial composition of neighborhoods. The historical racial composition of neighborhoods does not appear to explain differences in neighborhood assaults or exposures to Superfund or

chemical toxics.

5.4 Are Children Disadvantaged by Neighborhood Steering?

Much of the literature indicates that the social and physical characteristics of neighborhoods have the strongest effects on children. While children are not directly subject to discriminatory steering, they will be affected if real estate agents tend to discriminate against minority families. We make use of the comprehensive identity profiles developed in the 2012 HDS to test for differences within the subsample of tester groups (37%) who are assigned an identity of mother.[25] Results reported in Table 9 indicate the differences are magnified for this group. In particular, we find that minority mothers are steered into neighborhoods with a +4.81% higher poverty rate than white mothers and that this difference is particularly stark for African American (+5.23%) and Hispanic (+5.60%) mothers. The average poverty rate in the white comparison group is only 7.67%, meaning that these effects are quite large in percentage terms – i.e., 62.7% to 73.0% increases relative to the control mean. Differences in the skill level and share of college educated households in neighborhoods recommended to African American and Hispanic/LatinX mothers are also much larger than the differences for the average tester. Homes recommended to African American mothers have a 40% higher incidence in nearby assaults (+33), a 51% higher number of nearby Superfund sites (+0.18), and a 38% higher (+2,269.92) level of exposure to air toxics than white mothers compared to the control means. The exception is for elementary school quality – we find some evidence that homes recommended to Hispanic/LatinX mothers have higher school quality (+0.84).

In order to better understand how these findings relate to disparities in ultimate exposures to neighborhood attributes, we construct a comparison between differences in homes recommended to white versus African American mothers and differences in location choices within 2 km of Superfund sites (that had not been cleaned up in 2011). Using this definition of exposures to Superfund sites, Currie (2011) finds a 43% difference in the exposures of African American mothers relative to white mothers.[26] Using the HDS data, our test indicates that African American mothers are 42.5% more likely than their white counterpart to receive a recommendation within 2 km of a Superfund site.[27] These estimates indicate that the differences from discriminatory steering are almost exactly

[25] Results on in utero pollution exposures suggest that expecting mothers may also be an important group, though this is not a tester profile in the 2012 HDS.

[26] Currie (2011) reports that 1.74% of all mothers live within 2 km of a Superfund site and that African American mothers are +0.77 percentage points more likely to live within 2 km of a site.

[27] In our HDS sample of cities with large minority populations, 24% of homes recommended to the sample of mothers fall within 2 km of a Superfund site. The test for African American mothers indicates a 10 percentage point higher likelihood than a paired white mother. Estimate is significant at $p<.1$.

as large as the resulting differences in maternal exposures.[28] Currie (2011) discusses the disparity in exposures as possibly resulting from educational differences between the groups, which could result in different locational choices in the wake of Superfund cleanups or publicly disclosed emissions of toxic chemicals. The present findings from the HDS suggest that housing discrimination could also explain these differences.[29]

Potential Effects of Steering on Child Exposure to Poverty

In order to gain traction on the importance of discriminatory steering for child exposure to poverty, we consider the results on maternal steering in the context of long-run effects of the Moving to Opportunity (MTO) experimental voucher program. The MTO program provided vouchers for residents living in neighborhoods with a poverty rate of greater than 40% to obtain subsidies in neighborhoods with poverty rates of less than 10%. Chetty et al. (2016) find that for children under 13, the treatment was responsible for a 17 percentage point (intent to treat) or 36 percentage point (treatment on the treated) reduction in neighborhood poverty and subsequent impacts of this poverty reduction on income, college education, employment, marriage and fertility later in life. Chyn (2018) also finds large effects on later life employment and earnings for children in a non-volunteer sample who were moved out of housing projects in high poverty neighborhoods. We test for differences in steering into low poverty block groups (as defined by MTO) for tester pairs who present an advertised listing that falls in a low poverty census block group.[30]

Column 1 of Table 10 reports the estimates from this test, which indicate that African American testers are 11.8% and Hispanic/LatinX testers are 15.9% less likely than their white tester pair to be shown a home in a low poverty neighborhood when they demonstrate interest in such a neighborhood. The more relevant comparison given the findings in Chetty et al. (2016) involves a test for differences between minority and white testers who have families (according to their scripted roles). The results of this test, reported in Column 2, indicate that African American tester families are 17.3% less likely to receive recommendations in low poverty neighborhoods. Hispanic/LatinX testers with families are 19.9% less likely. Column 3 reports estimates from tests of differences between mi-

[28] We construct a similar test of differences in air toxics using our RSEI measure. On average, homes recommended to mothers in the HDS study have a RSEI level of 5313.1. Homes recommended to African American mothers have levels that are 2268.9 higher (estimate is significant at $p<.1$) than their white counterpart, indicating a 42.6% disparity in exposures.

[29] For buyers who may lack sufficient information about pollution exposures, adverse welfare impacts from discriminatory constraints are likely to come directly from the short and long-run outcomes associated with exposures themselves. Indeed, we expect that some buyers may be more and others less informed about pollution exposures, school quality, or public safety in the neighborhoods where they are searching.

[30] Another interesting question concerns the incidence of steering for buyers who present preferences for housing in high poverty neighborhoods. However, only 1% of recommended homes in the HDS sample are in neighborhoods with poverty rates of greater than 40%, making it difficult to draw an exact comparison with a statistically powered test for the high poverty neighborhoods. We focus instead on steering away from low poverty neighborhoods. We define a MTO-consistent measure as a recommended home in a census block group where the share of families living below the poverty line is less than 10%.

nority and white testers that are assigned the role of mother. We find that the differences are particularly magnified from this group: white mothers are nearly twice as likely to be shown homes in low poverty neighborhoods as African American or Hispanic/LatinX mothers that demonstrate equivalent interest.

In more recent work on income mobility gaps between race groups, Chetty et al. (2018) find that neighborhoods with low poverty rates (defined as <10%) and high rates of father presence among black families (defined as >50%) are associated with smaller racial gaps and better outcomes for black boys (the study documents persistent gaps between race groups *within* census tracts). The authors document that whereas 63% of white children currently grow up in these kinds of advantaged neighborhoods, fewer than 5% of black children are exposed to the same. Columns 4-6 of Table 10 test for differences in these neighborhoods and reveal differences that are highly similar to those reported for low poverty neighborhoods discussed above. Assuming that the recommendations of real estate agents affect buyer decisions, these results indicate that the impacts of discriminatory steering will likely result in *statistically* and *economically* significant long-run and intergenerational impacts within minority families. By reducing the access of minority families to low poverty neighborhoods where they experience higher income mobility and a higher likelihood of convergence with white counterparts, discrimination could simultaneously contribute to the *within-neighborhood* race gap.[31]

Potential Effects of Steering on Income Mobility

In more recent work, Chetty and Hendren (2018a) use a large panel of data on the adult outcomes of child movers to examine the effects of accumulated exposure to neighborhoods[32] on intergenerational income mobility. Their findings suggest that there is no critical age at which exposure as a child affects their outcomes as an adult, but rather that the incomes of children who move converge to the cohort-specific incomes of permanent residents of their destination.[33] Importantly, Chetty and Hendren (2018a) argue

[31] We isolate the effect of housing discrimination occurring in a single stage of the housing search process and is likely a lower bound on the overall effect of discriminatory behavior on choices related to a given search. Yinger (1997) discusses the total effect of discrimination on the surplus from a housing search, including differences in assistance and encouragement, assistance with a loan application, and loan approval. The effects of discriminatory steering into higher poverty neighborhoods estimated in this study could be also be compounded by differences in information provided by a real estate agent about neighborhood conditions, differences in recommendations regarding an initial offer, or differences during the process of negotiations.

[32] Neighborhoods are defined in this paper using the definition of "commute zones," which are designed to delineate the geographic boundaries of local economies, particularly improving their delineation in rural areas of the United States. The present study defines neighborhoods that are relevant for a housing search using census block groups within urban areas.

[33] Analysis in Chetty and Hendren (2018a) is based on the rank of an individual in the income in the income distribution, so the estimate above is interpreted as the following: a move into a neighborhood where permanent resident incomes are 1 percentile higher (at a given level of parental income) increases a child's income rank in adulthood by approximately 0.04 percentiles.

that the effects of exposure to lower/higher income families are due to exposure alone, irrespective of the income or sorting behavior of a child's family.

In Table 11, we test for differences in the median family income reported in census blocks recommended to minority versus white testers. We find large differences for African American testers, who receive recommendations for homes that are located in neighborhoods where families have or 7.3% lower median incomes than those recommended to white testers. This difference is magnified for African American families (10.8% lower) and especially for mothers (25.1% lower). As an illustration, we consider a family who moves a child at age 9 from the average neighborhood census block group in 2012 HDS sample. The median income of families living in these neighborhoods is $101,609, which ranks in the 83rd percentile of the national family income distribution of families with children of age 9 in the national of commuting zones in 2012 (Chetty and Hendren, 2018a). If this family were moving to a new neighborhood with the exact same family income level (lateral move), our results suggest that an African American family would be shown homes in the 78th percentile. At age 30, the effect of exposure due to steering alone would reduce the minority child's household income from the 62nd to the 60th percentile, amounting to a (permanent) reduction of approximately $2,488 per year.[34]

5.5 Is Discriminatory Steering Affected by Buyer Preferences?

Implied Preferences for Neighborhood Characteristics

In an actual housing search, interactions between discriminatory behavior and buyer preferences may have important impacts on location decisions and on the neighborhood effects that result. The incorporation of the buyer's *individual* preferences by a real estate agent will result in a *ceteris paribus* increase in that buyer's expected utility from housing search. The 2012 HDS allows us to test the extent to which information about individual preferences for neighborhood characteristics is incorporated into the recommendations of real estate agents and, in particular, how this differs by tester race. We define a tester's implied preference for a given neighborhood characteristic using the corresponding value

[34]This estimate uses the results reported in Figure 4 of Chetty and Hendren (2018a) to estimate the relationship between parent household income and child household income. $y = 30 + .384 * x$. The household income distribution of parents is taken from the cohort at age 9 in Online Data Table 6 (78th percentile is $89,700-91,900 and 83rd percentile is $101,600-104,400. According to the effect of 4% per year of exposure reported in Chetty and Hendren (2018a), a child who is exposed from age 9 to 23 would pick up 56% of the observed difference between permanent resident incomes. The household income distribution of children at age 30 is taken from the cohort with children at age 2 (61st percentile is $50,000-51,400, so 61.87th is approximated as 51,218. 59th percentile is $47,400-48,700, so 59.95th is approximated as 48,730). http://www.equality-of-opportunity.org/data/index.html#movers.

from the advertised house that the tester presented to the real estate agent.[35]

Each of the columns in Table 12 describes the difference in recommendations as a function of the strength in the implied preferences. We see first that the recommendation sets of white buyers, the omitted racial group, exhibit a strong positive and statistically significant relationship between each recommended house attribute and their preference for that attribute expressed through their advertised house. For African Americans, this relationship is significantly weakened for every neighborhood attribute with the exception of Superfund proximity. Hispanic testers have a significantly weaker relationship in the case of high skill, school quality and air toxics, and Asian testers have a weaker relationship in the case of assaults and all of the pollution variables. In the case of poverty, high skill and college education, recommendations for Asian testers exhibit a stronger relationship than their white counterpart, and the same is true in the case of assaults for Hispanic testers. The general finding is that particularly for African Americans, individual preferences for key neighborhood attributes appear to be discounted by real estate agents.

We also explore heterogeneity in discriminatory steering among buyers who present preferences for larger homes, higher priced homes, and homes in neighborhoods with larger shares of each of the minority groups represented in the study (interested readers can refer to Appendix G). We find that African American testers who present preferences for larger homes in higher priced neighborhoods with a higher percentage of white households face greater constraints[36], though this is not the case for all outcomes or for the other minority groups. The fact that discriminatory constraints facing African American buyers appear to be magnified in searches for larger or more expensive homes suggests that housing discrimination may disproportionately constrain upwardly mobile African American households. Targeted experimental research on housing and other forms of discrimination could be important for understanding disparities in intergenerational income mobility that appear to persist for African American households but not other minority groups (Chetty et al., 2018)

6 Conclusion

In this paper, we find strong evidence that contact with real estate agents differentially constrains the choice sets of minority buyers relative to a white counterpart. Building on prior literature, we show that while discrimination does not appear to have a significant

[35]For example, a tester who presents an advertised listing in a low poverty neighborhood has implied a preference for that low level of poverty. Note that income and other preferences are held constant by the matched-paired design. This design is similar to Ondrich et al. (2003), who find that real estate agents tend make recommendations that are at odds with the preferences that minority buyers imply for housing characteristics.

[36]These preferences are positively, though not perfectly correlated.

effect on the number of recommendations a minority buyer receives, it does have strong impacts on the quality of the neighborhoods that constitute the recommended set. The implications of these constraints are clear – the constraints imposed by real estate agents in the search process provide all minority groups with houses to choose from that are worse in at least one (and typically many) dimensions. Though adverse neighborhood characteristics such as toxics exposures and neighborhood poverty rates can be correlated with each other, the operate through discrete channels that may interact or compound the ultimate effects on inequality.

These findings have implications for several literatures in economics. First, they are important for studies of "neighborhood effects", which analyze the ways in which neighborhood attributes affect short and long-run (even multi-generational) outcomes in the dimensions of poverty, employment, schooling, criminal activity and public safety, and environmental health. Prior research has demonstrated that residential location choices can affect short- and long-run outcomes. In light of prior results, we interpret the steering behavior identified in this paper as likely to affect the neighborhood attributes in the household's choice set, and ultimately their house purchase decision, in ways that disadvantage them. Housing discrimination could contribute to root causes of inequality by constraining location choices and producing disparities in neighborhood effects.

Second, our results demonstrate that minority homebuyers and renters may not be "free to choose" in the housing market, and that their observed behavior may not accurately reveal their preferences. If households' choice sets are distorted by the recommendations provided by real estate agents, this can have important implications for the interpretation revealed preference studies are used to allocate public goods. Our results suggest that what might appear to be weak preferences for environmental quality on the part of minorities may actually result from a set of options that were disproportionately lower in environmental quality than were those given to similar white buyers. This suggests a potential source of bias in non-market valuation studies that assume that buyers are making choices in the absence of such constraints. This method has become standard in cost-benefit analyses and evaluation of environmental policies in the US and plays a critical role in determining how governments allocate scarce funds to the provision of public services across communities.

Finally, our results provide evidence that even holding income disparities or differences in preferences constant, housing discrimination could play an important role in determining observed spatial correlations between race, income, and local disamenities. This has particularly important implications considering pollution, and policies relating to environmental justice. Under an executive order signed by Bill Clinton in 1994, the federal government is obligated to consider the distributional impacts of its policies with respect to pollution and disadvantaged groups. Understanding the origins of existing inequities has been the topic of a large and growing literature (Graham, 2018, Banzhaf et al., 2018).

Discrimination has largely been overlooked in that literature. The results of the present study suggest that this may be an important oversight. The steering mechanism has important implications for the interpretation of long-run outcomes of neighborhood residence or relocation programs, as well as the development of fair housing laws as they relate to public expenditures on pollution abatement and public goods.

While we are able to identify the differential impacts of real estate agents on the housing search processes of white and minority buyers, we note that the HUD audit data do not allow for direct tests of the behavioral mechanisms underlying these effects. We find that the differential constraints imposed by agents occur irrespective of preferences demonstrated by testers in the form of their "choice" of advertised house, though we cannot disentangle mechanisms based on statistical discrimination from others based on, for example, racial animus. We also note that the magnitude of the impact of housing discrimination ultimately depends on the information, preferences, and behavior of buyers in the context of discrimination. Therefore, obtaining precise estimates of welfare effects would require an experiment that examines discriminatory behavior within the context of real preferences of individuals making decisions in a housing market. This is not possible with the HDS 2012 data, since the sampling design randomly draws advertisements from the set of naturally occurring listings rather than according to the preferences of real buyers. It is important to note that a minority buyer will nonetheless experience different outcomes than a white buyer with the exact same preferences.

We propose an expanded research agenda in the economics of housing discrimination, including complementary experimental designs that are capable of more directly testing the behavioral mechanisms underlying discriminatory steering as in Knowles et al. (2001), List (2004), and Charles and Guryan (2008). We highlight that an important avenue for experimental research involves the design of a research methodology that combines experimental identification of discriminatory behavior with individual preferences that are representative of decisions being made in the housing market. These could be used to obtain precise estimates of welfare effects. The results in the current study suggest that real estate agents may discount and even work in opposition to the preferences of African American buyers when making recommendations. An important remaining question is the extent to which the constraints from discriminatory steering may be overcome by tenacity – buyers with a sufficiently high marginal utility for certain housing characteristics may choose to absorb additional search costs in order to expand their choice set. Unfortunately, studying this aspect is not possible in the audit study context. Neither is a study of the mortgage lending process, where we might expect the sorts of discriminatory effects we identify here to be amplified.

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Table 1. Descriptive Statistics for Tester Dataset

	Tester Characteristics (True Actors, Not Assigned)				
Variable	All Groups	White	African American	Hispanic	Asian
Age	40.910	41.485	41.494	42.070	36.398
Percent Male	0.388	0.415	0.375	0.284	0.420
Percent Rented Home	0.588	0.580	0.630	0.516	0.614
Percent Owned Home	0.305	0.296	0.312	0.421	0.217
Personal Income					
Under $10,000	0.244	0.275	0.241	0.125	0.249
$10,000 - $19,999	0.164	0.130	0.225	0.114	0.235
$20,000 - $29,999	0.237	0.293	0.136	0.249	0.184
$30,000 - $39,999	0.136	0.114	0.152	0.183	0.152
$40,000 - $49,999	0.096	0.086	0.105	0.117	0.090
$50,000 - $74,999	0.068	0.062	0.069	0.136	0.022
$75,000 - $99,999	0.009	0.013	0.008	0.000	0.004
$100,000 or more	0.003	0.002	0.004	0.011	0.000
Education					
Attended High School	0.003	0.000	0.002	0.000	0.018
GED	0.012	0.021	0.004	0.000	0.000
High School Diploma	0.035	0.020	0.045	0.037	0.079
Attended Vocational School	0.005	0.005	0.000	0.018	0.000
Vocational School Diploma	0.022	0.032	0.006	0.007	0.029
Attended College	0.162	0.130	0.182	0.308	0.108
Associate's Degree	0.078	0.059	0.101	0.136	0.054
Bachelor's Degree	0.358	0.404	0.283	0.183	0.484
Attended Graduate School	0.052	0.074	0.020	0.048	0.025
Graduate Degree	0.243	0.230	0.308	0.253	0.170
	Assigned Characteristics				
Monthly Rent	1,332	1,334	1,392	1,277	1,285
Percent Tester Went First	0.516	0.589	0.417	0.454	0.462
Percent Appointment in AM	0.416	0.410	0.425	0.428	0.422
Percent Car Owner	0.854	0.861	0.796	0.922	0.861
Length of Employment (Years)	4.091	3.345	4.936	5.203	4.507
Years at Residence	3.650	2.925	4.405	4.766	4.101
Lease Type					
Month-to-Month	0.569	0.558	0.565	0.581	0.620
Lease	0.431	0.442	0.435	0.419	0.380
	N = 2,260	N = 1,161	N = 512	N = 286	N = 294

Table 2. Home and Neighborhood Characteristics

		Characteristics of Advertised Homes			
Variable	All Groups	White	African American	Hispanic	Asian
Listing Price	306,701	302,935	304,661	304,812	328,761
Building Type					
Single family, detached	0.739	0.743	0.738	0.699	0.748
Duplex	0.017	0.017	0.013	0.018	0.018
Rowhouse or Townhouse	0.134	0.128	0.118	0.158	0.155
Multi-family structure	0.101	0.101	0.125	0.112	0.069
Mobile home	0.001	0.001	0.000	0.005	0.000
		Pollution Measurements			
Superfund Sites	0.330	0.314	0.340	0.350	0.361
Particulate Matter	9.283	9.378	9.253	9.055	9.293
RSEI	6,071	6,244	7,860	4,283	5,127
		Neighborhood Characteristics			
Assaults	93	88	96	95	104
Elem. School Quality	6.207	6.198	6.202	6.169	6.260
Poverty Rate	0.089	0.088	0.092	0.090	0.086
Percent College Graduate	0.501	0.504	0.501	0.494	0.501
Percent High Skill	0.467	0.467	0.467	0.463	0.472
Percent White	0.675	0.685	0.684	0.639	0.664
Percent African American	0.090	0.091	0.103	0.082	0.084
Percent Asian	0.067	0.065	0.061	0.073	0.079
Percent Hispanic	0.148	0.140	0.135	0.185	0.151
	N = 7,033	N = 3,612	N = 1,213	N = 1,028	N = 1,109

Table 3. Balance Statistics for Testers

	Tester Characteristics (True Actors, Not Assigned)		
Variable	African American	Hispanic	Asian
Age	-0.874	1.476	-2.060
	(0.996)	(1.858)	(1.833)
Percent Male	0.009	0.000	0.000
	(0.015)	(0.000)	(0.000)
Percent Rented Home	0.138	-0.044	0.083
	(0.100)	(0.124)	(0.114)
Percent Owned Home	-0.153*	0.033	-0.111
	(0.093)	(0.113)	(0.110)
Personal Income			
Under $10,000	-0.012	-0.107	-0.000
	(0.097)	(0.116)	(0.125)
$10,000 - $19,999	0.118	0.012	0.235**
	(0.076)	(0.116)	(0.102)
$20,000 - $29,999	-0.212**	-0.066	-0.113
	(0.086)	(0.151)	(0.107)
$30,000 - $39,999	0.126	0.147*	0.008
	(0.081)	(0.088)	(0.114)
$40,000 - $49,999	-0.002	0.011	-0.066
	(0.063)	(0.079)	(0.077)
$50,000 - $74,999	-0.023	0.006	-0.090
	(0.057)	(0.065)	(0.080)
$75,000 - $99,999	-0.028	-0.027	-0.012
	(0.022)	(0.041)	(0.018)
$100,000 or more	0.000	0.030	0.000
	(0.000)	(0.046)	(0.000)
Education			
Attended High School	0.000	0.000	0.020
	0.000	0.000	0.031
GED	0.011	-0.071	-0.028
	(0.017)	(0.050)	(0.044)
High School Diploma	0.036	0.041	0.116*
	(0.035)	(0.037)	(0.068)
Attended Vocational School	-0.007	0.015	0.000
	(0.011)	(0.034)	(0.000)
Vocational School Diploma	-0.014	-0.002	-0.012
	(0.030)	(0.035)	(0.018)
Attended College	0.100	0.109	0.082
	(0.080)	(0.138)	(0.103)
Associate's Degree	-0.017	0.088	-0.016
	(0.043)	(0.066)	(0.052)
Bachelor's Degree	-0.161	-0.251*	-0.032
	(0.110)	(0.147)	(0.104)
Attended Graduate School	-0.062	-0.043	-0.036
	(0.054)	(0.075)	(0.032)
Graduate Degree	0.106	0.114	-0.088
	(0.107)	(0.120)	(0.113)
	Assigned Characteristics		
Percent Tester Went First	-0.093	-0.231	-0.047
	(0.165)	(0.200)	(0.209)
Percent Appointment in AM	0.002	-0.014	0.028
	(0.041)	(0.038)	(0.038)
Percent Car Owner	0.010	0.000	-0.065
	(0.015)	(0.000)	(0.058)
Length of Employment (Years)	1.559***	2.050***	1.444***
	(0.270)	(0.328)	(0.238)
Years at Residence	1.511***	1.898***	1.551***
	(0.288)	(0.301)	(0.203)
Lease Type			
Month-to-Month	0.012	0.072	0.115
	(0.047)	(0.091)	(0.076)
Lease	-0.012	-0.072	-0.115
	(0.047)	(0.091)	(0.076)
	N = 512	N = 286	N = 294

Table 4. Balance Statistics for Homes

	Characteristics of Advertised Homes		
Variable	African American	Hispanic	Asian
Listing Price	6,976	-2,199	10,907
	(14,999)	(14,224)	(14,410)
Building Type			
Single-family Detached	0.009	0.006	0.029*
	(0.014)	(0.018)	(0.016)
Duplex	-0.001	-0.002	-0.005
	(0.007)	(0.007)	(0.011)
Rowhouse or Townhouse	0.005	0.007	0.007
	(0.014)	(0.016)	(0.021)
Multi-family Structure	-0.006	-0.006	-0.030*
	(0.011)	(0.013)	(0.017)
Mobile Home	-0.001	-0.001	-0.000
	(0.002)	(0.004)	(0.00001)
	Pollution Measurements		
Superfund Sites	-0.001	0.017	-0.0003
	(0.007)	(0.015)	(0.009)
Particulate Matter	-0.010	0.0001	0.015
	(0.016)	(0.023)	(0.022)
RSEI	-30	-108	89
	(74.130)	(148.209)	(203.457)
	Neighborhood Characteristics		
Assaults	−0.040	0.109	−0.153
	(0.255)	(1.569)	(0.254)
Elem. School Quality	0.001	0.019	0.025
	(0.031)	(0.032)	(0.050)
Poverty Rate	0.0005	0.001	-0.001
	(0.002)	(0.003)	(0.002)
Percent College Educated	-0.005	-0.003	0.0002
	(0.003)	(0.005)	(0.003)
Percent High Skill	-0.005	-0.002	0.0004
	(0.004)	(0.005)	(0.003)
Percent White	-0.0003	-0.007	0.004
	(0.004)	(0.004)	(0.003)
Percent Black	0.003	0.004	-0.003
	(0.003)	(0.004)	(0.003)
Percent Asian	-0.001	-0.0002	-0.001
	(0.002)	(0.002)	(0.001)
Percent Hispanic	-0.002	0.003	0.001
	(0.002)	(0.003)	(0.002)
	N = 1,213	N = 1,028	N = 1,109

Table 5. Differences in Recommendations and Availability of Advertised Properties

	Dependent variable:			
	Number of Recommendations		Home Availability	
Racial Minority	−0.2947	−0.2286	0.0068	0.0052
	(0.4530)	(0.4436)	(0.1714)	(0.1719)
African American	−0.5137	−0.4652	0.0928	0.0935
	(0.5747)	(0.5676)	(0.2052)	(0.2050)
Hispanic	0.2877	0.3700	−0.0008	−0.0076
	(0.5202)	(0.5101)	(0.2411)	(0.2433)
Asian	−0.2464	−0.1809	−0.0507	−0.0496
	(0.6209)	(0.6088)	(0.2153)	(0.2150)
Other	4.0317	3.9882	0.1336	0.1421
	(2.4750)	(2.4891)	(0.6590)	(0.6604)
Racial Comp Advert Home	*N*	*Y*	*N*	*Y*
ln(Price) Advert Home	*N*	*Y*	*N*	*Y*
Observations	21,385	21,363	6,656	6,629
Adjusted R^2	0.6315	0.6318	-0.2093	-0.2127

*p<0.1; **p<0.05; ***p<0.01

Note: Coefficients report differences in the number of homes recommended and number of available homes recommended to minority testers relative to a white tester (the omitted category). Racial minority encompasses all individual minority groups. All regression specifications control for the full set of actor characteristics, assigned characteristics, and search characteristics. Actor characteristics: tester income, tester household income, gender of tester, age of tester, month of test, educational attainment of tester; Assigned Characteristics: household members, current home ownership status, current lease type, car ownership status, reason for moving, years in current residence, length of employment at current job, reason tester can afford down payment, current lease assigned to tester; Search Characteristics: month of test, sequence of tester appointments, time of the appointment (am/pm), type of recommended building. Standard errors are clustered by market for consistency with sampling design.

Table 6. Discriminatory Steering and Neighborhood Racial Composition

	Dep. Variable: White Household Share				
	I	II	III	IV	V
Racial Minority	−0.0123	−0.0122	−0.0124	−0.0127	−0.0127
	(0.0122)	(0.0122)	(0.0122)	(0.0121)	(0.0121)
African American	−0.0416**	−0.0415**	−0.0420**	−0.0425**	−0.0427***
	(0.0166)	(0.0166)	(0.0166)	(0.0165)	(0.0165)
Hispanic	0.0017	0.0017	0.0016	0.0017	0.0018
	(0.0165)	(0.0165)	(0.0165)	(0.0164)	(0.0164)
Asian	0.0131	0.0131	0.0131	0.0127	0.0127
	(0.0146)	(0.0146)	(0.0146)	(0.0146)	(0.0146)
Other	0.0643	0.0643	0.0653	0.0663	0.0662
	(0.0472)	(0.0472)	(0.0469)	(0.0469)	(0.0469)
Comparison Mean (White)	0.6952	0.6952	0.6952	0.6952	0.6952
Share White Advert Home	*N*	*Y*	*Y*	*Y*	*Y*
ln(Price) Advert Home	*N*	*N*	*Y*	*Y*	*Y*
Racial Comp Advert Home	*N*	*N*	*N*	*Y*	*Y*
Poverty Share Advert Home	*N*	*N*	*N*	*N*	*Y*
Observations	21,517	21,506	21,488	21,488	21,488
Adjusted R^2	0.7791	0.7792	0.7789	0.7788	0.7788

*p<0.1; **p<0.05; ***p<0.01

Note: Coefficients report differences in the racial composition of neighborhoods recommended to minority testers relative to a white tester (the omitted category). Racial minority encompasses all individual minority groups. All regression specifications control for the full set of actor characteristics, assigned characteristics, and search Characteristics. Actor characteristics: tester income, tester household income, gender of tester, age of tester, month of test, educational attainment of tester; Assigned Characteristics: household members, current home ownership status, current lease type, car ownership status, reason for moving, years in current residence, length of employment at current job, reason tester can afford down payment, current lease assigned to tester; Search Characteristics: month of test, sequence of tester appointments, time of the appointment (am/pm), type of recommended building, total number of homes recommended to tester, availability of advertised home as stated by agent. Standard errors are clustered by market for consistency with sampling design.

Table 7. Discriminatory Steering and Neighborhood Racial Composition by Income

	Dep. Variable: White Household Share by Income		
	High Inc	Mid Inc	Low Inc
Racial Minority	−0.0264***	−0.0035	0.0173**
	(0.0090)	(0.0085)	(0.0070)
African American	−0.0337***	−0.0185*	0.0099
	(0.0116)	(0.0112)	(0.0091)
Hispanic	−0.0146	−0.0037	0.0204**
	(0.0121)	(0.0112)	(0.0095)
Asian	−0.0244**	0.0155	0.0214**
	(0.0107)	(0.0103)	(0.0087)
Other	0.0582	0.0185	−0.0106
	(0.0390)	(0.0408)	(0.0264)
Comparison Mean (White)	0.2100	0.3388	0.1464
ln(Price) Advert Home	*Y*	*Y*	*Y*
Racial Comp Advert Home	*Y*	*Y*	*Y*
Poverty Share Advert Home	*Y*	*Y*	*Y*
Observations	21,500	21,500	21,500
Adjusted R^2	0.7177	0.7064	0.6666

*p<0.1; **p<0.05; ***p<0.01

Note: Coefficients report differences in the racial composition (by income level) of neighborhoods recommended to minority testers relative to a white tester (the omitted category). Racial minority encompasses all individual minority groups. All regression specifications control for the full set of actor characteristics, assigned characteristics, and search Characteristics. Actor characteristics: tester income, tester household income, gender of tester, age of tester, month of test, educational attainment of tester; Assigned Characteristics: household members, current home ownership status, current lease type, car ownership status, reason for moving, years in current residence, length of employment at current job, reason tester can afford down payment, current lease assigned to tester; Search Characteristics: month of test, sequence of tester appointments, time of the appointment (am/pm), type of recommended building, total number of homes recommended to tester, availability of advertised home as stated by agent. Standard errors are clustered by market for consistency with sampling design.

Table 8. Discriminatory Steering and Neighborhood Effects

	Dependent variable:			
	Poverty Rate	High Skill	College	Elem School
Racial Minority	0.0125**	−0.0228**	−0.0161	−0.2748
	(0.0060)	(0.0115)	(0.0113)	(0.2158)
African American	0.0124	−0.0272*	−0.0304**	−0.3831
	(0.0085)	(0.0151)	(0.0144)	(0.2951)
Hispanic	0.0216***	−0.0348**	−0.0184	−0.1728
	(0.0082)	(0.0149)	(0.0141)	(0.2872)
Asian	0.0005	−0.0059	0.0023	−0.3578
	(0.0076)	(0.0143)	(0.0153)	(0.2601)
Other	−0.0272	−0.0021	0.0050	−0.3279
	(0.0256)	(0.0458)	(0.0401)	(0.6681)
Comparison Mean (White)	0.0818	0.4823	0.5223	6.401
ln(Price) Advert Home	*Y*	*Y*	*Y*	*Y*
Racial Comp Advert Home	*Y*	*Y*	*Y*	*Y*
Outcome Advertised Home	*Y*	*Y*	*Y*	*Y*
Observations	21,342	21,342	21,342	10,743
Adjusted R^2	0.5237	0.6937	0.7560	0.7468
	Census Block Characteristics			
p-values	0.037	0.047	0.15	*DF*
hochberg q-values	0.094	0.094	0.15	*DF*

	Dependent variable:			
	Assaults	Superfund	Toxics	PM
Racial Minority	9.4284	0.0997***	787.9887**	−0.0448
	(7.5721)	(0.0360)	(355.1028)	(0.0580)
African American	23.8039**	0.1206**	915.4476**	−0.0228
	(11.7093)	(0.0517)	(447.0242)	(0.0777)
Hispanic	1.7870	0.0620	421.2600	0.0075
	(9.4729)	(0.0419)	(586.4115)	(0.0728)
Asian	5.7019	0.1030**	955.7904**	−0.1283*
	(8.9305)	(0.0522)	(480.9247)	(0.0704)
Other	−10.3010	−0.1229	−664.3224	−0.0588
	(69.1959)	(0.1875)	(1,726.1620)	(0.2170)
Comparison Mean (White)	80.43	0.3489	5079.6	9.414
ln(Price) Advert Home	*Y*	*Y*	*Y*	*Y*
Racial Comp Advert Home	*Y*	*Y*	*Y*	*Y*
Outcome Advertised Home	*Y*	*Y*	*Y*	*Y*
Observations	10,875	21,354	21,354	21,354
Adjusted R^2	0.7954	0.8760	0.6888	0.9634
			Local Pollutants	
p-values	*DF*	0.0056	0.026	0.44
hochberg p-values	*DF*	0.017	0.053	0.44

*p<0.1; **p<0.05; ***p<0.01

Note: Coefficients report differences in the attributes of neighborhoods recommended to minority testers relative to a white tester (the omitted category). Racial minority encompasses all individual minority groups. All regression specifications control for the full set of actor characteristics, assigned characteristics, and search Characteristics. Actor characteristics: tester income, tester household income, gender of tester, age of tester, month of test, educational attainment of tester; Assigned Characteristics: household members, current home ownership status, current lease type, car ownership status, reason for moving, years in current residence, length of employment at current job, reason tester can afford down payment, current lease assigned to tester; Search Characteristics: month of test, sequence of tester appointments, time of the appointment (am/pm), type of recommended building, total number of homes recommended to tester, availability of advertised home as stated by agent. Adjusted p-values use Hochberg adjustment for family-wise false discovery rate. DF refers to values that are not adjusted as they are from a different family of variables. Standard errors are clustered by market for consistency with sampling design.

Table 9. Discriminatory Steering and Neighborhood Effects (Mothers)

	Dependent variable:			
	Poverty Rate	High Skill	College	Elem School
Racial Minority	0.0481***	−0.0254	−0.0341*	0.5491
	(0.0117)	(0.0169)	(0.0192)	(0.4069)
African American	0.0523***	−0.0464*	−0.0605**	0.1576
	(0.0176)	(0.0267)	(0.0304)	(0.5639)
Hispanic	0.0560***	−0.0455**	−0.0361*	0.8435**
	(0.0144)	(0.0198)	(0.0201)	(0.4241)
Asian	0.0360**	0.0047	−0.0293	0.5426
	(0.0175)	(0.0236)	(0.0281)	(0.6429)
Other	0.0092	−0.0403	−0.0354	0.5679
	(0.0372)	(0.0578)	(0.0576)	(1.0661)
Comparison Mean (White)	0.0767	0.4742	0.5170	6.516
Observations	7,849	7,849	7,849	5,647
Adjusted R^2	0.4633	0.6629	0.7411	0.6891

	Dependent variable:			
	Assaults	Superfund	Toxics	PM
Racial Minority	3.5671	0.1154*	897.0170	−0.0601
	(17.3998)	(0.0676)	(742.4506)	(0.1330)
African American	33.2016**	0.1795*	2,268.9180*	−0.0155
	(15.2890)	(0.1036)	(1,245.5460)	(0.1845)
Hispanic	−4.5340	0.0207	1,178.3650	0.1472
	(20.3963)	(0.0865)	(828.1420)	(0.1501)
Asian	14.3675	0.0478	648.8790	−0.1493
	(26.7642)	(0.0826)	(995.8417)	(0.1632)
Other	31.5753	−0.3719	2,472.9360	0.5972**
	(53.7138)	(0.2733)	(2,341.9910)	(0.2862)
Comparison Mean (White)	82.12	0.3533	5993.9	9.389
Observations	5,615	7,850	7,850	7,841
Adjusted R^2	0.8214	0.8528	0.5922	0.9671

*p<0.1; **p<0.05; ***p<0.01

Note: Coefficients report differences in the attributes of neighborhoods recommended to minority testers (mothers) relative to a white tester (mother). Racial minority encompasses all individual minority groups. All regression specifications control for the full set of actor characteristics, assigned characteristics, and search Characteristics. Actor characteristics: tester income, tester household income, gender of tester, age of tester, month of test, educational attainment of tester; Assigned Characteristics: household members, current home ownership status, current lease type, car ownership status, reason for moving, years in current residence, length of employment at current job, reason tester can afford down payment, current lease assigned to tester; Search Characteristics: month of test, sequence of tester appointments, time of the appointment (am/pm), type of recommended building, total number of homes recommended to tester, availability of advertised home as stated by agent. Standard errors are clustered by market for consistency with sampling design.

Table 10. Discriminatory Steering: Low Poverty Neighborhoods

	Dependent variable:					
	Low Poverty	Low Poverty: Families	Low Poverty: Moms	Low Pov/High Dad	Low Pov/High Dad: Families	Low Pov/High Dad: Moms
African American	-0.1179^{**}	-0.1730^{**}	-0.4318^{***}	-0.1175^{**}	-0.1705^{**}	-0.3958^{***}
	(0.0522)	(0.0673)	(0.1494)	(0.0539)	(0.0683)	(0.1526)
Hispanic	-0.1585^{***}	-0.1986^{***}	-0.4283^{***}	-0.1543^{***}	-0.1657^{***}	-0.3358^{**}
	(0.0479)	(0.0621)	(0.1312)	(0.0483)	(0.0602)	(0.1541)
Asian	-0.0437	-0.0770	-0.3101^{**}	-0.0419	-0.0757	-0.2618^{*}
	(0.0501)	(0.0701)	(0.1510)	(0.0502)	(0.0709)	(0.1502)
Other	-0.4417^{***}	-0.3749^{*}	-1.1073^{***}	-0.4343^{***}	-0.2607	-0.7678^{*}
	(0.1632)	(0.1950)	(0.3177)	(0.1640)	(0.1878)	(0.3985)
Comparison Mean (White)	0.8123	0.8301	0.8311	0.8142	0.8310	0.8325
Observations	7,566	4,643	2,794	7,524	4,639	2,790
Adjusted R^2	0.3967	0.3959	0.4248	0.3954	0.3941	0.4205

*p<0.1; **p<0.05; ***p<0.01

Note: Coefficients report differences in the attributes of neighborhoods recommended to minority testers relative to a white tester (the omitted category). Racial minority encompasses all individual minority groups. All regression specifications control for the full set of actor characteristics, assigned characteristics, and search Characteristics. Actor characteristics: tester income, tester household income, gender of tester, age of tester, month of test, educational attainment of tester; Assigned Characteristics: household members, current home ownership status, current lease type, car ownership status, reason for moving, years in current residence, length of employment at current job, reason tester can afford down payment, current lease assigned to tester; Search Characteristics: month of test, sequence of tester appointments, time of the appointment (am/pm), type of recommended building, total number of homes recommended to tester, availability of advertised home as stated by agent. Standard errors are clustered by market for consistency with sampling design.

Table 11. Discriminatory Steering: Median Income in Neighborhood

	Dependent variable: log(Median Income)		
	All Testers	Families	Moms
African American	−0.0729*	−0.1081**	−0.2513***
	(0.0376)	(0.0458)	(0.0859)
Hispanic	−0.0478	−0.0382	−0.0836
	(0.0347)	(0.0430)	(0.0657)
Asian	−0.0126	−0.0508	−0.0814
	(0.0304)	(0.0420)	(0.0678)
Other	0.0549	0.1509	0.0758
	(0.1099)	(0.1222)	(0.1670)
Comparison Mean (White)	11.405	11.407	11.406
Observations	21,457	6,369	3,772
Adjusted R^2	0.6657	0.6756	0.6104

*p<0.1; **p<0.05; ***p<0.01

Note: Coefficients report differences in the median income of households in neighborhoods recommended to minority testers relative to a white tester (the omitted category). Racial minority encompasses all individual minority groups. All regression specifications control for the full set of actor characteristics, assigned characteristics, and search Characteristics. Actor characteristics: tester income, tester household income, gender of tester, age of tester, month of test, educational attainment of tester; Assigned Characteristics: household members, current home ownership status, current lease type, car ownership status, reason for moving, years in current residence, length of employment at current job, reason tester can afford down payment, current lease assigned to tester; Search Characteristics: month of test, sequence of tester appointments, time of the appointment (am/pm), type of recommended building, total number of homes recommended to tester, availability of advertised home as stated by agent. Standard errors are clustered by market for consistency with sampling design.

Table 12. Discriminatory Steering by Implied Preferences for Neighborhood Attributes

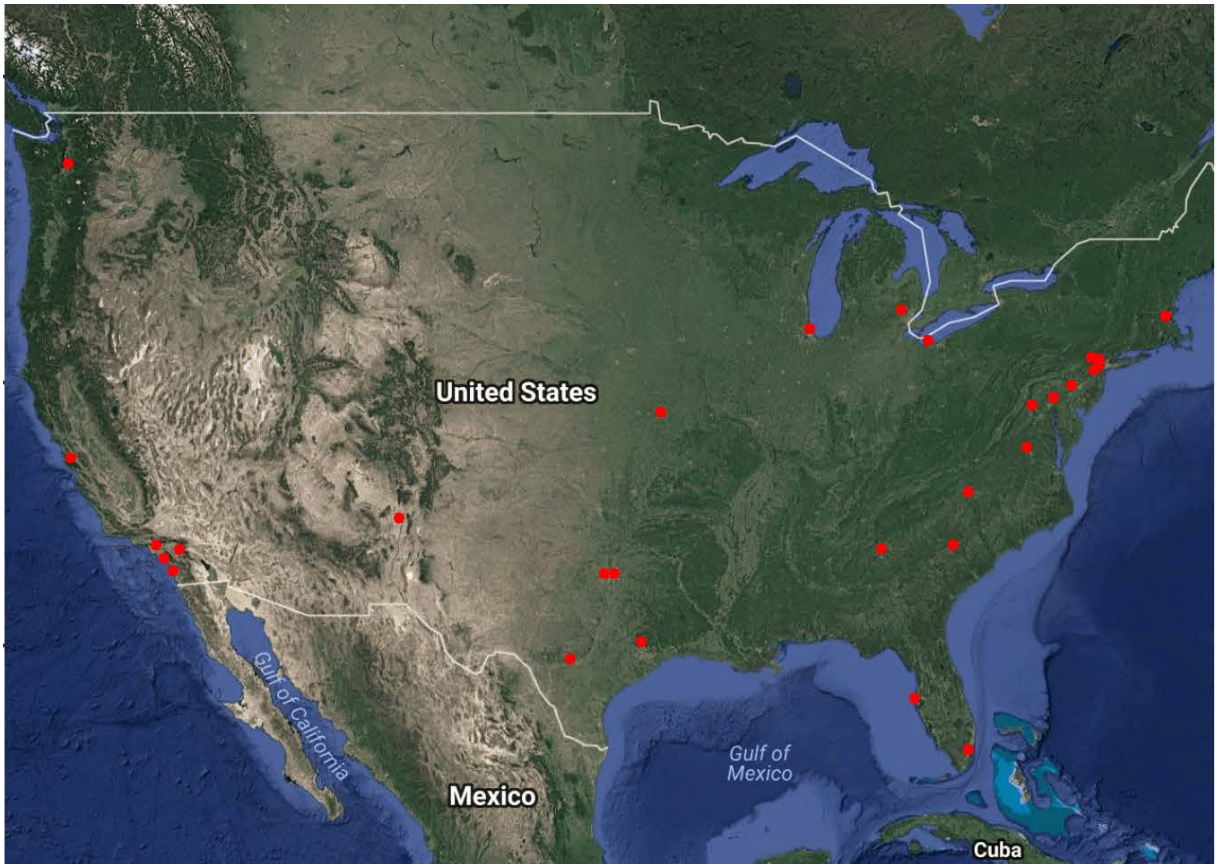
	Dependent variable: Recommended House Attribute			
	Poverty Rate	High Skill	College	Elem School
African American x Ad House Attribute	−0.0460***	−0.0180**	−0.0182**	−0.0783***
	(0.0160)	(0.0073)	(0.0072)	(0.0107)
Hispanic x Ad House Attribute	0.0176	−0.0186**	−0.0049	−0.0205*
	(0.0176)	(0.0077)	(0.0077)	(0.0118)
Asian x Ad House Attribute	0.0659***	0.0390***	0.0157**	−0.0082
	(0.0188)	(0.0074)	(0.0075)	(0.0106)
Other x Ad House Attribute	−0.1472***	−0.0285	−0.0028	−0.0529*
	(0.0440)	(0.0274)	(0.0283)	(0.0290)
Ad House Attribute	0.1746***	0.2733***	0.3489***	0.4343***
	(0.0102)	(0.0093)	(0.0089)	(0.0119)
Comparison Mean (White)	0.0818	0.4823	0.5223	6.401
Observations	21,342	21,342	21,342	10,743
Adjusted R^2	0.3645	0.5777	0.6528	0.6329

	Dependent variable: Recommended House Attribute			
	Assaults	Superfund	Toxics	PM
African American x Ad House Attribute	−0.1315***	−0.0287	−0.6713***	−0.0044*
	(0.0201)	(0.0470)	(0.0147)	(0.0023)
Hispanic x Ad House Attribute	0.1258***	0.0719	−0.4651***	0.0029
	(0.0191)	(0.0743)	(0.0163)	(0.0024)
Asian x Ad House Attribute	−0.0635***	−0.2831***	−0.3830***	−0.0125***
	(0.0190)	(0.1041)	(0.0327)	(0.0022)
Other x Ad House Attribute	0.1026	0.1572	−0.3376***	0.0098
	(0.0732)	(0.2018)	(0.0714)	(0.0084)
Ad House Attribute	0.3020***	0.2100***	0.6772***	0.3336***
	(0.0106)	(0.0437)	(0.0147)	(0.0072)
Comparison Mean (White)	80.43	0.3489	5079.6	9.414
Observations	10,888	21,354	21,376	21,354
Adjusted R^2	0.6650	0.8101	0.5876	0.9462

*p<0.1; **p<0.05; ***p<0.01

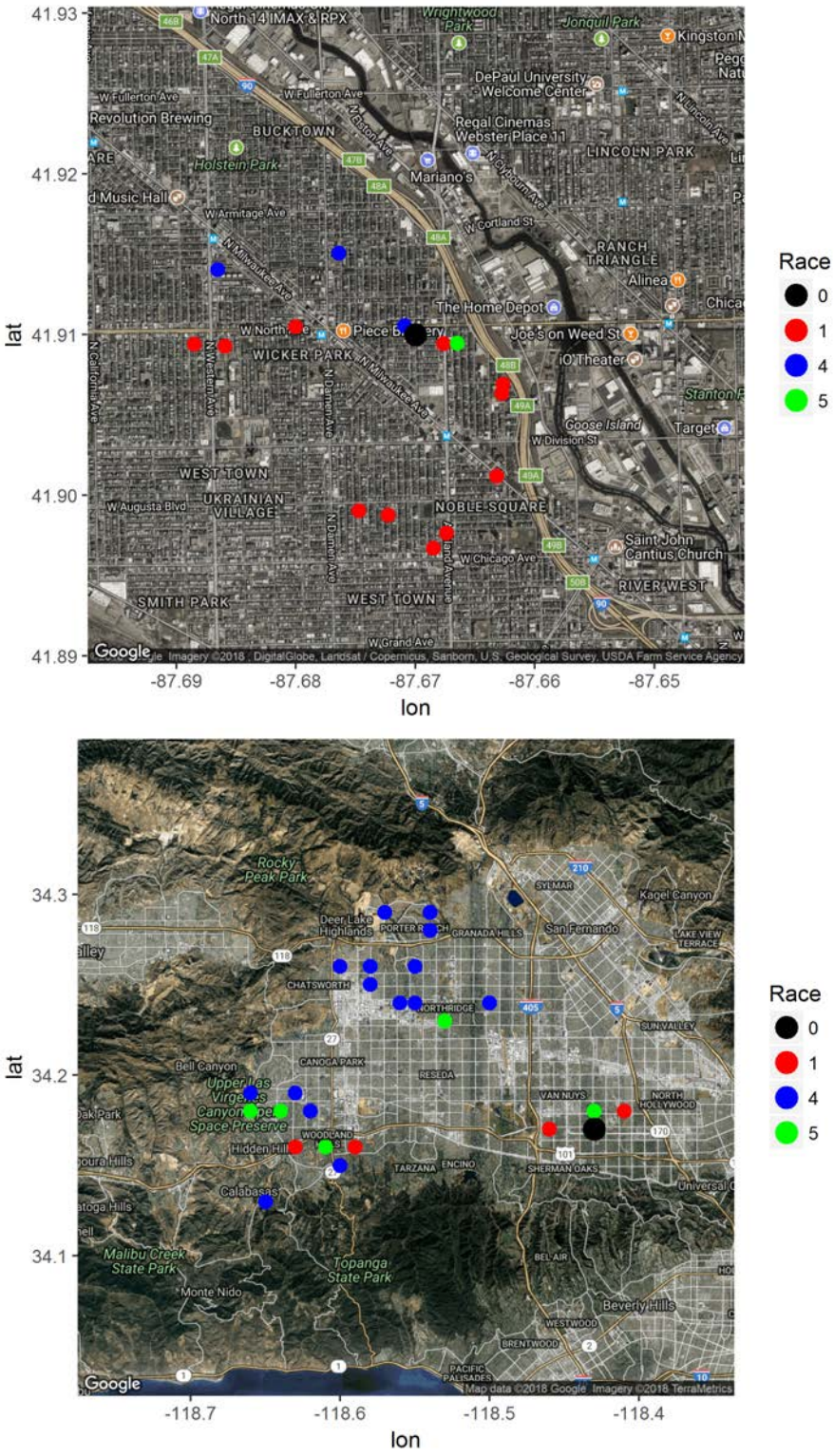
Note: Coefficients report differences in the neighborhoods recommended to minority testers relative to a white tester (the omitted category). Racial minority encompasses all individual minority groups. All regression specifications control for the full set of actor characteristics, assigned characteristics, and search Characteristics. Actor characteristics: tester income, tester household income, gender of tester, age of tester, month of test, educational attainment of tester; Assigned Characteristics: household members, current home ownership status, current lease type, car ownership status, reason for moving, years in current residence, length of employment at current job, reason tester can afford down payment, current lease assigned to tester; Search Characteristics: month of test, sequence of tester appointments, time of the appointment (am/pm), type of recommended building, total number of homes recommended to tester, availability of advertised home as stated by agent. Standard errors are clustered by market for consistency with sampling design.

Figure 1. Markets in 2012 HUD Buyer Experiment



Note: Red points indentify the location of 28 markets utilized in 2012 HDS study. See Turner et al. (2013) for detailed discussion of sampling design and methodology.

Figure 2. Trial Maps: Chicago and Los Angeles



Note: Example of listings data for a tester pair from an HDS 2012 trial in Chicago (above) and Los Angeles (below). Black points identify the advertised listing (Race= 0). Red points identify homes recommended to white tester (Race= 1). Blue points identify homes recommended to Asian tester (Race= 4). Green points identify homes recommended to both testers (Race= 5).

Online Appendix

A Model of Discrimination in Housing Search

In this section, we develop a model of housing search, paying particular attention to interactions with the real estate broker. A homebuyer with income y_i can observe many attributes of houses (X_k) along with neighborhood characteristics (N_k) and price (p_k).[37] Each individual will have a vector of preference parameters $\phi_i = [\alpha_i, \beta_i, \gamma_i]$ that determine the utility derived from house k:

$$U_{i,k} = \alpha_i ln(y_i - p_k) + X_k'\beta_i + N_k'\gamma_i + \epsilon_{i,k} \tag{.1}$$

where

$$\alpha_i = a_0 + Z_i'a_1 + u_i^a$$
$$\beta_i = b_0 + Z_i'b_1 + u_i^b$$
$$\gamma_i = g_0 + Z_i'g_1 + u_i^g$$

Z_i is a vector of observable attributes of tester i other than income, and

$$\bar{u} = \begin{pmatrix} u_i^a \\ u_i^b \\ u_i^g \end{pmatrix} \sim N\left(\begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}, \Sigma\right)$$

where the distribution of individual preference parameters is defined by the underlying parameter vector $\theta = [a_0, a_1, b_0, b_1, g_0, g_1, \Sigma]$. $\epsilon_{i,k}$ is an idiosyncratic shock specific to the individual and house. Assuming that it is distributed Type I Extreme Value, we have a closed form solution for the probability that individual i would choose house k:

$$P_{i,k} = \int \frac{\alpha_i ln(y_i - p_k) + X_k'\beta_i + N_k'\gamma_i}{\sum_{l \in \Gamma_i^*} (\alpha_i ln(y_i - p_l) + X_l'\beta_i + N_l'\gamma_i)} dF(\bar{u}) \tag{.2}$$

where Γ_i^* includes the set of all houses in i's feasible set (defined by income). The expected utility from i's choice set, Γ_i^*, is given by:

$$EU^* = \int ln\left(\sum_{l \in \Gamma_i^*} e^{\alpha_i ln(y_i - p_l) + X_l'\beta_i + N_l'\gamma_i}\right) dF(\bar{u}) \tag{.3}$$

A buyer i presents information on personal income (y_i) and other observable attributes (Z_i)[38] to a real estate agent. We assume that the agent knows the conditional distribution of preferences from which the tester's preferences are drawn, $F(\phi|Z_i, y_i, \theta)$, and may use this information in some capacity when selecting a set of recommended homes to show to

[37] We assume a buyer with access to a real estate search tool, which provides information about house and neighborhood attributes. X_k may include housing type (house, condominium, townhouse, mobile home), total rooms, bathrooms, bedrooms, square footage, lot size, and year built. N_k might include crime rate, air pollution and other environmental nuisances, school quality, and characteristics of the local population including poverty rate, educational attainment, race and income.

[38] In particular, we focus on race, but a richer model is possible with other financial information and borrowing constraints, household characteristics, and current home ownership status. We abstract away from those characteristics in this parsimonious model of utility, but they are implicitly included in the paired-tester experimental design and empirical tests (being held constant across testers).

buyer i. Our study focuses on bias in the definition of that set of recommended homes.

$$\Gamma_i^* | F(\phi | Z_i, y_i, \theta) \rightarrow \tilde{\Gamma}_i \tag{.4}$$

The set of recommendations that the agent provides to a buyer i will yield the following expected utility:

$$EU' = \int ln \left(\sum_{l \in \tilde{\Gamma}_i} e^{\alpha_i ln(y_i - p_l) + X_l' \beta_i + N_l' \gamma_i} \right) dF(\bar{u}) \tag{.5}$$

Denote the cardinality of the set $\tilde{\Gamma}_i$ by $\#(\tilde{\Gamma}_i)$. Previous work (Yinger, 1997) has focused on the number of recommended homes. Indeed, in our model the smaller is n_i, the smaller will be EU' by construction – i.e., more recommendations are always better. However, the previous equation makes clear that EU' will also be lower the more $\tilde{\Gamma}_i$ deviates from individual i's optimal choice, conditional upon the size of the choice set.

Given the advertised house "chosen" by the tester (k^*), it is possible that the real estate agent could update her impressions of the tester's preferences based in the following formula:

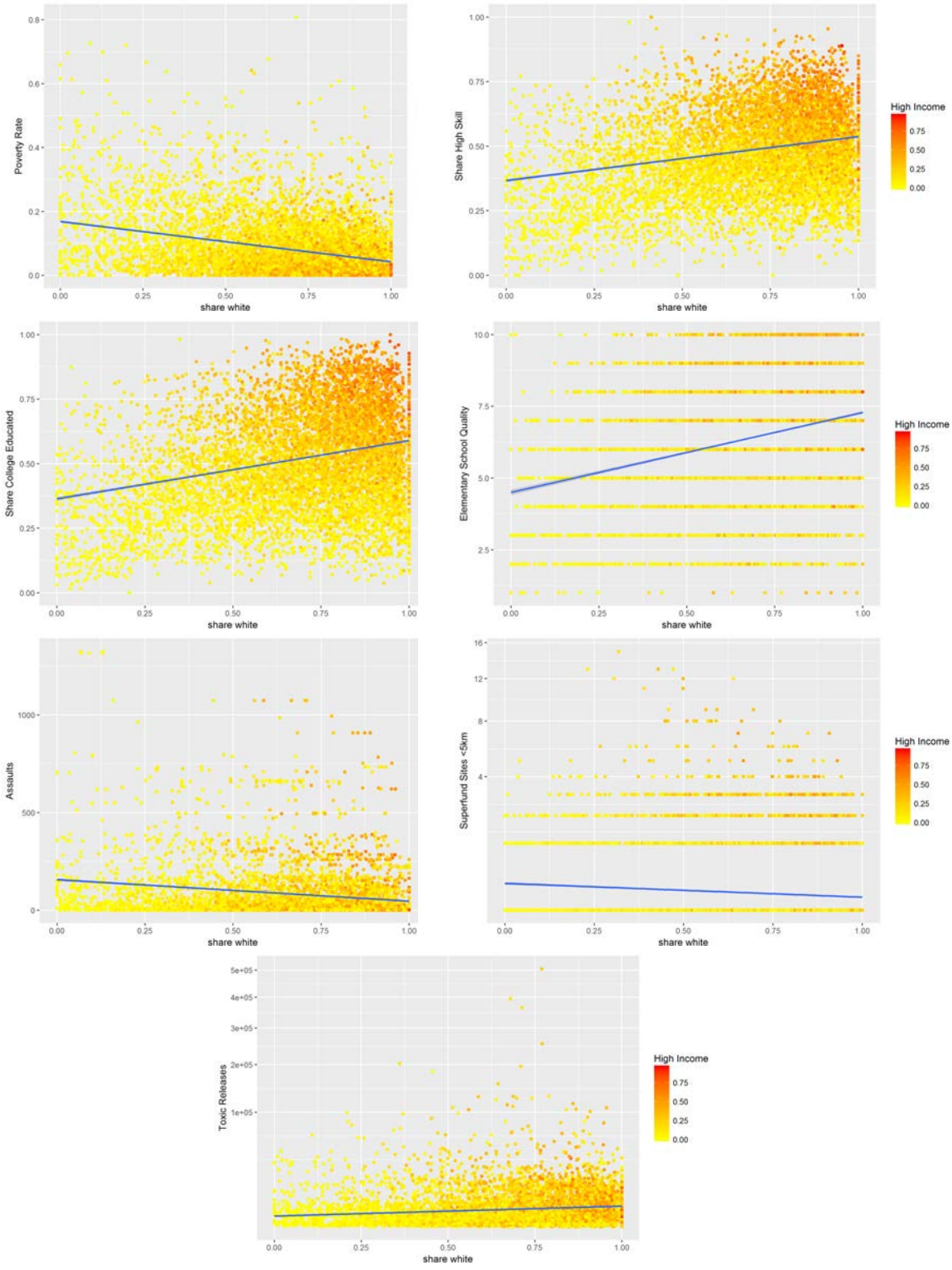
$$h(\phi | k^*, y_i, Z_i, \theta) = \frac{P(k^* | y_i, Z_i, \phi) g(\phi | y_i, Z_i, \theta)}{P(k^* | y_i, Z_i, \theta)}$$

$$\bar{\phi}_{k^*} = \int \phi h(\phi | k^*, y_i, Z_i, \theta) d\phi$$

Choosing a recommendation set based on these updated preferences, $\bar{\phi}_{k^*}$, will unambiguously improve expected utility of the tester, conditional upon the number of recommendations. In the analysis below, we test whether real estate agents incorporate individual testers' expressed preferences and whether the tendency to do so differs with tester race.

B Racial Composition, Incomes, and Neighborhood Characteristics

Figure B.1. White Share, Incomes and Neighborhood Characteristics



Note: Raw correlations between white share of households in census block group and neighborhood characteristics for all recommended homes in HDS 2012. Color of points delineates fraction of high income households in census block group.

C Steering and Neighborhood Racial Composition

This section replicates estimates of steering by neighborhood racial composition reported as white shares in Tables 6 and 7 using shares of each minority group.

Table C.1. Differential Steering and Neighborhood Racial Composition: African American Share

	Dep. Variable: African American Household Share				
	I	II	III	IV	V
Racial Minority	0.0164**	0.0164**	0.0165**	0.0166**	0.0167**
	(0.0081)	(0.0081)	(0.0081)	(0.0081)	(0.0080)
African American	0.0396***	0.0397***	0.0399***	0.0401***	0.0404***
	(0.0123)	(0.0123)	(0.0123)	(0.0124)	(0.0123)
Hispanic	0.0127	0.0127	0.0127	0.0127	0.0127
	(0.0095)	(0.0095)	(0.0095)	(0.0095)	(0.0095)
Asian	−0.0065	−0.0065	−0.0064	−0.0064	−0.0063
	(0.0105)	(0.0105)	(0.0105)	(0.0105)	(0.0105)
Other	−0.0045	−0.0045	−0.0049	−0.0054	−0.0052
	(0.0337)	(0.0337)	(0.0336)	(0.0336)	(0.0336)
Share Black Advert Home	*N*	*Y*	*Y*	*Y*	*Y*
ln(Price) Advert Home	*N*	*N*	*Y*	*Y*	*Y*
Racial Comp Advert Home	*N*	*N*	*N*	*Y*	*Y*
Poverty Share Advert Home	*N*	*N*	*N*	*N*	*Y*
Observations	21,517	21,506	21,488	21,488	21,488
Adjusted R^2	0.7736	0.7738	0.7724	0.7724	0.7724

*p<0.1; **p<0.05; ***p<0.01

Table C.2. Differential Steering and Neighborhood Racial Composition by Income: African American Share

	Dep. Variable: African American Household Share by Income		
	High Inc	Mid Inc	Low Inc
Racial Minority	0.0020	0.0098**	0.0051
	(0.0013)	(0.0041)	(0.0046)
African American	0.0052***	0.0176***	0.0178***
	(0.0018)	(0.0068)	(0.0065)
Hispanic	0.0005	0.0069	0.0055
	(0.0017)	(0.0046)	(0.0055)
Asian	0.0000	0.0030	−0.0094
	(0.0017)	(0.0047)	(0.0063)
Other	0.0013	−0.0084	0.0019
	(0.0054)	(0.0170)	(0.0202)
ln(Price) Advert Home	*Y*	*Y*	*Y*
Racial Comp Advert Home	*Y*	*Y*	*Y*
Poverty Share Advert Home	*Y*	*Y*	*Y*
Observations	21,500	21,500	21,500
Adjusted R^2	0.7297	0.7625	0.6704

*p<0.1; **p<0.05; ***p<0.01

Note: Coefficients report differences in the racial composition (by income) of neighborhoods recommended to minority testers relative to a white tester (the omitted category). Racial minority encompasses all individual minority groups. All regression specifications control for the full set of actor characteristics, assigned characteristics, and search Characteristics. Actor characteristics: tester income, tester household income, gender of tester, age of tester, month of test, educational attainment of tester; Assigned Characteristics: household members, current home ownership status, current lease type, car ownership status, reason for moving, years in current residence, length of employment at current job, reason tester can afford down payment, current lease assigned to tester; Search Characteristics: month of test, sequence of tester appointments, time of the appointment (am/pm), type of recommended building, total number of homes recommended to tester, availability of advertised home as stated by agent. Standard errors are clustered by market for consistency with sampling design.

Table C.3. Differential Steering and Neighborhood Racial Composition: Hispanic Share

	Dep. Variable: Hispanic Household Share				
	I	II	III	IV	V
Racial Minority	0.0038	0.0039	0.0040	0.0039	0.0038
	(0.0079)	(0.0079)	(0.0079)	(0.0079)	(0.0079)
African American	0.0152	0.0152	0.0154	0.0153	0.0151
	(0.0115)	(0.0115)	(0.0114)	(0.0115)	(0.0115)
Hispanic	−0.0010	−0.0009	−0.0008	−0.0009	−0.0009
	(0.0102)	(0.0102)	(0.0102)	(0.0102)	(0.0102)
Asian	−0.0073	−0.0073	−0.0073	−0.0074	−0.0074
	(0.0098)	(0.0098)	(0.0098)	(0.0098)	(0.0098)
Other	−0.0323	−0.0322	−0.0327	−0.0325	−0.0326
	(0.0305)	(0.0305)	(0.0305)	(0.0305)	(0.0304)
Share Hispanic Advert Home	*N*	*Y*	*Y*	*Y*	*Y*
ln(Price) Advert Home	*N*	*N*	*Y*	*Y*	*Y*
Racial Comp Advert Home	*N*	*N*	*N*	*Y*	*Y*
Poverty Share Advert Home	*N*	*N*	*N*	*N*	*Y*
Observations	21,517	21,506	21,488	21,488	21,488
Adjusted R^2	0.8452	0.8451	0.8452	0.8452	0.8452

*p<0.1; **p<0.05; ***p<0.01

Table C.4. Differential Steering and Neighborhood Racial Composition by Income: Hispanic Share

	Dep. Var: Hispanic Household Share by Income		
	High Inc	Mid Inc	Low Inc
Racial Minority	0.0016	−0.0012	0.0030
	(0.0019)	(0.0044)	(0.0048)
African American	0.0054*	0.0039	0.0055
	(0.0029)	(0.0054)	(0.0081)
Hispanic	−0.0017	−0.0049	0.0050
	(0.0026)	(0.0063)	(0.0063)
Asian	−0.0011	−0.0043	−0.0022
	(0.0027)	(0.0056)	(0.0052)
Other	−0.0165*	−0.0113	−0.0054
	(0.0085)	(0.0193)	(0.0114)
ln(Price) Advert Home	*Y*	*Y*	*Y*
Racial Comp Advert Home	*Y*	*Y*	*Y*
Poverty Share Advert Home	*Y*	*Y*	*Y*
Observations	21,500	21,500	21,500
Adjusted R^2	0.6518	0.8330	0.7123

*p<0.1; **p<0.05; ***p<0.01

Note: Coefficients report differences in the racial composition (by income) of neighborhoods recommended to minority testers relative to a white tester (the omitted category). Racial minority encompasses all individual minority groups. All regression specifications control for the full set of actor characteristics, assigned characteristics, and search Characteristics. Actor characteristics: tester income, tester household income, gender of tester, age of tester, month of test, educational attainment of tester; Assigned Characteristics: household members, current home ownership status, current lease type, car ownership status, reason for moving, years in current residence, length of employment at current job, reason tester can afford down payment, current lease assigned to tester; Search Characteristics: month of test, sequence of tester appointments, time of the appointment (am/pm), type of recommended building, total number of homes recommended to tester, availability of advertised home as stated by agent. Standard errors are clustered by market for consistency with sampling design.

Table C.5. Differential Steering and Neighborhood Racial Composition: Asian Share

	Dep. Variable: Asian Household Share				
	I	II	III	IV	V
Racial Minority	−0.0087	−0.0087	−0.0087	−0.0085	−0.0085
	(0.0059)	(0.0058)	(0.0058)	(0.0058)	(0.0058)
African American	−0.0144*	−0.0143*	−0.0143*	−0.0142*	−0.0142*
	(0.0075)	(0.0074)	(0.0074)	(0.0074)	(0.0074)
Hispanic	−0.0143*	−0.0146*	−0.0147*	−0.0145*	−0.0145*
	(0.0086)	(0.0085)	(0.0085)	(0.0085)	(0.0085)
Asian	0.0014	0.0014	0.0015	0.0016	0.0016
	(0.0072)	(0.0072)	(0.0072)	(0.0072)	(0.0072)
Other	−0.0224	−0.0228	−0.0228	−0.0228	−0.0229
	(0.0178)	(0.0179)	(0.0179)	(0.0179)	(0.0179)
Share Asian Advert Home	*N*	*Y*	*Y*	*Y*	*Y*
ln(Price) Advert Home	*N*	*N*	*Y*	*Y*	*Y*
Racial Comp Advert Home	*N*	*N*	*N*	*Y*	*Y*
Poverty Share Advert Home	*N*	*N*	*N*	*N*	*Y*
Observations	21,517	21,506	21,488	21,488	21,488
Adjusted R^2	0.7438	0.7438	0.7438	0.7438	0.7437

*p<0.1; **p<0.05; ***p<0.01

Table C.6. Differential Steering and Neighborhood Racial Composition by Income: Asian Share

	Dep. Variable: Asian Household Share by Income		
	High Inc	Mid Inc	Low Inc
Racial Minority	−0.0021	−0.0036	−0.0023
	(0.0021)	(0.0030)	(0.0024)
African American	−0.0033	−0.0068*	−0.0040
	(0.0026)	(0.0036)	(0.0033)
Hispanic	−0.0034	−0.0047	−0.0055*
	(0.0033)	(0.0046)	(0.0032)
Asian	0.0013	−0.0002	0.0010
	(0.0026)	(0.0037)	(0.0030)
Other	0.0060	−0.0118	−0.0189*
	(0.0064)	(0.0126)	(0.0103)
ln(Price) Advert Home	*Y*	*Y*	*Y*
Racial Comp Advert Home	*Y*	*Y*	*Y*
Poverty Share Advert Home	*Y*	*Y*	*Y*
Observations	21,500	21,500	21,500
Adjusted R^2	0.6869	0.7234	0.6256
Note:			*p<0.1; **p<0.05; ***p<0.01

Note: Coefficients report differences in the racial composition (by income) of neighborhoods recommended to minority testers relative to a white tester (the omitted category). Racial minority encompasses all individual minority groups. All regression specifications control for the full set of actor characteristics, assigned characteristics, and search Characteristics. Actor characteristics: tester income, tester household income, gender of tester, age of tester, month of test, educational attainment of tester; Assigned Characteristics: household members, current home ownership status, current lease type, car ownership status, reason for moving, years in current residence, length of employment at current job, reason tester can afford down payment, current lease assigned to tester; Search Characteristics: month of test, sequence of tester appointments, time of the appointment (am/pm), type of recommended building, total number of homes recommended to tester, availability of advertised home as stated by agent. Standard errors are clustered by market for consistency with sampling design.

D Steering and Neighborhood Poverty: Census Block Group vs Census Tract Measures

This section explores differences in steering into high poverty neighborhoods reported in the present study versus differences documented by Turner et al. (2013) in the initial HDS 2012 report. Replication code is not available for the steering-into-poverty tests or racial composition test from the HDS 2012 report. We therefore construct tests that are as similar as possible to the description provided in Turner et al. (2013) using publicly available data files that contain census tract measures of poverty rates and white shares used by the authors.

Table D.1 reports estimates of differences for African Americans relative to white testers, which are the main results in the present paper that are in the prior report. We compare results on white shares and poverty rates using the primary specification with block group measures used in the present study (Column 1), comparable specifications with/without controls that use census tract measures (Columns 2-3), and specifications that aggregate recommendations by tester and also use census tract measures (Columns 4-5). The tests reported in the final two columns are the most similar to those reported in Turner et al. (2013), though we note some difference in sample sizes that we cannot explain and stress that this is an approximate and not an exact replication. We note a substantial number of null values in RHGEO dataset, which contains the census tract data used in Turner et al. (2013). This constraints the total sample size relative to the tester dataset that is merged with block group measures.

Both sets of results indicate that the power and the magnitude of effects diminishes as a result of aggregation of neighborhood measures (census tract) and by tester. The choice of controls also affects estimate magnitudes, but less so. The most important effect appears to be the use of census block group versus census tract measures, which increase the estimates of differences in white neighborhoods shares by up to one third in the test of white shares and by up to about half in the test of poverty rates. Smaller estimates of differences when using tract-level measures could be especially important given the fact that housing recommendations in the HDS 2012 were highly localized: 33% of housing recommendations in the audit occur within a single census tract. Figure 2 illustrates the geographic range of a housing search for two trials in the 2012 HDS.

We note that estimates of differences become even smaller and tests less powered when we aggregate to the level of a tester recommendation set and compare differences in means. We find a difference of 2.8% [0.87] for differences in white shares when the test is constructed in this way, which is larger but not statistically different from the the 1.8% [0.8] difference reported in Turner et al. (2013). For differences in poverty rates, we estimate insignificant differences of for homes in tracts with a .27% [0.29] smaller share of white households than a white tester, which is very similar to the difference of .2% [0.2] that is documented in the report. Variation in poverty rates between block groups appears to be particularly diminished when using census tract measures. For instance, while the tract-level poverty rate (8.5%) is similar to the average block group-level poverty rate (8.6%) for the average home in the HDS sample, the standard deviation of neighborhood poverty rates for the set of homes within a given trial is substantially smaller when using the tract-level measure of poverty: 3.79% at the tract level vs. 5.02% at the block group level. The standard deviation of block group-level poverty rates within the average census tract where recommendations are made in the study also appears to be quite

large: 3%. When considering that the average neighborhood level poverty rate is 8.6%[39], it becomes clear that using tract-level measures may mask considerable heterogeneity in the neighborhoods that testers are steered into.

Table D.2. Differential Steering and White Share

	Dep. Variable: White Share				
	Block Gr	Tract	Tract	Tester Mean	Tester Mean
African American	−0.0430***	−0.0315*	−0.0358**	−0.0280***	−0.0294**
	(0.0166)	(0.0166)	(0.0164)	(0.0087)	(0.0135)
Poverty Rate Advert Home	*Y*	*N*	*Y*	*N*	*Y*
Racial Comp Advert Home	*Y*	*N*	*Y*	*N*	*Y*
ln(Price) Advert Home	*Y*	*N*	*Y*	*N*	*Y*
Observations	21,458	15,270	14,342	498	480
Adjusted R^2	0.7788	0.8320	0.8293	0.7598	0.7492
	Dep. Variable: Poverty Rate				
	Block Gr	Tract	Tract	Tester-Tract	Tester-Tract
African American	0.0159*	0.0093	0.0077	0.0027	0.0027
	(0.0088)	(0.0076)	(0.0075)	(0.0032)	(0.0029)
Poverty Rate Advert Home	*Y*	*N*	*Y*	*N*	*Y*
Racial Comp Advert Home	*Y*	*N*	*Y*	*N*	*Y*
ln(Price) Advert Home	*Y*	*N*	*Y*	*N*	*Y*
Observations	20,133	15,269	14,341	498	480
Adjusted R^2	0.5310	0.5877	0.5926	0.6721	0.7071
Note:					*p<0.1; **p<0.05; ***p<0.01

Note: Coefficients report differences in the poverty rates in neighborhoods recommended to minority testers relative to a white tester (the omitted category). Columns 1-3 report estimates from main specifications that measure outcomes at the block group level, whereas columns 4-6 report estimates from tests that measure poverty rates at the census Tract level (data come from (Turner et al., 2013). All regression specifications control for the full set of actor characteristics, assigned characteristics, and search Characteristics. Actor characteristics: tester income, tester household income, gender of tester, age of tester, month of test, educational attainment of tester; Assigned Characteristics: household members, current home ownership status, current lease type, car ownership status, reason for moving, years in current residence, length of employment at current job, reason tester can afford down payment, current lease assigned to tester; Search Characteristics: month of test, sequence of tester appointments, time of the appointment (am/pm), type of recommended building, total number of homes recommended to tester, availability of advertised home as stated by agent. Standard errors are clustered by market for consistency with sampling design.

[39]The average neighborhood level poverty rate is 8.5% when measured at the tract level.

E Discriminatory Steering and Home Price

This section provides a test of differences in the prices of homes recommended to minority testers relative to a white counterpart. We do not find any evidence that minority testers receive recommendations for lower priced homes relative to their white paired testers or fewer recommendations. Looking at point estimates alone, it appears that homes recommended to Hispanic/LatinX buyers may be moderately less expensive than those recommended to their white counterparts, but that African American and Asian buyers receive recommendations that may somewhat more expensive on average. Along with the tests of differences within tight intervals of price reported in Column 3 of Table F.1, we take these findings as evidence that the primary results on steering that are documented in this paper are not explained by steering of minority buyers into more affordable neighborhoods.

Table E.1. Discriminatory Steering and Home Price

	Dependent variable: log(Price)		
	1	2	3
Racial Minority	−0.0057	−0.0046	0.0043
	(0.1155)	(0.1164)	(0.1099)
African American	0.0659	0.0648	0.0823
	(0.1790)	(0.1792)	(0.1737)
Hispanic	−0.1657	−0.1622	−0.1594
	(0.1106)	(0.1114)	(0.1024)
Asian	0.0597	0.0598	0.0621
	(0.1070)	(0.1075)	(0.1003)
Other	−0.2234	−0.2189	−0.2554
	(0.2791)	(0.2766)	(0.2781)
Racial Comp Advert Home	*N*	*Y*	*Y*
ln(Price) Advert Home	*N*	*N*	*Y*
Observations	21,785	21,774	21,761
Adjusted R^2	0.7228	0.7226	0.7245

*p<0.1; **p<0.05; ***p<0.01

Note: Coefficients report differences in the listing prices of homes recommended to minority testers relative to a white tester (the omitted category). Racial minority encompasses all individual minority groups. All regression specifications control for the full set of actor characteristics, assigned characteristics, and search Characteristics. Actor characteristics: tester income, tester household income, gender of tester, age of tester, month of test, educational attainment of tester; Assigned Characteristics: household members, current home ownership status, current lease type, car ownership status, reason for moving, years in current residence, length of employment at current job, reason tester can afford down payment, current lease assigned to tester; Search Characteristics: month of test, sequence of tester appointments, time of the appointment (am/pm), type of recommended building, total number of homes recommended to tester, availability of advertised home as stated by agent. Standard errors are clustered by market for consistency with sampling design.

F Steering and Neighborhood Effects: Controls

This section compares three alternate specifications for the main tests reported in Table 8. The first column under each attribute reports estimates from specifications that drop controls for the attributes of advertised homes (buyer preferences). Column 2 reports estimates from the preferred specification in the paper. Estimates do not change when the implied preferences of buyers are added as controls, indicating that these do not appear to affect differences in recommendations made to minority buyers relative to a white counterpart. Column 3 adds a control for the average level of the particular neighborhood attribute being considered among recommended homes within a tight interval of price (within intervals of $20,000). Reported estimates of differences do not change with the addition of this control, suggesting that minorities are steered into homes with worse attributes than others at a similar price point and that the neighborhood steering behavior documented in this study is not explained by differential steering of buyers into neighborhoods that are simply more affordable. This evidence is consistent with the findings reported in Appendix E.

Table F.1. Discriminatory Steering and Neighborhood Effects: Robustness

	Dependent variable:								
	Poverty Rate			High Skill			College		
Racial Minority	0.0126**	0.0125**	0.0155**	−0.0222*	−0.0228**	−0.0220**	−0.0161	−0.0161	−0.0139
	(0.0061)	(0.0060)	(0.0064)	(0.0116)	(0.0115)	(0.0110)	(0.0113)	(0.0113)	(0.0120)
African American	0.0122	0.0124	0.0159*	−0.0271*	−0.0272*	−0.0281**	−0.0304**	−0.0304**	−0.0282*
	(0.0086)	(0.0085)	(0.0088)	(0.0151)	(0.0151)	(0.0137)	(0.0143)	(0.0144)	(0.0145)
Hispanic	0.0217***	0.0216***	0.0247***	−0.0326**	−0.0348**	−0.0294**	−0.0177	−0.0184	−0.0128
	(0.0084)	(0.0082)	(0.0087)	(0.0151)	(0.0149)	(0.0141)	(0.0140)	(0.0141)	(0.0146)
Asian	0.0009	0.0005	0.0019	−0.0061	−0.0059	−0.0063	0.0017	0.0023	0.0044
	(0.0077)	(0.0076)	(0.0081)	(0.0144)	(0.0143)	(0.0147)	(0.0152)	(0.0153)	(0.0163)
Other	−0.0268	−0.0272	−0.0245	−0.0004	−0.0021	0.0035	0.0043	0.0050	0.0185
	(0.0255)	(0.0256)	(0.0254)	(0.0462)	(0.0458)	(0.0453)	(0.0403)	(0.0401)	(0.0438)
Outcome Advert Home	*N*	*Y*	*Y*	*N*	*Y*	*Y*	*N*	*Y*	*Y*
Racial Comp Advert Home	*N*	*Y*	*Y*	*N*	*Y*	*Y*	*N*	*Y*	*Y*
ln(Price) Advert Home	*N*	*Y*	*Y*	*N*	*Y*	*Y*	*N*	*Y*	*Y*
Outcome by Price Bin	*N*	*N*	*Y*	*N*	*N*	*Y*	*N*	*N*	*Y*
Observations	21,364	21,342	20,133	21,364	21,342	20,133	21,364	21,342	20,133
Adjusted R^2	0.5224	0.5237	0.5310	0.6936	0.6937	0.7034	0.7558	0.7560	0.7664

*p<0.1; **p<0.05; ***p<0.01

	Dependent variable:								
	Superfund Prox			Toxic Releases			PM		
Racial Minority	0.1006***	0.0997***	0.1004***	805.8466**	787.9887**	786.6876**	−0.0464	−0.0448	−0.0445
	(0.0362)	(0.0360)	(0.0361)	(356.5548)	(355.1027)	(354.3281)	(0.0581)	(0.0580)	(0.0580)
African American	0.1233**	0.1206**	0.1210**	946.0394**	915.4476**	959.5564**	−0.0233	−0.0228	−0.0165
	(0.0518)	(0.0517)	(0.0515)	(452.4100)	(447.0242)	(450.1002)	(0.0778)	(0.0777)	(0.0773)
Hispanic	0.0612	0.0620	0.0647	438.9166	421.2600	383.5972	0.0009	0.0075	0.0058
	(0.0424)	(0.0419)	(0.0415)	(589.4368)	(586.4115)	(588.9472)	(0.0729)	(0.0728)	(0.0730)
Asian	0.1029**	0.1030**	0.1022*	961.9641**	955.7904**	937.5928*	−0.1269*	−0.1283*	−0.1324*
	(0.0524)	(0.0522)	(0.0523)	(486.3646)	(480.9247)	(483.0982)	(0.0706)	(0.0704)	(0.0705)
Other	−0.1284	−0.1229	−0.1192	−663.3114	−664.3224	−707.4001	−0.0616	−0.0588	−0.0583
	(0.1880)	(0.1875)	(0.1874)	(1,731.3800)	(1,726.1620)	(1,734.3390)	(0.2156)	(0.2170)	(0.2173)
Outcome Advert Home	*N*	*Y*	*Y*	*N*	*Y*	*Y*	*N*	*Y*	*Y*
Racial Comp Advert Home	*N*	*Y*	*Y*	*N*	*Y*	*Y*	*N*	*Y*	*Y*
ln(Price) Advert Home	*N*	*Y*	*Y*	*N*	*Y*	*Y*	*N*	*Y*	*Y*
Outcome by Price Bin	*N*	*N*	*Y*	*N*	*N*	*Y*	*N*	*N*	*Y*
Observations	21,376	21,354	21,354	21,376	21,354	21,354	21,376	21,354	21,354
Adjusted R^2	0.8760	0.8760	0.8762	0.6889	0.6888	0.6890	0.9634	0.9634	0.9634

*p<0.1; **p<0.05; ***p<0.01

Note: Coefficients report differences in the attributes of neighborhoods recommended to minority testers relative to a white tester (the omitted category). Racial minority encompasses all individual minority groups. All regression specifications control for the full set of actor characteristics, assigned characteristics, and search Characteristics. Actor characteristics: tester income, tester household income, gender of tester, age of tester, month of test, educational attainment of tester; Assigned Characteristics: household members, current home ownership status, current lease type, car ownership status, reason for moving, years in current residence, length of employment at current job, reason tester can afford down payment, current lease assigned to tester; Search Characteristics: month of test, sequence of tester appointments, time of the appointment (am/pm), type of recommended building, total number of homes recommended to tester, availability of advertised home as stated by agent. Standard errors are clustered by market for consistency with sampling design.

Table F.2 provides a variant of the main specifications which adds the (lagged) racial composition of each census block group as reported in the 2000 Census. Differences in the poverty level, skill level, and level of college attainment of neighborhoods recommended to African American households can be partially but not fully explained by lagged racial composition of neighborhoods. The historical racial composition of neighborhoods does not appear to explain differences for Hispanic/Latinx buyers or for differences in neighborhood assaults of exposures to Superfund or chemical toxics for any of the groups.

Table F.2. Discriminatory Steering and Neighborhood Effects: 2000 Racial Composition

	Dependent variable:			
	Poverty Rate	High Skill	College	Elem School
Racial Minority	0.0094*	−0.0162	−0.0099	−0.1499
	(0.0053)	(0.0114)	(0.0108)	(0.2038)
African American	0.0050	−0.0170	−0.0183	−0.1831
	(0.0074)	(0.0142)	(0.0125)	(0.2772)
Hispanic	0.0208***	−0.0269*	−0.0119	−0.0526
	(0.0077)	(0.0144)	(0.0130)	(0.2724)
Asian	0.0019	−0.0079	−0.0016	−0.3214
	(0.0069)	(0.0150)	(0.0155)	(0.2469)
Other	−0.0100	−0.0318	−0.0264	−0.4248
	(0.0232)	(0.0437)	(0.0375)	(0.6576)
ln(Price) Advert Home	*Y*	*Y*	*Y*	*Y*
Racial Comp Advert Home	*Y*	*Y*	*Y*	*Y*
Outcome Advertised Home	*Y*	*Y*	*Y*	*Y*
Observations	21,246	21,246	21,246	10,726
Adjusted R^2	0.5854	0.7359	0.8005	0.7557

*p<0.1; **p<0.05; ***p<0.01

	Dependent variable:			
	Assaults	Superfund	Toxics	PM
Racial Minority	8.5711	0.0986***	727.2588**	−0.0423
	(7.8553)	(0.0362)	(364.0121)	(0.0581)
African American	24.0199**	0.1155**	849.6192*	−0.0250
	(12.1722)	(0.0519)	(461.6873)	(0.0789)
Hispanic	−0.3235	0.0606	471.9643	0.0176
	(9.7427)	(0.0418)	(601.2154)	(0.0724)
Asian	5.2815	0.1073**	822.5450*	−0.1262*
	(9.2107)	(0.0521)	(498.8224)	(0.0709)
Other	−10.5991	−0.1101	−276.9493	−0.0535
	(67.2045)	(0.1846)	(1,758.6820)	(0.2130)
ln(Price) Advert Home	*Y*	*Y*	*Y*	*Y*
Racial Comp Advert Home	*Y*	*Y*	*Y*	*Y*
Outcome Advertised Home	*Y*	*Y*	*Y*	*Y*
Observations	10,825	21,250	21,250	21,250
Adjusted R^2	0.7975	0.8758	0.6893	0.9631

*p<0.1; **p<0.05; ***p<0.01

Note: Coefficients report differences in the attributes of neighborhoods recommended to minority testers relative to a white tester (the omitted category). Specifications replicate the estimates reported in Table 8 and add controls for the share of white, African American, Hispanic/LatinX, and Asian households from the 2000 Census. All regression specifications control for the full set of actor characteristics, assigned characteristics, and search Characteristics. Actor characteristics: tester income, tester household income, gender of tester, age of tester, month of test, educational attainment of tester; Assigned Characteristics: household members, current home ownership status, current lease type, car ownership status, reason for moving, years in current residence, length of employment at current job, reason tester can afford down payment, current lease assigned to tester; Search Characteristics: month of test, sequence of tester appointments, time of the appointment (am/pm), type of recommended building, total number of homes recommended to tester, availability of advertised home as stated by agent. Standard errors are clustered by market for consistency with sampling design.

G Discriminatory Steering and Implied Preferences

This section explores interactions between the implied preferences of buyers and discriminatory constraints facing buyers. Table G.1 tests for differences within the sample of buyers who present an advertised listing that falls above the median price in the audit ($245,000). These results suggest that the differences in poverty rate, skill, and college attainment may be amplified for African Americans who present these preferences and may be mitigated for Hispanic/LatinX buyers who present these preferences.

Table G.1. Discriminatory Steering and Neighborhood Effects: Above Median Price

	Dependent variable:			
	Poverty Rate	High Skill	College	Elem School
African American	0.0191*	−0.0355*	−0.0497***	−0.5422
	(0.0102)	(0.0199)	(0.0182)	(0.7073)
Hispanic	0.0172	−0.0142	−0.0192	−1.1563
	(0.0112)	(0.0199)	(0.0201)	(0.8471)
Asian	0.0140	0.0106	−0.0155	−0.9025
	(0.0103)	(0.0182)	(0.0185)	(0.8716)
Other	−0.0671	0.0424	0.0253	−4.5841
	(0.0497)	(0.0827)	(0.0893)	(4.8830)
Observations	10,633	10,633	10,633	4,814
Adjusted R^2	0.5599	0.6861	0.7245	0.7459

*p<0.1; **p<0.05; ***p<0.01

	Dependent variable:			
	Assaults	Superfund	Toxics	PM
African American	−23.2490	0.0559	825.8931	0.0668
	(38.0806)	(0.0793)	(1,933.0740)	(0.0995)
Hispanic	−48.3694	0.0445	1,777.9350	0.0833
	(49.2734)	(0.0877)	(2,128.0520)	(0.1096)
Asian	9.3051	0.0240	913.0304	−0.1420
	(29.0310)	(0.0807)	(1,965.9850)	(0.1016)
Other	141.5192	−0.6943*	3,630.4060	0.2256
	(246.0337)	(0.3877)	(9,469.7310)	(0.4876)
Observations	5,199	10,645	10,645	10,645
Adjusted R^2	0.8401	0.8771	0.6025	0.9606

*p<0.1; **p<0.05; ***p<0.01

Note: Coefficients report differences in the attributes of neighborhoods recommended to minority testers relative to a white tester (the omitted category) within the sample of testers presenting an advertised home that is listed above $245,000. All regression specifications control for the full set of actor characteristics, assigned characteristics, and search Characteristics. Actor characteristics: tester income, tester household income, gender of tester, age of tester, month of test, educational attainment of tester; Assigned Characteristics: household members, current home ownership status, current lease type, car ownership status, reason for moving, years in current residence, length of employment at current job, reason tester can afford down payment, current lease assigned to tester; Search Characteristics: month of test, sequence of tester appointments, time of the appointment (am/pm), type of recommended building, total number of homes recommended to tester, availability of advertised home as stated by agent. Standard errors are clustered by market for consistency with sampling design.

Table G.2 tests for differences within the sample of buyers who present an advertised listing that falls above the median price in the audit (1,872 square feet). Results are qualitatively consistent with those presented for higher priced homes, which is highly correlated with home size. However, the amplification of steering of African American buyers into lower skill and lower college attainment neighborhoods is considerably larger for this subsample.

Table G.2. Discriminatory Steering and Neighborhood Effects: Above Median Size

	Dependent variable:			
	Poverty Rate	High Skill	College	Elem School
African American	0.0246	-0.0814^{***}	-0.1040^{***}	-0.1095
	(0.0180)	(0.0297)	(0.0316)	(0.6570)
Hispanic	0.0144	-0.0012	-0.0326	-0.6689
	(0.0198)	(0.0326)	(0.0347)	(0.6635)
Asian	-0.0229	-0.0302	-0.0072	-1.2742^{*}
	(0.0190)	(0.0313)	(0.0333)	(0.6837)
Other	-0.0794^{*}	-0.0322	0.0830	-0.1433
	(0.0466)	(0.0767)	(0.0817)	(1.7176)
Observations	7,745	7,745	7,745	5,529
Adjusted R^2	0.5150	0.6616	0.7371	0.7342

*p<0.1; **p<0.05; ***p<0.01

	Dependent variable:			
	Assaults	Superfund	Toxics	PM
African American	17.2982	0.2102^{**}	-740.4405	-0.2257
	(38.7115)	(0.1003)	(1,683.3640)	(0.1742)
Hispanic	-44.9498	-0.1447	-713.8703	-0.4097^{**}
	(59.0451)	(0.1102)	(1,849.1520)	(0.1915)
Asian	-42.2158	0.1349	2,088.5800	-0.2773
	(49.6056)	(0.1056)	(1,772.7240)	(0.1833)
Other	-11.8575	0.0936	$-3,149.4970$	-0.2055
	(140.3389)	(0.2592)	(4,349.5300)	(0.4499)
Observations	5,154	7,745	7,745	7,745
Adjusted R^2	0.7594	0.8261	0.7985	0.9509

*p<0.1; **p<0.05; ***p<0.01

Note: Coefficients report differences in the attributes of neighborhoods recommended to minority testers relative to a white tester (the omitted category) within the sample of testers presenting an advertised home that is larger than 1,872 square feet. All regression specifications control for the full set of actor characteristics, assigned characteristics, and search Characteristics. Actor characteristics: tester income, tester household income, gender of tester, age of tester, month of test, educational attainment of tester; Assigned Characteristics: household members, current home ownership status, current lease type, car ownership status, reason for moving, years in current residence, length of employment at current job, reason tester can afford down payment, current lease assigned to tester; Search Characteristics: month of test, sequence of tester appointments, time of the appointment (am/pm), type of recommended building, total number of homes recommended to tester, availability of advertised home as stated by agent. Standard errors are clustered by market for consistency with sampling design.

Tables G.3 and G.4 tests for differences using a model that interacts the racial identity of the tester with the racial composition (larger than median share of any group) of the neighborhood of the advertised home.

Table G.3. Discriminatory Steering by Implied Preferences for Neighborhood Race

	Dependent variable:			
	Poverty Rate	High Skill	College	Elem School
White x White Block Group	−0.0065	0.0068	0.0080	0.3331
	(0.0085)	(0.0106)	(0.0136)	(0.2224)
African American x White Block Group	0.0145	−0.0544***	−0.0318**	−0.0620
	(0.0100)	(0.0169)	(0.0162)	(0.2528)
Hispanic x White Block Group	0.0026	−0.0163	−0.0089	0.4421
	(0.0103)	(0.0159)	(0.0167)	(0.2832)
Asian x White Block Group	−0.0094	−0.0358**	−0.0276	0.0041
	(0.0104)	(0.0182)	(0.0168)	(0.2670)
Other x White Block Group	−0.0140	0.0876*	0.0350	0.8918
	(0.0283)	(0.0515)	(0.0456)	(0.6284)
White x AA Block Group	−0.0071	−0.0029	0.0043	0.1927
	(0.0080)	(0.0117)	(0.0130)	(0.2281)
African American x AA Block Group	−0.0053	−0.0160	−0.0261	0.1143
	(0.0103)	(0.0194)	(0.0166)	(0.2660)
Hispanic x AA Block Group	−0.0031	−0.0181	−0.0052	−0.2121
	(0.0086)	(0.0128)	(0.0138)	(0.2154)
Asian x AA Block Group	−0.0397***	−0.0092	0.0297*	−0.1459
	(0.0101)	(0.0182)	(0.0162)	(0.2640)
Other x AA Block Group	−0.0341	−0.1061	0.0371	−3.9738**
	(0.0924)	(0.0923)	(0.1488)	(1.8194)
White x Hispanic Block Group	−0.0089	−0.0055	−0.0110	0.2713
	(0.0083)	(0.0146)	(0.0133)	(0.2244)
African American x Hispanic Block Group	−0.0136*	0.0126	0.0038	−0.2165
	(0.0078)	(0.0121)	(0.0126)	(0.2285)
Hispanic x Hispanic Block Group	−0.0023	−0.0060	0.0031	0.0327
	(0.0092)	(0.0155)	(0.0149)	(0.2270)
Asian x Hispanic Block Group	0.0010	−0.0023	−0.0020	0.1955
	(0.0108)	(0.0206)	(0.0174)	(0.2829)
Other x Hispanic Block Group	−0.0096	−0.1624**	−0.1279**	2.1202***
	(0.0351)	(0.0656)	(0.0565)	(0.7666)
White x Asian Block Group	−0.0084	0.0020	−0.0077	−0.2532
	(0.0084)	(0.0125)	(0.0136)	(0.2356)
African American x Asian Block Group	−0.0051	−0.0083	−0.0101	−0.2777
	(0.0090)	(0.0132)	(0.0145)	(0.2392)
Hispanic x Asian Block Group	0.0128	−0.0174	−0.0221	−0.0856
	(0.0107)	(0.0183)	(0.0172)	(0.2883)
Asian x Asian Block Group	0.0001	0.0139	−0.0052	0.1222
	(0.0105)	(0.0170)	(0.0169)	(0.2723)
Other x Asian Block Group	−0.0265	0.1462	0.0836	1.1850
	(0.0956)	(0.0916)	(0.1539)	(1.9611)
Observations	21,353	21,353	21,353	14,024
Adjusted R^2	0.5239	0.6949	0.7565	0.7392

*p<0.1; **p<0.05; ***p<0.01

Note: Coefficients report differences in the attributes of neighborhoods recommended to minority testers relative to a white tester (the omitted category) for a tester of a given race who presents an advertised listing in a neighborhood that has a higher than median share of households from a given race group. All regression specifications control for the full set of actor characteristics, assigned characteristics, and search Characteristics. Actor characteristics: tester income, tester household income, gender of tester, age of tester, month of test, educational attainment of tester; Assigned Characteristics: household members, current home ownership status, current lease type, car ownership status, reason for moving, years in current residence, length of employment at current job, reason tester can afford down payment, current lease assigned to tester; Search Characteristics: month of test, sequence of tester appointments, time of the appointment (am/pm), type of recommended building, total number of homes recommended to tester, availability of advertised home as stated by agent. Standard errors are clustered by market for consistency with sampling design.

Table G.4. Discriminatory Steering by Implied Preferences for Neighborhood Race

	Dependent variable:			
	Assaults	Superfund	Toxics	PM
White x White Block Group	0.9054	−0.0448	9.4721	0.0332
	(13.4995)	(0.0489)	(1,067.8610)	(0.0688)
African American x White Block Group	9.0721	−0.0456	283.3150	0.0816
	(15.5037)	(0.0580)	(1,266.7170)	(0.0816)
Hispanic x White Block Group	−9.3174	0.0642	−128.1759	0.0604
	(17.5422)	(0.0598)	(1,305.4640)	(0.0841)
Asian x White Block Group	12.9577	0.0468	−518.0471	−0.0773
	(17.3232)	(0.0602)	(1,314.6090)	(0.0847)
Other x White Block Group	−49.3236	0.1265	1,890.8250	0.2049
	(55.1905)	(0.1637)	(3,572.8160)	(0.2301)
White x AA Block Group	−2.1581	−0.0171	−128.0595	−0.0143
	(14.8595)	(0.0465)	(1,015.7800)	(0.0654)
African American x AA Block Group	2.0980	−0.0602	435.2966	−0.0636
	(18.0123)	(0.0598)	(1,304.5230)	(0.0840)
Hispanic x AA Block Group	−4.6260	0.0167	−173.8895	−0.0043
	(15.0738)	(0.0497)	(1,084.8560)	(0.0699)
Asian x AA Block Group	0.3710	0.0407	526.5117	−0.0696
	(17.2934)	(0.0583)	(1,272.1560)	(0.0819)
Other x AA Block Group	262.4755**	0.7636	2,246.0930	0.9613
	(125.2848)	(0.5342)	(11,658.1200)	(0.7508)
White x Hispanic Block Group	8.8579	0.0193	26.8393	−0.0035
	(13.8372)	(0.0478)	(1,041.9950)	(0.0671)
African American x Hispanic Block Group	5.7606	0.0641	130.7729	0.0691
	(13.4174)	(0.0453)	(987.5195)	(0.0636)
Hispanic x Hispanic Block Group	3.3077	0.0135	−3.9950	−0.0443
	(15.2298)	(0.0534)	(1,165.8150)	(0.0751)
Asian x Hispanic Block Group	−5.9164	0.0675	−289.4899	−0.0703
	(17.7129)	(0.0626)	(1,365.7790)	(0.0880)
Other x Hispanic Block Group	2.8976	−0.2862	188.3278	−0.8945***
	(66.1973)	(0.2030)	(4,430.2880)	(0.2853)
White x Asian Block Group	−8.4936	−0.0784	110.2458	−0.0333
	(13.4818)	(0.0488)	(1,065.1220)	(0.0686)
African American x Asian Block Group	3.6301	0.0396	318.6820	−0.0092
	(13.4076)	(0.0521)	(1,136.1060)	(0.0732)
Hispanic x Asian Block Group	−11.7546	−0.1584**	1,285.0670	0.0209
	(17.2707)	(0.0616)	(1,345.1810)	(0.0866)
Asian x Asian Block Group	−8.9682	−0.1377**	1,289.1560	0.0645
	(17.5584)	(0.0605)	(1,320.7750)	(0.0851)
Other x Asian Block Group	−508.6788***	−1.2315**	−7,946.8490	−0.5006
	(133.2316)	(0.5526)	(12,058.4600)	(0.7766)
Observations	14,017	21,365	21,365	21,365
Adjusted R^2	0.7741	0.8761	0.6887	0.9635

*p<0.1; **p<0.05; ***p<0.01

Note: Coefficients report differences in the attributes of neighborhoods recommended to minority testers relative to a white tester (the omitted category) for a tester of a given race who presents an advertised listing in a neighborhood that has a higher than median share of households from a given race group. All regression specifications control for the full set of actor characteristics, assigned characteristics, and search Characteristics. Actor characteristics: tester income, tester household income, gender of tester, age of tester, month of test, educational attainment of tester; Assigned Characteristics: household members, current home ownership status, current lease type, car ownership status, reason for moving, years in current residence, length of employment at current job, reason tester can afford down payment, current lease assigned to tester; Search Characteristics: month of test, sequence of tester appointments, time of the appointment (am/pm), type of recommended building, total number of homes recommended to tester, availability of advertised home as stated by agent. Standard errors are clustered by market for consistency with sampling design.