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SORTING OR STEERING:
THE EFFECTS OF HOUSING DISCRIMINATION ON NEIGHBORHOOD CHOICE

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Sorting or Steering: The Effects of Housing Discrimination on Neighborhood Choice
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ABSTRACT

Growing evidence indicates that neighborhoods affect human capital accumulation, raising concern that the exclusionary effects of housing discrimination could contribute to persistent inequality. 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 that discrimination constrains the neighborhood choices of minorities in a housing search. Minority testers are significantly more likely to be steered towards neighborhoods with lower quality schools and neighborhood human capital, and higher rates of assault and pollution exposure. Holding location preferences and income constant, discriminatory steering alone can explain a disproportionate number of minority households found in high poverty neighborhoods in the United States and could contribute to racial gaps in inter- generational income mobility. These results have important implications for the analysis of neighborhood effects and further establish discrimination as a mechanism underlying observed correlations between race and pollution exposures.

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A HDS 2012 data and documentation are publicly available here is available at
https://www.huduser.gov/portal/datasets/hsg_discrimination.html
A data and programs used in this paper will be made available here is available at
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. 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.[1] However, it has been challenging to disentangle the effect of discrimination from preference-based sorting in evaluating these persistent disparities.

This paper evaluates the effect of racial discrimination on neighborhood choice using experimental evidence from a nation-wide paired-actor audit 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 simulated the housing search process for a matched pair of testers who were assigned attributes that made them equally qualified to purchase a particular house or rent a particular unit. Paired testers were matched to an advertised listing and randomly assigned to a real estate agent; different aspects of their search experience were then documented. Evidence from prior HUD audit studies and the findings from the 2012 audit reported by Turner et al. (2013) suggests that the incidence of the most blatant forms of housing discrimination has declined dramatically in the period following the Fair Housing Act (FHA) of 1968.[2] However, more subtle forms of discriminatory behavior like steering remain prevalent, and can have important welfare consequences.

A large literature on residential choice has analyzed how preferences for neighborhood characteristics map onto household location decisions (Kuminoff et al., 2013). Building on that literature, this paper advances the idea that discriminatory steering can distort neighborhood location decisions by imposing constraints on buyer choice sets. Combined with voluntary segregation from sorting based on endogenous neighborhood characteristics (Bowles et al., 2014), the impacts of discrimination can be even more severe. We

[1]For summaries, see Graham (2018), Mohai et al. (2009), Banzhaf et al. (2019a), and Banzhaf et al. (2019b)

[2]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.

define four key conditions that can guide the interpretation of evidence from audit studies in a simple sorting framework, including conditions under which constraints will result in a *ceteris paribus* reduction in expected utility from search. We then use experimental data from the 2012 HDS to provide direct evidence on the effects of discriminatory steering in constraining access to key neighborhood amenities.

First, we find that there is no statistically significant difference in the number of housing units shown to white and minority testers. This result confirms that found by previous analyses of the 2012 HDS (Turner et al., 2013) and suggests that if there are welfare effects of housing discrimination, they will arise from the impacts on the quality, rather than the quantity, of recommended homes. Indeed, that turns out to be the case – our results indicate that, even holding income and preferences constant, systematic differences in the homes shown to white versus minority testers impart a number of critical disadvantages to the latter. Minority testers are (relative to their white counterparts) recommended homes in school attendance zones with considerably lower test scores and lower school ratings. Homes recommended to minority testers are located in neighborhoods with higher poverty rates, fewer skilled workers and college educated families, and more single-parent households.

We also provide the first experimental test of the hypothesis that housing discrimination in the home-buyer market could contribute to the race-gap in pollution exposures in the US (Crowder and Downey, 2010). We find that minority testers are steered towards neighborhoods with higher concentrations of Superfund sites and releases from the Toxic Release Inventory (TRI). Disparities in different dimensions are present for African American, Hispanic/LatinX, and Asian households and are consistent across specifications, though they are stronger and nearly ubiquitous in the case of African American testers and become more pronounced when tester pairs signal preferences for the neighborhood characteristic in question. Differences in school test scores and in neighborhoods with more assaults are entirely driven by choices made to African American testers. Consistent with prior evidence on segregation-based steering, we find that minority testers are less likely to be recommended houses in white neighborhoods. However, we also find that segregation-based steering (i.e., directed by persistent differences in neighborhood racial composition) cannot explain the disparities in pollution exposures resulting from discrimination.

An advantage of the HUD audit study data is that it allows us to examine heterogeneity in discriminatory constraints facing different subgroups. In particular, we find that the differences 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 racial gap in

intergenerational income mobility (Chetty and Hendren, 2018a).[3] In recent work, Chetty et al. (2018) find that gaps in income mobility between African Americans and whites are smaller in neighborhoods with lower poverty rates and intact families, suggesting that discriminatory steering may be relevant for understanding persistent racial gaps *within* neighborhoods. Systematic differences in the homes recommended to African American mothers are 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).

An additional advantage of the HUD audit is that it also allows us to examine 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 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.

[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.

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 and 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 and 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-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,

[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.

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 African American 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 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, where persistent

[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).

income inequality can result in disparate budget constraints and perpetuate the cycle. However, it is not clear whether all households have access to the same choices during a search. This distinction is critical for developing policies that can reduce disparities in short and long-run outcomes.

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, 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., 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).[11] These differences were substantially smaller than those documented in 1989, providing evidence of a downward trend in certain discriminatory 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 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 motivation for research on the relationship between steering and the channels through which neighborhood choice can affect long-run outcomes.

[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.

[11]Differences in the number of units inspected by African American testers also fell in the 2012 audit relative to 2000.

4 The 2012 HDS and Residential Choice

Audit studies have primarily been used to measure the incidence of discriminatory behavior rather than to consider impacts on buyers. As originally discussed in Becker (1957) and then described by Heckman (1998) in the context of the audit design, a challenge arises because the impacts of discriminatory behavior ultimately depend upon how the constraints interact with the search behavior and preferences of individuals that face them. As a consequence, it is not clear how or whether evidence of differential treatment from an audit can guide inferences about market outcomes.[12]

In Appendix A, we consider the inferences that can be made in the context of a residential choice model where discriminatory behavior can constrain buyer choice sets. Assuming that choices studied in an audit fit the preferences of actual buyers from groups of interest, the analyst can use the audit to identify systematic constraints on choices possessing key characteristics (i.e. high quality neighborhood schools). Using the choice framework, evidence on constraints encountered in a search can also inform an analysis of impacts on expected utility even when transactions are never fully executed. This is valuable for interpreting the evidence from audit or correspondence designs, where the analyst never observes the market outcomes of fictitious buyers. This section describes the 2012 Housing Discrimination Study (HDS) and the conditions under which interpretation of tests for constraints to the size and composition of choice sets can guide our understanding of their welfare implications.

The 2012 Housing Discrimination Study (HDS) was conducted in 28 metropolitan areas, with sampling designed to represent the racial/ethnic composition of buyers searching in each market based on the geographic distribution of each minority group as documented in the 2010 US population census. Subsequent stages were designed to construct a representative sample of real estate advertisements available for the market at the time of the study and deployed a matched-pair block randomized design, where tester recruitment and assignment were conducted in each of the 28 metropolitan area field offices. The sampling frame was defined using the following three steps: (1) A random sample of ZIP codes within each metropolitan market was constructed with weights assigned according to the percentage distribution of home mortgages within each ZIP code; (2) ZIP codes were randomly assigned a trial week that defined the time at which samples of advertised listings would be collected; (3) Within a given ZIP code, advertised listings were harvested from a combination of multiple major online real estate platforms, subjected to quality control protocol, and randomly assigned to a tester group.[13]

The tester group was then assigned to a corresponding local real estate office or rental housing provider and underwent a housing search process. Testers were blind-matched

[12]These limitations have been addressed in various ways in empirical work (Charles and Guryan, 2008).
[13]The quality control procedure removed ineligible listings based on the following criteria: duplicates, short sales, listings outside the price bounds specified for a given market.

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.[14] Income, asset and debt levels were assigned to make testers unambiguously well-qualified for the advertised listing.[15]

The matched-pair block randomized design employed by HDS 2012 contains a number of advantages and also some limitations for studying the interaction between discrimination and sorting in housing markets. The 2012 HDS did not measure the observed incomes and preferences of buyers that were making choices in the focus markets, but rather assigned preferences and family/job characteristics to match the characteristics of the advertisement and then controlled for these parameters in a housing search process using scripted profiles and preferences. As a result, inference based on evidence of differential treatment will apply to minority buyers that would consider the sample of advertised homes in their own search.

While the analyst does not have information about the exact willingness-to-pay for housing amenities for buyers simulated in an audit, a key feature of the design is that it simulates the search behavior of a buyer from a given group relative to a buyer from a different group that initiates an identical search. This allows the analyst to test for choice constraints facing a minority buyer relative to a counterfactual with equivalent income and preferences. In the HDS 2012, the counterfactual is constructed using a white tester group. The matched design also eliminates noise in the behavior of agents that might arise as a result of heterogeneity in the advertisements, providers, and characteristics that are assigned to testers of different races. 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 pref-

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

[15] 2012 HDS documentation states that the assignment of qualifications erred on the side of making minority testers slightly better qualified than their white counterparts for an advertised listing.

erences 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. Agents may make recommendations on the basis of characteristics that are not observed in the context of their interactions with testers but may be consistent with their observation of population-level differences (Heckman, 1998). Ondrich et al. (2003) find that real estate agents tend to make recommendations that are at odds with housing preferences of minority buyers.

We document four insights from the choice framework that can guide inferences from audit studies given standard assumptions: (1) By constraining the size of a choice set, discriminatory behavior can result in a *ceteris paribus* reduction to the expected utility from a housing search. (2) If minority testers are steered into lower quality homes/neighborhoods, the effects of compositional constraints will depend on the strength of preferences for given neighborhood attributes among the buyers simulated in an audit; (3) All else equal, factors that lower the marginal utility of income among simulated buyers (e.g., higher incomes or a weaker preferences for non-housing consumption) will increase the expected negative welfare effect of discrimination; (4) A compensating price differential associated with the better amenities could, in principal, mitigate the effect on expected utility.

Should we expect a compensating price differential in the presence of compositional constraints? Perhaps not. In his seminal work on discrimination, Becker et al. (1971) illustrates that discrimination will result in higher expected equilibrium prices for buyers that face the constraints. Empirical work on historical supply constraints (Cutler et al., 1999) and large-scale studies of repeat-sales data (Bayer et al., 2017) have both revealed evidence of racial price differentials in the housing market. This work suggests that any compensating price differential for lower quality choices could be small in markets that are segmented as a result of the very discrimination that an audit reveals. All else equal, a smaller compensating price differential associated with the better amenities that constitute the choice set for the counterfactual buyer will increase the expected negative impact of discrimination.

5 Empirical Design

Our baseline specification tests for differences in the neighborhood attributes of homes shown 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. This set includes all homes shown in a search, including recommended homes as well as the advertised homes if visited. *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,[16] characteristics that are assigned to the tester,[17] and characteristics of the search.[18] $W_{i,k,f}$ also includes a control for the housing market (defined as an MSA in the HDS) where a trial/search takes place.

5.1 Data from the HDS Audit

The HUD buyer audit generates data on the locations and attributes of advertised listings (assigned to buyers) and a set of listings that are recommended to a buyer. Recommendation sets include the advertised listing when it is visited with other recommended homes during the search. 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 single census tracts, 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

[16] 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.

[17] 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.

[18] Search Characteristics: month that a test was conducted, sequence of tester appointments within a trial, time of the tester's appointment (am/pm).

in Chicago.

The full sample of properties from the buyer study contains 21,904 recommendations and 6,962 advertised listings. Basic characteristics and price information are provided in the publicly available HDS 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. The majority of testers execute a small number of trials – 28% of the distribution has 1 trial, while the median tester does 3. Tester pairs are typically stationary.

Table 1 reports descriptive statistics on the general characteristics of the 2,260 testers recruited into in the sample. Half of the testers consists of focal racial/ethnic groups: 23% African American, 13% Hispanic/LatinX, 13% Asian. The other 50% of testers belong to the white comparison group. We do not report results for the 1% of testers that fall into an "other" category. The great majority of testers are assigned to a single trial, though testers can be matched to multiple trials. 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.

The top panel of 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.

5.2 Data on Local Schools and Neighborhoods

We geocode the addresses of advertised and recommended homes reported in the 2012 HDS and merge them with data on 2012 test scores in the attendance zones of associated elementary and middle schools provided by the Stanford Educational Opportunity Project (SEOP).[19] The SEOP data provide a comparative measure of the average test scores for students in a given school relative to the national average for students in the same cohort. Of the full set of 21,904 recommendations in the HDS, we are able to obtain test score data for 9,360 properties zoned for a local elementary and for 9,731 properties zoned for a local middle school.

[19] https://edopportunity.org/

Next, we merge information about school quality ("GreatSchools" ratings)[20] and crime (count of violent assaults)[21] from the platform of a major online real estate service. We scraped data for each property using the addresses of houses provided in the HDS, such that measures relate to the property-level characteristic of the home that would be observed in a search. We are able to obtain data on assaults for 11,161 properties and elementary school ratings for 11,032 properties. 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.

We collect and add 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, (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), (4) the share of single-parent households, and (5) the homeownership rate. We also obtain ACS data on the share of white, African American, Asian, and Hispanic households at the census block group level.

Finally, we add 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,[22] (2) the risk of exposure (in 2012) to industrial chemical releases from facilities monitored by the EPA's Toxics Release Inventory as reported by the Risk-Screening Environmental Indicators (RSEI) model,[23] and (3) particulate matter (PM2.5) concentrations taken from

[20] 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.

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

[22] 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

[23] We use RSEI as our preferred measure on concentrations as it accounts for differential releases, meteorological conditions such as wind speed and direction, decay rates, and other key characteristics of emissions that can affect exposures (EPA, 2018). The RSEI model uses three primary data sets: Chemical toxicity data, TRI release and transfer quantities, and the location of facilities. RSEI uses the American Meteorological Society/EPA Regulatory Model (AERMOD). The model incorporates information about facilities (location, stack height, etc.), meteorology (wind, wind direction, and ambient temperature), and chemical specific decay rates to calculate toxic concentrations in a given grid.

satellite data.[24]

The middle panel of Table 2 summarizes the quality of local schools test (scores/ratings) and other key characteristics of neighborhoods in the sample of advertised homes in the 2012 HDS. On average, the advertised homes fall in the attendance zones of schools that have 21-35 percentage points higher elementary school test scores and 12-25% higher middle school test scores than the national average. The average advertised home is associated with an elementary school that has a 6.2-6.3 "GreatSchools" rating and 88-105 local assaults. The racial composition of the census block group of an advertised listing has, on average, 64-69% white, 8-10% African American, 6-8% Asian, and 13-19% Hispanic (and 2% other). On average, advertised listings are in neighborhoods where 8-9% of the households have incomes at or below the poverty line, 46-47% have a member in a high skilled job, 49-50% have at least one member with a college degree, 14-16% have a single parent, and 72-74% own their homes.

5.3 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. The sequence of tester appointments and the timing of a given appointment are randomly assigned within a trial and balance tests indicate that they are well balanced within our sample. These

[24]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.

characteristics will necessarily differ within a trial and are included to increase precision. All actor and assigned characteristics are also 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.

6 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.

6.1 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 residential sorting 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. We test the following 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.

Point estimates indicate that African American and, to a lesser extent, Hispanic buyers receive fewer recommendations than their white counterparts. However, 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. These findings are consistent with estimates from the initial report of results from the HDS 2012 audit.[25] This test does not, however, imply anything about differences in the *quality* of the houses or neighborhoods that are being recommended.

6.2 Are Minority Buyers Steered into Minority Neighborhoods?

We begin our discussion of steering by re-examining the channel that has been the focus of research in prior decades (Yinger, 1995, Galster and Godfrey, 2005, Turner et al., 2013). 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 -0.04 – 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.[26] These estimates confirm the finding documented in prior studies on steering and segregation, providing strong evidence 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

[25] Turner et al. (2013) find that African Americans are shown .5 fewer homes than a white tester and no difference for Hispanic testers.

[26] 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.

buyers away from white neighborhoods (4.1% [0.147]) than was reported in the initial report of findings from the same 2012 audit (1.8% [0.8]) (Turner et al., 2013). Comparisons reported in Appendix D examine the effects of differences in the specifications of the current test relative to the initial report, where data were aggregated to the level of the trial (n<800) and outcomes were measured at the census tract level. In tests with aggregated tests and outcome measures, our estimates 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 somewhat larger than but not different from the 1.8% [0.8] difference reported in Turner et al. (2013).[27] These findings indicate aggregation affected the power and magnitude of prior estimates.

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 a welfare cost for minority households. 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.

6.3 Are Minorities Disadvantaged by Neighborhood Steering?

This section presents the core tests of our study, which advance the existing body of evidence on discriminatory steering by analyzing a set of key neighborhood characteristics that have been shown to have important effects on short- and long-run outcomes. These tests therefore examine specific channels through which, by constraining buyer choices, discriminatory steering could directly affect the human capital accumulation of minority households. Revealed preference evidence indicates that buyers have clear preferences

[27] 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.

for these characteristics and the neighborhood effects literature demonstrates that their effects on long-run outcomes operate through independent channels, such that the total effect of reduced access to a combination of beneficial attributes in any given neighborhood will be cumulative.

Assuming that the average buyer in the sampled markets will have a willingness-to-pay for these neighborhood attributes, all else equal, discriminatory constraints along these dimensions will have an impact on the expected utility from a search.[28] 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 = *(neighborhood characteristic)*. Tables 8-11 report core results from tests of differences between the homes recommended to minority versus white testers along key neighborhood dimensions. Each table reports estimates in levels using a pooled specification including all minority testers in the first row and a specification with seperate estimates for each minority tester group below. The mean value of the comparison group (white tester) is reported at the bottom of each 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 for multiple hypothesis testing by controlling for the family-wise false discovery rate (Benjamini and Hochberg, 1995).[29]

School Quality and Neighborhood Safety

The first panel of Table 8 reports differences in the local school quality and neighborhood safety levels of homes recommended to minority testers. Columns 1 and 2 focus on differences in average test scores in schools that fall in the attendance zones of the sample of recommended properties. These tests reveal evidence of disparities in both elementary and middle schools test scores, where homes recommended to minorities are substantially lower than those recommended to their white counterparts – 3.2 percentage points for elementary schools and 2.6 for middle schools. Below the estimates of differences between white versus minority testers, we report differences from a specification that includes terms for each tester race group. These estimates indicate that disparities in test scores are driven exclusively by the homes recommended to African American testers, where elementary school scores are 6.2 percentage points lower and middle school scores are 7.8 percentage points lower. These differences account for 12% and 56% of the comparison

[28] We examine these conditions in Appendix A.

[29] 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.

means in the respective tests, which measure differences between schools recommended to white testers in the HDS sample relative to national testing averages.[30]

Columns 3 and 4 report estimates of differences in school ratings and assault levels for homes in the HDS sample, as defined on a national online housing platform. We note that the power of these tests is affected by data availability on the online platform – the sample is approximately halved when merging HUD house addresses with information scraped from the online realty platform. Column 3 describes school quality as measured by the "GreatSchools" index. Relative to homes recommended to a white tester, homes recommended to minority testers have 0.34 lower rating. Consistent with the findings for test scores, this appears to be strongly driven by the quality of schools assigned to homes shown to African American testers (-0.47 points), as well as smaller differences in those recommended to Asian testers (-0.38). Column 4 reports the difference in assaults, which is positive though not statistically significant for minority testers as a whole. However, when considering only African Americans, we again find a strong, statistically significant difference. The average home recommended to African American testers is located in a neighborhood with 24 more recent assaults than is the case for a white tester, which accounts for 30% of the number of total assaults in the white recommendation set (80.43).

Neighborhood Poverty and Human Capital

The second panel of Table 8 reports the results of tests for differences in five key neighborhood characteristics using census block-group level characteristics from the American Community Survey. The estimates reported in columns 1-3 indicate that minority testers (as a whole) are recommended homes in census block groups with higher poverty rates (1.16%), fewer high-skilled neighbors (-2.54%), and fewer college-educated neighbors (-1.82%).[31] Considering the average values of these neighborhood attributes in the white tester comparison group (8.2%, 49%, and 53%), these impacts are substantial (especially poverty). We do not find differences in the share of single-parent households or home-ownership rates when considered as a whole, though the signs on both coefficients are consistent with evidence of greater economic hardship.

Tests for group-specific differences indicate that the steering behavior is largely driven by the experiences of African American and Hispanic testers. African American testers are shown homes that are in census block groups characterized by higher poverty rates (+1.2%), lower shares of skilled workers (-3.02%), lower shares of college educated neighbors (-3.4%), and higher shares of single-family households (1.67%), although the result

[30] Among homes recommended to a white tester in the HDS sample, the average test score is 53 percentage points higher than the national average for elementary schools and 14 percentage points higher for middle schools.

[31] High skill is based on share of census block group employed in American Community Survey defined management, business, science, and arts occupations.

for poverty is not statistically significant.[32] The disparities between white and Hispanic testers are even larger in terms of the poverty rate and high-skill neighbors, but smaller for college and single-family household shares. Differences between white and Asian testers are markedly lower and are not significant along any of the dimensions of neighborhood capital that we study using the American Community Survey.

Local Pollution Concentrations

Table 9 focuses on three measures of pollution exposure: (1) proximity to Superfund sites, (2) air toxics (as measured by the EPA's RSEI model), and (3) PM2.5, an important criteria pollutant with substantial long-run health effects. The top panel reports differences for the entire sample. 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. When considering African American testers in particular, we find evidence of elevated exposures to Superfund sites (a difference of +0.13 relative to an average of 0.36) and air toxicity (a difference of +872.98 relative to an average of 5,100).[33] Asian testers receive recommendations with similarly elevated exposures to for Superfund proximity and air toxics. Point estimates for Hispanic testers are positive, but estimates are smaller in magnitude and are not statistically significant.

In contrast to air toxics, results with respect to particulate matter suggest very little difference across testers. 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 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. Asian testers do exhibit a statistically significant reduction relative their white counterparts (-0.1243), but this difference is very small relative to the comparison mean of 9.4 for a white tester. None of the other race groups exhibit statistically significant differences within tester pairs.

Other Search Characteristics

These estimates indicate that minority buyers are steered toward neighborhoods that could disadvantage them in multiple dimensions. Furthermore, these differences do not

[32] In their initial evaluation of steering using the 2012 HDS audit data, Turner et al. (2013) report a null effect (0.2% [0.2]) on steering into high poverty neighborhoods. While the HDS report does not explicitly discuss the relationship between discrimination and neighborhood effects, this is the most closely related test available in prior work on housing discrimination. Appendix D provides a replication of the test specified in the report, which yields a similar null estimate (0.27% [0.32]). Our comparison illustrates that aggregation results in a substantial reduction in the power and magnitude of the test, directly affecting inference regarding the relationship between steering and neighborhood effects.

[33] Appendix H includes an analysis of sensitivity to the distance-based measure using a range of 3-6km.

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 E reports estimates with and 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. In Appendix Table E.1, we test the robustness of our primary estimates within tight ($20,000) intervals of price among recommended homes. Table F.1 presents results of tests for differences in home prices, where we do not find strong evidence of differences in the listing price of homes recommended to each group. In the final empirical section of the paper, we examine differences in the sales prices of ultimate transactions.

It is also possible that minorities are steered away from high amenity neighborhoods as a result of historical segregation, which could either bias the assumptions of real estate agents about buyer preferences or could induce steering irrespective of buyer preferences.[34] Table 7 suggests a more complicated picture, demonstrating that steering does not occur solely into same-race neighborhoods but rather depends on the interaction between race and neighborhood income. We examine steering into African American, Hispanic, and Asian neighborhoods in Appendix C. We do not find any evidence that Hispanic or Asian testers are steered into same-race neighborhoods. We do find evidence that African American testers are steered into African American neighborhoods, but that those effects are considerably weaker in high income African American neighborhoods.

In order to more directly examine the relationships between amenity levels and racial compositions in the neighborhoods toward which testers are steered, we also estimate the main effects from Tables 8-9 for testers that present a real estate agent with an advertised listing in a white neighborhood. Buyers with weak homophily preferences will face constraints that cannot be mitigated by the potential benefits from living in neighborhoods with higher group representation. Appendix Table G.1 reports the results of these tests, which provide evidence of even stronger differences in most amenities for this sub-population.

6.4 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

[34]Figure B.1 shows that the racial composition of neighborhoods is correlated with many of the neighborhood characteristics that we study.

are assigned an identity of mother.[35]

Results reported in Table 10 indicate the differences are magnified for this group. In particular, we find that minority mothers are steered into neighborhoods with -14.7% lower elementary and -9.7% lower middle school test scores, +39.5 more recent assaults, +4.81% higher poverty rates than white mothers. Differences in school test scores are particularly stark for African American (-22.3%) and Hispanic (-23.7%) mothers when compared to the white comparison group (33%), implying large effects in percentage terms – i.e., 67.5% to 71.8% increases relative to the control mean. Homes recommended to African American mothers have a 95% higher incidence in nearby assaults (+79.8) and 46.2% lower elementary school ratings (-3.0).

Differences in the average poverty rates are quite high for African American (+5.1%) and Hispanic (+5.60%) mothers imply 66.5% to 73.0% increases relative to the control mean. Differences in the skill level, the share of college educated households and home-ownership rates in neighborhoods recommended to African American and Hispanic mothers are also much larger than the differences for the average tester. Point estimates suggest a disproportionately large incidence of single-parent households in neighborhoods recommended to African American and Hispanic mothers, though we do not find evidence of statistical differences.

The bottom panel of Table 9 reports results for differences in local pollution exposures. Our results indicate larger disparities in pollution exposures in neighborhoods recommended to African American mothers. We find a 53% higher number of nearby Superfund sites (+0.20), and a 38% higher (+2,387.20) level of exposure to air toxics than white mothers compared to the control means. 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 the same definition of exposures to Superfund sites, Currie (2011) finds a 43% difference in the exposures of African American mothers relative to white mothers.[36] Using the HDS data, our test indicates that African American mothers are 52.6% more likely than their white counterpart to receive a recommendation within 2 km of a Superfund site.[37]

The present estimates indicate that the differences from discriminatory steering are

[35] All HDS identities define the full set of members in a tester's nuclear family, which ranges from just the tester (1) to a total of 6 (fictitious) members. We define the identity of a mother on the basis of: (1) the gender of the tester and (2) the presence of children in the assigned script. Results on in utero pollution exposures suggest that expecting mothers may be an important group, though this is not a characteristic that is assigned to any tester in the 2012 HDS.

[36] 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.

[37] In our HDS sample of cities with large minority populations, 38% of homes recommended to the sample of white mothers fall within 2 km of a Superfund site. The test for African American mothers indicates a 20 percentage point higher likelihood than a paired white mother.

of a similar magnitude to, if not slightly larger than, the resulting differences in maternal exposures.[38] Indeed, Currie (2011) also finds that the racial disparity in exposures is larger than disparities in exposures across groups with different levels of educational attainment, which could result in different locational choices in the wake of Superfund cleanups or publicly disclosed emissions of toxic chemicals. While racial disparities could result from a number of potential mechanisms, the present findings from the HDS suggest that the effects of steering are large enough to entirely explain these differences.[39]

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.[40]

Column 1 of Table 11 reports the estimates from this test, which indicate that African American testers are 11.8% and Hispanic 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

[38] 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 6300. Homes recommended to African American mothers have levels that are 2387.2 higher than their white counterpart, indicating a 37.8% disparity in exposures.

[39] 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.

[40] 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%.

recommendations in low poverty neighborhoods. Hispanic testers with families are 19.9% less likely. Column 3 reports estimates from tests of differences between minority 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 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 African American families (defined as >50%) are associated with smaller racial gaps and better outcomes for African American 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 African American children are exposed to the same. Columns 4-6 of Table 11 test for differences in these neighborhoods and reveal differences that are very similar to those reported for low poverty neighborhoods discussed above. Conditional on a set of assumptions that are required to identify these neighborhood effects as causal,[41] and if the recommendations of real estate agents ultimately affect buyer decisions, these results indicate that the impacts of discriminatory steering could result in *statistically* and *economically* significant long-run and intergenerational impacts within minority families. In particular, discrimination will reduce the access of minority families to low poverty neighborhoods where they would experience higher income mobility and a higher likelihood of convergence with white counterparts. Instead, it will steer these families to high poverty neighborhoods where they will experience low income mobility, contributing in the long run to the *within-neighborhood* race gap.

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[42] 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 per-

[41] In particular, Chetty et al. (2018) argue a causal interpretation for the role of place in children's economic mobility, in contrast to a story based on selection in residential location decisions. They base this argument on (i) flexible controls for time-invariant family characteristics, (ii) controls for particular time-varying family attributes (marital status and income), (iii) the exogeneity of particular displacement shocks (i.e., plant closures or natural disasters) and (iv) placebo tests based on cohort, gender, and quantile effects.

[42] 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.

manent residents of their destination.[43] Importantly, Chetty and Hendren (2018a) argue 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 12, 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 (10.9% lower) and especially for mothers (24.9% lower). As an illustration of the impacts of this steering, we consider a family who moves a child at age 9 from the average neighborhood census block group in the 2012 HDS sample. The median income of families living in that average block group is $101,609, which ranks in the 83rd percentile of the national distribution of family incomes found in Chetty and Hendren (2018a).[44] Now we consider what would happen if this family were to attempt a lateral move – i.e., to a new identical neighborhood block group. Relative to a counterfactual with no steering, our results suggest that an African American family would end up being shown homes in the 78th percentile of the income distribution. At age 30, the effect of exposure that results from this steering 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.[45]

6.5 Is Discriminatory Steering Affected by Buyer Preferences?

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. As real estate agents attempt to match prospective buyers to property listings, they will formulate expectations about buyer qualifications and preferences. In so doing, they may incorporate information from their observations or understanding of

[43] 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.

[44] In particular, this refers to the income distribution of families with children age 9 in 2012.

[45] 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.

population-level differences (Heckman, 1998). This would be consistent with the statistical discrimination mechanism. Steering behavior could also result from differences in how real estate agents attend to buyers from different groups.

We make use of a feature of the HDS design that allows us to examine 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. While more than 60 assigned parameters were used to define the qualifications and circumstances of a tester pair, testers were instructed to limit discussion about neighborhood/housing preferences to the characteristics of the advertised home that they presented to an agent. We define a tester's implied preference for a given neighborhood characteristic using the corresponding value from the advertised house that the tester presented to the real estate agent.[46] We then compute the gap between the level of implied preference and the level of the same attribute for the recommended home. We test for differences by race using each of the primary characteristics from Table 8.

Each of the columns in Table 13 reports differences in the gap between the implied preference level and homes recommended to different groups. We see that the comparison means for white buyers, the omitted racial group are close to zero for most characteristics, indicating that agents tend to match testers to neighborhoods that align with implied preferences. For minority testers, however, the gaps for test scores and school quality suggest that agents tend to recommend choices that substantially underperform the implied preferences of lower minority testers, relative to a white counterpart. On the other hand, minority testers receive recommendations with higher assaults than their implied preference level. Similar patterns are found in ACS neighborhood characteristics, with a few exceptions – poverty rates for African American testers, skill levels for Asian testers, and home ownership rates for Hispanic and Asian testers. The general finding is that, particularly for African Americans and Hispanic testers, individual preferences for key neighborhood attributes appear to be discounted or misintepreted by real estate agents.

We also explore heterogeneity in discriminatory steering among buyers who present preferences for homes in white neighborhoods and higher priced homes in 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 in most dimensions, though this is not the case for all outcomes or for the other minority groups. We find that discriminatory constraints facing African American buyers are also magnified in searches for larger or more expensive homes, suggesting that housing discrimination may disproportionately constrain upwardly mobile African

[46]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 to make recommendations that are at odds with the preferences that minority buyers imply for housing characteristics.

American households. Targeted experimental research on housing discrimination may 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).

6.6 Who Buys the Homes Shown in an Audit?

Audit research designs are inherently limited in the study of outcomes related to discriminatory behavior. Since buyer identities are fabricated and testers are never instructed to complete a transaction, the researcher never observes the outcome of a search. In this section, we combine property-level information from the HDS 2012 with transaction data from the ZTRAX housing transactions database to examine differences in the racial identities of individuals that ultimately purchased the properties sampled in the 2012 HDS and sale prices of properties recommended in the audit. Of the full sample of 21,496 recommended properties, 10,862 were sold between the beginning of the audit study in mid-2011 and the end of 2015 and could be matched to addresses provided in the HDS data.

Since racial/ethnic identities are not reported in transactions data, we use the WRU algorithm developed by Imai and Khanna (2016) to classify buyer identities on the basis of the probability that a buyer's first/last name is associated with a given racial/ethnic group. The power of this test depends heavily on the differentiability of buyer names, which we define using a score that is calculated as the difference between the probabilities associated with the two most likely classes.[47] The top row of Table 14 reports the differentiability scores for each group in the study. According to the classification algorithm, the buyers with the most differentiable names are Asian (91%), then Hispanic (87%), then white (68%), and finally African American (15%). The sample size of the African American group is particularly small (n=217), reducing the power of that test in particular.

The second row of Table 14 reports the results from a linear probability model that tests for differences in the probability that properties recommended to testers from a given group were ultimately sold to buyers from the same group. We do not find any evidence that properties recommended to white testers are disproportionately purchased by buyers of the same race. However, we do find that homes recommended to Hispanic and Asian testers are disproportionately purchased by buyers of the same race. These differences hold conditional on the racial composition of the census block group of the home advertised to a given tester. They also hold conditional on the racial composition of

[47]For instance, if the algorithm assigns a predicted probability of 80% Asian, 10% white, and a total of 10% for all remaining groups combined, then the name receives a differentiability score of 80%-10%=70%. If the algorithm assigns a predicted probability of 80% Asian, 18% white and a total of 2% for all other groups, then the name receives a differentiability score of 80%-18%=62%.

the census block group of the recommended/purchased home as well, suggesting that these differences cannot be explained by sorting patterns that are related to racial segregation.

The bottom panel of Table 14 reports the results of tests for differences in the transaction prices of homes that were recommended to buyers from different groups in the 2012 HDS. This is not a test of the transaction price for a tester in the HDS 2012, since the resulting sales do not capture the purchase behavior or conditions involving the testers studied in the HDS 2012. However, this test does provide information regarding differences in the market value of homes recommended to testers from different groups. The mean sales price in the sample is $285,277. Overall, we do not find strong evidence of statistical differences in the ultimate sales price of the set of homes recommended to testers from different groups within a given trial. The one exception is for Asian testers, where there is a marginally significant reduction of 11%.

A compelling explanation for this outcome can be found in past work on housing market discrimination. Becker et al. (1971) illustrates that discrimination will result in higher expected equilibrium prices for buyers facing the constraints. Moreover, evidence of racial price differentials in the housing market has been shown in empirical work on historical supply constraints (Cutler et al., 1999) and well as recent equilibrium outcomes in the housing market (Bayer et al., 2017). Put simply, buyers of color have been found to pay more for the same amenities as white buyers because markets are segmented by discrimination and the supply of these amenities may be different in the different segments. Our results on list and transaction prices suggest that the same forces may be operating in the cities sampled in the 2012 HDS, which were selected on the basis of large populations of the minority groups in the study. When interpreted in the context of the model that we provide in Appendix A, this evidence is consistent with a smaller compensating price differential for recommendations with lower quality amenities and would reduce the expected utility from a minority buyer's search.

7 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 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. Adverse neighborhood characteristics such as toxics exposures and neighborhood poverty rates can be correlated with each other. The literature on neighborhood effects demonstrates that they affect outcomes through discrete channels, such that the ultimate effects of choice constraints can interact

and accumulate across multiple dimensions.

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 of 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., 2019b). 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 some limitations of the

HDS design that could be addressed in future efforts. First, the HUD audit data do not allow for direct tests of the behavioral mechanisms underlying choice constraints. 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 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). Second, the interpretation of evidence from an audit requires the assumption that there is no difference in how testers performed their roles. While the 2012 HDS invested heavily in tester training and design features to address this issue, future audits could consider distributing all testers across multiple trials and allowing analysts to flexibly control for tester-specific factors with fixed effects.

Finally, we 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. We have shown that with the current design, an analyst can make important inferences about choice set constraints facing minority buyers relative to a counterfactual buyer that does not face the same constraints. We describe the conditions under which this will reduce expected utility and argue that the evidence is consistent with welfare reductions from choice constraints. An important direction for audit research involves the design of a methodology that combines experimental identification of discriminatory behavior with information on the search parameters of actual buyers that are making decisions in housing markets. This integrated framework could be accomplished by studying buyers who are searching at the time of an audit or by obtaining data on location decisions of buyers that were searching at the time of an audit and modeling the effect of discriminatory constraints on their ultimate decisions. Importantly, this would allow the analyst to more precisely estimate the magnitude of welfare impacts on buyers and potentially understand implications of discrimination on other equilibrium outcomes.

The results in the current study indicate that real estate agents may discount and even work in opposition to the preferences of African American buyers when making recommendations. These results have implications for considering the expected utility from a given round of search. An important remaining question is the extent to which the constraints from discriminatory steering can be mitigated through investment in ad-

ditional rounds of search – 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 using the HDS 2012, though future audit designs could integrate information on search intensity from studies of actual buyers in markets with discrimination. 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

Note: Table reports the mean values of the innate (actor) and the assigned (scripted) characteristics of testers in the study. Column 1 reports the mean for all testers in the study and columns 2-4 report the mean for testers in a given race group. Testers were matched based on approximately similar actor (not assigned) characteristics and then tester pairs were matched to assigned roles. Assigned incomes vary by trial and were calculated as a function of the listing price of an advertised home.

Table 2. Home and Neighborhood Characteristics

		Characteristics of Advertised Homes			
Variable	All Groups	White	African American	Hispanic	Asian
Listing Price	378,983	381,064	344,169	387,648	408,701
Building Type					
Single family, detached	0.739	0.744	0.738	0.699	0.749
Duplex	0.017	0.017	0.013	0.018	0.018
Rowhouse or Townhouse	0.134	0.128	0.118	0.158	0.154
Multi-family structure	0.101	0.101	0.125	0.112	0.069
Mobile home	0.001	0.001	0	0.005	0
		Neighborhood Characteristics			
School-Specific Test Scores					
Elem. School Test Score	0.278	0.279	0.206	0.344	0.340
Midd. School Test Score	0.173	0.164	0.185	0.116	0.247
Housing Search Platform					
Assaults	93.336	88.352	96.150	95.346	104.878
Elem. School Quality	6.210	6.203	6.202	6.169	6.260
ACS Block Group Characteristics					
Poverty Rate	0.089	0.088	0.092	0.090	0.086
Percent High Skill	0.467	0.467	0.467	0.463	0.472
Percent College Graduate	0.501	0.504	0.501	0.494	0.501
Single-Parent HH	0.146	0.146	0.141	0.155	0.147
Ownership Rate	0.731	0.735	0.731	0.715	0.728
ACS Block Group Racial Composition					
Percent White	0.675	0.685	0.684	0.639	0.664
Percent African American	0.090	0.090	0.103	0.082	0.084
Percent Hispanic	0.148	0.140	0.134	0.185	0.151
Percent Asian	0.067	0.065	0.061	0.073	0.079
		Pollution Measurements			
Superfund Sites	0.327	0.311	0.337	0.353	0.352
Risk-Screening Environmental Indicators (RSEI)	6,076.8	6,252.5	7,865.3	4,283.2	5,131.2
PM 25	9.283	9.378	9.253	9.056	9.293
	N = 7,026	N = 3,607	N = 1,212	N = 1,028	N = 1,108

Note: Table reports the mean values of the advertised listings assigned to testers in the study, which are based on sampling frames generated for each metropolitan market. The composition of trials within a given market is defined to match the racial composition of the market, such that the characteristics of advertised listings can vary across the race groups (though they will not vary within a trial). Column 1 reports the mean characteristics for all testers in the study and columns 2-4 report the mean for testers in a given race group.

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

Note: Table reports the results of balance tests that compare tester characteristics from a given group in a trial to the mean for the white (comparison) group. These tests are based on a simplified version of model 3 that includes a term for race group and a trial fixed effect, but omits other controls (tester and advertised home attributes). The top panel reports differences in innate (actor) characteristics, whereas the bottom panel reports differences in assigned (scripted) characteristics. Significance levels are: *p<0.1; **p<0.05; ***p<0.01.

Table 4. Balance Statistics for Homes

	Characteristics of Advertised Homes		
Variable	African American	Hispanic	Asian
Listing Price	-397.595	-388.358	-1,866.292
	(960.555)	(1,288.875)	(1,136.40)
Building Type			
Single-family Detached	0.009	0.006	0.029***
	(0.010)	(0.013)	(0.011)
Duplex	-0.001	-0.002	-0.005
	(0.005)	(0.005)	(0.008)
Rowhouse or Townhouse	0.005	0.007	0.005
	(0.010)	(0.011)	(0.015)
Multi-family Structure	-0.006	-0.006	-0.029**
	(0.008)	(0.009)	(0.012)
Mobile Home	-0.001	-0.001	-0.00000
	0.001	0.003	0.00000
	Neighborhood Characteristics		
School-Specific Test Scores			
Elem. School Test Score	0.012**	0.009	-0.006
	(0.006)	(0.007)	(0.006)
Midd. School Test Score	-0.010	-0.007	-0.005
	(0.006)	(0.005)	(0.005)
Housing Search Platform			
Assault	-0.040	0.109	-0.153
	(0.174)	(1.069)	(0.173)
Elem. School Quality	0.001	0.019	0.025
	(0.021)	(0.022)	(0.034)
ACS Block Group Characteristics			
Poverty Rate	0.0005	0.001	-0.001
	(0.002)	(0.002)	(0.001)
Percent High Skill	-0.005	-0.002	0.0004
	(0.003)	(0.003)	(0.002)
Percent College Educated	-0.005**	-0.003	0.0002
	(0.002)	(0.004)	(0.002)
Single-Parent HH	0.002	0.002	-0.001
	(0.002)	(0.002)	(0.002)
ACS Block Group Racial Composition			
Percent African American	0.003	0.004	-0.003
	(0.002)	(0.003)	(0.002)
Percent Hispanic	-0.002	0.003	0.001
	(0.001)	(0.002)	(0.001)
Percent Asian	-0.001	-0.0002	-0.001
	(0.001)	(0.001)	(0.001)
	Pollution Measurements		
Superfund Sites	-0.0002	0.012	0.001
	(0.005)	(0.011)	(0.006)
Risk-Screening Environmental Indicators (RSEI)	-30.108	-108.290	89.371
	(51.410)	(102.645)	(141.098)
PM 25	-0.010	0.0001	0.015
	(0.011)	(0.016)	(0.016)

Note: Table reports the results of balance tests that compare the mean values of home characteristics assigned to a given race group to the mean for the white (comparison) group. These tests are based on a simplified version of model 3 that includes a term for race group and a trial fixed effect, but omits other controls (tester and advertised home attributes). The top panel reports differences in property characteristics within trials, which could occur if the advertised home was removed from the market during a trial. The bottom panels report differences in neighborhood characteristics. Significance levels are: *p<0.1; **p<0.05; ***p<0.01.

Table 5. Differences in Recommendations and Availability of Advertised Properties

	Dependent variable:			
	Number of Recommendations		Home Availability	
Racial Minority	−0.1282	−0.1419	0.0048	0.0057
	(0.1990)	(0.1987)	(0.0183)	(0.0183)
African American	−0.1608	−0.1690	−0.0097	−0.0087
	(0.2713)	(0.2707)	(0.0220)	(0.0219)
Hispanic	−0.1340	−0.1304	−0.0090	−0.0077
	(0.2465)	(0.2474)	(0.0255)	(0.0258)
Asian	0.1231	0.0833	0.0174	0.0178
	(0.2477)	(0.2465)	(0.0227)	(0.0227)
ln(Price) Advert Home	*N*	*Y*	*N*	*Y*
Racial Comp Advert Home	*N*	*Y*	*N*	*Y*
Observations	6,580	6,555	6,588	6,562
Adjusted R^2	-0.2192	-0.2348	-0.1687	-0.1792

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). Regressions are estimated at the tester level using data for the testers from the total sample of 6,962 that report these variables. Racial minority encompasses all individual minority groups. All regression specifications include trial fixed effects and 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 trial, which is the level of randomization. Significance levels are: *p<0.1; **p<0.05; ***p<0.01.

Table 6. Discriminatory Steering and Neighborhood Racial Composition

	Dependent variable: White Household Share				
	I	II	III	IV	V
Racial Minority	−0.0089	−0.0089	−0.0091	−0.0096	−0.0096
	(0.0112)	(0.0112)	(0.0112)	(0.0112)	(0.0112)
African American	−0.0399***	−0.0398***	−0.0403***	−0.0409***	−0.0410***
	(0.0148)	(0.0148)	(0.0148)	(0.0147)	(0.0147)
Hispanic	0.0028	0.0028	0.0028	0.0025	0.0025
	(0.0152)	(0.0152)	(0.0152)	(0.0152)	(0.0152)
Asian	0.0182	0.0182	0.0181	0.0176	0.0176
	(0.0136)	(0.0136)	(0.0136)	(0.0136)	(0.0136)
Comparison Mean (White)	0.69	0.69	0.69	0.69	0.69
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	21,904	21,893	21,871	21,871	21,871
Adjusted R^2	0.7772	0.7772	0.7766	0.7766	0.7765

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 include trial fixed effects and 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, and time of the appointment (am/pm). Standard errors are clustered by trial, which is the level of randomization. Significance levels are: *p<0.1; **p<0.05; ***p<0.01.

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	−0.0265***	−0.0036	0.0173***
	(0.0081)	(0.0076)	(0.0062)
African American	−0.0338***	−0.0187*	0.0099
	(0.0104)	(0.0100)	(0.0081)
Hispanic	−0.0145	−0.0038	0.0201**
	(0.0108)	(0.0100)	(0.0084)
Asian	−0.0246***	0.0155*	0.0217***
	(0.0095)	(0.0092)	(0.0077)
Comparison Mean (White)	0.21	0.339	0.146
Share White Advert Home	*N*	*Y*	*Y*
ln(Price) Advert Home	*N*	*N*	*Y*
Racial Comp Advert Home	*N*	*N*	*N*
Poverty Share Advert Home	*N*	*N*	*N*
Observations	21,470	21,470	21,470
Adjusted R^2	0.7178	0.7064	0.6665

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 include trial fixed effects and 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, and time of the appointment (am/pm). Standard errors are clustered by trial, which is the level of randomization. Significance levels are: *p<0.1; **p<0.05; ***p<0.01.

Table 8. Discriminatory Steering and Neighborhood Effects

	School-Specific Test Scores:		*Housing Search Platform:*	
	Elem School	Middle School	Assaults	Elem School
Racial Minority	-0.0447**	-0.0328*	8.3591	-0.3424*
	(0.0227)	(0.0178)	(6.4744)	(0.1824)
African American	-0.0856**	-0.0891***	23.1146**	-0.4727**
	(0.0424)	(0.0242)	(9.8939)	(0.2379)
Hispanic	-0.0056	0.0100	-0.4643	-0.2462
	(0.0349)	(0.0294)	(8.0628)	(0.2423)
Asian	-0.0442	-0.0287	5.1582	-0.3756*
	(0.0380)	(0.0237)	(7.6687)	(0.2195)
Comparison Mean (White)	0.29	0.18	80.85	6.43
ln(Price) Advert Home	Y	Y	Y	Y
Racial Comp Advert Home	Y	Y	Y	Y
Outcome Advertised Home	Y	Y	Y	Y
Observations	9,360	9,713	11,161	11,032
Adjusted R^2	0.7625	0.9128	0.7971	0.7475

	American Community Survey				
	Poverty Rate	High Skill	College	Single-Parent HH	Ownership Rate
Racial Minority	0.0116**	-0.0254**	-0.0182*	0.0077	-0.0170
	(0.0054)	(0.0099)	(0.0101)	(0.0062)	(0.0142)
African American	0.0120	-0.0302**	-0.0340***	0.0167*	-0.0263
	(0.0075)	(0.0130)	(0.0127)	(0.0087)	(0.0184)
Hispanic	0.0205***	-0.0387***	-0.0216*	0.0157*	0.0059
	(0.0076)	(0.0130)	(0.0127)	(0.0084)	(0.0203)
Asian	-0.0009	-0.0072	0.0029	-0.0061	-0.0232
	(0.0069)	(0.0128)	(0.0142)	(0.0085)	(0.0176)
Comparison Mean (White)	0.082	0.49	0.53	0.14	0.74
ln(Price) Advert Home	Y	Y	Y	Y	Y
Racial Comp Advert Home	Y	Y	Y	Y	Y
Outcome Advertised Home	Y	Y	Y	Y	Y
Observations	21,871	21,871	21,871	21,871	21,871
Adjusted R^2	0.5205	0.6925	0.7548	0.5237	0.6024
p-values	0.01	0.033	0.073	0.21	0.23
hochberg q-values	0.052	0.13	0.22	0.23	0.23

Note: Coefficients report differences in the attributes of properties/neighborhoods recommended to minority testers relative to a white tester (the omitted category). Racial minority encompasses all individual minority groups. All regression specifications include trial fixed effects and 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, and time of the appointment (am/pm). Standard errors are clustered by trial, which is the level of randomization. Significance levels are: *p<0.1; **p<0.05; ***p<0.01.

Table 9. Discriminatory Steering and Local Pollution Exposures

	Pollution		
	Superfund	Toxics	PM
Racial Minority	0.1010***	765.9137**	−0.0438
	(0.0325)	(324.9800)	(0.0504)
African American	0.1256***	872.9819**	−0.0252
	(0.0465)	(403.4626)	(0.0678)
Hispanic	0.0591	459.7283	0.0102
	(0.0376)	(544.8236)	(0.0638)
Asian	0.1046**	899.5148**	−0.1243**
	(0.0484)	(424.3961)	(0.0617)
Comparison Mean (White)	0.36	5100	9.4
ln(Price) Advert Home	*Y*	*Y*	*Y*
Racial Comp Advert Home	*Y*	*Y*	*Y*
Outcome Advertised Home	*Y*	*Y*	*Y*
Observations	21,883	21,883	21,883
Adjusted R^2	0.8744	0.6939	0.9634

	Pollution		
	Superfund	Toxics	PM
Racial Minority	0.1444***	1,110.5330	0.0082
	(0.0496)	(691.5594)	(0.1091)
African American	0.1978***	2,387.1960**	0.0836
	(0.0750)	(992.5587)	(0.1470)
Hispanic	0.0276	1,361.6980	0.2007
	(0.0677)	(853.3277)	(0.1223)
Asian	0.0808	509.9719	−0.0378
	(0.0627)	(858.7148)	(0.1472)
Comparison Mean (White)	0.38	6300	9.3
ln(Price) Advert Home	*Y*	*Y*	*Y*
Racial Comp Advert Home	*Y*	*Y*	*Y*
Outcome Advertised Home	*Y*	*Y*	*Y*
Observations	8,016	8,016	8,016
Adjusted R^2	0.8508	0.5968	0.9672

Note: Coefficients report differences in the pollution levels at the location of properties recommended to minority testers relative to a white tester (the omitted category). Racial minority encompasses all individual minority groups. All regression specifications include trial fixed effects and 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, and time of the appointment (am/pm). Standard errors are clustered by trial, which is the level of randomization. Significance levels are: *p<0.1; **p<0.05; ***p<0.01.

Table 10. Discriminatory Steering and Neighborhood Effects (Mothers)

	School-Specific Test Scores:		*Housing Search Platform:*	
	Elem School	Middle School	Assaults	Elem School
Racial Minority	-0.1471***	-0.0979***	39.4893***	-3.0893***
	(0.0483)	(0.0278)	(14.0657)	(0.9501)
African American	-0.2231**	-0.2289***	79.7645***	-3.0262***
	(0.0954)	(0.0564)	(12.7280)	(0.7800)
Hispanic	-0.2374***	-0.1214***	29.3393	-1.9212**
	(0.0729)	(0.0364)	(18.4929)	(0.9598)
Asian	-0.0543	-0.1027**	22.2020	-3.8178***
	(0.1265)	(0.0452)	(25.4432)	(0.9020)
Comparison Mean (White)	0.33	0.28	84	6.5
ln(Price) Advert Home	Y	Y	Y	Y
Racial Comp Advert Home	Y	Y	Y	Y
Outcome Advertised Home	Y	Y	Y	Y
Observations	3,806	3,811	4,589	4,521
Adjusted R^2	0.7624	0.8925	0.8344	0.6992

	American Community Survey				
	Poverty Rate	High Skill	College	Single-Parent HH	Ownership Rate
Racial Minority	0.0453***	-0.0347**	-0.0424***	0.0001	-0.0950***
	(0.0102)	(0.0144)	(0.0163)	(0.0125)	(0.0242)
African American	0.0510***	-0.0622***	-0.0769***	0.0264	-0.1659***
	(0.0147)	(0.0210)	(0.0234)	(0.0164)	(0.0329)
Hispanic	0.0557***	-0.0530***	-0.0483***	0.0197	-0.1021***
	(0.0121)	(0.0171)	(0.0179)	(0.0139)	(0.0323)
Asian	0.0356**	-0.0081	-0.0432*	-0.0163	-0.0389
	(0.0155)	(0.0206)	(0.0232)	(0.0164)	(0.0313)
Comparison Mean (White)	0.08	0.48	0.52	0.14	0.77
ln(Price) Advert Home	Y	Y	Y	Y	Y
Racial Comp Advert Home	Y	Y	Y	Y	Y
Outcome Advertised Home	Y	Y	Y	Y	Y
Observations	8,015	8,015	8,015	8,015	8,015
Adjusted R^2	0.4561	0.6605	0.7395	0.4826	0.4863

Note: Coefficients report differences in the attributes of properties/neighborhoods recommended to minority testers that are assigned the role of a mother (female gender with children in household) relative to a white tester with the same assigned role (the omitted category). Racial minority encompasses all individual minority groups. All regression specifications include trial fixed effects and 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, and time of the appointment (am/pm). Standard errors are clustered by trial, which is the level of randomization. Significance levels are: *p<0.1; **p<0.05; ***p<0.01.

Table 11. 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^{***}
	(0.0464)	(0.0579)	(0.1268)	(0.0478)	(0.0588)	(0.1296)
Hispanic	-0.1585^{***}	-0.1986^{***}	-0.4283^{***}	-0.1543^{***}	-0.1657^{***}	-0.3358^{**}
	(0.0425)	(0.0534)	(0.1114)	(0.0429)	(0.0518)	(0.1308)
Asian	-0.0437	-0.0770	-0.3101^{**}	-0.0419	-0.0757	-0.2618^{**}
	(0.0445)	(0.0603)	(0.1282)	(0.0445)	(0.0610)	(0.1275)
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

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 include trial fixed effects and 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, and time of the appointment (am/pm). Standard errors are clustered by trial, which is the level of randomization. Significance levels are: *p<0.1; **p<0.05; ***p<0.01.

Table 12. Discriminatory Steering: Median Income in Neighborhood

	Dependent variable: log(Median Income)		
	All Testers	Families	Moms
African American	-0.0729^{**}	-0.1085^{***}	-0.2485^{***}
	(0.0335)	(0.0401)	(0.0738)
Hispanic	−0.0478	−0.0388	−0.0782
	(0.0310)	(0.0376)	(0.0567)
Asian	−0.0126	−0.0511	−0.0773
	(0.0271)	(0.0367)	(0.0583)
Comparison Mean (White)	11.405	11.46	11.45
Observations	21,457	6,369	3,772
Adjusted R^2	0.6657	0.6756	0.6104

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 include trial fixed effects and 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, and time of the appointment (am/pm). Standard errors are clustered by trial, which is the level of randomization. Significance levels are: *p<0.1; **p<0.05; ***p<0.01.

Table 13. Discriminatory Steering by Implied Preferences for Neighborhood Attributes

	School-Specific Test Scores:		*Housing Search Platform:*	
	Elem School	Middle School	Assaults	Elem School
Racial Minority	-0.0618***	-0.0326***	9.2013**	-0.2583***
	(0.0131)	(0.0092)	(4.3081)	(0.0618)
African American	-0.0810***	-0.0210*	3.9675	-0.5920***
	(0.0177)	(0.0122)	(5.7978)	(0.0821)
Hispanic	-0.0701***	-0.0124	12.9738**	-0.2014**
	(0.0204)	(0.0138)	(6.3158)	(0.0922)
Asian	-0.0557***	-0.0510***	17.3702***	-0.0299
	(0.0183)	(0.0128)	(5.9039)	(0.0826)
Comparison Mean (White)	0.02	0.016	-7.4	0.18
Observations	8,951	9,242	11,161	11,032
Adjusted R^2	0.3187	0.4313	0.2657	0.3751

	American Community Survey				
	Poverty Rate	High Skill	College	Single-Parent HH	Ownership Rate
Racial Minority	0.0012	-0.0070**	-0.0018	0.0042*	0.0042
	(0.0022)	(0.0034)	(0.0035)	(0.0024)	(0.0052)
African American	-0.0085***	-0.0120***	-0.0068	0.0092***	0.0035
	(0.0030)	(0.0045)	(0.0047)	(0.0032)	(0.0069)
Hispanic	0.0052	-0.0158***	0.0042	-0.0032	0.0146*
	(0.0033)	(0.0049)	(0.0051)	(0.0035)	(0.0075)
Asian	0.0032	0.0134***	0.0028	0.0059*	0.0139*
	(0.0031)	(0.0046)	(0.0049)	(0.0033)	(0.0072)
Comparison Mean (White)	7.6e-05	0.0025	0.0068	-0.0025	-0.0063
Observations	21,871	21,871	21,871	21,871	21,871
R^2	0.3396	0.3992	0.3838	0.3643	0.3727
Adjusted R^2	0.2778	0.3430	0.3262	0.3048	0.3140

Note: Coefficients report differences in the gap between implied preferences and homes recommended to minority testers relative to a white tester (the omitted category). Dependent variable is the difference between the level of each attribute in the advertised listing and the recommended property. Racial minority encompasses all individual minority groups. This specification omits trial fixed to allow identifying variation in the advertised home attribute, which is typically held fixed within a trial (and otherwise balanced). 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, and time of the appointment (am/pm). Standard errors are clustered by trial, which is the level of randomization. Significance levels are: *p<0.1; **p<0.05; ***p<0.01.

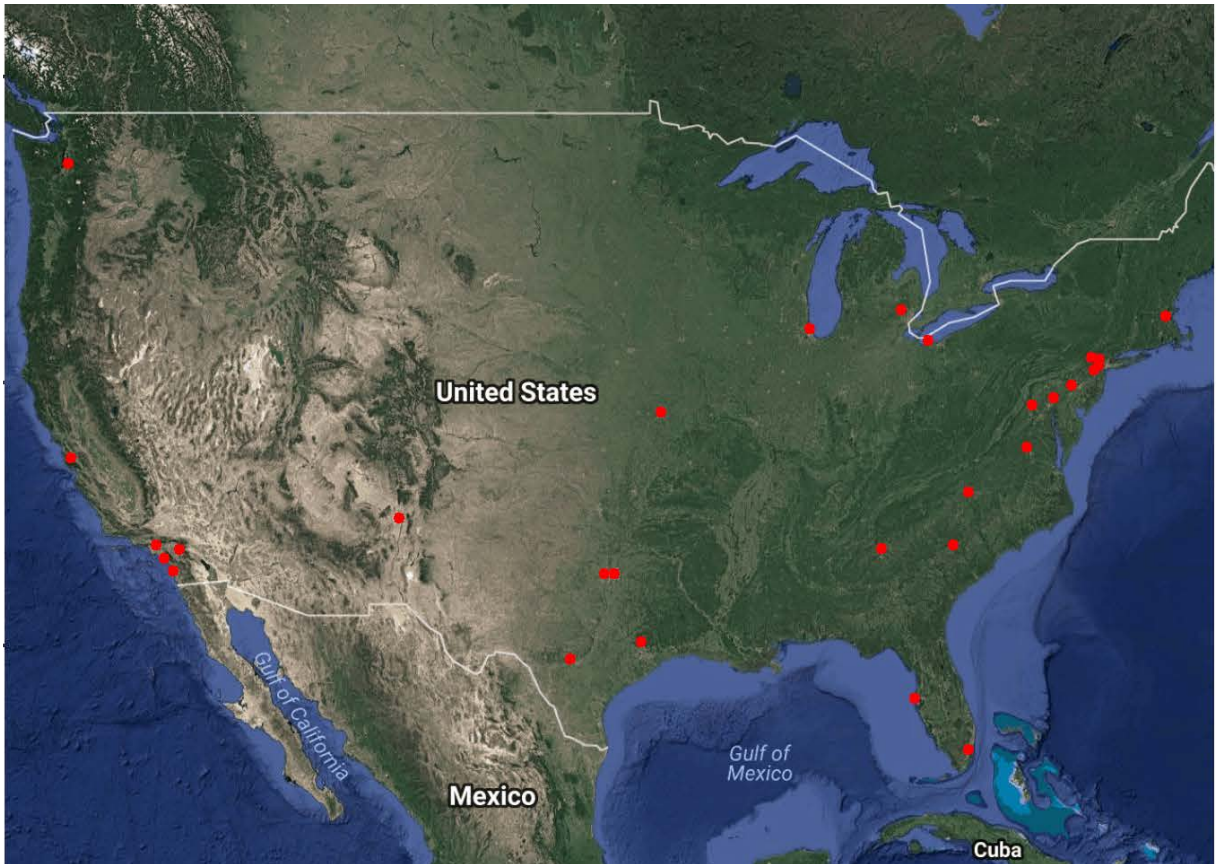
Table 14. Discriminatory Steering and Later Transactions

	Buyers Upon Sale			
	White	African American	Hispanic	Asian
Differentiability Score	68%	15%	87%	91%
Same Race Tester	-0.0064	-0.0019	0.0733*	0.1169**
	(0.0481)	(0.0149)	(0.0442)	(0.0510)
Buyers(n)	7,598	217	1,224	1,014
Observations	9,428	9,428	9,428	9,428
Adjusted R^2	0.3654	0.2035	0.3886	0.4163

	Dependent variable: Logarithm of Price				
	I	II	III	IV	V
Racial Minority	-0.0117	-0.0116	-0.0107	-0.0106	-0.0540
	(0.0336)	(0.0336)	(0.0336)	(0.0336)	(0.0371)
African American	0.0263	0.0262	0.0275	0.0276	-0.0363
	(0.0404)	(0.0404)	(0.0404)	(0.0404)	(0.0445)
Hispanic	0.0307	0.0305	0.0362	0.0360	-0.0004
	(0.0664)	(0.0665)	(0.0671)	(0.0674)	(0.0699)
Asian	-0.0899	-0.0897	-0.0896	-0.0892	-0.1101*
	(0.0561)	(0.0561)	(0.0560)	(0.0561)	(0.0592)
Comparison Mean (White)	0.66	0.66	0.66	0.66	0.66
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
Year	Y	Y	Y	Y	Y
Month of Year	Y	Y	Y	Y	Y
Observations	10,862	10,829	10,808	10,808	10,808
Adjusted R^2	0.8624	0.8621	0.8599	0.8599	0.8689

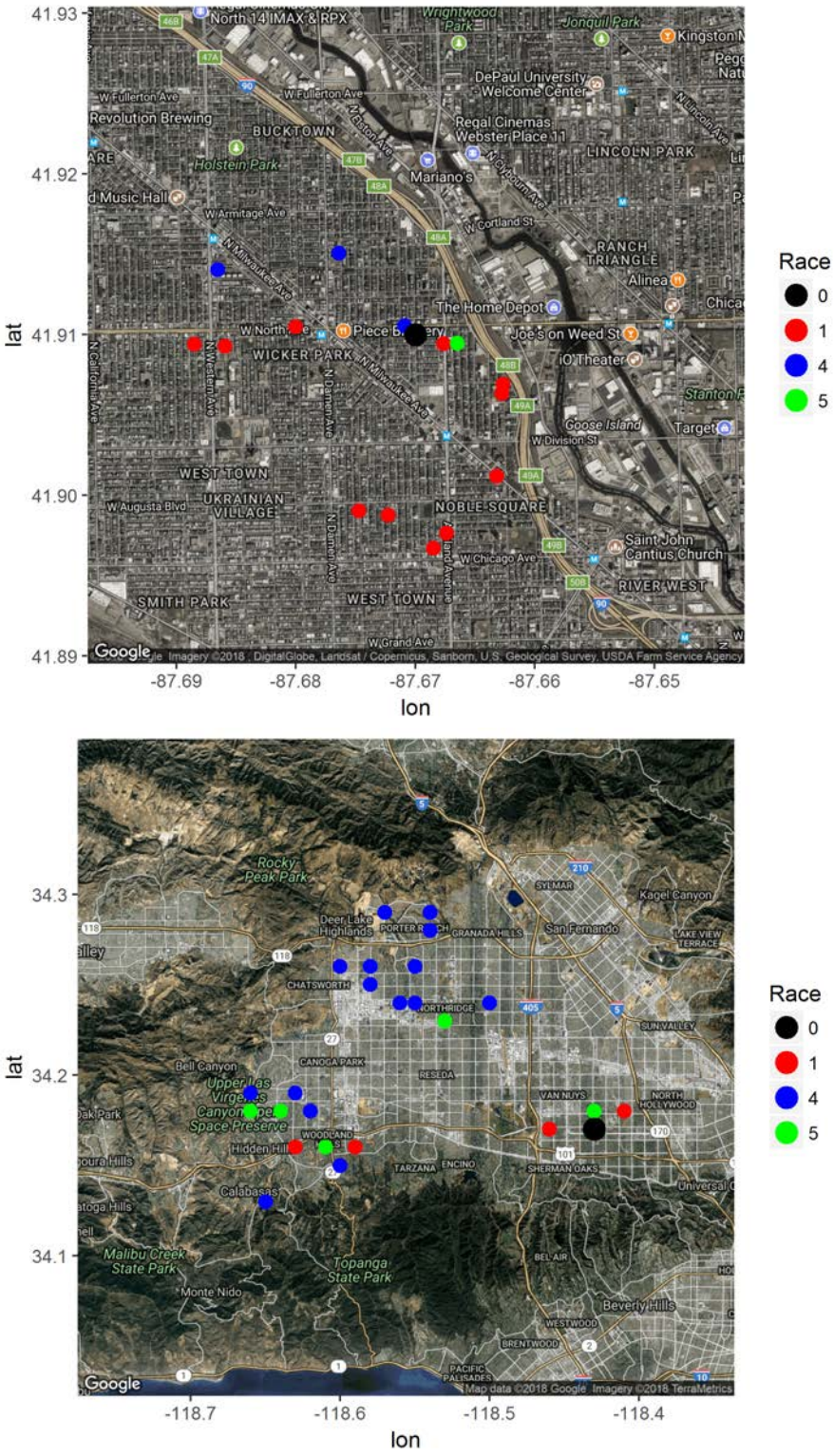
Note: Coefficients report differences in the predicted race groups of home buyers and sale prices (recorded in ZTRAX transactions data) of properties recommended to minority testers relative to a white tester (the omitted category). Top panel reports estimates from a regression where the outcome is the predicted racial/ethnic identity associated with a first/last name of a ZTRAX home buyer. Differentiability score is calculated as the difference in predicted probability of the most likely buyer race group and the second most likely buyer race group. Buyers(n) reports the number of buyers from each predicted group that are observed in the ZTRAX transactions data. Bottom panel reports estimates from a regression where the outcome is the transaction price of the property. Racial minority encompasses all individual minority groups. All regression specifications include trial fixed effects and 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, and time of the appointment (am/pm). Standard errors are clustered by trial, which is the level of randomization. Significance levels are: *p<0.1; **p<0.05; ***p<0.01.

Figure 1. Markets in 2012 HUD Buyer Experiment



Note: Red points identify 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 use a simple horizontal model of residential sorting in order to illustrate how discrimination affects choice sets and the resulting welfare effects. We begin with a homebuyer i with income I_i who receives the following utility from residential choice k:

$$U_{i,k} = \alpha ln(I_i - P_k) + X_k'\beta + \eta_{i,k} \tag{A.1}$$

where P_k is the price of choice k and X_k represents other housing and neighborhood attributes. $\eta_{i,k}$ is an idiosyncratic shock specific to the individual and residence. For the sake of simplicity, we treat X_k as a desirable scalar attribute, although all of the arguments below extend to a vector interpretation.

In the context of a search of the sort described by the HUD audit study, household i receives a set of recommended houses $k \in \Gamma_i$ upon visiting a real estate agent and requesting to view a particular advertised house. Treating the idiosyncratic shock $\eta_{i,k}$, which is assumed to be distributed Type I Extreme Value, as information that is revealed to the household after touring the house and completing an inspection, the *a priori* expected utility from the choice set Γ_i is given by:

$$EU_i = ln\left(\sum_{k\in\Gamma_i} e^{\alpha ln(I_i - P_k) + X_k'\beta}\right) \tag{A.2}$$

Given that all terms in the summation are positive, we can state without additional proof that, *ceteris paribus*, a smaller choice set will yield less expected utility. Consistent with prior results, we do not find statistical differences in choice set size across race groups. We do, however, find significant differences in choice set *composition*.

We examine the conditions under which evidence of discriminatory constraints that affect the quality of housing choices in an audit can be interpreted as affecting welfare by considering the following simple example of a minority buyer and their counterfactual condition who is identical in terms of preferences and income but is not subjected to discrimination.[48] In both conditions, the buyers receive a choice set made up of the same k=1,2,...,K alternatives. In the observed condition, however, the minority buyer then receives housing choice (X_{K+1}, P_{K+1}), while they receive choice $(\tilde{X}_{K+1}, \tilde{P}_{K+1})$ in the counterfactual condition. These choices may differ in amenity levels (X) as well as prices (P).

$$\tilde{X}_{K+1} = X_{K+1} + \Delta X \tag{A.3}$$

$$\tilde{P}_{K+1} = P_{K+1} + \gamma \Delta X \tag{A.4}$$

where ΔX measures the magnitude of the difference in amenity levels, $\gamma\Delta$X measures the magnitude of the difference in price and is fully observed, and γ specifically captures the

[48] This corresponds to the structure of the audit study, where the white tester is given attributes that make them identical to the minority buyer in every respect except racial identity.

price differential associated with the amenity difference. The expected utilities associated with these choice sets under each condition are, for the counterfactual condition:

$$\tilde{EU} = ln\left(\sum_{k=1}^{K} e^{\alpha ln(I-P_k)+X_k'\beta} + e^{\alpha ln(I-\tilde{P}_{K+1})+\tilde{X}_{K+1}'\beta}\right) \tag{A.5}$$

and for the observed condition:

$$EU = ln\left(\sum_{k=1}^{K} e^{\alpha ln(I-P_k)+X_k'\beta} + e^{\alpha ln(I-P_{K+1})+X_{K+1}'\beta}\right) \tag{A.6}$$

We next examine the conditions under which we expect $\tilde{EU} - EU > 0$ – i.e., the conditions under which the difference in the composition of the choice set negatively affects the minority buyer in their observed condition relative to their counterfactual. Re-writing this inequality as the log of the ratio of the terms inside parentheses in equations A.5 and A.6 and taking the exponential of both sides yields the following expression:

$$\left(\frac{\sum_{k=1}^{K} e^{\alpha ln(I-P_k)+X_k'\beta} + e^{\alpha ln(I-\tilde{P}_{K+1})+\tilde{X}_{K+1}'\beta}}{\sum_{k=1}^{K} e^{\alpha ln(I-P_k)+X_k'\beta} + e^{\alpha ln(I-P_{K+1})+X_{K+1}'\beta}}\right) > 1 \tag{A.7}$$

We cancel terms and cross-multiply to obtain the following simplified inequality:

$$\alpha ln(I-\tilde{P}_{K+1}) + \tilde{X}_{K+1}'\beta > \alpha ln(I-P_{K+1}) + X_{K+1}'\beta \tag{A.8}$$

Further simplification yields:

$$ln\left(\frac{I-P_{K+1}}{I-P_{K+1}-\gamma\Delta X}\right) < \Delta X\frac{\beta}{\alpha} \tag{A.9}$$

This inequality describes the circumstances under which the differences in the compositions of the two choice sets will result in a negative welfare impact for the minority buyer in the observed condition. We next characterize the conditions under which we expect this inequality to hold. In order to do this, we re-write the inequality as:

$$F(I, P_{K+1}, \gamma, \beta, \alpha, \Delta X) < 0 \tag{A.10}$$

where

$$F(I, P_{K+1}, \gamma, \beta, \alpha, \Delta X) = ln\left(\frac{I-P_{K+1}}{I-P_{K+1}-\gamma\Delta X}\right) - \Delta X\frac{\beta}{\alpha} \tag{A.11}$$

from which we can calculate a series of derivatives to explore the relationships between compositional constraints and expected welfare impacts. These derivatives are described in the folliwing five equations. Equation 1 illustrates that all else equal, increases in β will increase the value of ΔX and expected negative welfare impact on the minority buyer:

$$\frac{\partial F}{\partial \beta} = -\frac{1}{\alpha}\Delta X < 0 \tag{1}$$

Consistent with standard results in structural sorting models, the magnitude of the expected effect will depend on the size of β relative to the marginal utility of income α, as the ratio of these terms defines a buyer's willingness to pay for X. Equation 2 illustrates

that all else equal, a lower marginal utility of income will also increase the expected negative welfare effect for a minority buyer as it reduces the welfare effect of the higher price paid for the better amenity ΔX:

$$\frac{\partial F}{\partial \alpha} = -\frac{\beta}{\alpha^2}\Delta X > 0 \tag{2}$$

Equation 3 states that at higher incomes, the marginal utility of income similarly falls, leading to a larger expected negative welfare effect for the minority buyer:

$$\frac{\partial F}{\partial I} = \frac{-\gamma \Delta X}{(I - P_{K+1})(I - P_{K+1} - \gamma \Delta X)} < 0 \tag{3}$$

Equation 4 makes a similar point – the lower the price of X_{K+1}, the higher is $I - P_{K+1}$ and the lower the marginal utility of income, increasing the expected impact to the buyer.

$$\frac{\partial F}{\partial P} = \frac{\gamma \Delta X}{(I - P_{K+1})(I - P_{K+1} - \gamma \Delta X)} > 0 \tag{4}$$

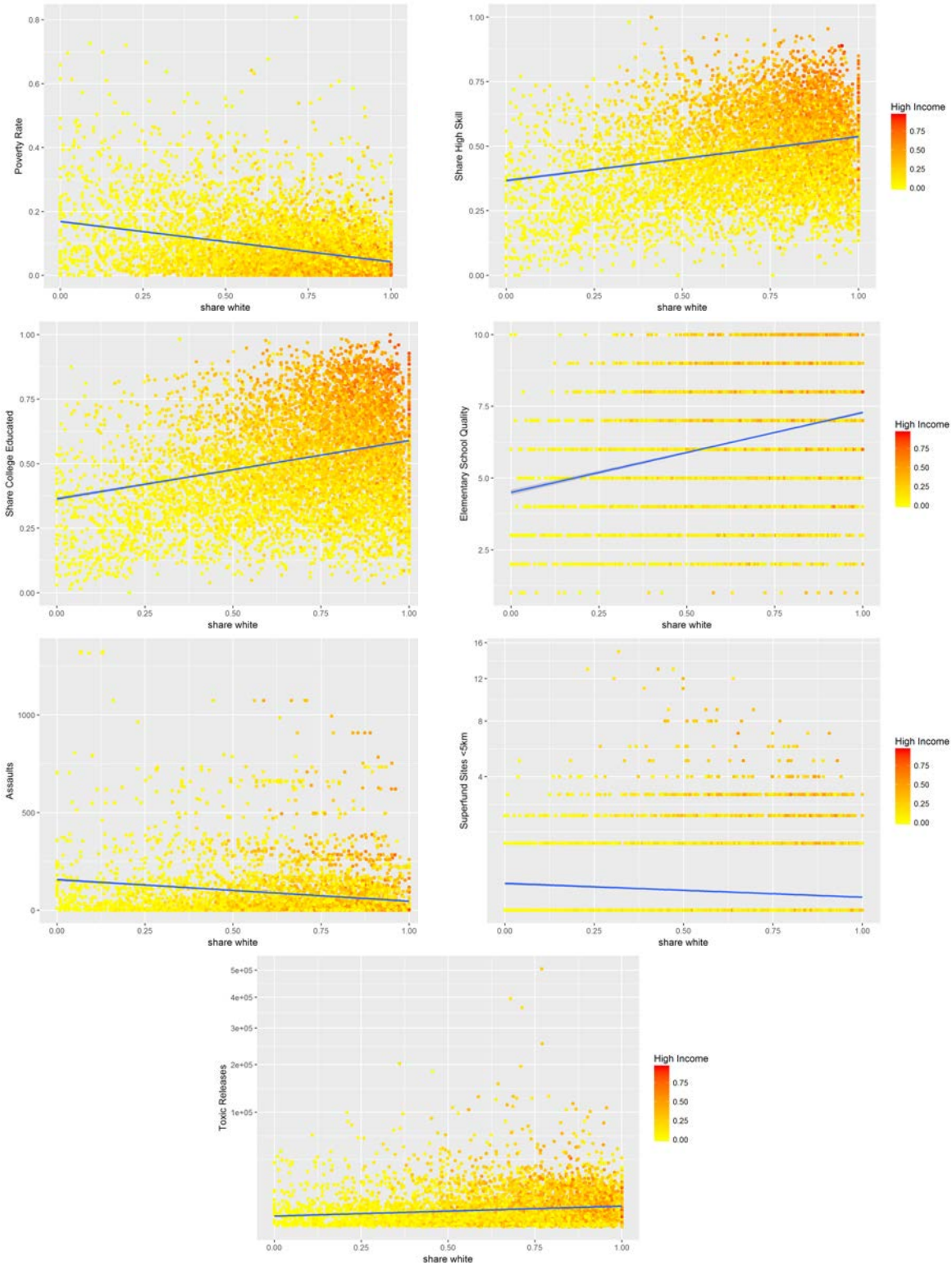
Finally, equation 5 implies that the smaller is γ, the less likely that the reductions in amenity value will be compensated by equivalent reductions in home prices. This will increase the expected negative welfare effect for the buyer at any level of income.

$$\frac{\partial F}{\partial \gamma} = \frac{\Delta X}{(I - P_{K+1} - \gamma \Delta X)} > 0 \tag{5}$$

A small γ may result from a number of possible factors. Most simply, a small γ may result from supply conditions for X. However, it may also be the case that there is little difference between P_{K+1} and $\tilde{P}_{K+1}$ because the two homes come from market segments that differ as a result of discrimination or segregation. For instance, $(\tilde{X}_{K+1}, \tilde{P}_{K+1})$ may be in a market segment in which houses are not made available to minority buyers, while (X_{K+1}, P_{K+1}) is in a segment available only to minority buyers. The amenity in question may be in much shorter supply in the minority housing segment, meaning that P_{K+1} could be similar to, or even higher than, $\tilde{P}_{K+1}$. In his seminal work on discrimination, Becker et al. (1971) illustrates that differential constraints will result in an equilibrium price differential. This is also consistent with a large body of empirical evidence that studies historical (Cutler et al., 1999) and well as recent equilibrium outcomes in the housing market (Bayer et al., 2017).

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

	Dependent variable: African American Household Share				
	I	II	III	IV	V
Racial Minority	0.0155**	0.0156**	0.0156**	0.0157**	0.0156**
	(0.0073)	(0.0073)	(0.0073)	(0.0073)	(0.0072)
African American	0.0388***	0.0389***	0.0390***	0.0393***	0.0396***
	(0.0107)	(0.0107)	(0.0107)	(0.0107)	(0.0107)
Hispanic	0.0126	0.0126	0.0126	0.0126	0.0126
	(0.0086)	(0.0086)	(0.0086)	(0.0086)	(0.0086)
Asian	−0.0068	−0.0068	−0.0068	−0.0067	−0.0067
	(0.0095)	(0.0095)	(0.0095)	(0.0095)	(0.0094)
Comparison Mean	0.09	0.09	0.09	0.09	0.09
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	21,904	21,893	21,871	21,871	21,871
Adjusted R^2	0.7719	0.7720	0.7693	0.7693	0.7693

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	0.0019*	0.0097***	0.0050
	(0.0011)	(0.0036)	(0.0041)
African American	0.0051***	0.0175***	0.0176***
	(0.0016)	(0.0061)	(0.0058)
Hispanic	0.0005	0.0068*	0.0055
	(0.0015)	(0.0041)	(0.0049)
Asian	−0.0000	0.0030	−0.0095*
	(0.0015)	(0.0042)	(0.0056)
Comparison Mean	0.01	0.04	0.04
Share White Advert Home	*N*	*Y*	*Y*
ln(Price) Advert Home	*N*	*N*	*Y*
Racial Comp Advert Home	*N*	*N*	*N*
Poverty Share Advert Home	*N*	*N*	*N*
Observations	21,470	21,470	21,470
Adjusted R^2	0.7299	0.7625	0.6706

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. Significance levels are: *p<0.1; **p<0.05; ***p<0.01.

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

	Dependent variable: Hispanic Household Share				
	I	II	III	IV	V
Racial Minority	0.0032	0.0033	0.0034	0.0034	0.0034
	(0.0070)	(0.0070)	(0.0070)	(0.0070)	(0.0070)
African American	0.0159	0.0160	0.0162	0.0161	0.0160
	(0.0103)	(0.0103)	(0.0103)	(0.0103)	(0.0103)
Hispanic	−0.0016	−0.0014	−0.0013	−0.0013	−0.0013
	(0.0091)	(0.0091)	(0.0091)	(0.0091)	(0.0091)
Asian	−0.0094	−0.0092	−0.0093	−0.0093	−0.0093
	(0.0088)	(0.0088)	(0.0088)	(0.0088)	(0.0088)
Comparison Mean	0.13	0.13	0.13	0.13	0.13
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	21,904	21,893	21,871	21,871	21,871
Adjusted R^2	0.8437	0.8437	0.8437	0.8437	0.8437

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

	Dep. Variable: Hispanic Household Share by Income		
	High Inc	Mid Inc	Low Inc
Racial Minority	0.0015	−0.0010	0.0030
	(0.0017)	(0.0039)	(0.0043)
African American	0.0053**	0.0044	0.0054
	(0.0026)	(0.0048)	(0.0072)
Hispanic	−0.0016	−0.0048	0.0050
	(0.0023)	(0.0056)	(0.0056)
Asian	−0.0012	−0.0042	−0.0023
	(0.0024)	(0.0050)	(0.0047)
Comparison Mean	0.03	0.07	0.03
Share White Advert Home	*N*	*Y*	*Y*
ln(Price) Advert Home	*N*	*N*	*Y*
Racial Comp Advert Home	*N*	*N*	*N*
Poverty Share Advert Home	*N*	*N*	*N*
Observations	21,470	21,470	21,470
Adjusted R^2	0.6521	0.8328	0.7115

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. Significance levels are: *p<0.1; **p<0.05; ***p<0.01.

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

	Dependent variable: Asian Household Share				
	I	II	III	IV	V
Racial Minority	−0.0097*	−0.0098*	−0.0098*	−0.0095*	−0.0097*
	(0.0053)	(0.0053)	(0.0053)	(0.0053)	(0.0053)
African American	−0.0150**	−0.0149**	−0.0149**	−0.0147**	−0.0148**
	(0.0069)	(0.0068)	(0.0068)	(0.0068)	(0.0068)
Hispanic	−0.0137*	−0.0140*	−0.0140*	−0.0136*	−0.0136*
	(0.0079)	(0.0078)	(0.0079)	(0.0078)	(0.0078)
Asian	−0.0014	−0.0013	−0.0013	−0.0011	−0.0011
	(0.0065)	(0.0065)	(0.0065)	(0.0064)	(0.0064)
Comparison Mean	0.07	0.07	0.07	0.07	0.07
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	21,904	21,893	21,871	21,871	21,871
Adjusted R^2	0.7433	0.7433	0.7433	0.7433	0.7432

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	−0.0020	−0.0036	−0.0022
	(0.0019)	(0.0027)	(0.0022)
African American	−0.0033	−0.0067**	−0.0039
	(0.0023)	(0.0033)	(0.0029)
Hispanic	−0.0034	−0.0046	−0.0055*
	(0.0030)	(0.0041)	(0.0028)
Asian	0.0013	−0.0002	0.0011
	(0.0023)	(0.0033)	(0.0027)
Comparison Mean	0.01	0.03	0.02
Share White Advert Home	*N*	*Y*	*Y*
ln(Price) Advert Home	*N*	*N*	*Y*
Racial Comp Advert Home	*N*	*N*	*N*
Poverty Share Advert Home	*N*	*N*	*N*
Observations	21,470	21,470	21,470
Adjusted R^2	0.6870	0.7235	0.6258

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. Significance levels are: *p<0.1; **p<0.05; ***p<0.01.

D Comparison with Specifications Used in HDS 2012 Report

This section examines 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 using Census tract-level data (Columns 1-2) and tester averages (Columns 3-4) from 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 (Table 8) to comparable specifications with/without controls that use census tract measures (Columns 1-2) and specifications that aggregate recommendations by tester and also use census tract measures (Columns 3-4). The tests reported in the final two columns are the most similar to those reported in Turner et al. (2013) though there are differences in the samples and we 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 reduces the 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 to the trial level and to the census tract. The choice of controls also affects estimate magnitudes, but less so.

In both cases, estimates of differences become substantially smaller and tests less powered when we measure outcomes at the census tract level and aggregate to the level of a tester recommendation set (comparing differences in tester 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). Differences in poverty rates fall by an order of magnitude and become statistically non-significant. Using this specification, we estimate that homes recommended to African American testers have a .27% [0.29] higher poverty share than those recommended to a white tester. This is very similar to the difference of .2% [0.2] that is documented in the HDS 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 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%[49], it becomes clear that using tract-level measures may mask considerable heterogeneity in the neighborhoods that testers are steered into.

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

Table D.2. Differential Steering and White Share

	Dep. Variable: White Share			
	Tract	Tract	Tester Mean	Tester Mean
African American	-0.0315^{*}	-0.0358^{**}	-0.0280^{***}	-0.0294^{**}
	(0.0166)	(0.0164)	(0.0087)	(0.0135)
Poverty Rate Advert Home	N	Y	N	Y
Racial Comp Advert Home	N	Y	N	Y
ln(Price) Advert Home	N	Y	N	Y
Observations	15,270	14,342	498	480
Adjusted R^2	0.8320	0.8293	0.7598	0.7492
	Dep. Variable: Poverty Rate			
	Tract	Tract	Tester-Tract	Tester-Tract
African American	0.0093	0.0077	0.0027	0.0027
	(0.0076)	(0.0075)	(0.0032)	(0.0029)
Poverty Rate Advert Home	N	Y	N	Y
Racial Comp Advert Home	N	Y	N	Y
ln(Price) Advert Home	N	Y	N	Y
Observations	15,269	14,341	498	480
Adjusted R^2	0.5877	0.5926	0.6721	0.7071

Note: Coefficients report differences in the poverty rates in neighborhoods recommended to minority testers relative to a white tester (the omitted category). Columns 1-2 report estimates from tests that measure poverty rates at the census Tract level whereas columns 3-4 report estimates using tester averages (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. Significance levels are: *p<0.1; **p<0.05; ***p<0.01.

E 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 F.

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

	Elem School Test Scores			Middle School Test Scores			Assaults		
Racial Minority	-0.0358*	-0.044**	-0.049**	-0.043**	-0.033*	-0.036**	7.7983	8.3591	3.4936
	(0.0210)	(0.0227)	(0.0222)	(0.0179)	(0.0178)	(0.0176)	(6.0232)	(6.4744)	(6.5735)
African American	-0.0625	-0.086**	-0.095**	-0.01***	-0.09***	-0.09***	19.213**	23.115**	17.600*
	(0.0385)	(0.0424)	(0.0401)	(0.0239)	(0.0242)	(0.0238)	(7.7954)	(9.8939)	(10.0867)
Hispanic	0.0013	-0.0056	-0.0121	-0.0010	0.0100	0.0096	0.3826	-0.4643	-4.7086
	(0.0338)	(0.0349)	(0.0353)	(0.0291)	(0.0294)	(0.0291)	(8.0997)	(8.0628)	(8.3707)
Asian	-0.0409	-0.0442	-0.0448	-0.0312	-0.0287	-0.0336	2.3480	5.1582	0.2606
	(0.0374)	(0.0380)	(0.0387)	(0.0240)	(0.0237)	(0.0236)	(8.3593)	(7.6687)	(7.9009)
Comparison Mean (White)	0.29	0.29	0.29	0.18	0.18	0.18	80.85	80.85	80.85
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	10,004	9,360	9,297	10,258	9,713	9,652	14,385	11,161	11,101
Adjusted R^2	0.7690	0.7625	0.7647	0.9139	0.9128	0.9149	0.7763	0.7971	0.8000

	Elem School			Poverty Rate			High Skill		
Racial Minority	-0.2266	-0.3424*	-0.3465*	0.0115**	0.0116**	0.0125**	-0.025**	-0.025**	-0.02**
	(0.1622)	(0.1824)	(0.1802)	(0.0055)	(0.0054)	(0.0054)	(0.0100)	(0.0099)	(0.0094)
African American	-0.43**	-0.47**	-0.54**	0.0114	0.0120	0.0123	-0.03**	-0.03**	-0.025**
	(0.2035)	(0.2379)	(0.2322)	(0.0076)	(0.0075)	(0.0075)	(0.0131)	(0.0130)	(0.0124)
Hispanic	-0.1012	-0.2462	-0.2282	0.02***	0.02***	0.02***	-0.04***	-0.04***	-0.03**
	(0.2246)	(0.2423)	(0.2462)	(0.0076)	(0.0076)	(0.0076)	(0.0132)	(0.0130)	(0.0127)
Asian	-0.0679	-0.38*	-0.3707	-0.0005	-0.0009	0.0006	-0.0070	-0.0072	-0.0042
	(0.1962)	(0.2195)	(0.2255)	(0.0070)	(0.0069)	(0.0069)	(0.0129)	(0.0128)	(0.0120)
Comparison Mean (White)	6.43	6.43	6.43	0.082	0.082	0.082	0.49	0.49	0.49
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	14,401	11,032	10,984	21,904	21,871	21,744	21,904	21,871	21,744
Adjusted R^2	0.7409	0.7475	0.7495	0.5200	0.5205	0.5302	0.6927	0.6925	0.7013

	College			Single-Parent HH			Ownership Ratel		
Racial Minority	-0.02*	-0.02*	-0.02*	0.007	0.0077	0.0086	-0.0159	-0.0170	-0.0186
	(0.0101)	(0.0101)	(0.0099)	(0.0062)	(0.0062)	(0.0062)	(0.0142)	(0.0142)	(0.0139)
African American	-0.04***	-0.03***	-0.04***	0.015*	0.017*	0.017*	-0.0255	-0.0263	-0.0251
	(0.0127)	(0.0127)	(0.0126)	(0.0088)	(0.0087)	(0.0088)	(0.0184)	(0.0184)	(0.0178)
Hispanic	-0.0207	-0.0212*	-0.023*	0.0141	0.016*	0.018**	0.0085	0.0059	0.0039
	(0.0126)	(0.0127)	(0.0124)	(0.0086)	(0.0084)	(0.0087)	(0.0202)	(0.0203)	(0.0202)
Asian	0.0027	0.0029	0.0024	-0.0065	-0.0061	-0.0056	-0.0234	-0.0232	-0.0259
	(0.0142)	(0.0142)	(0.0138)	(0.0086)	(0.0085)	(0.0085)	(0.0177)	(0.0176)	(0.0174)
Comparison Mean (White)	0.53	0.53	0.53	0.14	0.14	0.14	0.74	0.74	0.74
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	21,904	21,871	21,744	21,904	21,871	21,744	21,904	21,871	21,744
Adjusted R^2	0.7550	0.7548	0.7610	0.5236	0.5237	0.5310	0.6022	0.6024	0.6077

	Superfund			Toxics			PM		
Racial Minority	0.10***	0.10***	0.11***	779.06**	765.91**	682.7*	-0.0438	-0.0438	-0.0264
	(0.0326)	(0.0325)	(0.0332)	(326.3205)	(324.9800)	(359.3615)	(0.0504)	(0.0504)	(0.0531)
African American	0.13***	0.13***	0.13***	891.8**	872.9**	690.97	-0.025	-0.025	-0.022
	(0.0467)	(0.0465)	(0.0457)	(409.0238)	(403.4626)	(468.2560)	(0.0678)	(0.0678)	(0.0690)
Hispanic	0.0578	0.0591	0.0603	471.3270	459.7283	456.4245	0.0063	0.0102	0.0457
	(0.0381)	(0.0376)	(0.0392)	(546.7939)	(544.8235)	(559.8852)	(0.0639)	(0.0638)	(0.0684)
Asian	0.10**	0.11**	0.09*	909.50**	899.51**	885.51*	-0.12**	-0.12**	-0.11
	(0.0484)	(0.0484)	(0.0480)	(429.1031)	(424.3961)	(473.3210)	(0.0618)	(0.0617)	(0.0649)
Comparison Mean (White)	0.36	0.36	0.36	5100	5100	5100	9.4	9.4	9.4
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	21,916	21,883	21,756	21,916	21,883	21,756	21,916	21,883	21,756
Adjusted R^2	0.8745	0.8744	0.8777	0.6941	0.6939	0.6945	0.9635	0.9634	0.9641

Note: Coefficients report differences in the attributes of neighborhoods recommended to minority testers relative to a white tester (the omitted category) using different sets of controls. The 3rd specification for each variable contains a fixed effect using tight bins of list price ($20,000) for the recommended home. 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. Significance levels are: *p<0.1; **p<0.05; ***p<0.01.

F 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 strong evidence that minority testers receive recommendations for lower priced homes relative to their white paired testers, though we do find a marginally significant price reduction for Hispanic/LatinX testers. Looking at point estimates alone, it appears that homes recommended to African American and Asian buyers may have somewhat higher list prices on average. Along with the tests of differences in transaction prices reported in Table 14 and within tight intervals of list price reported in Column 3 of Table E.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. There is no evidence that this is the case for African American testers in particular, who are subject to the strongest steering effects.

Table F.1. Discriminatory Steering and Home Price

	Dependent variable: log(Price)		
	1	2	3
Racial Minority	0.0024	0.0034	0.0120
	(0.1047)	(0.1055)	(0.0994)
African American	0.0776	0.0764	0.0937
	(0.1633)	(0.1634)	(0.1583)
Hispanic	−0.1562	−0.1526	−0.1504*
	(0.0988)	(0.0996)	(0.0908)
Asian	0.0642	0.0642	0.0665
	(0.0966)	(0.0970)	(0.0904)
Comparison Mean (White)	12.40	12.40	12.40
Racial Comp Advert Home	*N*	*Y*	*Y*
ln(Price) Advert Home	*N*	*N*	*Y*
Observations	21,787	21,776	21,763
Adjusted R^2	0.7223	0.7222	0.7241

Note: Coefficients report differences in the list 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. Significance levels are: *p<0.1; **p<0.05; ***p<0.01.

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 in a census block group with an above-median white share. The results suggest stronger constraints for African American testers, in particular, that search in these neighborhoods. Homes recommended to these buyers are located in attendance zones with considerably lower elementary school test scores and neighborhoods with greater numbers of assaults, higher poverty rates, lower skill levels, lower college attendance rates, higher shares of single-parent households, lower home ownership rates, and higher exposures to toxic pollution.

Table G.1. Discriminatory Steering: White Neighborhoods

	School-Specific Test Scores:		*Housing Search Platform:*	
	Elem School	Middle School	Assaults	Elem School
African American	-0.4317***	-0.0670**	47.1246***	-2.0678
	(0.0418)	(0.0304)	(9.2629)	(1.7155)
Hispanic	-0.1327*	0.0197	-45.7471***	1.0544
	(0.0697)	(0.0309)	(11.7732)	(0.9374)
Asian	-0.1533**	-0.0081	18.5930***	1.0308
	(0.0685)	(0.0274)	(6.4357)	(1.3990)
Comparison Mean (White)	0.37	0.28	51	6.70
Observations	5,021	5,217	5,574	5,415
Adjusted R^2	0.8419	0.9240	0.9106	0.7569

	American Community Survey				
	Poverty Rate	High Skill	College	Single-Parent HH	Ownership Rate
African American	0.0293***	-0.0550***	-0.0434***	0.0203*	-0.0479**
	(0.0083)	(0.0149)	(0.0149)	(0.0106)	(0.0216)
Hispanic	0.0329***	-0.0215	-0.0108	0.0154*	-0.0372
	(0.0077)	(0.0173)	(0.0186)	(0.0087)	(0.0235)
Asian	0.0040	-0.0149	-0.0621***	0.0278*	-0.0639**
	(0.0108)	(0.0199)	(0.0213)	(0.0146)	(0.0298)
Comparison Mean (White)	0.07	0.50	0.54	0.12	0.77
Observations	10,975	10,975	10,975	10,975	10,975
Adjusted R^2	0.4631	0.7111	0.7806	0.4797	0.5685

	Pollution		
	Superfund	Toxics	PM
African American	0.0315	1,537.3840***	0.0500
	(0.0400)	(480.2213)	(0.0727)
Hispanic	0.1098**	779.8187	0.0828
	(0.0437)	(524.6936)	(0.0875)
Asian	0.1709***	328.7771	-0.2565**
	(0.0622)	(519.5311)	(0.1008)
Comparison Mean (White)	0.30	5900	9.80
Observations	10,977	10,977	10,977
Adjusted R^2	0.8642	0.5916	0.9438

Note: Coefficients report differences in the attributes of properties/neighborhoods recommended to minority testers relative to a white tester (the omitted category) for the subset of trials where the advertised home falls above the 50th percentile in the block group share of white households. Racial minority encompasses all individual minority groups. All regression specifications include trial fixed effects and 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, and time of the appointment (am/pm). Standard errors are clustered by trial, which is the level of randomization. Significance levels are: *p<0.1; **p<0.05; ***p<0.01.

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 ($245,000). These results suggest that the differences in elementary and middle school test scores, poverty rates, skill, college attainment, single-parent households, and exposure to toxics may be amplified for African Americans who present these preferences.

Table G.2. Discriminatory Steering and Neighborhood Effects: Higher-Priced Homes

	School-Specific Test Scores:		*Housing Search Platform:*	
	Elem School	Middle School	Assaults	Elem School
Racial Minority	-0.0285	0.1056***	-10.9046*	-0.0134
	(0.0320)	(0.0222)	(6.3792)	(0.2832)
African American	-0.1731***	-0.0219	-22.2033**	0.1497
	(0.0668)	(0.0285)	(10.8133)	(0.3350)
Hispanic	0.0420	0.1119***	-49.4148***	-0.0965
	(0.0378)	(0.0190)	(10.2786)	(0.5100)
Asian	-0.2061***	0.0704**	2.2784	-0.4517
	(0.0622)	(0.0357)	(7.7459)	(0.5991)
Comparison Mean (White)	0.4	0.36	80.9	6.94
ln(Price) Advert Home	Y	Y	Y	Y
Racial Comp Advert Home	Y	Y	Y	Y
Outcome Advertised Home	Y	Y	Y	Y
Observations	3,799	3,831	5,293	4,906
Adjusted R^2	0.8379	0.9283	0.8393	0.7440

	American Community Survey				
	Poverty Rate	High Skill	College	Single-Parent HH	Ownership Rate
Racial Minority	0.0146**	-0.0208*	-0.0332***	0.0106	-0.0118
	(0.0062)	(0.0118)	(0.0111)	(0.0068)	(0.0169)
African American	0.0254***	-0.0390**	-0.0599***	0.0157*	-0.0223
	(0.0078)	(0.0171)	(0.0150)	(0.0095)	(0.0239)
Hispanic	0.0104	-0.0240	-0.0224	-0.0024	0.0182
	(0.0083)	(0.0172)	(0.0156)	(0.0086)	(0.0233)
Asian	0.0063	-0.0003	-0.0156	0.0133	-0.0141
	(0.0080)	(0.0158)	(0.0151)	(0.0084)	(0.0207)
Comparison Mean (White)	0.071	0.54	0.6	0.12	0.73
ln(Price) Advert Home	Y	Y	Y	Y	Y
Racial Comp Advert Home	Y	Y	Y	Y	Y
Outcome Advertised Home	Y	Y	Y	Y	Y
Observations	10,850	10,850	10,850	10,850	10,850
Adjusted R^2	0.5589	0.6829	0.7236	0.5453	0.6698

	Pollution		
	Superfund	Toxics	PM
Racial Minority	0.0651	1,360.2900**	0.0179
	(0.0554)	(589.0348)	(0.0670)
African American	0.0758	994.0474*	0.0708
	(0.0831)	(578.0719)	(0.0868)
Hispanic	0.0247	2,239.0900**	0.1133
	(0.0716)	(907.8452)	(0.0889)
Asian	0.0578	1,272.7980*	-0.0896
	(0.0648)	(744.7305)	(0.0939)
Comparison Mean (White)	0.45	4900	9.5
ln(Price) Advert Home	Y	Y	Y
Racial Comp Advert Home	Y	Y	Y
Outcome Advertised Home	Y	Y	Y
Observations	10,862	10,862	10,862
Adjusted R^2	0.8758	0.6063	0.9599

Note: Coefficients report differences in the attributes of properties/neighborhoods recommended to minority testers relative to a white tester (the omitted category) for the subset of trials where the advertised home falls above the 50th percentile in the block group share of the price distribution (above $245,000). All regression specifications include trial fixed effects and 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 trial, which is the level of randomization. Standard errors are clustered by trial, which is the level of randomization. Significance levels are: *p<0.1; **p<0.05; ***p<0.01.

H Sensitivity Analysis: Superfund Proximity

This section explores the sensitivity of results to different distance-based measures of proximity to Superfund sites. We rely on proximity as our measure of exposure and evaluate the trade-off between different distances and statistical power. Table H.1 reports estimates using a range of distances between 3-6km, which is slightly wider than the 2-3 mile range used in prior work (Gamper-Rabindran and Timmins, 2011, Greenstone and Gallagher, 2008). The number of sites for the comparison mean recommendation gets mechanically smaller with a tighter radius and so do our estimates of differences (in levels) for the minority group as a whole. Estimates do not decrease monotonically within each tester group, but are consistent in magnitude across the range. We do not have sufficient power to detect differences within 3km.

Table H.1. Discriminatory Steering and Superfund Proximity by Distance

	Dependent variable: Superfund						
	3 Km	3.5 Km	4 Km	4.5 Km	5 Km	5.5 Km	6 Km
Racial Minority	0.0392	0.0782**	0.0773**	0.0813***	0.1010***	0.1010***	0.1031***
	(0.0280)	(0.0316)	(0.0313)	(0.0306)	(0.0325)	(0.0365)	(0.0387)
African American	0.0595	0.0789*	0.0805*	0.1041**	0.1256***	0.1118**	0.1008**
	(0.0364)	(0.0406)	(0.0431)	(0.0435)	(0.0465)	(0.0491)	(0.0488)
Hispanic	−0.0217	0.0425	0.0593	0.0516	0.0591	0.0343	0.0382
	(0.0378)	(0.0406)	(0.0405)	(0.0380)	(0.0376)	(0.0446)	(0.0490)
Asian	0.0820**	0.1231***	0.0963**	0.0849*	0.1046**	0.1339**	0.1528***
	(0.0385)	(0.0427)	(0.0425)	(0.0443)	(0.0484)	(0.0527)	(0.0578)
Comparison Mean (White)	0.13	0.17	0.22	0.29	0.35	0.41	0.48
ln(Price) Advert Home	*N*	*Y*	*N*	*Y*	*Y*	*Y*	*Y*
Racial Comp Advert Home	*N*	*Y*	*N*	*Y*	*Y*	*Y*	*Y*
Observations	21,883	21,883	21,883	21,883	21,883	21,883	21,883
Adjusted R^2	0.8028	0.8412	0.8439	0.8597	0.8744	0.8868	0.9015
Note:							*p<0.1; **p<0.05; ***p<0.01

Note: Coefficients report differences in the number of Superfund sites within close proximity (3-6km) to properties/neighborhoods recommended to minority testers relative to a white tester (the omitted category). All regression specifications include trial fixed effects and 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 trial, which is the level of randomization. Standard errors are clustered by trial, which is the level of randomization. Significance levels are: *p<0.1; **p<0.05; ***p<0.01.