Driving to Opportunities: Voucher Users, Cars, and Movement to Sustainable Neighborhoods

Rolf Pendall
Christopher Hayes
Arthur (Taz) George
Urban Institute

Casey Dawkins
Jae Sik Jeon
Elijah Knaap
University of Maryland

Evelyn Blumenberg
Gregory Pierce
University of California, Los Angeles

Michael Smart
Rutgers University

Abstract

Tenant-based rental vouchers have expanded housing choice for millions of low-income households, yet assisted households still face hurdles when trying to secure housing in high-opportunity neighborhoods with desirable economic, social, and environmental characteristics. Although inadequate transportation is arguably one of the most important hurdles to securing housing in high-opportunity neighborhoods, existing studies of voucher users' location choices have n ot yet explored the connections between transportation access and residential location outcomes. This article discusses the results from a recent study that attempts to close that gap. Our study draws on data from the Moving to Opportunity for Fair Housing demonstration program and the Welfare-to-Work Voucher Program, two residential mobility initiatives that randomly assigned rental vouchers to low-income households seeking housing assistance. Using a variety of approaches—including cluster analysis, bivariate comparisons, and multivariate analysis—we find evidence of important connections between automobile access and improved neighborhood conditions. We also find that neighborhoods with similar levels

Abstract (continued)

of poverty exhibit a wide array of other characteristics that matter differently for different kinds of households. Our findings suggest a need for more integrated and holistic planning and program development to account for the importance of both cars and transit to low-income households' well-being.

Introduction and Overview

Research on the linkages between tenant-based housing assistance and residential outcomes suggests that households receiving vouchers choose to live in a wider range of neighborhoods than public housing residents and unassisted renters (Schwartz, 2010). In the long term, however, voucher holders still face hurdles when trying to secure housing in high-opportunity neighborhoods—those with low poverty rates, high labor force participation rates, high-quality public services, convenient access to employment, and safe and healthful surroundings (Turner et al., 2011). Although transportation plays a widely recognized—even central—role in shaping residential location decisions, studies of voucher users' housing choices curiously have neglected explorations of how cars and transit contribute distinctively to neighborhood choices.

This article reports partial results of a larger study designed to close that gap. It uses data from two major experiments sponsored by the U.S. Department of Housing and Urban Development (HUD) in the 1990s and 2000s to test whether housing choice vouchers propelled low-income households into greater economic security. The Moving to Opportunity (MTO) for Fair Housing demonstration program and the Welfare to Work Voucher (WtWV) program sought to learn whether low-income families benefited from housing mobility through improved neighborhood conditions and better economic and health outcomes.[1]

Our study finds important, previously unreported connections between automobiles and positive outcomes in these experiments. Automobiles increase the likelihood that voucher participants will live and remain in high-opportunity neighborhoods, a result on which this article reports in depth. Our research also shows in work published elsewhere and in a research note in the current volume of *Cityscape* that automobiles are associated with greater neighborhood satisfaction and improved economic outcomes.

We begin our article by showing that most studies on voucher users' residential locations assess a limited number of indicators of distress and segregation and by suggesting a broader framework—based on other studies—for assessing the dimensions of neighborhood quality (which we call *neighborhood sustainability*). After discussing our data and methods, we present the results of two main analyses. First, we show that in the MTO and WtWV study areas, neighborhoods with similar levels of poverty have a wide array of other characteristics that matter differently for different kinds

[1] For more information on both programs, see Briggs, Popkin, and Goering (2010); Orr et al. (2003); Patterson et al. (2004); and Sanbonmatsu et al. (2011).

of households. Second, we show using bivariate and multivariate methods that households with access to cars consistently live in neighborhoods with greater neighborhood sustainability on some variables than transit-dependent households—but that these neighborhoods have less sustainability on other important measures, especially those related to walkability and transit access. Our findings suggest a need for more integrated and holistic planning and program development to account for the importance of both cars and transit to low-income households' well-being.

Voucher Users and Neighborhood Sustainability: Background and Research Questions

Past research shows that assisted households live in neighborhoods with higher levels of distress (for example, poverty, joblessness, and dropouts) and higher concentrations of racial minorities than unassisted households (Been et al., 2010; Galvez, 2010). Assisted tenants with the widest array of neighborhood choices, those with housing choice vouchers, live in about four-fifths of metropolitan area census tracts, and most of them live in tracts in which only a small share of other households hold vouchers (Galvez, 2010). Even so, voucher users are less evenly distributed across metropolitan neighborhoods than one would expect based on the supply of affordable housing. They live in neighborhoods with somewhat lower distress and higher opportunity than other low-income households, but on average their neighborhoods are still inferior to those of nonpoor metropolitan households (Cunningham and Droesch, 2005; Galvez, 2010). Hispanic and Black voucher users are more likely to live in distressed neighborhoods than non-Hispanic White voucher users (Pendall, 2000).

Numerous qualitative studies attest that voucher households prefer quiet, safe neighborhoods and are willing to make many sacrifices to find a safe place to live. The centrality of freedom from extreme violence even has led some observers to suggest retitling Moving to Opportunity as "Moving to Security" (Briggs, Popkin, and Goering, 2010: chapter 5). Some voucher users wish to stay near kin and friends, although many MTO households moved to avoid problematic kin and acquaintances (Briggs, Popkin, and Goering, 2010). Inner-city voucher users also worry about living in the suburbs, where they fear discrimination and the potential for being stranded if the voucher program ended (Galvez, 2010). Hence the search for security can sometimes mean moving within a few blocks.

Policymakers and researchers have recently broadened their perspective on the quality of voucher users' neighborhoods beyond measures of distress to include opportunity and livability. The Kirwan Institute, for example, focuses on *opportunity* metrics including neighborhood variables (many of the socioeconomic characteristics used in other studies), education and school-related variables, and health and environmental indicators (see Baek, Lee, and Gambhir, 2011, for example). HUD has recently developed national neighborhood opportunity data that include similar indicators of racial segregation and concentrated poverty and opportunity metrics including neighborhood school proficiency, job access, labor market engagement, environmental health hazard exposure, and transit access.[2] Other observers add *livability*—features of the built environment and amenities

[2] In our research, we use early versions of these metrics, which HUD first developed for its Sustainable Communities Regional Planning Grant recipients to use as they developed Regional Fair Housing and Equity Assessments.

that make neighborhoods pleasant for residents and visitors—to the list of desirable neighborhood characteristics (Appleyard and Lintell, 1972; Clark et al., 2013). Efforts to quantify livability have borne fruit in the measurement of *walkability*, which emerges from such concrete measures as the completeness of the sidewalk network, the length of blocks, and the number of destinations that can be reached within a given walk time (Ewing et al., 2006; Koschinsky and Talen, 2015; Leslie et al., 2007). Livability measurement also can include the mix of land uses and the completeness of transportation infrastructure within and around the neighborhood.

Together, opportunity and livability features constitute what we think of as the ingredients of *sustainable* neighborhoods. To date, published efforts to measure sustainability by both opportunity and livability characteristics are limited to a paper by Been et al. (2010), which measures "environmental sustainability" on the one hand and "opportunity and inclusion" on the other. Their indicators of environmental quality include measures of common chemical releases from the U.S. Environmental Protection Agency (EPA) Toxics Release Inventory (TRI) and the estimated total respiratory risk from air toxics from the EPA National Air Toxics Assessment. Been et al. (2010) grouped these environmental hazards with measures of neighborhood opportunity, including indicators of education, crime, and economic opportunity. In two case study metropolitan areas—Seattle, Washington, and New York City—the authors found that opportunity measures and walkability/transit accessibility measures are inversely correlated.

Been et al. (2010) showed that a high proportion of HUD-assisted households live in neighborhoods with low opportunity but high walkability/transit accessibility. This finding is especially true of households living in project-based units; two-thirds of people living in Seattle's assisted projects lived in low-opportunity, high-walkability neighborhoods compared with only about one-third of all Seattle residents. In New York, nearly 80 percent of assisted-project dwellers lived in low-opportunity, high-walkability neighborhoods, again more than twice the average rate for the metropolitan area. Even voucher users, however, gravitate toward neighborhoods with low opportunity and high walkability, as Been et al. (2010) defined them.

Subsidized households have far fewer location choices than unsubsidized ones. Waiting lists for affordable housing are long, and searches are seriously constrained. If it is offered a housing unit, a household will simply have to take it or give up the chance for a subsidy, and those that finally receive a housing voucher have to secure a unit as soon as possible (within a 60- to 120-day time limit). Not all landlords accept vouchers, but some actively recruit voucher users; often these landlords operate in specific geographic areas where assisted households can pay more than unassisted ones. Moreover, these households live within support networks of friends and kin who offer many reasons to stay nearby, even if some people in these networks also threaten harm (Briggs, Popkin, and Goering, 2010).

Transit-dependent households naturally are constrained in their housing search based on both the reality and their perception of the quality of suburban public transportation (Clampet-Lundquist, 2004, reviewed in Varady et al., 2010; see also Varady and Walker, 2007). About 15 percent of mothers interviewed by Briggs, Popkin, and Goering (2010) identified giving up convenient access to transit as a price they had paid to live in safer neighborhoods. The lack of transit options in their new neighborhoods subsequently presented a major obstacle to those who had moved and did not have cars. Voucher users who own cars, conversely, have a wider array of choices than those

who depend entirely on transit. Access to a car or a driver's license increased the likelihood that MTO program participants successfully found and secured a lease using their housing voucher (Shroder, 2002). Families who relocated under MTO were more likely to successfully lease up in a low-poverty neighborhood if they had consistent access to a car (Briggs, Popkin, and Goering, 2010). On the other hand, MTO experimental-group households with automobiles were less likely to move to racially integrated neighborhoods than experimental-group households without cars, and access to automobiles did not influence the likelihood of using a voucher to move (Clampet-Lundquist and Massey, 2008).[3]

This article extends the work begun by Been et al. (2010) and the mostly qualitative work on transportation factors in voucher users' location decisionmaking, addressing two key questions. First, how do neighborhood sustainability dimensions correlate and combine in different kinds of metropolitan areas? Second, how does automobile access associate with the attainment of sustainable neighborhoods? These two questions are part of a broader exploration of transportation and opportunity in the MTO and WtWV experiments that has also yielded a stream of research by Blumenberg and Pierce (2014) that is summarized in a companion article in this volume.

Data and Methods: Households and Neighborhoods

We focus on two HUD experiments, MTO and WtWV.[4] MTO tested whether public housing households with children benefited from living in low-poverty neighborhoods (Orr et al., 2003; Sanbonmatsu et al., 2011). MTO randomly assigned public housing residents in Baltimore, Maryland; Boston, Massachusetts; Chicago, Illinois; Los Angeles, California; and New York City to (1) a treatment group that received Section 8 housing vouchers[5] useable only in areas with a poverty rate of less than 10 percent, (2) a comparison group that received Section 8 vouchers without geographic restrictions, and (3) a control group that remained in project-based public housing. Baseline surveys were administered to 4,604 families from 1994 through 1998. An interim survey was conducted in 2002 including 4,252 of those households, and a final survey was conducted in 2008 on all participating families. Our analyses make use of data from all three surveys.

The WtWV experiment studied low-income households in Atlanta, Georgia; Augusta, Georgia; Fresno, California; Houston, Texas; Los Angeles; and Spokane, Washington to learn the effect of

[3] The interim and final MTO evaluations examined the effect of voucher access and living in a low-poverty neighborhood on *transportation access* (Orr et al., 2003; Sanbonmatsu et al., 2011). These evaluations defined transportation access as the share of adults with a working car or the share that lives less than a 15-minute walk to public transit. Using this measure, nearly everyone in both samples—95 percent of the interim sample and 94 percent of the final sample—had access to transportation. With little variation and the conflation of modes with very different characteristics, the evaluations unsurprisingly found no statistically significant relationship between transportation access and location. Transportation also did not factor into a family's decision to move. In the interim evaluation, participants were asked to state their most important reason for moving (Orr et al., 2003). Less than 1 percent (0.2 percent) of participants cited a desire to move to obtain "better transportation."

[4] Although Los Angeles, California, also hosted a WtWV demonstration, no followup data were collected there, so we exclude it from our analyses. Participants in these experiments could move to other metropolitan areas; we did not include any households in our analysis that moved to locations outside the 10 case study regions.

[5] In 1998, HUD's Section 8 voucher and certificate programs were merged into the newly named Housing Choice Voucher Program.

receiving housing assistance on households' neighborhood locations, obtaining and retaining employment, and welfare dependency (Patterson et al., 2004). All the recipients of WtWV vouchers had already applied for housing vouchers from local public housing agencies but had been placed on the waiting list. Most housing agencies that implemented WtWV did not provide counseling on mobility, housing search, or employment to experimental households beyond the level normally provided to their tenants (Patterson et al., 2004: 33). Baseline WtWV data were gathered in 2000 and 2001, when 7,684 households were assigned to a treatment group that received housing vouchers and a control group that did not. A followup survey was conducted in 2002. We exclude Los Angeles from our analysis because no followup data were collected there.

We concentrate in particular on the differences in neighborhood locations between *driving households*, those in which at least one member is both a licensed driver and has access to a running car, and *nondriving households*. Questions about car access in the MTO surveys changed from the baseline to the interim survey—to account for car ownership among household members other than the survey participant—from, "Do you have a car that runs?" at baseline to, "Does anyone in your household own a car, van, or truck that runs?" in the interim survey. All WtWV households were asked at baseline, "Do you have a car that runs?" The followup survey regrettably employed a skip pattern in which only employed household heads were asked about cars and driver licenses. It is therefore impossible to ascertain precisely how access to cars changed between the baseline and followup surveys in WtWV.

In addition to the MTO and WtWV surveys, we rely on publicly available data provided for census tracts from many sources to characterize the sustainability dimensions of neighborhoods. Based on our review of the literature on neighborhood opportunity, livability, and sustainability, we operationalize neighborhood sustainability with reference to six major dimensions: natural environment, functional environment, social environment, economic vitality, security, and access to opportunity. We identified indicators related to five of the six dimensions using the 2000 census, the National Land Cover Database, and indices produced by other organizations; for the sixth, security, we collected data from local sources but were able to obtain data only for central cities of most of the 10 metropolitan areas in our study area. Some sets of indicators were highly correlated and could be replaced by a single representative indicator. For others that were strongly related but not easily represented by a single measure, we used principal components analysis to produce a single factor score. Each dimension includes between two and four subdimensions (exhibit 1).

The *natural environment* dimension includes four subdimensions. Three reflect environmental hazards: (1) percentage of the tract's area within 1 mile of a facility listed in EPA (2000); (2) an index of cancer risk from EPA (2002); and (3) proximity to major highways, calculated as the percentage of land in a census tract lying within 200 meters of major highways as georeferenced in the 2000 census TIGER (Topologically Integrated Geographic Encoding and Referencing) files (U.S. Census Bureau, n.d.). For the fourth subdimension, urbanization, we chose to use the percentage of tract developed for urban uses, calculated from the 2001 National Land Cover Database (MRLC, n.d.), because it correlated well with other measures of development and open space.

The neighborhood's *functional environment* conveys features of the neighborhood's built environment that make it livable for residents, even if they have financial, mobility, and other limitations.

Exhibit 1

Dimensions and Subdimensions of Neighborhood Sustainability

Dimension	Subdimension
Natural environment	• Urbanization • Highway proximity • Health outcomes • Environmental hazards
Functional environment	• Housing market strength • Housing diversity • Transit access
Social environment	• Level of household distress • Socioeconomic status of residents
Economic vitality	• Level of household distress • Housing market strength • Presence of neighborhood work opportunities • Density of income
Security	• Incidence of violent and property crime • Public perceptions of safety
Access to opportunity	• Access to high-quality elementary schools

Source: Authors' data

We used principal components analysis to extract a single factor representing the neighborhoods' housing-market strength from three measures in the 2000 decennial census summary file 3 (SF3): vacancy rate, percentage of owner-occupied housing units, and median gross rent (U.S. Census Bureau, 2000).[6] We similarly extracted a single factor to represent housing diversity based on measures from the 2000 SF3 on the diversity of residential structures, average of residential density, and percentage of very old and very new housing. Our single indicator of transit access is the Fair Housing Equity Assessment (FHEA) transit access index created by HUD.[7] This index used data from public transit agencies to assess relative accessibility to amenities within metropolitan areas. Because of uniformly low index values for nearly all tracts in three of the five WtWV metropolitan areas (Atlanta, Augusta, and Spokane), we chose not to use this indicator for the neighborhood analysis for the WtWV group.

The *social environment* dimension, which expresses important aspects of the social and demographic makeup of the neighborhood, includes two subdimensions, household distress and social status. We analyzed year-2000 labor market participation rate, number of households on public assistance, poverty rate, and median household income as measures of distress and chose

[6] To control for variation in the rental market across our sites, we standardized median gross rent by metropolitan area and used the resulting *z*-score as the indicator. The standardization process means that the resulting indicator reflects a given neighborhood's median rent relative to other neighborhoods in that metropolitan area.

[7] In 2012, HUD created a database to support grantees of the Sustainable Communities Regional Planning Grant program in the preparation of their FHEAs. The data file included indicators for a wide array of neighborhood conditions at the block-group level, using 2010 census tract boundaries. HUD provided a readable version of the national file to the research team for use in this project. We imputed these values to 2000 census tract boundaries.

poverty rate as a single measure of this subdimension because it has the strongest relationship with the other indicators and is most clearly associated with household distress in the literature. We extracted a single factor score to indicate social status from the percentage of non-Hispanic White households, the percentage of population age 25 and older with a high school diploma, and the percentage of female-headed households.[8]

A neighborhood's *economic vitality* comes from a composite of characteristics that include both the presence of work opportunities in the neighborhood and the density of population and income in that area. Our measures for this dimension come from the 2000 SF3. Household distress and housing market strength are part of a neighborhood's economic vitality. In addition, economic activity and income density matter to neighborhood vitality. For economic activity, we calculated job density as total jobs per square mile, as reported in the 2000 Census Transportation Planning Products (FHWA, n.d.). We computed aggregate income density using the estimated aggregate income from the 2000 SF3, and then standardized the results by metropolitan area to control for differences among sites.

A neighborhood's sense of *security* is measured by the incidence of violent crime and public perceptions of safety in the neighborhood. For Atlanta, Baltimore, and Chicago, we used publicly available point-level crime records for varying years. We calculated the number of violent crime incidents in a given year for each census tract and divided by the estimated population of the tract in the year the crime data were collected to create a measure of number of violent crimes per 100,000 inhabitants at the census tract level. For Boston, Houston, and Los Angeles, we used data from the National Neighborhood Crime Study (Peterson and Krivo, 2010), which provided census tract-level statistics for those three sites, including the sum of violent crimes from 1999 through 2001. Within each metropolitan area, we ranked the census tracts for which crime data were available by violent crime rate and categorized them by quartile to establish low-, low- to moderate-, moderate- to high-, and high-crime neighborhoods. We were unable to secure reliable crime data for these six metropolitan areas or for any places in the other four metropolitan areas. To gauge perceptions of neighborhood safety, we used questions from the interim and final surveys for MTO and WtWV, respectively. The survey data were available only for tracts where survey respondents lived.

The neighborhood's *access to opportunity* is a function mainly of what the neighborhood is close to rather than what it contains. We include only one subdimension for this dimension, school quality, as represented by HUD's FHEA school quality index. The school quality index uses elementary school data on the performance of students in state exams to produce a score for each tract, based on the closest elementary schools.

When households decide where to live, they often make tradeoffs among characteristics based on their needs and preferences. Households with similar incomes may have different preferences based, for example, on whether they have children and how old the children are or whether they are transit dependent. To provide more clarity about how the MTO and WtWV households made these tradeoffs, we developed a neighborhood typology. Using all these subdimensions except

[8] We standardized percentage non-Hispanic White by metropolitan area to control for variations in racial composition across our sites.

crime rates (the availability of which was limited), we used hierarchical cluster analysis to group tracts into sets based on their relative similarity to one another.[9] Subdimensions that appear under more than one dimension enter the cluster analysis only once.[10]

Results

We discuss our results in two main sections. First, we describe the results of our neighborhood sustainability analysis and the neighborhood typology in the MTO and WtWV metropolitan areas, concentrating on the reasonably high number of neighborhoods with medium poverty levels but widely ranging values of other characteristics. Second, we describe how driving and nondriving MTO and WtWV households sort into these neighborhoods according to the sustainability dimensions. Our broad, descriptive overview and our multivariate approach both show that on most dimensions with positive or negative outcomes, driving households live in better neighborhoods than nondriving households.

Neighborhood Sustainability in the MTO and WtWV Metropolitan Areas

The MTO and WtWV metropolitan areas differ in a series of important ways that stand out when reviewing the sustainability dimensions (exhibit 2). First, the MTO metropolitan areas have many more tracts than the WtWV metropolitan areas. The WtWV metropolitan areas stand out for being generally less urban than the MTO metropolitan areas. MTO metropolitan areas also have higher cancer-risk scores, average shares of tracts within 200 meters of a major highway, and average shares of tracts developed for urban uses. The MTO metropolitan areas, in general, have lower vacancy and homeownership rates and higher gross rents than the WtWV metropolitan areas (exhibit 2). The MTO tracts also score higher on average housing diversity and density. The FHEA transit index is also generally higher in the MTO metropolitan areas than in the WtWV areas. In economic vitality, the MTO metropolitan areas stand out because they are larger, older, and denser than those in WtWV, starting with New York—the clear outlier, with an average of nearly $630 million in household income per square mile in 1999 and more than 12,400 jobs per square mile in 2000. Even excluding New York, however, the income and job density in the MTO metropolitan areas consistently exceed those of the WtWV metropolitan areas. The metropolitan areas do not fall as cleanly into MTO versus WtWV groups in terms of their average social environments. The components of social status do vary substantially among the metropolitan areas, but not in ways that distinguish MTO from WtWV systematically.

[9] Cluster analysis is a method in which cases' similarity to one another on an assortment of variables is used to place them into groups. Hierarchical cluster analysis begins with each case as its own cluster, uniting cases into clusters according to their proximity in *N*-variable space. We linked groups based on squared Euclidean distances.

[10] For job density we use the natural log of the indicator, and for aggregate income density we use the natural log standardized by metropolitan area (that is, the measure used is the *z*-score of the natural log). These changes caused distributions in the variables that more closely approximated a normal curve, eliminating dramatic skewing effects of extreme values on the construction of clusters.

Exhibit 2

Mean Levels of Sustainability Subdimensions and Their Factor-Score Contributors, MTO and WtWV, 2000–2001 (1 of 2)

	MTO					WtWV				
	Baltimore	Boston	Chicago	Los Angeles	New York City	Atlanta	Augusta	Fresno	Houston	Spokane
Number of tracts	601	832	1,958	2,564	4,307	675	94	154	864	104
Natural environment										
Land within buffer of TRI site (%)	16.6	64.6	65.5	24.2	57.3	28.9	24.9	26.2	38.4	37.2
Natural log of cancer risk score	3.8	3.8	3.8	4.1	4.0	3.8	3.4	3.5	3.7	3.5
Land within 200 meters of major highway (%)	27.5	24.0	17.5	13.4	22.7	17.3	16.9	10.3	11.0	10.2
Land developed for urban uses (%)	68.6	72.4	87.7	93.2	87.5	57.2	45.9	66.9	75.3	71.4
Functional environment										
Housing market strength factor	0.1	0.1	0.1	0.0	– 0.1	0.1	– 0.1	0.0	– 0.1	0.1
Vacancy rate (%)	7.9	4.0	6.4	4.0	5.4	5.9	10.2	6.1	7.9	6.6
Owner-occupied housing units (%)	66.8	59.9	61.6	52.7	51.2	66.1	69.1	57.7	62.5	67.7
Median gross rent ($)	669	803	700	857	836	727	505	572	637	582
Housing diversity factor	– 0.3	0.2	– 0.1	– 0.3	0.2	– 0.1	– 0.2	0.1	0.1	0.2
Diversity index of structure type	0.5	0.6	0.6	0.6	0.6	0.4	0.4	0.5	0.4	0.4
Housing density (dwellings/acre)	7.9	8.8	9.3	8.2	21.2	3.0	2.3	3.3	3.9	3.4
Housing ≥ 50 years old (%)	12.4	7.6	10.2	7.9	6.3	25.5	20.3	17.5	17.5	16.9
Housing < 11 years old (%)	30.6	45.5	36.3	21.5	42.8	10.4	13.6	15.2	10.5	27.4
FHEA transit index	45.4	41.2	52.6	49.4	32.8	1.8	1.0	1.0	36.2	44.2
Social environment										
Poverty rate (%)	12.0	10.0	13.5	16.2	14.5	12.1	17.9	22.5	14.9	13.1
Social status factor	0.02	0.09	0.02	– 0.05	– 0.01	0.02	– 0.06	– 0.11	– 0.01	0.15
Non-Hispanic White (%)	63.4	78.4	52.9	36.6	50.8	56.3	58.2	41.1	46.9	89.4
Female-headed households (%)	34.5	31.7	32.9	28.4	33.4	31.4	33.7	28.2	27.5	28.9
Adults with college degree (%)	25.9	36.1	26.3	24.7	27.6	28.6	19.3	16.9	23.9	24.4

Exhibit 2

Mean Levels of Sustainability Subdimensions and Their Factor-Score Contributors, MTO and WtWV, 2000–2001 (2 of 2)

	MTO					WtWV				
	Baltimore	Boston	Chicago	Los Angeles	New York City	Atlanta	Augusta	Fresno	Houston	Spokane
Economic vitality										
Aggregate income per square mile ($ millions)	113.0	194.6	218.0	195.7	629.3	51.1	21.8	52.9	75.1	50.2
Natural log of job density per square mile	6.65	7.19	7.25	7.50	7.90	5.84	4.99	6.10	6.25	5.98
Job density per square mile	2,570	4,179	4,188	3,521	12,403	1,754	951	1,460	1,726	1,631
Access to opportunity										
FHEA school performance index	48.6	50.2	44.2	49.7	49.1	50.3	43.8	39.6	51.4	54.0

FHEA = Fair Housing Equity Assessment. MTO = Moving to Opportunity for Fair Housing demonstration program. TRI = Toxics Release Inventory. WtWV = Welfare to Work Voucher program.

Note: For details on variable construction, see appendix A in Pendall et al. (2014).

Source: Authors' calculations

Neighborhood Typology

Analysis of the MTO sites produced 4, 6, 8, 10, 12, and 15 cluster solutions; we identified solutions of 5, 6, 10, and 13 members for the WtWV sites.[11] We use the 15- and 13-member cluster solutions, respectively, because they provide the most convincing and useful grouping of neighborhood types. These solutions consisted of a mix of identifiable neighborhood types; poverty and relative affluence were important sorting factors, but our other dimensions demonstrated variations. To simplify the interpretation of the many clusters produced, we divide the clusters into groups based on the average poverty rate of the cluster to which they are assigned, creating low-poverty (L), medium-poverty (M), and high-poverty (H) clusters. This method also addresses the problem that cluster analysis produces several clusters with very low tract counts, which can be analyzed more efficiently in combination with broadly similar clusters.

In broad terms, the clusters with the lowest average poverty levels rate favorably on other factors, whereas those with the highest average poverty levels have many other deficits. The high-poverty neighborhoods are densely developed areas with little open space and weak economic activity, and they are occupied mainly by highly distressed households. The low-poverty neighborhoods are less dense spaces with stronger commercial and economic growth and better performing schools.

The WtWV sites have 2 low-poverty, 4 medium-poverty, and 7 high-poverty clusters (exhibit 3). The 2 low-poverty clusters include 893 tracts in which, compared with tracts in other clusters, less of the neighborhood's land area is urban, less area is within 200 meters of a highway, schools have

[11] We exclude the FHEA transit index in the WtWV cluster analysis because so many tracts had no transit access or had missing data.

Exhibit 3

Cluster-Factor Average Values, WtWV Clusters

	WtWV Cluster													
	L1	L2	M1	M2	M3	M4	H1	H2	H3	H4	H5	H6	H7	Total
Number of tracts	443	450	183	328	228	11	71	109	40	3	15	6	4	1,891
Buffer of TRI facilities (%)	0.18	0.25	0.26	0.35	0.47	0.66	0.71	0.57	0.64	0.91	0.65	0.72	0.71	0.33
Natural log of cancer risk	3.62	3.63	3.69	3.64	3.71	3.88	3.97	3.79	4.07	4.16	4.01	3.82	4.17	3.68
Buffer of major highways (%)	0.09	0.12	0.16	0.13	0.14	0.16	0.23	0.19	0.24	0.16	0.37	0.40	0.13	0.13
Land area developed for urban uses (%)	0.59	0.58	0.68	0.65	0.73	0.95	0.91	0.84	0.92	0.99	0.88	0.81	0.92	0.66
Housing market strength factor	0.55	0.19	– 0.14	– 0.06	– 0.35	– 0.50	– 0.64	– 0.77	– 1.01	– 1.25	– 1.12	– 1.32	– 1.39	0.00
Housing diversity factor	– 0.46	– 0.22	0.18	0.06	0.30	0.36	0.66	0.69	0.82	1.00	0.85	1.04	1.38	0.00
Poverty rate (%)	5.47	8.50	13.40	13.46	21.46	22.27	29.75	35.68	42.47	46.04	54.29	65.05	71.20	14.58
Social status factor	0.84	0.42	– 0.45	– 0.12	– 0.53	– 0.43	– 1.12	– 1.16	– 1.41	– 1.78	– 1.65	– 1.70	– 1.90	0.00
FHEA school performance index	83.49	57.71	12.36	28.95	42.62	90.22	67.65	13.09	40.05	97.00	24.62	7.92	46.77	49.79
z-score of the natural log of aggregate income density, by MSA	0.11	– 0.10	0.16	– 0.14	– 0.11	0.24	0.27	0.09	0.20	0.57	0.09	0.00	0.15	0.00
Natural log of job density per square mile	5.73	5.69	6.01	5.79	6.26	7.69	7.29	6.74	7.66	7.44	7.31	6.53	7.36	6.01

FHEA = Fair Housing Equity Assessment. MSA = metropolitan statistical area. TRI = Toxics Release Inventory. WtWV = Welfare to Work Voucher program.

Source: Authors' calculations using data from sources detailed in Pendall et al. (2014), appendix A

higher test scores, and social status is higher than in the average neighborhood. Most of the land area of the WtWV metropolitan areas, by far, is in low-poverty tracts, but those tracts account for only about 47 percent of the tracts we classified into clusters. The high-poverty WtWV tracts have a higher than average share of land developed for urban uses, very weak housing markets, much lower than average expected social status, and school performance that ranges from average to very poor.

The middle-poverty group of WtWV clusters includes a variety of environments that sorted into 4 main groups. The 2 largest clusters are M2 (328 tracts) and M3 (228 tracts). Compared with M3, M2 has lower poverty rate (13 versus 21 percent), exposure to TRI facilities, cancer risk, income density, job density, developed land, and housing diversity, but it also has lower average FHEA school performance scores. The average poverty rate of M1 (183 tracts) is about the same as that of M2, but its social status is lower, its housing market is weaker and more diverse, its income and job density are higher, and its school performance is much worse. Cluster M4, the average poverty rate of which is highest in the group, includes only 11 tracts, all of them in either Atlanta or Houston. It is the most urban of the 4 clusters, with the highest exposure to TRI facilities, cancer risk, percentage of land developed for urban uses, housing diversity, income density, and job density, and the lowest average housing market strength. Its social status factor, however, is not as low as those of M1 or M3.

Of 15 clusters of the 10,262 MTO metropolitan census tracts we analyzed, 2 clusters are low poverty, 5 are medium poverty, and 8 are high poverty, although one-half of the high-poverty clusters contain fewer than 10 tracts (exhibit 4). The 2 low-poverty clusters account for 30 percent of the total tracts. Like the low-poverty WtWV clusters, these tracts have high social status, strong housing markets, and above average school performance. They differ from one another in their portion of land developed for urban uses and their income and job density, however, suggesting that cluster L1 represents wealthy suburban and exurban neighborhoods, whereas cluster L2 represents wealthy urban areas. The high-poverty clusters include only 2.3 percent of the total tracts. Contrasting sharply with the low-poverty clusters, these tracts are almost exclusively composed of densely developed neighborhoods with weak housing markets and low social status.

Of the 5 medium-poverty MTO clusters, 4 have more than 1,000 tracts, and M4 has more than 2,000. The fifth cluster, M3, has 710 tracts. All 5 clusters have job density near or greater than the average for all tracts and have about the same average exposure to highways (20 to 23 percent of the land area, on average, is within 200 meters of a highway). M1, M2, M3, and M4 have very slight differences in average poverty rates, whereas M5 has a substantially higher average poverty rate. M5 shares some traits with most of the high-poverty clusters, such as very low social status, poor school performance, a high portion of land developed for urban uses, and weak housing markets. The lowest average poverty rate among the high-poverty clusters is 41.1 percent, however, much higher than that of M5, the comparatively high income density and transit access of which also make it different from most of the high-poverty neighborhood clusters. The average income and job density of M5 are lower than those of either M1 or M3; its relatively high FHEA transit score is, however, comparable with those of M1 and M3. Few indices distinguish M1 and M3 from one another, but M1 has lower FHEA school performance scores, higher TRI exposure, and slightly higher cancer risk. M2 and M4, meanwhile, are less urban medium-poverty clusters with low school performance indices, social status, and income and job density, with M4 distinguished from M2 mainly by its very low average score (3.0) on the FHEA transit index.

Exhibit 4

Cluster-Factor Average Values, MTO Clusters

	MTO Cluster															
	L1	L2	M1	M2	M3	M4	M5	H1	H2	H3	H4	H5	H6	H7	H8	Total
Number of tracts	2,403	622	1,663	1,014	710	2,125	1,494	19	32	97	8	7	65	2	1	10,262
Buffer of TRI facilities (%)	0.28	0.29	0.58	0.50	0.46	0.59	0.63	0.50	0.51	0.84	0.78	0.08	0.73	1.00	1.00	0.49
Natural log of cancer risk	3.72	3.92	4.11	4.01	4.08	3.96	4.08	4.30	4.34	4.33	4.23	4.01	4.10	4.22	4.44	3.96
Buffer of major highways (%)	0.15	0.17	0.23	0.20	0.23	0.21	0.21	0.18	0.17	0.25	0.49	0.10	0.20	0.25	0.95	0.20
Land area developed for urban uses (%)	0.66	0.90	0.96	0.93	0.97	0.86	0.98	0.94	0.96	0.98	0.98	0.95	0.99	1.00	0.98	0.87
Housing market strength factor	0.55	0.57	– 0.08	– 0.06	– 0.06	– 0.19	– 0.50	– 0.92	– 1.10	– 1.16	– 1.31	– 0.45	– 1.41	– 0.96	– 0.94	0.00
Housing diversity factor	– 0.58	– 0.40	0.37	– 0.08	0.36	0.11	0.41	0.31	0.37	0.24	0.42	– 0.38	0.22	0.18	0.71	0.00
FHEA transit access index	4.65	46.47	82.08	46.22	86.59	3.00	87.50	54.31	68.74	2.53	35.84	77.67	92.64	1.00	1.00	42.13
Poverty rate (%)	5.03	5.47	12.48	14.96	15.06	16.90	24.45	41.10	42.41	44.57	52.73	61.53	62.67	93.97	100.00	14.25
Social status factor	0.79	0.76	– 0.04	– 0.31	0.08	– 0.22	– 0.89	– 0.93	– 1.31	– 1.40	– 1.44	0.18	– 1.43	– 2.02	– 1.65	0.00
FHEA school performance index	75.99	79.05	45.38	28.29	77.35	31.66	17.35	79.47	45.81	78.00	20.27	96.50	11.47	29.97	69.90	48.36
z-score of the natural log of aggregate income density, by MSA	– 0.65	0.08	0.57	– 0.01	0.61	– 0.16	0.40	0.12	0.03	0.33	0.01	– 0.36	– 0.43	– 3.08	– 5.24	0.01
Natural log of job density per square mile	6.37	7.30	8.39	7.50	8.45	7.54	8.03	8.78	8.28	9.17	7.73	8.99	8.27	8.98	7.59	7.55

FHEA = Fair Housing Equity Assessment. MSA = metropolitan statistical area. MTO = Moving to Opportunity for Fair Housing demonstration program. TRI = Toxics Release Inventory.

Source: Authors' calculations using data from sources detailed in Pendall et al. (2014), appendix A

Crime and Neighborhood Clusters

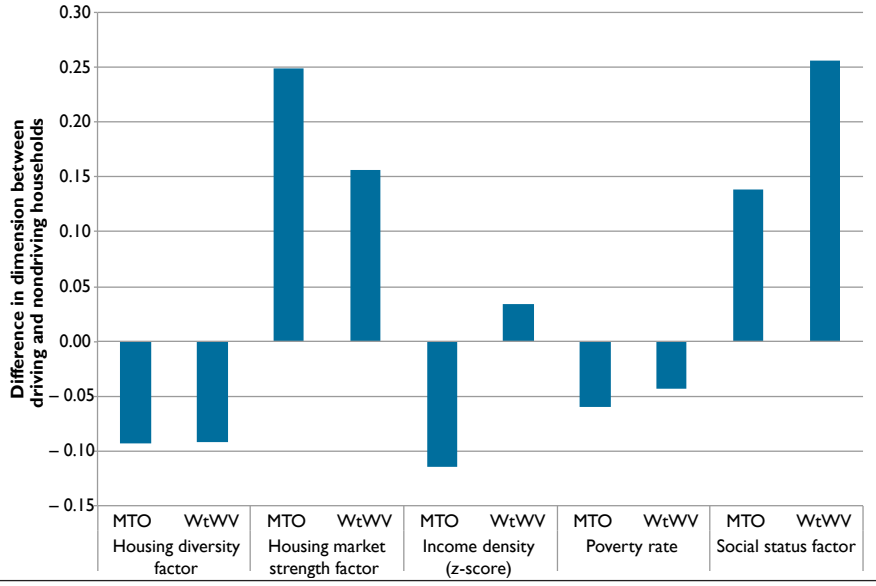
In an additional step, we calculated the share of MTO or WtWV households in each cluster that reported in the interim survey that they perceived their neighborhood as highly safe. We were not surprised to learn that households in lower poverty clusters tended to report feeling safer on their streets at night. Among all WtWV households, slightly less than 50 percent felt safe at night but, in the lowest poverty cluster, 70 percent felt safe and, in the highest poverty cluster, only 27 percent felt safe. The relationship was similar, although less consistent, among MTO clusters. In particular, high-poverty MTO clusters varied substantially in their share of households that felt safe at night. More than one-half of households felt safe in clusters H2 and H6, but in clusters H1 and H3 only 41 and 32 percent, respectively, felt safe. Furthermore, the lowest poverty MTO cluster had only a slightly greater share of households that reported feeling safe at night than did two of the medium-poverty clusters.

Car Ownership and Residential Sorting

Access to a car clearly associates with access to better neighborhood locations on most dimensions to which normative values can be ascribed—stronger housing markets, lower poverty rates, and higher social status (exhibit 5).[12] The relationship between driving and income density differs

Exhibit 5

Differences Between Driving and Nondriving Households in Neighborhood Social Dimensions, MTO and WtWV Experiments



MTO = Moving to Opportunity for Fair Housing demonstration program. WtWV = Welfare to Work Voucher program.
Note: Locations are as of 2002.
Source: Authors' data

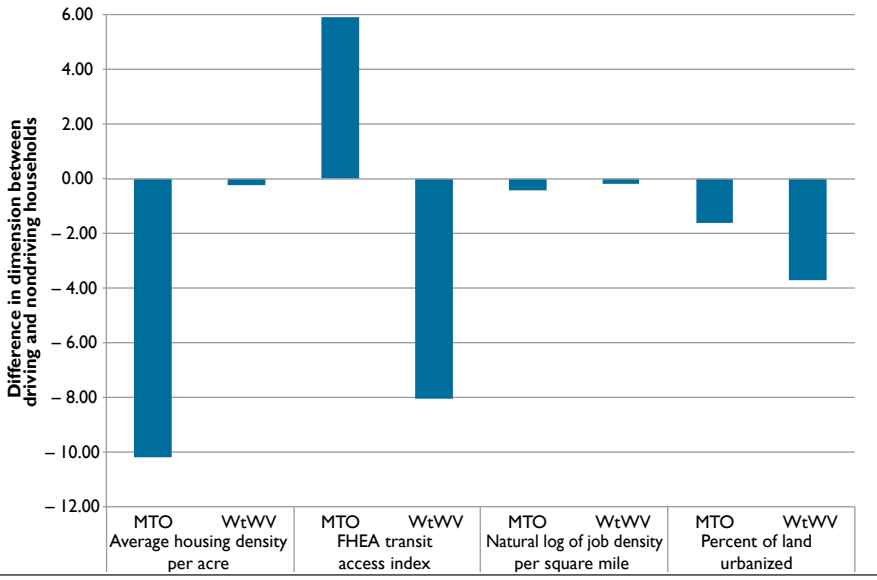
[12] We geocoded MTO households' locations in 2002 (the interim survey date). WtWV households' car-ownership status is as of the baseline survey (2000 to 2001), and their location is measured six quarters (18 months) after randomization. In both cases, we report the neighborhood locations of all households in the experiment for whom data are available.

between MTO (in which the neighborhoods had generally higher population densities), in which access to a car associated with lower income density, and WtWV, in which the reverse was true. These neighborhoods also had less diverse housing stock than the neighborhoods of nondriving households. Combined with other information about neighborhood quality, this result reinforces the idea that, although a diverse housing stock may be favored by urban designers and planners, the neighborhoods with the most diverse housing in these 10 metropolitan areas may also have counterbalancing negative aspects that will need to be addressed before they work well for families.

Driving households in MTO lived in neighborhoods with much lower housing density than did nondriving households, whereas the difference for WtWV households was less but still statistically significant (exhibit 6). Neighborhood job density and percentage of urbanized land were also significantly lower for driving than for nondriving households. We found it curious that driving households in MTO had better access to transit than nondriving households, which is opposite the result of the WtWV experiment. The MTO metropolitan areas, in general, have much better transit than the WtWV metropolitan areas; it would be intriguing to learn that MTO households with cars could find neighborhoods that were more convenient for both their transit users and their drivers.

Exhibit 6

Differences Between Driving and Nondriving Households in Neighborhood Natural and Functional Environment Dimensions, MTO and WtWV Experiments



FHEA = Fair Housing Equity Assessment. MTO = Moving to Opportunity for Fair Housing demonstration program. WtWV = Welfare to Work Voucher program.

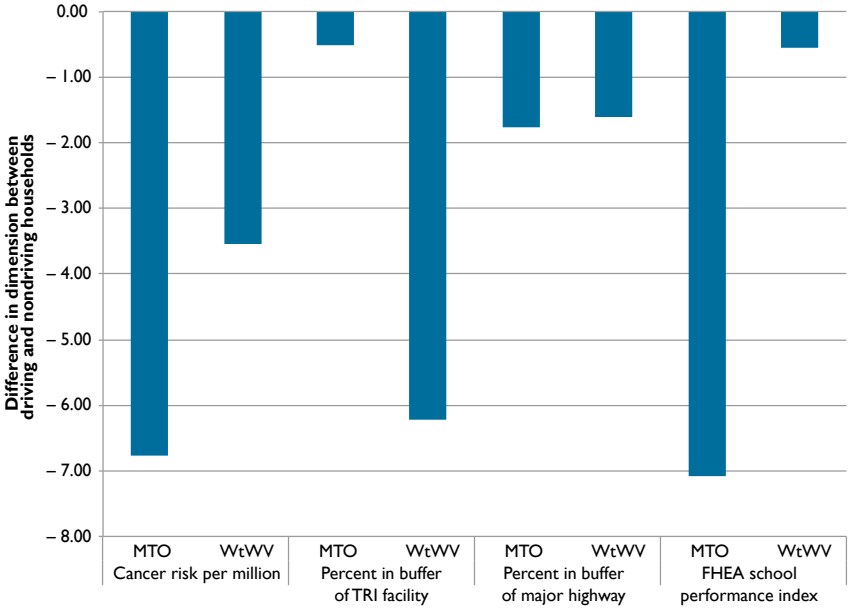
Note: Locations are as of 2002.

Source: Authors' data

Having a car also associated fairly consistently with lower exposure to neighborhood harms and hazards (exhibit 7). In both experiments the average cancer risk was lower for driving households than for nondriving households, and in WtWV driving households lived in neighborhoods that had less exposure to TRI facilities and highways. The neighborhoods of nondriving households outperformed those of driving households on only one dimension: nondriving households lived in neighborhoods with significantly better school quality than driving households. This result was statistically significant and large in the MTO experiment but not large enough to be significant at conventional levels in WtWV.

Exhibit 7

Differences Between Driving and Nondriving Households in Neighborhood Pollution Exposure and School Quality Dimensions, MTO and WtWV Experiments



FHEA = Fair Housing Equity Assessment. MTO = Moving to Opportunity for Fair Housing demonstration program. TRI = Toxics Release Inventory. WtWV = Welfare to Work Voucher program.

Note: Locations are as of 2002.

Source: Authors' data

Cars and Clusters: Driving Households Live in More Sustainable Neighborhoods—Up to a Point

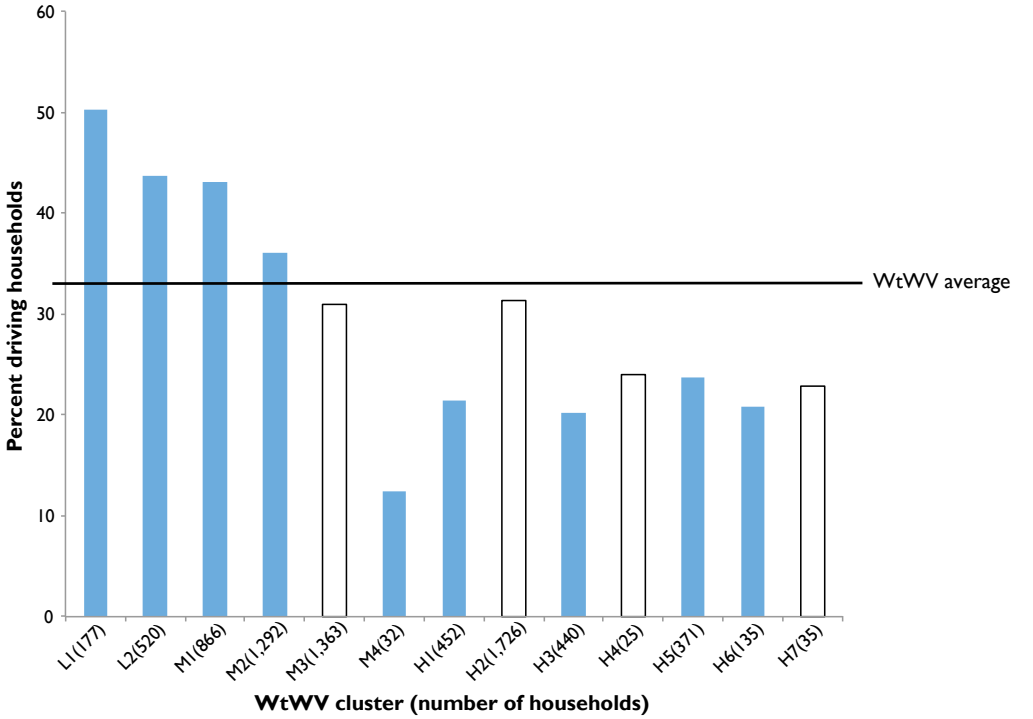
In both experiments, driving households were less likely than nondriving households to live in the least sustainable and most hazardous neighborhoods in their metropolitan areas. In WtWV, driving households were disproportionately likely to live in the low-poverty band neighborhoods and less likely to sort into the higher poverty clusters (exhibit 8). About 33 percent of all WtWV households had access to a car at baseline; 18 months after randomization, 45 percent of WtWV households in low-poverty neighborhoods were driving households compared with 36 percent of those in medium-poverty clusters and 27 percent of those in high-poverty clusters. Whereas

47 percent of nondriving WtWV households lived in high-poverty clusters 18 months after randomization, only 35 percent of driving WtWV households did; about 13 percent of the driving households lived in low-poverty clusters compared with only 8 percent of nondriving households.

At the finer grained level of individual clusters, we learned that 36 percent of WtWV households lived in three clusters near the sustainable end of the neighborhood quality spectrum. Driving households were 3 to 10 percentage points more likely than nondriving households to live in these neighborhoods six quarters after randomization ($p < 0.01$; exhibit 8). These low- to medium-poverty neighborhoods were predominantly outside city centers, with low job and income density, shares of land developed for urban uses, and exposure to highways; relatively high social status; and relatively poorly performing schools. Another 18 percent of WtWV households lived in cluster M3, in the middle of the sustainability spectrum. As with the more sustainable clusters, driving households were more likely to live in this cluster ($p < 0.01$). These 228 fairly dense, urban neighborhoods had medium to high poverty, decent schools, and low average social status. Nearly one-fourth of the WtWV households—more than 1,700 in all—lived in H2, a cluster with

Exhibit 8

Percent Driving Households, WtWV Households, by Cluster



H = high poverty. L = low poverty. M = medium poverty. WtWV = Welfare to Work Voucher program.

Notes: Shaded bars represent clusters in which drivers are overrepresented or underrepresented in the cluster by a statistically significant amount at the 95-percent or greater confidence level. Unfilled bars represent clusters in which drivers are not significantly overrepresented or underrepresented.

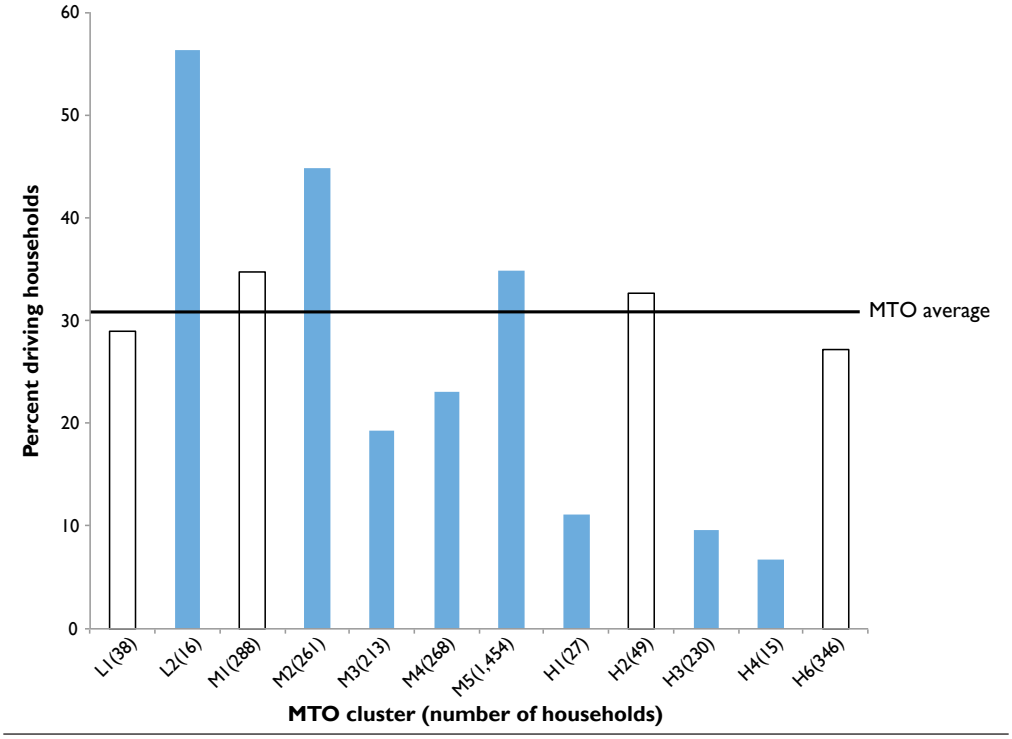
Source: Authors' data

high-poverty, high-density, low-social-status neighborhoods. These 109 tracts have poorly performing schools and low income and job density, closely representing traditionally understood inner-city, unsustainable neighborhoods. Households with access to cars were only 1 percentage point less likely to live in these neighborhoods than nondriving households, a statistically insignificant difference.

The same overall pattern held true, although less markedly so, among MTO households. Slightly less than 31 percent of MTO interim-survey respondents had a driver's license and access to a car. About 37 percent of MTO households in the two low-poverty clusters were driving households compared with 33.2 percent of those in the five medium-poverty clusters and 20.4 percent of those in the high-poverty clusters (exhibit 9). Only 14 percent of driving households in MTO lived in high-poverty clusters compared with 24 percent of nondriving households, with 84 percent of the driving households and 75 percent of nondriving households living in the medium-poverty band.

Exhibit 9

Percent Driving Households, MTO Households, by Cluster



H = high poverty. L = low poverty. M = medium poverty. MTO = Moving to Opportunity for Fair Housing demonstration program.

Notes: Shaded bars represent clusters in which drivers are overrepresented or underrepresented in the cluster by a statistically significant amount at the 95-percent or greater confidence level. Unfilled bars represent clusters in which drivers are not significantly overrepresented or underrepresented.

Source: Authors' data

Substantial numbers of MTO driving households sorted into a few clusters with relatively favorable conditions. For example, driving households were significantly more likely than nondriving households to live in the L2 neighborhoods, the more urban of the two low-poverty neighborhood types, but only 16 MTO households lived in these neighborhoods. Driving households also comprised a disproportionate 45 percent of the 261 MTO households in cluster M2, a medium-poverty cluster that had reasonably good transit; average levels of urban development, social status, and income and job density; and low school performance. On the other hand, driving households also were significantly more likely than nondriving households to live in M5 neighborhoods, which occupy the border between the medium and high poverty bands. With 1,454 MTO households, nearly one-half of the total, these high-density urban tracts have an average poverty rate of 24 percent—10 points higher than the other medium-poverty neighborhoods—and are more urbanized by our indicators. They have poorly performing schools, low social status, and weak housing markets, but they also have relatively high density of jobs and aggregate income. It is possible that driving households that sorted out of the high-poverty clusters ended up in this cluster.

The remaining four clusters with more than 50 MTO households had neighborhood characteristics near the middle across the dimensions, with the exception of school quality; they tended to have poorly performing schools. The quality of schools emerged as a largely noncorrelated indicator; the highest ranking tracts with respect to school quality were often in lower quality neighborhoods, perhaps because that indicator was collected nearly a decade after randomization.

Car Access, Crime, and Perceptions of Neighborhood Safety

Driving households also lived in neighborhoods with lower objective levels of violent crime (in six central cities, as discussed previously) and higher subjective sense of security than nondriving households. The plurality of households—with or without cars—lived in the highest crime neighborhood quartile; very few lived in the lowest crime quartile (exhibit 10). Driving households were significantly less likely ($p < .05$) to live in the highest crime quartile, however. Whereas 49 percent of nondriving households lived in this quartile, 45 percent of driving households lived there. Driving households were also somewhat less likely to live in the second highest quartile (although this difference was not statistically significant) and about 3 percentage points more likely than nondriving households to live in the second lowest crime quartile.

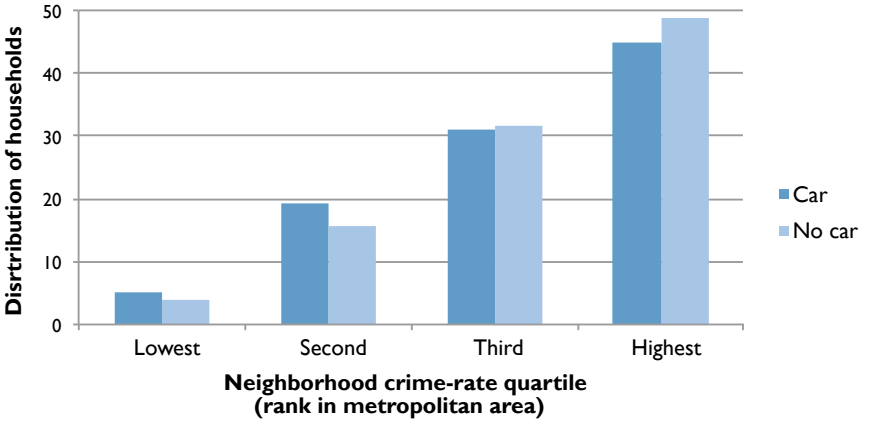
In every site for which crime data were available, the share of households with no car access that lived in the highest crime quartile exceeded the share of households with car access that lived in the highest crime quartile. Summing the top two crime quartiles, the pattern persists. In each site, nondriving households were more likely than driving households to live in neighborhoods with above median violent crime levels. Finally, in Baltimore, Chicago, and Houston, driving households were about twice as likely as nondriving households to live in the lowest crime quartile. In the other three sites, driving and nondriving households had similar probabilities of living in the lowest crime quartile.

We also examined perceptions of crime using the MTO and WtWV survey responses, emphasizing the percentage of respondents who felt safe at night, again comparing driving with nondriving households by metropolitan area. For all sites, a higher percentage of driving households reported feeling safe than did nondriving households, a difference that was statistically significant in all

sites except Los Angeles (exhibit 11). MTO households were more likely to feel safe than WtWV households, but the perceived safety gap of about 10 percentage points was persistent across both groups.

Exhibit 10

Driving Households Are Less Likely Than Nondriving Households To Live in Highest Crime Neighborhoods



Source: Authors' data

Exhibit 11

Share of Households Reporting High Neighborhood Safety, by Car Access

	With Car		Without Car	
	Percent	n	Percent	n
All MTO	69	738	59	1,364
Baltimore	78	108	61	243
Boston	69	234	61	251
Chicago	77	183	66	360
Los Angeles[a]	56	140	52	136
New York City	72	73	54	374
All WtWV	53	1,357	42	2,182
Atlanta	46	153	29	233
Augusta	66	231	52	212
Fresno	49	472	43	713
Houston	44	171	39	644
Spokane	65	330	59	380
All sites	**58**	**2,095**	**48**	**3,546**

MTO = Moving to Opportunity for Fair Housing demonstration program. WtWV = Welfare to Work Voucher program.

[a] Los Angeles is the only site in which a chi-squared test found no statistically significant difference between groups.

Source: MTO and WtWV surveys

Multivariate Results: Car Access Associates Independently With Positive Neighborhood Outcomes

These correlations show that driving households sort into neighborhoods that on average are better and safer, and feel more secure, than the neighborhoods that nondriving households live in. Personal characteristics of the households, however, likely explain some of the tendency both to secure a license and a car and to find safe neighborhoods. To control for some of those personal characteristics, we estimate several *locational attainment* models, in which the dependent variable is a census tract characteristic associated with a household's chosen neighborhood and independent variables include household-level determinants of location choice. A few examples of studies employing versions of this type of empirical approach are Alba and Logan (1992); Bayer, McMillan, and Rueben (2002); Dawkins (2005); Freeman (2008); and Woldoff (2008).

The dependent variable in our locational attainment models the neighborhood quality of MTO and WtWV households at the time of the final surveys (that is, 2002 for WtWV and 2008 for MTO), using the neighborhood opportunity dimensions outlined in the previous section. We add access to jobs as a final measure of neighborhood desirability.

We include three measures of automobile access. The first is an indicator variable equal to 1 if anyone in the household owned a car, van, or truck that ran or had access to a valid driver's license at the time of the interim survey (for MTO households) or at the time of the baseline survey (for WtWV households). For the MTO sample, we also include two indicator variables that measure whether the household had gained or lost access to cars or licensing since the interim survey. Change in automobile access could not be calculated for the WtWV sample, because a change in the wording of the question between the baseline and followup surveys limited the variable's coverage to only those who were employed at the time of the followup survey. We include access to a driver's license in our definition of automobile access, because even if a household does not own a car, access to a driver's license may enable a household member to rent a car or borrow one from a friend or family member. All these variables except the automobile access variables were measured contemporaneously with the date of the final survey. In addition, in each regression model we include the lagged measure (as of the baseline surveys) of the same neighborhood characteristic used to construct the dependent variable. All models are restricted to those who had moved from their baseline neighborhood to a new census tract by the final survey.

The independent variables in each model include household-level factors shown by previous studies to be associated with neighborhood choice. We also include measures of the randomly assigned treatment group for each sample, interacted with whether the household was still relying on voucher assistance at the time of the final survey. For the WtWV final sample, the voucher status variable is defined in terms of those who used the voucher to lease up in their current location. In the MTO final sample, because of data constraints, our measure of voucher status captures not whether the household leased up in their current location using a voucher but whether the household is receiving voucher assistance in their current location. We also include indicators of the household's metropolitan location, with Boston omitted as the reference category for the MTO sample and Augusta omitted as the reference category in the WtWV sample. Households living in Los Angeles were excluded from the WtWV sample because they were dropped from the followup survey.

Other household characteristics include income, income squared, and number of children in the household. Income is defined slightly differently for the two samples. In the MTO sample income is defined as the total household income earned during the previous year, whereas in the WtWV sample income is defined simply using a dummy variable indicating whether the household's income is above or below the poverty threshold. A measure of income based on annualized earnings for the WtWV sample proved to be unreliable because of missing data. Characteristics of the household head include age, age squared, race and ethnicity, marital status, gender, education, and employment status.

Automobile access has significant effects across a variety of locational outcomes ($p < 0.05$), whether access is measured in terms of having a car or license at an earlier period or gaining access during the survey period (summary of results in exhibit 12). Those with access to cars or licenses gain

Exhibit 12

Summary of Vehicle Access Regression Coefficients From Locational Attainment Models

Variable Description	MTO Sample			WtWV Sample
	Car Access at Interim	Car Access Gained	Car Access Lost	Car Access at Baseline
Functional environment				+
Median gross rent	+	+	–	–
Vacancy rate	–	NS	+	+
Owner occupied (%)	+	+	–	NS
Vouchers (% of rental housing)	NS	NS	NS	–
FHEA transit access index	NS	NS	+	
Social environment				–
Poverty rate	–	–	+	+
Median household income	+	+	–	+
Labor force participation rate	+	+	–	–
Unemployment rate	–	–	+	NS
Minority population (%)	–	–	+	–
Female-headed households (%)	–	–	+	NS
Age 25 or older with high school diploma or GED (%)	+	+	–	
Natural environment				NS
Open space (%)	+	+	–	+
Average block length	+	+	–	–
Population density	NS	–	+	NS
Buffer of major highways (%)	NS	NS	NS	–
Cancer risk per million	NS	NS	NS	NS
Buffer of TRI facilities (%)	NS	NS	NS	
Economic vitality				NS
Job density	NS	NS	+	–
Aggregate income density	NS	NS	NS	
Access to opportunity				+
FHEA school performance index	+	NS	NS	NS
Number of jobs within 30 minutes	NS	NS	NS	

FHEA = Fair Housing Equity Assessment. GED = general educational development. MTO = Moving to Opportunity for Fair Housing demonstration program. NS = not significant at the .05 level. TRI = Toxics Release Inventory. WtWV = Welfare to Work Voucher program.

Notes: + indicates positive and significant at the .05 level. – indicates negative and significant at the .05 level.

Source: Authors' data

access to neighborhoods with a more highly valued housing stock, higher school performance, lower poverty and unemployment rates, and, among MTO households, a more educated adult population.

These results reinforce the evidence from the bivariate correlations that households make tradeoffs among environmental conditions, economic vitality, and access to opportunity and that driving and nondriving households make different kinds of tradeoffs. Households with vehicles live in areas with more desirable environmental amenities, including more access to open space and less exposure to cancer risk (WtWV households only). Having a vehicle or license, however, also encourages moves to neighborhoods that are less accessible to transit (among WtWV households) and less conducive to walking. Thus, when it comes to measuring opportunity, one must recognize that the spatial distribution of opportunities is heterogeneous. When faced with an uneven distribution of opportunity structures, households often make tradeoffs and choose the opportunities they value most highly. Although our approach does not allow us to distinguish between the effect of household preferences versus spatial supply constraints as they influence the residential outcomes observed, we find that automobile access has fairly consistent effects across a range of housing market, social, economic, and environmental outcomes and that accessing one particular dimension of neighborhood opportunity often comes at the expense of other dimensions of opportunity.

Conclusions and Policy Implications

Our analysis of neighborhood clusters and residential sorting patterns advances the measurement of neighborhood quality, especially as it relates to the residential environments of low-income residents of metropolitan America, by identifying factors that matter in different ways for household outcomes. Our analysis of neighborhood sustainability dimensions has important implications.

Summary of Key Findings

Distressed neighborhoods have many serious problems, but only a small minority of tracts in U.S. metropolitan areas have crushing crime rates, failing schools, high levels of environmental degradation, and deep poverty. These tracts accommodate a disproportionate share of voucher users, however. Meanwhile, many tracts have lower moderate poverty levels, less distressed conditions, and enough housing to accommodate many voucher users. These neighborhoods, the poverty rates of which range between 10 and 30 percent, offer an assortment of combinations of desirable and undesirable characteristics. Our analysis suggests, therefore, that it is limited to characterize neighborhoods as offering either opportunity or environmental quality but not both, as found by Been et al. (2010). We found little or no relationship between poverty and income density, for example, meaning that whereas some high-poverty neighborhoods also have little economic vitality others have enough income circulating per square mile to justify greater investment by the public and private sectors. The correlation between poverty and measures of exposure to hazardous conditions, although troubling, generally did not exceed 0.50. On average, high-poverty neighborhoods had higher job density and better transit service than lower poverty neighborhoods. These differences are important enough to yield a mosaic of choices among medium-poverty neighborhoods, as our cluster analysis shows.

We have shown that households with access to cars found housing in neighborhoods where environmental and social quality consistently and significantly exceeded those of the neighborhoods of households without cars. In both experiments, households with cars lived in neighborhoods with significantly lower poverty, higher social status, stronger housing markets, lower cancer risk, and—as far as we have data to demonstrate it—lower crime rates than those without cars. They also felt safer than nondriving households. Our findings on neighborhood quality hold up in multivariate models (apart from findings on crime and security, which we did not test). Compared with nondriving households, driving households located in areas with lower concentrations of poverty and higher concentrations of households that are employed or participating in the workforce—even holding constant respondents' income, race, household size, and other characteristics. These areas also had higher median rents, more owner-occupied housing, lower vacancy rates, and better performing schools at the time of the final survey.

In analyses not included in this article, we found that access to vehicles influences neighborhood satisfaction interactively with transit access (Dawkins, Jeon, and Pendall, 2015). Estimates from an ordered probit model suggest that access to automobiles and a driver's license matters most in neighborhoods with low transit accessibility. In areas with the highest levels of transit access, households with and without access to cars or licenses are each moderately satisfied with their neighborhoods, although predicted neighborhood satisfaction levels are slightly higher for those without access to cars or licenses. In areas with the lowest levels of transit access, driving households are about 1.6 times more satisfied with their neighborhoods. Considering different levels of car and transit access together, those households living in areas with the least accessible public transit and that have access to cars or licenses exhibit the highest levels of neighborhood satisfaction.

Driving households must accept some less desirable neighborhood conditions as they find neighborhoods they can afford, however. The bivariate analysis shows that, in 2002, driving households in WtWV and MTO lived in neighborhoods with lower income density and less diverse housing stock. MTO households at that time also lived in neighborhoods with lower school performance scores. The multivariate analysis shows that vehicle owners lived in areas with more access to open space and less exposure to cancer risk and toxic facilities but with lower levels of transit access and urban environments that are potentially less conducive to walking. Those who lost access to cars also compensated by choosing neighborhoods that have higher levels of job accessibility.

Taken together, these findings suggest that having access to vehicles facilitates mobility to low-poverty neighborhoods over time and eventual satisfaction with the neighborhood chosen. Geographically targeted housing assistance also has measurable effects that persist over time, but the magnitude and significance of the effect varies after the geographic requirement is lifted.

Policy Implications

We do not conclude based on our analysis that voucher users or other low-income families simply should be provided with automobiles. A full accounting of the effects of car ownership on neighborhood choices would require a methodological approach accounting as fully for self-selection into car ownership as MTO tried to do for self-selection into low-poverty neighborhoods. Families with access to cars undoubtedly differ in unmeasured ways from those without access to cars.

Neither experiment "treated" voucher-assisted households with automobile access, denying access in an experiment to a control group. Many of the factors that would lead a household to secure access to a car could also motivate moves to good neighborhoods and to get and keep jobs. For the present, therefore, our results on car access must be treated as preliminary and promising.

Even so, this study and others provide enough information to justify new initiatives to improve voucher users' car access and to study the costs and benefits of car access (and car access programs) while doing so. Happily for policymakers seeking to improve neighborhood opportunity for low-income households, we are at the threshold of a new era in automobile access that opens up a series of alternatives that could be deployed immediately and, under the right conditions, explored in experimental research. Subsidies for automobile purchases still are likely to be the most popular approach to expanded car access, but short-term car rental services such as Zipcar and Car2Go also have the potential to address the travel needs of some low-income adults at a lower cost. (See, for example, McCarthy, 2012, and Ortega, n.d.) These services may be particularly useful to households with at least one licensed driver that do not have sufficient assets to own and maintain a car. Coordination of housing voucher assistance with nonprofit car donation services and rideshare services is a third possibility.[13] Of course, the tradeoffs of such policies are that additional car-based travel will exacerbate the negative externalities associated with automobile use, including congestion, air-quality degradation, and automobile accidents. Furthermore, car ownership entails costs that accrue directly to owners, which may place undue burdens on low-income families. These tradeoffs should be considered with any automobile-based mobility strategy.

The potential of cars to meet important mobility and opportunity goals for low-income households should not, however, be treated as an alternative to further investment in transit. Automobile access associated with better neighborhood outcomes in our studies partly because public transportation service is so miserable in many of the metropolitan areas in these two studies (especially the WtWV metropolitan areas). Even when they have access to a car, low-income households often need good transit service for their young or disabled members and for occasional use when they lose automobile access (as happened often to the MTO households). In addition, although transit access was not sufficient to lift unemployed workers into employment, according to the research by Blumenberg and Pierce (2014) conducted in tandem with our analyses of neighborhood sorting and summarized in this issue of *Cityscape*, policies that enable households to move to transit-rich neighborhoods can help participants retain employment. Moreover, transit service helps reinforce commercial and residential density and land use diversity, both of which help reduce trip length and thereby reduce the overall cost of travel for drivers. It also eases peak traffic loads. Hence, even for driving households, transit investment makes sense, especially when combined with supportive land use policies.

In all, then, we believe that the policy implications of this research, coupled with Blumenberg and Pierce's (2014) article, solidly support a more integrative approach to transportation for low-income households that helps build systems in which automobile access, transit, and support for pedestrians combine to maximize households' access to both high-quality neighborhoods and employment. Interjecting such a social-equity objective into considerations of how to link housing

[13] See National Economic Development Law Center (2007) and http://www.workingcarsforworkingfamilies.org/.

with land use, transportation, and air-quality plans can occur only with broad federal coordination. The Sustainable Communities Partnership between HUD, the Environmental Protection Agency, and the U.S. Department of Transportation is one example of such coordination. Our findings lend support for similar additional programs that consider social mobility more broadly, emphasizing the role of transportation access as it affects both residential and economic mobility.

Some actions in the short term could improve the development of mobility strategies for voucher holders. HUD could direct housing agencies and assisted-development operators to collect information about whether all their assisted tenants have access to working cars as part of the income verification process. Armed with such information, HUD could develop new programs and partnerships to help able families become economically self-sufficient. Information about car access could also be helpful for identifying neighborhoods where assisted families with cars are living so that new economic development efforts could concentrate there, including affordable options for car maintenance and educational opportunities for courses in automobile mechanics, for example. It is clear that even in high-density, transit-rich cities, voucher users—like many other low-income people—make huge sacrifices to get and maintain car access. Housing and community development policies and programs can be shaped so that the needs of assisted households with and without cars are accounted for individually.

Our results also imply that housing search services should be tailored to the transportation needs of households receiving assistance. Transporting those without access to a car to prospective residential locations, along with providing information about the public transportation options available in different neighborhoods, may help to improve the number and quality of units inspected before a housing search. Shroder (2002) also advanced this policy recommendation, finding that car ownership and the intensity of housing counseling services both increased the likelihood of lease up among MTO program participants. Providing long-term transportation services may be expensive, but combining such assistance with other educational programs may increase the rate at which mobility program participants successfully lease up in desirable neighborhoods (Shroder, 2002).

Finally, our findings call for a more nuanced reframing of the geography of opportunity debates. In our analyses, we find that low-income HUD-assisted households make tradeoffs among different neighborhood characteristics. Areas with high-performing schools, access to open space, and a lower risk of environmental contamination may have inadequate transportation systems, less accessibility to jobs, and an increased risk of exposure to automobile emissions. Furthermore, households at different life-cycle stages and with different levels of access to transportation value each of these amenities differently. Given the spatial heterogeneity of preferences and opportunity structures, our findings call for an expansion of housing assistance services that are tailored to the particular needs of individual households. Thus, the goal of "moving to opportunity" may be more usefully phrased as "moving to opportunities."

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Authors

Rolf Pendall is Director of the Metropolitan Housing and Communities Policy Center at the Urban Institute.

Christopher Hayes is a senior data manager at the Urban Institute, Metropolitan Housing and Communities Policy Center.

Arthur (Taz) George is a research associate at the Urban Institute, Housing Finance Policy Center.

Casey Dawkins is an associate professor of urban studies and planning and a research associate with the National Center for Smart Growth at the University of Maryland.

Jae Sik Jeon is a Ph.D. assistant at the University of Maryland, National Center for Smart Growth.

Elijah Knaap is a Ph.D. assistant at the University of Maryland, National Center for Smart Growth.

Evelyn Blumenberg is a professor at the University of California, Los Angeles, Luskin School of Public Affairs, Institute of Transportation Studies.

Gregory Pierce is a senior postdoctoral researcher at the University of California, Los Angeles, Luskin School of Public Affairs, Luskin Center for Innovation.

Michael Smart is assistant professor at Rutgers, the State University of New Jersey, Edward J. Bloustein School of Planning and Public Policy.

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