How Stable are Preferences for Neighborhood Characteristics & Accessibility? Analyzing Residential Relocation Decisions

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ABSTRACT

There is much talk in land-use and transportation planning circles these days about relationships between neighborhood characteristics and travel behavior. Despite a flurry of recent studies, several questions remain unanswered. Prominent among these questions is what stems from the issue of self-selection: overall attitudes and preferences for certain neighborhood characteristics and accessibility may influence travel moreso than the neighborhood characteristics themselves.

This research uses data from the Twin Cities (Minnesota, US) to analyze the consistency of preferences for neighborhood characteristics and accessibility among various groups in intra-county residential location decisions. Using household survey data and local land use data, the research measures a mix of demographics and neighborhood characteristics commonly espoused in planning initiatives. We employ factor analysis to identify a small set of neighborhood dimensions and cluster analysis to define 8 distinct neighborhood types. After geocoding the address of each respondent, we assign each a neighborhood type, and predict determinants of moves to the same neighborhood type. The findings suggest that nearly 54 percent of respondents moved to the same neighborhood type; the binary logistic regression helps identify several variables affecting such relocation decisions. The conclusions discuss the implications of

this research for land use and transportation policy. In particular, the research suggests the role of neighborhood preferences in affecting residential location decisions and the relatively limited role of neighborhood design, by itself, to temper the demand for travel.

INTRODUCTION

There is much excitement in land-use and transportation planning circles these days relating detailed neighborhood design characteristics with travel behavior. However, despite a flurry of recent studies—totaling over 50 different research efforts (Ewing 2001)—several questions remain outstanding. Prominent among these questions is what stems from the issue of self-selection: overall attitudes and preferences for certain neighborhood characteristics and accessibility may influence travel moreso than the neighborhood characteristics themselves. For example, the bulk of the research to date often fails to discern between the factors influencing one's inclination to walk versus their preference to live in neighborhoods that support walking. Pointing to correlations showing that people living in higher density/mixed-use developments walk more tells an incomplete story; it does not necessarily mean developing additional communities of this type will lead to more walking.

Such reasoning suggests that research needs to also consider relationships between neighborhood preferences and residential location, and not just correlations between neighborhood design and travel behavior. Preferences for certain neighborhood design characteristics is the larger issue worth considering; they are an important factor in assessing efficacy of many recent land use-transportation initiatives that aim to use neighborhood design to moderate travel demand or influence household moves.

Available literature on residential relocation indicates that household lifecycle and lifestyle changes help explain decisions to live in certain neighborhoods. In many cases, households might select similar physical and social surroundings as their previous neighborhood. Their preferences for specific neighborhood types are ingrained in their choices. This paper addresses these issues by assessing the consistency of preferences about neighborhood types among intra-county residential relocation decisions.

We begin by reviewing factors influencing residential relocation decisions and the role of preferences in such decisions. We describe data obtained from a household survey administered to three communities in Hennepin County, Minnesota (U.S.). To discern different types of neighborhoods, we assign 24 neighborhood characteristics (physical and demographic) and then employ factor analysis to identify a smaller set of dimensions from these characteristics. We use cluster analysis to classify eight neighborhood types based on the factor scores, and then binary logistic regression to predict determinants of moving to the same neighborhood type. We conclude by discussing the policy implications of this work as it relates to current land-use and transportation planning. specifically, how the potential of using neighborhood design to moderate travel demand is tempered by better understanding existing preferences of certain populations.

Importance of Understanding Neighborhood Preferences

The importance of understanding neighborhood preferences in policy and research has been of continued interest. Urban planners and many politicians have long been promoting compact, mixed-use, and pedestrian friendly neighborhoods for their travel related benefits (e.g., decreased congestion). More recent health concerns have caused many planners, epidemiologists, and public health advocates to promote the use of neighborhood design as a means to spur active travel and encourage physical activity.

While advocacy and enthusiasm is welcome, recent research suggests heeding possibly unmet expectation of such initiatives. Residential self-selection could play a role in limiting the success of these initiatives. Households may choose to live in areas that match their preferences, either for neighborhood design or to satisfy a particular behavior. For instance, a ‘walker’ might choose to live in a community that supports walking, suggesting that person’s travel behavior should not be credited to neighborhood design alone.

Any effort to analyze the factors affecting residential relocation decisions must consider self-selection. The difficulty is understanding causality; did household choose to relocate to a particular neighborhood or did the neighborhood characteristics themselves cause the relocation. In contrast to typical research that solely address causality, this study creates taxonomy of neighborhoods and *then* examines preferences for neighborhood types. This taxonomy provides both a simple answer as to whether households move to the same type of neighborhood and a more complex answer as to why. An investigation of preferences could help planners, policy-makers, and developers determine design characteristics that household’s prize, identify the potential market for various types of neighborhoods, and inform the prospect of using neighborhood design to moderate travel demand.

BACKGROUND

Myriad of factors influence the decision of when and where to move. Understanding these factors as they relate household relocation, neighborhood design, and travel is important for land-use and transportation policy as households move often. Figure 1 shows the number of years ago three U.S. age groups moved into their current residence. The dramatic decline after the 1-5 year category reveals over half the population moves more frequently than every six years. Given the amount and diversity of literature conjecturing about the nature of moving decisions, we briefly describe three strands of literature: the spatial distribution of residential relocations, the typical causes of relocations, and the role of preferences about neighborhood characteristics in these decisions.

INSERT FIGURE 1 APPROXIMATELY HERE

Strand One: The Distribution of Residential Relocations

The first strand looks at typical spatial distribution of residential relocations. Consistent with the prevailing U.S. trend over the past half-century, households generally move outward from urban to suburban areas or remain within suburban areas. An analysis of U.S. county level moves in the 1990’s found outward flows of both people and income (Manson 2000). Other metropolitan areas with similar empirical evidence include Chattanooga, TN, (Regional Planning Agency Information and Research. 2003), Boston, MA, Dallas, TX, and Philadelphia, PA (Kasarda 1997).

Most residential relocations are short-distance. In an examination of U.S. household moves, excluding international and moves from or within Alaska and Hawaii, 73 percent were less than 31 miles. Among those who had relocated once during the past 3 years, 46 percent reported moving less than 6.2 miles (Long 1988). A Minneapolis, Minnesota study indicated a clear tendency for short moves within or to a community of similar social class (Adams 1976).

Migration expectancies offer another method to examine moves. Migration expectancy is the number of expected moves a person will make in their lifetime, typically measured as within a county (intra-county) or between counties (inter-county). Using the same data source, three separate studies found little change in the ratio of U.S. intra-county to inter-county moves over the past the past 30 years. A pioneering study estimated 68 percent of a 1958 newborn's moves during their lifetime would be intra-county (Wilber 1963). A second study, analyzing 1966-71, predicted 62.7 percent of moves would be intra-county (Long 1973). A third found 62.5 percent were intra-county, measured separately in 1975-76, 1980-81, and 1987-91 (Kulkarni and Louis 1994).

Strand Two: The Typical Causes of Relocations

It is useful to understand how lifecycle and lifestyle factors affect residential relocations for two reasons. One, it provides context to assess the possible role of neighborhood design characteristics. Two, the literature suggests different factors explain intra-county and inter-county moves (Boehm 1991; Dieleman 2001).

Fifty years ago, Rossi offered what later became a classic piece in literature on residential location. In it, he focused on household decisions instead of traditional aggregate measures and found lifecycle changes, such as age, tenure type, tenure length and household size, often stimulate moving decisions (Rossi 1955). Many studies have since examined the role of lifecycle changes and several reviews are available—1960s-1970s (Ritchey 1976), 1970s-1980s (Greenwood 1985) and 1980s-1990s (Dieleman 2001).

Household lifecycle changes have a varying affect on the frequency of residential relocations. Younger generations move more frequently and for different reasons than families and retirees (Boehm 1986; Plane 2003). Improving neighborhood quality and a longer tenure decreases the number of moves for both renters and owners. Higher education increases the likelihood of moving for work related reasons—particularly at the inter-urban level, while being poor generates moves for family instead of work related reasons. Higher incomes increase relocations among renters, but not owners (Boehm 1986). Moves can also vary between races; blacks are more likely than whites to remain in and move to urban centers (South 1997). These findings stress the importance of considering lifecycle factors in relocation research.

Housing and job related reasons are other common explanations of household moves. A U.S. analysis estimated 51.6 percent of the population moved for housing related reasons, 26.3 percent for family, and 16.2 percent for work. Of those moving for housing reasons, 36 percent desired a new/better home or apartment and 22 percent wanted to own not rent. Furthermore, housing reasons better explain short distance moves—over 65 percent of intra-county relocations compared to 31.9 percent of inter-county moves (Schachter 2001). In support, job changes tend to cause long distance moves, while other factors often explain short distance relocations

(Dieleman 2001). The results propose shorter distance moves are more often for housing-related reasons.

Other work hypothesizes that housing disequilibrium, a result of current dissatisfaction, stimulates moves. Housing disequilibrium varies between households and socio-demographic groups and can result from differences in perceived and actual neighborhood quality (Boehm 1986; Schwanen 2004). Discontent in current residence has been shown as a strong predecessor of neighborhood dissatisfaction (Parkes 2002). Dissatisfaction with current residence led to a household's evaluation of their demand for and market supply of new locations (Wong 2002). No without contrast, another study found housing satisfaction to be insignificant relative to lifecycle and socio-demographic characteristics (Varady 1993). Housing dissatisfaction may be a reason to move to a different neighborhood type.

Studies that examine causes of relocations create an important context for this paper. However, moves for job or housing reasons do not mean neighborhood preferences change. Self-selection could still play a role; households might choose a neighborhood with similar design characteristics.

Strand Three: Role of Preferences About Neighborhood Design Characteristics
The literature reveals some preferences for design characteristics in residential relocations. Considering six Belgian cities, neighborhood attributes (e.g., parking, amount of traffic, privacy, safety) and housing attributes (e.g., number of rooms, type of house, mortgage/rent) were more important than accessibility among consumers seeking new residence (Molin 2003). Similarly in the Netherlands, albeit a regulated housing market, accessibility of a location is not significant compared to other variables in determining residential location (Zondag 2005).

Households might compromise in choosing design characteristics. Early work found households make trade offs between transportation and public services in moving decisions, but their role was small compared with socio-economic and demographic factors in ultimately deciding future residence (Weisbrod 1980). A choice-based analysis determined consumers' willingness to substitute New Urbanist type features. While households preferred suburban street layouts and lower housing densities, they also desired open space and shorter commute time. Improving school quality and neighborhood safety helped to make urban environments competitive with suburban ones (Morrow-Jones 2004).

Preferences for urban character may also play a role. In a study of interview responses, 50 percent of the working class and a strong majority of the middle and upper classes stated preferences for suburban or even rural environments (Coleman 1978). In one Texas community south of Dallas, many people are dissatisfied with several physical aspects of suburban development but lack support of higher density/mixed-use neighborhoods (Talen 2001).

Using hedonic models, proximity to various neighborhood design characteristics can both raise and lower home price, which may affect relocation decisions. Commercial and university uses (Franklin 2003), permanent open space, (Geohegan 2002) and urban off-street bicycle facilities (Krizek 2006) have been shown to increase home value, while K-12 educational and institutional uses (Franklin 2003) and suburban off-street bicycle facilities (Krizek 2006) may decrease home value. Preferences may vary among one and two worker households, although each prefers to move in the presence of high density employment and population centers (Waddell 1996). Thus, the desire to realize appreciation in home value may generate a move to a different type of neighborhood.

RESEARCH APPROACH

The literature jointly offers three key conclusions that inform the research in this study. First, intra-county relocations account for roughly 62 to 67 percent of all U.S. moves, although a slight outward shift away from the central city continues. Second, lifecycle and lifestyle factors appear to be as important as neighborhood design characteristics. Third, housing related reasons appear to play a prominent role in short-distance moves. Ultimately, varying evidence encourages new analyses to glean information about the importance of neighborhood design. Notwithstanding major changes in lifecycle, we hypothesize household preferences for neighborhoods are largely consistent and therefore expect people to move between areas of similar design characteristics. We expect design characteristics, housing quality, lifestyle, and lifecycle factors to be key predictors of this decision.

Our focus herein examines the consistency of household preferences about neighborhood types. Thus, our approach does *not* directly focus on the causes of one's decision to move to certain neighborhood types (though, this information certainly provides good context for our work). We measure an assortment of physical and demographic design characteristics and employ factor analysis to identify a smaller set of dimensions from the larger set of characteristics. We employ cluster analysis to create taxonomy of eight neighborhood types and model households that move within the same neighborhood type using objective and respondent variables to gain a better understanding of those decisions.

Description of Survey

One thousand randomly selected households from three geographically stratified areas in Hennepin County, Minnesota (U.S.), representing urban, inner suburban and outer suburban locations, received a survey querying household travel patters, perceptions of residential location decisions, and lifestyle. Administration began in mid-July of 2005 and continued with three reminder mailings (Dillman 2000). Excluding surveys returned as undeliverable, the response rate was over 40 percent. The urban response rate was somewhat lower, possibly reflecting higher rental rates and concomitant residential turnover in that study area.

Definition of Sample

We first remove respondents who had lived in their current address for more than ten years to narrow the likelihood of major "preference-changing" events as the survey did not track longitudinal lifecycle changes. After mapping respondent current and former address, we removed those who did not move intra-Hennepin County for three reasons: (1) the process of acquiring and operationalizing detailed design characteristics at a regional scale was beyond the scope of this research[1], (2) preferences for design characteristics are likely more revealing among intra-county movers, and (3) Hennepin County is largely developed. Restricting the analysis to a well developed county mitigates the number of changes in neighborhood design. These

[1] Necessary if we were to consider additional former addresses

constraints and missing data reduced the sample to 278 observations. Figure 2 shows the location of the former and current address of each respondent in the context of the three geographic areas.

INSERT FIGURE 2 APPROXIMATELY HERE

Definition of Neighborhood Size

Definitions of neighborhood size are as diverse as the research itself. The central problem—affecting the ability to detect subtle differences in design characteristics—is the unit of analysis. Spatial definitions range in size and shape from municipal boundary to census tract to simple buffer. Defining neighborhoods at the administrative or census tract level may fail to match a mover's perception of space or neighborhood description (Coulton, Korbin et al. 2001; Guo 2004). Other research found TAZ and census tracts to be too large (Moudon, Hess et al. 1997; Krizek 2003). One study found 32 percent of Seattle respondents define their neighborhood as an area between one square block and a 0.80 km (0.50 mile) radius, while 18.6 percent consider it larger. Nearly 25 percent describe their neighborhood as no larger than one square block and the remaining 14.3 percent define it as street block or cul-de-sac (Guest 1984). The ease of using data collected at the city or census tract level might also obscure subtle variations in design characteristics.

We employ a previously tested cellular approach that is easily applicable across an entire county and uses readily available geographic information systems (GIS) data (Krizek 2003). Such an approach offers a relatively disaggregate unit of analysis, accommodates a variety of neighborhood sizes, and is more appropriate than larger measures. Square grid cells with sides equal to 300 meters divide Hennepin County. Each individual cell represents the "immediate" neighborhood and the adjacent cells the "surrounding" neighborhood. Together these cells tests for variability in neighborhood characteristics, accommodate people who consider their neighborhood larger than 300 meters, and lessen the problem of a residence in the corner of an individual cell.

Definition of Neighborhood Design Characteristics

A range of readily available design characteristics often used in related past research are easy to operationalize at the grid cell level using GIS. Table 1 lists the name, provides the unit of measure, and shows summary statistics for 24 design characteristics, reflective of the range of variables that might impact a residential relocation. The demographic variables are from the US Census Bureau for the year 2000 and the neighborhood variables from the Metropolitan Council (Twin Cities metropolitan planning organization) Datafinder year 2000 or later.

INSERT TABLE 1 APPROXIMATELY HERE

RESULTS

The end goal is to discover whether respondents have preferences for similar neighborhood types and what factors affect those preferences. We examine and explain: (a) basic respondent information, (b) the neighborhood dimensions that describe the 24 variables within each grid cell, (c) the neighborhood types that reflect the similarities and differences among the neighborhood dimensions, and (d) preferences for neighborhood types.

General Relocation Findings

A number of general results help set the stage for the more detailed analysis. The average tenure length at current residence is 4.23 years, similar to Figure 1. Tenure type changed considerably between moves. Fifty-eight percent of all respondents rented at their former residence, in comparison to 28 percent at their current residence. A total of 92 percent of former owners remain owners and 57 percent of former renters now own at their current address.

Respondents tend to move within their geographic area. Sixty-six percent of moves between current and former residence were within the urban, inner suburban, or outer suburban areas of Hennepin County (Table 2). Eighty-nine percent of respondents moved within the urban area compared to 49 percent within the inner suburban area and 53 percent within the outer suburban area. Inter-area moves are generally outward, from urban to inner suburban and inner suburban to outer suburban. In terms of distance moved, the results are expected. Households moving within their geographic area did not move as far as those moving between areas. The aggregate mean and median distance moved is 6.42 and 5.78 miles respectively.

INSERT TABLE 2 APPROXIMATELY HERE

Factor Analysis

We employ principal component factor analysis, a data reduction technique, to better understand the relationships between the 24 neighborhood design characteristics. Factor analysis extracts a small number of dimensions (factors) from the larger set of intercorrelated characteristics, measuring different aspects of those characteristics. We extract ten dimensions (factors with eigenvalues greater than one) that jointly explain 81.5 percent of the variation among the characteristics. Table 3 sorts the characteristics according to size and sequential factor order; the last row displays the percent of total variation explained by each factor. The table also tests the association between immediate and surrounding grid characteristics for reasons aforementioned. Both measures fall into the same factor for each neighborhood design characteristic.

INSERT TABLE 3 APPROXIMATELY HERE

Factor 1 has high values of the following variables: residential lot size, open space, distance to downtown Minneapolis, single family home density, crime, population density, street connectivity, local roads, and number of residential lots. Race and high school graduation rate are associated strongly with factor two. The third factor reflects home ownership and the presence of children. The number of retail stores and weekday bus stops are associated strongly with factor four. The last six factors each represent a single variable: park area, non-local roads, estimated (home) market value, lake area, elementary school quality and bicycle trail length.

Cluster Analysis

The ten neighborhood dimensions serve as “reduced-form” data. The aim of k-means cluster analysis is to determine how each dimension combines to form unique neighborhood types[2]. This procedure, factor then cluster analysis has been used successfully before (Song and Knaap 2004).

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[2] In general, when one needs to classify many variables into fewer meaningful groups, factor analysis combined with cluster analysis is a valuable strategy of great utility.

Cluster analysis sorts the ten dimensions into groups in such a way that the degree of association between dimensions is maximal within groups and minimal between groups. The best "fit" for this data is an eight cluster (neighborhood type) model, based on cluster statistics and interpretability of the results[3]. The magnitude of the ten dimensions (cluster centers) in each of the eight clusters is presented in Table 4 and graphically in Figure 3.

INSERT TABLE 4 APPROXIMATELY HERE
INSERT FIGURE 3 APPROXIMATELY HERE

Differences in five of the neighborhood types are distinct. "Commercial Centers" reflect areas high in traffic, retail stores, and transit service and low in home ownership, children, and median household income. Large lots, high household income, children, less crime, and curvilinear streets describe "Low Density Home Ownership." "Urban Commercial Core" neighborhoods are few in number and located in downtown Minneapolis[4]. "Parks & Trail Residential" neighborhoods are located near parks and bicycle trails. "Lake Lots" are expensive single family homes situated in areas of curvilinear streets and low density.

Distinguishing between the final three neighborhood types, "Suburban Residential", "Mix Urban Residential", and "Family Urban Residential", requires additional interpretation. While these neighborhoods share some similarities, such as grid streets and smaller lots, the difficulty is identifying subtle differences between areas of primarily single family land use. Design characteristics that help differentiate them are elementary school quality, race, parks and trails, and residential lot size. Suburban Residential is best characterized by better quality schools and parks. Mix Urban Residential neighborhoods have poorer quality schools and a greater number of non-local roads. Family Urban Residential has the largest family size and highest percentage of the population that is black.

The spatial distribution of these neighborhood types across Hennepin County adds further context (see Figure 4). Family Urban Residential, Mix Urban Residential, and Suburban Residential neighborhoods were the first to fully develop before development spread to the outer Large Lot Residential areas. This helps explain differences in street pattern, demographics, school quality and residential lot size. The other neighborhood types are clearly specialized and fewer in number. The analysis underscores the value of local knowledge of the built environment when interpreting factor scores and more importantly, evaluating each possible cluster solution.

INSERT FIGURE 4 APPROXIMATELY HERE

Figure 4 maps current and former home locations for the 278 respondents[5]. The distribution of residences highlights a simple but important contribution of this work. A household relocating a short distance could easily move to a different neighborhood type. Similarly, long distance relocation could be to the same neighborhood type. Table 5 lists the number of respondents in

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[3] The eight cluster solution also balances spatial interpretation of the clusters.
[4] Commercial core neighborhoods are strongly associated with concentrations of retail and bus service. This may explain the unexpected values of low density and street connectivity.
[5] A few of the outlying former addresses are not shown for purposes of map clarity

each neighborhood type. Nearly 39 percent of former residences are in both the Suburban Residential and Mix Urban Residential neighborhoods compared to 45 percent of current residences in the Suburban Residential and 32.4 percent in the Mix Urban Residential neighborhoods.

INSERT TABLE 5 APPROXIMATELY HERE

Preferences for Neighborhood Types

Having assigned each address a neighborhood type, we turn to discussing the frequency of moves between neighborhood types. Over one-half of the respondents (53.6 percent) moved within the same neighborhood type. Among them, 27.4 percent moved within the Suburban Residential. Twenty-three percent moved within Mix Urban Residential and 1.4 percent within both Park and T rail Residential and Family Urban Residential neighborhoods. The largest number of moves between neighborhoods was from Mix Urban Residential to Suburban Residential.

INSERT TABLE 6 APPROXIMATELY HERE

Finally, we aim to better understand the factors—both neighborhood design and respondent characteristics—that affect neighborhood preferences. We employ a binary logistic regression (Table 7) to predict a dichotomous outcome: if the respondent moved within the same neighborhood type or not. The model includes 17 independent variables, seven that describe values of neighborhood design characteristics at the respondent's current address and six that relate respondents' characteristics. The final three variables are attitudinal questions. We code each as a dummy variable, indicating whether the respondent selected the three most common responses, among 18 choices, in choosing their current home location.

Six variables are statistically significant at the 0.05 level or greater. Each variable helps predict whether respondents move within the same type of neighborhood. Examining the odds ratio (probability of an event / probability of non-event), reveals the influence of each variable. A ratio greater than one indicates the odds of moving to the same neighborhood type are increased and vice-versa[6].

INSERT TABLE 7 APPROXIMATELY HERE

A respondent is less likely to have moved within the same neighborhood type if their current neighborhood has a greater percentage of homeowners or estimated market value, and if they moved farther from downtown Minneapolis. Each unit (one percent) increase in homeowners in the immediate and surrounding grid cells of a respondent's current neighborhood reduce the odds of moving within the same neighborhood type by a factor of 0.981. The odds also decrease for each $10,000 increase in estimated market value and with each additional mile moved from downtown, measured as the difference between current and former distance from downtown.

[6] Alternatively, if the confidence interval contains the value of one, meaning the independent variable is not related with a change in odds of the dependent for a given household, then that variable is not a helpful predictor of the binary logistic model.

Respondents who selected closeness to work/short commute time as a most important factor in choosing their new home location are 2.216 times as likely to have moved to the same neighborhood type while a biker[7] is 2.237 times as likely to make that mover. Each percentage increase of white neighbors in the current neighborhood improves the odds by 1.041.

DISCUSSION

The influence of the six significant variables is largely expected. Certain design characteristics, estimated home market value, appear to have an affect on moves between neighborhood types. Neighborhood demographics also have a role, as households in locations with a large portion of white residents have a greater chance of moving from a similar neighborhood while the opposite is true of households in locations with high home ownership rates. Bikers also desire similar neighborhood types, possibly for access to retail stores, and parks and trails. A household that stated closeness to work as the most important factor in choosing a new home location were more likely to move within the same neighborhood type, suggesting respondents seek out similar neighborhoods despite the importance of other factors (commute time).

The distance from downtown Minneapolis variable is also significant. Households that move a greater distance from downtown are more likely to change neighborhood types. While this relationship is linear, the squared distance from downtown (not included) would be nearly significant at the 90% level. The probable explanation for the near non-linear relationship is the concentration of current addresses. If a respondent formerly lived near downtown and moved an additional three miles away, they more than likely moved to a different neighborhood type. However, a respondent that lives in the Suburban Residential or Low Density Home Ownership neighborhoods could move an additional three miles and be less likely to change residence types.

These findings point towards the presence of self-selection for 53.6 percent of the sample. Respondents who are bikers or moved for a short commute, for instance, are more likely to self select the same neighborhood type. Alternatively, greater distance from downtown Minneapolis and design characteristics such as estimated market value are predictors of moves to a different neighborhood type.

The detailed analyses demonstrated the basic survey and relocation results alone would have falsely addressed the self-selection issue. Sixty-six percent of respondents moved within their geographic area. While this finding is similar to the percentage of respondents who moved within their neighborhood type (53.6 percent), the result can be deceiving. Assuming all moves within an urban area are to locations with similar design characteristics (e.g. higher density, mixed-use) would be a poor conclusion. Moves within geographic areas could be to neighborhoods with obvious design differences. In fact, at least five different neighborhood types comprise each geographic area in Hennepin County. Together, these findings have important policy implications.

POLICY IMPLICATIONS AND CONCLUSIONS

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[7] Defined as walking at least once per week for recreation or maintenance activities. This information was gleaned from the survey.

This work examines residential relocation decisions and neighborhood preferences for a sample population in Hennepin County, Minnesota. Based on the neighborhood taxonomy created, 53.6 percent of respondents moved within their neighborhood type. The taxonomy reflects the situation in many urban areas: a few unique neighborhoods dominated by a monoculture lacking defining design characteristics. The odds of making this move improve among bikers, respondents choosing their location for a shorter commute time, and those who share their neighborhood with a larger percentage white population.

One can draw three primary conclusions from the analysis. First, factor then cluster analysis is a useful method to reduce numerous design characteristics into far fewer distinct neighborhood types. Second, both neighborhood design and respondent characteristics can be determinants of moves within and between neighborhoods. Third, self-selection is common among the sample, suggesting an important policy implication. If households self-select similar neighborhoods, policies intended to alter neighborhood design and influence moves, particularly intra-county moves, might find little success.

The results have further implications. For instance, preferences for residential neighborhoods may temper the ability of neighborhood design to moderate travel demand. Success in moderating travel requires high density, mixed use neighborhoods, common only in the two smallest (in terms of area) neighborhood types. While the analysis cannot fully identify why respondents moved, preferences suggest high density, mixed use neighborhoods remain desirable to only a few individuals. Coupling these design characteristics with, for example, quality elementary schools might eventually increase their desirability to a larger population and presence in other neighborhood types. Subsequently, their importance in residential relocation would increase, advancing the possibility of slowly introducing other design characteristics capable of travel demand including traffic calming, narrow roads, and sidewalks.

Common with any residential location study, our analysis highlights the difficulty in understanding the factors that explain these decisions. We believe a quasi-pre-test/post-test methodology is an appropriate way to study moves within neighborhoods. GIS is a relatively expedient way to join information, pending access to an array of neighborhood data. We use spatial information that overlaps respondent moving decisions well, strengthening the internal validity of the conclusions.

Our study is prone to the same problems as other research on this topic; the complex interaction of household preferences, neighborhood design, and residential relocation. In addition, lifestyle and lifecycle changes are difficult to track, although this may be less important for intra-county moves. Future studies can refine survey instruments to better capture longitudinal changes in lifestyle, lifecycle, and preference. Our results may have a slight bias due to survey administration near major off-street bicycle facilities. Future studies can more carefully blanket a range of geographic areas. Our definition of neighborhood is consistent with some literature, but future studies could compare results between neighborhoods of various size. Future work can also strive to better uncover variations in the design characteristics of single family residential areas that complicate spatial analysis.

Identifying extreme changes in neighborhood types between high and low density moves is relatively straightforward. The challenge lies in detecting more subtle differences in neighborhood type and in better understanding preferences for each neighborhood's design characteristics. Satisfying this task will help identify populations that prefer certain types of neighborhood designs, assisting planners and policy-makers in making better-informed decisions concerning the market of households likely to move to areas with differing land use-transportation characteristics.

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TABLE 1: Summary of Variable Measures

Variable	Unit of Measure for Each Grid Cell	Mean	Std. dev.	Min.	Max.
Bicycle trail length	Sum of length (feet)	53.55	145.65	0.00	1679.13
Retail stores	Count	0.33	2.56	0.00	148.00
No. of residential lots	Count	22.97	29.96	0.00	194.00
Residential lot size	Average size of residential lots (acres)	12.07	24.85	0.00	195.24
Weekday bus service	Sum of weekday bus trips (count)	19.77	122.04	0.00	5400.00
Grade 5 school quality	Minnesota standardized test scores	4847.52	264.73	3791.00	5245.80
Average Annual Daily Traffic (AADT)	Sum of all road traffic	15311.36	39592.96	0.00	601523.00
Average Annual Daily Traffic (AADT)	Average of road traffic	4040.03	10633.49	0.00	132000.00
Road length	Sum of all road length (miles)	506.36	500.72	0.00	2679.63
No. of 4-way intersections	Count	0.58	1.29	0.00	12.00
Water area	Area (acres)	1.23	3.87	0.00	22.24
Park area	Area (acres)	1.84	4.36	0.00	22.24
Violent Crime	Count	1456.52	1790.32	0.00	7665.00
Distance to downtown Minneapolis	Network distance (miles)	23.45	10.84	0.00	45.65
Population density	Area weighted average of census tract	2051.17	2521.36	81.64	61633.69
Percent black	Area weighted average of census tract	3.35	7.08	0.15	66.80
Percent white	Area weighted average of census tract	90.69	11.76	8.27	97.96
Median household income	Area weighted average of census tract	69872.50	18519.89	124.14	113850.00
Percent own housing unit	Area weighted average of census tract	81.20	18.38	0.19	99.62
Percent with kids less than 18	Area weighted average of census tract	39.25	11.46	0.08	69.31
Household size	Area weighted average of census tract	2.69	0.40	0.01	3.79
Percent high school graduates	Area weighted average of census tract	93.48	5.13	51.10	99.40

TABLE 2: Distribution of Respondent Moves Between Geographic Areas

		Former Residence								
		Urban			Inner Suburban			Outer Suburban		
	Geographic Area	Distance moved (miles)	%[a]	n	Distance moved (miles)	%[a]	n	Distance moved (miles)	%[a]	n
Current Residence	Urban	1.6	89	99	5.0	7.2	8	12.5	3.6	4
	Inner Suburban	6.0	41	33	3.4	49	39	7.7	10	8
	Outer Suburban	13.2	20	17	9.7	28	24	3.9	53	46

a Row percentage, to read % of respondents who moved from current to former location

TABLE 3: Factor Analysis Defining Neighborhood Dimensions

		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9	Factor 10
Variable[a]		Street Design & Land Use	Race	Household Structure	Retail & Transit	Parks	Non-local Roads	Estimated Market Value	Water	School Quality	Bicycle Trails
Residential lot size	IN	**-0.678**	0.109	0.324	-0.007	-0.179	0.400	-0.086	-0.170	-0.135	-0.187
	SN	**-0.682**	0.111	0.328	-0.007	-0.182	0.400	-0.087	-0.171	-0.134	-0.188
Open space	IN	**-0.626**	0.099	0.267	-0.045	-0.380	0.313	0.047	-0.294	-0.120	-0.100
	SN	**-0.666**	0.114	0.308	-0.043	-0.369	0.328	0.029	-0.267	-0.112	-0.126
Dist. to downtown Minneapolis	IN	**-0.654**	0.306	0.406	-0.086	-0.147	0.340	-0.061	0.048	0.116	-0.112
	SN	**-0.655**	0.307	0.406	-0.085	-0.149	0.338	-0.061	0.048	0.116	-0.112
SFDU density	IN	**0.440**	-0.037	-0.062	-0.002	-0.167	0.232	-0.101	0.062	-0.099	0.111
	SN	**0.690**	-0.096	-0.105	0.000	-0.146	0.191	-0.140	0.035	-0.139	0.062
Violent crime	IN	**0.571**	-0.395	-0.237	0.091	0.219	-0.127	-0.039	-0.058	-0.274	0.117
	SN	**0.577**	-0.394	-0.243	0.093	0.220	-0.127	-0.040	-0.058	-0.277	0.118
Population density	IN	**0.606**	-0.485	-0.302	0.186	0.019	-0.044	-0.016	0.005	-0.152	0.053
	SN	**0.624**	-0.495	-0.316	0.195	0.028	-0.059	-0.017	0.006	-0.167	0.058
Street connectivity	IN	**0.609**	-0.229	-0.159	0.183	-0.085	0.046	-0.053	-0.134	-0.104	-0.047
	SN	**0.727**	-0.336	-0.252	0.193	-0.051	-0.014	-0.087	-0.095	-0.190	-0.040
Local roads	IN	**0.810**	-0.163	-0.148	0.097	-0.074	-0.008	-0.091	-0.156	0.046	0.002
	SN	**0.868**	-0.217	-0.213	0.104	-0.025	-0.092	-0.114	-0.079	-0.023	0.040
Number of residential lots	IN	**0.872**	-0.064	-0.024	-0.037	-0.063	0.136	-0.113	-0.087	-0.023	-0.066
	SN	**0.918**	-0.096	-0.058	-0.021	-0.010	0.073	-0.133	-0.038	-0.087	-0.017
Percent black	IN	0.254	**-0.913**	-0.040	0.105	0.030	-0.110	-0.015	-0.016	-0.015	0.030
	SN	0.271	**-0.910**	-0.050	0.117	0.033	-0.115	-0.018	-0.017	-0.037	0.031
Percent high school graduates	IN	-0.076	**0.841**	0.146	-0.054	0.079	-0.041	0.200	0.015	0.216	0.134
	SN	-0.089	**0.842**	0.146	-0.067	0.079	-0.038	0.201	0.017	0.242	0.138
Percent white	IN	-0.303	**0.905**	0.089	-0.094	-0.051	0.141	0.057	0.029	0.067	-0.067
	SN	-0.320	**0.896**	0.101	-0.103	-0.054	0.148	0.060	0.030	0.088	-0.068
Median household income	IN	-0.164	0.544	**0.639**	-0.066	0.052	-0.022	0.336	0.002	0.221	0.086
	SN	-0.181	0.546	**0.632**	-0.072	0.049	-0.015	0.333	0.002	0.234	0.089
Percent own housing unit	IN	-0.094	0.477	**0.757**	-0.165	-0.002	0.092	0.014	-0.011	-0.089	-0.109
	SN	-0.118	0.479	**0.761**	-0.174	-0.007	0.103	0.008	-0.013	-0.081	-0.109
Household size	IN	-0.321	-0.030	**0.894**	-0.115	-0.067	0.146	0.014	-0.058	-0.003	-0.046
	SN	-0.346	-0.021	**0.888**	-0.120	-0.075	0.153	0.007	-0.063	-0.010	-0.046
Percent with kids less than 18	IN	-0.297	0.026	**0.913**	-0.114	-0.043	0.108	0.003	-0.037	0.055	0.025
	SN	-0.314	0.038	**0.905**	-0.116	-0.048	0.114	-0.002	-0.041	0.050	0.027
Retail stores	IN	0.026	-0.001	-0.057	**0.687**	-0.014	-0.105	-0.087	0.021	0.064	-0.001
	SN	0.075	-0.069	-0.197	**0.776**	-0.030	-0.140	-0.047	-0.020	0.013	0.017
Weekday bus service	IN	0.105	-0.166	-0.095	**0.807**	0.006	0.018	0.037	-0.025	-0.110	-0.010
	SN	0.148	-0.265	-0.173	**0.792**	-0.002	-0.002	0.055	-0.036	-0.165	-0.004
Park area	IN	-0.062	-0.003	-0.049	-0.025	**0.871**	0.102	-0.021	0.015	-0.043	0.131
	SN	-0.011	0.008	-0.049	-0.028	**0.891**	0.065	-0.025	0.080	-0.023	0.111
Non-local roads	IN	-0.047	-0.090	-0.149	0.102	-0.122	**-0.703**	-0.076	-0.060	-0.105	0.057
	SN	0.017	-0.194	-0.271	0.155	-0.102	**-0.702**	-0.092	-0.078	-0.050	0.065
Estimated market value	IN	-0.217	0.217	0.054	-0.037	-0.036	0.075	**0.894**	0.160	0.092	-0.049
	SN	-0.223	0.223	0.055	-0.037	-0.038	0.080	**0.890**	0.161	0.106	-0.052
Lake area	IN	-0.073	0.026	-0.048	-0.020	0.023	0.044	0.086	**0.914**	-0.006	-0.006
	SN	-0.069	0.050	-0.077	-0.024	0.085	0.062	0.169	**0.890**	0.031	-0.009
Grade 3 school quality	IN	-0.238	0.443	0.017	-0.096	-0.041	0.096	0.142	0.020	**0.781**	0.007
	SN	-0.248	0.460	0.020	-0.100	-0.042	0.095	0.151	0.023	**0.774**	0.008
Bicycle trail length	IN	0.057	0.017	-0.038	-0.001	0.097	-0.025	-0.025	-0.022	-0.028	**0.874**
	SN	0.149	0.027	-0.032	0.000	0.155	-0.109	-0.045	0.013	0.036	**0.849**
Percent of Variance Explained		**38.2**	**10.5**	**7.9**	**5.6**	**4.4**	**4.4**	**3.4**	**2.6**	**2.4**	**2.2**

a: Variables tested at two levels: 1) IN - Immediate neighborhood (individual cell) & 2) SN - surrounding neighborhood (adjacent cells)

TABLE 4: Final Cluster Center Values for Each Neighborhood Type

Neighborhood Dimension	Commercial Center	Surburban Residential	Mix Urban Residential	Family Urban Residential	Lake Lots	Urban Commercial Core	Park & Trail Residential	Large Lot Residential
Street Design & Land Use	-0.147	0.477	1.409	0.659	-0.234	-0.941	0.251	-0.814
Race	-0.363	0.161	-0.182	-5.070	0.146	0.654	0.155	0.146
Household Structure	-1.272	-0.281	-0.948	0.684	-0.141	0.170	0.189	0.394
Retail & Transit	6.176	-0.122	0.148	0.189	-0.060	27.766	-0.051	-0.044
Parks	-0.154	0.363	-0.023	-0.104	-0.121	1.147	0.254	-0.391
Non-local Roads	-1.129	-0.480	0.282	-0.253	0.177	0.798	-0.140	0.440
Estimated Market Value	-0.261	-0.229	0.081	0.380	0.416	0.069	-0.157	0.153
Water	-0.072	-0.145	-0.149	-0.004	3.150	0.457	-0.092	-0.384
School Quality	-0.072	0.452	-1.995	0.237	0.169	0.363	0.347	-0.181
Bicycle Trails	-0.018	-0.427	0.013	-0.091	-0.225	-0.621	2.091	-0.246
Grid cell count (N=16424)	91	5626	1218	395	1106	11	1986	5991
Percent of total grid cells	0.55%	34.25%	7.42%	2.41%	6.73%	0.07%	12.09%	36.48%

TABLE 5: Number of Respondent Residences in Each Neighborhood Type

	Former Residence		Current Residence	
Neighborhood Type	n	%	n	%
Commercial Center	16	5.8	3	1.1
Surburban Residential	110	39.6	126	45.3
Mix Urban Residential	111	39.9	90	32.4
Family Urban Residential	17	6.1	19	6.8
Lake Lots	3	1.1	1	0.4
Urban Core	0	0.0	0	0.0
Park & Trail Residential	20	7.2	36	12.9
Large Lot Residential	1	0.4	3	1.1

TABLE 6: Moves to and from Neighborhood Types

Move Direction (Former to Current)	N[a] (%)
Suburban Residential to Suburban Residential	76 (27.4)
Mix Urban Residential to Mix Urban Residential	65 (23.4)
Mix Urban Residential to Suburban Residential	27 (9.7)
Suburban Residential to Park & Trail Residential	24 (8.6)
Park & Trail Residential to Suburban Residential	11 (3.6)
Commercial Center to Mix Urban Residential	9 (3.2)
Mix Urban Residential to Family Urban Residential	9 (3.2)
Mix Urban Residential to Park & Trail Residential	8 (2.9)
Suburban Residential to Mix Urban Residential	7 (2.5)
Family Urban Residential to Mix Urban Residential	7 (2.5)
Family Urban Residential to Suburban Residential	5 (1.8
Park & Trail Residential to Park & Trail Residential	4 (1.4)
Family Urban Residential to Family Urban Residential	4 (1.4)
Commercial Center to Suburban Residential	4 (1.4)
Commercial Center to Family Urban Residential	3 (1.1)
Lake Lots to Suburban Residential	2 (0.7)
Park & Trail Residential to Family Urban Residential	2 (0.7)
Park & Trail Residential to Large Lot Residential	2 (0.7)
Mix Urban Residential to Commercial Center	2 (0.7)
Suburban Residential to Family Urban Residential	1 (0.4)
Suburban Residential to Lake Lots	1 (0.4)
Suburban Residential to Large Lot Residential	1 (0.4)
Family Urban Residential to Commercial Center	1 (0.4)
Lake Lots to Mix Urban Residential	1 (0.4)
Park & Trail Residential to Mix Urban Residential	1 (0.4)
Large Lot Residential to Suburban Residential	1 (0.4)

a Combinations with zero moves not reported

TABLE 7: Logistic Regression Predicting Moves Within Neighborhood Types

Variable	Beta	Odds Ratio	p-value	95.0% C.I.for Odds Ratio Lower	95.0% C.I.for Odds Ratio Upper
Current Neighborhood Characteristics					
Residential lot size	-0.031	0.970	0.859	0.690	1.362
Percent white	0.040	**1.041**	0.003	1.014	1.069
Percent own housing unit	-0.019	**0.981**	0.038	0.963	0.999
Retail stores	-0.147	0.863	0.178	0.696	1.070
Lake area	0.467	1.595	0.068	0.966	2.635
Estimated Market Value (per $10,000)	-0.022	**0.978**	0.022	0.960	0.997
Grade 3 school quality	-0.001	0.999	0.676	0.996	1.002
Respondent Characteristics					
Age	-0.014	0.986	0.227	0.964	1.009
Have kids at home	0.252	1.287	0.476	0.643	2.576
Owned at former address	0.391	1.478	0.295	0.712	3.068
Walker	0.050	1.051	0.875	0.562	1.967
Biker	0.805	**2.237**	0.016	1.159	4.317
Distance moved from downtown	-0.189	**0.827**	0.000	0.763	0.898
Most Important Factors in Choosing New Home Location (Attitude)					
Closeness to work, short commute time	0.796	**2.216**	0.039	1.040	4.722
Cost of housing	-0.497	0.608	0.127	0.321	1.153
Quality of home and others around it	0.031	1.032	0.926	0.534	1.992
Constant	1.668	5.304	0.683		
Nagelkerke R-squared	0.273				
N:	278				

FIGURE 1 Relationship between Tenure Length and the Inclination to Move

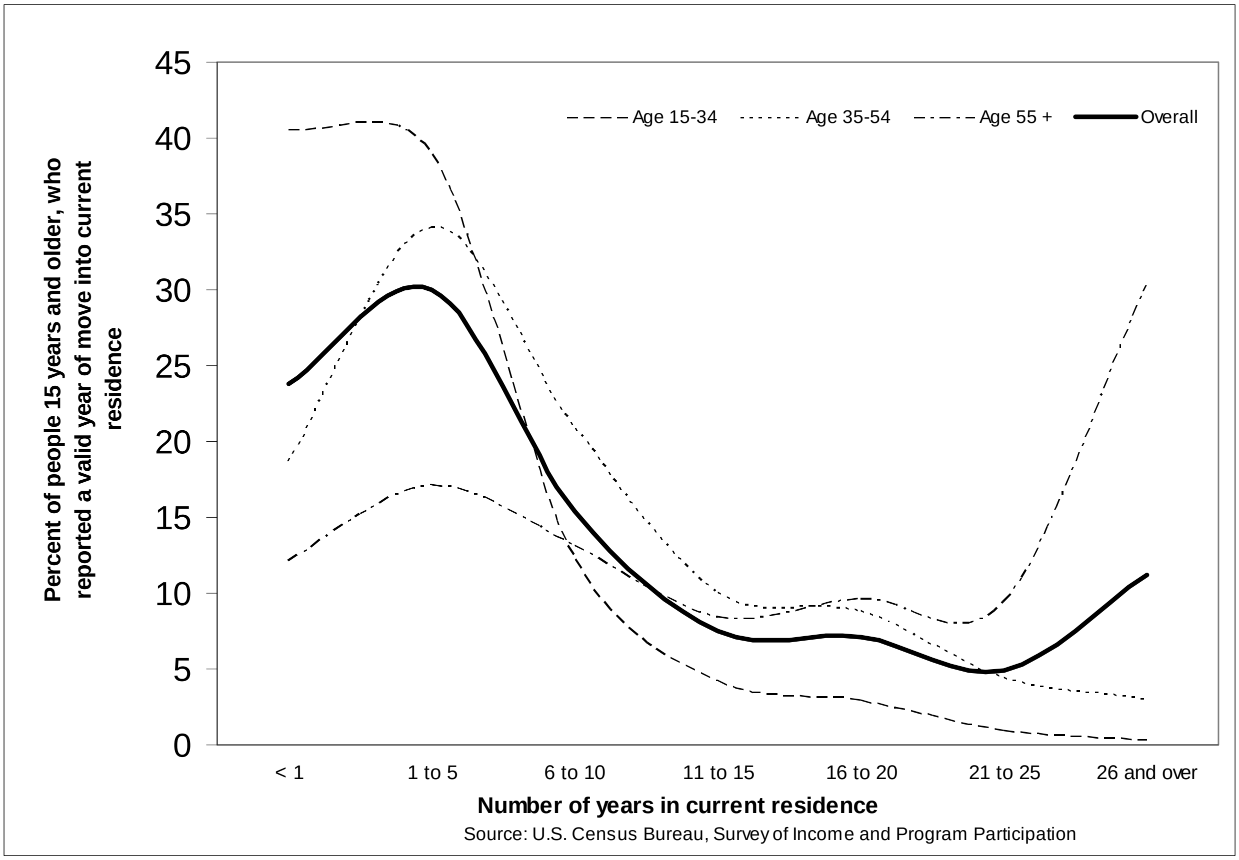

FIGURE 2 Respondent Location and Geographic Areas

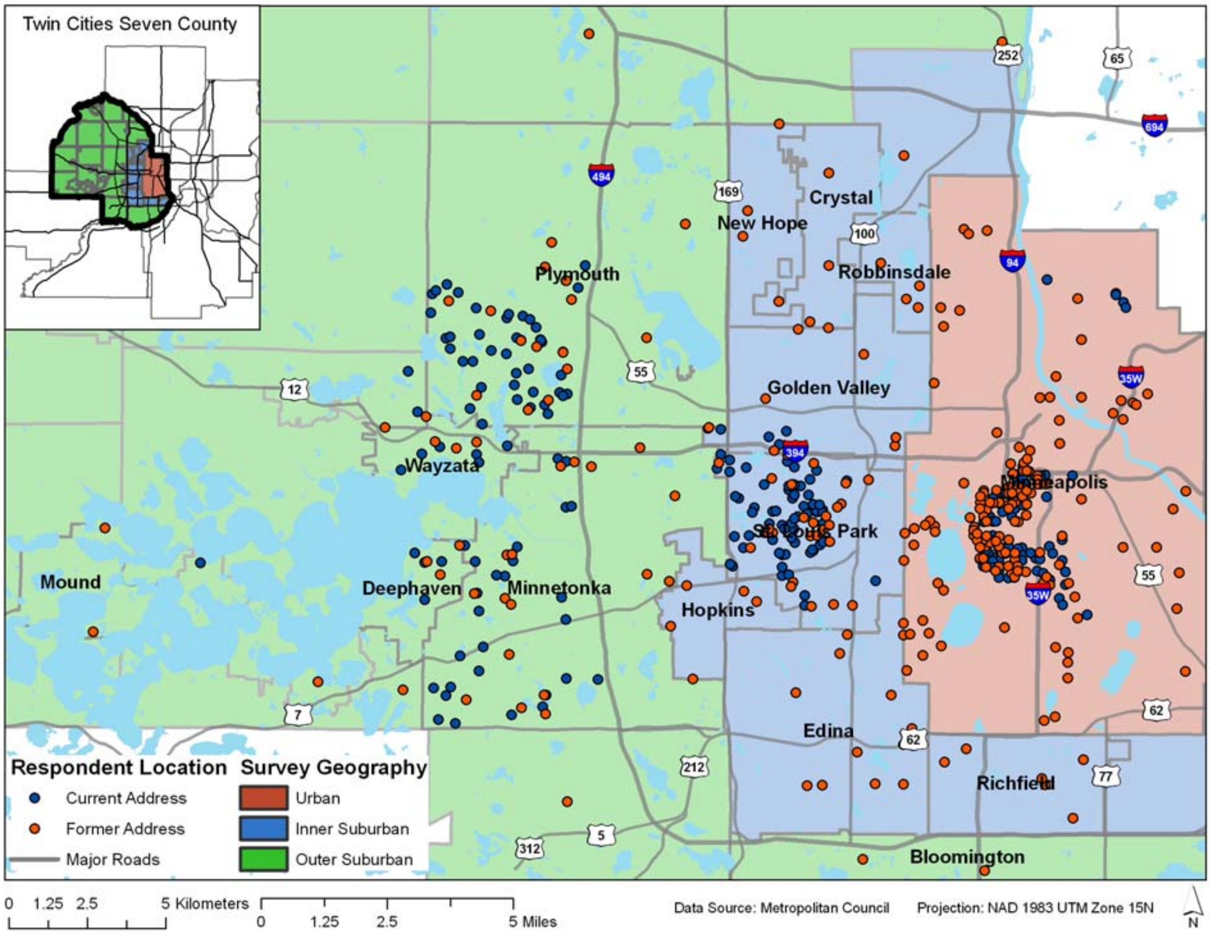

FIGURE 3 Final Cluster Center Values for Each Neighborhood Type

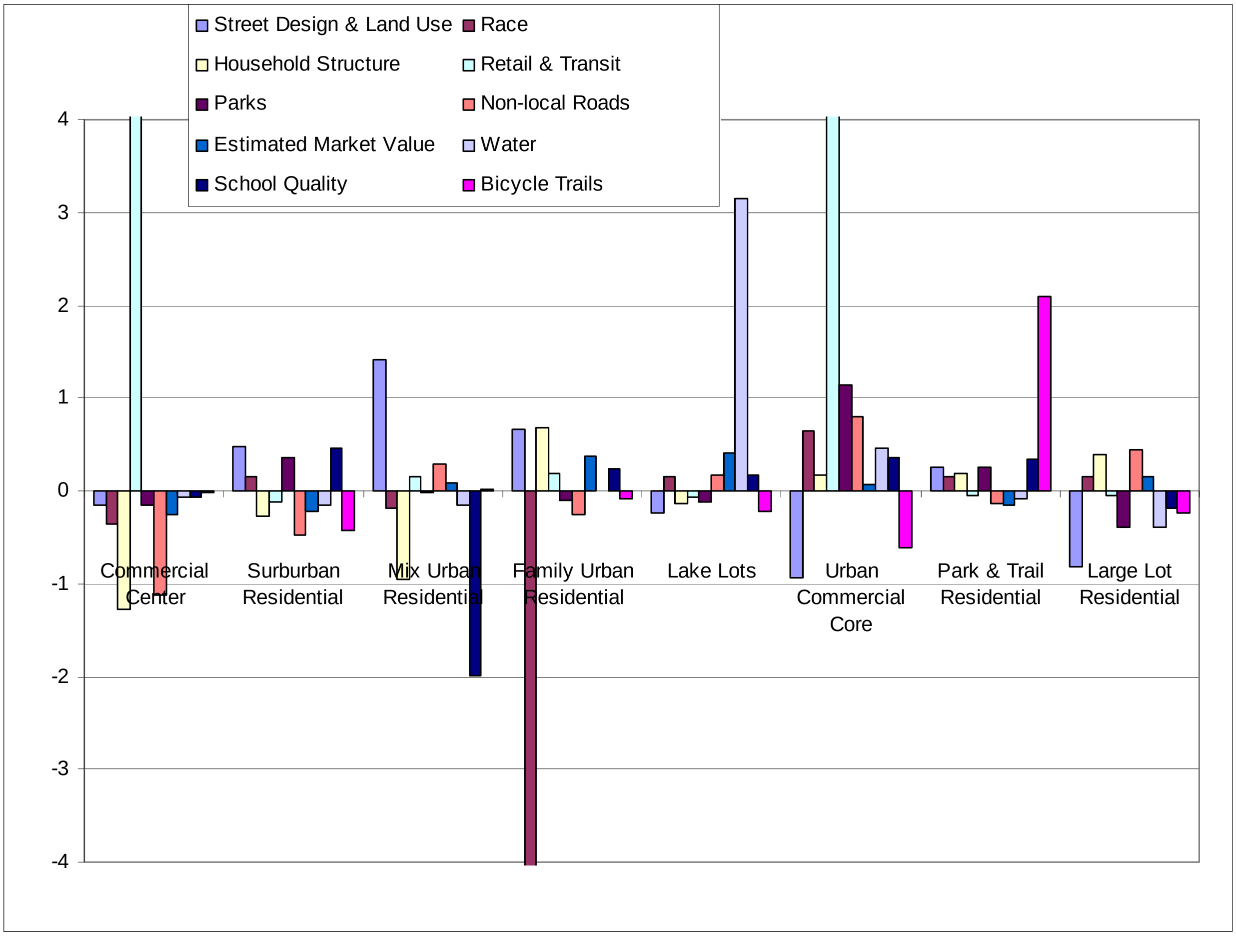

FIGURE 4 Hennepin County, MN Neighborhood Types and Respondent Locations