The Value of Trail Access on Home Purchases

Paul Mogush [1]
Kevin J. Krizek [2 *]
David Levinson [3]

[1] Urban and Regional Planning Program
Active Communities Transportation (ACT) Research Group
Humphrey Institute of Public Affairs
University of Minnesota

[2] Assistant Professor, Urban and Regional Planning
Director, Active Communities Transportation (ACT) Research Group
University of Minnesota
301 19th Ave S., Minneapolis, MN 55455
Phone: 612-625-7318
Fax: 612-625-3513
kjkrizek@umn.edu

[3] Department of Civil Engineering
University of Minnesota
500 Pillsbury Drive SE
Minneapolis, MN 55455
Phone: 612 625 6354
Fax: 612 626 7750
levin031@umn.edu

[*] corresponding author

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Abstract
We use hedonic analysis of home sales data from the Twin Cities Metropolitan Area to estimate the effects of access of different types of trails on home value. Our model includes proximity to three distinct types bicycle facilities, controlling for local fixed effects and open space characteristics. Using interaction terms detect different preferences between city and suburban homebuyers. Regression results show that off-street bicycle trails situated alongside busy streets are negatively associated with home sale prices in both the city and suburbs. Proximity to off-street bicycle trails away from trafficked streets in the city are positively associated with home sale prices, with no significant result in the suburbs. On-street bicycle lanes have no effect in the city and are a disamenity in the suburbs.

The following policy issues are relevant from this research. First, type of trail matters. On-street trails and road-side trails may not be as appreciated as many city planners or policy officials think. Second, city residents have different preferences than suburban residents. Third and as suspected, larger and more pressing factors likely influencing residential location decisions. The finding also suggest that urban planners and advocates need to be aware of the consequences of providing for bicycle facilities, as the change in welfare is not necessarily positive for all homeowners.

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Introduction

Concerns about "sprawling" land use practices and auto-reliant development patterns are increasingly apparent in communities nationwide. In response, many cities—through public dialogues, community initiatives, and other land use-transportation policies—are relying on myriad strategies to increase the "livability" of their communities. While "livability" is a relatively ambiguous term, there is emerging consensus on the following: the ease by which residents can travel by pedestrian or bicycle represents a critical component of this goal. Communities well endowed with non-motorized infrastructure, either in the form of sidewalks, bicycle paths, or compact and mixed land uses are increasingly acknowledged to be more livable than those without. This is an often relied-upon argument used by policy officials or groups advocating bicycle paths or sidewalks.

If livability is a cherished commodity among residents, and one important component of livability includes bicycle paths, then the following would hold true. Proximity to bicycle paths would be capitalized into the value of home purchases. Documenting this relationship would go a long way for advocates of bicycle facilities who often seek ways to economize these facilities. Such an endeavor would be especially beneficial since bicycle facilities are non-market goods, making it difficult to attach an economic value to them.

Social or economic benefits can be measured either through stated preferences, in which users are asked to attach a value to non-market goods, or through revealed preferences. The revealed preference approach measures individuals' actual behavior. In this study, we measure homebuyers' revealed preferences in the form of hedonic modeling to learn if and how much residents value proximity to bicycle paths, and subsequently one dimension of livability. The first part of this paper reviews previous literature on hedonic modeling focusing primarily on the dimension of open space and trails. It also motives the need for this research. The second part describes the setting for this work, our data, descriptive statistics, and methodological approach. Part three describes the results of a hedonic regression model and part four summarizes the lessons for policy and relevant conclusions.

Review of Relevant Literature and Concepts

Discerning the relative value of non-market goods using hedonic modeling techniques is a method that has been employed for years, ever since first applications by Lancaster [1] and Rosen [2]. An extensive review of this literature [3] documents nearly 200 applications that have examined home purchases to estimate values of several home attributes including structural features (e.g., lot size, a home's finished square feet, and number of bedrooms), internal and external features (e.g., fireplaces, air conditioning, garage spaces, and porches), the natural environment features (e.g., scenic views), attributes of the neighborhood and location (e.g., crime, golf courses, and trees), public services (e.g., school and infrastructure quality), marketing, and financing. The common theme in such studies is that most employ a combination of structural, internal, and external features as control variables to focusing on a specific phenomenon.

As the literature describes various methods to assign value to housing characteristics, there exist opportunities to increase the explanatory power of hedonic models. Recent contributions include accessibility, perceived school quality, and open space measures. For example, Franklin and Waddell [4] used a hedonic model to predict home prices in King County, Washington as a function of accessibility to four types of activities. In assessing the relationship between public school quality and housing prices, Brasington [5] found that proficiency tests, per-pupil spending, and student/teacher ratios most consistently capitalize into the housing market.

Our application here focuses on the relative impact of bicycle lanes and trails. To the casual observer, bicycle lanes and trails may be considered as a single facility where any type of bicycle trail would have the same attraction. More careful thinking, however, suggests otherwise, especially for different types of trails. Consider, for example, the three different types of trails/lanes shown in Figure 1. Some trails are on existing streets (demarcated by paint striping, hereafter "on-street lanes"); some trails are adjacent to existing roadways (hereafter "road-side trails") but are separated by curbs or mild landscaping (these facilities are sometimes referred to as "black sidewalks" because they are nothing more than blacktop in the usual location of sidewalks); other trails are clearly separated from traffic and often within open spaces (hereafter "non road-side trails"). For the latter category, it is important to explain and control for the degree to which open space versus the bike trail contained within the open space contribute to a home's value. This is because in many metropolitan areas, bike trails and open space often share a spatial location and at minimum exhibit similar recreational qualities. In the case of on-street lanes or road-side trails, these facilities are often on or near roads. In some cases they will be on well used collector streets or trunk highways; in other cases they may be on neighborhood arterial streets. Home buyers tend to disvalue proximity to busy roadways. Much of the attraction of these facilities therefore depends on the design speed of the roadway facility and/or the average annual daily traffic. Any research failing to account and control for any of these factors is misguided in its estimate of the independent value of bicycle trails.

It is therefore important to consider and understand relevant literature estimating the value of open space. For example, Quang Do [6] found that homes abutting golf courses sell for a 7.6 percent premium over others. Geoghegan [7] compared the price effects of the amount of permanent and developable open space within a one-mile radius. Similarly, Irwin and Bockstael [8] used a quarter-mile radius, dividing open space into three categories. Other studies seek to attach values to views of open space. Benson, et al [9] created a series of dummy variables for four different qualities of ocean views, as well as lake and mountain views. Luttik [10] combined the vicinity and view approaches, dividing the geography into three levels of proximity. Anderson and West's work [11] is particularly helpful for this specific application. They modeled both proximity and size of six specific open space categories, comparing effects on home prices between the city and suburb. They found that proximity to golf courses, large parks, and lakes has a positive effect on home prices in the city, with no significant results in the suburbs. The effects of open space on home prices also increased with the size of the open space. Proximity to small parks and cemeteries tended to reduce sale prices. To our knowledge, only one application focuses on proximity to bicycle trails. Lindsey [12] performed a hedonic analysis of 9,348 home sales, identifying properties as falling inside or outside a half-mile buffer around fourteen greenways in Marion County, Indiana. This research found that some greenways have a positive, significant effect on property values while others have no significant effect.

Given the novelty of the application presented herein, specific theory is derived from a combination of sources, including existing published work (described in part above), foundations of consumer theory, and anecdotal evidence. Our first underpinning is that open spaces—and bicycle facilities—may be perceived and valued differently, depending on whether they are located in the city or suburbs. This theory was primarily motivated by Anderson and West's application [11], which found that urban residents value parks more than suburban residents. Unlike other attributes which tend to be more universally valued (e.g., home size, number of bathrooms, views), we hypothesize that trails are appreciated by a subset of the population (e.g., those who are likely to use them more often). Simply put, this population is comprised of those more likely to walk or cycle which. This in turn suggests that households who choose to live in the city are more likely to walk or bike (see, for example [13, 14]) and therefore more likely to value bicycle facilities. Because we specify three different types of facilities with two populations who likely value such facilities differentially, we present Figure 1 displaying the nature of our hypothesized relationships.

Setting and Data

Our investigation is based in the Twin Cities (Minnesota) Metropolitan Area which proves to be an almost ideal laboratory for a variety of reasons. First, the Twin Cities boasts an almost unparalleled system of off-street bike paths for any major metropolitan area in the U.S., totaling over 2,700 kilometers (1,692 miles). While not nearly as extensive, striped on-street bike lanes are common as well. The network of on- and off-street trails is accessible to most Twin Citians, with 90 percent of homes within 1,600 meters (one mile) of an off-street trail. In fact, in many communities within the metropolitan area, over 90 percent of the homes have some form of trail within 400 meters (one-quarter mile).

Second, several municipalities and county governments pursue active roles in the construction and maintenance of these facilities. The Grand Rounds Parkway in Minneapolis, considered by many to be the crown jewel of parks and recreational trails in Minnesota, consists of 43 miles of off-street paved trails along the city's chain of lakes, the Mississippi River, and Minnehaha Creek. Hennepin County, which includes the city of Minneapolis and many of its suburbs, works in cooperation with the Three Rivers Park District to build and maintain the largest network of off-street trails in the metro area [15]. Many off-street trails in Hennepin and other counties are located on former railroad rights-of-way for the dual purposes of recreation and preservation of the land for future transit corridors. Other off-street trails in the Twin Cities follow arterial and collector streets. The cities of Chanhassen, Eden Prairie, and Plymouth have extensive networks of these roadside trails, with somewhat smaller networks in Maple Grove, Roseville, Eagan, and Apple Valley (Figure 2). Roseville is the only inner-ring suburb with a substantial network of off-street trails. Third, Twin Citians comprise a population who appears to cherish such trails, particularly in the summer months. For example, Minneapolis ranks among the top in the percentage of workers commuting by bicycle [16].

Consistent with the prevailing literature, the hedonic model assumes a competitive market in which homebuyers are seeking a set of home attributes that can be tied to a location [11]. Locations are defined by structural attributes (*S*) (including internal and external attributes), neighborhood characteristics (*N*), location and accessibility (*L*), and environmental amenities (*A*). We build the equilibrium hedonic price function on these assumptions, where the market price of a home (P_h) depends on the quantities of its various attributes:

$$P_h = P(S, N, L, A)$$

The Regional Multiple Listing Services of Minnesota, Inc. (RMLS) maintains home sale data from major real estate brokers in Minnesota. This database includes all home sales in Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, and Washington Counties in 2001, totaling 42,750 home sale purchases, including structural attributes of each home. Geocoding and removing records with missing or unreasonable data (e.g., homes with zero bathrooms, zero square feet, or built before 1800) reduced our sample to 35,002. The relatively small number of records removed still provided an even distribution of home sales across the metro area. The address of each home was then mapped and married with GIS features for the spatial analysis using ArcMap.

Table 1 lists each variable and its definition, with descriptive statistics separated by city and suburb in Table 2. We measure location attributes through simple calculations of linear distance to the nearest central business district (either Minneapolis or St.Paul) (*Cbdnear*), the nearest major highway (*Hwynear*), and the nearest arterial street (*Busyroad)*. Because homebuyers in polycentric metropolitan areas may base location decisions based on a variety of destinations other than the CBD, we measure accessibility to employment for each home at both the regional and neighborhood level. The measure of regional accesibility, *Emp_f24* uses an approach with the aim of deriving a measure of activity concentrations that have drawing power from various centers of metropolitan regions, accounting for distance. Opportunities were measured using total employment in a transportation analysis zone (TAZ). Of the many ways to account for travel impedance, we chose the most common approach, which specifies an exponential function f(impedance)=$\exp^{-\beta * t_{ij}}$ and is specific for each TAZ. Neighborhood accessibility, *cut100_8,* measures a select set of retail activity within one-half mile of one's home, aiming to capture types of services to which individuals might value close proximity. This comprised a number of establishment types (selected based on codes used by the North American Industrial Classification System, the NAICS) that included general merchandise stores, grocery stores, food and drinking establishments, miscellaneous retail and the sort. In such a measure, it is important to capture the diversity of different types of retail establishments while controlling for the potential disproportionate drawing power of larger establishments (e.g., a large clothing store offers high employment but little diversity). We therefore set an upper limit of businesses containing more than 100 and tallied the number of employees for each area. The final measure is the number of employees within the "neighborhood retail" subset within 800 meters of each home location.

Other neighborhood attributes include school district and demographic variables. Standardized test scores capitalize into home sale prices and are an effective measure of perceived school quality [5]. *Mca5_att* represents the sum of the average math and reading scores achieved by fifth grade students taking the Minnesota Comprehensive Assessment. Scores associated with suburban homes are measured at the school district level, while Minneapolis and St. Paul scores are assigned to elementary school attendance areas. Demographic variables are derived from the 2000 United States Census. We include the density of households in each home's block group (*Hh_dens)*, the percentage of people in the census tract who do not classify themselves as Caucasian (*Pctnonwt),* and the average number of people in each household in the census tract (*Avghhsize)*.

Measures of Interest and Methodology

Measures of Distance to Bicycle Facility

The measures of interest in this specific research center on bicycle facilities and to a certain extent, open space. The facilities and trails this setting are shown in Figure 2. Detailed GIS data allowed us to discern all bike trails in the region, separately identifying on- and off-street facilities. Such trails include a combination of on and off-street facilities which are distributed across both major open space corridors (e.g., railway lines, rivers, and lakes) and other roadways. We marry the MLS data for every home sale in the seven county study area from 2001 with the spatial attributes of these trails.

Some on-street and off-street trails are located alongside busy trafficked streets, which is presumably propelling characteristic for home locations. We therefore disaggregated the off-street layer into roadside and non-roadside trails based on proximity to busy streets. We then calculated airline distance to the nearest roadside trail, non-roadside trail, and on-street bicycle lane for each home. We calculated distance to open space measures as well, classifying areas as active or passive. Active open spaces are primarily used for recreation, and are comprised of neighborhood parks and some regional parks. Passive open spaces are less accessible on foot. They include areas such as golf courses, cemeteries, and large regional parks that are accessible only through designated entrance points and often only by car. Our hypothesis is that active and passive open spaces create different externalities that will result in different location choices by homebuyers.

Measures of Density of Bicycle Facilities

Motivated by Anderson and West's [11] findings that proximity and size of open space matters, we also theorized it to be important to consider not only the distance to facilities but also the density of trails around a particular home. The overall density (length) of different facilities within a buffer area may also be appreciated by home buyers. They might value a well-connected system of trails, which are prevalent in many areas throughout the Twin Cities metropolitan area. We therefore calculated the kilometer of trails within buffer distance. See for example, Figure 3 showing an example home in Minneapolis and how we measured open space and density of bicycle facilities by differing by radii of 10, 20, 50, 100, 200, 400, 800, and 1600 meters.

Interaction terms

Many of the structural attributes used in this application tend to be universally valued (e.g., home size, number of bathrooms, views) across settings. However, several of the spatial attributes employed are hypothesized vary by segments of the population (urbanites versus suburbanites). Again, this distinction was found by Anderson and West's application to the same region. We therefore generated interaction terms (e.g., city * variable) to measure the attributes that may vary spatially. Doing so is a notable contribution and has the following advantage. It allows us to pool the sample of urban and suburban homes, thereby estimating a single model. This single model provides coefficients that describe the effect of common attributes while producing different coefficients for the spatial attributes that may vary across suburbanites and urbanites. Accessibility, open space, and bicycle variables are prefixed by a *c* for city and *s* for suburb.

Fixed Effects

Finally, as with any analysis of this type there are omitted attributes to consider. When estimating phenomena associated with the real estate market this dimension is particularly important. There are likely spatial attributes—not captured by any of our measures—which invariably affect home value. These attributes may include but are not limited to general housing stock of neighboring homes, the reputation effects of different neighborhoods or unobserved characteristics of the neighborhood.

We control for potential omitted variables by using local fixed effects. Without fixed effects variation across all observations in all neighborhoods is used to identify the effect. But given the likely spatial correlation between proximity to bicycle facility with other variables, this effect is susceptible to omitted variable bias. Our geographic area of fixed effects is based on RMLS-defined market areas (104 areas in our region), which helps control for this bias. These boundaries mostly follow city limits in suburban areas and divide the central cities into several neighborhoods that closely follow similarly natured real-estate markets. This process, however, also makes the identification of proximity to bicycle trails difficult since the distance within each area may have little variation. While this is an important and notable aspect of this research, it should be mentioned that by controlling for fixed effects, we are estimating the effect of proximity to a bicycle trail, assuming a household has already decided to locate in one of the 104 MLS areas in the region.

Results and Discussion

Our final model (shown in Table 3) is an OLS regression which determines the effect of bicycle trails on home sale prices. We employ a logged dependent variable and also log transformations of several continuous independent variables, indicated by an *ln* following the variable name. All structural and location variables are statistically significant and have the expected signs. Home values increase with number of bedrooms, bathrooms, lot size, finished square feet, fireplaces, garage stalls, proximity to a central business district, and school quality. Home values decrease with age and percent non-white in the census tract. Similarly, proximity to a freeway has a negative effect on home value, which implies that the disamenity effects of freeways (e.g., noise, pollution) likely outweigh any accessibility benefits within particular neighborhoods. Looking at some of the location and amenity variables reveals a different story. Open space coefficients are generally consistent with Anderson and West's [11] findings. Suburbanites value passive open space over active recreational areas. City residents also value lakes and golf courses, but active open space does not affect sale price.

We now discuss the variables of interest in this application: bicycle facilities. Our analysis reveals a relatively complex story. It fails to be crisp and clean because we measure three types of facilities for two different populations (urban and suburban). We separately discuss findings for city and suburban residents. First, city residents clearly value proximity to non-roadside trails (after controlling for open space). As Minneapolis is well endowed with many off-road facilities and appears to exhibit a relatively high cycling population, this comes as little surprise. The opposite is true for trails alongside busy streets, however, even when controlling for proximity to the streets themselves. On-street bicycle lanes have no significant effect in the city. The possible reason for this is that in general, the nature of on-street facilities differs considerably between Minneapolis and St. Paul. In Minneapolis, several of the streets in the downtown core have bicycle lanes (although there are few home sales downtown). Most other on-street bicycle lanes are on busy commuting arterials or around the University of Minnesota commercial district. In St. Paul, it is a different story. On-street lanes are along a well maintained boulevard-type corridor (Summit Avenue), the Mississippi River corridor, and a neighborhood lake. These counter acting effects between Minneapolis and St. Paul may possibly cancel out one other.

As in the city, suburban homes near roadside trails sell for less than those further away, even when controlling for busy streets. The same is true for on-street bicycle lanes, for which there was no statistically significant effect in the city. However, suburban off-street trails appear not to influence home prices, unlike in the city. There are possibly several reasons for this. First, it may be the case that because of decreased cycling use, suburbanites simply do not value access to trails. Such proximity may not even factor into their use or option value of their home purchase locations. Second, it may be the case where there are counter acting phenomena taking place. Some suburbanites may indeed value such trails. However, their preferences may be cancelled out by a combination of the two following factors. Some of the suburban trails are along former railway beds. If these property values were formally depressed because of such an externality, such legacy effect may likely still be in effect. Second, many suburbanites simply appreciate the seclusion of their settings. Proximity to trails—no matter their character—may be an indication of unwanted people passing by or other symptoms that run counter to factors that prompted their decision.

Conclusion

There are several important implications for our results with confirm the hypothesis that the three types of trails influence home sale prices in different ways. They demonstrate the importance of controlling for bias induced by omitted spatial variables. Such bias is especially relevant for large complex and polycentric housing markets (such as in the Twin Cities, with two CBDs) and in areas where factors that influence home price differ tremendously by neighborhood. We use local neighborhood fixed effects to reduce spatial autocorrelation and also lead to more robust coefficient estimates. Of course, using this methodology—while technically sound and robust—also makes it more difficult to detect the effects of such proximity because we are now comparing homes within MLS areas.

Our results are also able to robustly test for the fact that urbanites and suburbanites perceive and value bicycle facilities differently. The use of interaction terms between city and suburb reveal this difference in preferences between city dwellers and suburbanites. We measure bicycle facilities in different ways. Distance to nearest facility is the measure discussed in detail above. Models that were estimated to examine the role of trail density did not produce statistically significant findings. The comprehensiveness of the Twin Cities' bicycle trails may contribute to a lack in variation among trail densities near homes.

From a policy perspective, this research produces three important insights. First, type of trail matters. On-street trails and road-side trails may not be as appreciated as many city planners or policy officials think. Second, city residents have different preferences than suburban residents. Third and as suspected, larger and more pressing factors likely influencing residential location decisions. Our use of fixed effects detects such considerations in terms of neighborhood quality and character. Overall, our results suggest that off-street bicycle trails add value to home sale prices in the city, implying a contribution to social livability. No positive or significant relationship, however, is found for other types of facilities in either city or suburb. This suggests that urban planners and advocates need to be aware of the consequences of providing for bicycle facilities, as the change in welfare is not necessarily positive for all homeowners.

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Tables and Figures

Table 1. Variable definitions.

Variable	*Definition*
SALEPRIC	Sale price of home ($)
BEDROOMS	Number of bedrooms
BATHROOM	Number of bathrooms
FINISHED	Finished square feet of floor space
LOTSIZE	Size of lot (square meters)
AGESTRCT	Age of house
FIREPLS	Number of fireplaces
GARAGEST	Number of garage stalls
CUT100_8	Neighborhood accessibility
RET_F24	Regional accessibility
CBDNEAR	Distance to nearest central business district (meters)
HWYNEAR	Distance to nearest major highway (meters)
BUSYROAD	Distance to nearest busy street
MCA5_ATT	Average composite fifth grade standardized test score in school district
HH_DENS	Households per square meter in census block group
PCTNONWT	Percent nonwhite in census tract
AVGHHSIZ	Average number of persons per household in census tract
ACTIVE	Distance to nearest active open space (meters)
PASSIVE	Distance to nearest passive open space (meters)
ONTRNEAR	Distance to nearest on-street bicycle lane (meters)
NRTRNEAR	Distance to nearest non-roadside bicycle trail (meters)
RSTRNEAR	Distance to nearest roadside bicycle trail (meters)

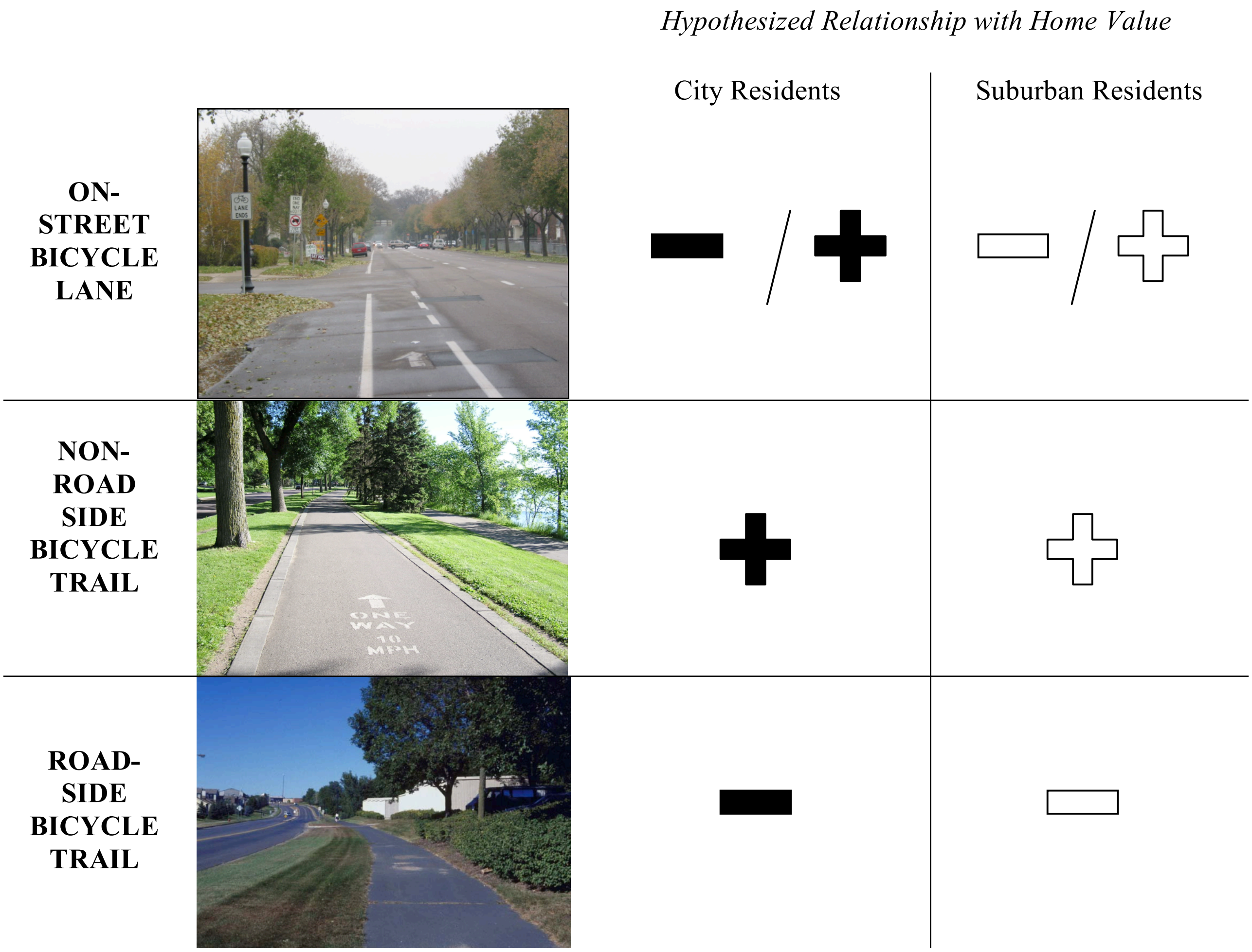
Table 2. Descriptive Statistics of sample.

	City		*Suburbs*	
Variable	*Mean*	*Standard. Deviation*	*Mean*	*Standard. Deviation*
SALEPRIC	172,701.21	108,907.12	222,803.59	143,223.74
BEDROOMS	2.83	0.86	3.20	0.91
BATHROOM	1.61	0.72	2.28	0.86
FINISHED	1,457.75	743.60	1,979.23	916.88
LOTSIZE	683.59	935.18	2,468.38	8,997.11
AGESTRCT	73.11	24.62	26.12	21.02
FIREPLS	0.40	0.65	0.77	0.77
GARAGEST	1.35	0.75	1.82	1.05
CUT100_8	157.31236	320.58	40.47	113.66
RET_F24	5,011.94	1,542.91	3,122.30	2,189.96
CBDNEAR	5,5587.90	1,973.18	20,693.50	9,400.14
HWYNEAR	1,171.13	773.29	1,803.57	1,986.68
BUSYROAD	357.11	284.73	525.95	443.80
MCA5_ATT	4,368.51	249.89	4,863.10	171.92
HH_DENS	0.0012	0.0007	0.0004	0.0003
PCTNONWT	28.53	21.56	8.31	6.44
AVGHHSIZ	2.46	0.46	2.72	0.37
ACTIVE	340.15	203.41	569.92	1,176.45
PASSIVE	683.10	396.64	760.73	641.12
ONTRNEAR	1,276.31	947.90	1,580.51	2,240.18
NRTRNEAR	837.35	565.99	1,110.23	1,737.61
RSTRNEAR	958.96	545.61	1,073.12	1,451.55

Table 3. Regression Results

```
                                                  Number of obs =   35002
                                                  F( 29, 34869) = 2787.21
                                                  Prob > F      =  0.0000
                                                  R-squared     =  0.7928
                                                  Adj R-squared =  0.7920
                                                  Root MSE      =  .19633
```

slprceln	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
contrln	.0003513	.002842	0.12	0.902	-.0052192	.0059218
cnrtrln	-.0143337	.0042585	-3.37	0.001	-.0226804	-.0059869
crstrln	.0263595	.0044327	5.95	0.000	.0176713	.0350478
cbusy	.0163276	.0026314	6.20	0.000	.0111699	.0214853
cactive	-.0000229	.0000123	-1.87	0.062	-.0000469	1.15e-06
cpassive	-.0000646	7.12e-06	-9.06	0.000	-.0000785	-.0000506
ccut1008	-2.38e-06	.0000103	-0.23	0.817	-.0000225	.0000178
cret_f24	-5.68e-06	3.09e-06	-1.84	0.066	-.0000117	3.83e-07
sontrln	.0035443	.0012847	2.76	0.006	.0010262	.0060624
snrtrln	.002949	.001399	2.11	0.035	.0002068	.0056911
srstrln	.0091945	.0017026	5.40	0.000	.0058573	.0125318
sbusy	.002256	.0014198	1.59	0.112	-.0005268	.0050389
sactive	6.76e-06	1.65e-06	4.10	0.000	3.53e-06	1.00e-05
spassive	-.0000283	2.21e-06	-12.83	0.000	-.0000327	-.000024
scut1008	2.34e-06	.0000114	0.21	0.837	-.00002	.0000246
sret_f24	1.67e-06	1.74e-06	0.96	0.339	-1.75e-06	5.08e-06
bedrooms	.0332147	.0015707	21.15	0.000	.0301362	.0362933
bathroom	.0800598	.0020182	39.67	0.000	.076104	.0840157
homestea	-.027164	.0034809	-7.80	0.000	-.0339866	-.0203414
ageln	-.0930408	.0017649	-52.72	0.000	-.0965	-.0895815
lotsize	3.09e-06	1.41e-07	21.88	0.000	2.81e-06	3.36e-06
finished	.0001678	2.04e-06	82.15	0.000	.0001638	.0001718
firepls	.068836	.0017694	38.90	0.000	.065368	.072304
garagest	.0752291	.0012691	59.28	0.000	.0727416	.0777166
cbdnrln	-.0532216	.0073205	-7.27	0.000	-.0675699	-.0388732
hwynear	9.61e-06	9.43e-07	10.19	0.000	7.76e-06	.0000115
mca5_att	.0001563	.0000104	15.00	0.000	.0001359	.0001768
pctnonwt	-.0038195	.000189	-20.21	0.000	-.0041899	-.0034491
avghhsiz	.0402903	.0046576	8.65	0.000	.0311613	.0494193
_cons	11.28966	.0859193	131.40	0.000	11.12126	11.45807
areacode	F(103, 34869) =		51.914	0.000	(104 categories)	



Undetermined hypothesized relationships depends on the ability to control for confounding explanations such as the quantity and speed of adjacent traffic. The difference between light and dark relationships suggests the strength in which city residents might value facilities differently than suburban residents, based on use patterns.

Figure 1. Representative photographs of an on-street bicycle lane, non-roadside trail, and roadside trail, hypothesized relationships.

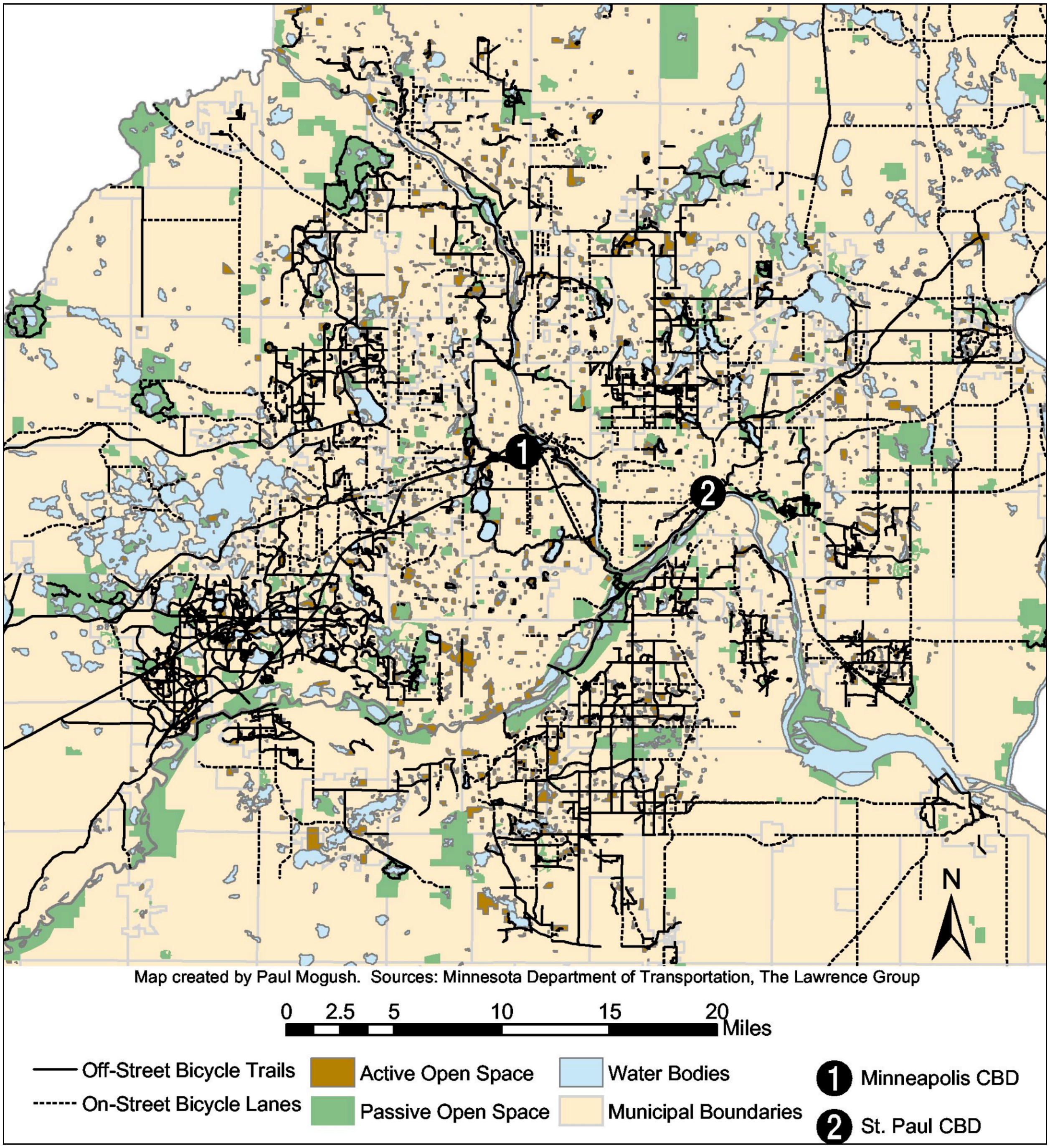


Figure 2: Off-street bike trails, on-street bike lanes, and open space

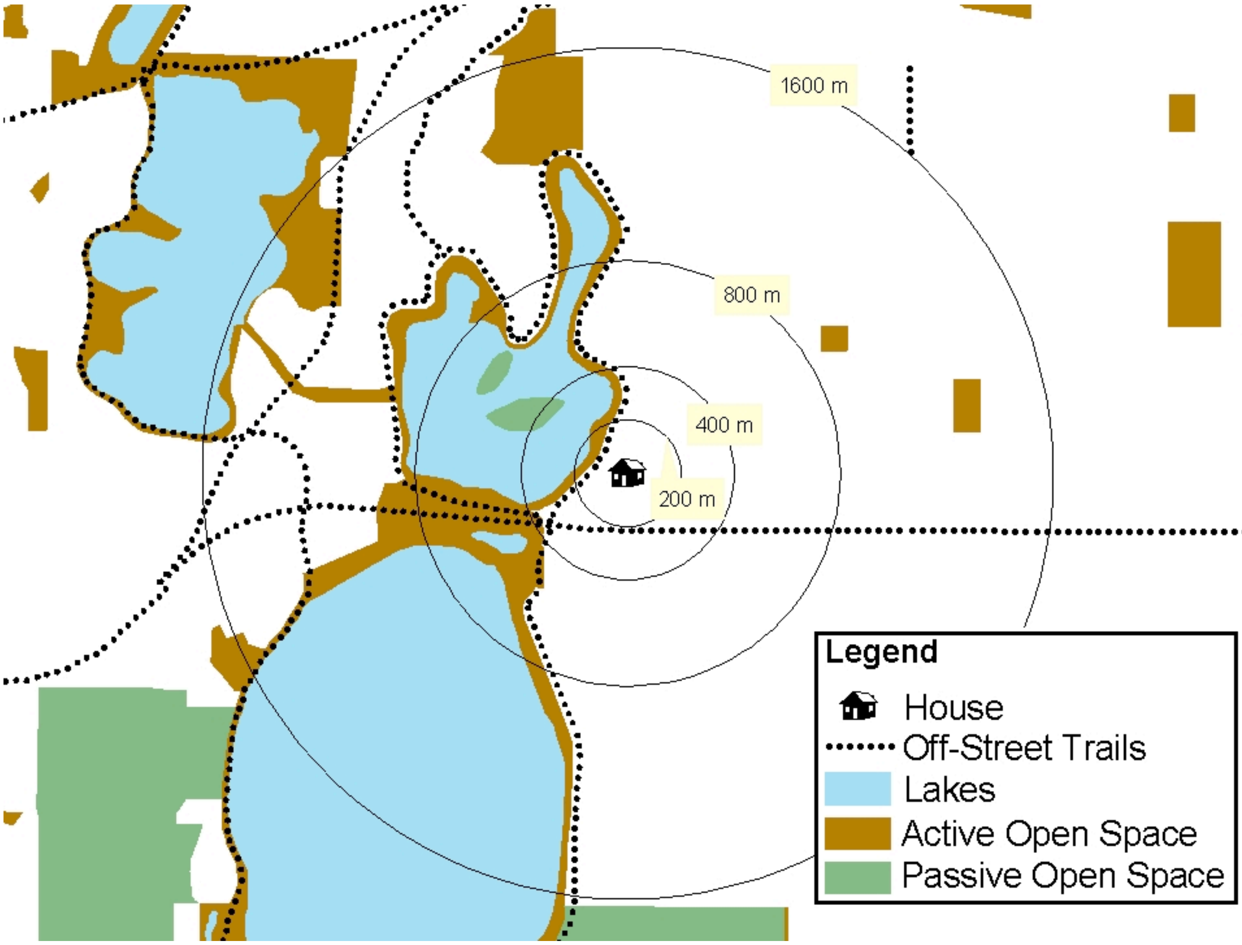


Figure 3: Off-street trails and open space within 200, 400, 800, and 1600 meters of a Minneapolis house